

Mechanical Design 3

Exam Information	Description
Exam number 663 Items 34 National Career Cluster Advanced Manufacturing Certification available Yes	The Mechanical Design 3 industry certification exam assesses the development of technical knowledge and skills to create working drawings and prototypes for the mechanical and industrial engineering industries. This includes evaluation of proficiency in the use of 3D modeling software, 3D prototyping, and understanding threads and fasteners, welding symbols, and assemblies. Please make sure candidates have access to CAD software while taking this certification.

Exam Blueprint and Performance Skills

Standard	Percentage of exam score
1. Portfolio and Resume*	4%
2. Fasteners*	27%
3. Welding Symbols*	13%
4. 3D Printing*	16%
5. Flat Pattern Development*	7%
6. Assembly and Working Drawings*	33%

*Includes performance skill evaluation

Standard 1 - Portfolio and Resume (4% of exam score)

Objective 1 A student's notebook/portfolio records:

1. the chronological account of all projects
2. research and citations
3. notes
4. sketches
5. test procedures and resulting data.

Objective 2 Resume and Cover Letter

Optional: Standard performance evaluations on the final page of this document

Standard 2 - Fasteners (27%)

3D modeling with dimensional and geometric size constraints

Objective 1 Define thread terminology.

1. Major Diameter
2. Minor Diameter
3. Pitch Diameter
4. Root
5. Flank Angle
6. Pitch
7. Angle
8. Crest
9. Flank

Objective 2 Identify the following thread types.

1. Unified
2. Acme
3. Pipe
4. Square

Objective 3 Know the common uses of the thread types in Objective 2.

Objective 4 Calculate thread pitch.

1. $TP = L/n$
 - a. TP = Thread Pitch
 - b. L = Length of thread
 - c. n = Number of threads

Objective 5 Understand thread callout notes.

Objective 6 Draw screw threads using these three methods:

1. Detailed
2. Schematic
3. Simplified

Objective 7 Compare common head types:

1. Round
2. Oval
3. Pan
4. Countersink
5. Hex

Objective 8 Compare common drive types:

1. Slotted
2. Philips
3. Square
4. Hexagonal

Objective 9 Understand the hardness grading system:

1. Metric
 - a. Class 8.8
 - b. Class 10.9
 - c. Class 12.9
2. SAE
 - a. Grade 2
 - b. Grade 5
 - c. Grade 8

Optional: Standard performance evaluations on the final page of this document

Standard 3 - Welding Symbols (13%)

Objective 1 Understand, identify and specify welds on drawings.

1. Type
2. Size and length
3. Finish & contour
4. Field welds
5. Basic welding processes

Optional: Standard performance evaluations on the final page of this document

Standard 4 - 3D Printing (16%)

Objective 1 Successfully prepare a 3D printing strategy using slicing software.

1. File Types
 - a. STL vs OBJ
 - b. G-Code
2. Layer Height
3. Infill
4. Base Supports
 - a. Raft
 - b. Brim
 - c. Skirt
5. Overhang Supports
 - a. Breakaway
 - b. Dissolvable

Objective 2 Identify each of the 3D printing materials and technologies.

1. FDM Fused Deposition Modeling (Filament)
2. SLA Stereolithography (Resin)

Objective 3 Understand commonly used 3D printing materials and their appropriate applications.

1. PLA
2. PETG
3. ABS
 - a. Filament
 - b. Resin
4. TPU

Objective 4 Identify the specific parts of a 3D printer.

1. Feeder
2. Extruder Assembly
3. Bed
 - a. Heated
 - b. Glass
 - c. Flexible
4. X,Y, & Z Axes
5. Print Envelope
6. Spool/Reservoir
7. Control Board
8. Power Supply
9. Guide Tube

Optional: Standard performance evaluations on the final page of this document

Standard 5 - Flat Pattern Development (7%)

Candidates will be able to demonstrate the ability to create a flat pattern development.

Objective 1 Understand and calculate bend allowance.

Optional: Standard performance evaluations on the final page of this document

Standard 6 - Dimensioning and Tolerancing (33%)

Candidates will create assembly and working drawings.

Objective 1 Develop a set of working drawings of six or more parts of industry assembled parts.

1. Draw all necessary views of each part.
2. Draw only one part per sheet.
3. Dimension parts as per current ASME/ANSI standards.
4. Apply appropriate tolerances.
5. Apply necessary notes, material specifications, symbols, and other data.
6. Complete a parts list of the parts, which include, parts number, manufacturer's name, manufacturer's stock number, material specs, quantity of each part, and notes for assembly.
7. Complete an assembly drawing showing the relationship of the parts to each other.
8. Analyze center of mass, surface area, and volume of an assembly.
9. Include title block and border on each production drawing sheet.

Optional: Standard performance evaluations on the final page of this document

Performance Skills Evaluation

Exam name: Mechanical Design 3

Candidate Name: _____

Performance assessments may be completed and evaluated any time before the certification is issued. The following performance skills can be used in connection with the associated standards and exam. The evaluator will function as the subject matter expert to determine if the candidate meets the skills requirements with a Yes/No for passing.

Standard 1 – Portfolio and Resume • Create and maintain a digital Portfolio of work (hard copy can be used if necessary). • Create a digital Resume and Cover Letter with professional formatting (hard copy can be used if necessary).	Pass:
Standard 2 – Fasteners • Candidates can correctly place and label fasteners in their mechanical models and drawings	Pass:
Standard 3 – Welding Symbols • Candidates can correctly place a weld symbol on a mechanical drawing	Pass:
Standard 4 – 3D Printing • A candidate will model, slice, and successfully print an object/prototype of their own design.	Pass:
Standard 5 – Flat Pattern Development • Create a flat pattern development of a simple part to be made from sheet metal.	Pass:
Standard 6 – Assembly and Working Drawings • A candidate can create parts and assembly drawings. They can analyze the center of mass, surface area, and volume.	Pass:

Evaluator Name:

Date:
