29.5 /30

CHECKSHEET FOR INITIALS ASSIGNMENT (HW6)

NAME: [redacted] SECTION #: 03

Part A. Pre-CAD Plan *(submit doc/docx AND pdf for preliminary grading on Day 7)*

10 /10

_1_ Ordered list of feature creation steps

1__ Indicate sketch plane and position/orientation of origin (show consistent xyz coordinate system in all 2D and 3D sketches)

_2_ Identification/depiction of basic 2D shapes (2 pts)

_1_ Identification of key dimensions (attempting to minimize these)

_2_ Identification of key supporting relations (use SolidWorks icons) (2 pts)

_1_ Depictions of how/where you will use reference geometry

Above and Beyond (Exemplary)

_1_ Exceptional organization and neatness

_1_ List/description of assumptions and potential roadblocks

__Other:_____

Deductions on 6A

___ No cover page (*-1*)

___ Not a doc (*-1*)

___ Incorrect filename (*-1*)

Use: *HW6A_firstname_lastname*

10 /10

Part B. Process Documentation

_1_ Appropriate use of curvature/angled geometry in 2D sketches

_2_ Clear visualization of relations (2 pts)

_1_ Thoughtful/purposeful use of reference geometry

_1_ Details/rationale on implementation of SW features

_1_ Annotated design tree

_1_ Completed part properties custom tab

_1_ Compelling lessons learned

Above and Beyond (Exemplary)

_1_ Exceptional organization and neatness

_1_ Sketches appear to be “powerful” (easily resized due to dimensions and relations)

__ Other:_____

9.5 /10

Part C. Products (based on finished model and drawing)

_2_ Fully-defined sketches (2 pts)

_1.5_ Sufficiently complex solid model (2 pts)
_1_ Enhancements to appearance of solid model
_1_ Use of ME drawing template
_1_ Multiple, non-redundant views in 3rd Angle orientation
_1_ 6 general dimensions (size/position of letters)

Above and Beyond (Exemplary)

_1_ Exceptional organization and neatness
_1_ Creative/complex design
__ Other: _____

Deductions on 6B and 6C

___ Not graded cover page from 6A submission (*-2*)
___ Not a .doc/.docx (*-2*)
___ Incorrect filename (*-2*)
Use: *HW6_firstname_lastname*

ME 301 INITIALS ASSIGNMENT

PURPOSE: 1) Gain experience with constraining non-straight-line sketch geometry. 2) Practice making 'powerful' sketches that can be easily resized by editing only a few dimensions.

INSTRUCTIONS: Draw your initials with a custom-designed font using minimum dimensions and maximum relations. Your initials should be made in 3 separate 'powerful' sketches that can be easily rescaled. Properly use the origin and define your sketch without using "fix". Next, make your initials "cool and 3D" using feature tools like extrude, shell, fillet, chamfer, wrap etc. Add personal touches like shading, texture, color, etc.

Turn in the following **Pre-CAD plan**:

Initial and/or simplifying assumptions; bulleted list of feature creation steps; 2-D hand drawings of each initial with construction lines, basic shapes, origin position/orientation, location of basic dimensions, and planned use of key sketch relations to create fully defined sketches; list of potential challenges.

Turn in the following **Process Documentation**:

Design journal (including sketches with relations and dimensions, discussion of your use of sketch tools, development of your extruded final product, annotated design tree, completed part file properties summary and custom tabs, and at least three lessons learned through the assignment). Capture and comment on your work at intermediate stages of development. **Note:** completed part properties for this assignment should include Author in the *Summary* tab, and Quantity, PartNo, Material, and Description in the *Custom* tab.

Turn in the following **Final Products**:

Fully-defined sketch(es) of your initials before extrusion.

Solid model showing details of your finished product in the display window. Use color screenshots in your word doc for a more impactful presentation.

Engineering drawing of your finished product (including shaded isometric view, non-redundant orthographic views, part properties, necessary and non-redundant dimensional annotations). Use the ME drawing template (3rd angle orientation and data exchanged between the part and drawing using part property information).

SUBMISSION SCHEDULE/INSTRUCTIONS:

Day	Files to Submit	Submission Instructions
7	Part A (.pdf AND .doc/.docx) 1. PDF (**no** checksheet needed) **AND** 2. DOC (**with** checksheet)	○ PDF: use Adobe scan (or similar) to scan your Pre-CAD plan. ○ DOC/DOCX: Take a screen snip (Snip & Sketch tool in Windows) of your scan and paste it into this Word document under section "*Pre-CAD Plan (1st Submission)".* ○ Those that receive <7/10 can resubmit for up to 8/10 at final submission ○ Those that receive >=7/10 can resubmit for up to 10/10 at final submission
9	Parts A-C (*.doc/.docx*) 1. Part A – 1st submission 2. Part A – 2nd submission (if needed 3. Part B 4. Part C	○ If you made changes to your Pre-CAD plan, re-scan, snip, and paste it into the Word document under section "*Pre-CAD Plan (2nd Submission)*". ○ If you are not re-submitting your pre-CAD for more points, simply remove the 2nd submission section. ○ In either case, include your 1st submission of Part A in the final submission.

Pre-CAD Plan (1st Submission)

Initial Assumptions:

I assume that the hardest part of this project will be drawing the intricate initials and fully defining them.

Bulleted Feature Creation Steps

1. **Sketch circle**
2. **Extrude circle**
3. **Cut circle into extrusion**
4. **Sketch initials on inset plane and fully define**
5. **Extrude initials back up to surface level**
6. **Add coin edge, fillets, and metal finish**

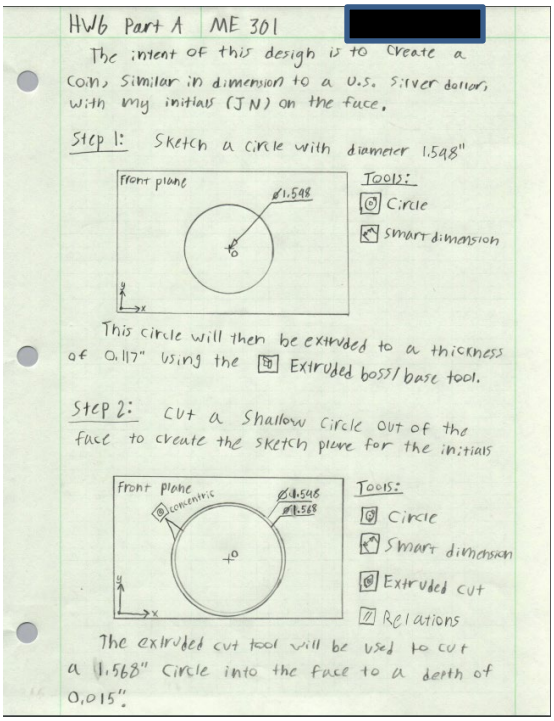
<u>More Details on Primary Features</u>

From Step (#): ***1*** *and 2*

Sketch Plane: Front Plane

3D Feature type: Sketch and boss

Key Feature Details (dimensions/end conditions): Initial circle with dimensions and secondary circle on boss face.

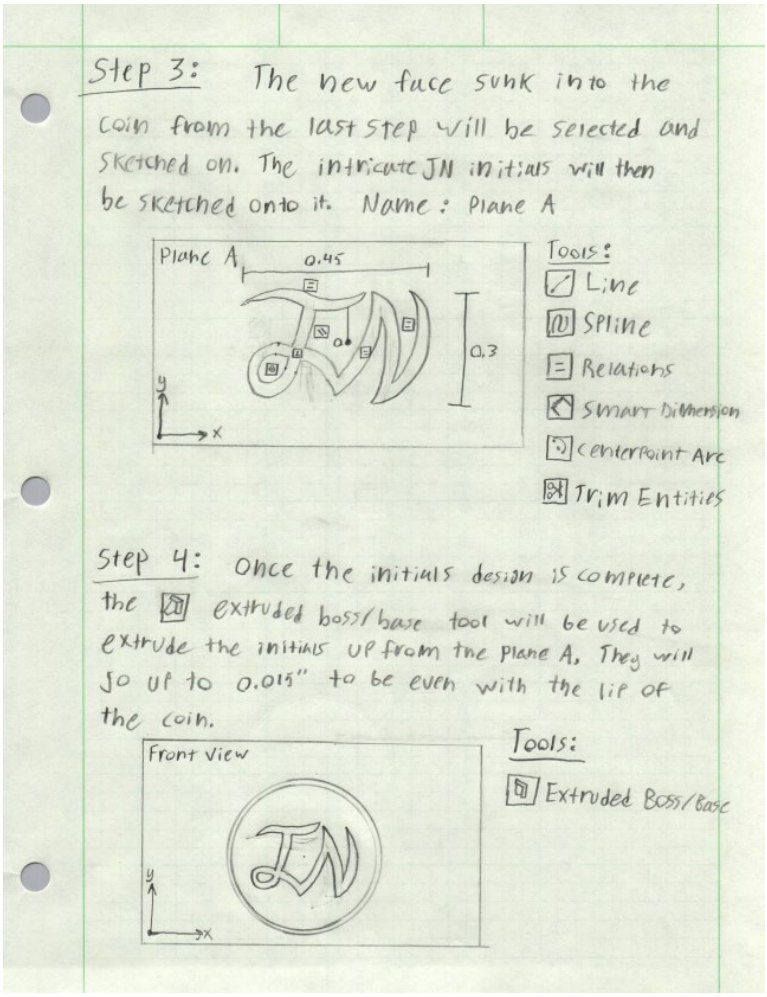


From Step (#): 3 and 4

Sketch Plane: A

3D Feature type: sketch and boss

Key Feature Details (dimensions/end conditions): Drawing the initials and fully defining them. They are then extruded back to the face height.

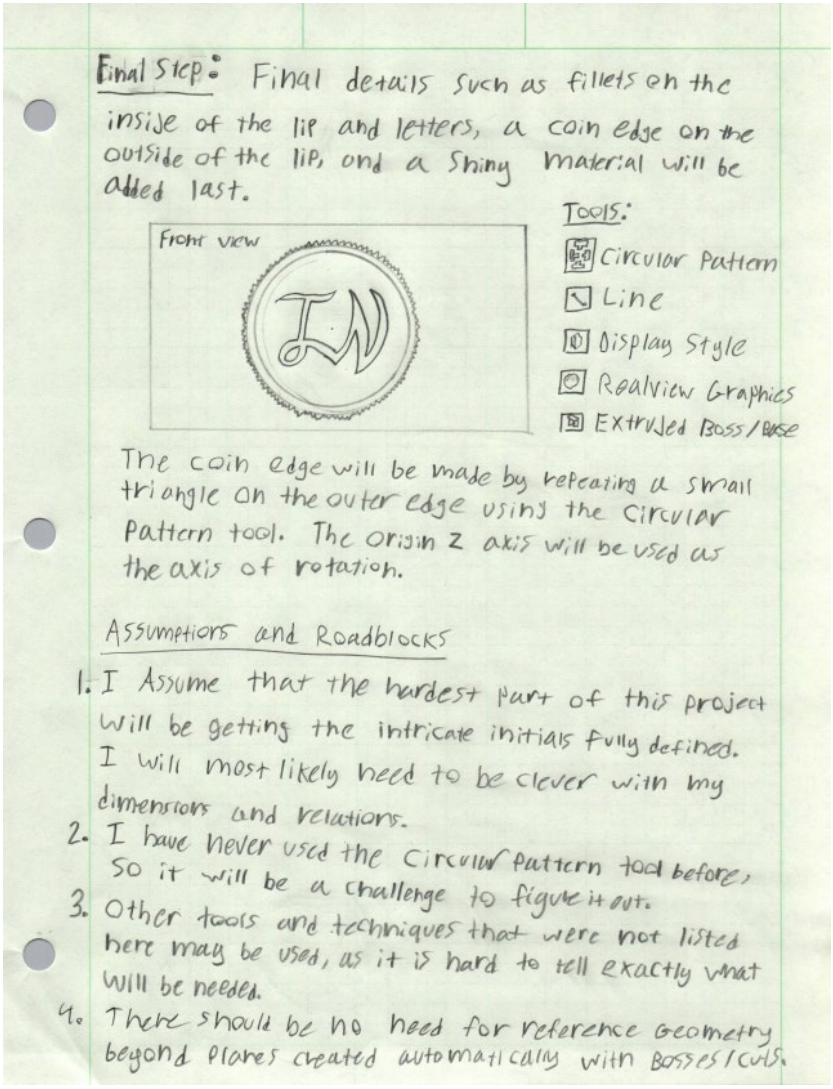


From Step (#): *5 (Final)*

Sketch Plane: Front

3D Feature type: Circular Pattern, fillet, and boss

Key Feature Details (dimensions/end conditions): Finishing details such as fillets, a coin edge, and a shiny material are added.



Final Step: Final details such as fillets on the inside of the lip and letters, a coin edge on the outside of the lip, and a shiny material will be added last.

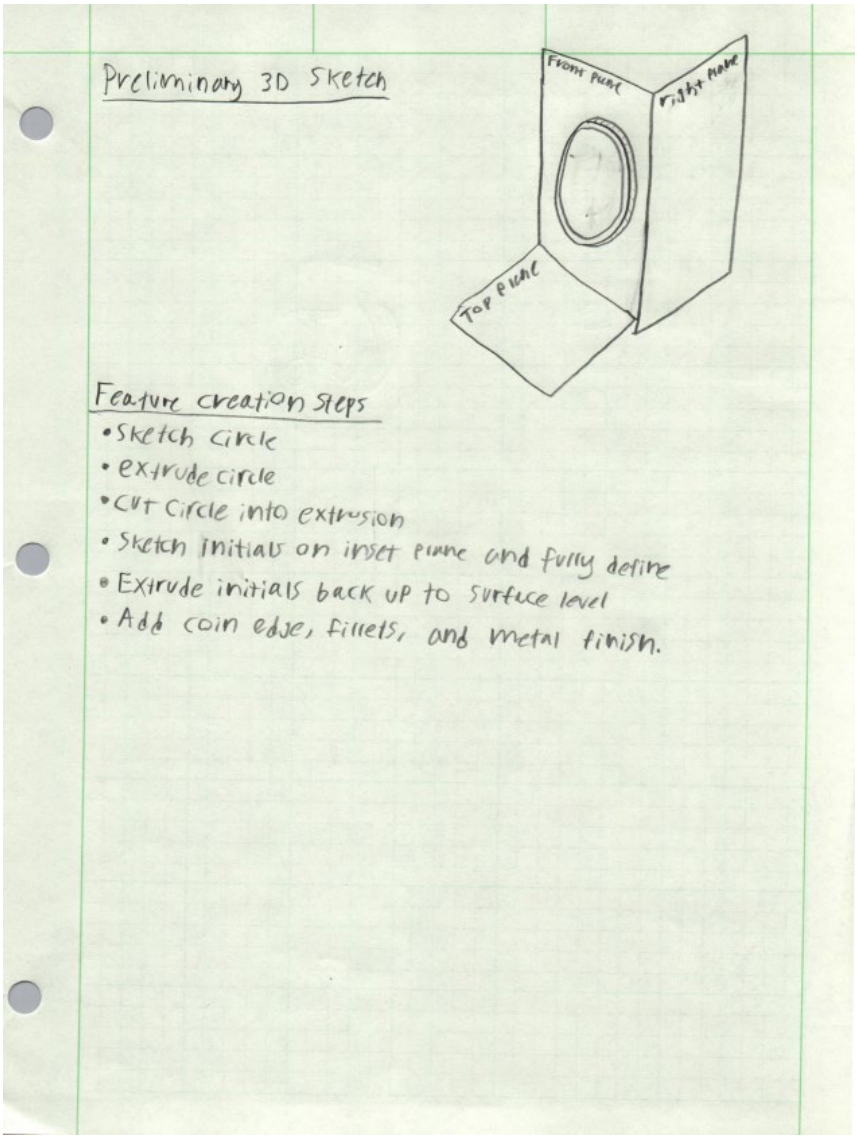
Front view

Tools:
- Circular Pattern
- Line
- Display Style
- Realview Graphics
- Extruded Boss/Base

The coin edge will be made by repeating a small triangle on the outer edge using the Circular Pattern tool. The origin z axis will be used as the axis of rotation.

Assumptions and Roadblocks

1. I Assume that the hardest part of this project will be getting the intricate initials fully defined. I will most likely need to be clever with my dimensions and relations.
2. I have never used the Circular Pattern tool before, so it will be a challenge to figure it out.
3. Other tools and techniques that were not listed here may be used, as it is hard to tell exactly what will be needed.
4. There should be no need for reference Geometry beyond Planes created automatically with Bosses/Cuts.



Potential Challenges:

- Learning to use the circular pattern tool
- Fully defining the initials sketch
- Properly documenting the process

Pre-CAD Plan (2nd Submission)

(This resubmission is an edited version of submission 1. Changes include:

- **New drawings of initials to reflect change in design.**
- **Addition of discussion and diagram of reference geometry used, as per the grading rubric. (End of page 4)**

Initial Assumptions:

I assume that the hardest part of this project will be drawing the intricate initials and fully defining them.

Bulleted Feature Creation Steps

- **Sketch circle**
- **Extrude circle**
- **Cut circle into extrusion**
- **Sketch initials on inset plane and fully define**
- **Extrude initials back up to surface level**
- **Add coin edge, fillets, and metal finish**

<u>More Details on Primary Features</u>

From Step (#): *1 and 2*

Sketch Plane: Front Plane

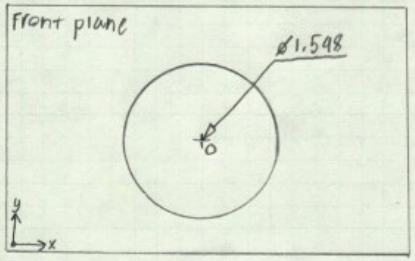
3D Feature type: Sketch and boss

Key Feature Details (dimensions/end conditions): Initial circle with dimensions and secondary circle on boss face.

HW6 Part A | ME 301 | [redacted]

The intent of this design is to create a coin, similar in dimension to a U.S. silver dollar, with my initials (JN) on the face.

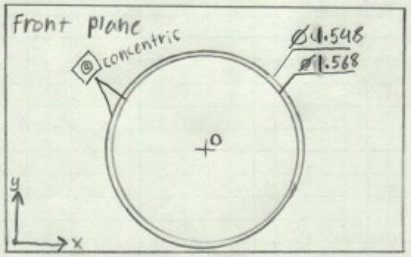
Step 1: Sketch a circle with diameter 1.548"



Tools:
- Circle
- Smart dimension

This circle will then be extruded to a thickness of 0.117" using the Extruded boss/base tool.

Step 2: Cut a shallow circle out of the face to create the sketch plane for the initials



Tools:
- Circle
- Smart dimension
- Extruded cut
- Relations

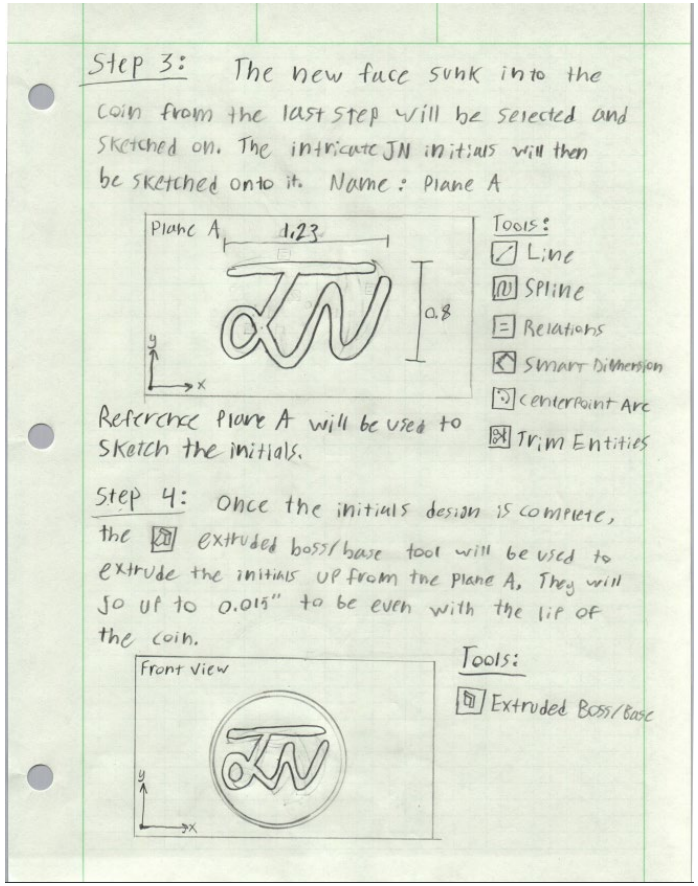
The extruded cut tool will be used to cut a 1.568" circle into the face to a depth of 0.015".

From Step (#): 3 and 4

Sketch Plane: A

3D Feature type: sketch and boss

Key Feature Details (dimensions/end conditions): Drawing the initials and fully defining them. They are then extruded back to the face height.



From Step (#): *5 (Final)*

Sketch Plane: Front

3D Feature type: Circular Pattern, fillet, and boss

Key Feature Details (dimensions/end conditions): Finishing details such as fillets, a coin edge, and a shiny material are added.

Final Step: Final details such as fillets on the inside of the lip and letters, a coin edge on the outside of the lip, and a shiny material will be added last.

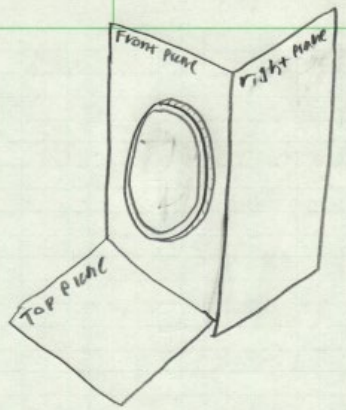
Tools:
- Circular Pattern
- Line
- Display Style
- RealView Graphics
- Extruded Boss/Base

The coin edge will be made by repeating a small triangle on the outer edge using the Circular Pattern tool. The origin z axis will be used as the axis of rotation.

Assumptions and Roadblocks

1. I assume that the hardest part of this project will be getting the intricate initials fully defined. I will most likely need to be clever with my dimensions and relations.
2. I have never used the Circular Pattern tool before, so it will be a challenge to figure it out.
3. Other tools and techniques that were not listed here may be used, as it is hard to tell exactly what will be needed.
4. There should be no need for reference geometry beyond planes created automatically with Bosses/Cuts.

Preliminary 3D Sketch



Feature creation steps

- Sketch circle
- extrude circle
- cut circle into extrusion
- Sketch initials on inset plane and fully define
- Extrude initials back up to surface level
- Add coin edge, fillets, and metal finish.

Submission 2 Additions

The only reference geometry that should be needed is a plane tangent to the face of the coin to draw the sketch for the circular inset. Beyond that, the only other geometry used was an axis through the origin to repeat the coin edge pattern around using the circular pattern tool.

Reference Axis used in design

Potential Challenges:

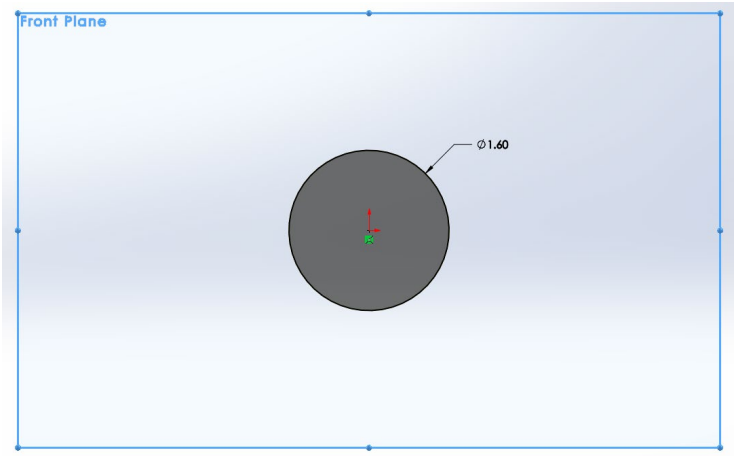
- Learning to use the circular pattern tool
- Fully defining the initials sketch
- Properly documenting the process

Process Documentation

To preface, the final design of this project is slightly altered from the original Pre-CAD plan. Upon attempting the original initial font design, it became extremely difficult to fully define. So much so, that I felt that the number of dimensions that would be needed (mostly for center marks of curves) would not be appropriate for this project. Therefore, the newer design is different, and simpler. This is shown in the second submission of the Pre-CAD plan. All other design details described are unchanged.

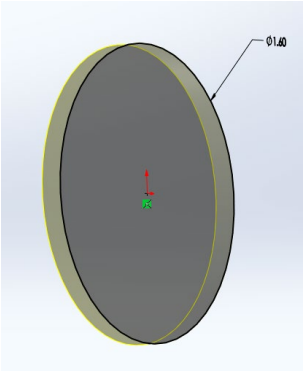
Step 1:

Step one of this project is very simple. All that is drawn is a circle of diameter 1.598 inches centered at the origin. **Smart dimension** is used to constrain its diameter. This is done on the front plane.



Circle Drawn to Diameter 1.598''

Next, the circle is simply extruded to a thickness of 0.117 inches.

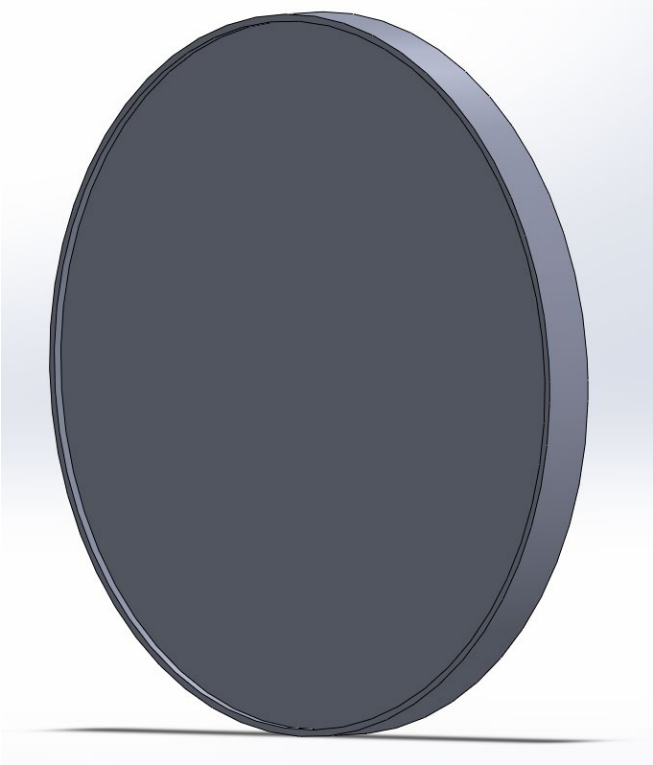


Extruded Boss Used to Create Basic Shape

Step 2:

Step 2 involves cutting a circular inlay into the face of the coin. This is so we can sketch on the inset face and extrude it back up to create the effect of the coins we're all used to.

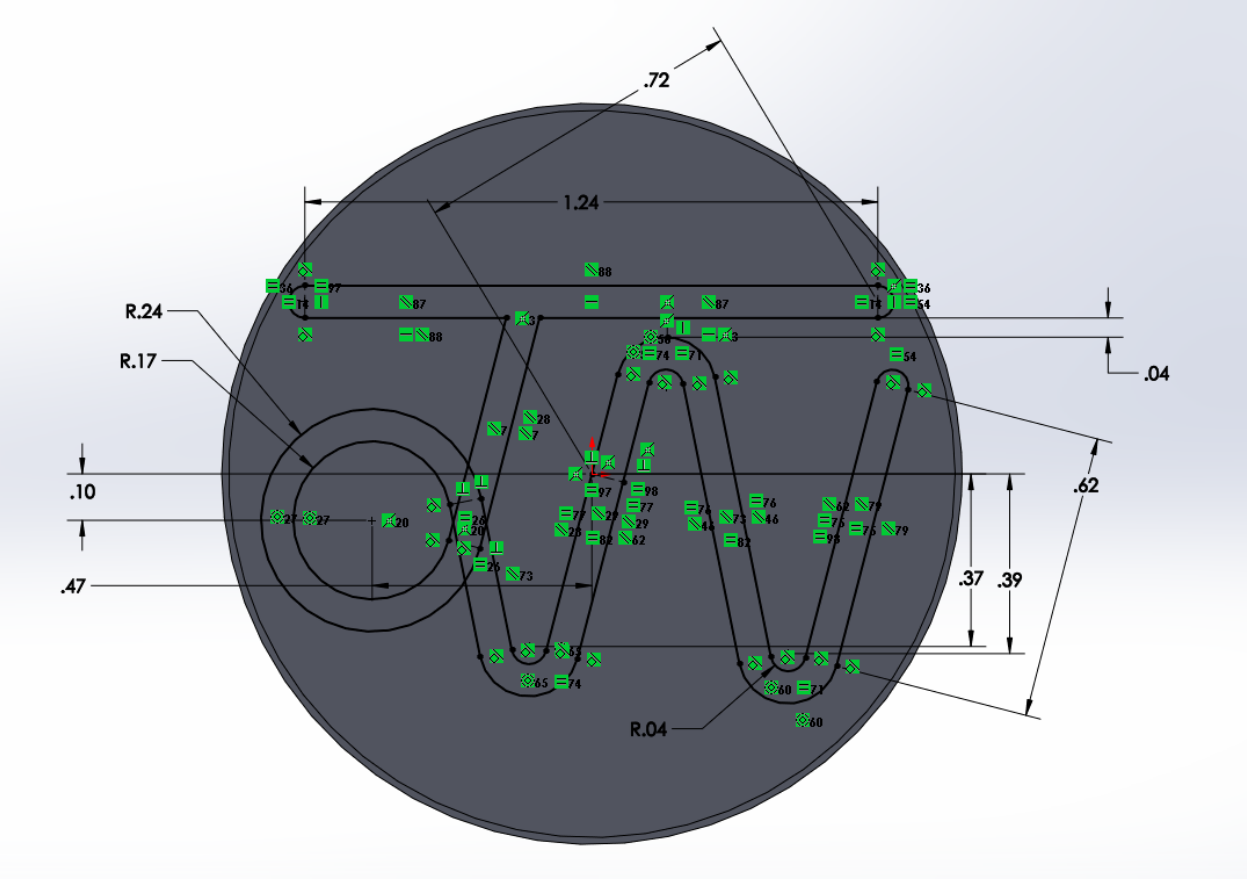
A circle is drawn on the face of the coin, centered at the origin, to a diameter of 1.568 inches. The **extruded cut** tool is then used to cut 0.015 inches into the coin, as shown below:



Inset Cut Into Coin Face

Step 3:

Step three is to sketch the initials design onto the inset plane of the coin. This plane is named "Plane A". First, the plane is selected, and the initials design is drawn onto it. The final initials design, fully constrained, is shown below:



Fully Defined Initials Sketch

As can be seen, there are numerous relationships used to define this sketch. The most important were the **parallel, concentric, tangent,** and **equal** relationships. Many others were used as well, such as **Collinear** to attach to origin to the sketch, **vertical** for a few construction lines, and **perpendicular** to define the width of the font at all points needed using construction lines. A minimal number of dimensions are used, with most being used to set center point locations with respect to the origin.

Step 4:

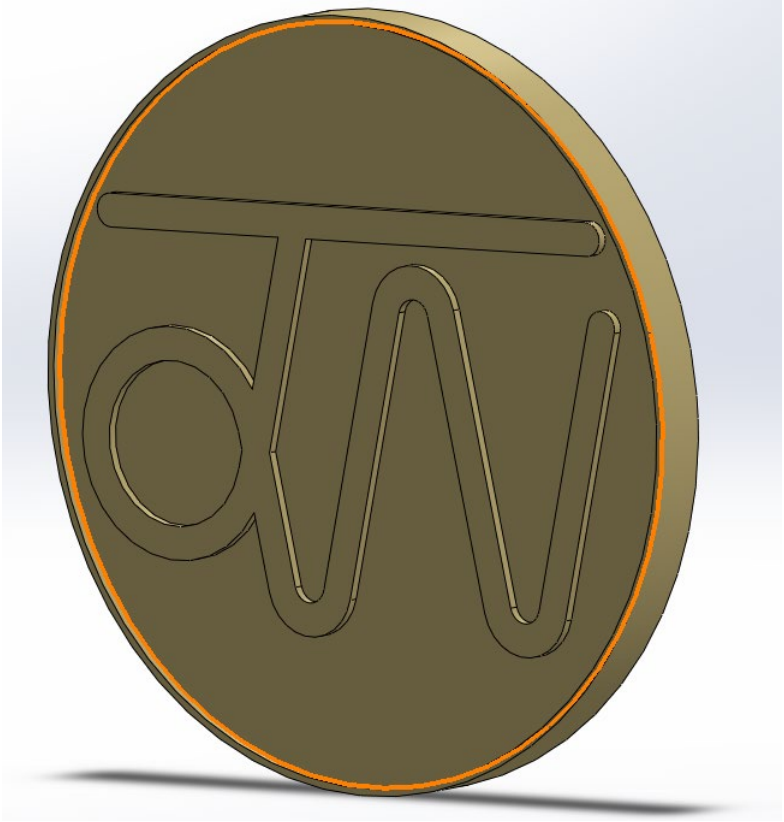
The next step of the process was to use the **extruded boss** tool once again to raise the initials back up to the level of the lip of the coin. This process is shown below:

Initials Raised Back to Face Level

Final Step:

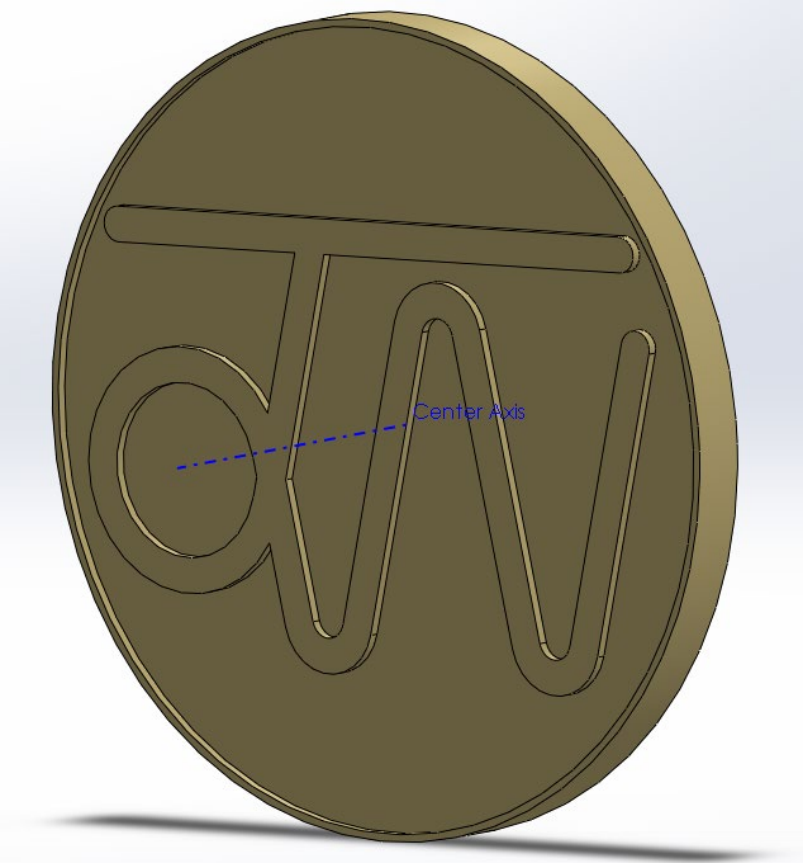
The final step(s) of this project are to add finishing details to the design that will make it look like a real coin. These steps are listed below:

First, the material is changed to pure gold.



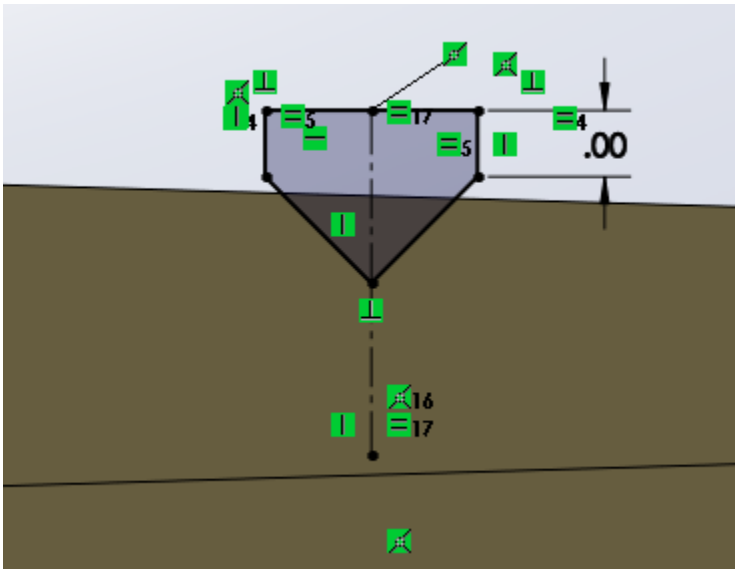
Material Changed to Pure Gold

Next, the center axis is added by creating a reference axis along the Z-axis from the origin. This will be used to create the coin edge.



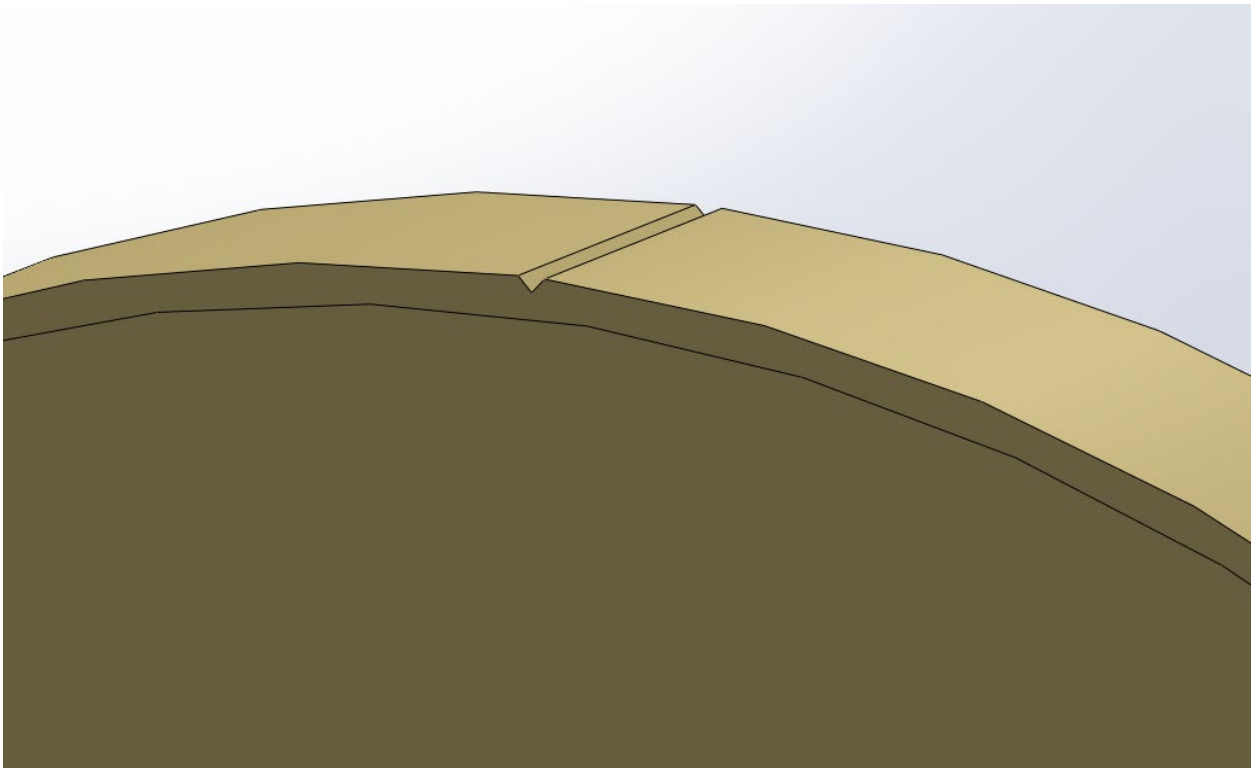
Center Reference Axis Added

Next, on the front plane of the coin, a single notch is sketched into the edge of the coin, as shown below:



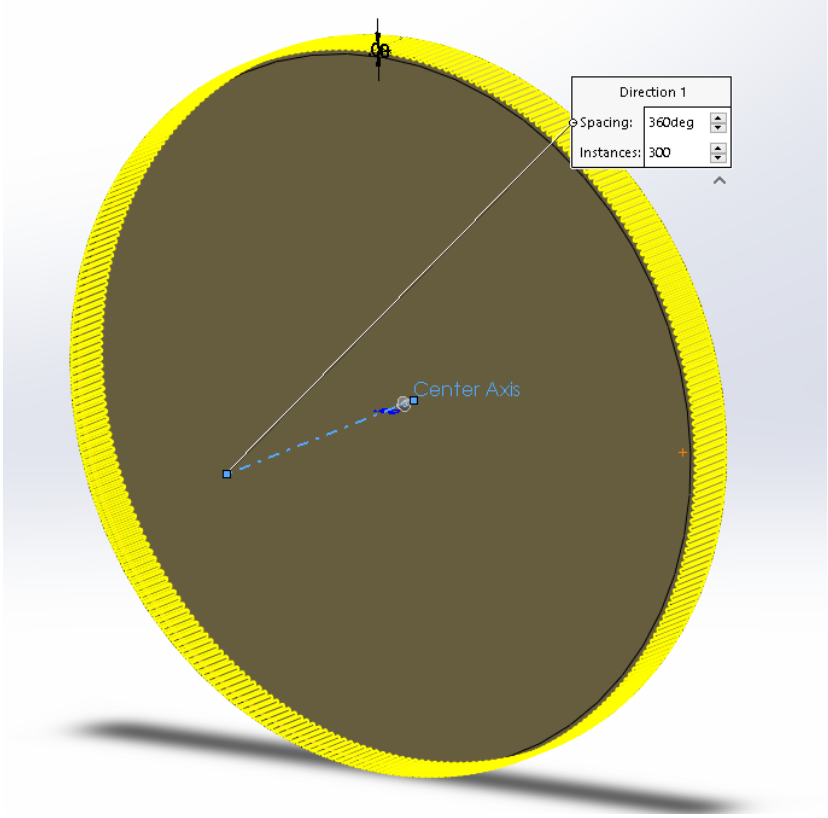
First Notch Added to Coin Edge

Next, the notch profile is cut though the coin using the **extruded cut** tool.



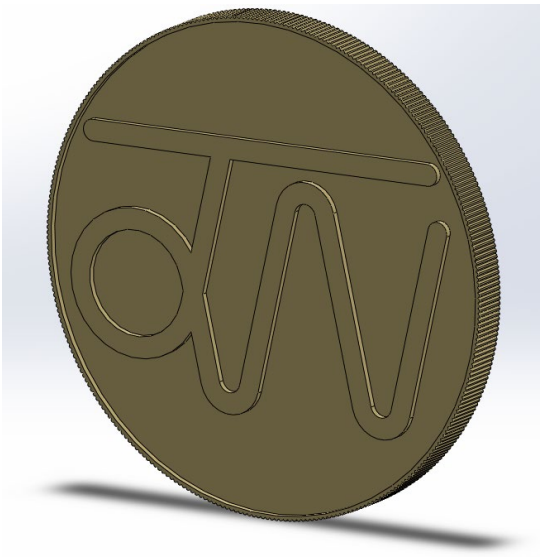
First Notch Cut Into Edge

Finally, the circular pattern tool is used to copy this single notch around the edge of the coin 300 times.

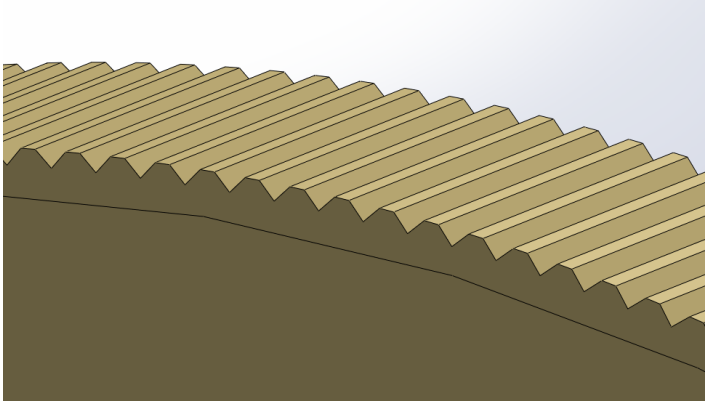


Notch Copied Around Edge (x300)

This leaves us with a nice coin edge on the coin, resembling that found on U.S. silver dollars and gold American eagles.



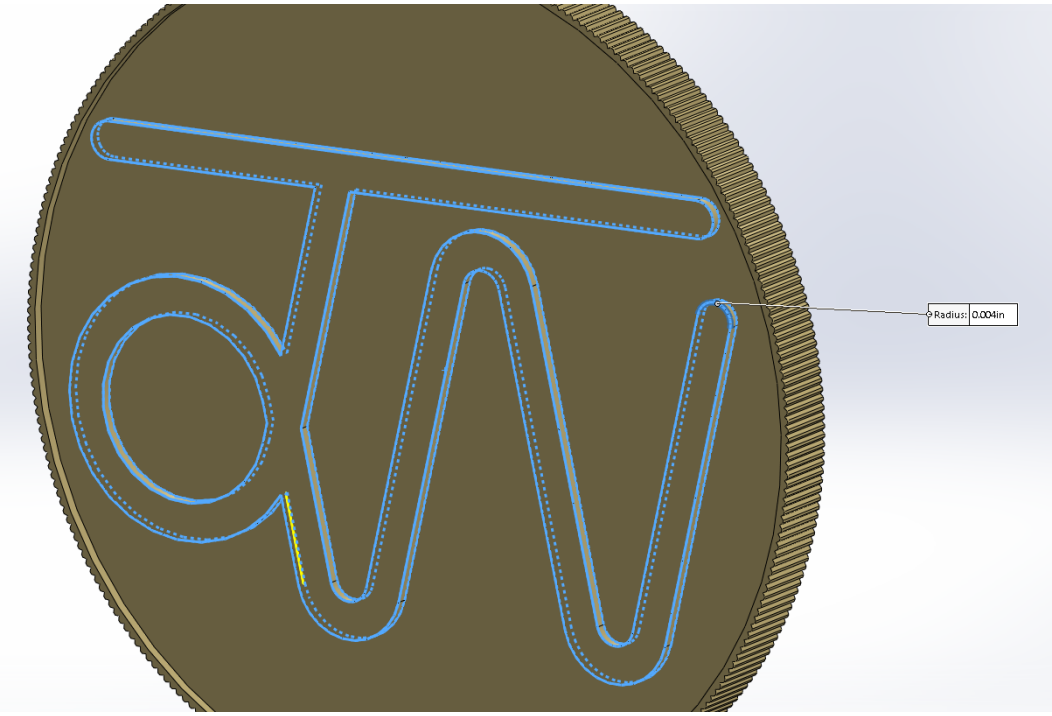
Final Coin Edge



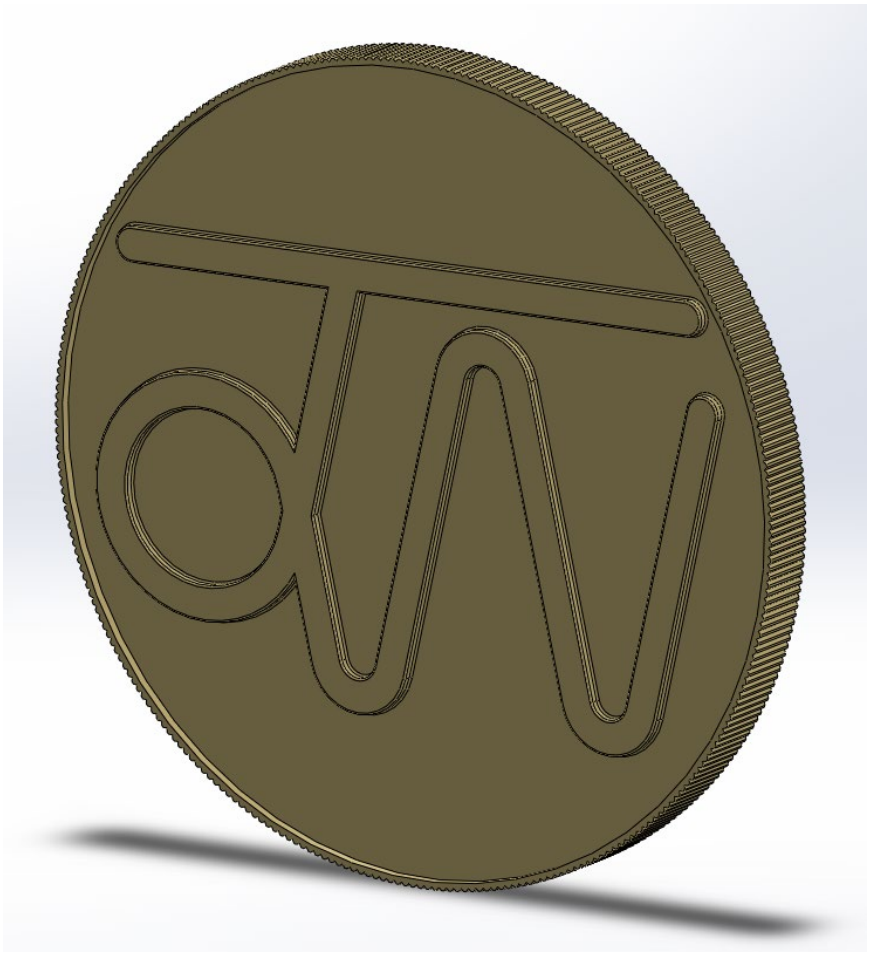
Close Up of Coin Edge

For the final step of the “prettying up” process is to add fillets to the initials boss on the face of the coin. This will make them look smoother and appear more realistic.

This process is simple. All that is done is the top and bottom edges of the initials are selected, and the **fillet** tool is used to round them down to a radius of 0.004in.



Fillet Tool Used on Initial Edges

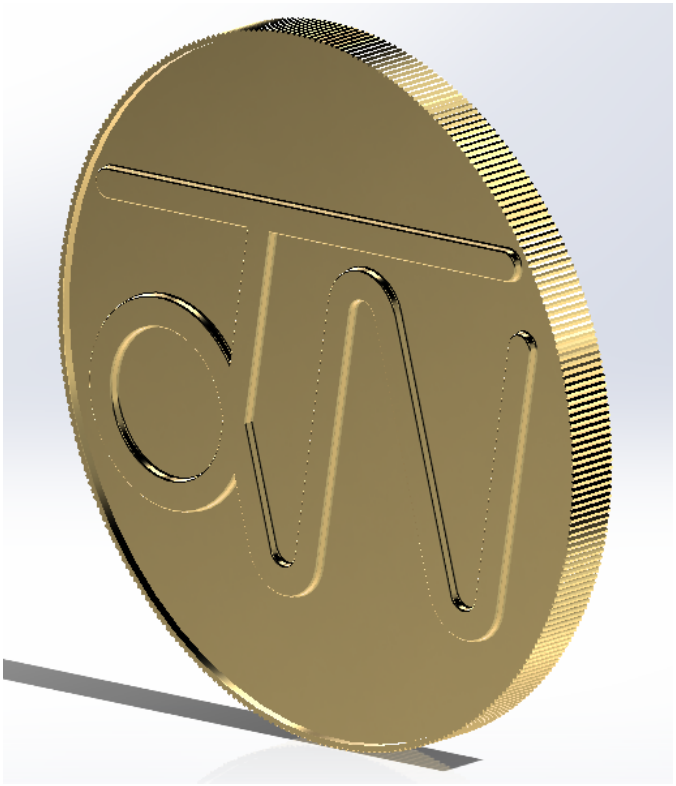


Final Product with Filleted Edges

Close up of Filleted Initials

Final Product with Shaded Edges

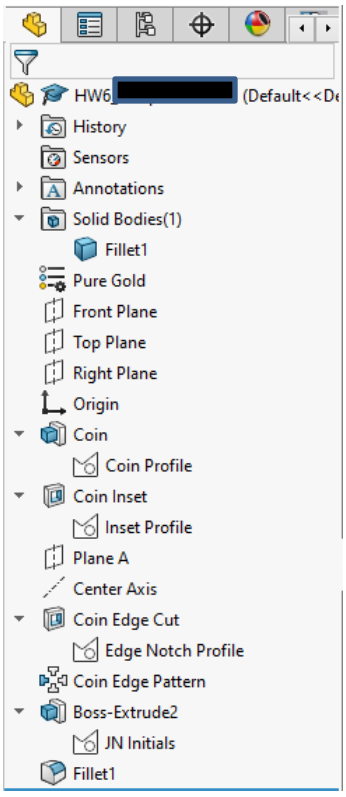
As a final step, RealView graphics is enabled to give a realistic, shiny representation of the final coin.



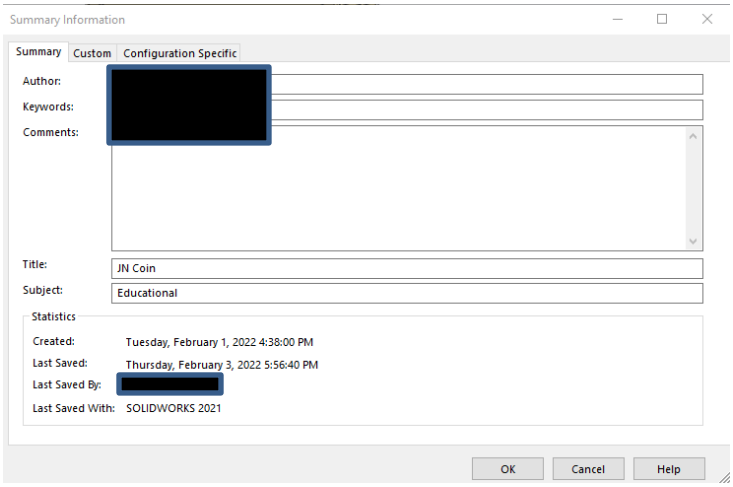
Final Product with RealView Graphics

Other Screenshots

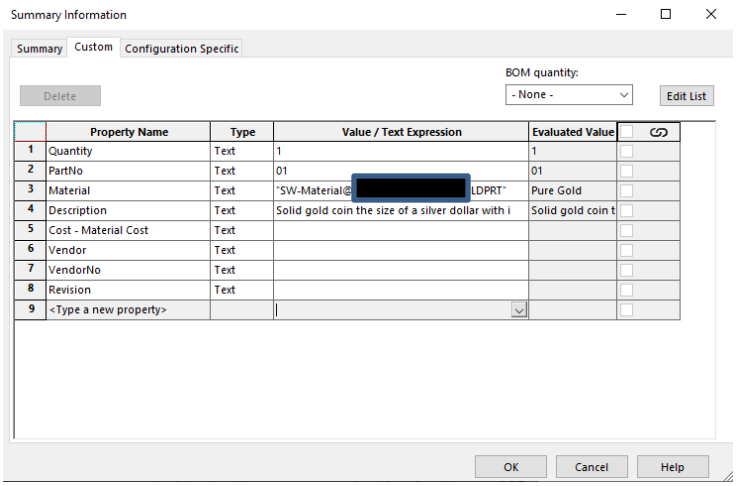
Other screenshots requested are shown below:



Annotated Design Tree



Properties Summary Tab



Properties Custom Tab 1

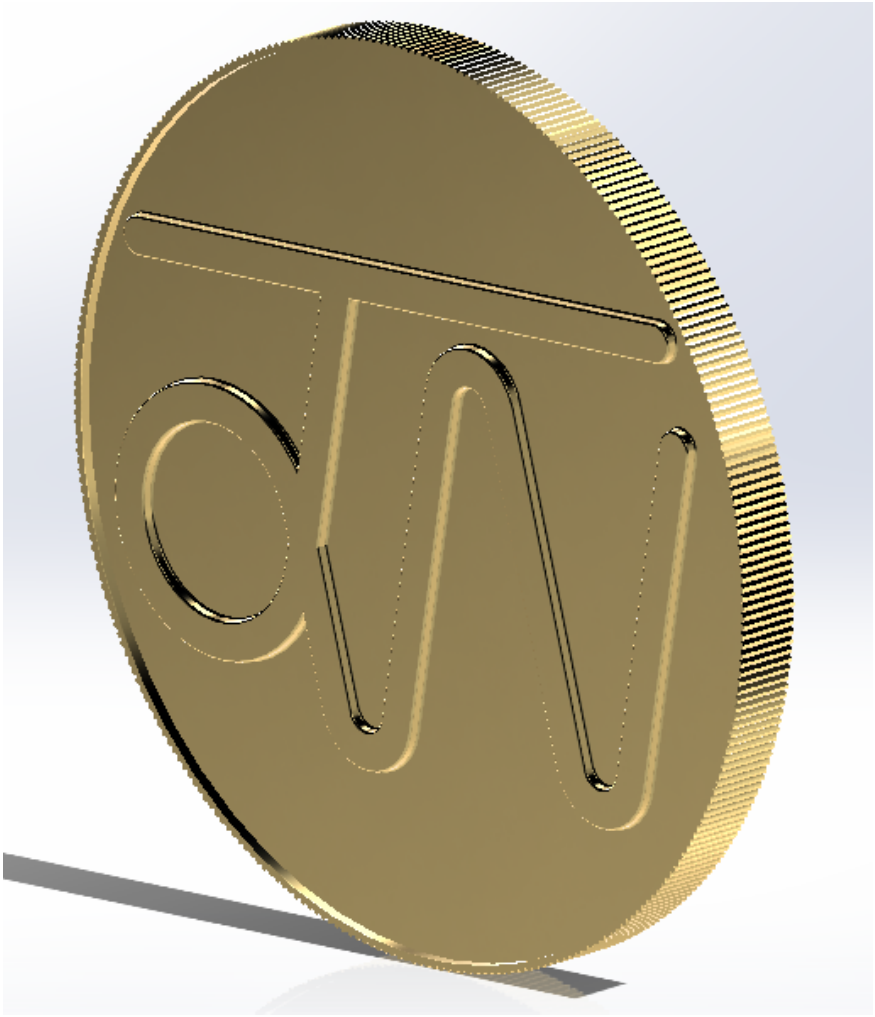
Lessons Learned

I learned a lot about Solidworks in this project. The three biggest lessons I had were:

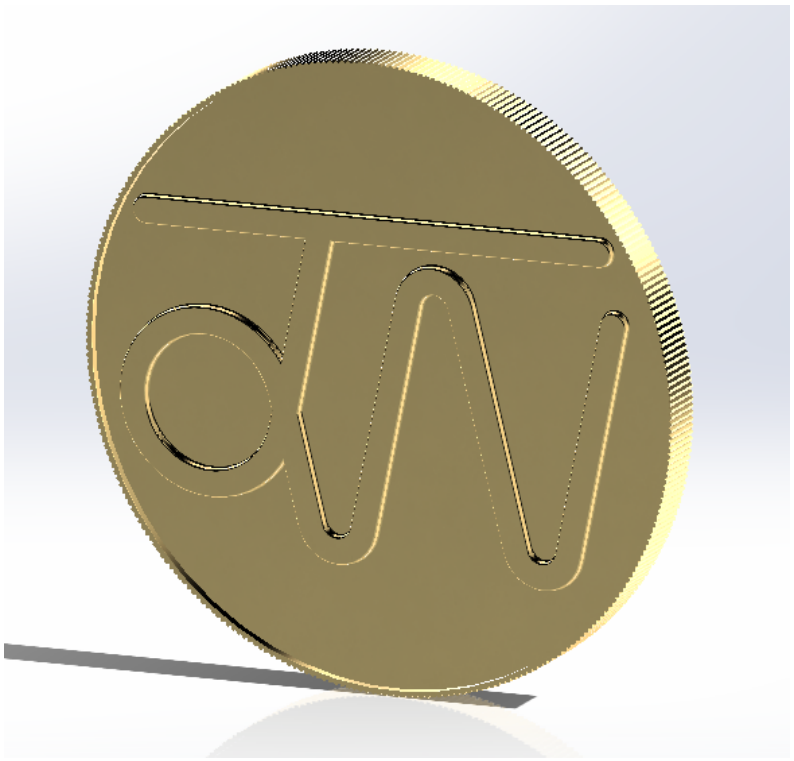
1. The biggest lesson would have to be fully constraining a sketch. Fully constraining a sketch can be very tricky, but once it's done, it's worth it. It took me a few tries to get my initials sketch fully defined, but once it was, I could resize it in multiple way by simply editing one of the defined dimensions. I found that what worked the best for fully defining the sketch was this process:
    a. Make sure that the origin is colinear with at least one element of the sketch, this makes that line locked in position
    b. Add as many sensible relationships between elements as possible. Use construction line where needed to get the sketch fully constrained and measurable.
    c. Add dimensions to each important element of the design. For me, this was mainly center points of arcs and line lengths. Relationships should carry dimensions through to other elements and fully define the sketch one enough dimensions are placed. Pulling on undefined lines to see how they move was very helpful to see how different elements needed to be constrained.
2. The second lesson I learned was how to use the repeating pattern tool. I imagined this tool would be extremely useful in many situations, and I don't see any other way I could have added my coin edge without it. To use it, you need a reference point, and a pattern to repeat. For me, the reference was the central axis, and the pattern was the single notch profile. Once you have these components, the tool is very intuitive. It lets you control how far the pattern is repeated, how many repetitions of the pattern there will be, and more.

3. Finally, I learned the general process of creating a quality part in Solidworks. It's east to get ahead of yourself, using undefined sketches and skipping the "boring parts", but this will lead to an unsatisfactory final product. Taking the time to think out your process of design, fully defining your sketches, and documenting your work are worth it in the end. While it may not be as fun, it results in a better product that will work better for you or whoever you're making it for.

Final Products

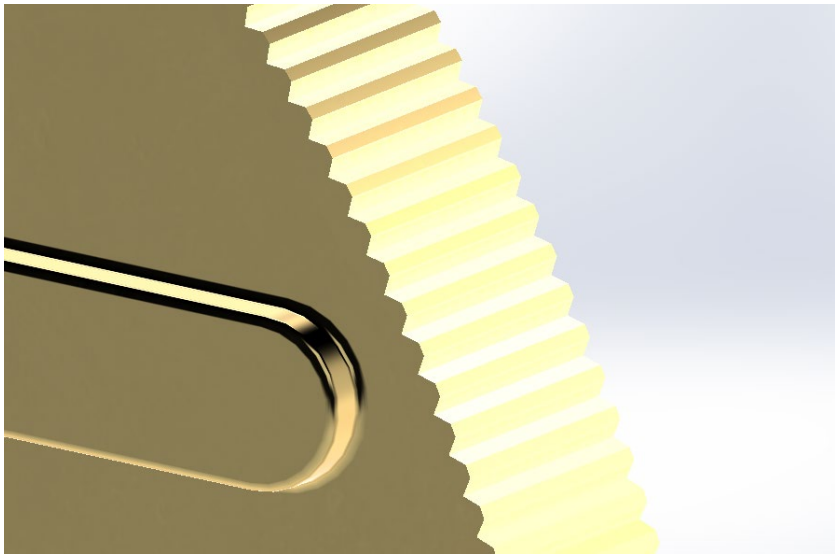


Final Product

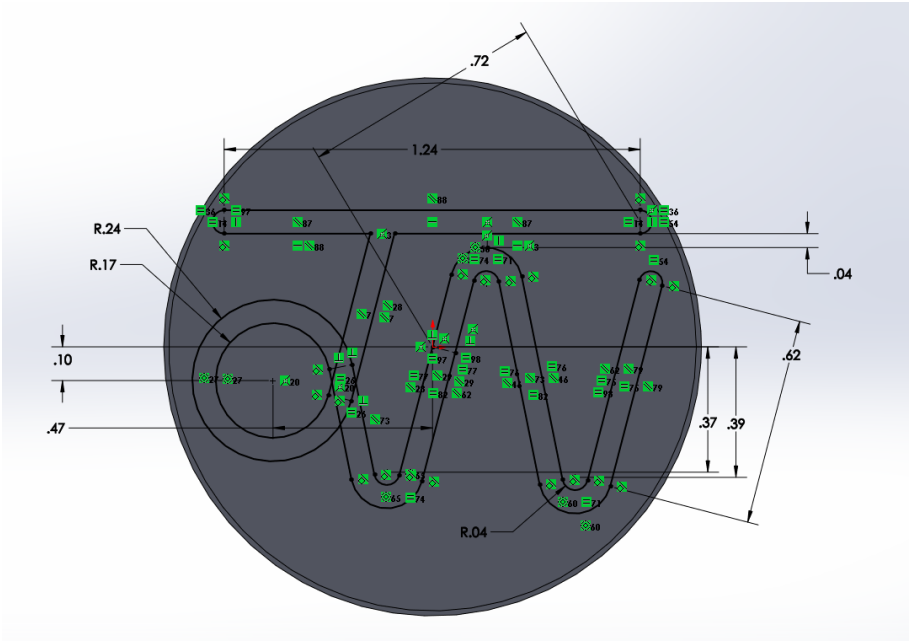


Another View of Final Product

This is the final product, with gold material applied.

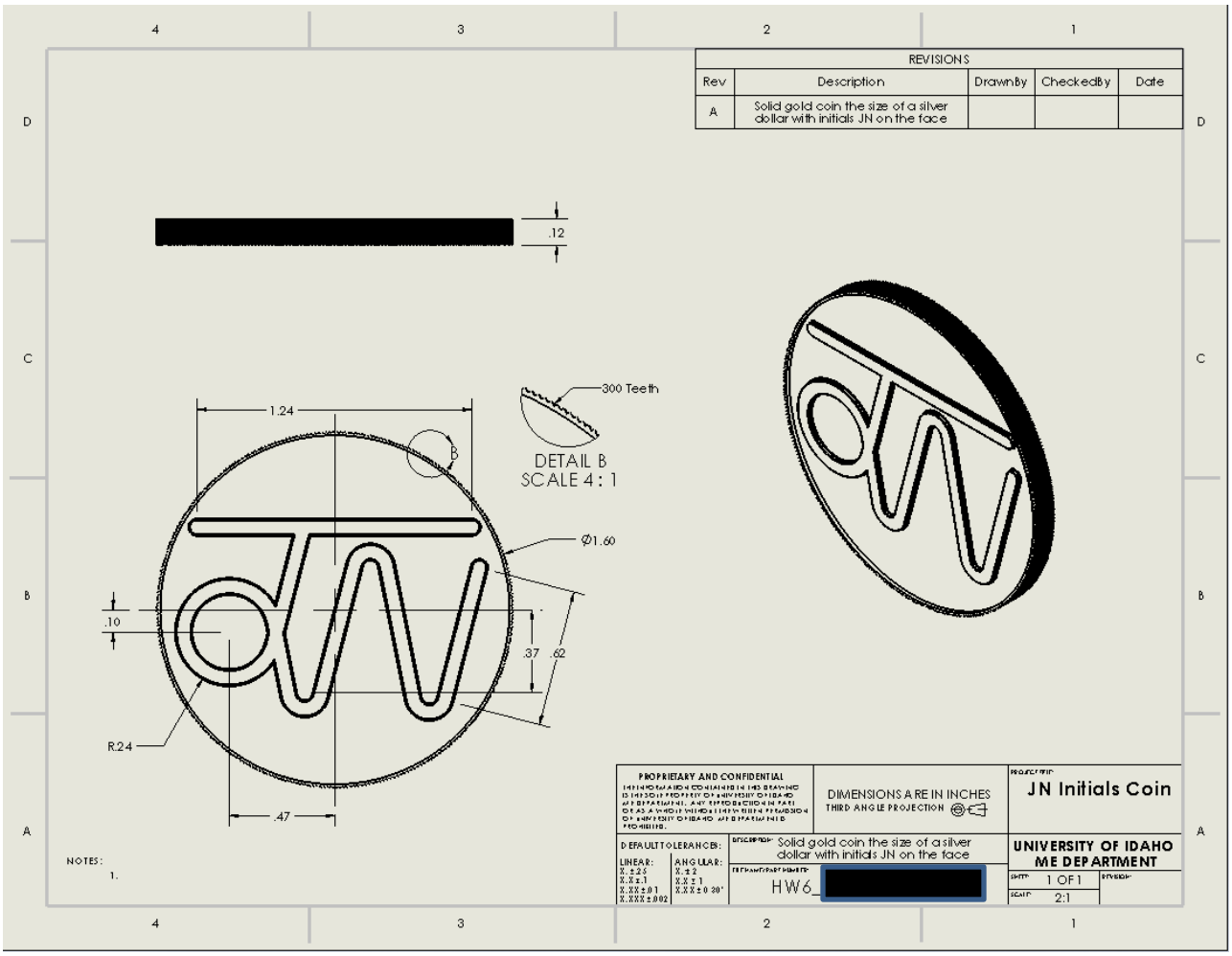


Close Up of Coin Edge

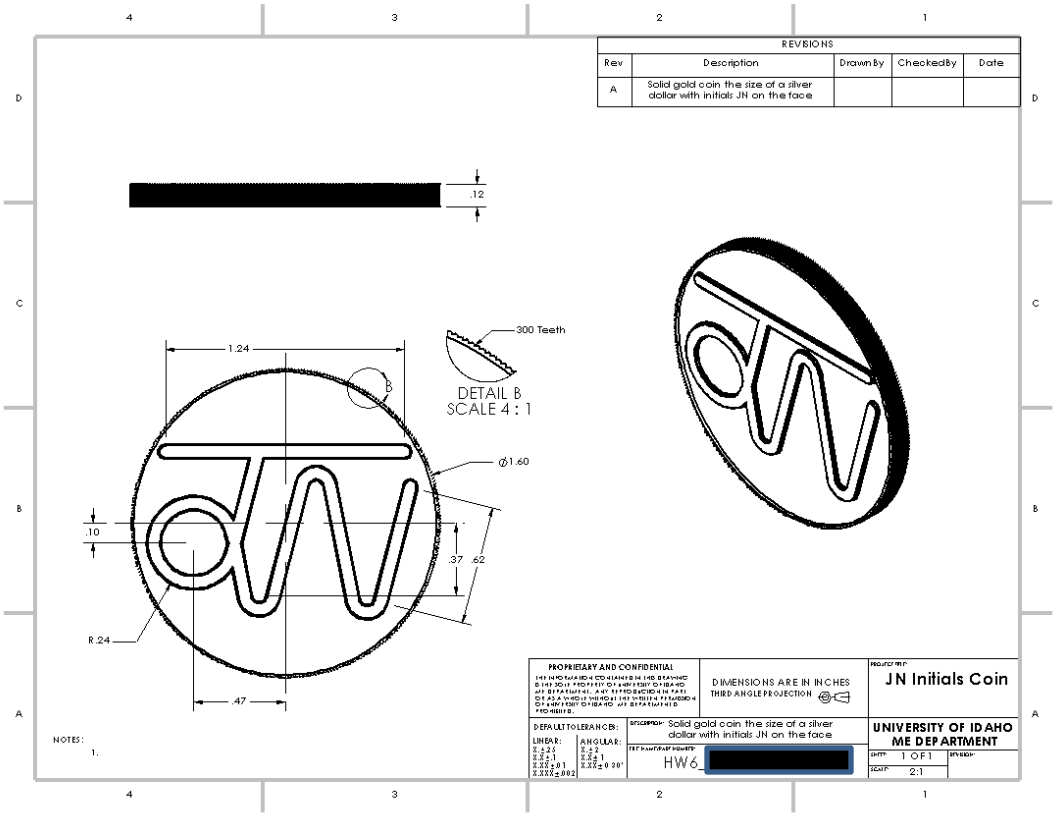


Fully Defined Sketch of Initials

This is the final sketch of the initials on the face of the coin, fully defined with as few dimensions as possible.



Final Drawing as Seen in SolidWorks



Final Drawing Exported as PNG

These are the final versions of the drawing. Only two views besides the ISO view are shown as a right view would have been redundant. There is also a cutout view of the coin edge included to show the profile of the teeth and detail the total number of teeth on the edge.