CARBIDE

TOTEM®

High Performance Cutting Tools

END MILLS

END MILLS

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END MILLS

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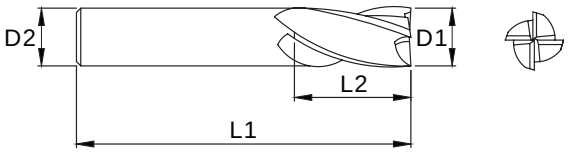
4 Flute

Centre cutting Proton Plus end mill

Carbide | REG | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

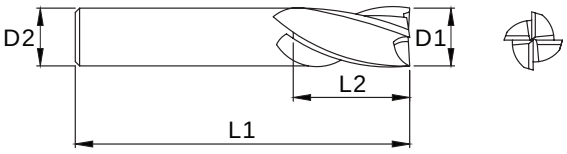
Diameter	EDP No	Flute Length	Overall Length	Shank Diameter	Corner Radius
Ø D1		L2	L1	Ø D2	Cr
3	FBK0503424	12	38	3	-
3	FBK0503425	12	38	3	0.5
3	FBK0503426	12	38	3	1.0
4	FBK0503427	14	51	4	-
4	FBK0503428	14	51	4	0.5
4	FBK0503429	14	51	4	1.0
5	FBK0503430	15	60	5	-
5	FBK0503431	15	60	5	0.5
5	FBK0503432	15	60	5	1.0
6	FBK0503433	15	60	6	-
6	FBK0503434	15	60	6	0.5
6	FBK0503435	15	60	6	1.0
8	FBK0503436	19	60	8	-
8	FBK0503437	19	60	8	0.5
8	FBK0503438	19	60	8	1.0
10	FBK0503439	22	75	10	-

*Custom Solution possible Refer page 261

4 Flute

Centre cutting Proton Plus end mill

Carbide | REG | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

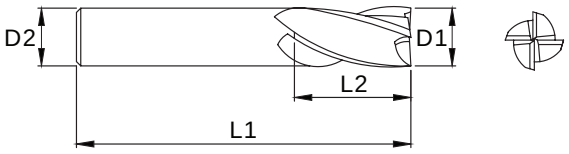
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2	Corner Radius Cr
10	FBK0503440	22	75	10	0.5
10	FBK0503441	22	75	10	1.0
12	FBK0503442	22	76	12	-
12	FBK0503443	22	76	12	0.5
12	FBK0503444	22	76	12	1.0
16	FBK0503445	32	100	16	-
16	FBK0503446	32	100	16	0.5
16	FBK0503447	32	100	16	1.0

*Custom Solution possible Refer page 261

4 Flute Centre cutting Proton Plus end mill

Carbide | LONG | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

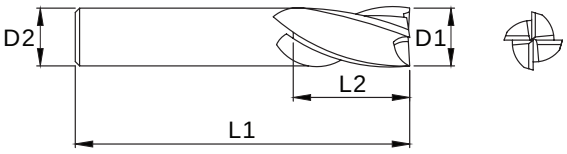
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2	Corner Radius Cr
3	FBK0503448	12	60	3	-
3	FBK0503449	12	60	3	0.5
3	FBK0503450	12	60	3	1.0
4	FBK0503451	14	76	4	-
4	FBK0503452	14	76	4	0.5
4	FBK0503453	14	76	4	1.0
5	FBK0503454	15	76	5	-
5	FBK0503455	15	76	5	0.5
5	FBK0503456	15	76	5	1.0
6	FBK0503457	20	80	6	-
6	FBK0503458	20	80	6	0.5
6	FBK0503459	20	80	6	1.0
8	FBK0503460	25	80	8	-
8	FBK0503461	25	80	8	0.5

*Custom Solution possible Refer page 261

4 Flute

Centre cutting Proton Plus end mill

Carbide | LONG | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

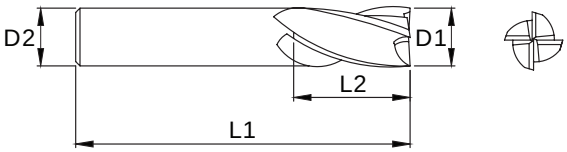
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2	Corner Radius Cr
8	FBK0503462	25	80	8	1.0
10	FBK0503463	25	100	10	-
10	FBK0503464	25	100	10	0.5
10	FBK0503465	25	100	10	1.0
12	FBK0503466	30	102	12	-
12	FBK0503467	30	102	12	0.5
12	FBK0503468	30	102	12	1.0
16	FBK0503469	40	150	16	-
16	FBK0503470	40	150	16	0.5
16	FBK0503471	40	150	16	1.0

*Custom Solution possible Refer page 261

4 Flute Centre cutting Proton Plus end mill

Carbide | LONG REACH | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

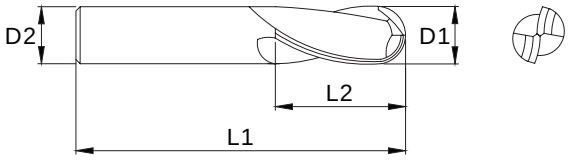
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2	Corner Radius Cr
6	FBK0503472	25	100	6	-
6	FBK0503473	25	100	6	0.50
6	FBK0503474	25	100	6	1.00
8	FBK0503475	25	100	8	-
8	FBK0503476	25	100	8	0.50
8	FBK0503477	25	100	8	1.00
10	FBK0503478	30	150	10	-
10	FBK0503479	30	150	10	0.50
10	FBK0503480	30	150	10	1.00
12	FBK0503481	30	150	12	-
12	FBK0503482	30	150	12	0.50
12	FBK0503483	30	150	12	1.00

*Custom Solution possible Refer page 261

2 Flute

Centre cutting Proton Plus ball nose end mill

Carbide | REG | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

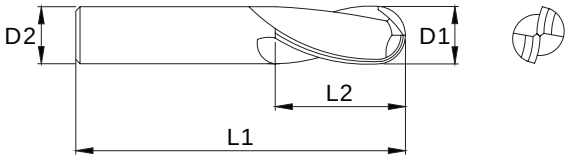
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0501561	2	60	4
1.5	FBK0501562	3	60	4
2	FBK0501563	4	60	4
2.5	FBK0501564	4	60	4
3	FBK0501565	5	60	6
4	FBK0501566	6	60	6
5	FBK0501571	4	80	6
6	FBK0501553	10	60	6
8	FBK0501554	16	60	8
10	FBK0501555	19	75	10
12	FBK0501556	22	80	12

*Custom Solution possible Refer page 261

2 Flute Centre cutting Proton Plus ball nose end mill

Carbide | LONG | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

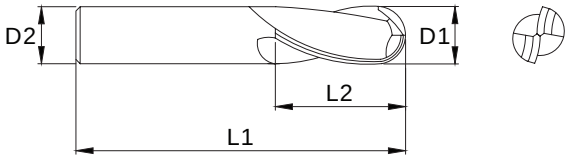
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0501567	2	80	4
2	FBK0501568	3	80	4
3	FBK0501569	4	80	6
4	FBK0501570	4	80	6
6	FBK0501557	10	80	6
6	FBK0503367	12	102	6
8	FBK0503390	16	80	8
8	FBK0501558	16	100	8
10	FBK0501559	19	100	10
12	FBK0501560	22	100	12

*Custom Solution possible Refer page 261

2 Flute

Centre cutting Proton Plus ball nose end mill

Carbide | LONG REACH | 30° | Above 45 HRC | Proton Plus



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

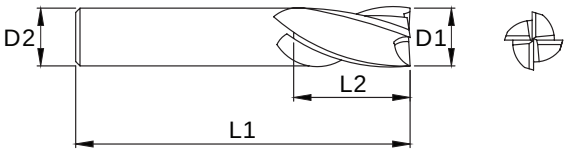
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
6	FBK0503367	12	102	6
8	FBK0501558	16	100	8
10	FBK0503912	32	152	10
12	FBK0503913	32	152	12

*Custom Solution possible Refer page 261

4 Flute — Centre cutting HSM end mill

Carbide | REG | 30° | 30 - 45 HRC | TiAlN

P2-P4



Unit : mm

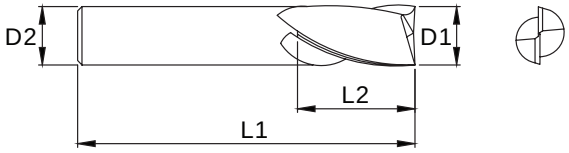
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0501200	12	38	3
4	FBK0501974	14	51	4
5	FBK0501326	20	51	5
6	FBK0501366	20	64	6
8	FBK0501975	20	64	8
10	FBK0500846	25	70	10
12	FBK0500942	25	76	12
14	FBK0501017	30	89	14
16	FBK0501048	30	89	16
20	FBK0501125	38	102	20

*Custom Solution possible Refer page 261

2 Flute — Centre cutting HSM end mill

Carbide | REG | 30° | 30 - 45 HRC | TiAlN

P2-P4



Unit : mm

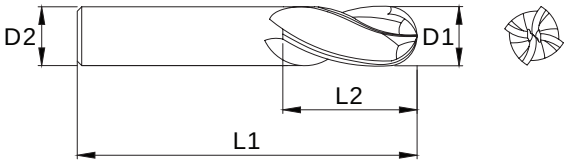
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0501196	12	38	3
4	FBK0501986	14	51	4
5	FBK0501318	20	51	5
6	FBK0501987	20	64	6
8	FBK0501441	20	64	8
10	FBK0500834	25	70	10
14	FBK0501015	30	89	14
16	FBK0501046	30	89	16
20	FBK0501122	38	102	20

*Custom Solution possible Refer page 261

4 Flute Centre cutting HSM ball nose end mill

Carbide | REG | 30° | 30 - 45 HRC | TiAlN

P2-P4



Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0501198	12	38	3
4	FBK0501980	14	51	4
5	FBK0501322	20	51	5
6	FBK0501361	20	64	6
8	FBK0501448	20	64	8
10	FBK0500838	25	70	10
12	FBK0500937	25	76	12
16	FBK0501047	30	89	16
20	FBK0501981	38	102	20

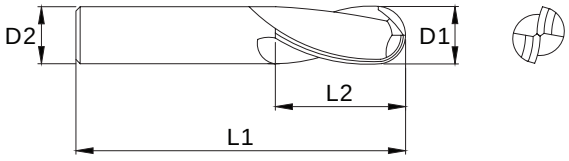
*Custom Solution possible Refer page 261

2 Flute

Centre cutting HSM ball nose end mill

Carbide | REG | 30° | 30 - 45 HRC | TiAlN

P2-P4



Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0501195	12	38	3
4	FBK0501241	14	51	4
5	FBK0501320	20	51	5
6	FBK0501992	20	64	6
8	FBK0501437	20	64	8
10	FBK0501993	25	70	10
12	FBK0501994	25	76	12
16	FBK0501045	30	89	16
20	FBK0501995	38	102	20

*Custom Solution possible Refer page 261

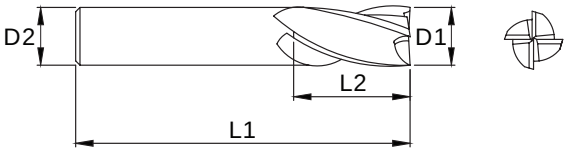
Solid Carbide End Mills

F177 TR Series

4 Flute

Centre cutting high performance end mill

Carbide | REG | 35/38° | Cr Base



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

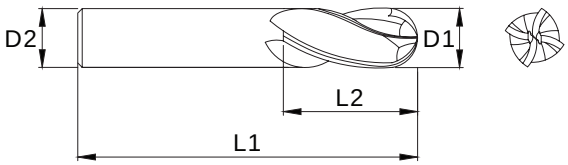
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
6	FBK0503484	20	64	6
8	FBK0503485	20	64	8
10	FBK0503422	25	70	10
12	FBK0503487	25	76	12
16	FBK0503489	30	89	16
20	FBK0503490	35	102	20

*Custom Solution possible Refer page 261

4 Flute

Centre cutting high performance ball nose end mill

Carbide | REG | 35/38° | Cr Base



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

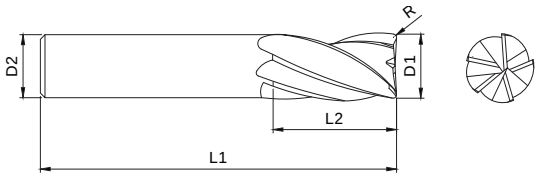
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
6	FBK0503889	16	64	6
8	FBK0503890	20	64	8
10	FBK0503891	20	70	10
12	FBK0503892	25	76	12
16	FBK0503893	30	89	16

*Custom Solution possible Refer page 261

5 Flute

Centre cutting high performance end mill

Carbide | REG | 38° | Cr Base



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
6	FBK0503491	20	64	6
8	FBK0503492	20	64	8
10	FBK0503493	25	70	10
12	FBK0503494	25	76	12
14	FBK0503495	30	89	14
16	FBK0503496	30	89	16
20	FBK0503497	35	102	20

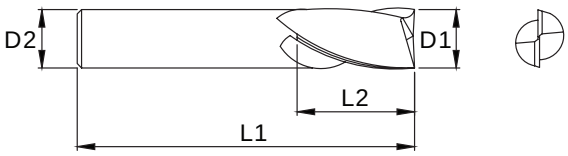
*Custom Solution possible Refer page 261

2 Flute

Centre cutting high performance end mill

Carbide | REG | 30° | BF

N1-N4



Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
4	FBK0501238	14	51	4
5	FBK0501315	20	51	5
6	FBK0501355	20	64	6
8	FBK0503383	20	64	8
10	FBK0500829	20	70	10
12	FBK0503384	20	76	12
14	FBK0503522	30	89	14
16	FBK0501605	30	89	16
20	FBK0501613	30	102	20

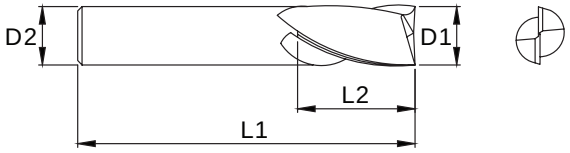
*Custom Solution possible Refer page 261

2 Flute

Centre cutting high performance end mill

Carbide | REG | 45° | BF

N1-N4



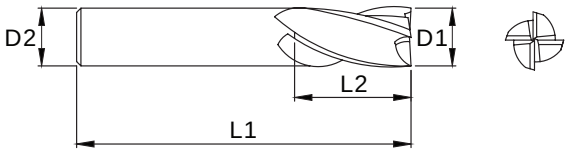
Unit : mm

Diameter ØD1	FG Code	Flute Length L2	Overall Length L1	Shank Diameter ØD2
4	FBK0501239	14	51	4
5	FBK0501316	20	51	5
6	FBK0501356	20	64	6
8	FBK0501618	20	64	8
10	FBK0500830	25	70	10
12	FBK0500930	26	76	12
16	FBK0501606	30	89	16

*Custom Solution possible Refer page 261

4 Flute — Centre cutting regular length end mill

Carbide | REG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

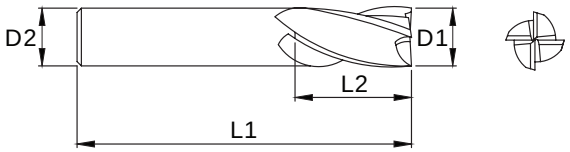
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0500003	3	38	3
1.5	FBK0500006	6	38	3
2	FBK0500009	9	38	3
2.5	FBK0500012	12	38	3
3	FBK0500015	12	38	3
3.5	FBK0500017	12	51	4
4	FBK0500020	14	51	4
4.5	FBK0500023	20	51	5
5	FBK0500026	20	51	5
5.5	FBK0500029	20	64	6
6	FBK0500032	20	64	6
7	FBK0500037	20	64	8
8	FBK0500040	20	64	8
9	FBK0500043	20	64	9
10	FBK0500046	25	70	10
11	FBK0500048	25	70	11

*Custom Solution possible Refer page 261

4 Flute Centre cutting regular length end mill

Carbide | REG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

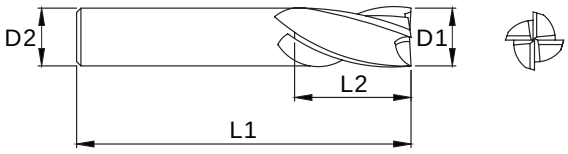
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
12	FBK0500051	25	76	12
14	FBK0500056	30	89	14
16	FBK0500062	30	89	16
18	FBK0500065	35	102	18
20	FBK0500068	38	102	20
22	FBK0500070	38	102	20
25	FBK0500072	38	102	25

*Custom Solution possible Refer page 261

4 Flute — Centre cutting stub length end mill

Carbide | STUB | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4

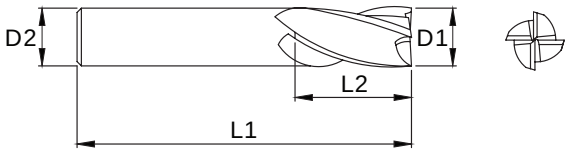
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0502014	2	38	3
1.5	FBK0500533	3	38	3
2	FBK0500535	4	38	3
2.5	FBK0500537	5	38	3
3	FBK0500539	6	38	3
4	FBK0500541	8	51	4
5	FBK0500543	11	51	5
6	FBK0500545	13	51	6
8	FBK0500547	13	51	8
10	FBK0500549	14	51	10
12	FBK0500551	16	64	12
14	FBK0500553	18	70	14
16	FBK0500555	20	76	16
20	FBK0500557	25	76	20

*Custom Solution possible Refer page 261

4 Flute — Centre cutting long length end mill

Carbide | LONG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

Unit : mm

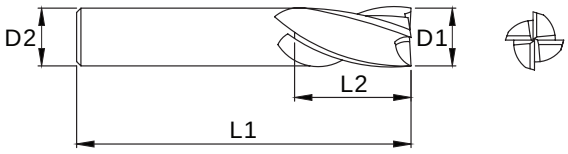
Diameter Ø D1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter Ø D2
3	FBK0500336	25	64	3
4	FBK0500339	25	64	4
5	FBK0500342	25	64	5
6	FBK0500345	30	76	6
7	FBK0500347	30	83	8
8	FBK0500350	35	83	8
9	FBK0500352	35	89	10
10	FBK0500355	40	89	10
12	FBK0500360	50	102	12
16	FBK0500365	65	117	16
20	FBK0500368	80	133	20
25	FBK0500370	80	152	25

*Custom Solution possible Refer page 261

4 Flute

Centre cutting extra long end mill

Carbide | EXTRA LONG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

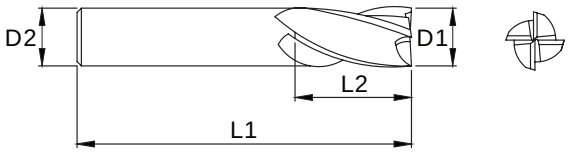
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0502681	40	100	3
4	FBK0502682	40	100	4
5	FBK0502683	40	100	5
6	FBK0502684	50	100	6
8	FBK0502685	50	100	8
10	FBK0502686	50	100	10
12	FBK0502687	75	152	12
16	FBK0502688	75	152	16
20	FBK0502689	75	152	20

*Custom Solution possible Refer page 261

4 Flute — Centre cutting long reach end mill

Carbide | LONG REACH | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

Unit : mm

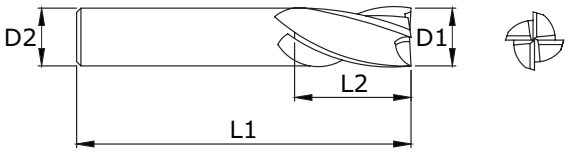
Diameter Ø D1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter Ø D2
3	FBK0500455	6	60	3
4	FBK0500457	9	76	4
5	FBK0500459	15	76	5
6	FBK0500461	15	76	6
8	FBK0500463	20	101	8
10	FBK0500465	25	101	10
12	FBK0500467	25	152	12
16	FBK0500469	30	152	16
18	FBK0500471	40	152	18
20	FBK0500473	50	152	20

*Custom Solution possible Refer page 261

4 Flute

Centre cutting regular length chip breaker end mill

Carbide | REG | 30°



P0-P6
K1-K3
S1-S4
H1-H4

Without Coating

Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
4	FBK0500636	14	51	4
5	FBK0500637	20	51	5
6	FBK0500639	20	64	6
8	FBK0500642	20	64	8
9	FBK0500644	20	64	9
10	FBK0500646	25	70	10
12	FBK0500648	25	76	12
14	FBK0500650	30	89	14
16	FBK0500652	30	89	16
18	FBK0500654	35	102	18
20	FBK0500655	38	102	20

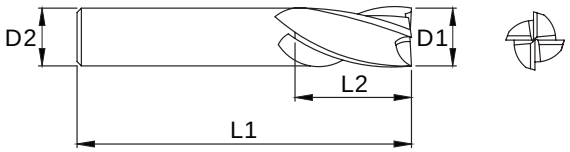
With TiAlN Coating

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
4	FBK0504095	14	51	4
5	FBK0500638	20	51	5
6	FBK0500640	20	64	6
8	FBK0500643	20	64	8
9	FBK0500645	20	64	9
10	FBK0500647	25	70	10
12	FBK0500649	25	76	12
14	FBK0500651	30	89	14
16	FBK0500653	30	89	16
18	FBK0504096	35	102	18
20	FBK0503975	38	102	20

*Custom Solution possible Refer page 261

4 Flute — Centre cutting long length chip breaker end mill

Carbide | LONG | 30° | BF



P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

Without Coating

Diameter Ø D1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter Ø D2
6	FBK0500656	30	76	6
8	FBK0500658	35	83	8
10	FBK0500660	40	89	10
12	FBK0500662	50	102	12
16	FBK0500664	65	117	16

With TiAlN Coating

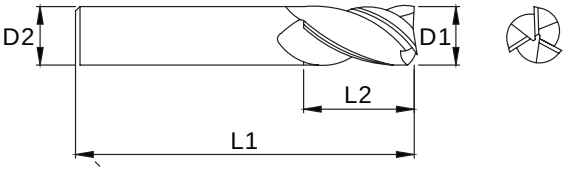
Diameter Ø D1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter Ø D2
6	FBK0500657	30	76	6
8	FBK0500659	35	83	8
10	FBK0500661	40	89	10
12	FBK0500663	50	102	12

*Custom Solution possible Refer page 261

3 Flute

Centre cutting regular length end mill

Carbide | REG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

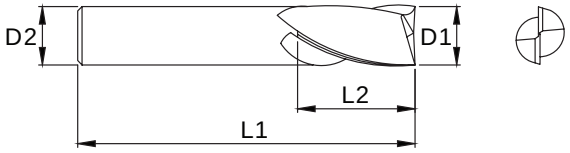
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0500140	3	38	3
1.5	FBK0500143	6	38	3
2	FBK0500146	9	38	3
2.5	FBK0500149	12	38	3
3	FBK0500152	12	38	3
4	FBK0500157	14	51	4
5	FBK0500162	20	51	5
6	FBK0500165	20	63	6
8	FBK0500171	20	63	8
10	FBK0500176	25	70	10
12	FBK0500181	25	76	12
16	FBK0500189	30	89	16
20	FBK0500195	38	102	20
25	FBK0500198	40	102	25

*Custom Solution possible Refer page 261

2 Flute Centre cutting stub length end mill

Carbide | STUB | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4

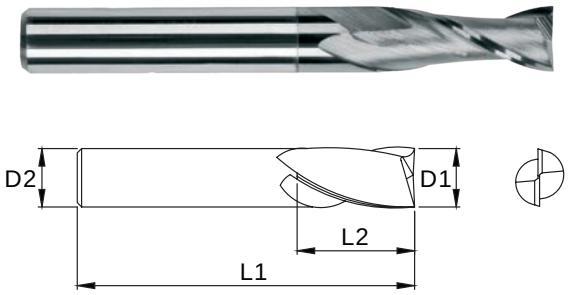
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0500565	6	38	3
4	FBK0500567	8	51	4
5	FBK0500569	11	51	5
6	FBK0500571	13	51	6
8	FBK0500573	13	51	8
10	FBK0500575	14	51	10
12	FBK0500577	16	63	12
16	FBK0500581	20	76	16
20	FBK0500583	25	76	20

*Custom Solution possible Refer page 261

2 Flute — Centre cutting regular length end mill

Carbide | REG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

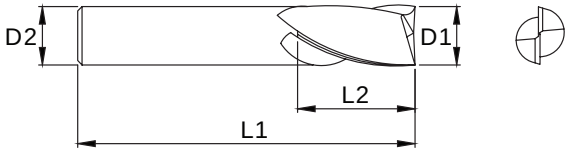
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0500075	3	38	3
1.5	FBK0500078	6	38	3
2	FBK0500081	9	38	3
2.5	FBK0500084	12	38	3
3	FBK0500087	12	38	3
4	FBK0500092	14	51	4
5	FBK0500097	20	51	5
6	FBK0500102	20	63	6
8	FBK0500109	20	63	8
10	FBK0500114	25	70	10
12	FBK0500119	25	76	12
16	FBK0500127	30	89	16
20	FBK0500133	38	102	20
25	FBK0500137	40	102	25

*Custom Solution possible Refer page 261

2 Flute Centre cutting long length end mill

Carbide | LONG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

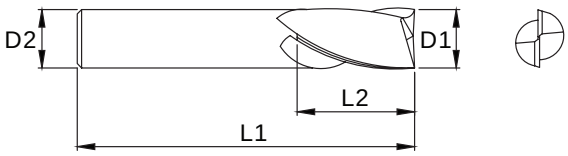
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0500372	25	63	3
4	FBK0500375	25	63	4
5	FBK0500378	25	63	5
6	FBK0500380	30	76	6
7	FBK0500382	30	83	8
8	FBK0500385	35	83	8
9	FBK0500387	35	89	10
10	FBK0500390	40	89	10
12	FBK0500393	50	102	12
16	FBK0500396	65	117	16
20	FBK0500398	80	152	20

*Custom Solution possible Refer page 261

2 Flute — Centre cutting long reach end mill

Carbide | LONG REACH | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

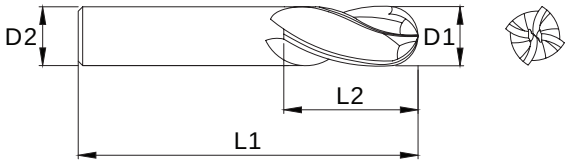
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0500475	6	60	3
4	FBK0500477	9	76	4
5	FBK0500479	15	76	5
6	FBK0500481	15	76	6
8	FBK0500483	20	101	8
10	FBK0500485	25	101	10
12	FBK0500487	25	152	12
16	FBK0500489	30	152	16
20	FBK0500491	50	152	20

*Custom Solution possible Refer page 261

4 Flute Centre cutting ball nose stub length end mill

Carbide | STUB | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

Unit : mm

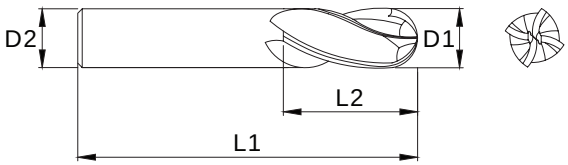
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0500591	6	38	3
4	FBK0500593	8	51	4
5	FBK0500595	11	51	5
6	FBK0500597	13	51	6
8	FBK0500599	13	51	8
10	FBK0500601	14	51	10
12	FBK0500603	16	63	12
16	FBK0500607	20	76	16
20	FBK0500609	25	76	20

*Custom Solution possible Refer page 261

4 Flute

Centre cutting ball nose regular length end mill

Carbide | REG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

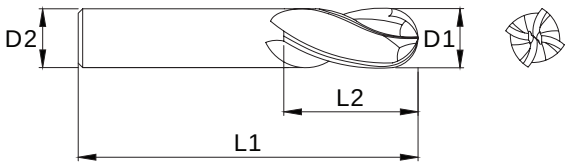
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0500201	3	38	3
1.5	FBK0500204	6	38	3
2	FBK0500207	9	38	3
2.5	FBK0500210	12	38	3
3	FBK0500213	12	38	3
4	FBK0500219	14	51	4
5	FBK0500225	20	51	5
6	FBK0500231	20	63	6
8	FBK0500240	20	63	8
10	FBK0500245	25	70	10
12	FBK0500250	25	76	12
16	FBK0500260	30	89	16
20	FBK0500266	38	102	20
25	FBK0500270	40	102	25

*Custom Solution possible Refer page 261

4 Flute Centre cutting ball nose long reach end mill

Carbide | LONG REACH | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

Unit : mm

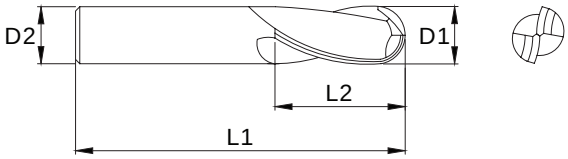
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0500493	6	60	3
4	FBK0500495	9	76	4
5	FBK0500497	15	76	5
6	FBK0500499	15	76	6
8	FBK0500501	20	101	8
10	FBK0500503	25	101	10
12	FBK0500505	25	152	12
16	FBK0500507	30	152	16
18	FBK0500509	40	152	16
20	FBK0500511	50	152	20

*Custom Solution possible Refer page 261

2 Flute

Centre cutting ball nose regular length end mill

Carbide | REG | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

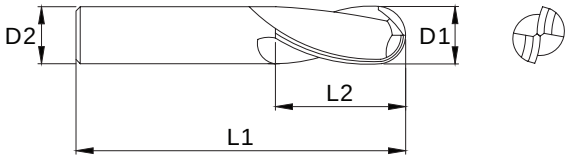
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
1	FBK0500273	3	38	3
1.5	FBK0500276	6	38	3
2	FBK0500279	9	38	3
2.5	FBK0500282	12	38	3
3	FBK0500285	12	38	3
4	FBK0500290	14	51	4
5	FBK0500295	20	51	5
6	FBK0500300	20	63	6
8	FBK0500307	20	63	8
10	FBK0500312	25	70	10
12	FBK0500317	25	76	12
16	FBK0500323	30	89	16
20	FBK0500329	38	102	20
25	FBK0500333	40	102	25

*Custom Solution possible Refer page 261

2 Flute Centre cutting ball nose stub length end mill

Carbide | STUB | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

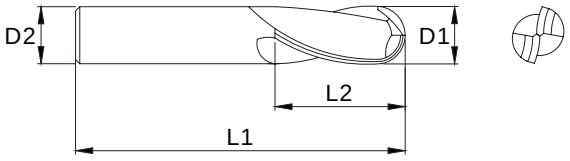
Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0500617	6	38	3
4	FBK0500619	8	51	4
5	FBK0500621	11	51	5
6	FBK0500623	13	51	6
8	FBK0500625	13	51	8
10	FBK0500627	14	51	10
12	FBK0500629	16	63	12
16	FBK0500633	20	76	16
20	FBK0500635	25	76	20

*Custom Solution possible Refer page 261

2 Flute — Centre cutting ball nose long reach end mill

Carbide | LONG REACH | 30° | TiAlN



P0-P6
K1-K3
S1-S4
H1-H4
N1-N6

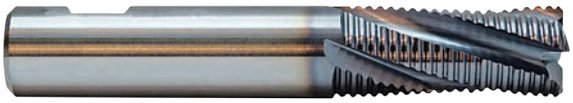
Unit : mm

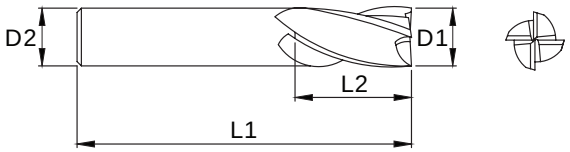
Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
3	FBK0500513	6	60	3
4	FBK0500515	9	76	4
5	FBK0500517	15	76	5
6	FBK0500519	15	101	6
8	FBK0500521	20	101	8
10	FBK0500523	25	152	10
12	FBK0500525	25	152	12
16	FBK0500527	30	152	16
18	FBK0500529	40	152	18
20	FBK0500531	50	152	20

*Custom Solution possible Refer page 261

4 Flute Sinusoidal regular length chip breaker end mill

Carbide | REG | 20° | TiAlN





P0-P6
K1-K3
S1-S4
H1-H4

Unit : mm

Diameter ØD1	EDP No	Flute Length L2	Overall Length L1	Shank Diameter ØD2
8	FBK0504087	8	51	8
8	FBK0504029	16	64	8
10	FBK0504088	10	51	10
10	FBK0504089	20	70	10
12	FBK0504090	12	64	12
12	FBK0504091	25	76	12
16	FBK0504092	16	76	16
16	FBK0503359	35	89	16
20	FBK0504093	20	76	20
20	FBK0504094	38	102	20

8 mm available in 3 flute

*Custom Solution possible Refer page 261

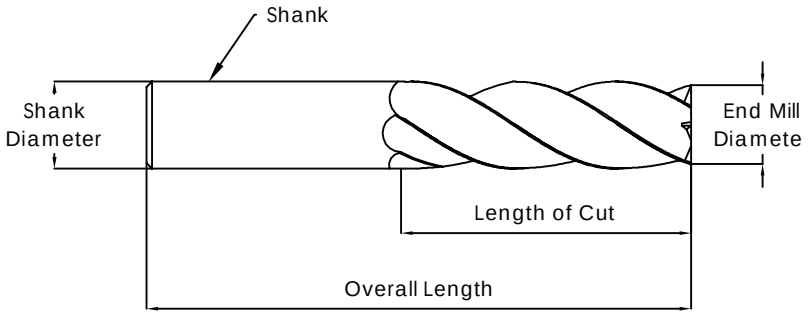
END MILLS

TOTEM®

High Performance Cutting Tools

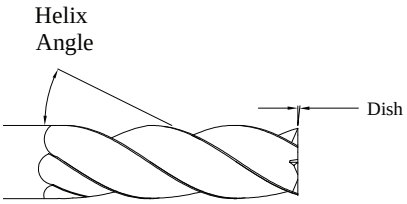
TECHINCAL DETAILS

END MILL NOMENCLATURE



Length of Cut (Flute Length) – Always select the shortest Flute Length possible for your application. By selecting the shortest Flute Length, you can increase rigidity and allow for higher feed rates.

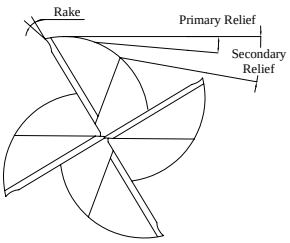
End Mill Diameter – Always select the largest diameter possible for your milling operation. Increasing your diameter by just 10%, can increase your rigidity by 25%.

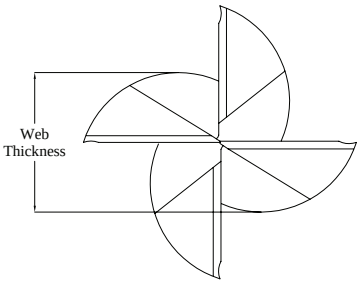


Helix Angle – Varies from 0 to 60 degrees. Higher helix angles can increase the number of teeth in a cut, and help in redirecting cutting forces. This is beneficial in harder to machine materials in particular. Changes in helix angle can also greatly affect the flute form of an end mill, and affect chip evacuation.

Rake Angle – The measurement of the curvature of the cutting edge in the face of the flute. A high rake angle will cut more aggressively and make the cutting action smoother, while a lower rake angle will increase the strength of the cutting edge.

Primary & Secondary Relief – The clearance directly behind the cutting edge. High primary relief angles will allow for more aggressive milling, while lower relief angles will increase the strength of the cutting edge. The primary relief will also affect the wear on a cutting edge. Lower primary relief angles can tend to develop larger wear lands.





Web Thickness – The cross section of the fluting of the end mill. Larger webs allow for more rigidity, while smaller webs allow for better chip evacuation. This feature is highly dependent on the material being machined.

HOW TO REDUCE VIBRATION & CHATTER IN END MILLING

When chatter occurs, it can be self-sustaining until the problem is corrected. Chatter causes poor finish on the part, and will damage and significantly reduce the life of end mills. Carbide end mills are particularly susceptible to damage.

Typical methods to reduce chatter include reducing cutting forces by:
1. Reducing the number of flutes in cut.
2. Decreasing the chipload per tooth by reducing the feed or increasing the speed or RPM.
3. Reducing the axial or radical depth or cut.

Though these steps will reduce the chatter, slowing down the cutting process is not always the best course of action, and reducing the chipload can be detrimental to the cutter.
It is better to first improve rigidity and stability:
1. Use a larger end mill with a larger core diameter.
2. Use end mills with reduced clearance or a small circular margin.
3. Use the shortest overhang from spindle nose to tip of tool.
4. Use stub length end mills where possible.
5. Use balanced tool holders.
6. Rework fixture to hold the workpiece more securely.
7. Reprogram the cutter path to shift cutting forces into stiffer portions of the workpiece.
8. Look for ways to improve spindle speeds then adjust feed accordingly.

Chatter is common when machining corners. As the end mill enters the corner, the percentage of engagement increases the number of teeth in the cut. This drastically increases the cutting forces, causing chatter.

To reduce chatter when machining corners, consider using circular interpolation to produce a bigger corner radius than indicated by the part print. Then remove the remaining stock with a smaller end mill using circular interpretation.

Reducing Chatter in End Milling

Chatter in the form of vibration and noise is a frequent challenge when end milling. It can cause scalloping and uneven finishes.

To reduce chatter, try the following:
1. Ensure that the starting places for speeds and feeds are correct for the workpiece material and the cut.
2. Decrease the feed, or chipload per tooth/tool.
3. Make the workpiece as secure and rigid as possible.
4. Reduce excess overhang between the workpiece and spindle.
5. Select an end mill with less flutes.
6. Check the tool run-out.
7. Review the tool geometry to ensure the cutting face, relief, fluting and helix angle are appropriate for the workplace material.
8. If conventional, try climb milling.

End Mill Accuracy and Deflection

Because end mills are supported only at the shank end, they are subject to deflection, which can reduce the accuracy of the milled part. Several factors affect the amount of deflection that will occur.

1. Overall Length and Length of Cut: As the length of the mill increases, difficulty in maintaining dimensional accuracy also increases. Rigidity decreases in proportion to length of cut to the 3rd power. Thus, a 4th length of cut is 1/8 as rigid as a 2" length of cut. A regular length end mill cutting 7075 aluminium can deflect <.002", while an extra long end mill can deflect >.006".

2. End Mill Diameter: Rigidity increases in proportion to diameter to the 4th power. A 1" – diameter end mill is 16 times more rigid than a ½" end mill. A 1" – diameter end mill over a 5/8" length of cut in 1040 steel will cut to size, while a 3/8" – diameter end mill may deflect to >.003".

3. End Mill Material Composition: Solid carbide is about three times more rigid and resistant to deflection than high-speed steel end mills, but not as tough.

4. Radial Depth of Cut and Axial Length of Cut: Heavy radical cuts as well as long axial lengths of cuts will deflect the end mill much more. A light-finishing pass is generally required to produce accurate parallel cuts.

Tips:

- Always use the shortest tool possible.
- Shorter tools can reduce chatter.
- Increase coolant.
- Try left-hand spiral end mills.
- Try using higher helix end mills.
- Increase overall system rigidity.
- Reduce overhang.
- Conventional milling can resist deflection better than climb milling.
- Dull tools deflect more than sharp tools.

CUTTTING SPEED & FEED RATE CHART

Series Proton Plus

Parameters for Endmill 2 flute and 4 flute Proton plus						
Tool Diameter	For 45 to 55 HRC		For 56 to 68 HRC		DOC in mm	
	Vc = 120 m/min.		Vc = 150 m/min			
	RPM	Feed	RPM	Feed		
mm		mm/min		mm/min	Axial	Radial
1.5	25455	1714	31819	1650	0.06	0.15
2	23864	1650	28637	1747	0.08	0.2
3	15910	1739	19091	1669	0.12	0.3
4	11932	1820	14319	1674	0.16	0.4
5	9546	1577	11455	1689	0.2	0.5
6	7955	1735	9546	1683	0.24	0.6
8	5966	1622	7160	1575	0.32	0.8
10	4773	1562	5728	1516	0.4	1
12	3978	1735	4773	1683	0.48	1.2

Series Proton Plus Ball Nose

Parameters for Ball nose endmill 2 flute and 4 flute Proton plus						
Tool Diameter	For 45 to 55 HRC		For 56 to 68 HRC		DOC in mm	
	Vc = 150 m/min.		Vc = 180 m/min			
	RPM	Feed	RPM	Feed		
mm		mm/min		mm/min	Axial	Radial
1.5	31819	1714	38182	1650	0.06	0.15
2	23864	1650	28637	1747	0.08	0.2
3	15910	1739	19091	1669	0.12	0.3
4	11932	1820	14319	1674	0.16	0.4
5	9546	1577	11455	1689	0.2	0.5
6	7955	1735	9546	1683	0.24	0.6
8	5966	1622	7160	1575	0.32	0.8
10	4773	1562	5728	1516	0.4	1
12	3978	1735	4773	1683	0.48	1.2

All posted speed and feed parameters are suggested starting values that may be increased given optimal setup conditions.
Considering requirements of customer parameters may be decreased or increased.
If less than minimum Axial or Radial DOC values are used, increased feed rates are possible.
If greater than maximum Axial or Radial DOC values are used, decreased feed rates may be needed.
WARNING: Cutting tools may shatter under improper use. Government regulations require use of safety glasses and other appropriate safety equipment in the vicinity of use.

CUTTTING SPEED & FEED RATE CHART

Series HSM

Parameters for Endmill 2 flute and 4 flute HSM						
Tool Diameter	For 35 to 45 HRC Min Vc 60 m/min		For 35 to 45 HRC Max Vc 75 m/min		Max DOC in mm	
	RPM	Feed m/min	RPM	Feed m/min		
mm					Axial	Radial
3	6369	102	7961	207	0.3	1.5
4	4777	95	5971	238	0.4	2
5	3821	99	4777	363	0.5	2.5
6	3184	82	3980	302	0.6	3
8	2388	119	2985	304	0.8	4
10	1910	95	2388	243	1	5
12	1592	79	1990	302	1.2	6
16	1194	121	1492	226	1.6	8
20	955	122	1194	212	2	10

Series HSM Ball Nose

Parameters for Ball nose endmill 2 flute and 4 flute HSM						
Tool Diameter	For 35 to 45 HRC Min Vc 60 m/min		For 35 to 45 HRC Max Vc 75 m/min		Max DOC in mm	
	RPM	Feed m/min	RPM	Feed m/min		
mm					Axial	Radial
3	6369	102	7961	207	0.3	1.5
4	4777	95	5971	238	0.4	2
5	3821	99	4777	363	0.5	2.5
6	3184	82	3980	302	0.6	3
8	2388	119	2985	304	0.8	4
10	1910	95	2388	243	1	5
12	1592	79	1990	302	1.2	6
16	1194	121	1492	226	1.6	8
20	955	122	1194	212	2	10

All posted speed and feed parameters are suggested starting values that may be increased given optimal setup conditions.
If less than minimum Axial or Radial DOC values are used, increased feed rates are possible.
If greater than maximum Axial or Radial DOC values are used, decreased feed rates may be needed.
WARNING: Cutting tools may shatter under improper use. Government regulations require use of safety glasses and other appropriate safety equipment in the vicinity of use.

CUTTING SPEED CHART

Series F114/F132 INCH

Workpiece Material Group		Example	SFM
Steels	P	Steel - Mild (.2 - .3 Carbon) 1018	340 - 500
		Steel - Mild (.4 - .5 Carbon) 4140	250 - 300
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	125 - 250
Cast Iron	K	Iron Cast (Soft)	450 - 600
		Iron - Cast (Medium Hard)	300 - 400
		Iron (Hard Chilled)	250 - 300
		Iron (Malleable)	225 - 300
Stainless Steels	M	Stainless Free Machining	200 - 300
		Austenitic Stainless 304/316	180 - 225
		Ferritic	200 - 275
		Martensitic	150 - 200
		PH Stainless 17-4 PH	125 - 200
Special Alloys	S	Titanium 6AL-4V	175 - 375
		Cobalt-Based Alloys Stellite	80 - 125
		Nickel-Based Alloys Inconel 625/718	80 - 125
		Iron-Based Alloys Incoloy 800-802	80 - 125
Hardened Steels	H	Hardened Steels 35-45 Rc	200 - 250
		Hardened Steels 45-55 Rc	150 - 200

#RPM = SMM x 318.057/Tool Dia. #IPM = RPM/number of teeth x (inch/tooth)

FEED RATE CHART

Series F114/F132 INCH

Workpiece Material Group		Example	Tool Diameter (inch)								
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
			Inch/Tooth								
Steels	P	Steel - Mild (.2-.3 Carbon) 1018 Steel - Mild (.4-.5 Carbon) 4140	.0005 - .0008	.0010 - .0012	.0015 - .0020	.0015 - .0025	.0021 - .0030	.0020 - .0035	.0023 - .0040	.0022 - .0043	.0032 - .0050
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.0003 - .0005	.0008 - .0010	.0012 - .0015	.0014 - .0018	.0018 - .0020	.0020 - .0023	.0023 - .0030	.0024 - .0032	.0024 - .0032
Cast Iron	K	Iron Cast (Soft) Iron - Cast(Medium Hard) Iron (Hard Chilled) Iron (Malleable)	.0005 - .0008	.0010 - .0012	.0015 - .0020	.0015 - .0025	.0021 - .0030	.0020 - .0035	.0023 - .0040	.0022 - .0043	.0032 - .0050
Stainless Steel	M	Stainless Steel Free Machining Ferritic	.0005 - .0008	.0010 - .0012	.0012 - .0015	.0015 - .0025	.0021 - .0030	.0020 - .0035	.0023 - .0040	.0022 - .0043	.0032 - .0050
		Austenitic Stainless 304/316 Martensitic PH Stainless 17-4 PH	.0003 - .0005	.0008 - .0010	.0012 - .0015	.0014 - .0018	.0018 - .0020	.0020 - .0023	.0023 - .0030	.0024 - .0032	.0024 - .0032
Special Alloys	S	Titanium 6AL-4V	.0003 -.0004	.0004 - .0006	.0006 - .0008	.0008 - .0012	.0008 - .0012	.0012 - .0016	.0016 - .0018	.0018 - .0020	.0020 - .0030
		Stellite Inconel 625/718 Incoloy 800-802	.0003 - .0005	.0005 - .0015	.0005 - .0015	.0010 -.0020	.0010 -.0020	.0010 -.0030	.0020 -.0030	.0025 - .0035	.0025 - .0035
Hardened Steels	H	Hardened Steels 35-45 Rc Hardened Steels 45-55 Rc Hardened Steels 55-65 Rc	.0003 - .0005	.0005 - .0015	.0005 - .0015	.0010 -.0020	.0010 -.0020	.0010 -.0030	.0020 -.0030	.0025 - .0035	.0025 - .0035

*For TiAlN Coated Tool Increase RPM by 20% and Feed by 10%

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

Series F114/F132 METRIC

Workpiece Material Group		Example	Vc
Steels	P	Steel - Mild (.2 - .3 Carbon) 1018	135 - 150
		Steel - Mild (.4 - .5 Carbon) 4140	75 - 90
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	40 - 75
Cast Iron	K	Iron Cast (Soft)	135 - 185
		Iron - Cast (Medium Hard)	90 - 120
		Iron (Hard Chilled)	75 - 90
		Iron (Malleable)	70 - 90
Stainless Steels	M	Stainless Free Machining	60 - 90
		Austenitic Stainless 304/316	55 - 70
		Ferritic	60 - 85
		Martensitic	45 - 60
		PH Stainless 17-4 PH	40 - 60
Special Alloys	S	Titanium 6AL-4V	55 - 115
		Cobalt-Based Alloys Stellite	25 - 40
		Nickel-Based Alloys Inconel 625/718	25 - 40
		Iron-Based Alloys Incoloy Incoloy 625/718	25 - 40
Hardened Steels	H	Hardened Steels 35-45 Rc	60 - 75
		Hardened Steels 45-55 Rc	45 - 60

#RPM = SMM x 318.057/Tool Dia. #mm/min = RPM x number of teeth x mm/tooth

FEED RATE CHART

Series F114/F132 METRIC

Workpiece Material Group		Example	Tool Diameter (mm)								
			3	5	6	8	10	14	16	18	25
			mm/Tooth								
Steels	P	Steel - Mild (.2-.3 Carbon) 1018 Steel - Mild (.4-.5 Carbon) 4140	.013 - .020	.025 - .30	.038 - .051	.038 - .064	.053 - .076	.056 - .076	.058 - .102	.056 - .109	0.081 - .127
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.008 - .013	.020 - .025	.030 - .038	.036 - .046	.046 - .051	.051 - .058	.058 - .076	.060 - .081	.060 - .081
Cast Iron	K	Iron Cast (Soft) Iron - Cast(Medium Hard) Iron (Hard Chilled) Iron (Malleable)	.013 - .020	.020 - .025	.038 - .051	.038 - .064	.053 - .076	.056 - .076	.058 - .102	.056 - .109	.081 - .127
Stainless Steel	M	Stainless Steel Free Machining Ferritic	.013 - .020	.020 - .025	.038 - .051	.038 - .064	.053 - .076	.056 - .076	.058 - .102	.056 - .109	.081 - .127
		Austenitic Stainless 304/316 Martensitic PH Stainless 17-4 PH	.008 - .013	.020 - .025	.030 - .038	.036 - .046	.046 - .051	.051 - .058	.058 - .076	.060 - .081	.060 - .081
Special Alloys	S	Titanium 6AL-4V	.008 - .010	.010 - .015	.015 - .020	.020 - .030	.020 - .030	.030 - .041	.041 - .046	.046 - .051	.051 - .076
		Stellite Inconel 625/718 Incoloy 800-802	.008 - .013	.020 - .025	.030 - .038	.036 - .046	.046 - .051	.051 - .058	.058 - .076	.060 - .081	.060 - .081
Hardened Steels	H	Hardened Steels 35-45 Rc Hardened Steels 45-55 Rc Hardened Steels 55-65 Rc	.008 - .013	.013 - .038	.013 - .038	.025 - .051	.025 - .051	.025 - .076	.051 - .076	.064 - .089	.064 - .089

*For TiAlN Coated Tool Increase RPM by 20% and Feed by 10%

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

TECHNICAL DETAILS

CUTTING SPEED CHART

Series F135 INCH

Workpiece Material Group		Example	Coolant	Slotting			Small Radial Depth ==> Large Radial Depth 1 x Diameter Axial Depth Profile Milling		
			Max	25% Axial	50% Axial	100% Axial	25% Dia.	50% Dia.	100% Dia.
			Type	SFM					
Non-Ferrous	N	Aluminium < 10% Si	•	1000-2000			2000	1625	1000
		Aluminium > 10% Si	•	800-1500			1500	1230	800
		Brass	•	500-900			900	750	500
		Plastic	•	800-1200			1200	1050	800

FEED RATE CHART

Series F135 INCH

Workpiece Material Group		Example	Milling Type	Tool Diameter (inch)								
				1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
				Inch/Tooth								
Non-Ferrous	N	Aluminium / Aluminium Alloys < 10% Si Aluminium / Aluminium Alloys > 10% Si Brass Plastics	Slotting	0.0012	0.0018	0.0025	0.0032	0.0037	0.0005	0.0065	0.0075	0.01
			Profile Milling	0.003 - 0.004	0.004 - 0.006	0.004 - 0.008	0.006 0.009	0.007 - 0.012	0.010 - 0.045	0.015 - 0.04	0.015 - 0.04	0.015 - 0.04

Above 20,000 RPM, Tool Balancing Is Required

During Profile Milling less than 50% of the cutter diameter's Radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Example: Profile Milling

1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = IPM (inch/min)

Spindle Max.

Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

Series F135 METRIC

Workpiece Material Group		Example	Coolant	Slotting			Small Radial Depth ==> Large Radial Depth 1 x Diameter Axial Depth Profile Milling		
			Max	25% Axial	50% Axial	100% Axial	25% Dia.	50% Dia.	100% Dia.
			Type	Vc (m/min)					
Non-Ferrous	N	Aluminium < 10% Si	•	305 - 610			610	495	305
		Aluminium > 10% Si	•	245 - 460			460	375	245
		Brass	•	150 - 275			900	230	155
		Plastic	•	245 - 365			365	320	245

FEED RATE CHART

Series F135 METRIC

Workpiece Material Group		Example	Milling Type	Tool Diameter (mm)								
				1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
				mm/Tooth								
Non-Ferrous	N	Aluminium / Aluminium Alloys < 10% Si Aluminium / Aluminium Alloys > 10% Si Brass Plastics	Slotting	0.03	0.046	0.064	0.081	0.094	0.127	0.165	0.191	0.254
			Profile Milling	.076 - 0.102	.102 - 0.152	.102 - 0.203	.152 - 0.229	.178 - 0.305	0.254 - 1.143	.381 - 1.1016	.381 - 1.1016	.381 - 1.1016

Above 20,000 RPM, Tool Balancing Is Required

During Profile Milling less than 50% of the cutter diameter's Radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Example: Profile Milling

1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = mm/min

Spindle Max.

Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

Series F136 INCH

Workpiece Material Group		Example	Coolant	Slotting			Small Radial Depth ==> Large Radial Depth 1 x Diameter Axial Depth Profile Milling		
			Max	25% Axial	50% Axial	100% Axial	25% Dia.	50% Dia.	100% Dia.
			Type	SFM					
Non-Ferrous	N	Aluminium < 10% Si	•	1400-2000			2000	1775	1400
		Aluminium > 10% Si	•	1000-1500			1500	1310	1000
		Brass	•	500-900			900	750	500
		Plastic	•	800-1200			1200	1050	800

FEED RATE CHART

Series F136 INCH

Workpiece Material Group		Example	Milling Type	Tool Diameter (inch)								
				1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
				Inch/Tooth								
Non-Ferrous	N	Aluminium / Aluminium Alloys < 10% Si Aluminium / Aluminium Alloys > 10% Si Brass Plastics	Slotting	0.0012	0.0018	0.0025	0.0032	0.0037	0.0005	0.0065	0.0075	0.01
			Profile Milling	0.0024	0.0036	0.005	0.0064	0.0074	0.01	0.012	0.014	0.02

Above 20,000 RPM, Tool Balancing Is Required

During Profile Milling less than 50% of the cutter diameter's Radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Example: Profile Milling

1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = IPM (inch/min)

Spindle Max.

Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

Series F136 METRIC

Workpiece Material Group		Example	Coolant	Slotting			Small Radial Depth ==> Large Radial Depth		
							1 x Diameter Axial Depth		
							Profile Milling		
			Max	25% Axial	50% Axial	100% Axial	25% Dia.	50% Dia.	100% Dia.
			Type	Vc					
Non-Ferrous	N	Aluminium < 10% Si	•	425-610			610	540	425
		Aluminium > 10% Si	•	305-460			460	400	305
		Brass	•	150-275			275	230	150
		Plastic	•	245-365			365	320	245

FEED RATE CHART

Series F136 METRIC

Workpiece Material Group		Example	Milling Type	Tool Diameter (mm)								
				3	5	6	8	10	14	16	18	25
				mm/Tooth								
Non-Ferrous	N	Aluminium / Aluminium Alloys < 10% Si Aluminium / Aluminium Alloys > 10% Si Brass Plastics	Slotting	0.03	0.046	0.064	0.081	0.094	0.127	0.165	0.191	0.254
			Profile Milling	0.061	0.091	0.127	0.163	0.188	0.254	0.305	0.356	0.508

Above 20,000 RPM, Tool Balancing Is Required

During Profile Milling less than 50% of the cutter diameter's Radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Example: Profile Milling

1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = mm/min

Spindle Max.

Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

TOTEM TECHNICAL DETAILS

CUTTING SPEED CHART

Series F177/F179 INCH

Workpiece Material Group		Example	Coolant			Slotting		1 x Diameter Axial Depth Small Radial Depth Profiling > Largest Radial Depth						
			Max	Air	MMS	25% Axial	50% Axial	1% of Dia	5% of Dia	10% of Dia	15% of Dia	20% of Dia	30% of Dia	50% of Dia
			Type			SFM								
Steels	P	Free Machining	•	•	•	500	500	2400	2250	2050	1850	1660	1260	500
		Low Carbon	•	•	•	500	500	2400	2250	2050	1850	1660	1260	500
		Medium Carbon	•	•	•	300	300	1100	1030	950	875	790	620	300
		Alloys Steels	•	•	•	250	250	500	480	450	430	400	350	250
		High Strength Alloys	•	•	•	250	250	500	480	450	430	400	350	250
		Structural Steels	•	•	•	500	500	2400	2250	2050	1850	1660	1260	500
		Die/Tool Steels	•	•	•	200	200	400	390	380	370	360	300	200
Stainless Steels	M	Free Machining	•	X	o	300	300	500	485	460	450	430	380	300
		Moderate Stainless	•	X	o	250	250	500	390	380	370	360	320	250
		Difficult Stainless	•	X	o	200	200	350	330	320	300	295	260	200
		PH Stainless	•	X	o	125	125	250	245	240	235	230	195	125
		Cobalt Chrome Alloys	•	X	o	150	150	250	245	230	225	215	190	150
		Duplex (22%)	•	X	o	125	125	250	245	230	225	215	185	125
		Super Duplex (25%)	•	X	o	100	100	200	195	180	180	170	140	100
Special Alloys	S	High Temp Alloys	•	X	X	150	150	250	240	220	215	200	180	150
		Titanium Alloys	•	X	X	175	175	425	400	380	350	325	275	175
Cast Iron	K	Gray Cast Iron	•	o	o	400	400	1500	1420	1315	1210	1100	860	400
		SG Iron	•	o	o	350	350	1200	1130	1050	980	900	710	350
		Ductile Cast Iron	•	o	o	300	300	500	485	460	450	430	380	300
		Malleable Iron	•	o	o	300	300	400	385	375	360	345	330	300

•	Preferred	o	Possible	X	Not Possible

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

FEED RATE CHART

Series F177/F179 INCH

Workpiece Material Group		Example	Tool Diameter								
			1/16	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
			Inch/Tooth									
Steels	P	Free Machining, Low Carbon, Medium Carbon, Alloys Steels, High Strength Alloys, Structural Steels, Die/Tool Steels	0.0002	0.0004	0.0007	.0010 - .0016	.0013 - .0021	.0016 - .0026	.0020 - .0031	.0026 - .0033	.0031 - .0035	.0035 - .0051
Stainless Steels	M	Free Machining, Moderate Stainless, Difficult Stainless, PH Stainless, Cobalt Chrome Alloys, Duplex (22%), Super Duplex (25%)	0.0002	0.0004	0.0007	.0010 - .0016	.0012 - .0021	.0012 - .0026	.0020 - .0031	.0020 - .0033	.0022 - .0035	.0024 - .0039
Special Alloys	S	High Temp Alloys, Titanium Alloys	0.0001	0.0002	0.0008	.0005 - .0008	.0007 - .0011	-0.0013	.0010 - .0016	.0010 - .0016	.0011 - .0018	.0012 - .0020
Cast Iron	K	Gray Cast Iron, SG Iron, Ductile Cast Iron, Malleable Iron	0.0002	0.0004	0.0007	.0007 - .0016	.0010 - .0022	.0015 - .0028	.0018 - .0033	.0024 - .0035	.0028 - .0039	.0024 - .0050

Example: Profile Milling

1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = IPM (Inches per Minute)

Example: Slotting

1) Select material from chart
2) Select tool size
3) Select feed per chart
4) Multiply Feed per tooth x Number of teeth x RPM
5) Answer: IPM (Inches Per Minute)

Spindle Max.

Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

During Profile Milling less than 50% of the cutter diameter's Radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

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CUTTING SPEED CHART

Series F177/F179 METRIC

Workpiece Material Group		Example	Coolant			Slotting		1 x Diameter Axial Depth Small Radial Depth Profiling > Largest Radial Depth						
			Max	Air	MIST	25% Axial	50% Axial	1% of Dia	5% of Dia	10% of Dia	15% of Dia	20% of Dia	30% of Dia	50% of Dia
			Type			Vc (m/min)								
Steels	P	Free Machining	•	•	•	150	150	730	685	620	565	500	380	150
		Low Carbon	•	•	•	150	150	730	685	620	565	500	380	150
		Medium Carbon	•	•	•	90	90	335	310	290	260	240	180	90
		Alloys Steels	•	•	•	75	75	150	140	130	130	120	105	75
		High Strength Alloys	•	•	•	75	75	150	140	130	130	120	105	75
		Structural Steels	•	•	•	150	150	730	685	620	565	500	380	150
		Die/Tool Steels	•	•	•	60	60	120	115	115	110	110	90	60
Stainless Steels	M	Free Machining	•	X	o	90	90	150	145	140	130	130	115	90
		Moderate Stainless	•	X	o	75	75	150	115	115	105	105	95	75
		Difficult Stainless	•	X	o	60	60	105	100	95	90	90	75	60
		PH Stainless	•	X	o	40	40	75	75	75	70	70	60	40
		Cobalt Chrome Alloys	•	X	o	45	45	75	75	75	70	70	60	45
		Duplex (22%)	•	X	o	40	40	75	75	75	70	70	60	40
		Super Duplex (25%)	•	X	o	30	30	60	60	55	55	50	45	30
Special Alloys	S	High Temp Alloys	•	X	X	45	45	75	75	75	70	60	55	45
		Titanium Alloys	•	X	X	55	55	125	120	115	105	100	80	55
Cast Iron	K	Gray Cast Iron	•	o	o	120	120	450	430	400	360	335	250	120
		SG Iron	•	o	o	105	105	365	345	320	295	275	215	105
		Ductile Cast Iron	•	o	o	90	90	150	145	140	130	130	115	90
		Malleable Iron	•	o	o	90	90	120	115	110	105	105	100	90

•	Preferred	X	Possible	o	Not Possible

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

FEED RATE CHART

Series F177/F179 METRIC

Workpiece Material Group		Example	Tool Diameter (mm)									
			1	3	4	6	8	10	12	16	18	25
			mm/Tooth									
Steels	P	Free Machining, Low Carbon, Medium Carbon, Alloys Steels, High Strength Alloys, Structural Steels, Die/Tool Steels	0.005	0.01	0.017	.025 - .040	.033 - .053	0.04	0.066	.066 - .083	.078 - .088	.088 - .129
Stainless Steels	M	Free Machining, Moderate Stainless, Difficult Stainless, PH Stainless, Cobalt Chrome Alloys, Duplex (22%), Super Duplex (25%)	0.005	0.01	0.017	.025 - .040	.033 - .053	0.04	0.066	.066 - .083	.078 - .088	.088 - .129
Special Alloys	S	High Temp Alloys, Titanium Alloys	0.002	0.005	0.02	.012 - .020	.017 - .027	.017 - .033	.025 - .040	.025 - .043	.027 - .045	.030 - .050
Cast Iron	K	Gray Cast Iron, SG Iron, Ductile Cast Iron, Malleable Iron	0.005	0.01	0.017	.017 - .040	.025 - .055	.038 - .071	.045 - .083	.060 - .088	.071 - .099	.060 - .127

Example: Profile Milling
1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = mm/min (millimetres per minute)

Example: Slotting
1) Select material from chart
2) Select tool size
3) Select feed per chart
4) Multiply Feed per tooth x Number of teeth x RPM
5) Answer: mm/min (Millimetres Per Minute)

Spindle Max.
Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

During Profile Milling less than 50% of the cutter diameter's Radial depth,the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

Series F178 INCH

Workpiece Material Group		Example	Coolant			1 x Diameter Axial Depth Small Radial Depth Profiling > Largest Radial Depth						
			Max	Air	MMS	1% of Dia	5% of Dia	10% of Dia	15% of Dia	20% of Dia	30% of Dia	50% of Dia
			Type			SFM						
Steels	P	Free Machining	•	•	•	2400	2250	2050	1850	1660	1260	500
		Low Carbon	•	•	•	2400	2250	2050	1850	1660	1260	500
		Medium Carbon	•	•	•	1100	1030	950	875	790	620	300
		Alloys Steels	•	•	•	500	480	450	430	400	350	250
		High Strength Alloys	•	•	•	500	480	450	430	400	350	250
		Structural Steels	•	•	•	2400	2250	2050	1850	1660	1260	500
		Die/Tool Steels	•	•	•	400	390	380	370	360	300	200
Stainless Steels	M	Free Machining	•	X	o	500	485	460	450	430	380	300
		Moderate Stainless	•	X	o	500	390	380	370	360	320	250
		Difficult Stainless	•	X	o	350	330	320	300	295	260	200
		PH Stainless	•	X	o	250	245	240	235	230	195	125
		Cobalt Chrome Alloys	•	X	o	250	245	230	225	215	190	150
		Duplex (22%)	•	X	o	250	245	230	225	215	185	125
		Super Duplex (25%)	•	X	o	200	195	180	180	170	140	100
Special Alloys	S	High Temp Alloys	•	X	X	250	240	220	215	200	180	150
		Titanium Alloys	•	X	X	425	400	380	350	325	275	175
Cast Iron	K	Gray Cast Iron	•	o	o	1500	1420	1315	1210	1100	860	400
		SG Iron	•	o	o	1200	1130	1050	980	900	710	350
		Ductile Cast Iron	•	o	o	500	485	460	450	430	380	300
		Malleable Iron	•	o	o	400	385	375	360	345	330	300

•	Preferred	X	Possible	o	Not Possible

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

FEED RATE CHART

Series F178 INCH

Workpiece Material Group		Example	Tool Diameter (inches)									
			1/16	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
			Inch/Tooth									
Steels	P	Free Machining, Low Carbon, Medium Carbon, Alloys Steels, High Strength Alloys, Structural Steels, Die/Tool Steels	0.0002	0.0004	0.0007	.0010 - .0016	.0013 - .0021	.0016 - .0026	.0020 - .0031	.0026 - .0033	.0031 - .0035	.0035 - .0051
Stainless Steels	M	Free Machining, Moderate Stainless, Difficult Stainless, PH Stainless, Cobalt Chrome Alloys, Duplex (22%), Super Duplex (25%)	0.0002	0.0004	0.0007	.0010 - .0016	.0012 - .0021	.0012 - .0026	.0020 - .0031	.0020 - .0033	.0022 - .0035	.0024 - .0039
Special Alloys	S	High Temp Alloys, Titanium Alloys	0.0001	0.0002	0.0008	.0005 - .0008	.0007 - .0011	-0.0013	.0010 - .0016	.0010 - .0016	.0011 - .0018	.0012 - .0020
Cast Iron	K	Gray Cast Iron, SG Iron, Ductile Cast Iron, Malleable Iron	0.0002	0.0004	0.0007	.0007 - .0016	.0010 - .0022	.0015 - .0028	.0018 - .0033	.0024 - .0035	.0028 - .0039	.0024 - .0050

Example: Profile Milling

1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = IPM (Inches per Minute)

Spindle Max.
Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

During Profile Milling less than 50% of the cutter diameter's Radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

Series F178 METRIC

Workpiece Material Group		Example	Coolant			1 x Diameter Axial Depth Small Radial Depth Profiling > Largest Radial Depth						
			Max	Air	MMS	1% of Dia	5% of Dia	10% of Dia	15% of Dia	20% of Dia	30% of Dia	50% of Dia
			Type			Vc (m/min)						
Steels	P	Free Machining	•	•	•	730	685	620	565	500	380	150
		Low Carbon	•	•	•	730	685	620	565	500	380	150
		Medium Carbon	•	•	•	335	310	290	260	240	180	90
		Alloys Steels	•	•	•	150	140	130	130	120	105	75
		High Strength Alloys	•	•	•	150	140	130	130	120	105	75
		Structural Steels	•	•	•	730	685	620	565	500	380	150
		Die/Tool Steels	•	•	•	120	115	115	110	110	90	60
Stainless Steels	M	Free Machining	•	X	o	150	145	140	135	130	115	90
		Moderate Stainless	•	X	o	150	115	115	110	105	95	75
		Difficult Stainless	•	X	o	105	100	95	90	90	75	60
		PH Stainless	•	X	o	75	75	75	70	70	60	40
		Cobalt Chrome Alloys	•	X	o	75	75	75	70	70	60	45
		Duplex (22%)	•	X	o	75	75	75	70	70	60	40
		Super Duplex (25%)	•	X	o	60	60	55	55	50	45	30
Special Alloys	S	High Temp Alloys	•	X	X	75	75	75	70	60	55	45
		Titanium Alloys	•	X	X	125	120	115	105	100	80	55
Cast Iron	K	Gray Cast Iron	•	o	o	450	430	400	360	335	250	120
		SG Iron	•	o	o	365	345	320	295	275	215	105
		Ductile Cast Iron	•	o	o	150	145	140	130	130	115	90
		Malleable Iron	•	o	o	120	115	110	105	105	100	90

•	Preferred	X	Possible	o	Not Possible

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

FEED RATE CHART

Series F178 METRIC

Workpiece Material Group		Example	Tool Diameter (mm)									
			1	3	4	6	8	10	12	16	18	25
			mm/Tooth									
Steels	P	Free Machining, Low Carbon, Medium Carbon, Alloys Steels, High Strength Alloys, Structural Steels, Die/Tool Steels	0.005	0.01	0.017	.025 - .040	.033 - .053	0.04	0.066	.066 - .083	.078 - .088	.088 - .129
Stainless Steels	M	Free Machining, Moderate Stainless, Difficult Stainless, PH Stainless, Cobalt Chrome Alloys, Duplex (22%), Super Duplex (25%)	0.005	0.01	0.017	.025 - .040	.033 - .053	0.04	0.066	.066 - .083	.078 - .088	.088 - .129
Special Alloys	S	High Temp Alloys, Titanium Alloys	0.002	0.005	0.02	.012 - .020	.017 - .027	.017 - .033	.025 - .040	.025 - .043	.027 - .045	.030 - .050
Cast Iron	K	Gray Cast Iron, SG Iron, Ductile Cast Iron, Malleable Iron	0.005	0.01	0.017	.017 - .040	.025 - .055	.038 - .071	.045 - .083	.060 - .088	.071 - .099	.060 - .127

Example: Profile Milling

1) Select material from chart
2) Select tool size
3) Select feed per tooth
4) Figure percentage of cutter diameter radial cut depth
5) Select chip load factor for radial depth
6) Select chip load factor x Feed per tooth
7) Answer: New feed per tooth
8) New feed per tooth x Number of teeth x RPM = mm/min (millimetres per minute)

Spindle Max.
Should the calculated Spindle Speed be more than your actual Spindle Max., Use the Formula given below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

During Profile Milling less than 50% of the cutter diameter's Radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1
30%	1.1
20%	1.2
15%	1.4
10%	1.8
5%	2.3
1%	5

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

General Purpose Technical Metric

	2 Flute Series			3 Flute Series		4 Flute Series		
Stub	F164	F166				F163	F165	
standard	F121	F150		F116	F145	F111	F140	
long length/reach	F123		F183 / F186			F122		F181 / F184 / F187

Workpiece Material Group		Example	VC
Steels	P	Steel - Mild (.2 - .3 Carbon) 1018	105 - 150
		Steel - Mild (.4 - .5 Carbon) 4140	75 - 105
		Tool Steels (1.2 carbon) A2/D2/ H13/P20	60 - 75
		Forgings	40 - 75
Cast Iron	K	Iron Cast (Soft)	140 - 185
		Iron - Cast (Medium Hard)	90 - 120
		Iron (Hard Chilled)	75 - 90
		Iron (Malleable)	70 - 90
Stainless Steels	M	Stainless Free Machining	90 - 120
		Austenitic Stainless 304/316	55 - 70
		Ferritic	60 - 85
		Martensitic	45 - 60
		PH Stainless 17-4 PH	40 - 60

Workpiece Material Group		Example	VC
Special Alloys	S	Titanium 6AL-4V	55 - 115
		Cobalt-Based Alloys Stellite	30 - 60
		Nickel-Based Alloys Inconel 625/718	30 - 60
		Iron-Based Alloys Incoloy 800-802	40 - 60
Hardened Steels	H	Hardened Steels 35-45 Rc	60 - 75
		Hardened Steels 45-55 Rc	45 - 60
		Hardened Steels 55-65 Rc	15 - 30
Non-Ferrous	N	Aluminium / Aluminium Alloys	150 - 215
		Brass / Bronze	120 - 185
		Magnesium / Magnesium Alloys	215 - 305
		Plastics / Bakelite	245 - 365

FEED RATE CHART

General Purpose Technical Metric

Workpiece Material Group		Example	Tool Diameter (mm)								
			3	5	6	8	10	12	16	20	25
			mm/Tooth								
Steels	P	Steel - Mild (.2-.3 Carbon) 1018 Steel - Mild (.4-.5 Carbon) 4140	.013 - .020	.025 - .030	.038 - .051	.038 - .051	.053 - .076	.051 - .089	.058 - .102	.056 - .109	.081 - .127
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.008 - .013	.020 - .025	.030 - .038	.036 -.046	.046 - .051	.051 - .058	.058 - .076	.061 - .081	.061 - .081
Cast Iron	K	Iron Cast (Soft) Iron - Cast(Medium Hard) Iron (Hard Chilled) Iron (Malleable)	.013 - .020	.025 - .030	.038 - .051	.038 - .051	.053 - .076	.051 - .089	.058 - .102	.056 - .109	.081 - .127
Stainless Steel	M	Stainless Steel Free Machining Ferritic	.013 - .020	.025 - .030	.038 - .051	.038 - .051	.053 - .076	.051 - .089	.058 - .102	.056 - .109	.081 - .127
		Austenitic Stainless 304/316 Martensitic PH Stainless 17-4 PH	.008 - .013	.020 - .025	.030 - .038	.036 -.046	.046 - .051	.051 - .058	.058 - .076	.061 - .081	.061 - .081
Special Alloys	S	Titanium 6AL-4V	.008 - .010	.010 -.015	.015 - .020	.020 -.030	.020 -.030	.030 -.041	.041 -.046	.046 - .051	.051 - .076
		Stellite Inconel 625/718 Incoloy 800-802	.008 -.013	0.13 - .038	0.13 - .038	.025 -.051	.025 -.051	.025 -.076	0.51 -.076	.064 - .089	.064 - .089
Hardened Steels	H	Hardened Steels 35-45 Rc Hardened Steels 45-55 Rc Hardened Steels 55-65 Rc	.008 -.013	0.13 - .038	0.13 - .038	.025 -.051	.025 -.051	.025 -.076	0.51 -.076	.064 - .089	.064 - .089
Non-Ferrous	N	Aluminium/Aluminium Alloys Brass/Bronze Magnesium/Magnesium Alloys Plastics/Bakelite	.020 - .038	.038 -.051	.051 -.064	.064 - .076	.076 - .089	.089 - .127	.127 -.216	.191 - .241	.216 - .254

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUTTING SPEED CHART

General Purpose Technical Inch

	2 Flute Series			3 Flute Series		4 Flute Series		
Stub	F164	F166		F169		F163	F165	
standard	F121	F150		F116	F145	F111	F140	
long length/reach	F123		F183 / F186			F122		F181 / F184 / F187

Workpiece Material Group		Example	SFM
Steels	P	Steel - Mild (.2 - .3 Carbon) 1018	350 - 500
		Steel - Mild (.4 - .5 Carbon) 4140	250 - 350
		Tool Steels (1.2 carbon) A2/D2/ H13/P20	200 - 250
		Forgings	125 - 250
Cast Iron	K	Iron Cast (Soft)	450 - 600
		Iron - Cast (Medium Hard)	300 - 400
		Iron (Hard Chilled)	250 - 300
		Iron (Malleable)	225 - 300
Stainless Steels	M	Stainless Free Machining	300 - 400
		Austenitic Stainless 304/316	180 - 225
		Ferritic	200 - 275
		Martensitic	150 - 200
		PH Stainless 17-4 PH	125 - 200

Workpiece Material Group		Example	SFM
Special Alloys	S	Titanium 6AL-4V	175 - 375
		Cobalt-Based Alloys Stellite	100 - 200
		Nickel-Based Alloys Inconel 625/718	100 - 200
		Iron-Based Alloys Incoloy 800-802	125 - 200
Hardened Steels	H	Hardened Steels 35-45 Rc	200 - 250
		Hardened Steels 45-55 Rc	150 - 200
		Hardened Steels 55-65 Rc	50 - 100
Non-Fer-rous	N	Aluminium / Aluminium Alloys	500 - 700
		Brass / Bronze	400 - 600
		Magnesium / Magnesium Alloys	700 - 1000
		Plastics / Bakelite	800 - 1200

FEED RATE CHART

General Purpose Technical Inch

Workpiece Material Group		Example	Tool Diameter (inch)								
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
			Inch/Tooth								
Steels	P	Steel - Mild (.2-.3 Carbon) 1018 Steel - Mild (.4-.5 Carbon) 4140	.0005 - .0008	.0010 - .0012	.0015 - .0020	.0015 - .0025	.0021 - .0030	.0020 - .0035	.0023 - .0040	.0022 - .0043	.0032 - .0050
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.0003 - .0005	.0008 - .0010	.0012 - .0015	.0014 - .0018	.0018 - .0020	.0020 - .0023	.0023 - .0030	.0024 - .0032	.0024 - .0032
Cast Iron	K	Iron Cast (Soft) Iron - Cast(Medium Hard) Iron (Hard Chilled) Iron (Malleable)	.0005 - .0008	.0010 - .0012	.0015 - .0020	.0015 - .0025	.0021 - .0030	.0020 - .0035	.0023 - .0040	.0022 - .0043	.0032 - .0050
Stainless Steel	M	Stainless Steel Free Machining Ferritic	.0005 - .0008	.0010 - .0012	.0012 - .0015	.0015 - .0025	.0021 - .0030	.0020 - .0035	.0023 - .0040	.0022 - .0043	.0032 - .0050
		Austenitic Stainless 304/316 Martensitic PH Stainless 17-4 PH	.0003 - .0005	.0008 - .0010	.0012 - .0015	.0014 - .0018	.0018 - .0020	.0020 - .0023	.0023 - .0030	.0024 - .0032	.0024 - .0032
Special Alloys	S	Titanium 6AL-4V	.0003 -.0004	.0004 - .0006	.0006 - .0008	.0008 - .0012	.0008 - .0012	.0012 - .0016	.0016 - .0018	.0018 - .0020	.0020 - .0030
		Stellite Inconel 625/718 Incoloy 800-802	.0003 - .0005	.0005 - .0015	.0005 - .0015	.0010 -.0020	.0010 -.0020	.0010 -.0030	.0020 -.0030	.0025 - .0035	.0025 - .0035
Hardened Steels	H	Hardened Steels 35-45 Rc Hardened Steels 45-55 Rc Hardened Steels 55-65 Rc	.0003 - .0005	.0005 - .0015	.0005 - .0015	.0010 -.0020	.0010 -.0020	.0010 -.0030	.0020 -.0030	.0025 - .0035	.0025 - .0035
Non-Ferrous	N	Aluminium/Aluminium Alloys Brass/Bronze Magnesium/Magnesium Alloys Plastics/Bakelite	.0008 - .0015	.0015 - .0020	.0020 - .0025	.0025 - .0030	.0030 - .0035	.0035 - .0050	.0050 - .0080	.0075 - .0095	.0085 - .100

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

MATERIAL DETAILS

Material Group	Material Description	Content	Tensile Strength RM (MPa)*	Hardness (HB)	Hardness (HRC)
P0	Low-Carbon Steels, Long Chipping	C <0,25%	<530	<125	—
P1	Low-Carbon Steels, Short Chipping, Free Machining	C <0,25%	<530	<125	—
P2	Medium- and High-Carbon Steels	C >0,25%	<530	<220	<25
P3	Alloy Steels and Tool Steels	C >0,25%	600-850	<330	<35
P4	Alloy Steels and Tool Steels	C >0,25%	850-1400	340–450	35-48
P5	Ferritic, Martensitic, and PH Stainless Steels	—	600-900	<330	<35
P6	High-Strength Ferritic, Martensitic, and PH Stainless Steels	—	900-1350	350–450	35-48
M1	Austenitic Stainless Steel	—	<600	130-200	-
M2	High-Strength Austenitic Stainless and Cast Stainless Steels	—	600-800	150–230	<25
M3	Duplex Stainless Steel	—	<800	135–275	<30
K1	Grey Cast Iron	—	125-500	120–290	<32
K2	Low- and Medium-Strength Ductile Irons (Nodular Irons) and Compacted Graphite Irons (CGI)	—	<600	130–260	<28
K3	High-Strength Ductile Irons and Austempered Ductile Iron (ADI)	—	>600	180–350	<43
N1	Wrought Aluminium	—	—	—	—
N2	Low-Silicon Aluminium Alloys and Magnesium Alloys	Si <12,2%	—	—	—
N3	High-Silicon Aluminium Alloys and Magnesium Alloys	Si > 12,2%	—	—	—
N4	Copper-, Brass-, Zinc-Based on Machinability Index Range of 70–100	—	—	—	—
N5	Nylon, Plastics, Rubbers, Phenolics, Resins, Fibreglass	—	—	—	—
N6	Carbon, Graphite Composites, CFRP	—	—	—	—
N7	Metal Matrix Composites (MMC)	—	—	—	—
S1	Iron-Based, Heat-Resistant Alloys	—	500-1200	160-260	25-48
S2	Cobalt-Based, Heat-Resistant Alloys	—	1000-1500	250-450	25-48
S3	Nickel-Based, Heat-Resistant Alloys	—	600-1700	160-450	<48
S4	Titanium and Titanium Alloys	—	900-1600	300-400	33-48
H1	Hardened Materials	—	—	—	44-48
H2	Hardened Materials	—	—	—	48-55
H3	Hardened Materials	—	—	—	56-60
H4	Hardened Materials	—	—	—	>60

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

MATERIAL DETAILS

Material Group	ANSI	DIN
P0	A36, 1008, 1010, 1018 through 1029; 1108, 1117	
P1	10L18, 1200 Series, 1213, 12L14	C15, Ck22, ST37-2, S235JR, 9SMnPb28, GS38
P2	1035, 1045, 10L45, 1050, 10L50, 1080, 1137, 1144, 11L44, 1525, 1545, 1572	ST52, S355JR, C35, GS60, Cf53
P3	1300, 2000, 3000, 4000, 5000, 8000, P20, SAE: A, D, H, O, S, M, T	16MnCr5, Ck45, 21CrMoV5-7, 38SMn28
P4	1300, 2000, 3000, 4000, 5000, 8000, P20, SAE: A, D, H, O, S, M, T	100Cr6, 30CrNiMo8, 42CrMo4, C70W2, S6525, X120Mn12
P5	15–5 PH, 13–8 PH, 17–4 PH, 400 and 500 Series	100Cr6, 30CrNiMo8, 42CrMo4, C70W2, S6525, X120Mn12
P6	15–5 PH, 13–8 PH, 17–4 PH, 400 and 500 Series	X102CrMo17, G-X120Cr29
M1	200 Series, 301, 302, 304, 304L, 309	X5CrNi 18 10, X2CrNiMo 17 13 2, G-X25CrNiSi18 9, X15CrNiSi 20 12
M2	310, 316, 316L, 321, 347, 384 ASTM Cast XM-1, XM-5, XM-7, XM-21	X2CrNiMo 13 4, X5NiCr 32 21, X5CrNiNb 18 10, G-X15CrNi 25-20
M3	323, 329, F55, 2205, S329000	X8CrNiMo27 5, X2CrNiMoN22 5 3, X20CrNiSi25 4, G-X40CrNiSi27 4
K1	class 20, 25, 30, 35, 40, 45, 50, 55, 60, G1800, G3000, G3500, G4000	GG15, GG25, GG30, GG40, GTW40
K2	60-40-18, 65-45-12, 80-55-06, SAE J434:D4018, D4512, D5506, ASTM A47: Grade 32510, 35018, SAE J158: Grade M3210, M4504, M5003, M5503, M7002,ASTM A842: Grade 250, 300, 350, 400, 450	GGG40, GTS35
K3	ASTM A536:100-70-03, 120-90-02, SAE J434: D7003, SAE J158:Grade M8501AST A897: 125-80-10, 150-100-7, 175-125-4, 200-150-1, 230-185	GGG60, GTW55, GTS65
N1	2025, 5050, 7050, 1000, 2017	AlMg1, Al99.5, AlCuMg1, AlCuBiPb, AlMgSi1, ALMgSiPb
N2	2024, 6061, 7075	GAlSiCu4, GDAlSi10Mg
N3	—	G-ALSi12, G-AlSi17Cu4, G-AlSi21CuNiMg
N4	C81500	CuZn40, Ms60, G-CuSn5ZnPb, CuZn37, CuSi3Mn
N5	—	LEXAN®, HOSTALEN™, Polystyrol, Makralon®
N6	Graphite, CFK, CFRP	CFK, GFK
N7	C63000	—
S1	INCOLOY® 800 Series, A608, A567, Discaloy™, INVAR®, N-155, 16-25-6, 19-9 DL; Cast: ASTM A-297, A-351, A-567, A-608	X1NiCrMoCu32 28 7, X12NiCrSi36 16, X5NiCrAlTi31 20, X40CoCrNi20 20
S2	Haynes® 25 (L605), Haynes 188, J-1570, Stellite®, AiResist 213; Cast: AiResist 13, Haynes 21, MAR-M302, MAR-M509, NASA Co-W-Re, WI-52	Haynes® 188, Stelllite® 6,21,31
S3	Astroloy™, Hastelloy® B/C/ C-276 /X, INCONEL® 600 and 700 Series, IN102,INCOLOY 900 Series, Rene 41, Waspalloy®, Monel®, K-500, MAR-M20, NIMONIC®, UDIMET®	INCONEL® 690, INCONEL 625, Hastelloy®, NIMONIC® 75
S4	Pure: Ti 98.8, Ti 98.9,Ti 99.9; Alloyed: Ti 5Al-2.5Sn, Ti6Al-4V, Ti6Al-2Sn-4Zr-2Mo,Ti-3Al-8V-6Cr-4Mo-4Zr, Ti-10V-2Fe-3Al, Ti-13V-11Cr-3Al	Ti1, TiAl5Sn2, TiAl6V4, TiAl4Mo4Sn2
H1	Tool Steel H10, H11, H13, D2, D3, 4340, P20	GX260NiCr42, GX330NiCr42, GX300CrNiSi952, GX300CrMo153, HARDOX® 400
H2	Tool Steel H10, H11, H13, D2, D3, 4340, P20	—
H3	Tool Steel H10, H11, H13, D2, D3, 4340, P20	—
H4	Tool Steel H10, H11, H13, D2, D3, 4340, P20	—

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

SURFACE TREATMENT

STEAM OXIDE:
A black oxided surface (Fe3O4) produced on the surface of a finished tap by means of a steam furnace. This oxidized surface is porous and helps retain cutting fluid in the working portion of the tap. The materials on which steam oxide has shown improvement in performance are stainless steels, steel forgings, tool and die steels, hot and cold rolled steels, and high nickel alloys.

TITANIUM NITRIDE (TiN):
A thin deposit (approx. 0.0001") applied to the surface of a finished tap utilizing PVD coating technology. TiN coating increases the surface hardness and wear resistance. Use of TiN coating on standard tools will help increase tool life in harder materials (up to 32 HrC), such as stainless steels, steel forgings, tool and die steels and hot and cold rolled steels. TiN coating also works very well with water-base cutting fluids.

TITANIUM CARBON NITRIDE (TiCN):
Similar to TiN, TiCN is applied utilizing PVD coating technology. This coating combines high hardness (approx. 2800 vickers) with the anti-seizure properties of Nitride. A lower coefficient of friction helps reduce welding by 75% over TiN coated tools. These features make TiCN especially beneficial in non-ferrous material and hardened steels.

TITANIUM ALUMINUM NITRIDE (TiAlN):
TiAlN is applied using PVD coating technology. The addition of aluminum reduces friction and increases the coating oxidation temperature. As a result, TiAlN has increased resistance to heat and oxidation wear. This makes TiAlN better suited for High Speed/High Heat applications. TiAlN coating is incorporated into many of our tools.

PROTON + COATING :
Proton + coating devised explicitly for solid carbide tools used in roughing and finishing of hardened steels and difficult-to-machine materials.
Major competitive advantages in tool and die-making can be attained by cutting steels with hardness >60 HRC.

Cr BASED COATING
Cr based coating, has made it possible to systematically optimize and decisively improve the key coating properties for milling applications.

Greater abrasion resistance, extra shear strength, lower adhesion tendency, maximum toughness and a very smooth surface achieve a quantum leap in drilling performance.

END MILL TROUBLESHOOTING

Problem	Rigidity	Increase Inches/Tooth	Reduce Inches/Tooth	Material	Recutting Chips	Increase Rake Angle	Handling	Runout	Reduce Speed	Increase Speed	Depth of Cut	Fixturing	Coolant	Finish	Dull Tool	Chip Evaluation	Inadequate Number of Flutes	Insufficient Coolant	Plunge Cutting	Reduce Feed	Increase Feed	Tool Holder	Balance Holder & Tool
Chipping	X		X	X	X		X	X														X	
Chatter	X	X							X		X	X										X	
Built Up Edge		X				X				X			X	X									
Breakage	X		X								X				X	X						X	
Chip Packing																	X	X	X				
Poor Slotting	X	X	X						X		X	X								X			
Premature Wear				X					X	X			X							X	X	X	
Chip Welding			X			X			X				X	X									
Cratering																							X

FORMULAS:-

INCH
RPM = SFM x 3.82/Tool Diameter
IPM = RPM x number of teeth x (inches/tooth)

METRIC
RPM = Vc x 318.057/Tool Diameter
mm/min. = RPM x number of teeth x (mm/tooth)

CONVERSION INCH TO METRIC
Vc = SFM x 3.084
mm/min. = IPM x 25.4

CONVERSION METRIC TO INCH
SFM = Vc/ . 3048
IPM = (mm/min.)/25.4

SAFETY NOTE:-

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

END MILL TROUBLESHOOTING GUIDE

PROBLEM	CAUSE	SOLUTION
Chip packing	Too great a cutting amount	Adjust feed or speed
	Not enough chip room	Use end mill fewer flutes
	Not enough coolant	Apply more coolant. Use air pressure
Rough surface finish	Feed too fast	Slow down to correct feed
	Slow speed	Use higher speed
	Too much wear	Regrind earlier stage
	Chip biting	Cut less amount per pass
	No end tooth concavity	Add margin (touch primary with oilstone)
Burr	Too much wear on primary relief	Regrind sooner
	Incorrect condition	Correct milling condition
	Improper cutting angle	Change to correct cutting angle
No dimensional accuracy	Too tough condition	Change to easier condition
	Lack of accuracy (machine & holder)	Repair machine or holder
	Not enough rigidity (machine & holder)	Change machine or holder or condition
	Not sufficient number of flutes	Use end mill with greater number of flutes
No perpendicular side	Feed too fast	Slow down to correct feed
	Too great a cutting amount	Reduce cutting amount
	Too long a flute length or long overall length	Use proper length tool. Hold shank deeper
	Not sufficient number of flutes	Use end mill with greater number of flutes
Chipping	Feed too fast	Slow down to proper feed
	Feed too fast on first cut	Slow down on first bite
	Not enough rigidity of machine tool & holder	Change rigid machine tool or holder
	Loose holder	Tighten tool holder
	Loose holder (workpiece)	Tighten workpiece fixture
	Lack of rigidity (tool)	Use shortest end mill available. Hold shank deeper. Try down cut
	Teeth too sharp	Change to lower cutting angle, primary relief
Wear	Speed too fast	Slow down, use more coolant
	Hard material	Use higher grade tool material, add surface treatment
	Biting chips	Change feed speed to change chip size or clear chips with coolant or air pressure
	Improper feed speed (too slow)	Increase feed speed. Try down cut
	Improper cutting angle	Change to correct cutting angle
	Too low a primary relief angle	Change to larger relief angle
Breakage	Feed too fast	Slow down feed
	Too large cutting amount	Adjust to smaller cutting amount per teeth
	Too long flute length or long overall length	Hold shank deeper, use shorter end mill
	Too much wear	Regrind at earlier stage
Chattering	Feed and speed too fast	Correct feed and speed
	Not enough rigidity (machine & holder)	Use better machine tool or holder or change condition
	Too much relief angle	Change to smaller relief angle. Add margin (touch primary with oil stone)
	Loose holder (workpiece)	Hold workpiece tighter
	Cutting too deep	Correct to smaller cutting depth
	Too long flute length or long overall length	Hold shank deeper, use shorter end mill or try down cut

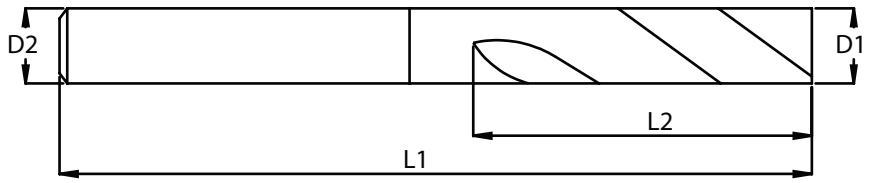
Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

CUSTOMER TOOL REQUEST FORM

Fill in information requested on drawing.
(*Required Fields)

☐ Request Approval Drawing

D1 = _____
D2 = _____
L1 = _____
L2 = _____



***Material**

☐ Solid Carbide

☐ Carbide Coolant Thru

***Number of Flutes**

_____

***Flute Form**

☐ Straight

☐ Helical _____ ° Helix

***Flute Form**

☐ Cylindrical

☐ Shank Flat

Flat Style _____

***Flute Form**

☐ Corner Radius_____ +/-.002"

☐ Corner Chamfer_____ x_____°

☐ Chipbreaker

***Coating**

☐ TiN

☐ TiCN

☐ TiAlN

☐ None

Other _____

Note:
This information enables us to engineer and manufacture a tool for your specific requirments.

Customer Name: _____

Phone: _____

* Work Material Machined:

Hardness: _____

Distributor: _____

Quantities: _____

TRIAL TOOL RESULTS FORM

Customer Name		Ref No.	
Address		Date	
		Sales Engineer Name:	
		Contact No.:	
Contact Person :		Trial PO OA No:	
Tool Diameter :			
Component Details:		**Operation Details:**	
Name		End Milling Depth	
Material		No of Passes	
Material Hardness		Slotting/Profiling/Ramping	
Machine Make /Model/No.		Roughing/Finishing	
Tool No.		Tol/Finish required :	
Machining Details :			
Parameters	**Existing**	**Proposed**	
Holding			
M/c.Type			
Cycle Time			
Coolant			
Coolant Press.			
Tool Data:			
Parameters	**Existing**	**Trial 1**	**Trial 2**
Make			
Ext/Thru cool			
Cutting Speed (Vc) m/min			
RPM			
Feed			
Depth of cut			
Life Obtained (TIME)			
Kind of Failure			
Cost Data:			
Tool Cost (Rs.)			
Cost/Component (Rs.)			
Remarks:-			
Customer Benefit:-1.			
Customer Benefit:-2.			

Sales Engineer
FORBES & COMPANY LIMITED

Authorised Signatory
CUSTOMER