MotoSize Step by Step: Sizing a Headstock using SolidWorks

Introduction

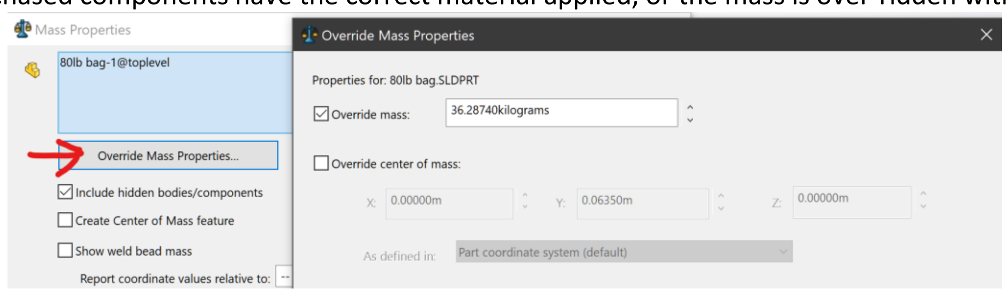
Sizing the right positioner is about having the correct mass data of the part and fixture. It is important to note that MotoSize needs to calculate the mass data for EVERYTHING connected to the headstock…not just the part being calculated…the part fixture is just as important.

Below are instructions to configure Solidworks CAD data, export it to MotoSize, and calculate the results for the best headstock positioner.

STEP 1: Check CAD model Integrity

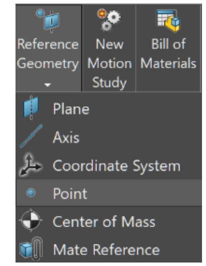
In Solidworks make sure the following are completed for the part/fixture:

1. All relevant components are represented (anything that generates sufficient mass.)
    a. Part
    b. Fixture (pay attention to the clamps, if any)
    c. Fasteners…if numerous
2. Verify there are no redundant component copies.
3. All relevant models are solid bodies; not surface bodies (surfaces have no volume to calculate mass).
4. All manufactured models have the correct material applied (steel, aluminum, plastics, rubber, etc.), giving it a density that mass can be calculated from.
5. All purchased components have the correct material applied, or the mass is over-ridden with a value provided by the manufacturer.



STEP 2: Setup Second Coordinate System

It is critical that the coordinate system is located accurately. It will affect the center of gravity and moments of inertia.
The origin needs to be located at the connection point where the fixture is fastened to the Headstock faceplate.
For simplicity make sure the Z axis is normal to the headstock face (see Figure 1).

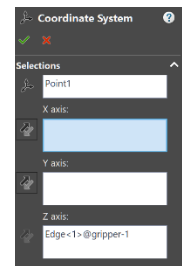


1. In the Solidworks **Assembly** tab select **Reference Geometry/Point** and select the surface that will mount to the Headstock faceplate.

   A point will appear at the center of that surface.

2. Select **Reference Geometry/Coordinate System** and a new coordinate system will appear on the point previously created.

   Use the X, Y, Z options to align to match Figure 1



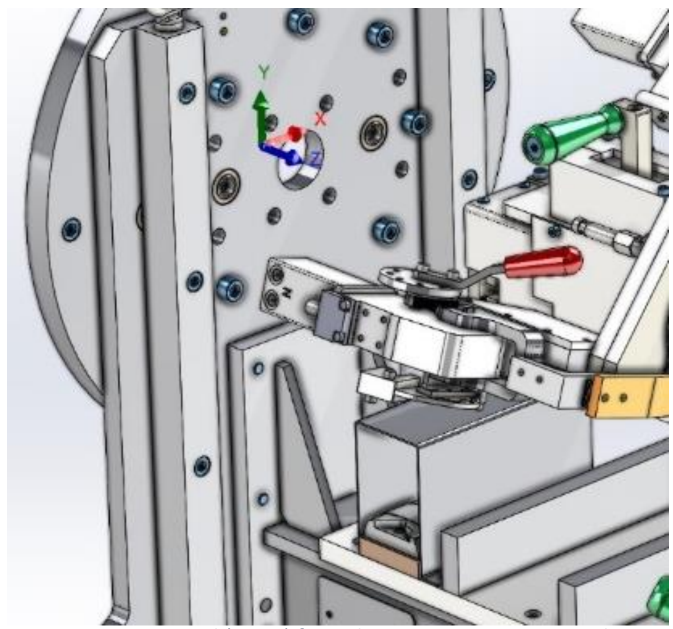


Figure 1:Z is normal (away) from the Positioner Mounting plate.

STEP 3: Configure & Output the Mass Data

After the models and origin have been configured, the next step is the mass properties output.

It can be found on the Evaluate Tab, **Mass Properties**

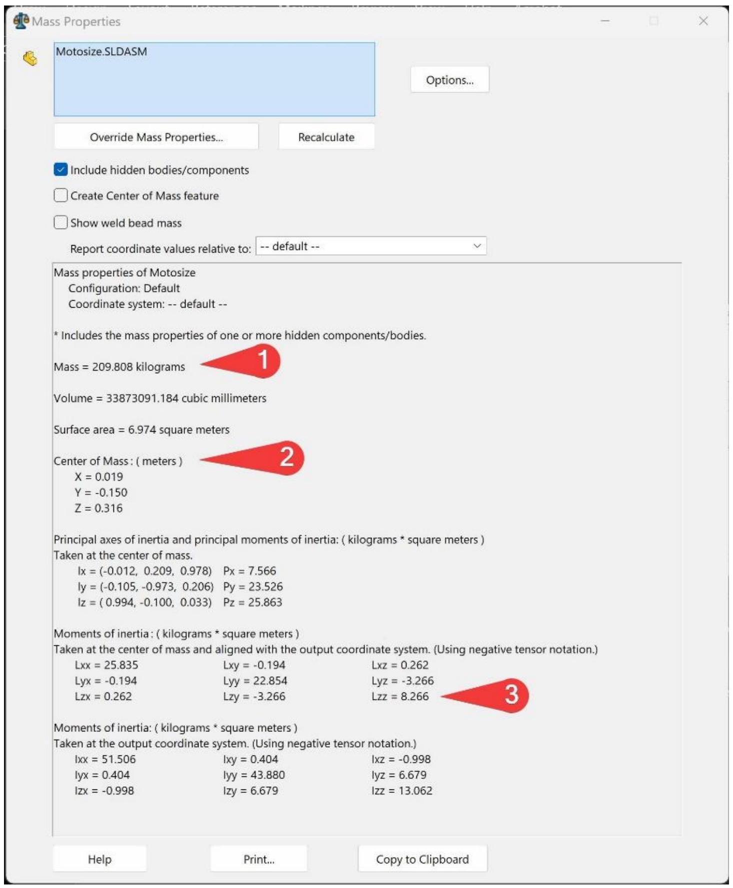
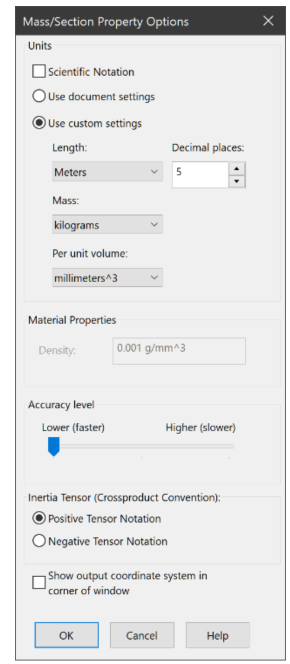


Figure 2: Mass Properties

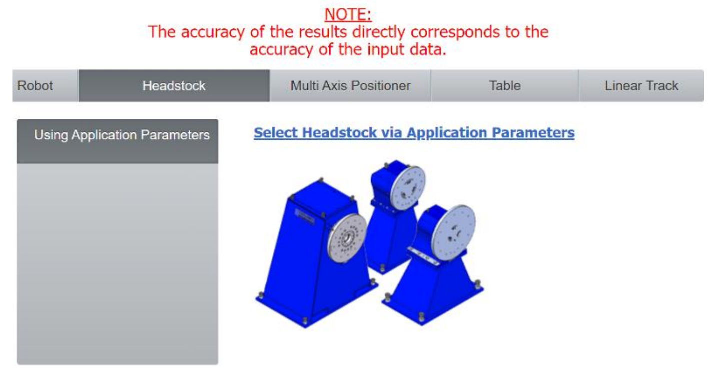
Figure 3 displays how the results should look.

1. Select the user-defined coordinate system.
2. Set units to Kilogram/meters, using **Options/Custom Settings**.
3. The following data will be needed:
   a. Mass
   b. Center of Mass (X, Y, Z)
   c. The **Lzz** value from the **Moments of Inertia taken at the center of mass and aligned with the output coordinate system**.



STEP 4: Enter the Data in MotoSize

Login to MotoSize.motoman.com

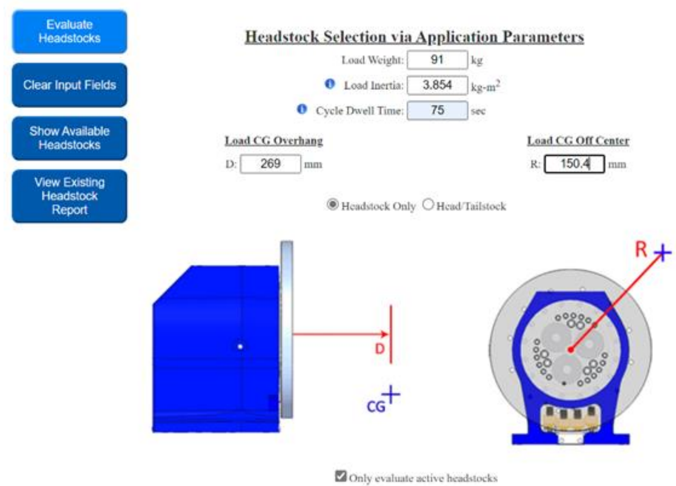


At the main page select the heading for **Headstock**, then **Select Headstock via Application Parameters**

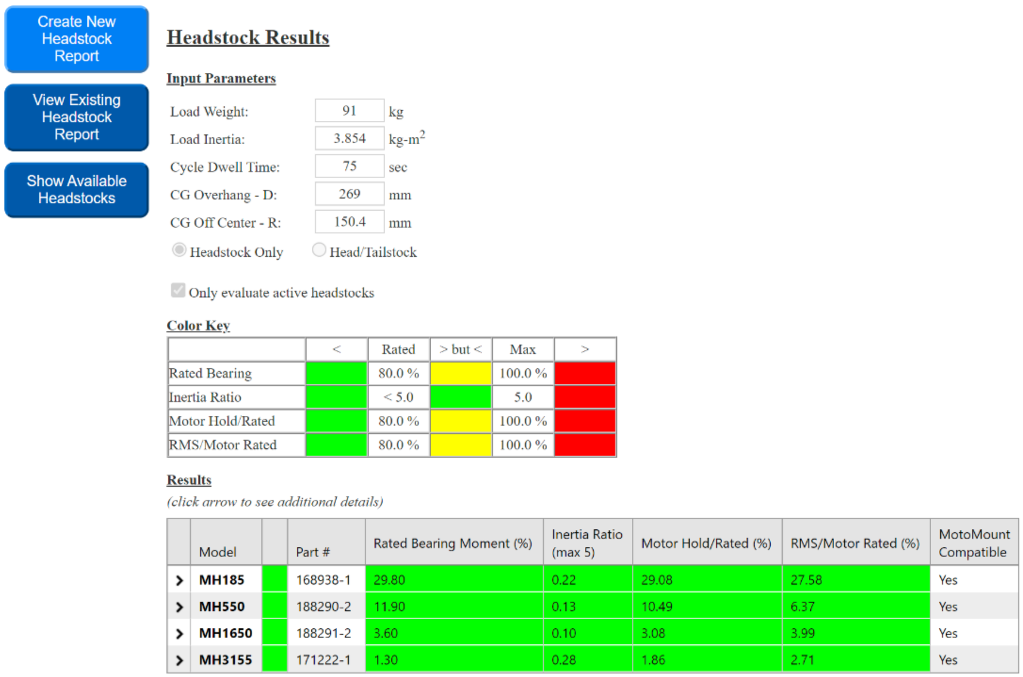
Using the results from Mass Properties, fill in the data fields:

1. **Load Weight** = Mass (Kg)
2. **Load Inertia** = Lzz (see Figure 2)
3. **Cycle Dwell Time** = Time (sec) the headstock is NOT rotating during a process cycle
4. **Load CG Overhang** = The center of mass in Z
    a. If using a Tailstock, select **Head/Tailstock** and the Overhang variable is turn off.
5. **Load CG Off Center** = Calculated radial distance (absolute value) from the Center of mass X and Y values.
    a. HINT: Use the Pythagorean Theorem $\boldsymbol{Load\ CG\ off\ Center} = \boldsymbol{sqrt}(x^2 + y^2)$
6. Select **Evaluate Headstocks**

Note: If older models of headstocks need evaluation, uncheck the box **Only evaluate active headstocks**



STEP 5: Review the Results



As can be seen, everything is **GREEN**. This model can safely be used with all current Headstocks.

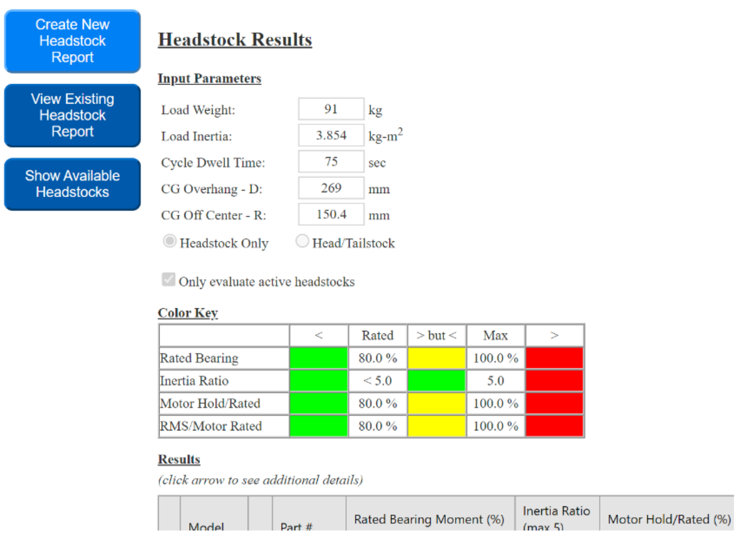
The headstocks are evaluated by:

1. **Rated Bearing**: Amount of reducer bearing moment load generated by the application. Given as a % of the reducer bearing capacity.
2. **Inertia Ratio**: The (reflected load inertia)/(motor inertia) ratio. Servo control stability requires this ratio stay below 5.
3. **Motor Hold/Rated:** Amount of motor torque required to hold the load in a worst-case position. Given as a % of rated motor torque.
4. **RMS/Motor Rated:** RMS current requirements for the entire simulated duty cycle (motion and dwell) based off the application. Given as a % of rated motor torque.

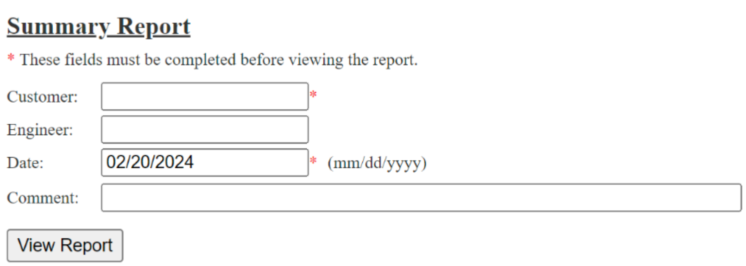
STEP 6: Saving the Results

Once satisfied with the results, they can be saved to a PDF.

1. Select **Create New Headstock Report**

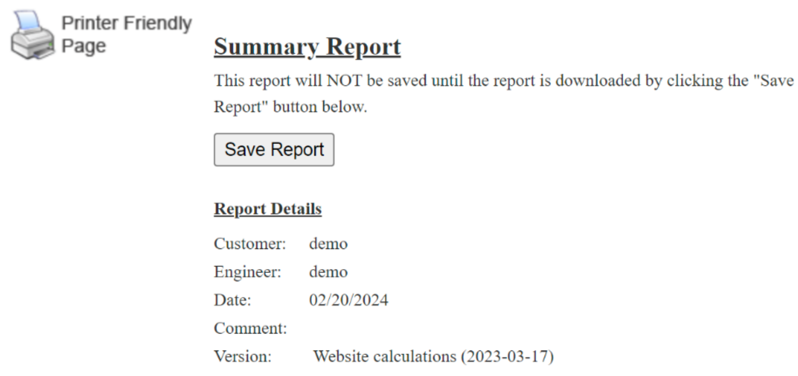


2. Fill in the **Customer** field and any other optional field desired.



3. When ready, select **View Report**

4. The finished report will appear…select **Printer Friendly Page**



Printer Friendly Page

Summary Report

This report will NOT be saved until the report is downloaded by clicking the "Save Report" button below.

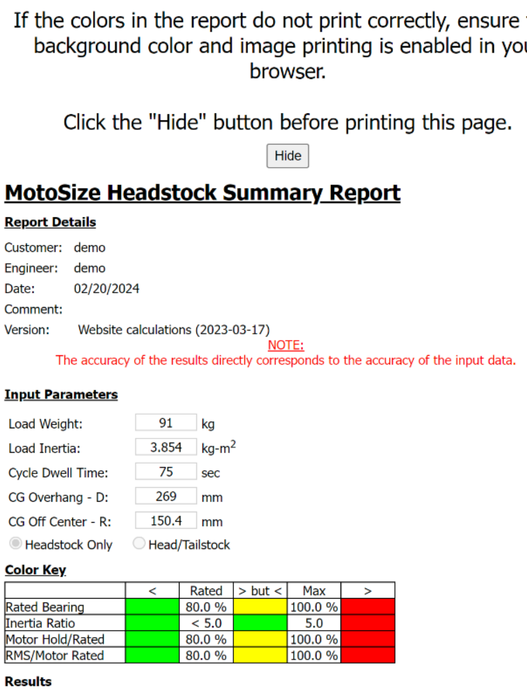
Save Report

Report Details

Customer: demo
Engineer: demo
Date: 02/20/2024
Comment:
Version: Website calculations (2023-03-17)

6. The printer friendly page will display a message reminding the user to verify their browser background graphics are enabled in the printer settings.
   a. If not, then the color key will be gray and harder to interpret.

7. Select the **Hide** button to remove the message.
8. Use the browser to print to PDF.
9. Done



If the colors in the report do not print correctly, ensure that background color and image printing is enabled in your browser.

Click the "Hide" button before printing this page.

Hide

MotoSize Headstock Summary Report

Report Details

Customer: demo
Engineer: demo
Date: 02/20/2024
Comment:
Version: Website calculations (2023-03-17)

NOTE:
The accuracy of the results directly corresponds to the accuracy of the input data.

Input Parameters

Load Weight:	91	kg
Load Inertia:	3.854	$kg\text{-}m^2$
Cycle Dwell Time:	75	sec
CG Overhang - D:	269	mm
CG Off Center - R:	150.4	mm

Headstock Only   Head/Tailstock

Color Key

	<	Rated	> but <	Max	>
Rated Bearing		80.0 %		100.0 %	
Inertia Ratio		< 5.0		5.0	
Motor Hold/Rated		80.0 %		100.0 %	
RMS/Motor Rated		80.0 %		100.0 %	

Results