



OSG
Tap & Die, Inc.

Tooling for Drilling and Tapping Hardened Steels

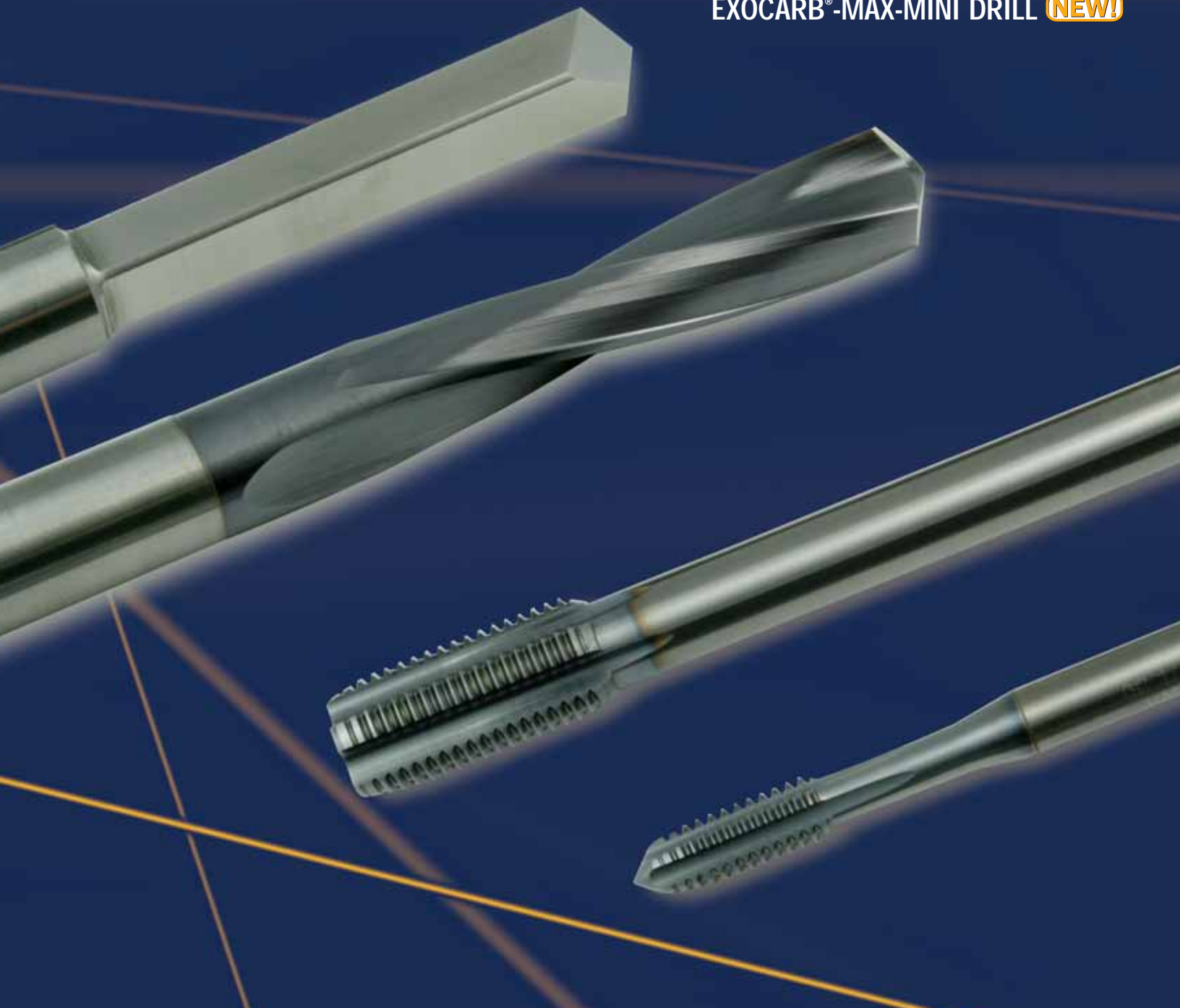
EXOCARB® -VX TAP

EXOTAP® -VCX **NEW!**

EXOCARB® -SH-DRL

EXOCARB® -XH-DRL **NEW!**

EXOCARB® -MAX-MINI DRILL **NEW!**



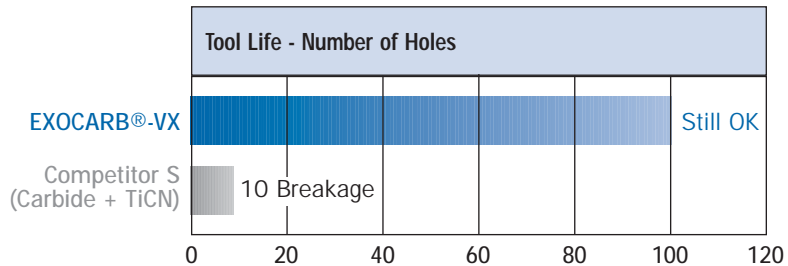
List 311 & 341

Features:

- Tapping hardened steels up to 65Hrc is now possible. In the past, these applications could only be accomplished by EDM.
- The VX tap has a large core diameter providing the tap with superior rigidity.
- It is designed with a special cutting edge, giving it incredible strength with excellent cutting capabilities.
- It is also coated with TiCN providing this tap with excellent heat resistance along with good lubricity.

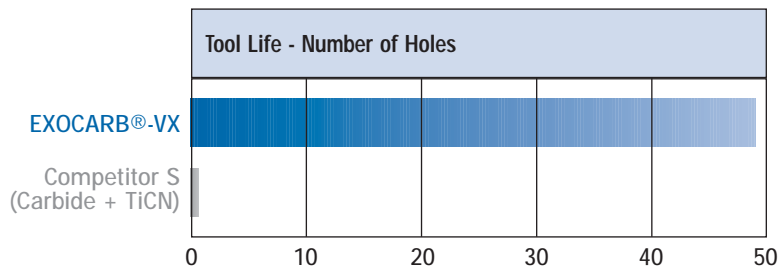
Processing Data: Comparing taps made especially for hardened steels

EXOCARB®-VX Tap Performance:	
Tool:	List 311 1/4-20 NC
Material:	D2 (55HRC)
Speed:	100 RPM
Depth:	1.5D
Coolant:	Water soluble
Drill used:	EXOCARB® SH-DRL



Processing Data: Comparing taps made especially for hardened steels

EXOCARB®-VX Tap Performance:	
Tool:	List 311 6-32 UNC
Material:	4140H (53Hrc)
Speed:	100 RPM
Depth:	0.145" (Through)
Coolant:	Water soluble
Drill used:	EXOCARB® SH-DRL



Tapping Guidelines

1. Set tapping speed between 3 ~ 10 SFM.
2. Choose largest hole-size possible, within the recommended tolerance range.
3. Use a non-water soluble cutting fluid.
4. Use highly rigid machine and tool holders.
5. Tapping by hand is NOT recommended.
6. For tapping length over 1.5D, step feed is recommended.

List 311



Straight Flute, DIN Overall Length, Modified Bottom(2.5P-3P)



Tap Size	Threads Per Inch		Class of Fit	No. Of Flutes	OAL	Recomm'd SH-DRL	EDP Number	List Price (Each)
	UNC	UNF						
4	40	—	2B	4	56	2.3mm	3110108	96.23
6	32	—	2B	4	56	2.8mm	3110208	99.65
8	32	—	2B	4	63	3.5mm	3110308	99.65
10	24	—	2B	4	70	4.0mm	3110408	104.40
10	—	32	2B	4	70	4.2mm	3110508	104.40
1/4	20	—	2B	5	80	5.3mm	3110608	113.90
1/4	—	28	2B	5	80	5.6mm	3110708	113.90
5/16	18	—	2B	5	90	6.8mm	3110808	140.25
5/16	—	24	2B	5	90	7.1mm	3110908	140.25
3/8	16	—	2B	5	100	8.2mm	3111008	188.49
3/8	—	24	2B	5	100	8.7mm	3111108	188.49
7/16	14	—	2B	5	100	9.6mm	3111208	209.84
7/16	—	20	2B	5	100	10.1mm	3111308	209.84
1/2	13	—	2B	5	110	11.1mm	3111408	242.79
1/2	—	20	2B	5	110	11.7mm	3111508	242.79

Packed: 1 pc. Available TiCN finish only.

*Please see page 6-9 to find the recommended EXOCARB® SH-DRL drill.

List 341



Straight Flute, JIS, Modified Bottom(2.5P-3P)



Tap Size	Pitch	Thread Limit	No. Of Flutes	Recomm'd SH-DRL	EDP Number	List Price (Each)
M2.6	0.45	OH3	4	2.2mm	8330049	117.33
M3	0.5	OH3	4	2.6mm	8330055	81.59
M4	0.7	OH3	4	3.4mm	8330061	85.11
M5	0.8	OH3	4	4.3mm	8330067	88.66
M6	1.0	OH3	5	5.2mm	8330073	96.63
M8	1.25	OH3	5	7.0mm	8330085	119.33
M8	1.0	OH3	5	7.2mm	8330087	119.33
M10	1.5	OH3	5	8.8mm	8330097	159.51
M10	1.25	OH3	5	9.0mm	8330099	159.51
M10	1.0	OH3	5	9.2mm	8330101	159.51
M12	1.75	OH3	5	10.6mm	8330115	207.05

Tap Size	Pitch	Thread Limit	No. Of Flutes	Recomm'd SH-DRL	EDP Number	List Price (Each)
M12	1.5	OH3	5	10.8mm	8330117	207.05
M12	1.25	OH4	5	11.0mm	8330119	207.05
M12	1.0	OH3	5	11.2mm	8330121	207.05
M14	2.0	OH4	6	12.4mm	8330123	431.35
M14	1.5	OH3	6	12.8mm	8330125	431.35
M16	2.0	OH4	6	14.4mm	8330131	521.94
M16	1.5	OH3	6	14.8mm	8330133	521.94
M18	2.5	OH4	6	16.0mm	8330139	627.62
M18	1.5	OH4	6	16.8mm	8330141	627.62
M20	2.5	OH4	6	18.0mm	8330147	731.16
M20	1.5	OH4	6	18.8mm	8330149	731.16

Packed: 1 pc. Available TiCN finish only.

*Please see page 6-9 to find the recommended EXOCARB® SH-DRL drill.

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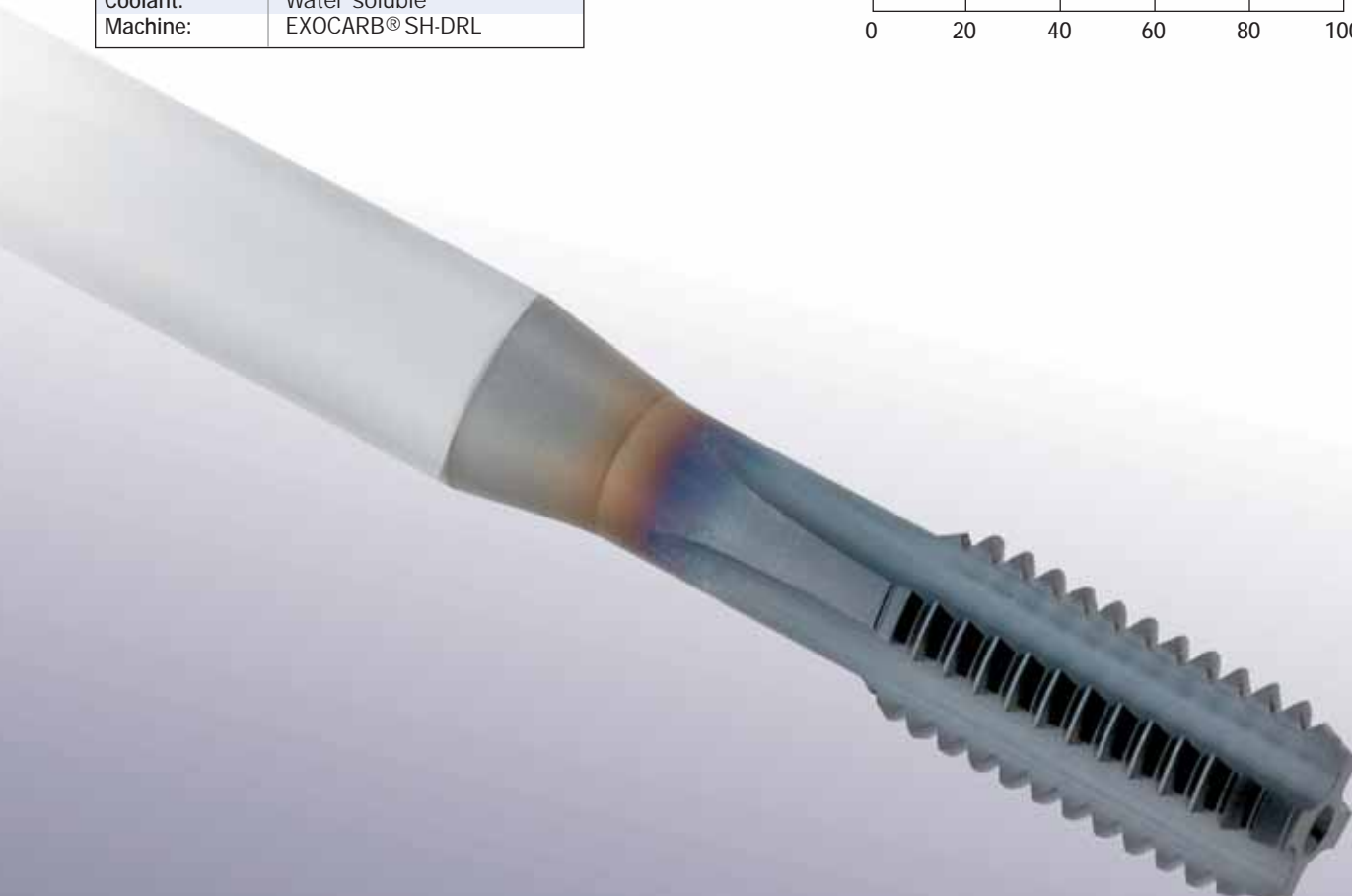
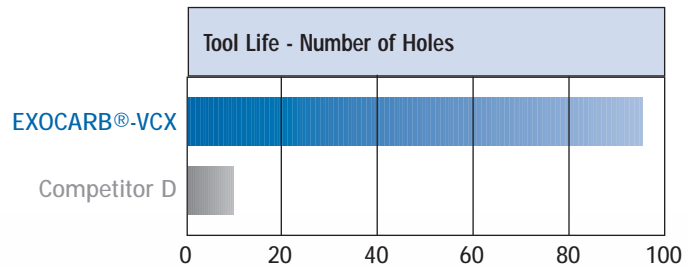
List 10051 & 11051

Features:

- The EXOTAP® VCX is specifically designed for tapping steels with hardness of 42-52 Hrc, such as alloy steels, die steels, and tool steels.
- The VCX tap is composed of a premium powder metal substrate providing this tap with added hardness and wear resistance.
- Along with the superior substrate, the VCX tap has OSG's proprietary V coating for added lubricity along with wear and heat resistance.

Processing Data: Comparing taps made especially for hardened steels

EXOCARB®-VX Tap Performance:	
Tool:	List 10051 5/16-18 UNC
Material:	H13 (46HRC)
Speed:	90 RPM
Hole Size:	.257" x 1.00" (Through)
Tapping Length:	.468" (1.5D)
Coolant:	Water soluble
Machine:	EXOCARB® SH-DRL



List 10051

Modified Bottom(2.5P-3P)



Tap Size	Threads Per Inch		Thread Limit	No. Of Flutes	EDP Number	List Price (Each)
	UNC	UNF				
6	32	—	H3	4	1005110508	20.84
8	32	—	H3	4	1005110808	20.84
10	24	—	H3	4	1005111008	21.27
10	—	32	H3	4	1005111208	21.27
1/4	20	—	H5	4	1005111408	27.52
1/4	—	28	H4	4	1005111608	27.52

Tap Size	Threads Per Inch		Thread Limit	No. Of Flutes	EDP Number	List Price (Each)
	UNC	UNF				
5/16	18	—	H5	5	1005111808	30.01
5/16	—	24	H4	5	1005112008	30.01
3/8	16	—	H5	5	1005112208	33.76
3/8	—	24	H4	5	1005112408	33.76
1/2	13	—	H5	5	1005113008	51.01
1/2	—	20	H5	5	1005113208	51.01

Packed: Up to 3/8" = 10 pcs; 1/2" = 5 pcs.
Available TiCN finish only.

List 11051 **NEW!**

Modified Bottom(2.5P-3P)



Tap Size	Pitch	Thread Limit	No. Of Flutes	EDP Number	List Price (Each)
M3	0.5	D3	4	1105100108	20.84
M4	0.7	D4	4	1105100208	20.84
M5	0.8	D4	4	1105100308	21.27
M6	1.0	D5	4	1105100408	27.52
M8	1.0	D5	4	1105100608	30.01
M8	1.25	D5	4	1105100508	30.01

Tap Size	Pitch	Thread Limit	No. Of Flutes	EDP Number	List Price (Each)
M10	1.0	D5	5	1105100908	33.76
M10	1.25	D5	5	1105100808	33.76
M10	1.5	D6	5	1105100708	33.76
M12	1.25	D5	5	1105101208	51.01
M12	1.5	D6	5	1105101108	51.01
M12	1.75	D6	5	1105101008	51.01

Packed: Up to M10 = 10 pcs; M12 = 5 pcs.
Available TiCN finish only.

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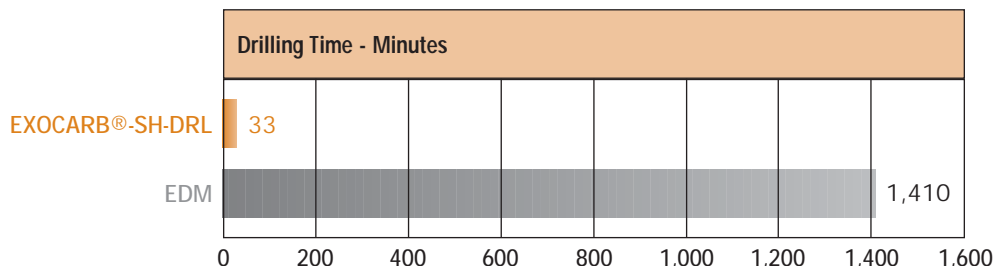
List 5170

Features:

- Drilling in hardened steels up to 70 Hrc is now possible! In the past, these applications could only be accomplished by EDM.
- The SH-DRL Drill is designed with a specially developed point thinning specifically for high hardened steels to prevent chipping.
- It is solid carbide with a large web diameter and slow spiral flute design to provide high rigidity in drilling.
- It also has sharp honed cutting edges to provide lower torque and higher feed rates to improve productivity.

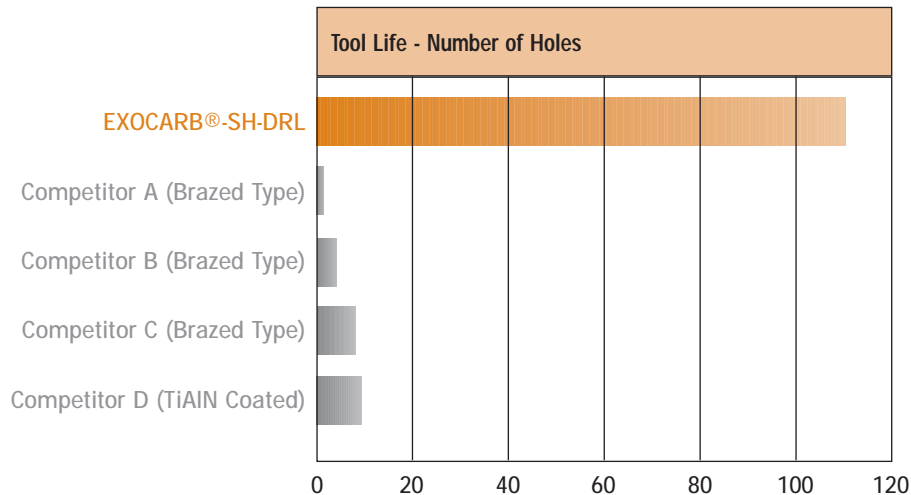
Processing Data: Comparing the SH-DRL vs. Electric Discharge Machining

EXOCARB®-SH-DRL Performance:	
Tool:	List 5170 6MM
Material:	D2 (60HRC)
Speed:	40 SFM
Feed:	.0015 IPR
Depth:	6MM (Blind)
Coolant:	Water soluble
Machine:	Horizontal Lathe



Processing Data: Performance of drills made especially for high hardened steels

EXOCARB®-SH-DRL Performance:	
Tool:	List 5170 6MM
Material:	D2 (60HRC)
Speed:	40 SFM
Feed:	.0025 IPR
Depth:	24MM (Blind)
Coolant:	Water soluble
Machine:	Vertical MC



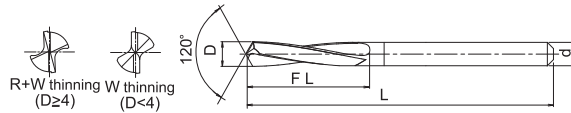
Drilling Guidelines

1. Use a water soluble oil with high density (5 to 10 times dilution).
2. Tight work holding is critical.
3. For drilling depth > 3D, use a step feed.
4. For materials susceptible to chip packing in the flutes, apply a step feed.



List 5170

SH-DRL for Hardened Steel up to **50-70HRC**



h8 Tolerance for cutting diameter
 $D \leq 3$ 0 - 0.014
 $3 < D \leq 6$ 0 - 0.018
 $6 < D \leq 10$ 0 - 0.022
 $10 < D \leq 18$ 0 - 0.027
 $18 < D \leq 24$ 0 - 0.033

EDP Number	Size					Flute Length FL	Overall Length L	Shank Diameter d	List Price (Each)
	Fractional Size	Wire Gauge	Letter Size	mm	Inch				
856020018	—	—	—	2.00	0.0787	12	42	3.0	59.72
856021018	—	—	—	2.10	0.0827	12	42	3.0	59.72
856022018	—	—	—	2.20	0.0866	13	43	3.0	59.72
856023018	—	—	—	2.30	0.0906	13	43	3.0	59.72
856024018	—	—	—	2.40	0.0945	14	44	3.0	59.72
856025018	—	—	—	2.50	0.0984	14	44	3.0	59.72
856026018	—	—	—	2.60	0.1024	14	44	3.0	59.72
856027018	—	—	—	2.70	0.1063	16	46	3.0	59.72
856028018	—	—	—	2.80	0.1102	16	46	3.0	59.72
856029018	—	—	—	2.90	0.1142	16	46	3.0	59.72
856030018	—	—	—	3.00	0.1181	16	46	3.0	59.72
856031018	—	—	—	3.10	0.1220	18	48	4.0	60.11
856032018	—	—	—	3.20	0.1260	18	48	4.0	60.11
856033018	—	—	—	3.30	0.1299	18	48	4.0	60.11
856034018	—	—	—	3.40	0.1339	20	50	4.0	60.11
856035018	—	—	—	3.50	0.1378	20	50	4.0	60.11
856036018	—	—	—	3.60	0.1417	20	50	4.0	63.39
856037018	—	—	—	3.70	0.1457	20	50	4.0	63.39
856038018	—	25	—	3.80	0.1496	22	52	4.0	63.39
856039018	—	—	—	3.90	0.1535	22	52	4.0	63.39
856040018	—	—	—	4.00	0.1575	22	52	4.0	63.39
856041018	—	—	—	4.10	0.1614	25	65	6.0	67.92
856042018	—	—	—	4.20	0.1654	25	65	6.0	67.92
856043018	—	—	—	4.30	0.1693	28	68	6.0	67.92
856044018	—	—	—	4.40	0.1732	28	68	6.0	67.92
856045018	—	16	—	4.50	0.1772	28	68	6.0	67.92
856046018	—	—	—	4.60	0.1811	28	68	6.0	69.31
856047018	—	13	—	4.70	0.1850	28	68	6.0	69.31
856048018	—	12	—	4.80	0.1890	32	72	6.0	69.31
856049018	—	—	—	4.90	0.1929	32	72	6.0	69.31
856050018	—	—	—	5.00	0.1969	32	72	6.0	69.31
856051018	—	—	—	5.10	0.2008	32	72	6.0	69.84
856052018	—	—	—	5.20	0.2047	32	72	6.0	69.84
856053018	—	—	—	5.30	0.2087	32	72	6.0	69.84
856054018	—	—	—	5.40	0.2126	35	75	6.0	69.84
856055018	—	—	—	5.50	0.2165	35	75	6.0	69.84
856056018	—	—	—	5.60	0.2205	35	75	6.0	71.15
856057018	—	—	—	5.70	0.2244	35	75	6.0	71.15
856058018	—	—	—	5.80	0.2283	35	75	6.0	71.15
856059018	—	—	—	5.90	0.2323	35	75	6.0	71.15
856060018	—	—	—	6.00	0.2362	35	75	6.0	75.77
856061018	—	—	—	6.10	0.2402	40	80	6.1	75.77
856062018	—	—	—	6.20	0.2441	40	80	6.2	75.77
856063018	—	—	—	6.30	0.2480	40	80	6.3	75.77
856064018	—	—	—	6.40	0.2520	40	80	6.4	75.77
856065018	—	—	—	6.50	0.2559	40	80	6.5	75.77
856066018	—	—	—	6.60	0.2598	40	80	6.6	82.64
856067018	—	—	—	6.70	0.2638	40	80	6.7	82.64
856068018	—	—	—	6.80	0.2677	45	85	6.8	82.64

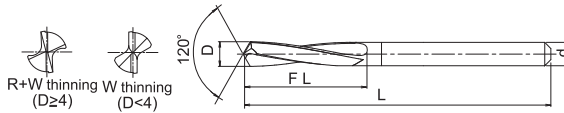
Packed: 1 pc. Available TiAIN finish only.
 See page 2-3 to find recommended EXOCARB® VX Taps.

continued on next page



List 5170 (continued)

SH-DRL for Hardened Steel up to 50-70HRC



h8 Tolerance for cutting diameter
 $D \leq 3$ 0 -0.014
 $3 < D \leq 6$ 0 -0.018
 $6 < D \leq 10$ 0 -0.022
 $10 < D \leq 18$ 0 -0.027
 $18 < D \leq 24$ 0 -0.033

EDP Number	Size					Flute Length FL	Overall Length L	Shank Diameter d	List Price (Each)
	Fractional Size	Wire Gauge	Letter Size	mm	Inch				
856069018	—	—	I	6.90	0.2717	45	85	6.9	82.64
856070018	—	—	—	7.00	0.2756	45	85	7.0	82.64
856071018	—	—	—	7.10	0.2795	45	85	7.1	89.81
856072018	—	—	—	7.20	0.2835	45	85	7.2	89.81
856073018	—	—	—	7.30	0.2874	45	85	7.3	89.81
856074018	—	—	—	7.40	0.2913	45	85	7.4	89.81
856075018	—	—	—	7.50	0.2953	45	85	7.5	89.81
856076018	—	—	—	7.60	0.2992	50	98	7.6	94.53
856077018	—	—	—	7.70	0.3031	50	98	7.7	94.53
856078018	—	—	—	7.80	0.3071	50	98	7.8	94.53
856079018	—	—	—	7.90	0.3110	50	98	7.9	94.53
856080018	—	—	—	8.00	0.3150	50	98	8.0	94.53
856081018	—	—	—	8.10	0.3189	50	98	8.1	99.40
856082018	—	—	P	8.20	0.3228	50	98	8.2	108.28
856083018	—	—	—	8.30	0.3268	50	98	8.3	112.82
856084018	—	—	—	8.40	0.3307	50	98	8.4	112.82
856085018	—	—	—	8.50	0.3346	50	98	8.5	112.82
856086018	—	—	—	8.60	0.3386	57	105	8.6	123.80
856087018	—	—	—	8.70	0.3425	57	105	8.7	123.80
856088018	—	—	—	8.80	0.3465	57	105	8.8	123.80
856089018	—	—	—	8.90	0.3504	57	105	8.9	123.80
856090018	—	—	—	9.00	0.3543	57	105	9.0	123.80
856091018	—	—	—	9.10	0.3583	57	105	9.1	129.60
856092018	—	—	—	9.20	0.3622	57	105	9.2	129.60
856093018	—	—	—	9.30	0.3661	57	105	9.3	129.60
856094018	—	—	—	9.40	0.3701	57	105	9.4	129.60
856095018	—	—	—	9.50	0.3740	57	105	9.5	129.60
856096018	—	—	—	9.60	0.3780	63	111	9.6	147.51
856097018	—	—	—	9.70	0.3819	63	111	9.7	147.51
856098018	—	—	W	9.80	0.3858	63	111	9.8	147.51
856099018	—	—	—	9.90	0.3898	63	111	9.9	147.51
856100018	—	—	—	10.00	0.3937	63	111	10.0	147.51
856101018	—	—	—	10.10	0.3976	63	111	10.1	153.65
856102018	—	—	—	10.20	0.4016	63	111	10.2	153.65
856103018	—	—	—	10.30	0.4055	63	111	10.3	153.65
856104018	—	—	—	10.40	0.4094	63	111	10.4	153.65
856105018	—	—	—	10.50	0.4134	63	111	10.5	153.65
856106018	—	—	—	10.60	0.4173	63	111	10.6	159.95
856107018	—	—	—	10.70	0.4213	71	119	10.7	159.95
856108018	—	—	—	10.80	0.4252	71	119	10.8	159.95
856109018	—	—	—	10.90	0.4291	71	119	10.9	159.95
856110018	—	—	—	11.00	0.4331	71	119	11.0	166.60
856111018	—	—	—	11.10	0.4370	71	119	11.1	173.53
856112018	—	—	—	11.20	0.4409	71	119	11.2	173.53
856113018	—	—	—	11.30	0.4449	71	119	11.3	173.53
856114018	—	—	—	11.40	0.4488	71	119	11.4	173.53
856115018	—	—	—	11.50	0.4528	71	119	11.5	190.88
856116018	—	—	—	11.60	0.4567	71	119	11.6	197.12
856117018	—	—	—	11.70	0.4606	71	119	11.7	197.12

Packed: 1 pc. Available TiAIN finish only.
 See page 2-3 to find recommended EXOCARB® VX Taps.



List 5170 (continued)

EDP Number	Size					Flute Length	Overall Length	Shank Diameter	List Price (Each)
	Fractional Size	Wire Gauge	Letter Size	mm	Inch	FL	L	d	
856118018	—	—	—	11.80	0.4646	71	119	11.8	197.12
856119018	—	—	—	11.90	0.4685	76	127	11.9	197.12
856120018	—	—	—	12.00	0.4724	76	127	12.0	197.12
856122118	—	—	—	12.10	0.4764	76	136	16.0	210.36
856122618	—	—	—	12.60	0.4961	79	139	16.0	210.36
856124118	—	—	—	14.10	0.5551	90	150	16.0	253.94
856124618	—	—	—	14.60	0.5748	90	150	16.0	256.24
856125618	—	—	—	15.60	0.6142	96	156	16.0	278.96
856126118	—	—	—	16.10	0.6339	102	162	20.0	290.77
856126618	—	—	—	16.60	0.6535	102	162	20.0	301.15
856176018	—	—	—	17.60	0.6929	108	168	20.0	327.38
856186018	—	—	—	18.60	0.7323	114	174	20.0	353.59

Packed: 1 pc. Available TiAlN finish only.
See page 2-3 to find recommended EXOCARB® VX Taps.



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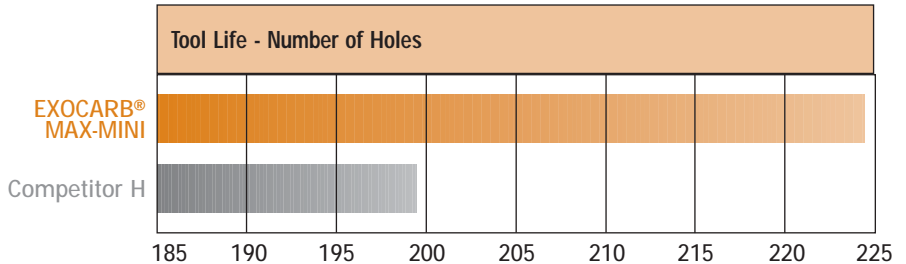
List 5300

Features:

- The MAX-MINI has been developed for small diameter drilling in hardened steels up to 65 Hrc.
- It is designed with a large web diameter and low helix angle, resulting in excellent wear and breakage resistance.
- The MAX-MINI can drill up to 5-10xD, depending on diameter.

Processing Data: Small diameter boring on hardened steel

EXOCARB®-MAX-MINI Performance:		
Tool:	List 5300	Competitor H
Size:	ø 1MM	ø 1MM
Material:	D2	D2
Speed:	165 SFM	98 SFM
Feed:	13 IPM	.75 IPM
Depth:	6MM (Through)	6MM (Through)
Coolant:	Water soluble	Water soluble
Machine:	Vertical MC	Vertical MC



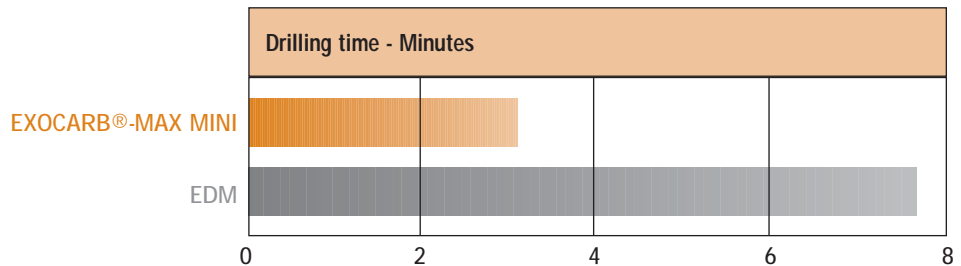
List 5310

Features:

- Drilling small diameters (Ø1~3) in hardened steels up to 20xD! In the past, these applications could only be accomplished by EDM.
- The MAX-MINI has a triple margin design to provide higher rigidity, higher precision, and better surface finish.
- It has a long reduced neck shape with a stub groove which collects chips during operation, while providing extra rigidity.
- The MAX-MINI is coated with OSG's proprietary EXO coating, giving this tool excellent wear and heat resistance.

Processing Data: Comparison of List 5310 to EDM ~ Drilling 55 Hrc steel - 20xD

EXOCARB®-MAX-MINI Performance:	
Tool:	List 5310 1MMx20
Material:	420 Stainless (55HRC)
Speed:	165 SFM
Feed:	.0025 IPR
Step Feed:	.0025"
Depth:	20MM (20xD) (Blind)
Coolant:	Water soluble
Machine:	Vertical MC



Electric Discharge Machining	
Amperage:	6 Ampres
Condenser:	0.5µF
Voltage:	24V

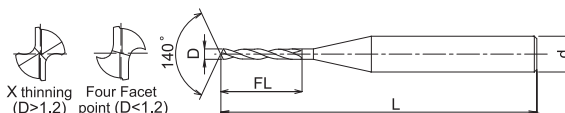
Drilling Guidelines

1. Please use a machine with a precision spindle.
2. The indicated feeds and speeds are for drilling with water soluble coolant.
3. Use a water soluble oil with high density (less than 20 times dilution)
4. We recommend using List 5300 - MAX-MINI as a pilot hole operation prior to List 5310 - MAX-MINI
5. The List 5300 - MAX-MINI is effective for preventing burrs at the entrance of the hole as well as chamfering.
6. The T.I.R. of the drill in the spindle should be less than 0.0001".
7. For optimum tool life, please utilize the recommended peck cycle.
8. OSG's Shrink Fit System is the recommended tool holder for these drills.

Note: For machines that cannot achieve the speeds indicated in the above table, please set rotation as high as possible. Tool life may be decreased.

List 5300

Miniature Drills



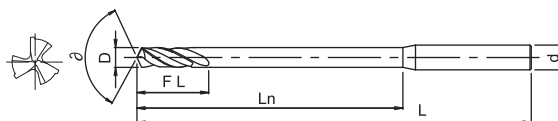
h8 Tolerance for cutting diameter
 $D \leq 3$ 0 -0.014
 $3 < D \leq 6$ 0 -0.018
 $6 < D \leq 10$ 0 -0.022
 $10 < D \leq 18$ 0 -0.027
 $18 < D \leq 24$ 0 -0.033

EDP Number	Size					Flute Length FL	Overall Length L	Shank Diameter d	List Price (Each)
	Fractional Size	Wire Gauge	Letter Size	mm	Inch				
53000211	—	—	—	0.20	0.0079	2	38.1	3	23.86
53000311	—	—	—	0.30	0.0118	3	38.1	3	19.28
53000411	—	—	—	0.40	0.0157	4	38.1	3	19.28
53000511	—	—	—	0.50	0.0197	4	38.1	3	19.28
53000611	—	—	—	0.60	0.0236	5	38.1	3	19.28
53000711	—	—	—	0.70	0.0276	5	38.1	3	19.28
53000811	—	—	—	0.80	0.0315	6	38.1	3	19.28
53000911	—	—	—	0.90	0.0354	6	38.1	3	19.28
53001011	—	—	—	1.00	0.0394	8	38.1	3	28.45
53001111	—	—	—	1.10	0.0433	8	38.1	3	28.45
53001211	—	—	—	1.20	0.0472	8	38.1	3	28.45
53001311	—	—	—	1.30	0.0512	8	38.1	3	28.45
53001411	—	54	—	1.40	0.0551	8	38.1	3	28.45
53001511	—	—	—	1.50	0.0591	10	38.1	3	28.45
53001611	—	—	—	1.60	0.0630	10	38.1	3	28.45
53001711	—	51	—	1.70	0.0669	10	38.1	3	28.45
53001811	—	—	—	1.80	0.0709	10	38.1	3	28.45
53001911	—	—	—	1.90	0.0748	10	38.1	3	28.45
53002011	—	—	—	2.00	0.0787	10	38.1	3	28.45

Packed: 1 pc. Available EXO® coating only.

List 5310 **NEW!**

Miniature Drills, Up to 20xD, 40-65 HRC



EDP Number	Size					Neck Length L1	Flute Length FL	Overall Length L	Shank Diameter d	List Price (Each)
	Fractional Size	Wire Gauge	Letter Size	mm	Inch					
8569010	—	—	—	1.00	0.0394	20	6	62	3	89.29
8569011	—	—	—	1.10	0.0433	20	7	62	3	83.05
8569012	—	—	—	1.20	0.0472	20	8	62	3	83.05
8569013	—	—	—	1.30	0.0512	20	8	62	3	83.05
8569014	—	54	—	1.40	0.0551	20	8	62	3	83.05
8569015	—	—	—	1.50	0.0591	20	8	62	3	83.05
8569016	—	—	—	1.60	0.0630	20	10	62	3	74.50
8569017	—	51	—	1.70	0.0669	20	10	62	3	74.50
8569018	—	—	—	1.80	0.0709	20	11	62	3	74.50
8569019	—	—	—	1.90	0.0748	20	11	62	3	74.50
8569020	—	—	—	2.00	0.0787	30	12	62	3	74.50
8569025	—	—	—	2.50	0.0984	30	15	62	3	74.50
8569030	—	—	—	3.00	0.1181	30	17	62	3	74.50

Packed: 1 pc. Available EXO® coating only.

Shrink Fit Holders Recommended. Must Utilize Recommended Peck Cycle for Optimum Tool Life.

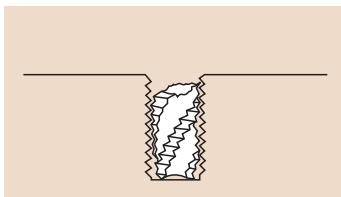


List 5172

Features:

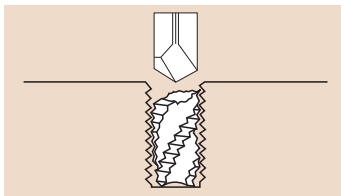
- The XH-DRL is specifically designed for removing broken taps, but can also be applied to broken drills, screw extractors, dowel pins, and screws.
- It is designed with a flute less back taper, giving this drill the ultimate rigidity.
- It also has a special negative point geometry, giving this drill an added cutting edge strength.
- In addition to the above applications, the EX-DRL can also drill glass, ceramics, and granite.

Procedure for Removing Broken Taps:



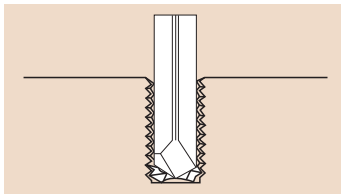
1. Broken Tap

Check how tap is broken. If any portion of the tap is protruding, grind the damaged surface of the tap flush with the workpiece. This will allow the damaged tap to be drilled easier.



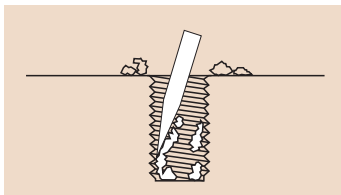
2. Centering of Drill

Position the drill over the center of the tap. Please make sure both the workpiece and drill are properly secured. Make an initial light drill approach, and then quickly retract the drill. For this step, do not use lubrication.



3. Hole Processing

Drill the hole at a fixed feed and speed, stopping the operation occasionally to remove broken chips. In addition, use plenty of high quality cutting fluid.



4. Chip Removal

Once the tap has been broken up, the remaining portions of the tap can be removed, for best results use a scribe. Once the hole is cleaned, tapping can be resumed.

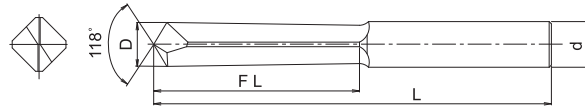
Cutting Condition and Procedures to Note

1. Use a drilling speed of 65-80SFM.
2. Hand feed of .0005-.001 in/rev is normal.
3. Use a rigid holder.
4. Select a high quality cutting oil and apply in sufficient amounts.
5. This tool should not be used to drill soft steels, aluminum alloys or other soft materials.
6. Resharpening should be done periodically.
7. For through hole processing of heat treated steels, use a spare piece of material underneath the material being drilled this will prevent breakage caused by sudden torque.

List 5172 **NEW!**



XH-DRL for Removing Broken Taps



EDP Number	Size mm	Flute Length FL	Overall Length L	Shank Diameter d	List Price (Each)	Tap Types					
						Straight Fluted		Spiral Pointed		Spiral Fluted	
						Metric	ANSI	Metric	ANSI	Metric	ANSI
87702	2	10	30	2	28.45	M3	#4, #5, #6	M3	#4, #5	M3	#4, #5, #6
87703	3	15	40	3	33.38	M4, M5	#8, #10	M4	#8, #10	M4, M5	#8, #10
87704	4	20	45	4	38.46	M6	1/4 and 5/16	M5 and M6	1/4	M6	1/4 and 5/16
87705	5	25	50	5	45.56	M8, M10	3/8	—	5/16	M8, M10	3/8
87706	6	30	60	6	57.19	M12	7/16 and 1/2	M8	3/8	M12	7/16, 1/2
87707	7	35	80	7	93.62	M14	9/16	M10	7/16	M14	9/16
87708	8	40	80	8	106.37	M16	5/8	M12	1/2	M16	5/8
87709	9	45	100	9	144.70	M18	3/4	M14	9/16	M18	3/4
87710	10	50	100	10	153.83	M20	-	M16	5/8	M20	—
87781	11	55	110	11	200.27	M22	7/8	M18	—	M22	7/8
87782	12	60	110	12	210.44	M24	1.00	M20	3/4	M24	1.00
87700	2-6 Set	—	—	—	193.07	—	—	—	—	—	—

Packed: 1 pc.

For drill diameter selection, use the method outline below.

(T=Tap Diameter D=Drill Diameter)

Straight Fluted & Spiral Fluted Taps: $0.46T < D < 0.75D$

Spiral Pointed Taps: $0.6T < D < 0.75T$

Drills are available in 5pc sets (EDP 87700) for Ø2 through Ø6

Recommended Drilling Conditions

Work Material	Broken Taps, Drills, etc.
Speed (SFM)	65-80 SFM
Drill Dia. (mm)	Speed RPM
2	3,150 - 3,880
3	2,100 - 2,590
4	1,580 - 1,940
5	1,260 - 1,550
6	1,050 - 1,290
7	900 - 1,110
8	790 - 970
9	700 - 860
10	630 - 780
11	570 - 710
12	530 - 650



Recommended Tapping Conditions 55 to 65 HRC

List 311 – EXOCARB®-VX

Inch Sizes

Work Material	Hardened Steels D2, H13
Speed (SFM)	3 - 10
Tap Size	Speed RPM
4 - 40	102 - 341
6 - 32	83 - 277
8 - 32	70 - 233
10 - 24	60 - 201
10 - 32	60 - 201
1/4 - 20	46 - 153
1/4 - 28	46 - 153
5/16 - 18	37 - 122
5/16 - 24	37 - 122
3/8 - 16	31 - 102
3/8 - 24	31 - 102
7/16 - 14	26 - 87
7/16 - 20	26 - 87
1/2 - 13	23 - 76
1/2 - 20	23 - 76

1. Use a non-water soluble cutting fluid.
2. Set the tapping speed between 3-10 SFM.
3. Choose the largest hole-size possible, within the recommended tolerance range.
4. Use highly rigid machines and tool holders.

List 341 – EXOCARB®-VX

Metric Sizes

Work Material	Hardened Steels D2, H13
Speed (SFM)	3 - 10
Tap Size	Speed RPM
M 2.6 x 0.45	122 -- 367
3 x 0.5	106 -- 318
4 x 0.7	80 -- 239
5 x 0.8	64 -- 191
6 x 1.0	53 -- 159
8 x 1.25	40 -- 119
8 x 1.0	40 -- 119
10 x 1.5	32 -- 95
10 x 1.25	32 -- 95
10 x 1.0	32 -- 95
12 x 1.75	27 -- 80
12 x 1.5	27 -- 80
12 x 1.25	27 -- 80
12 x 1.0	27 -- 80
14 x 2.0	23 -- 68
14 x 1.5	23 -- 68
16 x 2.0	20 -- 60
16 x 1.5	20 -- 60
18 x 2.5	18 -- 53
18 x 1.5	18 -- 53
20 x 2.5	16 -- 48
20 x 1.5	16 -- 48

1. Use a non-water soluble cutting fluid.
2. Set the tapping speed between 3-10 SFM.
3. Choose the largest hole-size possible, within the recommended tolerance range.
4. Use highly rigid machines and tool holders.

List 5170 – EXOCARB® SH-DRL

Work Material	Hardened Steels			
	D2-57 55-60 HRC		D2-CPM-9V 60-70 HRC	
Speed (SFM)	33-52 SFM		26-42 SFM	
Drill Dia. (mm)	Speed RPM	Feed IPR	Speed RPM	Feed IPR
2	2,050	0.001-0.002	1,900	0.001-0.002
3	1,360	0.001-0.002	1,250	0.001-0.002
4	1,020	0.001-0.002	950	0.001-0.002
5	820	0.001-0.002	760	0.001-0.002
6	680	0.001-0.002	630	0.001-0.002
7	580	0.001-0.002	540	0.001-0.002
8	510	0.001-0.002	470	0.001-0.002
9	450	0.001-0.002	420	0.001-0.002
10	410	0.001-0.002	380	0.001-0.002
11	370	0.001-0.002	350	0.001-0.002
12	340	0.001-0.002	315	0.001-0.002
14	290	0.001-0.002	270	0.001-0.002
15	270	0.001-0.002	250	0.001-0.002
16	260	0.001-0.002	240	0.001-0.002
17	240	0.001-0.002	220	0.001-0.002
18	230	0.001-0.002	210	0.001-0.002

1. Use a water soluble oil with high density (5 to 10 times dilution).
2. Tight clamping is critical.
3. For drilling depth > 3D, use a step feed.
4. For materials susceptible to chip packing in the flute, apply a step feed.

List 5310 – EXOCARB®-MAX-MINI

Work Material	Hardened Steel, Pre-Hardened Steels 40-50 HRC			H113 50-55 HRC			D2, 44SUS 55-62 HRC		
	130-160 SFM			110-150 SFM			100-130 SFM		
Drill Dia. (mm)	Speed RPM	Feed Rate IPR	Pecking (IN)	Speed RPM	Feed Rate IPR	Pecking (IN)	Speed RPM	Feed Rate IPR	Pecking (IN)
1	14,000	0.0008-0.0020	0.0008-0.0020	13,000	0.0008-0.0020	0.0008-0.0020	11,000	0.0008-0.0020	0.0008-0.0020
1.1	13,000	0.0008-0.0020	0.0008-0.0020	12,000	0.0008-0.0020	0.0008-0.0020	10,000	0.0008-0.0020	0.0008-0.0020
1.2	12,000	0.0008-0.0020	0.0008-0.0020	11,000	0.0008-0.0020	0.0008-0.0020	9,000	0.0008-0.0020	0.0008-0.0020
1.3	11,000	0.0008-0.0020	0.0008-0.0020	10,000	0.0008-0.0020	0.0008-0.0020	8,600	0.0008-0.0020	0.0008-0.0020
1.4	10,000	0.0008-0.0020	0.0008-0.0020	9,000	0.0008-0.0020	0.0008-0.0020	8,000	0.0008-0.0020	0.0008-0.0020
1.5	9,500	0.0008-0.0020	0.0008-0.0020	8,500	0.0008-0.0020	0.0008-0.0020	7,400	0.0008-0.0020	0.0008-0.0020
1.6	9,000	0.0008-0.0020	0.0008-0.0020	8,000	0.0008-0.0020	0.0008-0.0020	7,000	0.0008-0.0020	0.0008-0.0020
1.7	8,400	0.0008-0.0020	0.0008-0.0020	7,500	0.0008-0.0020	0.0008-0.0020	6,600	0.0008-0.0020	0.0008-0.0020
1.8	8,000	0.0008-0.0020	0.0008-0.0020	7,100	0.0008-0.0020	0.0008-0.0020	6,200	0.0008-0.0020	0.0008-0.0020
1.9	7,500	0.0008-0.0020	0.0008-0.0020	6,700	0.0008-0.0020	0.0008-0.0020	5,900	0.0008-0.0020	0.0008-0.0020
2.0	7,200	0.0008-0.0020	0.0008-0.0020	6,400	0.0008-0.0020	0.0008-0.0020	5,600	0.0008-0.0020	0.0008-0.0020
2.5	5,700	0.0008-0.0020	0.0008-0.0020	5,100	0.0008-0.0020	0.0008-0.0020	4,500	0.0008-0.0020	0.0008-0.0020
3.0	4,800	0.0008-0.0020	0.0008-0.0020	4,200	0.0008-0.0020	0.0008-0.0020	3,700	0.0008-0.0020	0.0008-0.0020

1. Please use in a machine with precise spindle rotation. Tight clamping is critical.
2. The indicated speeds and feeds are for drilling with water soluble fluid.
3. Please use water-soluble high density fluid (less than 20 times dilution).
4. We recommend the pilot hole operation prior to FHL-GDTS.
5. The run out with a drill in the spindle should be less than 0.002mm.
6. OSG' Shrink Fit System is the recommended tool holder for these drills.

Note: For machines that cannot achieve the speeds indicated in the above table, please set rotation as high as possible. Tool life may be decreased.



Speeds & Feeds

List 5300 – EXOCARB® MAX MINI

Work Material	Special Alloy Steels-Hardened Steels								
	Carbon Steels Alloy Steels			Special Alloy Steels HRC			Hardened Steels 40-50 HRC		
Speed (SFM)	164-177 SFM			164-177 SFM			164-177 SFM		
Drill Dia. (mm)	Speed RPM	Feed IPR	Pecking (IN)	Speed RPM	Feed IPR	Pecking (IN)	Speed RPM	Feed IPR	Pecking (IN)
0.2	See Note 1	0.00020	0.0002	See Note 1	0.00016	0.0002	See Note 1	0.00016	0.0002
0.3	See Note 1	0.00030	0.0004	See Note 1	0.00024	0.0002	See Note 1	0.00024	0.0002
0.4	See Note 1	0.00039	0.0005	See Note 1	0.00031	0.0003	See Note 1	0.00047	0.0003
0.5	See Note 1	0.00059	0.0007	See Note 1	0.00059	0.0006	See Note 1	0.00059	0.0006
0.6	See Note 1	0.00071	0.0008	See Note 1	0.00071	0.0007	See Note 1	0.00071	0.0007
0.7	24,000	0.00083	0.0010	24,000	0.00083	0.0008	24,000	0.00083	0.0008
0.8	21,000	0.00094	0.0011	21,000	0.00094	0.0009	21,000	0.00094	0.0009
0.9	18,000	0.00106	0.0012	18,000	0.00106	0.0011	18,000	0.00106	0.0011
1.0	17,000	0.00118	0.0014	17,000	0.00113	0.0012	17,000	0.00118	0.0012
1.1	15,000	0.00130	0.0015	15,000	0.00130	0.0013	15,000	0.00130	0.0013
1.2	14,000	0.00142	0.0017	14,000	0.00142	0.0014	14,000	0.00142	0.0014
1.3	13,000	0.00154	0.0018	13,000	0.00154	0.0015	13,000	0.00154	0.0015
1.4	12,000	0.00165	0.0019	12,000	0.00165	0.0017	12,000	0.00165	0.0017
1.5	11,000	0.00177	0.0021	11,000	0.00177	0.0018	11,000	0.00177	0.0018
1.6	10,000	0.00189	0.0022	10,000	0.00189	0.0019	10,000	0.00189	0.0019
1.7	10,000	0.00201	0.0023	10,000	0.00201	0.0020	10,000	0.00201	0.0020
1.8	9,000	0.00213	0.0025	9,000	0.00213	0.0021	9,000	0.00213	0.0021
1.9	9,000	0.00224	0.0026	9,000	0.00224	0.0022	9,000	0.00224	0.0022
2.0	8,000	0.00236	0.0028	8,000	0.00236	0.0024	8,000	0.00236	0.0024

Work Material	Special Alloy Steels-Hardened Steels					
	Hardened Steels 50-60 HRC			Hardened Steels 55-62 HRC		
Speed (SFM)	164-177 SFM			164-177 SFM		
Drill Dia. (mm)	Speed RPM	Feed IPR	Pecking (IN)	Speed RPM	Feed IPR	Pecking (IN)
0.2	See Note 1	0.00016	0.00008	See Note 1	0.00016	0.00008
0.3	See Note 1	0.00024	0.00012	See Note 1	0.00024	0.00012
0.4	See Note 1	0.00031	0.00031	See Note 1	0.00031	0.00016
0.5	See Note 1	0.00039	0.00039	See Note 1	0.00039	0.00020
0.6	See Note 1	0.00047	0.00047	See Note 1	0.00047	0.00024
0.7	24,000	0.00055	0.00055	24,000	0.00055	0.00028
0.8	21,000	0.00063	0.00063	21,000	0.00063	0.00031
0.9	18,000	0.00071	0.00071	18,000	0.00071	0.00035
1.0	17,000	0.00079	0.00079	17,000	0.00079	0.00039
1.1	15,000	0.00087	0.00087	15,000	0.00087	0.00043
1.2	14,000	0.00094	0.00094	14,000	0.00094	0.00047
1.3	13,000	0.00102	0.00102	13,000	0.00102	0.00051
1.4	12,000	0.00110	0.00110	12,000	0.00110	0.00055
1.5	11,000	0.00118	0.00118	11,000	0.00118	0.00059
1.6	10,000	0.00126	0.00126	10,000	0.00126	0.00063
1.7	10,000	0.00134	0.00134	10,000	0.00134	0.00067
1.8	9,000	0.00142	0.00142	9,000	0.00142	0.00071
1.9	9,000	0.00150	0.00150	9,000	0.00150	0.00075
2.0	8,000	0.00157	0.00157	8,000	0.00157	0.00079

1. Please set spindle speed as high as possible.
2. Please use a carbide drills with precise spindle rotation.
3. Please use water soluble oil (less than 20 times dilution).
4. T.I.R. with a drill in a spindle should be less than 0.0001"
5. Shrink Fit System holders are recommended.



- Use safety cover, safety glasses and safety shoes during operation.
- Do not touch cutting edges with bare hands.
- Do not touch cutting chips with bare hands. Chips will be hot after cutting.
- Stop Cutting when the tool becomes dull.
- Stop cutting operation immediately if you hear any strange sounds.
- Do not modify tools.
- Use correct tools for the operation. Check dimensions to ensure proper selection.



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