Automated Manufacturing Technology

CONTEST DATE & LOCATION: Refer to the Kansas State Championship Conference Packet

PURPOSE: To evaluate each contestant's preparation for employment in automated manufacturing and the team approach to problem-solving work environment. To recognize outstanding students for excellence and professionalism in the field of automated manufacturing technology.

ELIGIBILITY: Team of three. Open to a team of three active SkillsUSA members enrolled in programs with precision machining, automated manufacturing, or CAD/CAM or CNC as the occupational objective.

CLOTHING REQUIREMENT: Unless the contest chair says otherwise, students are required to wear the Official SkillsUSA Kansas T-shirt and blue jeans (no tears, holes, or bagginess) clean and neat with appropriate shoes for contest or Official SkillsUSA white polo shirt with black dress slacks, black socks and black leather shoes.

** Safety glasses with side shields or goggles. (Prescription glasses can be used only if they are equipped with side shields. If not, they must be covered with goggles.)*

Official SkillsUSA khaki work shirt and pants attire

NOTE: The Official Kansas State T-shirt will be mailed to schools prior to the competition.

CONTEST UPDATES: *Follow the technical standards to prepare for this contest.*

Contact for link to Virtual Machining Software:

Cameron Collins

ccollins@depcollc.com

Contest Instructions Below-

2020 SKILLS KS CHAMPIONSHIP

AUTOMATED MANUFACTURING TECHNOLOGY COMPETITION

Updated 4/2020

Contents

Contest Overview

CAD, CAM, and CNC are the current manufacturing technologies that are making the United States competitive in the world market today. To remain competitive, companies worldwide must be able to access and apply current and emerging technologies in the Design and Manufacturing process. With today's complex designs and manufacturing problems, no one person can have all the answers, so it is imperative for manufacturers to combine the resources and abilities of a team to resolve problems. Workers in the field of Automated Manufacturing have found success in the team approach, and as it is our aim to emulate industry whenever possible, we will use the team approach in this competition. We suggest a team comprised of a specialist in each of the following fields: CAD, CAM, and CNC.

Rapid Prototype and Concurrent Engineering are two of the newest methods used by industry to reduce the time and cost of bringing a new product to market. Rapid Prototype is defined by its title how quickly you can make a prototype. Concurrent Engineering involves the designer and manufacturer working on the design of the product throughout the entire development of the product.

Statement of the Problem

As the Automated Manufacturing Technology team, your team is Pro Design, Incorporated. D&F Industries, Incorporated (hereafter referred to as The Client) has presented your team with a print of the part that they wish to have prototyped and manufactured.

The Client is dissatisfied with its old supplier, who uses manual machines; the part signatures have an unacceptable variance, quotations are not accurate, and the lead-time is unacceptable. Rapid prototyping and the ability to meet engineering changes at any point of the process are critically important. The Client wishes to find the best shop to have parts prototyped and manufactured. Your company will be competing for this lucrative contract with several other firms. The Team Leader is responsibility for communication between Pro Design, Incorporated and D&F Industries, Incorporated.

Instructions

Your assignment is as follows:

Rapid Prototype

The Client wishes to check the feasibility of a design and requests it to be machined from the provided prototyping material.

Your assignment is to establish a complete prototype process for manufacturing the part from a dimensional print. The client will verify the process by reviewing your CAD prints, your in process documentation, and a simulation run of your NC file using CNCMOTION software. The client requires that each stage of the CAD/CAM/CNC process be well documented, including a properly dimensioned CAD print. After you simulate the prototype and it has passed your internal quality control, you will submit it to the clients Quality Assurance Group. The Client has specified accuracy, finish, and the turn-around-time it takes to complete the process. All drawings should meet proper guidelines for engineering drawings.

Concurrent Engineering

The Client will review the prototype simulation and documentation and may require one or more changes. The Client requires quick updates to product design throughout the development process. The Client will require you to produce a CAD dimensioned print (right, front, and top views) and a pictorial view. The Client specifies dimensional accuracy, finish, and efficiency in part programming as the significant issues in this stage.

Guidelines

The client Engineering Project Manager has provided the base outline of the materials within this document to begin your planning and manufacturing process. Your success on this project is based upon the following criteria:

1. Providing complete documentation of the design.
2. Providing complete documentation of the process plan, tooling and setup.
3. Quality Assurance approval of any engineering changes.
4. Proper use of the technology for the preparation of product documentation, setups, design, and machining.
5. Packaging the complete project with accompanying documentation in an orderly, professional presentation.
6. Effective use of team work in managing this project.

7. Safety in the manufacturing process.
8. Efficient use of time, materials, and resources.

QA and Design Restrictions

Sample Model Part is considered perfect if it meets the following:

1. Hole Locations = + OR - .005"
2. Hole Diameter = + OR - .00250" on finished holes
3. Slot Dimension = + OR - .005"
4. Hole Depths = + OR - .010"
5. Slot and Shoulder Locations = + OR - .010"

Team Guidelines

1. The team is organized for primary responsibilities and duties.
2. There will be a team leader identified to interact with judges.
3. Your breaks are based upon team decisions with the exception of the mandatory lunch break.
4. Breaks are to be taken within assigned individual work areas.
5. Team members must notify a Technical Committee member or a judge before taking a bathroom break. Only one member of a team is allowed to leave the contest area at a time.
6. IN THE CASE OF A MACHINE FAILURE PROBLEM:
   The team leader will communicate the problem to a judge or technical committee member. The judge or technical committee member will notify the Project Manager and, if it is determined that it is in fact a machine problem, the running time clock may be stopped for that team. In the case of a stopped time clock, all work will stop for the entire team until the problem is resolved.
7. Choice of CAD and CAM software is the responsibility of the team. If your team develops a problem with your software, the clock will not be stopped. The Technical Committee will work in whatever way it can to resolve the problem. The software must be original copies.
8. You must create a separate file on your CAD system and transport it to your CAM system via a floppy disk or USB memory flash drive..

Official Competition

This is an officially sanctioned Skills USA competition. As a demonstration competition it was run for two years before being adopted by Skills USA in 1994

This competition is unique due to its three-member team concept and the intensive amount of hardware and software used.

Purpose

To evaluate each school's preparation of students for employment in the emerging arena of Automated Manufacturing and the Team approach to the problem solving work environment, and to recognize outstanding performance in the use of new work styles and technology by students and schools.

Clothing Requirement

White work pants (#240), white work shirt (#230), leather work shoes, (leather or canvas athletic shoes are not acceptable) and safety glasses with side shields or goggles in the designated areas. Prescription glasses can be used only if equipped with side shields. If not, they must be covered with goggles. Refer to general regulations for skills USA.

Eligibility

Open to active SKILLS members enrolled in programs with precision machining, automated manufacturing, or CAD/CAM or CNC as the occupational objective.

Scope of the Contest

Teams of three will demonstrate their ability to perform, exhibit, and compile skills and knowledge necessary from the following list of competencies determined by the AMT National Skills USA Technical Committee Members.

The teams will be provided with a dimensioned print to prototype. The team will ask the Client (Judges) to review the finished simulation of the prototype part and then the team will receive a change order. The team will make the necessary changes to the part program and produce a finished part.

A. **Performing Mathematical and Measurement Calculations**
   1. Measure work piece to the nearest .001 inch
   2. Calculate CNC speed and feeds
   3. Calculate stock utilization and setup
   4. Calculate tolerances

B. **Designing, Sketching, Planning Machine Work**
   1. Transfer information from drawing to CAD drawing
   2. Create CAD file for manufacturing
   3. Begin manufacturing documentation process
   4. Develop manufacturing process plan
   5. Plot CAD file prototype
   6. Export CAD file
   7. Process ECO (Engineering Change Order[s])
   8. Plot CAD drawing with ECO part

C. **Create Toolpath (CAM file), CNC Code**
   1. Create Process Plan (Job Plan)
   2. Read-in CAD export file
   3. Create toolpath
   4. Verify toolpath
   5. Create CNC code
   6. Send CNC code to machine tool
   7. Process ECO

D. **Perform CNC Machining Functions**

1. Verify toolpath
2. Setup part on mill
3. Set all offsets and tooling
4. Adjust speeds and feeds as needed
5. In-process Quality Assurance
6. Perform tool changes
7. Perform multiple machining operations in one setup
8. Verify (TQM) process and part
9. Process ECO

E. **Inspection of Part TQM Process**

1. Verify part to standards
2. Verify part to ECO standards
3. Document process

Group Organizational Goal

This is a group competition and team members may interact at will. It is our hope that the competition will run much like industry. The CAD operator will construct the part geometry, the CAM operator will generate the tool paths, and the CNC operator will do the setup and machine the part. We expect that when a group member has spare time he or she will help others in the group.

It is our hope that one person will not dominate a team. We do not want one person doing the CAD drawing, the CAM tool path and running the CNC machine while using the other members simply as support. We have taken this course to promote creativity in organization of production responsibility.

All group members are responsible for double-checking each other's work and quality control.

General Information

1. .
2. Teams must provide three computers, one of which must accept an Ethernet connection.
3. Each team will have licensed versions of CAD/CAM software.
4. Teams must consist of 3 members.
5. The Prototype and the finished part will be machined in a prototype material.

Goals

1. To have every team complete the contest.
2. To have each team member demonstrate reading and writing skills.
3. To have each team member use their critical thinking and problem solving abilities in the contest.
4. To have each team member illustrate responsibility, team work, and self-management skills.

Notebooks

Each team will be issued a notebook and information packet. This will be a 3-ring view binder that will allow the team to display a plot or print of their operation.

Required Materials

The teams will require the following materials at each workstation to complete the competition. The Technical Committee provides many of the required materials, but the teams must also bring certain items.

AMT Technical Committee Provides:.

- Part design
- Competition notebook
- Pencils
- Blank diskettes (thumb drives)

Teams Provide:

Three computers with licenses and software for CAD and CAM programs

Division of Duties

Process Documentation Notebook	*Possible Division of Duties*
CAD Department	**CAD Engineer**
Stage 1, Rapid Prototype Original print CAD dimensioned top and front view print system Stage 2, Finish Part Production Change order CAD dimensioned print (right, front, and top views) and pictorial view	All CAD system import and export Creating part geometry Exporting necessary geometry to CAM Dimensioning parts Plots Receive change order Communication of changes to team Update all CAD files All drawings should meet guidelines for Engineering drawings
CAM Department	**CAM Engineer**
Stage 1, Rapid Prototype Process documentation to include selection of tools, machining order, etc. Generate NC code Stage 2, Finish Part Production Develop new process plan Program new toolpath Generate NC code	All CAM system input and output Importing CAD geometry Creating tool paths Process sequencing Tool selection Creating NC code

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CNC Department

Stage 1, Rapid Prototype
Fixturing description
Tool description
Tool setup

Fixture and set-up
Stage 2, Finish Part Production
Finish part production

CNC Engineer

All CNC setup and operation
CNC control software input
Fixturing stock, tool offsets

Quality Control Department

Stage 1, Rapid Prototype
Part inspection sheet, all team members sign-off
All members check positions, tolerances, etc.

Stage 2, Finish Part Production
Part inspection sheet, all members sign
All members double-check work, clean-up

Quality Control

All Members

Suggested Automated Manufacturing Organizational Flow

I. RECEIVE THE PART DRAWING

A. CAD operator confers with the CAM operator and only draws what is necessary for the CAM operator to program a toolpath. Once that drawing is ready the drawing is transferred to the CAM operator.
B. CAM operator, after consulting with the CAD operator, consults with CNC operator and fills out the Job Sequence Plan, defining machining order, tool paths, tool definitions and sequencing.
C. CNC operator squares up the vise and CNC operator confers with the CAM operator on tool definition and sequencing. CNC operator sets and mounts selected tools in holders and sets tool length offsets in the CNC control software. CNC operator then sketches the fixture.

II. CAD OPERATOR TRANSFERS FILE TO CAM

A. CAD operator copies CAM transfer file to diskette to be transferred to CAM operator, then begins work on documenting the part with all necessary views.
B. CAM operator transfers in CAD file and double checks against Drawing. CAM operator begins programming tool paths and if necessary documents any changes to the Job Process Plan.
C. CNC operator helps either CAD or CAM operator, staying aware of CAM toolpath sequencing and tool changes. CNC operator could also study part for most efficient tool paths.

III. TRANSFER OF NC-CODE TO CNC MACHINE

A. CAD operator continues to document part and prints dimensioned CAD drawing.
B. CAM operator transfers NC-Code to CNC operator.
C. CNC operator loads program, runs simulation, sets touch off point, and then runs the program.

IV. PROTOTYPE COMPLETE, QUALITY CONTROL

A. Each team member inspects the part and fills out inspection sheet and if errors are found, they are documented and part is handed-in.

V. RECEIVE CHANGE ORDER

A. CAD operator revises CAD drawing and produces new-dimensioned drawings for plotting assurance.
B. CAM operator and CNC operator review change order and develop a new Job Process Plan, as deemed necessary.
C. CNC operator loads program, runs simulation, sets touch-off point, and then runs the program.

VI. MANUFACTURE FINISHED PART

A. CAD operator completes all part documentation and hard copies.
B. CAM operator assembles part documentation booklet and assists CAD and CNC operators.
C. CNC operator manufactures and inspects part.

VII. QUALITY CONTROL AND FINAL HAND-IN

A. CAD, CAM, and CNC operators complete part inspection, documentation, and cleanup work area.

SAFETY

The safety aspects are judged in this contest because in the real industrial environment safety is an economic business factor. The welfare of employees is in the best interest of any employer and employee to maintain the effectiveness and competitiveness of the company. Also, the safer a company is in its working environments the more cost effective the company is and the more likely to obtain superior insurance. In addition, workman compensation fees are reduced if the accident history of a company is good.

If during this contest a team or a team member violates a safety rule or operates their work cell in an unsafe condition the following rule will be in effect.

1st Violation:

Team will be issued a written warning.

2nd Violation

Team will have 50 points deducted from total score.

3rd Violation

Team will be disqualified.

Some safety issues:

1. Team members must keep their work area reasonably clean. Clean work places promote efficient and safe working conditions.
2. Team members must keep other team members and teams aware of possible dangerous situations, such as flying chips, noise, possible tool breakage, etc.
3. Safety guards must be in place and properly interlocked during machining or whenever the spindle is turning.
4. The emergency switch must be depressed during tool change operations.
5. Team members must wear safety glasses when they are in the proximity of the machine during setup as well as during actual machining.
6. Team members must use the spindle locking pin during any tool change.

SKILLS USA
AUTOMATED MANUFACTURING TECHNOLOGY
NOTEBOOK JUDGING FORM

	MAXIMUM POINTS	CHECK	POINTS AWARDED
CAD Rapid Prototype			
1. Dimensioned Print of Prototype, Hardcopy (top and front views)	170		
2. Prototype Contest Drawing	25		
CAD Subtotal	**195**		
CAM Rapid Prototype			
1. Process Plan Form	100		
CAM Subtotal	**100**		
CNC Rapid Prototype			
1. Fixturing Description Form	80		
2. Quality Assurance Form	50		
3. Virtual Verification	150		
4. Hand-In-Time	100		
CNC Subtotal	**380**		
Concurrent Engineering			
1. Engineering Change Order Drawing	25		
2. Process Plan Form	30		
3. CAD Drawing (top, front, side & pictorial), Hard Copy	70		
4. Surface Finish/Dimensional Accuracy	100		
5. Area Clean-up	50		
Concurrent Engineering Subtotal	**275**		

Math Problem	50		
Safety (deductions)			
GRAND TOTAL	**1000 pts**		

AUTOMATED MANUFACTURING TECHNOLOGY
RAPID PROTOTYPE

PROCESS PLAN

TEAM NUMBER _____ **CUSTOMER** _____

COMPLETED BY _____

DATE _____ **PART DUE DATE**

PART NAME _____

PART NUMBER _____ **CNC MACHINE** _____

BLANK SIZE _____ **MATERIAL** _____

Operation #	Operation Description	Tool #	Tool Description	Spindle Speed	Feed Rate	Plunge Rate

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NOTES

Possible Pts. 100 Total

Team #

AUTOMATED MANUFACTURING TECHNOLOGY
RAPID PROTOTYPE

FIXTURING DESCRIPTION

TEAM NUMBER _____ **CUSTOMER** _____

DRAWN BY _____ _____

DATE _____ **PART DUE DATE**

PART NAME _____

PART NUMBER _____

SKETCH FIXTURE WITH TOOL TOUCH-OFF INDICATED

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Possible Pts. 80 Total _____

Team #

_____

AUTOMATED MANUFACTURING TECHNOLOGY
RAPID PROTOTYPE

QUALITY ASSURANCE FORM

TEAM NUMBER _____ **CUSTOMER** _____

COMPLETED BY _____

DATE _____ **PART DUE DATE**

PART NAME _____

PART NUMBER _____ **CNC MACHINE** _____

BLANK SIZE _____ **MATERIAL** _____

Object # Errors	Object Description	Defined Tolerance	Met Tolerance		Amount Off	Finish	
			Yes No	No		Yes	

Identify errors on picture

NOTES

Possible Pts. 50

Total

Team#

AUTOMATED MANUFACTURING TECHNOLOGY
CONCURRENT ENGINEERING

PROCESS PLAN

TEAM NUMBER _____ **CUSTOMER** _____

COMPLETED BY _____

DATE _____ **PART DUE DATE**

PART NAME _____

PART NUMBER _____ **CNC MACHINE** _____

BLANK SIZE _____ **MATERIAL** _____

Operation #	Operation Description	Tool #	Tool Description	Spindle Speed	Feed Rate	Plunge Rate

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NOTES

Possible Pts. 30

Total

Team #