CNC Turning

Contest Location	▪ C-Hall
Eligibility	▪ Please refer to the National Technical Standards for this contest. ▪ Schools may send one competitor or team for every 50 paid SkillsUSA members based on local competition enrolled in a program where the scope of the contest described in the SkillsUSA Technical Content Standards reflects a major component of the program. ▪ REGIONAL QUALIFIER - ONLY THE TOP 3 (THREE) FROM REGIONAL COMPETITION PROCEED TO STATE CHAMPIONSHIPS
Clothing	Work/School Attire: School uniform with all identifying logos/markers covered. Field specific work clothing required for the work environment or that matches the service conditions for the contest. This may include jeans if they are clean and professional looking and are accepted in the respective field (no holes or overly soiled pants). Work shoes or boots with hard sole or anti-slip properties (steel toes may be required-refer to **Provided by Contestant** section below). Clothing should be as such that it will not get caught in moving equipment or power tools. School uniforms may be worn if they meet the above requirements with all identifiers covered.
Testing	▪ Students should be prepared to take a written knowledge test for this contest. ▪ Students should also be prepared to take a SkillsUSA written knowledge test (required for all contestants).
Provided by Contestant **(Tool List)**	▪ Contestants will be required to bring their own Haas Simulator or Laptop, or computer with access to text editor i.e., Note pad or Word Pad ▪ (Required)Pen or pencil for notes, or written calculations. ▪ (Optional)Basic calculator ▪ NEW FOR 2023 PRESENTATION (Required) Part manufactured at contestant's facility by using CAM software. Presentation should contain the actual part, NC Program, Set up sheet and a process plan.

Special Notes	▪ Exhibit Halls do not open to observers until 12:00pm. ▪ No smart watches, earbuds and/or phones are permitted during the contest and/or in contest ▪ No contact with anyone outside of the contest area once the contest begins ▪ No inappropriate communication between contestants such as verbally degrading another contest ▪ No cheating on any portion of the contest such as informing another contestant of the skills/test prior to competing.
National Technical Standards	▪ Please refer to the 2022-2023 National Technical Standards for all contests. Any and all standards included may be tested in any competition. ▪ In conjunction with National Standards, violations may result in student loss of contest.
Resume	▪ All SkillsUSA Ohio State Championship Contest will require a short interview component. Students should be prepared with basic job interview skills. ▪ All contestants must have a hard copy of a one (1) page personal resume.

Haas Automation is a sponsor of the 2023 SkillsUSA CNC Machining Competitions. We are committed to providing materials for Regional and State competitions throughout the United States for the 2023 CNC Machining Competitions.

In addition, we are providing a list of resources to help prepare students to enter the CNC Machining competitions, and the workforce of our industry, feeling well-equipped for success. For resources, please see the following pages, or visit our website at haascnc.com.

For Regional- and State-level SkillsUSA testing materials, please contact your local Haas Factory Outlet distributor, or the SkillsUSA State Director in your state.

About the Competition:

Regional, and State-level CNC Milling Specialist, CNC Turning Specialist and CNC Technician competitions will test three major skills areas (1) a CNC theory test, (2) G&M code programming, and(3) CAD/CAM proficiency.

CNC Theory Test:

The CNC theory test is set of multiple-choice questions closely related to the CNC subject area of focus for the competition, i.e. milling, or turning. Competitors must select the best answer that applies, reading each question carefully before selecting an answer. Contestant numbers must be written on the test in the space provided on each page, or the competitor will receive 0 points.

Programming:

The g & m code programming test will provide competitors with access to a part drawing, operation sheet, tooling list and an NC code template file. The NC code template file is incomplete, and it is the competitor's job to use the provided documents to complete this NC code file so that if run, the program would produce a machined part that is accurate to the part drawing provided. The drawing will be complete with multiple views making it easy for competitors to visualize the part and understand its geometry. The operation sheet will provide a sequence for each operation as well as basic tooling information and instruction. Contestant numbers must be written within the NC Code file, as well as within the document name when saving. If this step is missed, the competitor will receive 0 points. Remember, save early, save often.

Competitors will be provided with all testing documents mentioned above, but competitors must provide the following items in order to successfully compete.

- (Required) Laptop, or computer with access to text editor i.e. Notepad or Word Pad
- (Required) Pen or pencil for notes, or written calculations
- (Optional) Basic calculator

NOTE: Judges have access to a theory test key, a working copy of the NC Code file and a programming score card each which can be used to calculate the appropriate points for the SkillsUSA State Score Card.

Recommended Competitor Preparation

Set yourself up for success by committing to continuous learning. Haas Automation, and other supporting partners, offer an array of opportunities for everyone to learn about principles of CNC machining practice. Get ahead by preparing yourself as a competitor, before and after competitions.

Haas Certification Program

These online courses are designed to provide the basic knowledge necessary to get started as a CNC machine operator or CNC machinist. They offer an introduction to basic CNC machine operation, proper machine safety, and fundamental machining processes. For more information, and to sign-up for the free online courses, visit: learn.haascnc.com

Haas Programming Workbooks

These programming workbooks provide the basic principles necessary to program Haas Mills, and Haas Lathes. Numerous exercises throughout the workbook enable users to build their skills at their own pace. Answer Books are also available. To download, visit the Haas Learning Resources webpage: https://www.haascnc.com/myhaas/Haas_Learning_Resources.htm

Haas Video Library

The Haas Video Library gives you access to thousands of videos recorded specifically to help Haas CNC users everywhere to grow their skills and understanding of CNC machining to maximize their abilities. Access videos directly from the Haas Video Library, via the Haas YouTube channel or using the Quick Picklist of the Haas Learning Resources page which organizes a handful of videos from entry- to advanced-level to help get you started. For the complete Video Library, visit: https://www.haascnc.com/video.html Or, for the shortened Quick Picklist, visit: https://www.haascnc.com/myhaas/Haas_Learning_Resources.html

CAM Programming Training

In 2022 the 5-Axis CNC Programmer competition is the only to require CAM. Various CAM partners provide access to software and video training programs. Please visit training partner's websites for more information at https://help.autodesk.com/view/fusion360/ENU/courses/ or https://university.mastercam.com/

Competitor Instruction:

Theory Test:

Add your contestant number in the space provided. If printed, add contestant number on each page. For each multiple-choice question, select the best answer that applies. Be sure to read each question carefully before selecting the answer. Write neatly. Make sure your contest number is on the test before submitting. Questions without an answer, receive 0 points.

Programming:

Open NC Code Template file, save the document with your contestant number in the name. Add your contestant number in the beginning of the program as a comment. Save again. Use the provided documents (print, setup sheet, operation sheet, etc.) to fill in the NC Code Template file for each missing, or incomplete operation. When done, check the entire code start to finish, and save. Competitor code should resemble a perfect program, which, if run on a machine would produce a machined part that is accurate to the print.

CAD/CAM:

Each student should first create a 3D model of the print given. After completing the model the student should use the model to create tool paths in the cam software of their choice. After successfully posting the code student should then create a tooling list, process plan, and a set up sheet. The student should then use all of the materiel that they have made to make the part on machines at their facility.

The student is to have the tooling list, process plan, set up sheet, nc program, and 3D model saved on a flash drive in a folder that is named their contestant number. Student should have the finished part with them as well on the day of the contest. The part is going to be inspected by the panel of judges.

Decimal Equiv.	Drill Size	mm	Tap Sizes	Decimal Equiv.	Drill Size	mm	Tap Sizes
.0059	97	0.150		.0320	67	0.813	
.0063	96	0.160		.0330	66	0.838	
.0067	95	0.170		.0350	65	0.889	
.0071	94	0.180		.0360	64	0.914	
.0075	93	0.191		.0370	63	0.940	
.0079	92	0.201		.0380	62	0.965	
.0083	91	0.211		.0390	61	0.991	
.0087	90	0.221		.0400	60	1.016	
.0091	89	0.231		.0410	59	1.041	
.0095	88	0.241		.0420	58	1.067	
.0100	87	0.254		.0430	57	1.092	
.0105	86	0.267		.0465	56	1.181	
.0110	85	0.279		.0469	$3/64$	1.191	#0-80
.0115	84	0.292		.0520	55	1.321	
.0120	83	0.305		.0550	54	1.397	
.0125	82	0.318		.0595	53	1.511	#1-64•#1-72
.0130	81	0.330		.0625	$1/16$	1.588	
.0135	80	0.343		.0635	52	1.613	
.0145	79	0.368		.0670	51	1.702	
.0156	$1/64$	0.397		.0700	50	1.778	#2-56•#2-64
.0160	78	0.406		.0730	49	1.854	
.0180	77	0.457		.0760	48	1.930	
.0200	76	0.508		.0781	$5/64$	1.984	
.0210	75	0.533		.0785	47	1.994	#3-48
.0225	74	0.572		.0810	46	2.057	
.0240	73	0.610		.0820	45	2.083	#3-56
.0250	72	0.635		.0860	44	2.184	
.0260	71	0.660		.0890	43	2.261	#4-40
.0280	70	0.711		.0935	42	2.375	#4-48
.0292	69	0.742		.0938	$3/32$	2.381	
.0310	68	0.787		.0960	41	2.438	
.0313	$1/32$	0.794		.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 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 Equiv.	Drill Size	mm	Tap Sizes	Decimal Equiv.	Drill Size	mm	Tap Sizes
.3020	N	7.671		.5625	$9/16$	14.288	$5/8$-18
.3125	$5/16$	7.938	$3/8$-16	.5781	$37/64$	14.684	$5/8$-24
.3160	O	8.026		.5938	$19/32$	15.081	
.3230	P	8.204		.6094	$39/64$	15.478	$11/16$-12
.3281	$21/64$	8.334		.6250	$5/8$	15.875	
.3320	Q	8.433	$3/8$-24	.6406	$41/64$	16.272	$11/16$-20•$11/16$-24
.3390	R	8.611		.6563	$21/32$	16.669	$3/4$-10
.3438	$11/32$	8.731	$3/8$-32	.6719	$43/64$	17.066	
.3480	S	8.839		.6875	$11/16$	17.462	$3/4$-16
.3580	T	9.093		.7031	$45/64$	17.859	$3/4$-20
.3594	$23/64$	9.128		.7188	$23/32$	18.256	
.3680	U	9.347	$7/16$-14	.7344	$47/64$	18.653	$13/16$-12
.3750	$3/8$	9.525		.7500	$3/4$	19.050	$13/16$-16
.3770	V	9.576		.7656	$49/64$	19.447	$13/16$-20•$7/8$-9
.3860	W	9.804		.7813	$25/32$	19.844	
.3906	$25/64$	9.922	$7/16$-20	.7969	$51/64$	20.241	$7/8$-14
.3970	X	10.084		.8125	$13/16$	20.637	
.4040	Y	10.262	$7/16$-28	.8281	$53/64$	21.034	$7/8$-20
.4063	$13/32$	10.319		.8438	$27/32$	21.431	
.4130	Z	10.490		.8594	$55/64$	21.828	$15/16$-12
.4219	$27/64$	10.716	$1/2$-13	.8750	$7/8$	22.225	$15/16$-16•1.0-8
.4375	$7/16$	11.113		.8906	$57/64$	22.622	$15/16$-20
.4531	$29/64$	11.509	$1/2$-20	.9063	$29/32$	23.019	
.4688	$15/32$	11.906	$1/2$-28	.9219	$59/64$	23.416	1.0-12
.4844	$31/64$	12.303	$9/16$-12	.9375	$15/16$	23.813	
.5000	$1/2$	12.700	$9/16$-18	.9531	$61/64$	24.209	1.0-20
.5156	$33/64$	13.097	$9/16$-24	.9688	$31/32$	24.606	
.5313	$17/32$	13.494	$5/8$-11	.9844	$63/64$	25.003	
.5469	$35/64$	13.891		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.

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

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

2.000
1.250
1.000
.500
.250
.250

A

B

1/4−20 UNC X .75
.201⌀X 1.0'
.280⌀45°

⌀.750 X2
⌀.550
R.100
R.125

⌀1.600
⌀1.370

1 3/4−12 UN−2A

30°X2
.100

DETAIL A

45°
.075

DETAIL B

Skills USA

HAAS AUTOMATION, INC.

APPROVALS	DATE
DRAWN Ernie Simmons	01−26−22
CHECKED	
ENGINEER	

State CNC Turning Competition

MATERIAL Aluminum	FINISH NONE	SIZE A	SCALE 1:1	DWG 2023−5	REV

A   B   C   D   E   F   G   H   J