SHOP NOTES

Pocket Guide and Reference Charts
for CNC Machinists

– Made in the U.S.A. –

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Decimal Equivalent Chart .0059 – .0980

Decimal Equiv.	Drill Size	mm	Tap Sizes
.0059	97	0.150	
.0063	96	0.160	
.0067	95	0.170	
.0071	94	0.180	
.0075	93	0.191	
.0079	92	0.201	
.0083	91	0.211	
.0087	90	0.221	
.0091	89	0.231	
.0095	88	0.241	
.0100	87	0.254	
.0105	86	0.267	
.0110	85	0.279	
.0115	84	0.292	
.0120	83	0.305	
.0125	82	0.318	
.0130	81	0.330	
.0135	80	0.343	
.0145	79	0.368	
.0156	1/64	0.397	
.0160	78	0.406	
.0180	77	0.457	
.0200	76	0.508	
.0210	75	0.533	
.0225	74	0.572	
.0240	73	0.610	
.0250	72	0.635	
.0260	71	0.660	
.0280	70	0.711	
.0292	69	0.742	
.0310	68	0.787	
.0313	1/32	0.794	
.0320	67	0.813	
.0330	66	0.838	
.0350	65	0.889	
.0360	64	0.914	
.0370	63	0.940	
.0380	62	0.965	
.0390	61	0.991	
.0400	60	1.016	
.0410	59	1.041	
.0420	58	1.067	
.0430	57	1.092	
.0465	56	1.181	
.0469	3/64	1.191	#0-80
.0520	55	1.321	
.0550	54	1.397	
.0595	53	1.511	#1-64 • #1-72
.0625	1/16	1.588	
.0635	52	1.613	
.0670	51	1.702	
.0700	50	1.778	#2-56 • #2-64
.0730	49	1.854	
.0760	48	1.930	
.0781	5/64	1.984	
.0785	47	1.994	#3-48
.0810	46	2.057	
.0820	45	2.083	#3-56
.0860	44	2.184	
.0890	43	2.261	#4-40
.0935	42	2.375	#4-48
.0938	3/32	2.381	
.0960	41	2.438	
.0980	40	2.489	

Tap drill sizes above based on approximately 75% full thread
Tap # Sizes #0 = .060 #1 = .073 #2 = .086 #3 = .099 #4 = .112
Tap # x .013 + .060 = Thread # OD

Decimal Equivalent Chart .0995 – .2969

Decimal Equiv.	Drill Size	mm	Tap Sizes	Decimal Equiv.	Drill Size	mm	Tap Sizes
.0995	39	2.527		.1875	3/16	4.763	#12-32
.1015	38	2.578	#5-40	.1890	12	4.801	
.1040	37	2.642	#5-44	.1910	11	4.851	
.1065	36	2.705	#6-32	.1935	10	4.915	
.1094	7/64	2.778		.1960	9	4.978	
.1100	35	2.794		.1990	8	5.055	
.1110	34	2.819		.2010	7	5.105	1/4-20
.1130	33	2.870	#6-40	.2031	13/64	5.159	
.1160	32	2.946		.2040	6	5.182	
.1200	31	3.048		.2055	5	5.220	
.1250	1/8	3.175		.2090	4	5.309	
.1285	30	3.264		.2130	3	5.410	1/4-28
.1360	29	3.454	#8-32 • #8-36	.2188	7/32	5.556	1/4-32
.1405	28	3.569		.2210	2	5.613	
.1406	9/64	3.572		.2280	1	5.791	
.1440	27	3.658		.2340	A	5.944	
.1470	26	3.734		.2344	15/64	5.953	
.1495	25	3.797	#10-24	.2380	B	6.045	
.1520	24	3.861		.2420	C	6.147	
.1540	23	3.912		.2460	D	6.248	
.1563	5/32	3.969		.2500	1/4&E	6.350	
.1570	22	3.988		.2570	F	6.528	5/16-18
.1590	21	4.039	#10-32	.2610	G	6.629	
.1610	20	4.089		.2656	17/64	6.747	
.1660	19	4.216		.2660	H	6.756	
.1695	18	4.305		.2720	I	6.909	5/16-24
.1719	11/64	4.366		.2770	J	7.036	
.1730	17	4.394		.2810	K	7.137	
.1770	16	4.496	#12-24	.2813	9/32	7.144	5/16-32
.1800	15	4.572		.2900	L	7.366	
.1820	14	4.623	#12-28	.2950	M	7.493	
.1850	13	4.699		.2969	19/64	7.541	

Tap drill sizes above based on approximately 75% full thread
Tap # Sizes #5 = .125 #6 = .138 #8 = .164 #10 = .190 #12 = .216
Tap # x .013 + .060 = Thread # OD

Decimal Equivalent Chart .3020 – 1.000

Decimal Equiv.	Drill Size	mm	Tap Sizes
.3020	N	7.671	
.3125	5/16	7.938	3/8-16
.3160	O	8.026	
.3230	P	8.204	
.3281	21/64	8.334	
.3320	Q	8.433	3/8-24
.3390	R	8.611	
.3438	11/32	8.731	3/8-32
.3480	S	8.839	
.3580	T	9.093	
.3594	23/64	9.128	
.3680	U	9.347	7/16-14
.3750	3/8	9.525	
.3770	V	9.576	
.3860	W	9.804	
.3906	25/64	9.922	7/16-20
.3970	X	10.084	
.4040	Y	10.262	7/16-28
.4063	13/32	10.319	
.4130	Z	10.490	
.4219	27/64	10.716	1/2-13
.4375	7/16	11.113	
.4531	29/64	11.509	1/2-20
.4688	15/32	11.906	1/2-28
.4844	31/64	12.303	9/16-12
.5000	1/2	12.700	9/16-18
.5156	33/64	13.097	9/16-24
.5313	17/32	13.494	5/8-11
.5469	35/64	13.891	
.5625	9/16	14.288	5/8-18
.5781	37/64	14.684	5/8-24
.5938	19/32	15.081	
.6094	39/64	15.478	11/16-12
.6250	5/8	15.875	
.6406	41/64	16.272	11/16-20 • 11/16-24
.6563	21/32	16.669	3/4-10
.6719	43/64	17.066	
.6875	11/16	17.462	3/4-16
.7031	45/64	17.859	3/4-20
.7188	23/32	18.256	
.7344	47/64	18.653	13/16-12
.7500	3/4	19.050	13/16-16
.7656	49/64	19.447	13/16-20 • 7/8-9
.7813	25/32	19.844	
.7969	51/64	20.241	7/8-14
.8125	13/16	20.637	
.8281	53/64	21.034	7/8-20
.8438	27/32	21.431	
.8594	55/64	21.828	15/16-12
.8750	7/8	22.225	15/16-16 • 1.0-8
.8906	57/64	22.622	15/16-20
.9063	29/32	23.019	
.9219	59/64	23.416	1.0-12
.9375	15/16	23.813	
.9531	61/64	24.209	1.0-20
.9688	31/32	24.606	
.9844	63/64	25.003	
1.000	1	25.400	

Tap drill sizes above based on approximately 75% full thread
A decimal equivalent chart can be displayed on a Haas control by pressing the HELP/CALC button, and then selecting the Drill Table tab. Use the jog handle or cursor keys to scroll through the chart.

Tap Thread Size	Approx. inside Dia.	Approx. outside Dia.	Tap Drill
1/8 – 27	1/4	3/8	11/32
1/4 – 18	3/8	17/32	7/16
3/8 – 18	1/2	11/16	37/64
1/2 – 14	5/8	13/16	23/32
3/4 – 14	13/16	1	59/64
1 – 11 1/2	1 1/16	1 5/16	1 5/32
1 1/4 – 11 1/2	1 3/8	1 5/8	1 1/2
1 1/2 – 11 1/2	1 5/8	1 7/8	1 47/64
2 – 11 1/2	2 1/16	2 3/8	2 7/32
2 1/2 – 8	2 9/16	2 7/8	2 5/8

Pipe sizes are generally determined by the inside diameter of the pipe. The chart above gives nominal and approximate actual dimensions of commonly used sizes of standard threaded pipe.

Millimeter to Inch Chart 0.01 – 12.5

mm	Inch	mm	Inch	mm	Inch	mm	Inch
0.01	.0004	2.6	.1024	6.0	.2362	9.4	.3701
0.02	.0008	2.7	.1063	6.1	.2402	9.5	.3740
0.03	.0012	2.8	.1102	6.2	.2441	9.6	.3780
0.04	.0016	2.9	.1142	6.3	.2480	9.7	.3819
0.05	.0020	3.0	.1181	6.4	.2520	9.8	.3858
0.06	.0024	3.1	.1220	6.5	.2559	9.9	.3898
0.07	.0028	3.2	.1260	6.6	.2598	10.0	.3937
0.08	.0032	3.3	.1299	6.7	.2638	10.1	.3976
0.09	.0035	3.4	.1339	6.8	.2677	10.2	.4016
0.1	.0039	3.5	.1378	6.9	.2717	10.3	.4055
0.2	.0079	3.6	.1417	7.0	.2756	10.4	.4094
0.3	.0118	3.7	.1457	7.1	.2795	10.5	.4134
0.4	.0157	3.8	.1496	7.2	.2835	10.6	.4173
0.5	.0197	3.9	.1535	7.3	.2874	10.7	.4213
0.6	.0236	4.0	.1575	7.4	.2913	10.8	.4252
0.7	.0276	4.1	.1614	7.5	.2953	10.9	.4291
0.8	.0315	4.2	.1654	7.6	.2992	11.0	.4331
0.9	.0354	4.3	.1693	7.7	.3031	11.1	.4370
1.0	.0394	4.4	.1732	7.8	.3071	11.2	.4409
1.1	.0433	4.5	.1772	7.9	.3110	11.3	.4449
1.2	.0472	4.6	.1811	8.0	.3150	11.4	.4488
1.3	.0512	4.7	.1850	8.1	.3189	11.5	.4528
1.4	.0551	4.8	.1890	8.2	.3228	11.6	.4567
1.5	.0591	4.9	.1929	8.3	.3268	11.7	.4606
1.6	.0630	5.0	.1969	8.4	.3307	11.8	.4646
1.7	.0669	5.1	.2008	8.5	.3346	11.9	.4685
1.8	.0709	5.2	.2047	8.6	.3386	12.0	.4724
1.9	.0748	5.3	.2087	8.7	.3425	12.1	.4764
2.0	.0787	5.4	.2126	8.8	.3465	12.2	.4803
2.1	.0827	5.5	.2165	8.9	.3504	12.3	.4843
2.2	.0866	5.6	.2205	9.0	.3543	12.4	.4882
2.3	.0906	5.7	.2244	9.1	.3583	12.5	.4921
2.4	.0945	5.8	.2283	9.2	.3622		
2.5	.0984	5.9	.2323	9.3	.3661		

Setting 9 on a Haas allows you to change between inch and millimeter dimensioning.

Millimeter to Inch Chart 12.6 – 25.4

mm	Inch	mm	Inch	mm	Inch	mm	Inch
12.6	.4961	15.9	.6260	19.2	.7559	22.5	.8858
12.7	.5000	16.0	.6299	19.3	.7598	22.6	.8898
12.8	.5039	16.1	.6339	19.4	.7638	22.7	.8937
12.9	.5079	16.2	.6378	19.5	.7677	22.8	.8976
13.0	.5118	16.3	.6417	19.6	.7717	22.9	.9016
13.1	.5157	16.4	.6457	19.7	.7756	23.0	.9055
13.2	.5197	16.5	.6496	19.8	.7795	23.1	.9094
13.3	.5236	16.6	.6535	19.9	.7835	23.2	.9134
13.4	.5276	16.7	.6575	20.0	.7874	23.3	.9173
13.5	.5315	16.8	.6614	20.1	.7913	23.4	.9213
13.6	.5354	16.9	.6654	20.2	.7953	23.5	.9252
13.7	.5394	17.0	.6693	20.3	.7992	23.6	.9291
13.8	.5433	17.1	.6732	20.4	.8031	23.7	.9331
13.9	.5472	17.2	.6772	20.5	.8071	23.8	.9370
14.0	.5512	17.3	.6811	20.6	.8110	23.9	.9409
14.1	.5551	17.4	.6850	20.7	.8150	24.0	.9449
14.2	.5591	17.5	.6890	20.8	.8189	24.1	.9488
14.3	.5630	17.6	.6929	20.9	.8228	24.2	.9528
14.4	.5669	17.7	.6968	21.0	.8268	24.3	.9567
14.5	.5709	17.8	.7008	21.1	.8307	24.4	.9606
14.6	.5748	17.9	.7047	21.2	.8346	24.5	.9646
14.7	.5787	18.0	.7087	21.3	.8386	24.6	.9685
14.8	.5827	18.1	.7126	21.4	.8425	24.7	.9724
14.9	.5866	18.2	.7165	21.5	.8465	24.8	.9764
15.0	.5906	18.3	.7205	21.6	.8504	24.9	.9803
15.1	.5945	18.4	.7244	21.7	.8543	25.0	.9843
15.2	.5984	18.5	.7283	21.8	.8583	25.1	.9882
15.3	.6024	18.6	.7323	21.9	.8622	25.2	.9921
15.4	.6063	18.7	.7362	22.0	.8661	25.3	.9961
15.5	.6102	18.8	.7402	22.1	.8701	25.4	1.0
15.6	.6142	18.9	.7441	22.2	.8740		
15.7	.6181	19.0	.7480	22.3	.8780		
15.8	.6220	19.1	.7520	22.4	.8819		

Metric Taps

Tap Sizes	MM Tap Drill	Drill Dia. in Inches
M1 x 0.25	0.75	.0295
M1.1 x 0.25	0.85	.0335
M1.2 x 0.25	0.95	.0374
M1.4 x 0.3	1.10	.0433
M1.6 x 0.35	1.25	.0492
M1.8 x 0.35	1.45	.0571
M2 x 0.4	1.60	.0630
M2.2 x 0.45	1.75	.0689
M2.5 x 0.45	2.05	.0807
M3 x 0.5	2.50	.0984
M3.5 x 0.6	2.90	.1142
M4 x 0.7	3.30	.1299
M4.5 x 0.75	3.70	.1457
M5 x 0.8	4.20	.1654
M6 x 1	5.00	.1969
M7 x 1	6.00	.2362
M8 x 1.25	6.75	.2657
M8 x 1	7.00	.2756
M10 x 1.5	8.50	.3346
M10 x 1.25	8.75	.3445
M12 x 1.75	10.20	.4016
M12 x 1.25	10.80	.4252

Tap Sizes	MM Tap Drill	Drill Dia. in Inches
M14 x 2	12.00	.4724
M14 x 1.5	12.50	.4921
M16 x 2	14.00	.5512
M16 x 1.5	14.50	.5709
M18 x 2.5	15.50	.6102
M18 x 1.5	16.50	.6496
M20 x 2.5	17.50	.6890
M20 x 1.5	18.50	.7283
M22 x 2.5	19.50	.7677
M22 x 1.5	20.50	.8071
M24 x 3	21.00	.8268
M24 x 2	22.00	.8661
M27 x 3	24.00	.9449
M27 x 2	25.00	.9843
M30 x 3.5	26.50	1.0433
M30 x 2	28.00	1.1024
M33 x 3.5	29.50	1.1614
M33 x 2	31.00	1.2205
M36 x 4	32.00	1.2598
M36 x 3	33.00	1.2992
M39 x 4	35.00	1.3780
M39 x 3	36.00	1.4173

Tap drill sizes based on 77% full metric thread
Metric tap and drill sizes can be displayed on a Haas control by pressing the HELP/CALC button twice, and then selecting the Drill Table tab.

Metric Thread Pitch Conversion

Metric Thd. Pitch	Thd. Pitch in Inches	Threads Per In.	Basic Height
. 25	. 00984	101.6002	. 00639
. 30	. 01181	84.6668	. 00767
. 35	. 01378	72.5716	. 00895
. 40	. 01575	63.5001	. 01023
. 45	. 01772	56.4446	. 01151
. 50	. 01969	50.8001	. 01279
. 60	. 02362	42.3334	. 01534
. 70	. 02756	36.2858	. 01790
. 75	. 02953	33.8667	.01918
. 80	. 03150	31.7501	.02046
. 90	. 03543	28.2228	. 02301
1.00	. 03937	25.4000	.02557
1.25	. 04921	20.3200	. 03196
1.50	. 05906	16.9334	. 03836
1.75	. 06890	14.5143	. 04475
2.00	. 07874	12.7000	. 05114
2.50	. 09843	10.1600	. 06393
3.00	. 11811	8.4667	. 07671
3.50	. 13780	7.2572	. 08950
4.00	. 15748	6.3500	. 10229
4.50	. 17717	5.6445	. 11508
5.00	. 19685	5.0800	. 12785
6.00	. 23622	4.2333	. 15344

HAAS MILL G-CODES

(may vary with software version)

Code	Description	Group
G00*	Rapid Motion Positioning	01
G01	Linear Interpolation Motion	01
G02	Circular Interpolation Motion CW	01
G03	Circular Interpolation Motion CCW	01
G04	Dwell	00
G09	Exact Stop	00
G10	Set Offsets	00
G12	Circular Pocket Milling CW	00
G13	Circular Pocket Milling CCW	00
G17*	XY Plane Selection	02
G18	XZ Plane Selection	02
G19	YZ Plane Selection	02
G20	Select Inches	06
G21	Select Metric	06
G28	Return To Machine Zero Point	00
G29	Return From Reference Point	00
G31	Feed Until Skip	00
G35	Automatic Tool Diameter Measurement	00
G36	Automatic Work Offset Measurement	00
G37	Automatic Tool Offset Measurement	00
G40*	Cutter Compensation Cancel	07
G41	2D Cutter Compensation Left	07
G42	2D Cutter Compensation Right	07
G43	Tool Length Compensation + (Add)	08
G44	Tool Length Compensation - (Subtract)	08
G47	Text Engraving	00
G49*	G43/G44/G143 Cancel	08
G50*	Cancel Scaling	11
G51	Scaling	11
G52	Set Work Coordinate System	00 or 12
G53	Non-Modal Machine Coordinate Selection	00

* default

Code	Description	Group
G54*	Select Work Coordinate System #1	12
G55	Select Work Coordinate System #2	12
G56	Select Work Coordinate System #3	12
G57	Select Work Coordinate System #4	12
G58	Select Work Coordinate System #5	12
G59	Select Work Coordinate System #6	12
G60	Uni-Directional Positioning	00
G61	Exact Stop Mode	15
G64*	G61 Cancel	15
G65	Macro Subroutine Call Option	00
G68	Rotation	16
G69*	Cancel G68 Rotation	16
G70	Bolt Hole Circle	00
G71	Bolt Hole Arc	00
G72	Bolt Holes Along an Angle	00
G73	High-Speed Peck Drilling Canned Cycle	09
G74	Reverse Tap Canned Cycle	09
G76	Fine Boring Canned Cycle	09
G77	Back Bore Canned Cycle	09
G80*	Canned Cycle Cancel	09
G81	Drill Canned Cycle	09
G82	Spot Drill Canned Cycle	09
G83	Normal Peck Drilling Canned Cycle	09
G84	Tapping Canned Cycle	09
G85	Boring Canned Cycle	09
G86	Bore and Stop Canned Cycle	09
G87	Bore In and Manual Retract Canned Cycle	09
G88	Bore In, Dwell, Manual Retract Canned Cycle	09
G89	Bore In, Dwell, Bore Out Canned Cycle	09
G90*	Absolute Position Command	03
G91	Incremental Position Command	03

* default

In the Offset display on a Haas, you can zero all offsets at once by pressing ORIGIN, and following the simple on-screen commands. You can't undo this.

Code	Description	Group
G92	Set Work Coordinate Systems Shift Value	00
G93	Inverse Time Feed Mode	05
G94*	Feed Per Minute Mode	05
G95	Feed per Revolution	05
G98*	Canned Cycle Initial Point Return	10
G99	Canned Cycle R Plane Return	10
G100	Cancel Mirror Image	00
G101	Enable Mirror Image	00
G103	Limit Block Buffering	00
G107	Cylindrical Mapping	00
G110-G129	Coordinate System #7 - #26	12
G136	Automatic Work Offset Center Measurement	00
G141	3D+ Cutter Compensation	07
G143	5-Axis Tool Length Compensation +	08
G150	General Purpose Pocket Milling	00
G153	5-Axis High Speed Peck Drilling Canned Cycle	09
G154	Select Work Coordinates P1-P99	12
G155	5-Axis Reverse Tap Canned Cycle	09
G161	5-Axis Drill Canned Cycle	09
G162	5-Axis Spot Drill Canned Cycle	09
G163	5-Axis Normal Peck Drilling Canned Cycle	09
G164	5-Axis Tapping Canned Cycle	09
G165	5-Axis Boring Canned Cycle	09
G166	5-Axis Bore and Stop Canned Cycle	09

* default

Code	Description	Group
G169	5-Axis Bore and Dwell Canned Cycle	09
G174	CCW Non-Vertical Rigid Tap	00
G184	CW Non-Vertical Rigid Tap	00
G187	Setting the Smoothness Level	00
G188	Get Program From PST	00
G234	Tool Center Point Control (TCPC)	08
G254	Dynamic Work Offset (DWO)	23
G255	Cancel Dynamic Work Offset (DWO)	23

To Zero the POS-OPER Display: This display is used for reference only. Each axis can be zeroed out independently, to then show its position relative to where you selected to zero that axis. To zero out a specific axis, press HAND JOG, and then press POSIT. When you Handle Jog the X, Y, or Z axis and then press ORIGIN, the axis that is selected will be zeroed. Or, you can press an X, Y, or Z letter key and then ORIGIN to zero that axis display. You can also press the X, Y, or Z key and enter a number (X2.125), then press ORIGIN to enter the number in that axis display.

M00	Stop Program
M01	Optional Program Stop
M02	Program End
M03	Spindle On Foward
M04	Spindle On Reverse
M05	Spindle Stop
M06	Tool Change
M07	Shower Coolant On
M08	Coolant On
M09	Coolant Off
M10	Engage 4th Axis Brake
M11	Release 4th Axis Brake
M12	Engage 5th Axis Brake
M13	Release 5th Axis Brake
M16	Tool Change
M18	Clamp APC Pallet and Close Door
M19	Orient Spindle
M21-M25	Optional User M Function with M-Fin
M29	Set Output Relay with M-Fin
M30	Program End and Reset
M31	Chip Conveyor Forward
M33	Chip Conveyor Stop
M34	Coolant Increment
M35	Coolant Decrement
M36	Pallet Part Ready
M39	Rotate Tool Turret
M41	Low Gear Override
M42	High Gear Override
M49	Set Status of Pallet
M51-M55	Set Optional User M-codes

When Setting 32 on a Haas machine is set to IGNORE, then all commands for turning coolant on or off will be ignored. The coolant can still be turned on and off manually with the COOLNT button.

M59	Set Output Relay
M61-M65	Clear Optional User M-codes
M69	Clear Output Relay
M73	Tool Air Blast (TAB) On
M74	Too Air Blast (TAB) Off
M75	Set G35 or G136 Reference Point
M78	Alarm if Skip Signal Found
M79	Alarm if Skip Signal Not Found
M80	Auto Door Open
M81	Auto Door Close
M82	Tool Unclamp
M83	Auto Air Gun On
M84	Auto Air Gun Off
M86	Tool Clamp
M88	Through-Spindle Coolant On
M89	Through-Spindle Coolant Off
M95	Sleep Mode
M96	Jump If No Input
M97	Local Sub-Program Call
M98	Sub-Program Call
M99	Sub-Program Return or Loop
M109	Interactive User Input
M130 / M131	Display Media / Cancel Display Media
M138 / M139	M138/M139 Spindle Speed Variation On/Off

Jog Keys: You can select an axis for jogging on a Haas by entering the axis letter on the input line and then pressing the HANDLE JOG button.

Code	Description	Group
G00*	Rapid Motion Positioning	01
G01	Linear Interpolation Motion	01
G02	CW Circular Interpolation Motion	01
G03	CCW Circular Interpolation Motion	01
G04	Dwell	00
G09	Exact Stop	00
G10	Set Offsets	00
G14	Secondary Spindle Swap	17
G15	Secondary Spindle Cancel	17
G17	XY Plane Selection	00
G18*	XZ Plane Selection	02
G19	YZ Plane Selection	02
G20	Select Inches	06
G21	Select Metric	06
G28	Return To Machine Zero Point	00
G29	Return From Reference Point	00
G31	Skip Function	00
G32	Thread Cutting	01
G40*	Tool Nose Compensation Cancel	07
G41	Tool Nose Compensation (TNC) Left	07
G42	Tool Nose Compensation (TNC) Right	07
G50	Spindle Speed Clamp	00
G50	Set Global Coordinate Offset FANUC	00
G52	Set Local Coordinate System FANUC	00
G53	Machine Coordinate Selection	00
G54*	Coordinate System #1 FANUC	12
G55	Coordinate System #2 FANUC	12
G56	Coordinate System #3 FANUC	12
G57	Coordinate System #4 FANUC	12
G58	Coordinate System #5 FANUC	12

* default

Code	Description	Group
G59	Coordinate System #6 FANUC	12
G61	Exact Stop Modal	15
G64*	Exact Stop Cancel G61	15
G65	Macro Subroutine Call Option	00
G70	Finishing Cycle	00
G71	O.D./I.D. Stock Removal Cycle	00
G72	End Face Stock Removal Cycle	00
G73	Irregular Path Stock Removal Cycle	00
G74	End Face Grooving Cycle	00
G75	O.D./I.D. Grooving Cycle	00
G76	Threading Cycle, Multiple Pass	00
G80*	Canned Cycle Cancel	09
G81	Drill Canned Cycle	09
G82	Spot Drill Canned Cycle	09
G83	Normal Peck Drilling Canned Cycle	09
G84	Tapping Canned Cycle	09
G85	Boring Canned Cycle	09
G86	Bore and Stop Canned Cycle	09
G89	Bore and Dwell Canned Cycle	09
G90	O.D./I.D. Turning Cycle	01
G92	Threading Cycle	01
G94	End Facing Cycle	01
G95	Live Tooling Rigid Tap (Face)	09
G96	Constant Surface Speed On	13
G97*	Constant Surface Speed Off	13
G98	Feed Per Minute	10
G99*	Feed Per Revolution	10
G100	Disable Mirror Image	00
G101	Enable Mirror Image	00
G103	Limit Block Lookahead	00

* default

Code	Description	Group
G105	Servo Bar Command	09
G110	Coordinate System #7	12
G111	Coordinate System #8	12
G112	XY to XC interpretation	04
G113	Cancel G112	04
G114-G129	Coordinate System #9 - #24	12
G154	Select Work Coordinates P1-99	12
G184	Reverse Tapping Canned Cycle For Left Hand Threads	09
G186	Reverse Live Tool Rigid Tap (For Left Hand Threads)	10
G187	Accuracy Control	00
G195	Forward Live Tool Radial Tapping (Diameter)	00
G196	Reverse Live Tool Radial Tapping (Diameter)	00
G198	Disengage Synchronous Spindle Control	00
G199	Engage Synchronous Spindle Control	00
G200	Index on the Fly	00
G211	Manual Tool Setting	
G212	Auto Tool Setting	
G241	Radial Drill Canned Cycle	09
G242	Radial Spot Drill Canned Cycle	09
G243	Radial Normal Peck Drilling Canned Cycle	09
G245	Radial Boring Canned Cycle	09
G246	Radial Bore and Stop Canned Cycle	09
G249	Radial Bore and Dwell Canned Cycle	09

M00	Stop Program
M01	Stop Program
M02	Program End
M03	Spindle On Foward
M04	Spindle On Reverse
M05	Spindle Stop
M08	Coolant On
M09	Coolant Off
M10	Chuck Clamp
M11	Chuck Unclamp
M12	Auto Jet Air Blast On (Optional)
M13	Auto Jet Air Blast Off (Optional)
M14	Main Spindle Brake On (Optional C-Axis)
M15	Main Spindle Brake Off (Optional C-Axis)
M17	Turret Rotation Fwd
M18	Turret Rotation Rev
M19	Orient Spindle (Optional)
M21	Tailstock Advance (Optional)
M22	Tailstock Retract (Optional)
M23	Chamfer Out of Thread On
M24	Chamfer Out of Thread Off
M30	End of Program and Reset
M31	Chip Auger Forward (Optional)
M33	Chip Auger Stop (Optional)
M36	Parts Catcher On (Optional)
M37	Parts Catcher Off (Optional)
M38	Spindle Speed Variation On
M39	Spindle Speed Variation Off
M41	Low Gear (Optional)
M42	High Gear (Optional)

M43	Turret Unlock (Service Use Only)
M44	Turret Lock (Service Use Only)
M51	User M Turn On (Optional)
M52	User M Turn On (Optional)
M53	User M Turn On (Optional)
M54	User M Turn On (Optional)
M55	User M Turn On (Optional)
M56	User M Turn On (Optional)
M57	User M Turn On (Optional)
M58	User M Turn On (Optional)
M59	Set Output Relay
M61	User M Turn Off (Optional)
M62	User M Turn Off (Optional)
M63	User M Turn Off (Optional)
M64	User M Turn Off (Optional)
M65	User M Turn Off (Optional)
M66	User M Turn Off (Optional)
M67	User M Turn Off (Optional)
M68	User M Turn Off (Optional)
M69	Clear Output Relay
M78	Alarm if Skip Signal Found
M79	Alarm if Skip Signal Not Found
M85	Automatic Door Open (Optional)
M86	Automatic Door Close (Optional)
M88	High-Pressure Coolant On (Optional)
M89	High-Pressure Coolant Off (Optional)
M95	Sleep Mode
M96	Jump If No Signal
M97	Local Subprogram Call
M98	Subprogram Call
M99	Subprogram Return Or Loop

M104	Probe Arm Extend (Optional)
M105	Probe Arm Retract (Optional)
M109	Interactive User Input
M110	Secondary Spindle Chuck Clamp (Optional)
M111	Secondary Spindle Chuck Unclamp (Optional)
M112	Secondary Spindle Air Blast On (Optional)
M113	Secondary Spindle Air Blast Off (Optional)
M114	Secondary Spindle Brake On (Optional)
M115	Secondary Spindle Brake Off (Optional)
M119	Secondary Spindle Orient (Optional)
M121	User M-codes (Optional)
M122	User M-codes (Optional)
M123	User M-codes (Optional)
M124	User M-codes (Optional)
M125	User M-codes (Optional)
M126	User M-codes (Optional)
M127	User M-codes (Optional)
M128	User M-codes (Optional)
M130 / M131	Display Media / Cancel Display Media
M133	Live Tool Fwd (Optional)
M134	Live Tool Rev (Optional)
M135	Live Tool Stop (Optional)
M138	Spindle Speed Variation On
M139	Spindle Speed Variation Off
M143	Secondary Spindle Forward (Optional)
M144	Secondary Spindle Reverse (Optional)
M145	Secondary Spindle Stop (Optional)
M154	C-Axis Engage (Optional)
M155	C-Axis Disengage (Optional)

°C = Degrees Celsius

DIA = Diameter

d = Depth of Cut

F = Feed in Inches or mm Per Minute (F)

°F = Degrees Fahrenheit

FPR = Feed Per Revolution (F)

FPT = Feed Per Tooth

IPM = Inches Per Minute

IPR = Inches Per Revolution

L = Length of Cut

MRR = Metal Removal Rate (cubic in./min.)

RPM = Revolutions Per Minute

SFM = Surface Feed Per Minute

SMPM = Surface Meters Per Minute

MMPR = Millimeters Per Revolution

T = Number of Teeth in a Cutter

TCm = Time Cutting in Minutes

TCs = Time Cutting in Seconds

TPI = Threads Per Inch

W = Width of Cut

Chip Conveyor - The chip conveyor on a Haas can be turned on or off when a program is running, either manually using the control keys or in the program using M-codes. The M-code equivalent to CHIP FWD is M31, and CHIP STOP is M33. You can set the Conveyor Cycle time (in minutes) with Setting 114, and the Conveyor On-Time (in minutes) with Setting 115.

Cutting Speed (surface feet/min.)
SFM = 0.262 x DIA x RPM

Revolutions Per Minute
RPM = 3.82 x SFM ÷ DIA

Feed Rate (in/min.)
IPM = FPT x T x RPM

Feed Per Revolution
FPR = IPM ÷ RPM

Feed Per Tooth (in)
FPT = IPM ÷ (RPM x T)

Metal Removal Rate
MRR = W x d x F

Converting IPR to IPM
IPM = IPR x RPM

Converting IPM to IPR
IPR = IPM ÷ RPM

Converting SFM to SMPM
SMPM = SFM x .3048

Converting IPR to MMPR
MMPR = IPR x 25.40

Distance over Time (in minutes)
L = IPM x TCm

Time Cutting over Distance (Mill) (minutes)
TCm = L ÷ IPM

Time Cutting over Distance (Mill) (seconds)
TCs = L ÷ IPM x 60

INCH METRIC CONVERSION

mm x 0.03937 = in.	in. x 25.4 = mm
m x 39.37 = in.	in. x 0.0254 = m
m x 3.2808 = ft	ft x 0.3048 = m
m x 1.0936 = yd	yd x 0.9144 = m
km x 0.621 = mi	mi x 1.6093 = km
Celsius to Fahrenheit (˚C x 1.8) + 32 = ˚F	Fahrenheit to Celsius (˚F - 32) ÷ 1.8 = ˚C

INCH TAPS

Tap Drill Size (inch) = Thread Diameter – $\frac{0.01299 \times \%\text{ of Full Thread}}{\text{Number of TPI}}$

% of Full Thread (inch) = Number of TPI x $\frac{\text{Major DIA of Thread} - \text{Drilled DIA}}{0.01299}$

IPM (Mill Tapping Feed Rate) = RPM ÷ TPI

IPR (Lathe Threading) = 1 ÷ TPI

Form Tap Drill Size = Basic Tap DIA – $\frac{0.0068 \times \%\text{ of Full Thread}}{\text{Number of TPI}}$

Recommended 65% form thread:

Form Tap Drill Size = Basic Tap DIA – $\frac{0.442}{\text{Number of TPI}}$

METRIC TAPS

Tap Drill Size (metric) = Thread Diameter (mm) – $\frac{\%\text{ of Full Thread} \times \text{MM Pitch}}{147.06}$

% of Full Thread (metric) = $\frac{147.06}{\text{MM Pitch}} \times [\text{Thread DIA (mm)} - \text{Drilled Hole DIA (mm)}]$

SMPM = RPM x Metric Pitch

Recommended 65% form thread:

Form Tap Drill Size (metric) = Basic Tap DIA – (.75 x pitch (in metric) x .65)

FIND TAP DRILL SIZES ON ANY BASIC SIZE THREAD

for an Approximate 75% Thread

NC/NF INCH & ISO METRIC

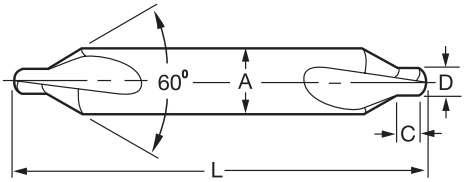
Major dia. less thread pitch = Tap drill size

Note: thread pitch = 1.0 inch divided by threads per inch (TPI)

Inch Example:
(1 ÷ 16 = .0625)
3/8 – 16 = .375 – .0625 = .3125 tap drill

Metric Example:
M10 – 1.5 = 10 – 1.5 = M8.5 tap drill

STANDARD 60° CENTERDRILL



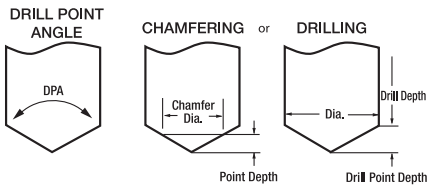
Size	Body Dia (A)	Drill Dia (D)	Drill Length (C)	OAL (L)
00	1/8	0.025	0.030	1 1/8
0	1/8	1/32	0.038	1 1/8
1	1/8	3/64	3/64	1 1/4
2	3/16	5/64	5/64	1 7/8
3	1/4	7/64	7/64	2
4	5/16	1/8	1/8	2 1/8
5	7/16	3/16	3/16	2 3/4
6	1/2	7/32	7/32	3
7	5/8	1/4	1/4	3 1/4
8	3/4	5/16	5/16	3 1/2

To calculate drill tip depth for a chamfer diameter, or drill point depth for a required drilling depth:

Drill Point Angle (DPA)	Factor
60˚	0.866 x Dia. = Point Depth
82˚	0.575 x Dia. = Point Depth
90˚	0.500 x Dia. = Point Depth
118˚	0.300 x Dia. = Point Depth
120˚	0.288 x Dia. = Point Depth
135˚	0.207 x Dia. = Point Depth

Example: To calculate for a 118-degree drill tip depth, multiply the dia. by 0.3

i.e., 0.250 drill diameter x .3 = 0.075 drill tip depth



CONVERT MINUTES OF A DEGREE TO A DECIMAL:

Divide minutes by 60

degree minutes to convert:	30° 42'
divide minutes by 60:	42 ÷ 60 = 0.7
bring down degrees:	30.7°

CONVERT MINUTES AND SECONDS TO DECIMAL:

Divide seconds, then minutes by 60

degree minutes and seconds to convert:	30° 41' 15"
divide seconds by 60:	15 ÷ 60 = 0.25
divide decimal minutes by 60:	41.25 ÷ 60 = 0.6875
bring down degrees:	30.6875°

CONVERT A DECIMAL DEGREE TO MINUTES:

Multiply decimal by 60

decimal degree to convert:	30.7°
multiply decimal degree by 60:	0.7 x 60 = 42'
bring down degrees:	30° 42'

CONVERT DECIMAL TO MINUTES AND SECONDS:

Multiply decimal by 60

decimal degree to convert:	30.6875°
multiply the degree decimal by 60:	0.6875 x 60 = 41.25'
multiply decimal minutes by 60:	0.25 x 60 = 15"
bring down degrees:	30° 41' 15"

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