

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.

🔮 Mass Properties		🕂 Override Mass Properties						
4	80lb bag-1@toplevel	Properties for: 80lb bag.S	LDPRT					
		Override mass:	36.28740kilograms	÷				
-	Override Mass Properties	Override center of ma	ass:					
	Include hidden bodies/components	x: 0.00000m	. y. 0.06350m	^	7:	0.00000m	0	
	Create Center of Mass feature			~				
	Show weld bead mass	As defined in:	Part coordinate system (default)					
	Report coordinate values relative to:							



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

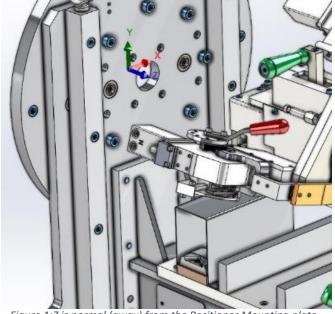
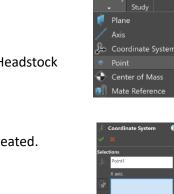


Figure 1:Z is normal (away) from the Positioner Mounting plate.







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

Motosize.SLDASM		
		Options
Override Mass Pro	perties Recalculat	te
🗹 Include hidden bodies	/components	
Create Center of Mass	feature	
Show weld bead mass		
Report coordinate valu	es relative to: default	~
Mass properties of Motos	ize	
Configuration: Default		
Coordinate system:	default	
* Includes the mass prope	rties of one or more hidden comp	ponents/bodies.
Mass = 209.808 kilogram	s —1	
Volume = 33873091.184	cubic millimeters	
Surface area = 6.974 squa	re meters	
Center of Mass : (meters)	2	
X = 0.019		
Y = -0.150		
Z = 0.316		
	nd principal moments of inertia: (kilograms * square meters)
Taken at the center of ma		
lx = (-0.012, 0.209,		
1 (0.105 0.073	0.206) Py = 23.526	
ly = (-0.105, -0.973, lz = (0.994, -0.100,	0.033) Pz = 25.863	
Iz = (0.994, -0.100,		
Iz = (0.994, -0.100, Moments of inertia : (kilo	grams * square meters)	ordinate system. (Using negative tensor notation.)
Iz = (0.994, -0.100, Moments of inertia : (kilo	grams * square meters)	ordinate system. (Using negative tensor notation.) Lxz = 0.262
Iz = (0.994, -0.100, Moments of inertia : (kilo Taken at the center of ma	grams * square meters) ss and aligned with the output co	
Iz = (0.994, -0.100, Moments of inertia : (kilo Taken at the center of ma Lxx = 25.835	grams * square meters) ss and aligned with the output co Lxy = -0.194	Lxz = 0.262
Iz = (0.994, -0.100, Moments of inertia : (kilo Taken at the center of ma Lxx = 25.835 Lyx = -0.194 Lzx = 0.262	grams * square meters) sand aligned with the output co Lxy = -0.194 Lyy = 22.854 Lzy = -3.266	Lxz = 0.262 Lyz = -3.266
iz = (0.994, -0.100,	grams * square meters) sand aligned with the output co Lxy = -0.194 Lyy = 22.854 Lzy = -3.266 grams * square meters) linate system. (Using negative ter	Lxz = 0.262 Lyz = -3.266 Lzz = 8.266 sor notation.)
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$i_z = (0.994, -0.100)$, Moments of inertia : (kilo Taken at the center of ma Lxx = 25.835 Lyx = -0.194 Lzx = 0.262 Moments of inertia: (kilo; Taken at the output coord bx = 51.506 bx = 51.506	grams * square meters) sand aligned with the output co Lyy = -0.194 Lyy = 22.854 Lzy = -3.266 grams * square meters) linate system. (Using negative ter lyy = 0.404 Jyy = 43.880	Lyz = 0.262 Lyz = -3.266 Lyz = 8.266 3 sor notation.) byz = -0.998 lyz = 6.679
Iz = (0.994, -0.100, Moments of inertia : (kilo Taken at the center of ma Lxx = 25.835 Lyx = -0.194 Lzx = 0.262 Moments of inertia: (kilo Taken at the output coord bx = 51.506	grams * square meters) ss and aligned with the output co Lxy = -0.194 Lyy = 2.2.854 Lzy = -3.266 grams * square meters) linate system. (Using negative ter lxy = 0.404	Lxz = 0.262 Lyz = -3.266 Lzz = 8.266 sor notation.) kz = -0.998
iz = (0.994, -0.100), Moments of inertia : (kilo Taken at the center of ma Lxx = 25.835 Lyx = -0.194 Lzx = 0.262 Moments of inertia: (kilo; Taken at the output coord bx = 51.506 bx = 51.506	grams * square meters) sand aligned with the output co Lyy = -0.194 Lyy = 22.854 Lzy = -3.266 grams * square meters) linate system. (Using negative ter lyy = 0.404 Jyy = 43.880	Lyz = 0.262 Lyz = -3.266 Lyz = 8.266 3 sor notation.) byz = -0.998 lyz = 6.679

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.

Mass/Section Property Options	\times
Units	
Scientific Notation	
O Use document settings	
Use custom settings	
Length: Decimal places:	
Meters V 5	
Mass:	
kilograms ~	
Per unit volume:	
millimeters^3 ~	
Density: 0.001 g/mm^3	
Lower (faster) Higher (slower)	
Inertia Tensor (Crossproduct Convention):	
Positive Tensor Notation	
O Negative Tensor Notation	
Show output coordinate system in corner of window	
OK Cancel Help	

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STEP 4: Enter the Data in MotoSize

Login to MotoSize.motoman.com

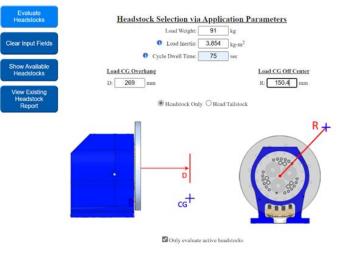
At the main page select the heading for **Headstock**, then **Select Headstock via Application Parameters**

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

- 1. Load Weight = Mass (Kg)
- 2. Load Inertia = 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 *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







PARTNER SUPPORT Shared Integration Experience 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.

STEP 5: Review the Results

Create New Headstock Report	<u>Headstock Results</u>				
	Input Parameters				
View Existing Headstock	Load Weight:	91	kg		
Report	Load Inertia:	3.854	kg-m ²		
Show Available	Cycle Dwell Time:	75	sec		
Headstocks	CG Overhang - D:	269	mm		
	CG Off Center - R:	150.4	mm		
	Headstock Only	O Head/Ta	ilstock		

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

Create New							
Headstock Report	Headstock Rest	<u>ilts</u>					
	Input Parameters						
View Existing Headstock	Load Weight:	91	kg				
Report	Load Inertia:	3.854	kg-m ²				
	Cycle Dwell Time:	75	sec				
Show Available Headstocks	CG Overhang - D:	269	mm				
	CG Off Center - R:	150.4	mm				
	Headstock Only	O Head/T	ailstock				
	Only evaluate active	e headstock:	5				
	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 addi	tional detai	ls)				
	Model P	art #	Rated Bea	aring Mom	ent (%)	Inertia Ratio (may 5)	Motor Hold/Rated (%)

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

Summary Report

* These field	s must be completed before viewing the report.
Customer:	*
Engineer:	
Date:	02/20/2024 * (mm/dd/yyyy)
Comment:	
View Rep	ort

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

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- 4. The finished report will appear...select Printer Friendly Page
- 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:
 0/20/2024

 Comment:
 Version:

 Version:
 Version:

 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
CG Overhang - D:	269	mm
CG Off Center - R:	150.4	mm
Headstock Only	O Head/Ta	ilstock
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							

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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:

 Version:
 Website calculations (2023-03-17)