2018 SKILLS USA CHAMPIONSHIP

AUTOMATED MANUFACTURING TECHNOLOGY COMPETITION

This is a sample of what is expected. For a State level competition, the Tech Committee would need to review modify or alter the material in this example based on time resources available.

1: Contest Overview

1.1: Cutting-edge Technology

Current advances in manufacturing technologies such as CAD, CAM, and CNC, have allowed the United States to remain competitive within the global market. To compete in this evolving field, companies worldwide must remain at the forefront of both current and emerging technologies in design and manufacturing. With today's complex design and manufacturing challenges, no individual is equipped with all the answers, so it is imperative for manufacturers to combine the resources and abilities of a team to resolve problems.

1.2: Your Team

Success in Automated Manufacturing is often found using a team approach. In the interest of emulating industry, this competition will be structured in this manner. For optimum team efficiency, we suggest your team be comprised of a specialist in each of the following fields:

- Computer Aided Design (CAD)
- Computer Aided Manufacturing (CAM)
- Computer Numeric Control (CNC)

1.3: Cost Reduction

Rapid Prototyping and Concurrent Engineering are two of the most efficient methods used by industry to reduce the time and cost of bringing a new product from concept to market. Rapid Prototyping is simply the development of a prototype as quickly as possible. Concurrent Engineering is the pairing of the designer with the manufacturer to simultaneously work on the design of the product throughout the development of the product in its entirety.

1.1: Statement of the Problem

1.1.1: The Client's Needs

D&J Industries, Incorporated (hereafter referred to as The Client) is dissatisfied with its old supplier. They used manual machines causing the part signatures to have an unacceptable variance, their quotations were inaccurate, and their lead-time was unacceptable.

It is critically important that The Client locate a firm able to rapid prototype and meet engineering changes at any point of the prototyping process. The Client wishes to find the best shop to have the 4 cavity cap mold prototyped and manufactured.

As an Automated Manufacturing Technology team, known as Pro Design, Incorporated, your company will be competing for this lucrative contract against several other firms.

1.1.2: Your Assignment

Pro Design has been presented with a sample part drawing that the Client wishes to have mass produced. Your team will need to prototype the 4 cavity cap mold, incorporate any changes that the client might make, then manufacture the final assembly.

Pro Design's Team Leader is responsible for communication between your company and D&J Industries, Incorporated.

1.2: Instructions

1.2.1: Rapid Prototype

The Client is a manufacturing plant that needs a new product designed and created. Currently, the only information they can supply is a rough concept and drawing for the 4 cavity cap mold. This assembly is made up of three pieces, and the prototype material (Ren board-440) will be provided by the client. Your team's job is to machine this assembly prototype.

The Client requires that each stage of the CAD/CAM/CNC process be well documented, including a properly dimensioned CAD print for each of the components. All drawings should meet proper guidelines for engineering drawings.

After your prototype has been cut and has passed your internal quality control, you will submit it to The Client's Quality Assurance Group. The Client has specified accuracy, finish, and the turn-around-time it takes to complete the process.

1.2.2: Concurrent Engineering

The Client will review the prototype and may require one or more changes. The Client requires quick updates to product design throughout the development process. Significant issues in this stage are The Client's specified dimensional accuracy, finish, and efficiency in part programming.

1.3: Guidelines

1.3.1: Requirements

The Client's Engineering Project Manager has provided an outline of materials to begin your planning and manufacturing process. Your success on this project is based upon the following criteria:

1. Provide complete documentation of your design.
2. Provide complete documentation of process plan, tooling and setup.
3. Provide Quality Assurance on all parts.
4. Use the technology in preparation of documentation, setups, design, and machining properly.
5. Package completed project with accompanying documentation in an orderly, professional presentation.
6. Use team work in project management effectively.
7. Take safety precautions in the manufacturing process.
8. Use time, materials, and resources effectively.

1.4: QA and Design Restrictions

1.4.1: Tolerances

The prototype parts are considered perfect if their measurements are within the following tolerances:

1. Hole Locations = + OR - .005"
2. Hole Diameter = + OR - .003" on finished holes
3. Slot Dimension = + OR - .005"
4. Hole Depths = + OR - .003"
5. Slot and Shoulder Locations = + OR - .005"

1.5: Team Guidelines

1.5.1: Production Guidelines

Your team should follow these guidelines:

1. Primary responsibilities and duties are organized.
2. A team leader is identified to interact with Technical Committee representatives.
3. Your team decides upon appropriate break times 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 representative before taking a bathroom break. Only one team member is allowed to leave the contest area at a time.
6. You must create a separate file of your CAD drawing on your CAD computer and transport it to your CAM computer via floppy disk or USB memory stick.

1.5.2: Equipment Malfunctions

IN THE CASE OF A MACHINE FAILURE: The team leader will communicate the problem to a representative of the Technical Committee. The representative will then notify the Project Manager.
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.

IN THE CASE OF SOFTWARE PROBLEMS: The choice of CAD and CAM software is the responsibility of the team. All software must be original copies. If your team develops a problem with your software, the Technical Committee will work in whatever way it can to resolve the problem but the clock will not be stopped.

2: Purpose

2.1.1: Goals of the Competition

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

2.1: Scope of Contest

2.1.1: Teams and Documentation

1. Teams MUST be composed of three members. Teams will demonstrate their ability to perform, utilize skills and knowledge necessary to complete the project as presented to them by the Technical Committee.

2. Your team is presented with a dimensioned drawing(s) of a part(s) to prototype. When you finish machining the prototype part(s) you will present it to The Client (judges). At this time you will be presented with a new drawing(s); either a change order or an additional part(s) request.

3. Each team will be issued a notebook. This will include all of the necessary information and forms to complete the project. These forms will not be highly specific but will coach the teams. All forms and drawings must be turned in to the judges at the end of the competition.

2.2: Group Organizational Goal

2.2.1: Team Dynamics

The competition should run much like you would expect from industry; with group members interacting at will. The CAD operator will construct the part geometry, the CAM operator will generate the toolpaths, and the CNC operator will do the setup and machine the part.

The contest is designed to promote creativity in organization of production responsibility. Teams should divide duties among all team members. No one individual should dominate by taking responsibility for more than one project specialty. When a team member has spare time, they will help their teammates. All Team members are responsible for double-checking each other's work and quality control.

2.3: General Information

2.3.1: Necessities

The following items are required to compete in this contest:

1. Intelitek's Benchmill 6100 series CNC milling machines and tooling will be provided.
2. Teams must provide two computers, one of which must accept a Ethernet connection.
3. Each team will have licensed versions of CAD/CAM software.
4. Each team will provide a 6" dial or digital Vernier caliper.
5. Dial indicator (i.e. Starrett Last Word Dial Test Indicator, must have 3/8" holding shank)
6. a calculator
7. 6" or 12" steel rule
8. soft face hammer.
9. The Prototype and the finished part will be machined in a prototype material.
10. Each team can provide 3/8 edge finder.
11. Each team can provide a set of parallels.
12. Each team can provide appropriate sized end mills.
13. Each team must provide a machinist handbook.

2.4: Goals

2.4.1: Team Objectives

1. To have every team complete the competition.
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, teamwork, self-management skills, and professionalism.

2.5: Notebook

2.5.1: Supplied Documentation

Each team is issued this notebook and information packet. This will allow the team to display a plot or print of their operation. Required documentation is also included.

2.6: Required Materials

2.6.1: Workstation Components

Teams require the following materials to complete the competition. The Technical Committee provides many of these materials, but the teams must also bring certain items.

AMT Technical Committee provides:

intelitek's Benchmill 6100 CNC Machining Center with:

- Machinist vise
- Hold-downs and clamps
- Tool holders
- Jog wheel

Part(s) design.
Competition notebook.
Pencils.
Prototype Material for machining.
Information and furnishings for judges and technical committee.

2.7.2: Team Provided Components

Teams provide:

Two computers:

- One computer loaded with CAD software for CAD program.
- One computer loaded with software for CAM program. This computer MUST have an open LAN Port (ethenet connection)

Licensed versions of the above CAD and CAM software must be available at start of the orientation/practice session on Tuesday for loading onto the technical committee's computer(s).

One six inch dial or digital vernier caliper.

One dial indicator (example: L.S. Starrett Last Word dial test indicator)
Dial indicator MUST have 3/8" holding shank to fit into tool holder supplied by Technical Committee.
One calculator.
One set of parallels (multiple heights).
One soft-face hammer
One 6" or 12" steel rule.
Each team can provide 3/8 edge finder.
Each team must provide a machinist handbook.
Each team can provide appropriate size end mills.
Two USB memory storage devises (with your team number clearly marked on it)

Note: ONLY the above listed items will be allowed in the contest area during the competition.

2.8: Suggested Organizational Flow

2.8.1: RECEIVE THE PART DRAWING

A. CAD operator confers with the CAM operator and draws only 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 the 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 the CNC operator confers with the CAM operator on tool definition and sequencing. The CNC operator sets and mounts selected tools in holders and sets tool length offsets in the CNC control software. The CNC operator then sketches the fixture.

2.8.2 : CAD OPERATOR TRANSFERS FILE TO CAM

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

2.9 : TRANSFER OF NC-CODE TO CNC MACHINE

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

2.10 : PROTOTYPE COMPLETE, QUALITY CONTROL

A. Each team member inspects the part and fills out inspection sheet. If errors are found, they are documented and the part is submitted.

2.11 : RECEIVE CHANGE ORDER

A. CAD operator revises CAD drawing and produces new-dimensioned drawings for plotting assurance.

B. CAM operator and the CNC operator review the change order and develop a new Job Process Plan, as deemed necessary.
C. CNC operator loads the program, runs a simulation, sets the touch-off point, and then runs the program.

2.12 : 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.

2.12.1: QUALITY CONTROL AND FINAL HAND-IN

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

3: Safety

3.1: Importance of Safety

To maintain an effective and competitive company, it is in the best interest of both employer and employee to maintain a safe work environment. When a company's history of incidents resulting in injury is minimal, the company increases its likelihood of reduced insurance rates and workman compensation fees.

Safety considerations are taken into account during judging to further replicate a professional industrial environment.

3.2: Safety Violations

If a team or a team member violates a safety rule, or operates their work cell in an unsafe manner, the following penalties will be enforced:

1st Violation:
Team will be issued a written warning.

2nd Violation
Team will have 50 points deducted from their total score.

3rd Violation
Team will be disqualified.

3.3: Avoiding Safety Hazards

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 their teammates and other 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 and when the spindle is turning.
4. Team members must wear safety glasses when they are in the proximity of the machine during setup as well as during machining.
5. Spindle must NOT be in motion during a tool change.
6. Tampering with or dismantling of any part of the supporting equipment (ie: computers, printers, ect.) is a direct safety violation, and can be grounds for immediate disqualification.

4: Additional Forms

4.1: Document Submission

The following documentation must be prepared by teams for judging. These sheets are included on the following pages of this team information packet:

- Notebook Judging Form
- Process Plan
- Fixturing Description
- Quality Assurance
- Mathematics Problem
- Concurrent Engineering Process Plan

4.2: Judge Prepared Documentation

Judges will prepare the following documentation for each team:

- CAD Evaluation
- Surface Finish/ Dimensional Accuracy
- Hand-In Time Run
- Concurrent Engineering CAD Evaluation
- Concurrent Engineering Surface Finish/ Dimensional Accuracy
- Area Clean-Up
- Safety Violations (if applicable)

SKILLS USA
AUTOMATED MANUFACTURING TECHNOLOGY
NOTEBOOK JUDGING FORM 2018

	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. Surface Finish/Dimensional Accuracy	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
AMT Insert
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

NOTES _____

_____

_____

Possible Pts. 100 Total _____

Team # _____

AUTOMATED MANUFACTURING TECHNOLOGY
AMT Insert
FIXTURING DESCRIPTION

TEAM NUMBER _____ **CUSTOMER** _____

DRAWN BY _____

DATE _____ **PART DUE DATE**_____

PART NAME _____

PART NUMBER _____

SKETCH FIXTURE WITH TOOL TOUCH-OFF INDICATED

Possible Pts. 80 Total _____

Team # _____

AUTOMATED MANUFACTURING TECHNOLOGY
AMT Insert
QUALITY ASSURANCE FORM

TEAM NUMBER _____ **CUSTOMER** _____

COMPLETED BY _____

DATE _____ **PART DUE DATE** _____

PART NAME _____

PART NUMBER _____ **CNC MACHINE** _____

BLANK SIZE _____ **MATERIAL** _____

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

Identify errors on picture

NOTES _____

_____

_____
Signature

_____
Signature

_____
Signature

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

Possible Pts. 30 Total _____

Team # _____

Automated Manufacturing Technology
Math Problem
2018

Pro Design, Inc, a rapid prototyping and manufacturing organization, employs your team. The growth of the company can be attributed to the expertise within the organization to quickly respond and provide quality products to client organizations.

The research and development department has asked you to provide a prototype for a new game that has been designed by a new client. The client requires that you provide 100 prototypes of the game to be sent to 100 different sites throughout the United States for market testing. The client wishes to obtain the results of the market studies before investing in a mold that will be manufactured if the market studies show high demand for the game.

The game has a base, cover and 5 game pieces. The base and cover each require Ren Board that is 4"x 4" x 2" thick. The 5 game pieces require a 1 3/8" x 1 3/8" x 2" thick piece of Ren Board for each piece. The Ren Board is supplied in sheets measuring 48"x 48" x 2" each costing $100.00 per sheet.
NOTE: The math problems do not resemble the dimensions of your prototype parts, made in the AMT competition.
Please answer the following questions. Each question is worth 10 points.

1. How many prototype games does the client require?

2. Are you required to manufacture a mold?

3. How many square inches of Ren Board are in a sheet?

4. How many 4"x 4" x 2" pieces of Ren Board do you need to make the cover and the base?

5. How many 1 3/8"x 1 3/8" x 2" pieces of Ren Board do you need to make the game pieces for the prototypes required by the client?

6. How many sq. in. of Ren Board are required for the base?

7. How many sq. in. of Ren Board are required for the cover?

8. How many sq. in. of Ren Board is required to manufacture to 1 game piece?

9. How many sq. in. of Ren Board is required to manufacture all the game pieces required for client?

10. Assuming that you must purchase the Ren Board in full sheets will two sheets of Ren Board be enough to complete the job?