This document captures ideas, experiences, and informal recommendations from the Yaskawa Partner Support team. It is meant to augment – not supersede manuals or documentation from motoman.com. Please contact the Partner Support team at partnersupport@motoman.com for updates or clarification.

MotoSize Step by Step: Sizing a Headstock Using Inventor

Introduction

It is always important to size the right positioner to the correct mass 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 step by step instructions to configure Inventor CAD data, export it to MotoSize, and calculate the results.

STEP 1: Verify CAD Model Integrity

In Inventor, verify the following in the Assembly:

1. All relevant components are represented (anything that will generate enough mass.) This includes fasteners if they are numerous.
2. Verify there are no duplicate components embedded in the assembly.
3. In addition to the part mass, the mass of the fixture needs to be represented, since it can significantly impact the overall mass properties.
4. All relevant models are solid bodies; not just surfaces (surfaces have no volume for mass to be calculated).
5. All manufactured models have the correct material applied (steel, aluminum, plastics, rubber, etc.) …giving it mass.
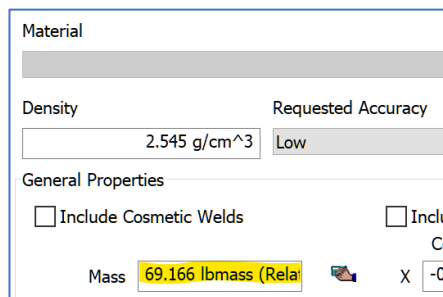
6. All purchased components have either the correct material applied, or the mass is over-ridden with a value provided by the manufacturer.

STEP 2: Setup Second Coordinate System

It is critical that the coordinate system is accurately located. It will affect the center of gravity and moments of inertia.
The origin needs to be located at the connection 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).
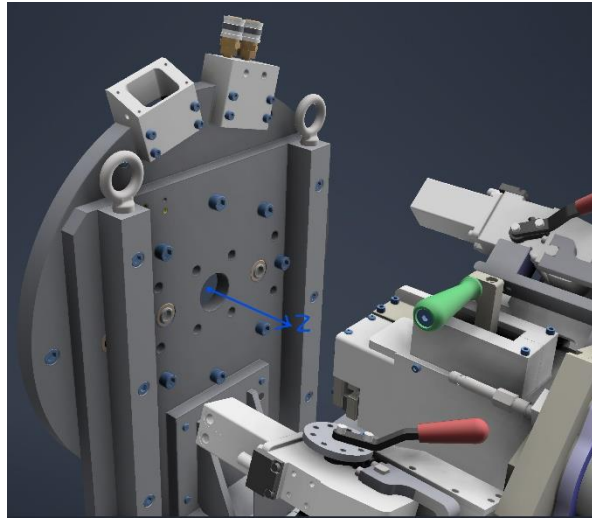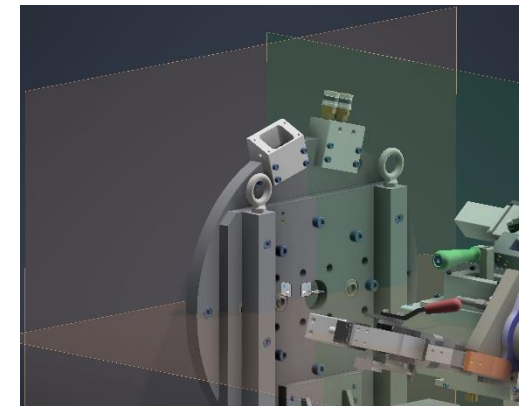

Figure 1: Reference for Proper Alignment

1. In the Inventor, unless the Assembly was prebuilt using Figure 1's coordinate system, create a new top-level assembly and insert the Part/Fixture as a subassembly.
2. Use the constraints to align the sub-assembly to the top-level's origin, using the top-level's work-planes as a reference.

STEP 3: Configure and Output the Mass Data

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

It can be found by right clicking the top-level assembly in the model tree and selecting iProperties/Physical
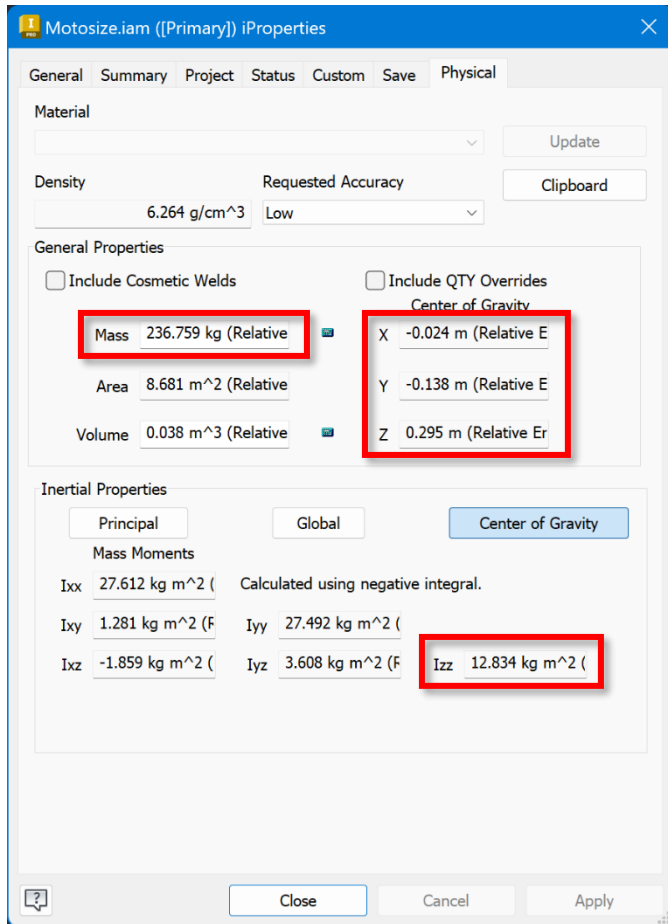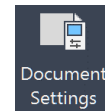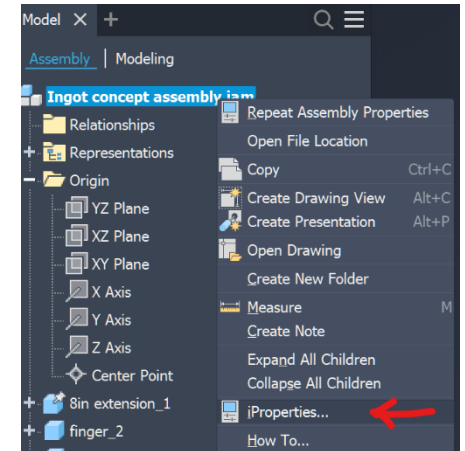
The sample Mass Properties to the left displays how the results should look.

1. Verify that the units are set to Kilogram and meters, using the **Tool** Tab / **Document Settings**.

2. Select **Units** to change the length and mass options.
3. The following data will be needed:
   a. Mass
   b. Center of Mass (X, Y, Z)
   c. The **Izz** value from **Center of Gravity**.

Figure 2: Mass Properties

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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** = Izz (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 $Load\ CG\ off\ Center = sqrt(x^2 + y^2)$
6. Select **Evaluate Headstocks**

Note: If older models of headstocks need evaluation, uncheck the box **Only evaluate active headstocks**
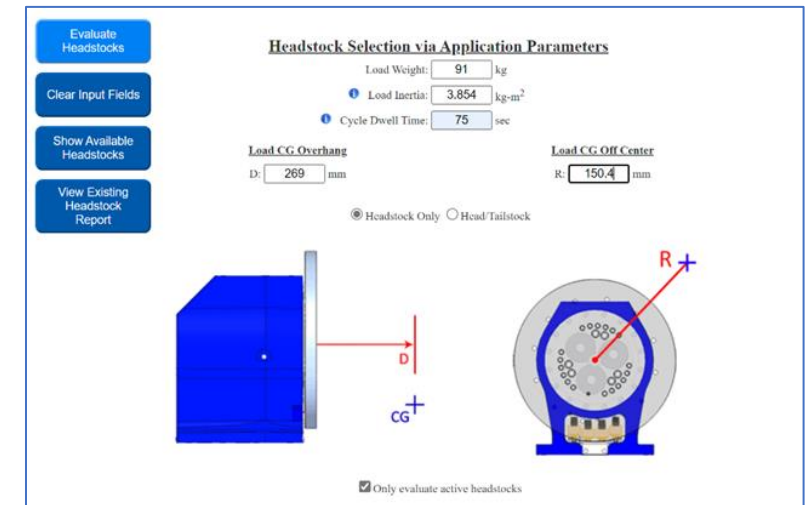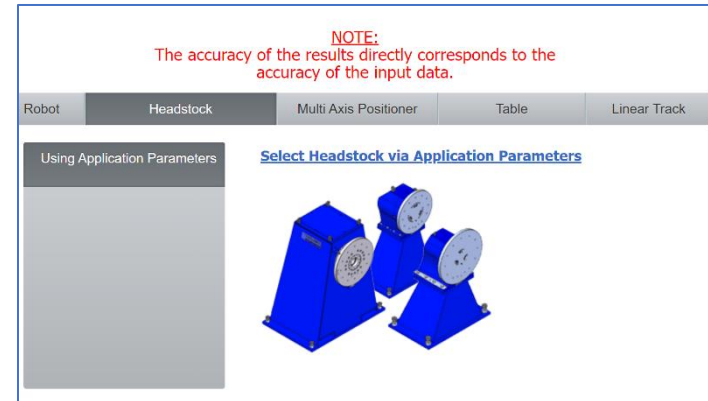
STEP 5: Review the Results

Headstock Results

Input Parameters

Load Weight:	91	kg
Load Inertia:	3.854	kg-m²
Cycle Dwell Time:	75	sec
CG Overhang - D:	269	mm
CG Off Center - R:	150.4	mm

○ Headstock Only   ○ Head/Tailstock

☑ Only evaluate active headstocks

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
(click arrow to see additional details)

	Model	Part #	Rated Bearing Moment (%)	Inertia Ratio (max 5)	Motor Hold/Rated (%)	RMS/Motor Rated (%)	MotoMount Compatible
>	MH185	168938-1	29.80	0.22	29.08	27.58	Yes
>	MH550	188290-2	11.90	0.13	10.49	6.37	Yes
>	MH1650	188291-2	3.60	0.10	3.08	3.99	Yes
>	MH3155	171222-1	1.30	0.28	1.86	2.71	Yes

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**

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

7. 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.

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

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)

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-m^2
Cycle Dwell Time:	75	sec
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Results