Project Objectives:

* This project is to simulate a part design and quality control process using CMM, PC-Dmis and Creo.
* Iso-dimension tolerance H11/c11 will be utilized when determining dimension tolerances.
* Form/Orientation/True-position geometric tolerances will be obtained.
* Teams will do their best to produce excellent engineering graphic communications.

This project consists of three parts:

1. Measurement of specimen dimensions for IGES or STEP file generation (unit: mm)

* Two specimens will be provided.
* Utilize calipers and hole-size measurement devices to measure all dimensions.
* The measurement devices and specimens are accessible at TE 120. You must schedule a 1-hour Calipers Lab appointment. Refer to the available schedule below (X indicates NOT available). Sign up for your appointment by the end of this week. The table is also posted at the door of TE 120.
* Utilize Creo to develop 3-D models of the specimens and save them in IGES or STEP format.
* Bring the files to your scheduled CMM project lab session.

1. CMM Measurements and Geometric Tolerances

* Every team must arrange a 2-hour CMM Lab appointment for this project. Refer to the available schedule below (X indicates NOT available). Sign up for your appointment before the end of this week.
* Students are required to utilize the CMM to obtain dimensions and geometric tolerances under the supervision of Mr. Kevin Schull.
* Each team must accurately document all measurements.
* **Measurement unit: mm**

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|  | **April**  **11** | **April**  **12** | **April**  **15** | **April**  **16** | **April**  **17** | **April**  **18** | **April**  **19** | **April**  **22** | **April**  **23** | **April**  **24** | **April**  **25** | **April**  **26** |
|  | Thu | Fri | Mon | Tue | Wed | Thu | Fri | Mon | Tue | Wed | Thu | Fri |
| **9 AM** |  |  |  |  |  |  |  |  |  |  |  |  |
| **10AM** |  |  |  |  |  |  |  |  |  |  |  |  |
| **11AM** |  |  |  |  |  |  |  |  |  |  |  |  |
| **12PM** | X | X | X | X | X | X | X | X | X | X | X | X |
| **1 PM** |  |  |  |  |  |  |  |  |  |  |  |  |
| **2 PM** |  |  |  |  |  |  |  |  |  |  |  |  |
| **3 PM** |  |  |  |  |  |  |  |  |  |  |  |  |
| **4 PM** | X | X | X | X | X | X | X | X | X | X | X | X |

3. Determination of dimension/geometric tolerances

3-1. The dimension tolerance of each dimension should be obtained:

* <http://theoreticalmachinist.com/IsoTolZoneCalc>
* Select “mm”
* Up to the 3rd decimal place
* Input a specified dimension (= dimension without a tolerance) obtained from the Calipers lab.
* Find Range
* Click both “C” icons to reset
* Select H11 and c11
* Calculate
* Internal features adhere to dimensional tolerances determined by H11, while external features follow tolerances determined by c11.
* Once dimensional tolerances are established, compare them with the dimensions measured by the CMM. If a dimension falls outside acceptable ranges, change the color of the toleranced dimension to **RED** to indicate it is out of tolerance.

3-2. The following geometric tolerance should be obtained:

* Obtain 2 form tolerances, 2 orientation tolerances including an axis orientation, and a true-position tolerance (total 5 geometric tolerances per specimen)
* For the axis orientation and true-position, call MMC as a modifier.
* When determining form (surface) geometric tolerances, you must consider

Geometric tolerance < Dimension tolerance

* For the axis orientation tolerance, use f 0.01 as the tolerance value.
* For the surface orientation tolerance, use 0.008 as the tolerance value.
* For the true position tolerance, follow the discussed 3 steps:

Step 1: Find the Allowance (=difference between MMC of Hole and MMC of shaft)

Allowance = MMC of Hole - MMC of shaft

**MMC of Hole and MMC of shaft should be obtained from 3-1.**

Step 2: Consider manufacturability and other design conditions when determining actual tolerances for the hole and shaft.

Step 3: Then divide the allowance into Hole GT and Shaft GT.

Usually, Hole GT ≥ Shaft GT

* After determining geometric tolerances, Compare them with the CMM-measured tolerances. If the out-tolerance is non-zero, you need to change the color of the feature control frame into **RED** to indicate out-tolerance.

4. Creo Engineering drawings

- The part drawings using Caliper-measured dimensions should be created.

* Use the ME 203 official title block.
* Include dimension tolerances (**Plus/minus tolerance** format).
* Include geometric tolerance symbols and feature control frames.

5. Project submission (due: 11:59 PM Friday May 3, 2024)

* Each team turns in an ORIGINAL engineering drawings (orthographics) in pdfs. Use “Save as/Export.”
* Create a project report (in a WORD file) having the following sections:
  + Introduction of CMM
  + Project overview
  + Step-by-step procedures of the whole project
  + Make a table similar to the shown below for each specimen. All the measured geometric tolerances should be listed.
  + Conclusion

|  |  |  |  |  |  |  |
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| Feature | Nominal | +TOL | Measure | Deviation | Out-tolerance | Bonus\*\* |
| True Position |  |  |  |  |  |  |
| Perpendicularity |  |  |  |  |  |  |
| ….. |  |  |  |  |  |  |
| ….. |  |  |  |  |  |  |
| ….. |  |  |  |  |  |  |