



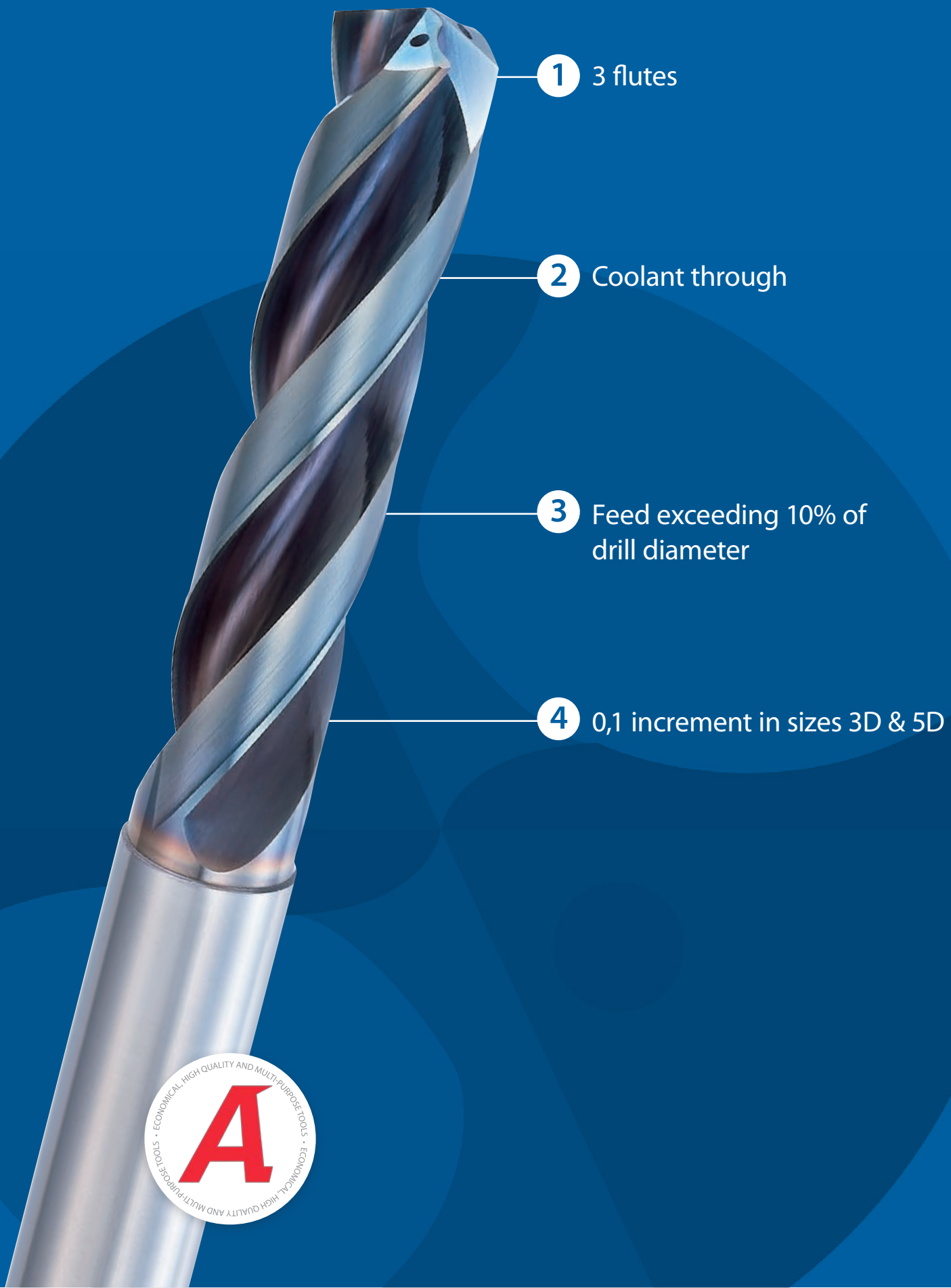
Coolant-Through - Three fluted - Carbide Drills

TRS SERIES

TRS-HO-3D TRS-HO-5D TRS-HO-10D



TRS redefines the meaning of high speed drilling



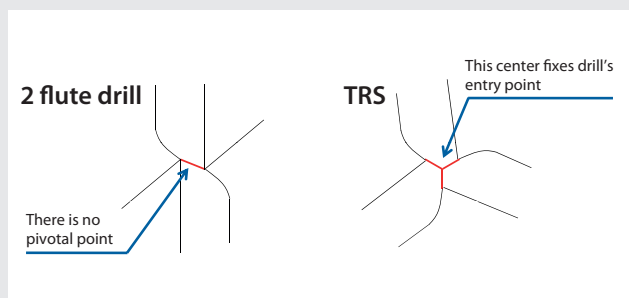
Three concepts differentiate the TRS series from two-flutes & conventional drills

1 Higher Precision

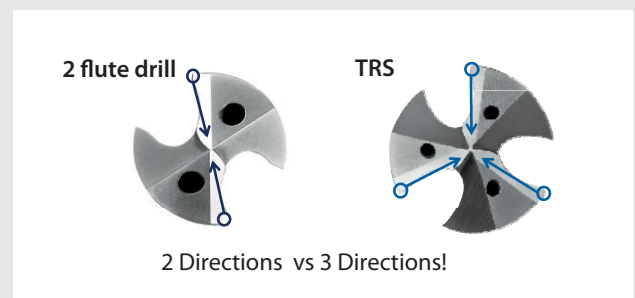
- Better tapping process from improved pilot holes
- Reamer-less drilling can be achieved

There are 2 keys to High Precision Drilling

1. Good biting properties to minimize deflection



2. Stable guide to keep the drilling process straight

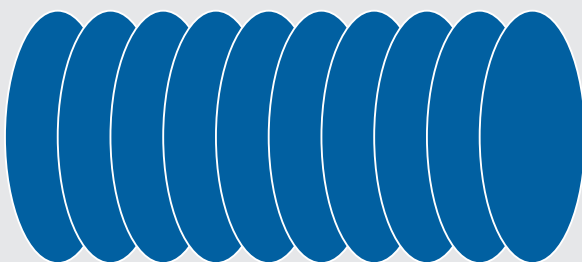


2 Improved feed rate

- The higher the feed rate, the more the output
- Reduced cost per unit

If we needed to drill 10mm through hole...

TRS will complete the process in 10 revolutions with feed rate of 1mm/rev.



10 revolutions = 10mm

Conventional Drill, on the other hand, will require 100 revolutions at 0.1mm/rev feed rate

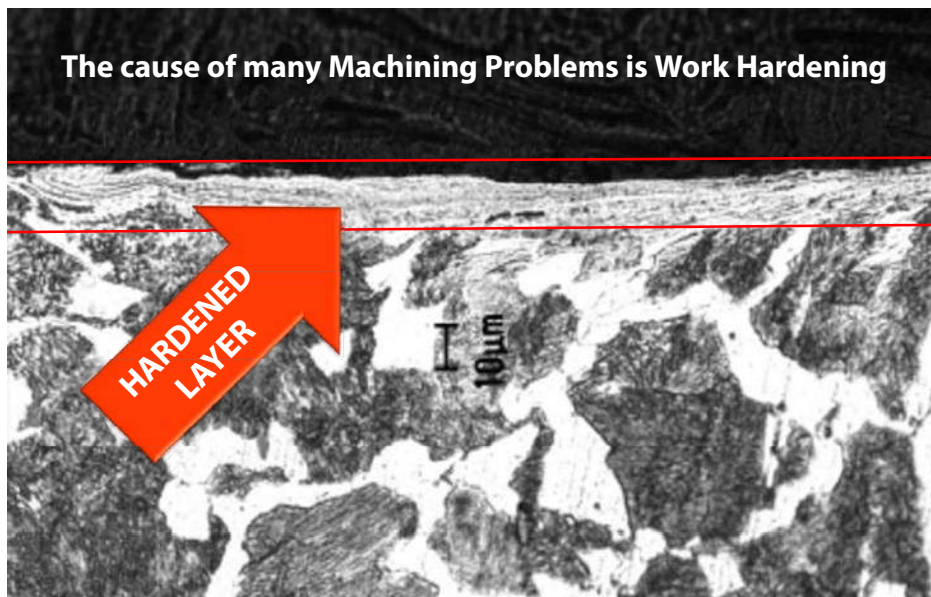


10 revolutions = 1.0mm

Three concepts differentiate the TRS series from two-flutes & conventional drills

3 Reduced work hardening

- Optimal conditions for thread making
- Improved tool life for succeeding cutting tools



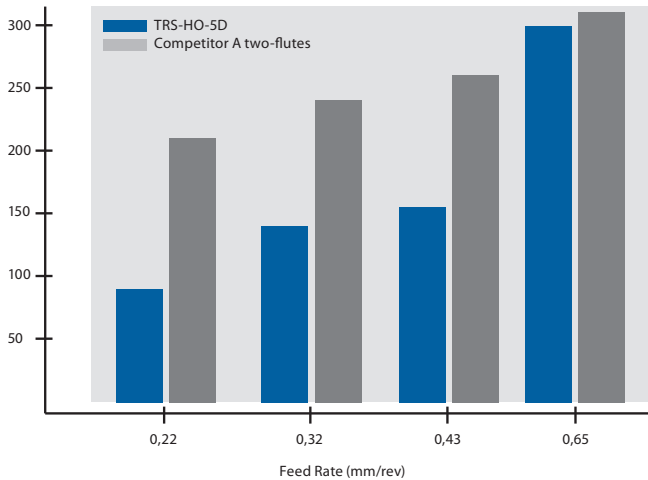
Work Hardening can cause:

1. Unstable tapping quality for both cutting and forming taps
2. Increased machine load that often result in reduced tool life for the drill and succeeding cutting tools.

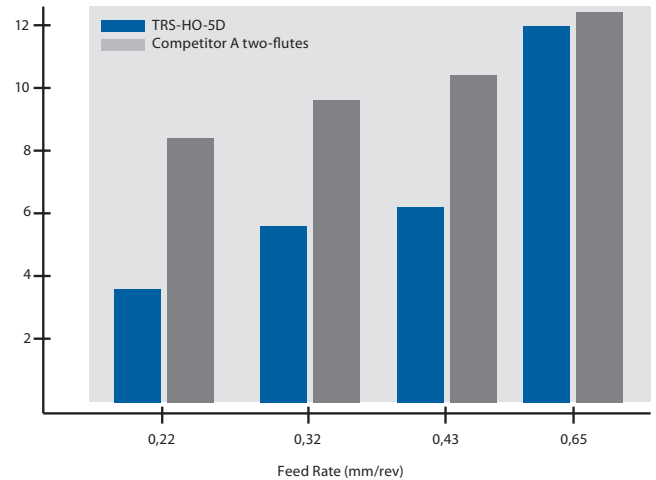
The WDI coating is effective in high feed drilling

- Comparison of the amount of work hardening versus feed per revolution in carbon steel.

Work hardening rate comparison



Work hardening layer depth comparison



Tool	TRS-HO-5D ø10,8
Work Material	S50c (DIN CK50) (AISI 1050)
Drilling Speed	100m/min (2.950min ⁻¹)
Feed	Variable (See chart)
Depth of Hole	25mm (Through)
Coolant	Water Soluble
Machine	Horizontal Machining Center

	TRS-HO-5D		Competitor A Two-Flute	
	Work Hardening Level (Hv0,1)	Work Hardening Depth (µm)	Work Hardening Depth (Hv0,1)	Work Hardening Depth (µm)
Feed Rate	(Hv0,1)	(µm)	(Hv0,1)	(µm)
f=0,22mm/rev	120	3	220	8
f=0,32mm/rev	185	5	240	9
f=0,43mm/rev	220	6,5	265	10
f=0,65mm/rev	295	11	300	12

These graphs show the level and depth of work hardening in carbon steel when comparing the Mega Muscle drill versus 2-fluted drills. The amount of feed per revolution ranges from 0.22 to 0.65 mm/rev. Regardless of the number of flutes, work hardening has the tendency to increase with the increase of the feed rate. It can be noted, when the same feed rate is applied to both drills, the 3-fluted type has a much lower work hardening effect. 3-fluted drills always achieve lower work hardening rates when compared to 2-fluted drills. Thus, it is best practice to keep the work hardening as low as possible when secondary operations such as tapping or reaming are required. The Mega Muscle Drill offers this process stability, reducing the burden of the taps and reamers by increasing their tool life.

Unmatched Processing Efficiency

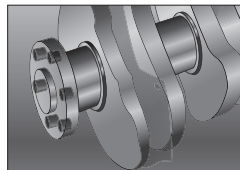
- Feed rates of $F = 1480\text{mm/min}$ were achieved in this crankshaft application (carbon steel)

Tool	TRS-HO-3D $\phi 10,3$	Competitor A
Work Material	S50C (DIN CK50 - AISI 1050)	
Drilling Speed	100m/min (2.950min ⁻¹)	
Feed	1.480mm/min (0,5mm/rev)	560mm/min 0,19mm/rev
Depth of Hole	24mm (Blind)	
Coolant	Water Soluble	
Machine	Horizontal Machining Center	

Drills	Number of Holes			
	400	800	1.200	1.600
TRS-HO-3D	1.542 (Holes)			
Competitor A	1.020 (Holes)			

Continue

Wear



1,5 times the tool life
2,7 times the productivity

Example of the hole processing for the mounting holes on the crankshaft flywheel. TRS Drill achieved 1.5 times the tool life and 2.7 times the productivity over Competitor A's 2 fluted drill. With the ability to control work hardening, one has the ability to extend tool life on secondary processes such as tapping, thus decreasing overall tooling and part cost per unit. For example, by lowering the cutting speed to 80m/min, tool life of the drill and all secondary process tools can be extended.

- Feed rates of $F=1.480\text{mm/min}$ were achieved, with overall cutting lengths of 166m.

Tool	TRS-HO-3D $\phi 10,3$
Work Material	S50C (DIN CK50 - AISI 1050)
Drilling Speed	100m/min (3.090 min ⁻¹)
Feed	1.480mm/min (0,48mm/rev)
Depth of Hole	32mm (Through)
Coolant	Water Soluble
Machine	Horizontal Machining Center

Drills	Number of Holes					
	1.000	2.000	3.000	4.000	5.000	6.000
TRS-HO-3D	5.200 (Holes)					
Competitor A	1.600 (Holes)					

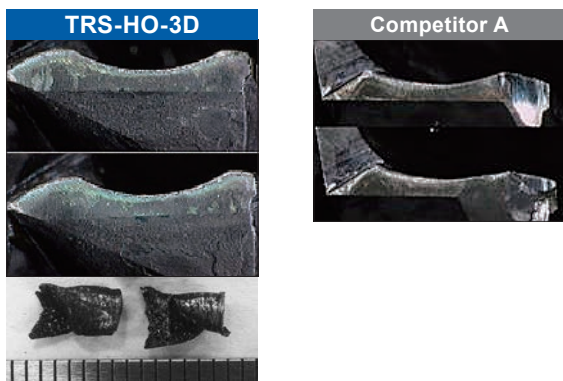
Continue

Wear

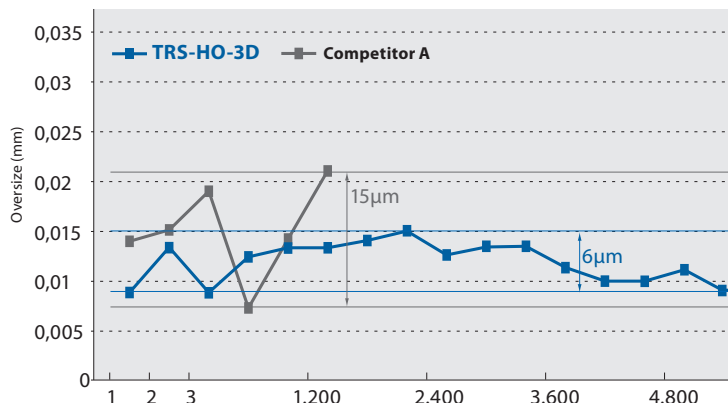
Abnormal Wear

Breakage

- Tool wear comparison



- Changes in amount of hole oversize



Example of carbon steel processing. Because of the high feed rate of 0.48mm/rev, the competitor company's drill showed a large variation in hole expansion as well as low tool life. However, the Mega Muscle Drill was able to achieve 5200 holes (cutting length 166m) with stable hole sizes. The competitor A's hole expansion ranged up to 15µm, while the TRS Drill had only a 6µm variation.

Drilling feeds exceeding 1.000 mm/min

- Feed rates of $F=1.140\text{mm/min}$ were achieved, with overall cutting lengths of 110m

Tool	TRS-HO-5D ϕ 10,5
Work Material	SCM440 (Alloy Steel)
Drilling Speed	80m/min (2.430min ⁻¹)
Feed	1.140mm/min (0,47mm/rev)
Depth of Hole	50mm (Through)
Coolant	Water Soluble
Machine	Horizontal Machining Center

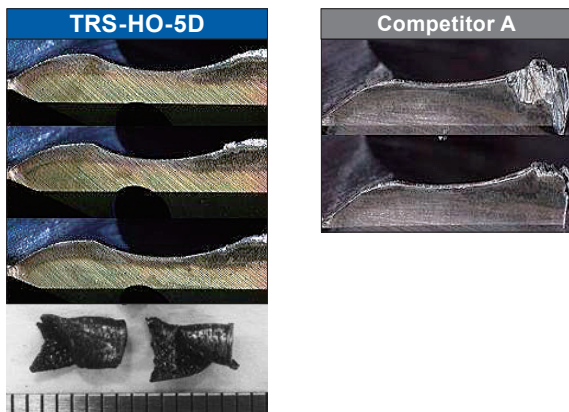
Drills	Number of Holes					
	500	1.000	1.500	2.000	2.500	3.000
TRS-HO-5D	2.600 (Holes)					Wear
	2.200 (Holes)					Wear
Competitor A	1.075 (Holes)			Breakage		
	1.000 (Holes)			Breakage		

- Feed rates of $F=1010\text{mm/min}$ were achieved in 30HRC alloy steel.

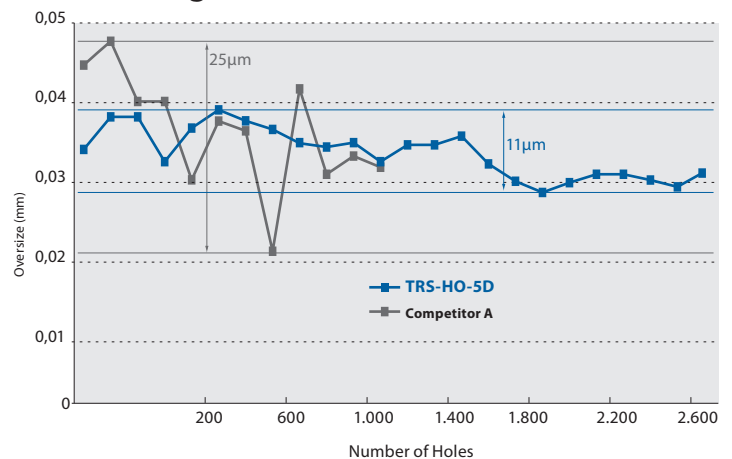
Tool	TRS-HO-5D ϕ 10,8
Work Material	SCM440 (30HRC) (Alloy Steel)
Drilling Speed	70m/min (2.060min ⁻¹)
Feed	1.010mm/min (0,49mm/rev)
Depth of Hole	50mm (Through)
Coolant	Water Soluble
Machine	Horizontal Machining Center

Drills	Number of Holes					
	500	1.000	1.500	2.000	2.500	3.000
TRS-HO-5D	2.000 (Holes)					Wear
	1.700 (Holes)					Wear
Competitor A	174 (Holes)			Breakage		
	300 (Holes)			Abnormal Wear		

- Tool wear comparison



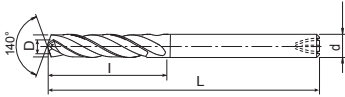
- Changes in amount of hole oversize



Example of hole processing in alloy steel. At high feed machining of 0.47mm/rev, Competitor A's drill was found to be unstable in hole size as well as having low tool life. However, the TRS Drill exceeded 2200 (cutting length 110m) holes of tool life, limited by normal wear, thus decreasing overall tooling and part cost per unit. When comparing the hole expansion values, Competitor A was found to have a large variation of up to 25µm. While the Mega Muscle Drill had up to 11µm.

Drills

- High performance
- Coolant through, 3 flutes, high feed drilling, for 3XD drilling
- High performance
- Innenkühlung, 3 Schneiden, Hochleistungsbohrer, 3xD
- Alta prestazione
- Con foro di lubrificazione, 3 eliche, alto avanzamento, 3 D
- Haute performance
- Arrosage interne, 3 lèvres, perçage haute vitesse, perçage 3D
- Yüksek performans
- İçten soğutmalı, 3 ağızlı, yüksek kesme hızlı delme, 3D boy
- High performance
- Indvendig køling, 3 skær, high feed boring, 3D
- High performance
- Kylkanalsborr med 3-skär, hög matning, 3xD
- Altas prestaciones
- Refrigeración interna, 3 labios, para gran avance, tipo 3D
- Высокая производительность
- Трёхзубые сверла с внутренними каналами и высокой подачей, 3D
- Wysoka wydajność
- Do wysokich posuwów wiercenia, trójzostrowe, chłodzenie wewnętrzne, 3D



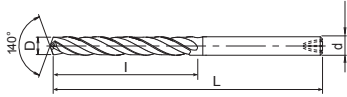
EDP	D	L	l	d	Price	EDP	D	L	l	d	Price
48157050	5	80	25	6		48157955	9,55	106	48	10	
8660510	5,1	82	26	6		8660960	9,6	106	48	10	
8660520	5,2	82	26	6		8660970	9,7	106	49	10	
8660530	5,3	82	27	6		8660980	9,8	106	49	10	
8660540	5,4	82	27	6		8660990	9,9	106	50	10	
8660550	5,5	82	28	6		8661000	10	106	50	10	
48157555	5,55	82	28	6		48157101	10,1	113	51	12	
8660560	5,6	82	28	6		48157102	10,2	113	51	12	
8660570	5,7	82	29	6		48157103	10,3	113	52	12	
8660580	5,8	82	29	6		48157104	10,4	113	52	12	
8660590	5,9	82	30	6		48157105	10,5	113	53	12	
8660600	6	82	30	6		48157106	10,6	113	53	12	
48157061	6,1	88	31	8		48157107	10,7	113	54	12	
48157062	6,2	88	31	8		48157108	10,8	113	54	12	
48157063	6,3	88	32	8		48157109	10,9	113	55	12	
48157064	6,4	88	32	8		48157110	11	113	55	12	
48157065	6,5	88	33	8		8661110	11,1	120	56	12	
48157066	6,6	88	33	8		8661120	11,2	120	56	12	
48157067	6,7	88	34	8		8661130	11,3	120	57	12	
48157068	6,8	88	34	8		8661140	11,4	120	57	12	
48157069	6,9	88	35	8		8661150	11,5	120	58	12	
48157070	7	88	35	8		8661160	11,6	120	58	12	
8660710	7,1	94	36	8		8661170	11,7	120	59	12	
8660720	7,2	94	36	8		8661180	11,8	120	59	12	
8660730	7,3	94	37	8		8661190	11,9	120	60	12	
8660740	7,4	94	37	8		8661200	12	120	60	12	
8660750	7,5	94	38	8		48157125	12,5	128	63	14	
48157755	7,55	94	38	8		48157130	13	128	65	14	
8660760	7,6	94	38	8		8661350	13,5	134	68	14	
8660770	7,7	94	39	8		8661400	14	134	70	14	
8660780	7,8	94	39	8		48157145	14,5	140	73	16	
8660790	7,9	94	40	8		48157150	15	140	75	16	
8660800	8	94	40	8		8661550	15,5	145	78	16	
48157081	8,1	101	41	10		8661600	16	145	80	16	
48157082	8,2	101	41	10		48157165	16,5	150	83	18	
48157083	8,3	101	42	10		48157170	17	150	85	18	
48157084	8,4	101	42	10		8661750	17,5	155	88	18	
48157085	8,5	101	43	10		8661800	18	155	90	18	
48157086	8,6	101	43	10		48157185	18,5	160	93	20	
48157087	8,7	101	44	10							
48157088	8,8	101	44	10							
48157089	8,9	101	45	10							
48157090	9	101	45	10							
8660910	9,1	106	46	10							
8660920	9,2	106	46	10							
8660930	9,3	106	47	10							
8660940	9,4	106	47	10							
8660950	9,5	106	48	10							

Applications - Anwendungen - Applicazioni - Applications - Applikation - Applikation - Aplicaciones - Применение - Uygulama - Zastosowania

C≤0.2%	0.25<C≤0.4%	C≥0.45%	SCM	~35 HRC	35~45 HRC	45~50 HRC	50~70 HRC	SUS
☉	☉	☉	☉	☉	○	○		○
SKD	GG	GGG	Cu	Al	AC	Ti	Tiall	Inc
	☉	☉					○	

Drills

- High performance
- Coolant through, 3 flutes, high feed drilling, for 5XD drilling
- High performance
- Innenkühlung, 3 Schneiden, Hochleistungsbohrer, 5xD
- Alta prestazione
- Con foro di lubrificazione, 3 eliche, alto avanzamento, 5 D
- Haute performance
- Arrosage interne, 3 lèvres, perçage haute vitesse, perçage 5D
- Yüksek performans
- İçten soğutmalı, 3 ağızlı, yüksek kesme hızlı delme, 5D boy
- High performance
- İndvendig køling, 3 skær, high feed boring, 5D
- High performance
- Kylkanalsborr med 3-skär, hög matning, 5xD
- Altas prestaciones
- Refrigeración interna, 3 labios, para gran avance, tipo 5D
- Высокая производительность
- Трёхзубые сверла с внутренними каналами и высокой подачей, 5D
- Wysoka wydajność
- Do wysokich posuwów wiercenia, trójzostrowe, chłodzenie wewnętrzne, 5D



EDP	D	L	l	d	Price	EDP	D	L	l	d	Price
48158050	5	95	45	6		48158955	9,55	136	77	10	
8662510	5,1	100	41	6		8662960	9,6	136	77	10	
8662520	5,2	100	42	6		8662970	9,7	136	78	10	
8662530	5,3	100	43	6		8662980	9,8	136	79	10	
8662540	5,4	100	44	6		8662990	9,9	136	80	10	
8662550	5,5	100	44	6		8663000	10	136	80	10	
48158555	5,55	100	45	6		48158101	10,1	146	81	12	
8662560	5,6	100	45	6		48158102	10,2	146	82	12	
8662570	5,7	100	46	6		48158103	10,3	146	83	12	
8662580	5,8	100	47	6		48158104	10,4	146	84	12	
8662590	5,9	100	48	6		48158105	10,5	146	84	12	
8662600	6	100	48	6		48158106	10,6	146	85	12	
48158061	6,1	109	49	8		48158107	10,7	146	86	12	
48158062	6,2	109	50	8		48158108	10,8	146	87	12	
48158063	6,3	109	51	8		48158109	10,9	146	88	12	
48158064	6,4	109	52	8		48158110	11	146	88	12	
48158065	6,5	109	52	8		8663110	11,1	156	89	12	
48158066	6,6	109	53	8		8663120	11,2	156	90	12	
48158067	6,7	109	54	8		8663130	11,3	156	91	12	
48158068	6,8	109	55	8		8663140	11,4	156	92	12	
48158069	6,9	109	56	8		8663150	11,5	156	92	12	
48158070	7	109	56	8		8663160	11,6	156	93	12	
8662710	7,1	118	57	8		8663170	11,7	156	94	12	
8662720	7,2	118	58	8		8663180	11,8	156	95	12	
8662730	7,3	118	59	8		8663190	11,9	156	96	12	
8662740	7,4	118	60	8		8663200	12	156	96	12	
8662750	7,5	118	60	8		48158121	12,1	167	97	14	
48158755	7,55	118	61	8		48158122	12,2	167	98	14	
8662760	7,6	118	61	8		48158123	12,3	167	99	14	
8662770	7,7	118	62	8		48158124	12,4	167	100	14	
8662780	7,8	118	63	8		48158125	12,5	167	100	14	
8662790	7,9	118	64	8		48158126	12,6	167	101	14	
8662800	8	118	64	8		48158127	12,7	167	102	14	
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48158083	8,3	128	67	10		48158130	13	167	104	14	
48158084	8,4	128	68	10		8663350	13,5	176	108	14	
48158085	8,5	128	68	10		8663400	14	176	112	14	
48158086	8,6	128	69	10		48158145	14,5	185	116	16	
48158087	8,7	128	70	10		48158150	15	185	120	16	
48158088	8,8	128	71	10		8663550	15,5	193	124	16	
48158089	8,9	128	72	10		8663600	16	193	128	16	
48158090	9	128	72	10		48158165	16,5	201	132	18	
8662910	9,1	136	73	10		48158170	17	201	136	18	
8662920	9,2	136	74	10		8663750	17,5	209	140	18	
8662930	9,3	136	75	10		8663800	18	209	144	18	
8662940	9,4	136	76	10		48158185	18,5	217	148	20	
8662950	9,5	136	76	10							

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C≤0.2%	0.25<C≤0.4%	C≥0.45%	SCM	~35 HRC	35~45 HRC	45~50 HRC	50~70 HRC	SUS
☉	☉	☉	☉	☉				○
SKD	GG	GGG	Cu	Al	AC	Ti	Tiall	Inc
	☉	☉						

TR-S-HO-10D



Drills

- High performance
- Coolant through, 3 flutes, high feed drilling, for 10XD drilling

- High performance
- Innenkühlung, 3 Schneiden, Hochleistungsbohrer, 10xD

- Alta prestazione
- Con foro di lubrificazione, 3 eliche, alto avanzamento, 10 D

- Haute performance
- Arrosage interne, 3 lèvres, perçage haute vitesse, perçage 10D

- Yüksek performans
- İçten soğutmalı, 3 ağızlı, yüksek kesme hızlı delme, 10D boy

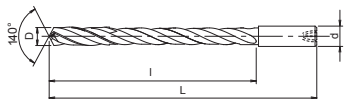
- High performance
- Indvendig køling, 3 skær, high feed boring, 10D

- High performance
- Kylkanalsborr med 3-skär, hög matning, 10xD

- Altas prestaciones
- Refrigeración interna, 3 labios, para gran avance, tipo 10D

- Высокая производительность
- Трёхзубые сверла с внутренними каналами и высокой подачей, 10D

- Wysoka wydajność
- Do wysokich posuwów wiercenia, trójzostrowe, chłodzenie wewnętrzne, 10D




EDP	D	L	l	d	Price	EDP	D	L	l	d	Price
48159050	5	115	65	6		8664075	7,5	155	100	8	
8664055	5,5	128	78	6		8664080	8	155	105	8	
8664060	6	128	78	6		48159085	8,5	165	110	10	
48159065	6,5	140	87	8		48159090	9	165	115	10	
48159070	7	140	90	8		8664100	10	190	130	10	
						8664120	12	215	155	12	


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C≤0.2%	0.25<C≤0.4%	C≥0.45%	SCM	~35 HRC	35~45 HRC	45~50 HRC	50~70 HRC	SUS
☉	☉	☉	☉					
SKD	GG	GGG	Cu	Al	AC	Ti	Tiall	Inc
	☉	☉						

Conditions


TRS-HO-3D/5D

	Mild Steel - Low Carbon Steel		Carbon Steel		Alloys Steel	
	SS400 ■ S10C ■ ~150HB ~500 N/mm ²		S35C ■ S50C ■ ~210HB ~710 N/mm ²		SCM ■ SCr ■ SNCM ■ 16-28HRC 710-900 N/mm ²	
Vc	80 ~ 120 m/min		80 ~ 120 m/min		60 ~ 90 m/min	
∅	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)
5	6.400	0,18 ~ 0,25	6.400	0,18 ~ 0,25	4.800	0,18 ~ 0,25
6	5.300	0,21 ~ 0,30	5.300	0,21 ~ 0,30	4.000	0,21 ~ 0,30
7	4.500	0,25 ~ 0,35	4.500	0,25 ~ 0,35	3.400	0,25 ~ 0,35
8	4.000	0,28 ~ 0,40	4.000	0,28 ~ 0,40	3.000	0,28 ~ 0,40
9	3.500	0,32 ~ 0,45	3.500	0,32 ~ 0,45	2.700	0,32 ~ 0,45
10	3.200	0,35 ~ 0,50	3.200	0,35 ~ 0,50	2.400	0,35 ~ 0,50
11	2.900	0,39 ~ 0,55	2.900	0,39 ~ 0,55	2.200	0,39 ~ 0,50
12	2.700	0,42 ~ 0,60	2.700	0,42 ~ 0,60	2.000	0,42 ~ 0,54
13	2.400	0,46 ~ 0,65	2.400	0,46 ~ 0,65	1.800	0,46 ~ 0,59
14	2.300	0,49 ~ 0,70	2.300	0,49 ~ 0,70	1.700	0,49 ~ 0,63
16	2.000	0,48 ~ 0,72	2.000	0,48 ~ 0,72	1.500	0,48 ~ 0,64
18	1.800	0,54 ~ 0,81	1.800	0,54 ~ 0,81	1.300	0,54 ~ 0,72

TRS-HO-3D/5D

	Alloys Steel		Cast Iron		Ductile Cast Iron	
	SCM ■ SCr ■ SNCM ■ 28-35HRC 900-1100 N/mm ²		FC250 ~350 N/mm ²		FCD450 ■ FCD600 400-600 N/mm ²	
Vc	60 ~ 90 m/min		80 ~ 120 m/min		60 ~ 100 m/min	
∅	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)
5	4.800	0,18 ~ 0,25	6.400	0,18 ~ 0,30	5.100	0,18 ~ 0,25
6	4.000	0,21 ~ 0,30	5.300	0,21 ~ 0,36	4.200	0,21 ~ 0,30
7	3.400	0,25 ~ 0,35	4.500	0,25 ~ 0,42	3.600	0,25 ~ 0,35
8	3.000	0,28 ~ 0,40	4.000	0,28 ~ 0,48	3.200	0,28 ~ 0,40
9	2.700	0,32 ~ 0,45	3.500	0,32 ~ 0,54	2.800	0,32 ~ 0,45
10	2.400	0,35 ~ 0,50	3.200	0,35 ~ 0,60	2.500	0,35 ~ 0,50
11	2.200	0,39 ~ 0,50	2.900	0,39 ~ 0,66	2.300	0,39 ~ 0,55
12	2.000	0,42 ~ 0,54	2.700	0,42 ~ 0,72	2.100	0,42 ~ 0,60
13	1.800	0,46 ~ 0,59	2.400	0,46 ~ 0,78	2.000	0,46 ~ 0,65
14	1.700	0,49 ~ 0,63	2.300	0,49 ~ 0,84	1.800	0,49 ~ 0,70
16	1.500	0,48 ~ 0,64	2.000	0,56 ~ 0,80	1.600	0,48 ~ 0,72
18	1.300	0,54 ~ 0,72	1.800	0,63 ~ 0,90	1.400	0,54 ~ 0,81

TRS-HO-10D

	Mild Steel Low Carbon Steel		Carbon Steel		Alloys Steel		Cast Iron		Ductile Cast Iron	
	SS400 ■ S10C ■ ~150HB ~500 N/mm ²		S35C ■ S50C ■ ~210HB ~710 N/mm ²		SCM ■ SCr ■ SNCM ■ 28-35HRC 900-1100 N/mm ²		FC250 ~350 N/mm ²		FCD450 ■ FCD600 400-600 N/mm ²	
Vc	80 ~ 120 m/min		80 ~ 120 m/min		60 ~ 120 m/min		80 ~ 120 m/min		60 ~ 100 m/min	
∅	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)	S (min ⁻¹)	F (mm/rev.)
5	6.400	0,18 ~ 0,25	6.400	0,18 ~ 0,25	5.700	0,18 ~ 0,25	6.400	0,18 ~ 0,30	5.100	0,18 ~ 0,25
6	5.300	0,21 ~ 0,30	5.300	0,21 ~ 0,30	4.800	0,21 ~ 0,30	5.300	0,21 ~ 0,36	4.200	0,21 ~ 0,30
7	4.500	0,25 ~ 0,35	4.500	0,25 ~ 0,35	4.100	0,25 ~ 0,35	4.500	0,25 ~ 0,42	3.600	0,25 ~ 0,35
8	4.000	0,28 ~ 0,40	4.000	0,28 ~ 0,40	3.600	0,28 ~ 0,40	4.000	0,28 ~ 0,48	3.200	0,28 ~ 0,40
9	3.500	0,32 ~ 0,45	3.500	0,32 ~ 0,45	3.200	0,32 ~ 0,45	3.500	0,32 ~ 0,54	2.800	0,32 ~ 0,45
10	3.200	0,35 ~ 0,50	3.200	0,35 ~ 0,50	2.900	0,35 ~ 0,50	3.200	0,35 ~ 0,60	2.500	0,35 ~ 0,50
11	2.900	0,39 ~ 0,55	2.900	0,39 ~ 0,55	2.600	0,39 ~ 0,55	2.900	0,39 ~ 0,66	2.300	0,39 ~ 0,55
12	2.700	0,42 ~ 0,60	2.700	0,42 ~ 0,60	2.400	0,42 ~ 0,60	2.700	0,42 ~ 0,72	2.100	0,42 ~ 0,60



shaping your dreams

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