Sizing & Selecting Drive/Motor Solutions Using Motion Analyzer Online Tool

For Classroom Use Only!

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Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid a hazard
- recognize the consequence

SHOCK HAZARD

Labels may be located on or inside the drive to alert people that dangerous voltage may be present.

BURN HAZARD

Labels may be located on or inside the drive to alert people that surfaces may be dangerous temperatures.

Sizing & Selecting Drive/Motor Solutions Using Motion Analyzer Online Tool Size

Contents

Before You Begin

About this lab

With advancement in the cloud platform and demand of accessibility, Motion Analyzer was re-introduced as a web-based platform to enable engineers to easily share, access, and store information via the cloud. A user with a Motion Analyzer online account can create new applications, access existing application data, share sizing information, or simply browse for drive or motor product information.

By offering a broad range of functionality, Motion Analyzer online tool helps you evaluate your options earlier in the design process, expands your options to find the best solution, provides the latest offerings from Rockwell Automation and our PartnerNetwork™, optimizes ramp up time, and ultimately helps you build a better machine.

In this lab, we will explore an application popular among motion specialists and distributors. The goal of the lab is to help you understand how to use the online tool to size a drive system with Direct Front Ends and Dual Axis Inverters.

This lab takes approximately **90** minutes to complete.

Pick and Place Application

The Pick and Place machine below accepts packages at random, stages packages to be picked up from assembly and places packages into a case on a synchronized product belt before cases are taken away for shipment.

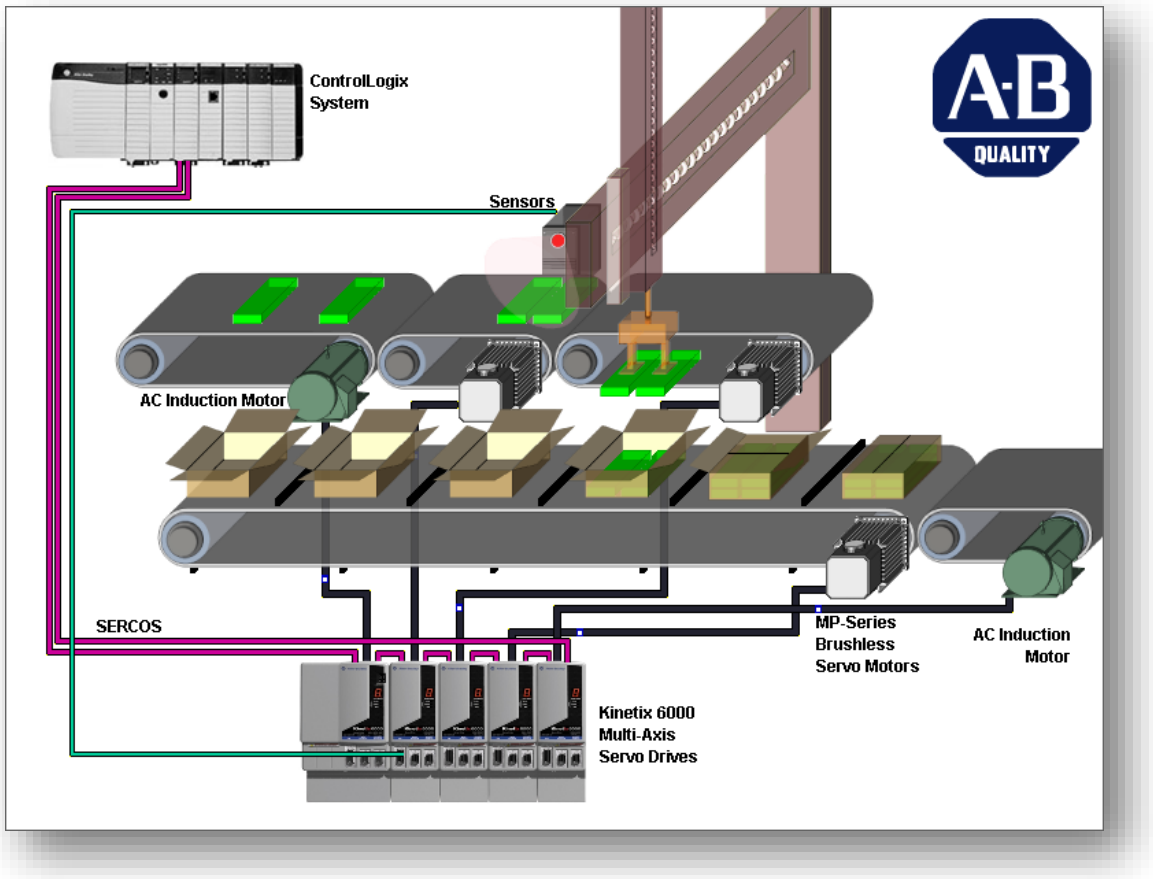


Figure 1: Pick & Place machine

Customer Briefing

The ABC Foods Company has Pick and Place machines that are exactly like the machine in the above example. The company is going green and has been working with OEM Packenship to make their machines more energy efficient. ABC Foods is also making a huge commitment to remove all safety relays and older model VFDs from their control panels and to integrate all motion control over Ethernet using a **GuardLogix Controller**; so, Packenship is eager to propose an upgrade for the original Allen Bradley control system on the first machine installed at ABC Foods. Unfortunately, Packenship engineers cannot agree on which drives to use for a complete CIP Motion Solution. Luckily, you happen to stop by Packenship and here's what you found out:

The original Allen Bradley control systems at ABC Foods include L63 CPUs and 8-axis SERCOS modules used to control Kinetix 6000 drives. Packenship has an inventory of L72S GuardLogix controllers and they are certain ABC Foods will agree to purchase a complete set of L72S GuardLogix controllers and EN2TR Ethernet modules along with Safety I/O modules for every machine. *ABC Foods attended Automation Fair to learn about CIP Safety Drives and wants to take advantage of this new technology.* Packenship is certain that ABC Foods will want to replace the older model servomotors and asynchronous motors used on their belt actuators and conveyors. *ABC Foods is using Wittenstein Alpha SP+ gearheads for the original smartbelt design and prefer to use them if still necessary.*

Packenship engineers realize this application needs servo drives that can support more than 3kW and that it does not need a Safety Drive like the Kinetix 6500; so, the Kinetix 5500 does appear to be the right drive for the job. After all, it is a more efficient drive and it can even control the induction motors on the two outer conveyors. Packenship is certain that ABC Foods will want to replace the older model servomotors and asynchronous motors used on their belt actuators and conveyors, especially after hearing about how VP-series motors are designed to be more energy efficient.

The problem is, Packenship engineers heard about plans for a new Kinetix 5700 dual-axis inverter drive that can support both VP and MP series motors without the need for a Hiperface converter and began debating the Kinetix 5500 drive cannot support the MP-series Actuators without adding a Hiperface Converter for each lead screw actuator.

One Packenship engineer suggested that using a Kinetix 5500 for all 7 axes might take up more room than (1) Kinetix 5700 DFE Module and (4) Dual-axis inverter modules while another engineer argued that the existing panel space is not an issue since they used to have Kinetix 6000 drives and older model VFDs in their system.

Still another Packenship engineer pointed out, "At least ABC Foods doesn't have a need for a hard-wired auxiliary encoder; otherwise, they would not be able to use the Kinetix 5500".

Objectives

You've received a call from one of the OEM Packenship engineers. The engineer shares the information with you and asked for your thoughts. After reviewing the customer requirements, you figured the Kinetix 5700 will be the most efficient solution for the application.

You are meeting with your OEM Packenship contact, and you suggested to use Motion Analyzer online tool. The engineer is more familiar with Motion Analyzer desktop tool, however the desktop tool does not offer the latest and greatest from Rockwell Automation and the encompass partners. Using your diplomatic skills, you convinced the distributor to work with you to model the application on Motion Analyzer online tool. You would be able to determine if the application requires more than 15kW for any axis. After all, if the Kinetix 5500 and Kinetix 5700 do come up as adequate drive solutions, one still needs to consider other costs (e.g. Drive hardware, installation/labor, cables and accessories, etc.) as you optimize a final drive/motor solution.

General Requirements

Motion Analyzer online supports many filters to eliminate incompatible products from drive/motor solutions; so be sure to utilize the following data to optimize your search:

- Plant operates at ***460Vac*** with an ambient temp of ***30 degrees (C)***
- ***GuardLogix*** L72S Controllers are used for Machine Safety
- All Motion Control must be over ***EtherNet/IP*** and use ***CIP Safety***
- Servo Drives and Motors must be ***more energy efficient***

Belt Actuator Requirements

Assembly Index Belt - for <u>each</u> Assembly Index belt axis:

- Package weight <u>≤</u>1.5kg, and two packages at a time = 3kg total
- Belt Weight = .7 kg
- Drive Rolls, Quantity (2):
  - 100mm diameter (about 4")
  - 600mm long (about 24")
  - Rolled Steel
- Motor Coupling Moment of Inertia = 2.6g-cm^2
- Move 250mm (about 10") in 1 sec. and dwell for 1 sec.

Product Index Belt

In this section of the exercise, you will use the axis data from the Assembly Index Belts as the starting point for sizing this axis, but be sure to enter the differences below:

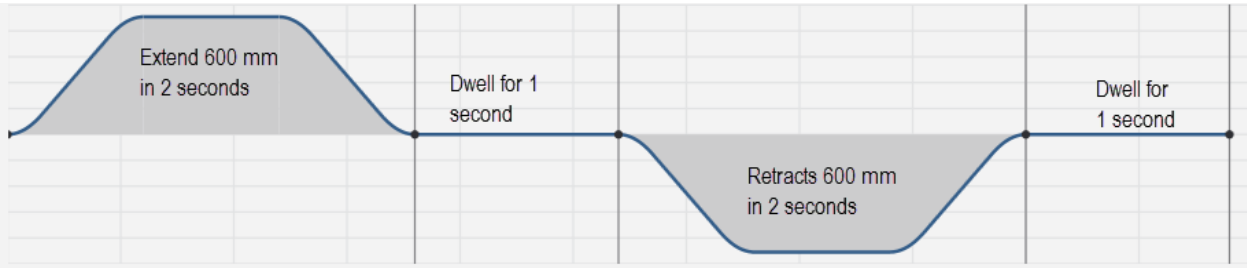
- Package weight <u>≤</u>1.5kg, and four packages per case x 3 cases = 18kg total
- Belt Weight = 2 kg
- Move 250mm (about 10") in 1 sec. and dwell for 2 sec.

Lead Screw Actuator Requirements

Horizontal Lead Screw Axis Setup Data:

- Package weight to be moved <u>≤</u> 3 kg
- Total Slide Mass (Includes Mass of Vertical Axis) = 45 kg
- Coefficient of Friction = 0.01 (= 1%)
- Lead Screw Specification:
  - Lead = 25 mm/rev
  - Length = 1200 mm
  - Diameter = 25 mm
  - Material = Steel
  - Efficiency = 90%
- Motor Coupling Moment of Inertia = 2.6g-cm^2

  Bi-directional move of 600 mm in 6 seconds overall. See profile drawing.

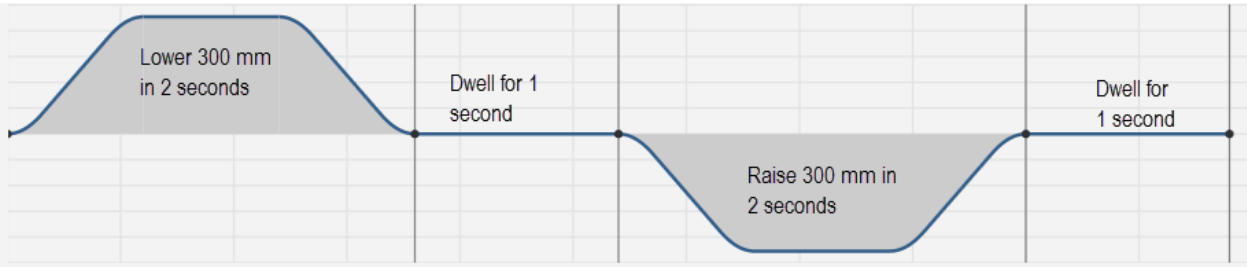


The move profile is described as "extending the horizontal actuator to transfer packages to the **Product Index Belt**, pausing for 1 second to complete the drop off, retracting the actuator back to the **Assembly Index Belt** and pausing for 1 second to pick up the next product."

Vertical Lead Screw Axis Setup Data:

In this section of the exercise, you will use the axis data from the horizontal lead screw as the starting point for sizing the vertical lead screw axis, but be sure to enter the differences below:

- Total Slide Mass = 25 kg (including fixtures and product grippers)
- Bi-directional move of 300 mm in 6 secs overall. See profile drawing.



The move profile is described as a Lower/Raise cycle which must occur at each end of the horizontal lead screw for

- Picking up packages from the **Assembly Index Belt**, remaining raised while the horizontal actuator finishes its move to a location over the **Product Index Belt**
- Placing packages into a case, remaining raised while the horizontal actuator finishes its move back to the start location over the **Assembly Index Belt**

Note: In an effort to use the worst case profile, the dwells in the above profile do not include the time for the horizontal actuator movements.

Constant Speed Conveyor Requirements

Infeed Conveyor Axis Setup Data:

- Package weight ≤1.5kg, up to two packages at a time = 3kg total
- Belt Weight = .7 kg
- Drive Rolls, Quantity (2):
  - 100mm diameter (about 4")
  - 600mm long (about 24")
  - Rolled Steel
- Motor Coupling Moment of Inertia = 2.6g-cm^2
- Move at a constant velocity near ≤ 250mm/sec.

Takeaway Conveyor Axis Setup Data:

In this section of the exercise, you will use the axis data from the Infeed Conveyor as the starting point for sizing this axis, but be sure to enter the differences below:

- Package weight ≤1.5kg, and 4 packages per case x 3 cases = 18kg total
- Belt Weight = 2 kg
- Move at a constant velocity ≤ 300mm/sec.

Tools & Prerequisites

The following are required to complete the exercises:

- Internet Explorer web browser
- Valid Motion Analyzer online user credentials to access the website

Login to the Motion Analyzer Website

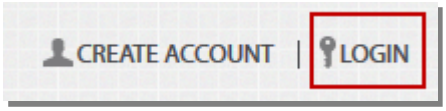
Motion Analyzer online tool requires a valid account for full access to the features of the tool. By logging in, you can create new applications, access existing application data, or simply browse for drive or motor product information. Let's begin by logging into the site.

Entering Lab User Credentials

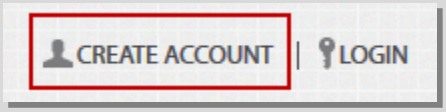
1. Open Internet Explorer web browser.
2. Click in the web address bar and type "**motionanalyzer.rockwellautomation.com**" to navigate to the Motion Analyzer website.

   NOTE: Do not type "www." prior to the web address, the link will take you to an unavailable webpage.

3. Enter your email address and Password by clicking on LOGIN



If you do not have an account, please register using the Create Account button.



Partitioning the Machine

You've visited ABC Foods facility with the OEM Packenship engineer. You were able to see the machine run and you documented it in the picture below:

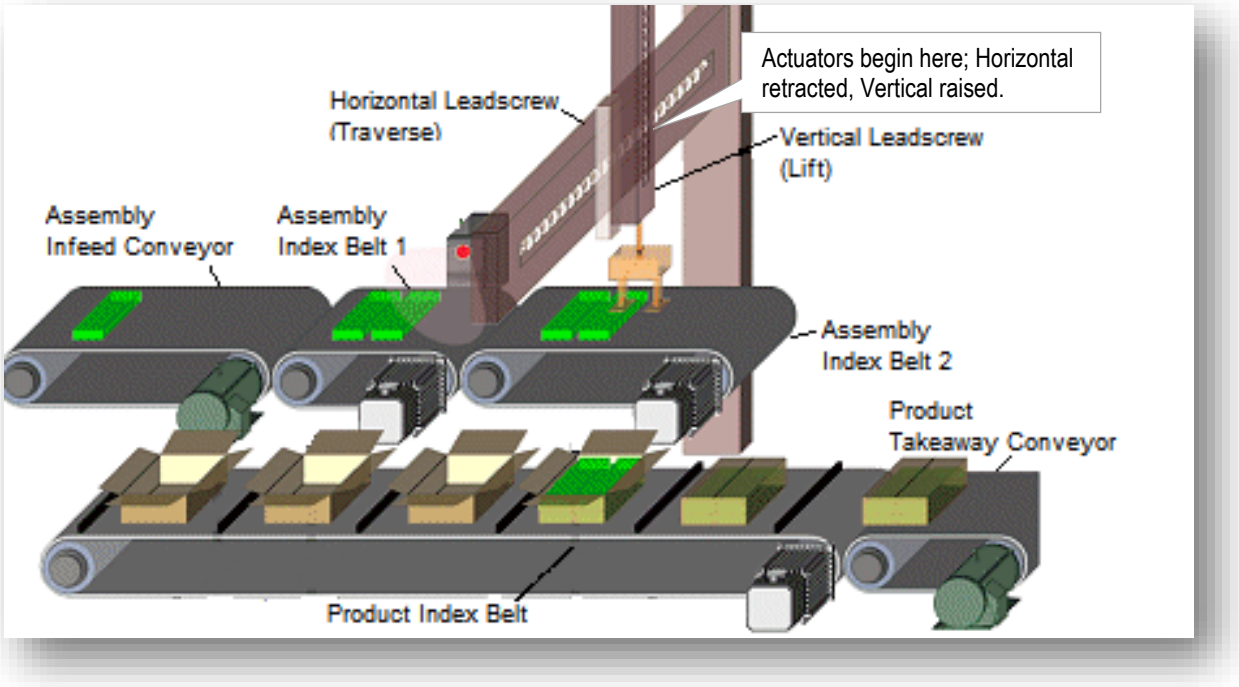


Figure 2: Pick & Place machine

You've partitioned the application into 3 sections with a total of 7 axes.

Section 1: Belt Actuator

- Part A: Assembly Index Belt 1
- Part B: Assembly Index Belt 2
- Part C: Product Index Belt

Section 2: Lead Screw Actuator

- Part A: Horizontal Lead Screw Axis
- Part B: Vertical Lead Screw Axis

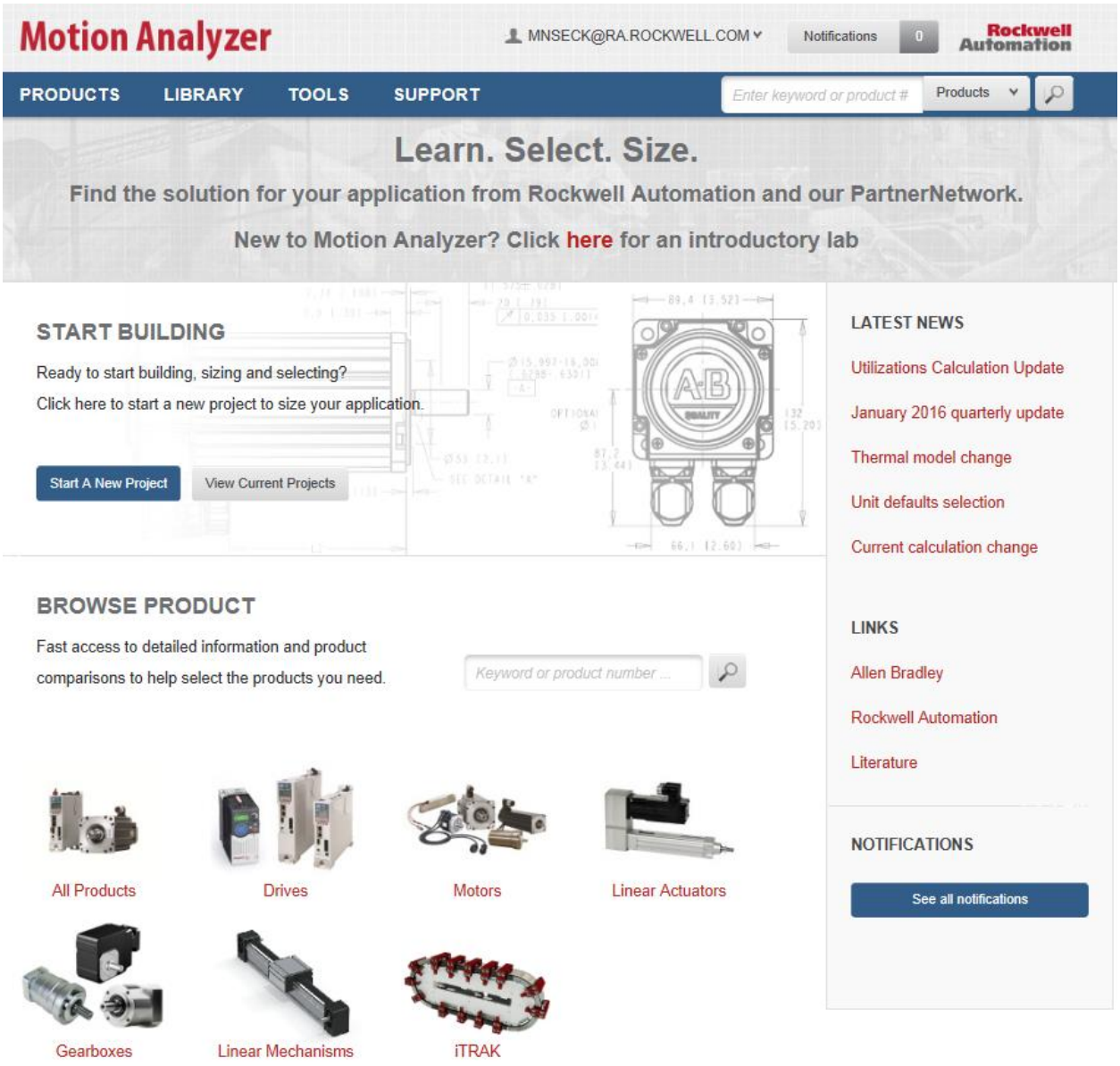
Section 3: Constant Speed Conveyor

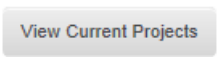
- Part A: Infeed Conveyor Axis
- Part B: Takeaway Conveyor Axis

At this point, we will begin to create our project and size our application.

Motion Profile

When you have logged into Motion Analyzer, you can see the following:



The current view offers you access to your project library in 

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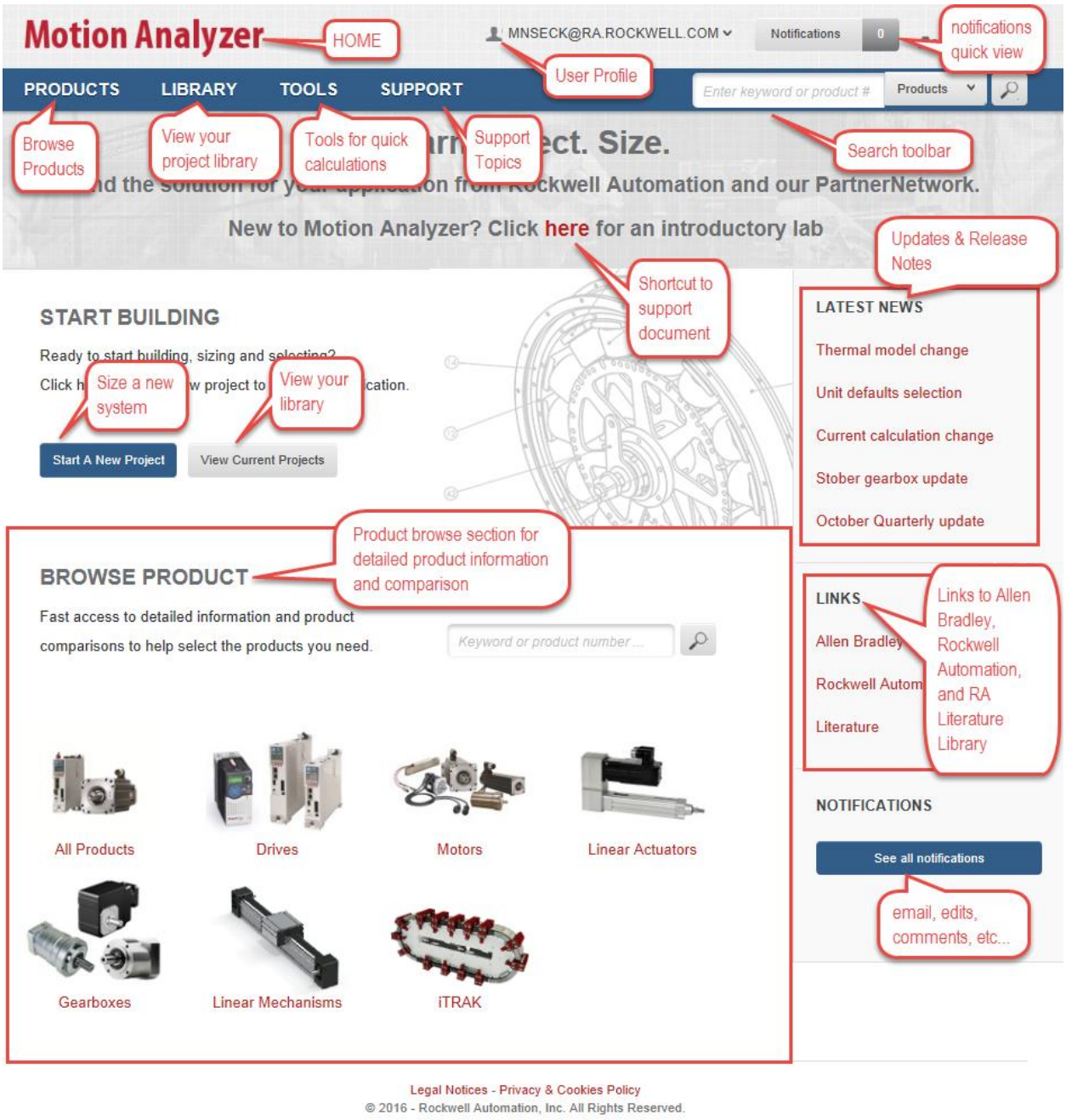
So what is available from the Home page? On the next page, we will describe the navigation buttons and Link sections that are available on the Home page.



Home Button: is accessible from any point within the tool and will bring you back to this home view.

Products Button: takes you to the Browse Product page where you can view drives, motors, iTrak, linear Actuators, linear mechanisms, and gearboxes. You can select to browse any family of products from Rockwell Automation and from our Encompass Partners.

Library Button: takes you to your projects list where you can view the projects by name, last modified or date created, owner, shared status, and actions (share, duplicate, or delete).

Tools Button: provides the Compatibility Browser, to quickly find compatible product combinations; Inertia Calculator, to find the inertia of an object based on size and material; Common Bus Estimator, for guidelines, considerations, and limitation for the proper application of drives used in common bus configurations; and cable selector, to select cables.

Support Button: provides support topics ranging from Library object descriptions, benefits and security of the cloud, lab resources and tutorials, calculation changes, updates information, etc…

User Profile: displays the email used to login. You can click on the dropdown arrow to View Profile, Manage Sharing, and Logout.

Notifications Quick View Button: similar to "See All Notifications", provides a quick view of the number of notifications.

Search Toolbar: provides a faster search for specific products.

Start A New Project Button: start building your system profile using this button

View Current Projects: takes you to your projects library

Browse Product: select a product to view detailed information or compare between product families

Latest News: post section for released noted, changes to features, and updates news

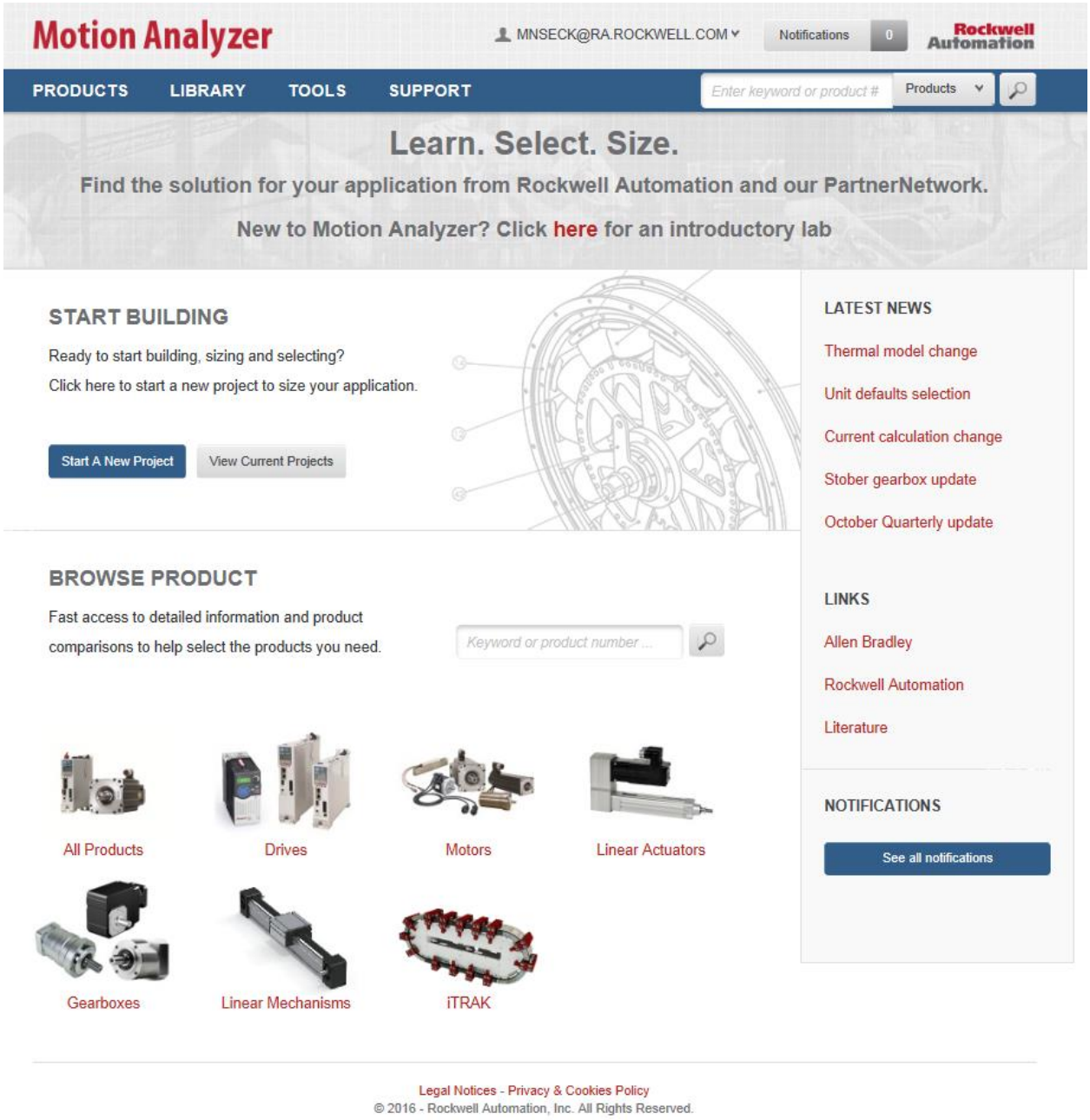
Links: portals to Allen Bradley website, Rockwell Automation website, and Rockwell Automation Literature library

NOTE: For more details on Navigation, please review the Motion Analyzer Online Tool Navigation Guide found in the Support page of the online tool under Additional Resources.

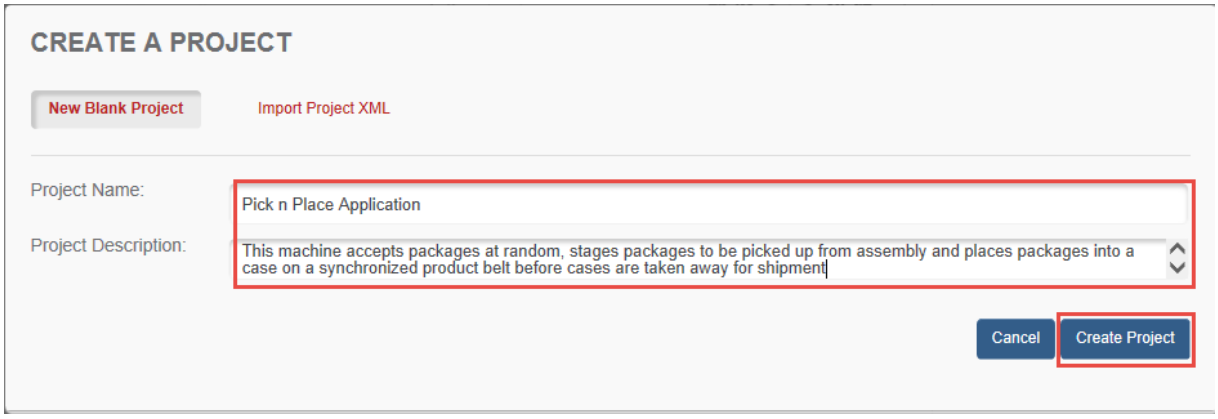
Belt Actuator

Part A: Assembly Index Belt 1

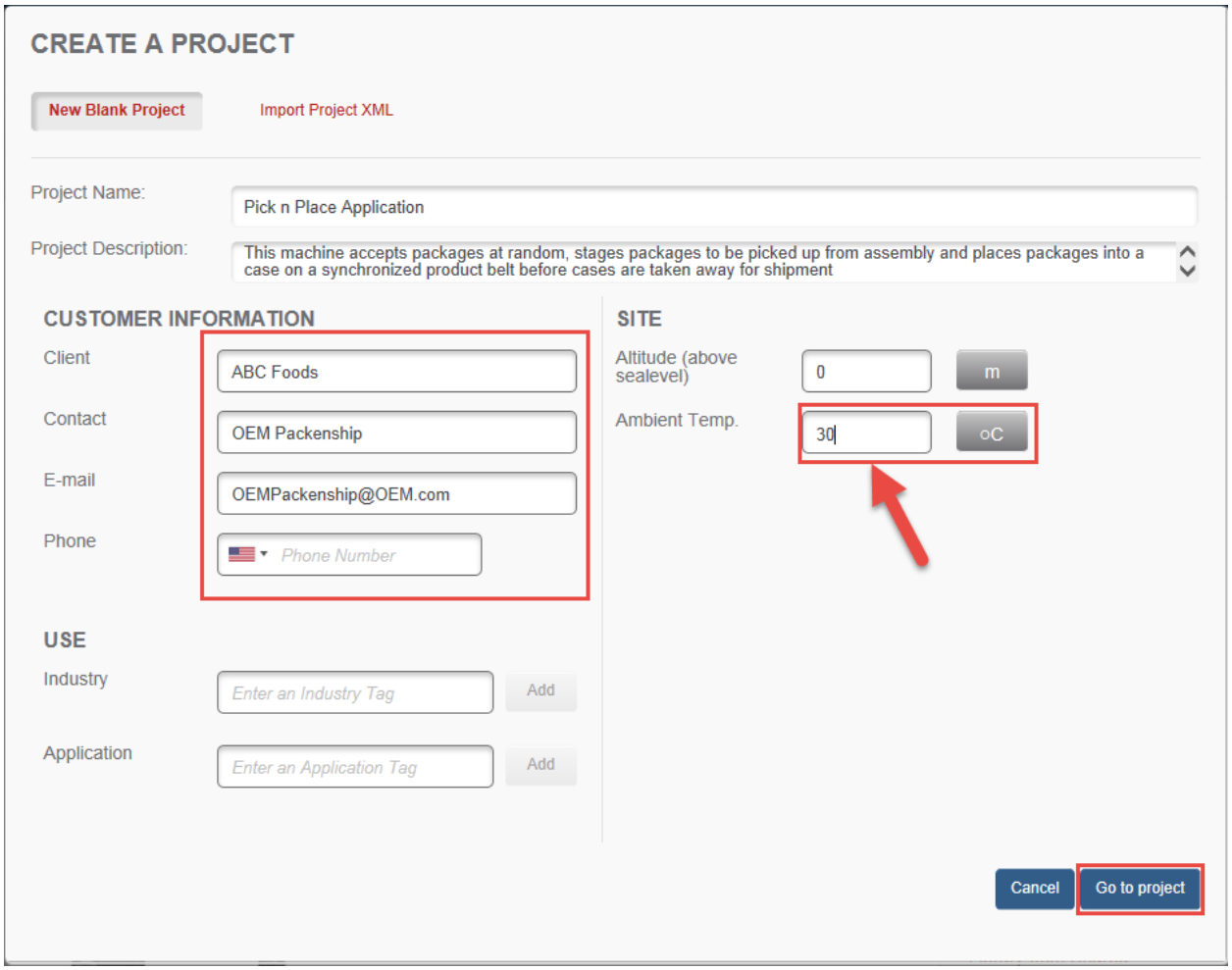
1. On the home page, click the "**Start A New Project**" button.



2. In **Create A Project** dialog box, you will enter a name for *Project Name* and a description (optional) in the *Project Description* input box, and click the **Create Project** button.

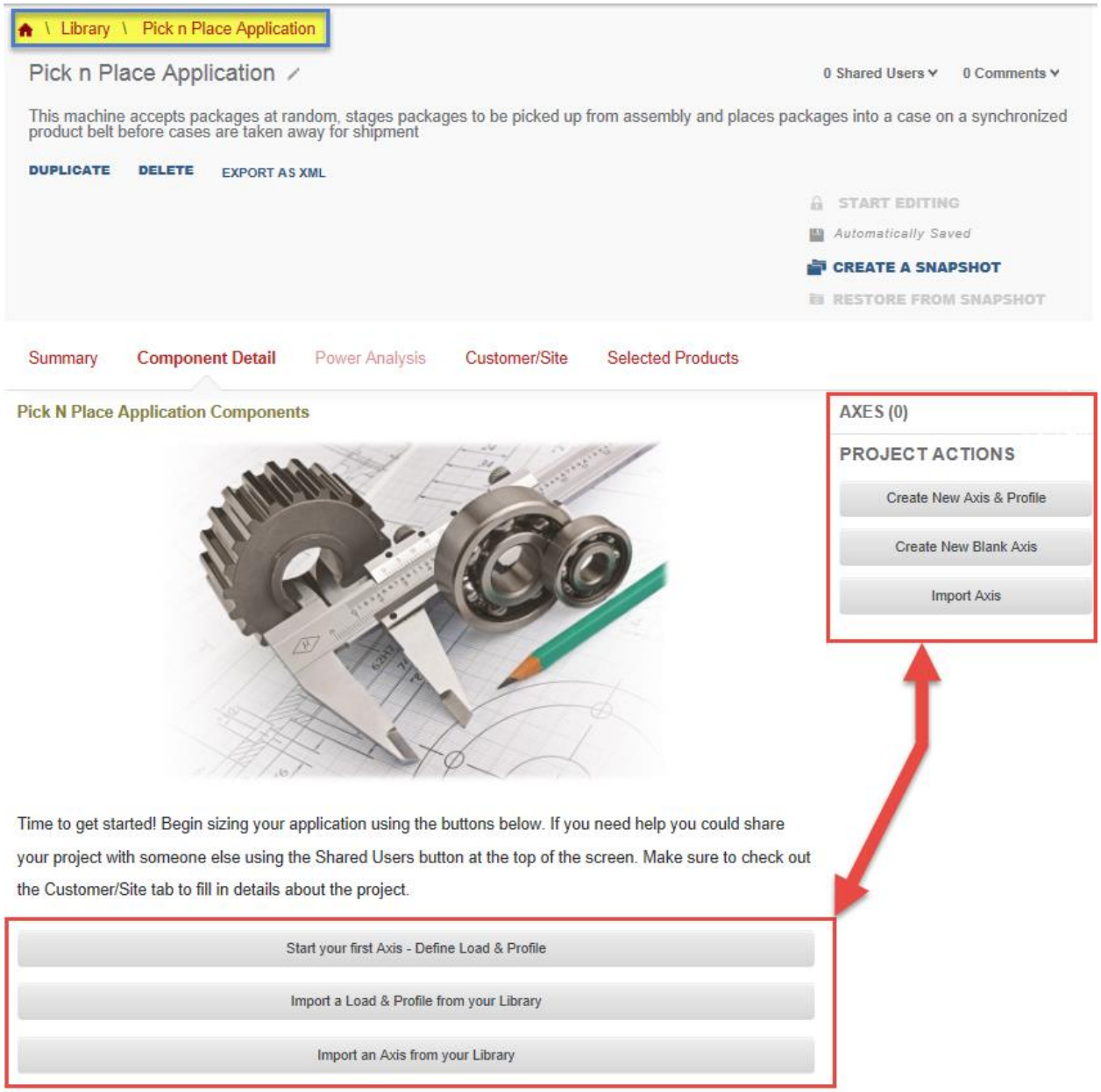


3. Enter customer data in the Customer Information section and fill the Site section of this lab. The Ambient Temp can be entered at this point. Click the **Go to project** button.



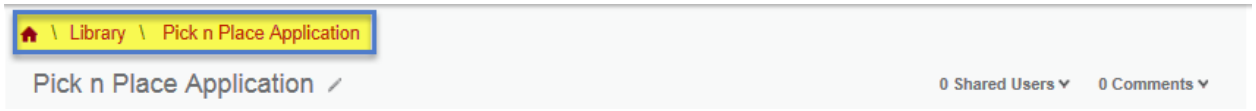
NOTE: In the Use section, you can enter filters in the *Industry and Application* tabs by entering the information and clicking *Add*. You then will be able to filter your Library by industry and application specific projects.

4. The Project Detail page will appear. Click the *Create New Axis & Profile* button in the Project Actions section.



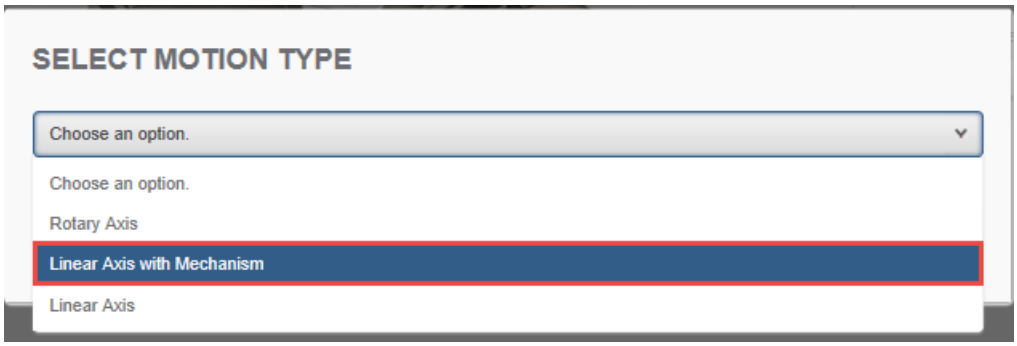
NOTE: Both red encircled sections perform the same task in creating your profile. You may select to start your project using "Start your first Axis – Define Load & Profile" or "Create New Axis & Profile."

NOTE: The blue higlighted section shows quick access links to home\Library\Name of Project. At any point in the lab, you can go to the Home page, Library, or Component details page of your project. Make sure to Save your project when needed.

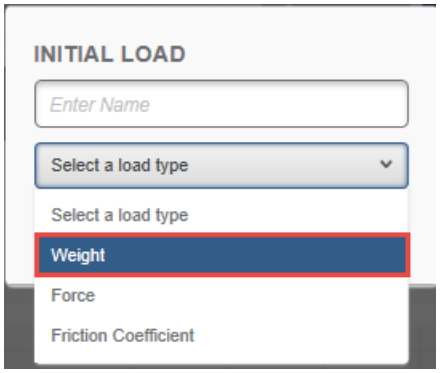


5. The Belt Actuator axes are linear axes with mechanism types. The motion profile is entered for the load, so in our case, we will be entering linear motion profile data.

   Select **Linear Axis with Mechanism** from the Select Motion Type dropdown list and click the **OK** button.

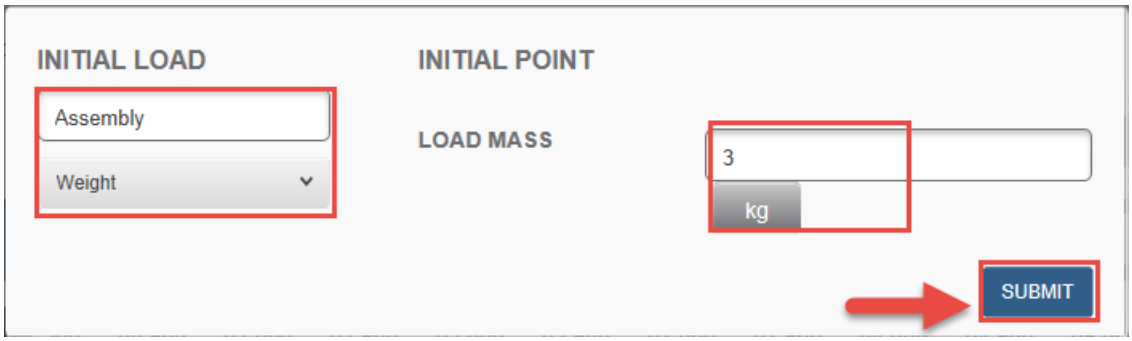


6. Select **Weight** from the Initial Load dropdown list.



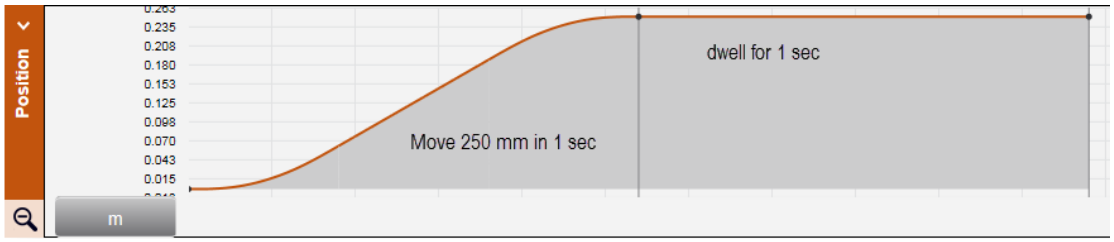
7. The Assembly Index Belt is moving up to two packages at a time. Each packages is 1.5 kg, therefore our load mass is 3 kg. The belt weight will be entered at a different section.

   Enter "**Assembly"** for the name of the load. Since the profile starts with the load on the conveyor, enter "**3**" kilograms as the initial point, and click the Submit button

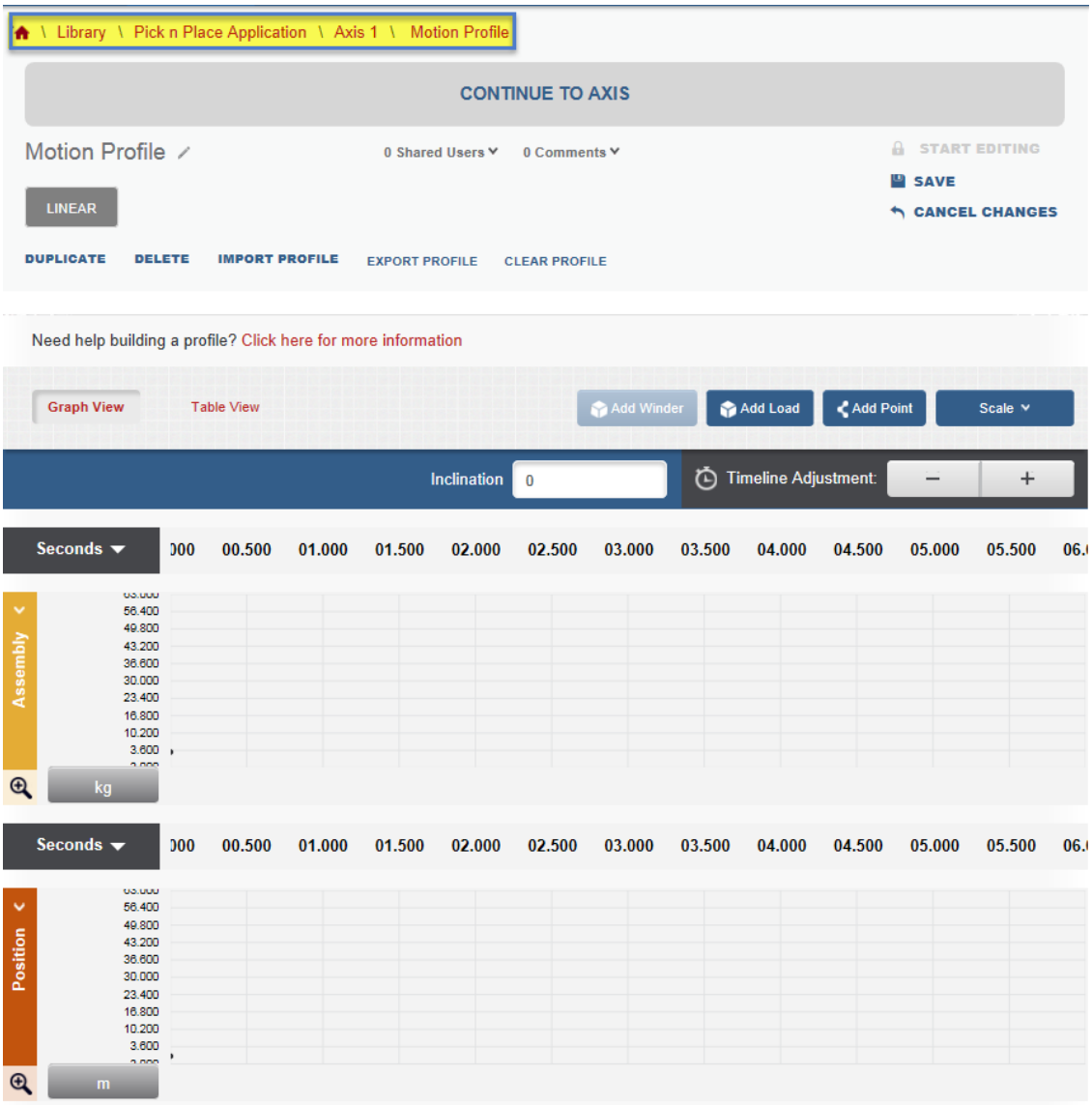


Defining a Motion Profile

Here is the motion profile that has been specified for the application.

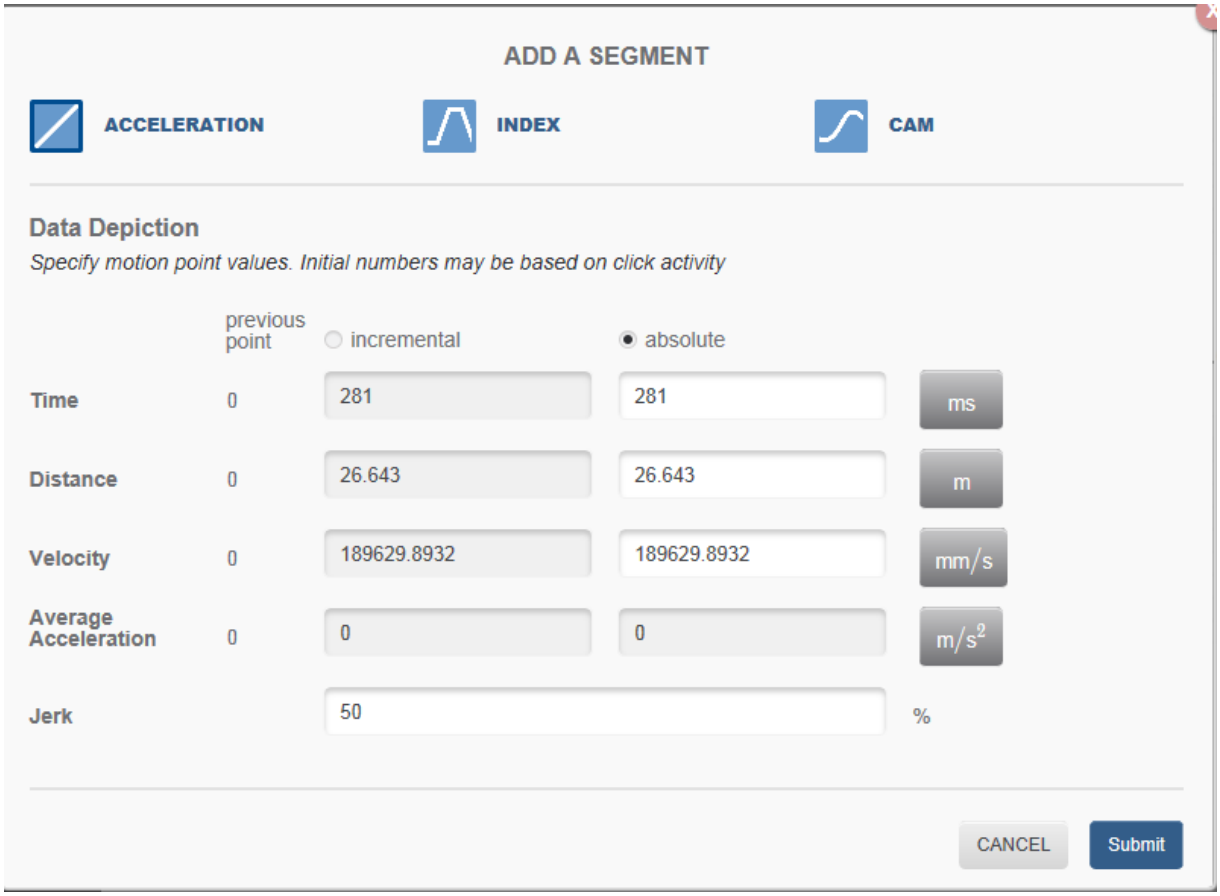


Since the Assembly Index Belt axis is running for 250 mm for 1 second then dwelling for 1 second. We have two segments in our position profile. Let's look at how to enter this information into the Profile page in Motion Analyzer.

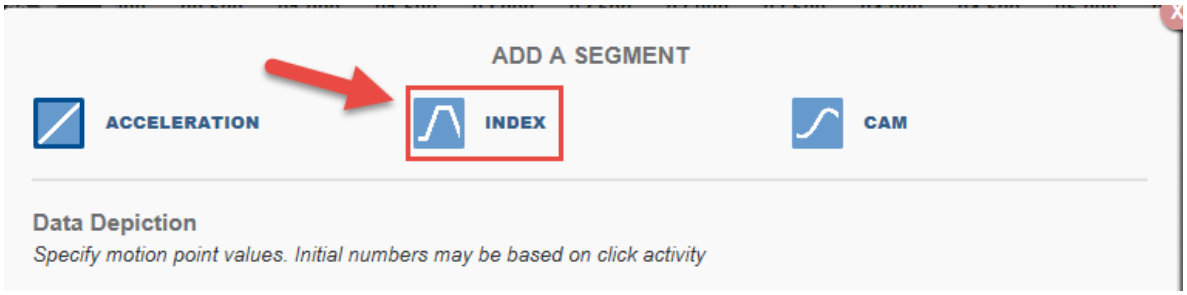


NOTE: Your highlighted page navigation links can now direct you to Home\Library\Component Detail\Axis properties\Motion Profile.

1. To enter a position profile data point, click anywhere on the **Position Plot**. The Add a Segment dialog box will appear at the Acceleration option.

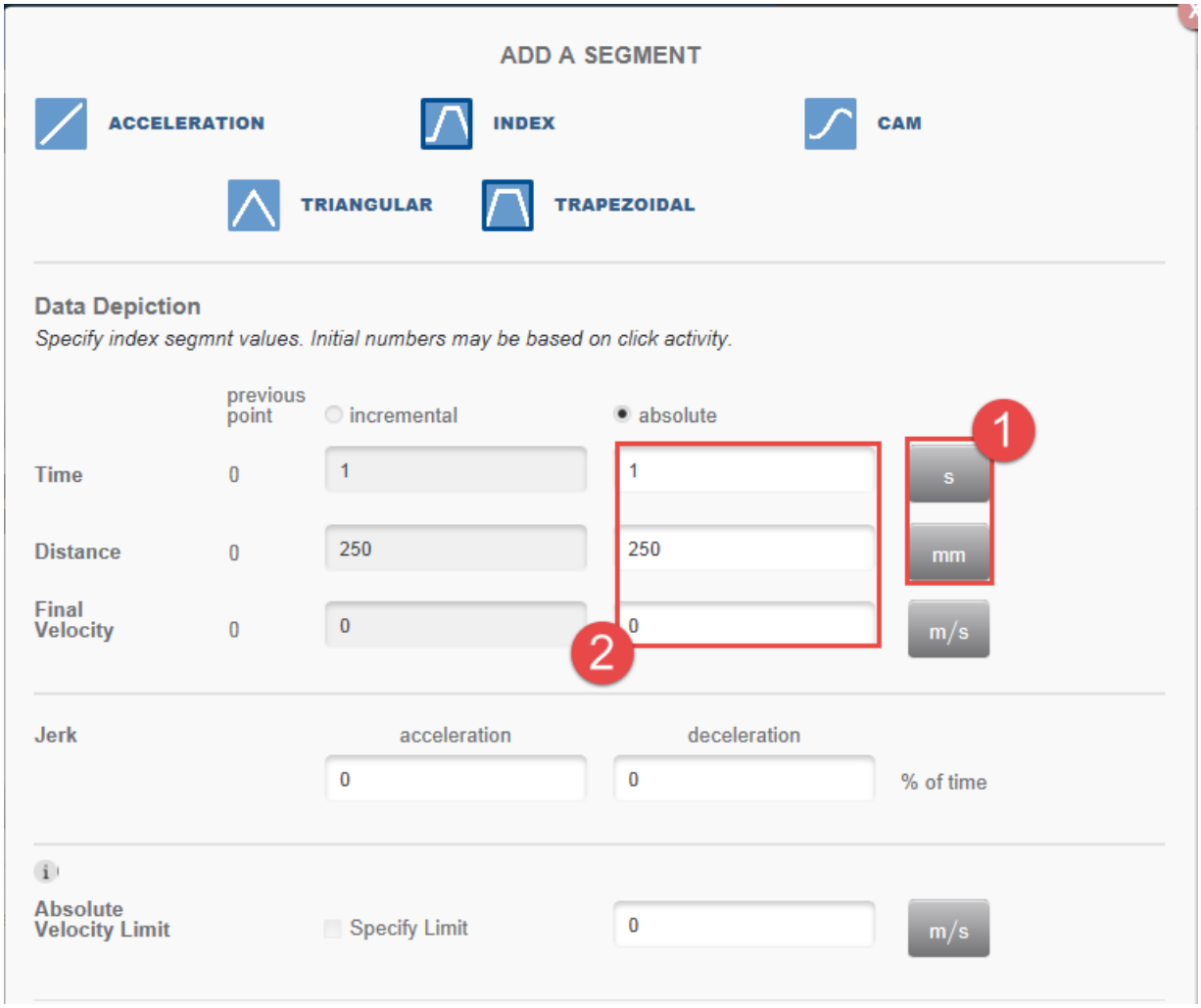


2. Our first segment is an Index move. Click **Index** to add the index segment.

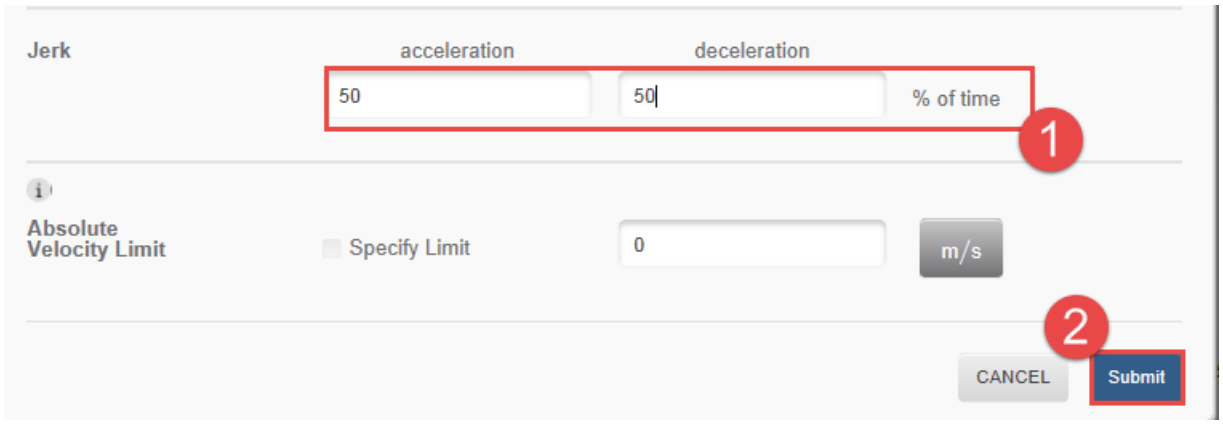


3. When selected, the **Index** segment will automatically preselect a **Trapezoidal** Index Segment.

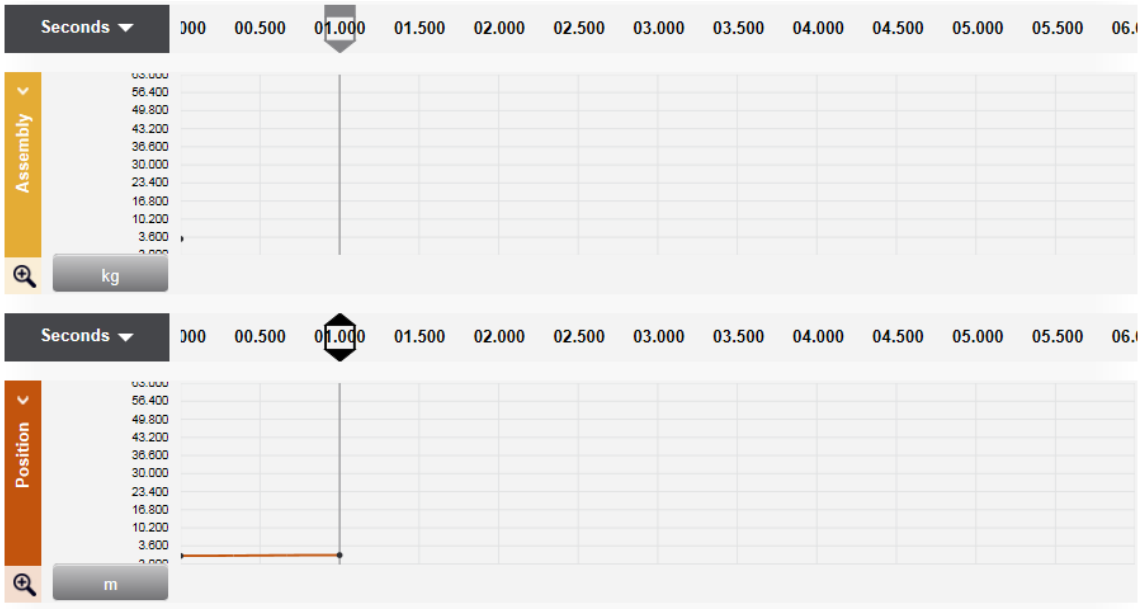
4. With the **Absolute** entry method selected, change the units of *Time* to **s** and *Distance* to **mm**. Replace the pre-selected time value with "**1**" and the pre-selected distance value with **"250"**.



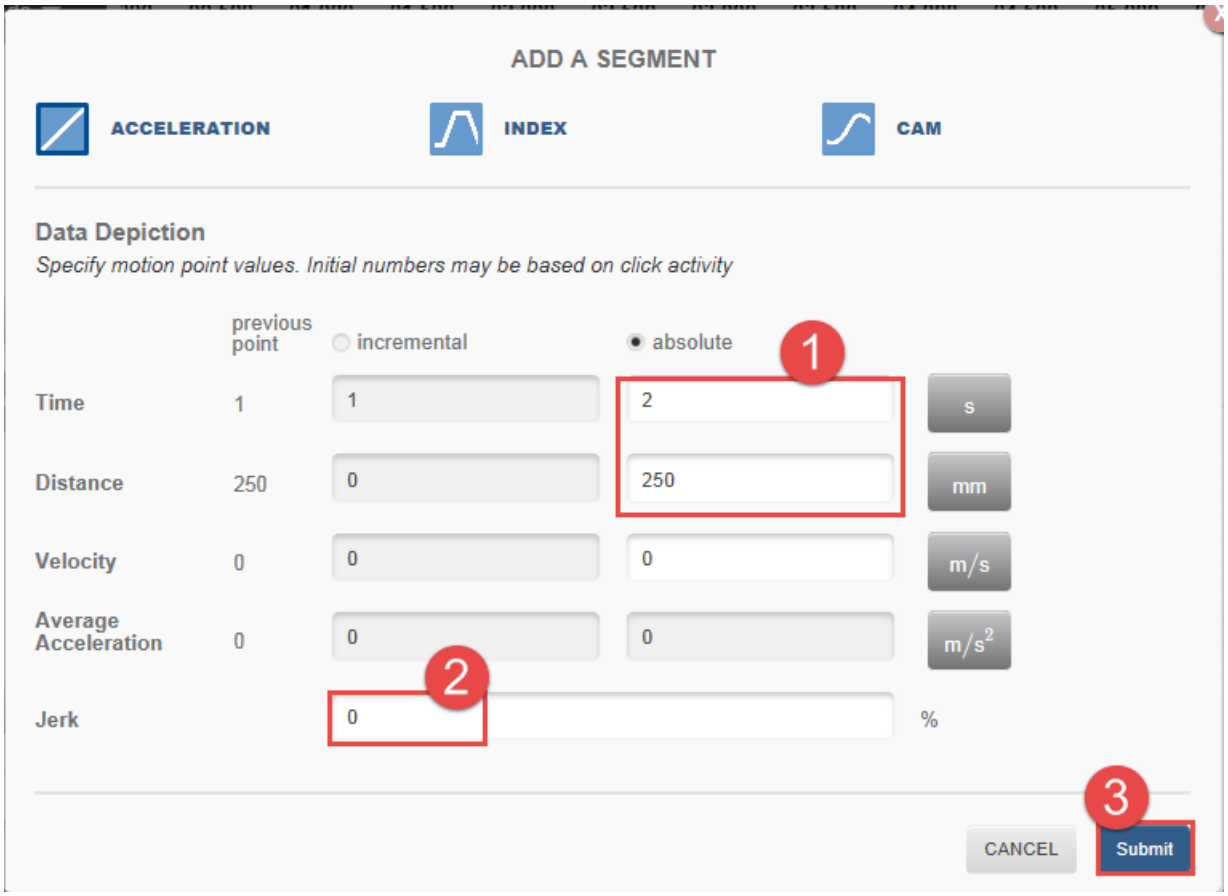
5. Before clicking **Submit**, we will add an accel/decal *Jerk* for a smoother acceleration and deceleration profile. Enter 50 for both *acceleration* and *deceleration*.



6. The first segment of our profile has been added and looks as follows:



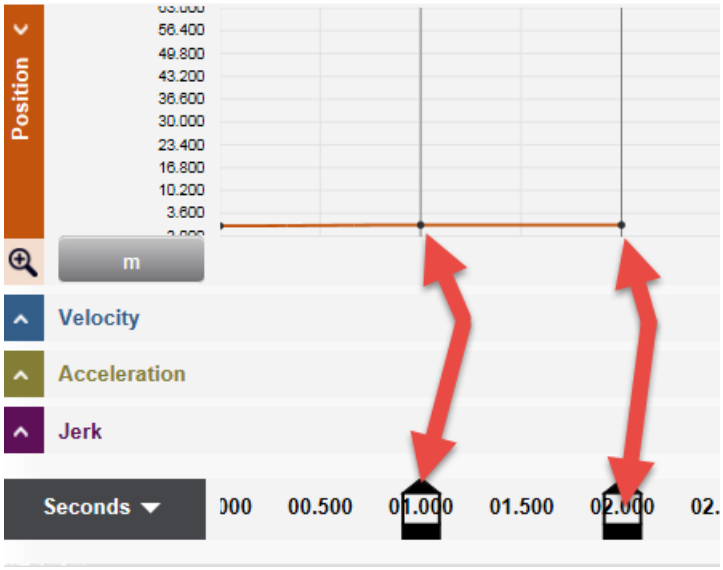
7. Let's add our second segment to the profile by clicking on the *Position* plot again. The second segment is a dwell segment, therefore we will use the **Acceleration** Segment. Enter the values to match the image below and click **Submit**



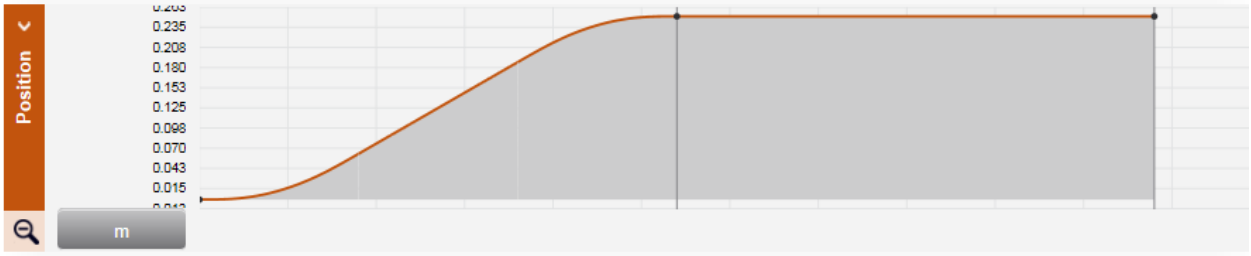
NOTE: When you enter values for an Acceleration segment, the velocity input will automatically change when you enter a time with prefixed distance. Motion Analyzer is assuming a Time/Distance entry and will estimate the velocity and Average Acceleration. When we have a specific velocity, we can enter Time/Velocity and Motion Analyzer will estimate the distance and Average Acceleration.

NOTE: With the a*bsolute* entry method, user needs to be conscious that absolute position = previous point + incremental. Motion Analyzer does the calculations to reflect a*bsolute* or *incremental* entry method. If we were to select the incremental entry method, our Time entry would be 1 second and the Distance 0.

8. After clicking the **Submit** button, we will see two points in our plot ending at 2 seconds.



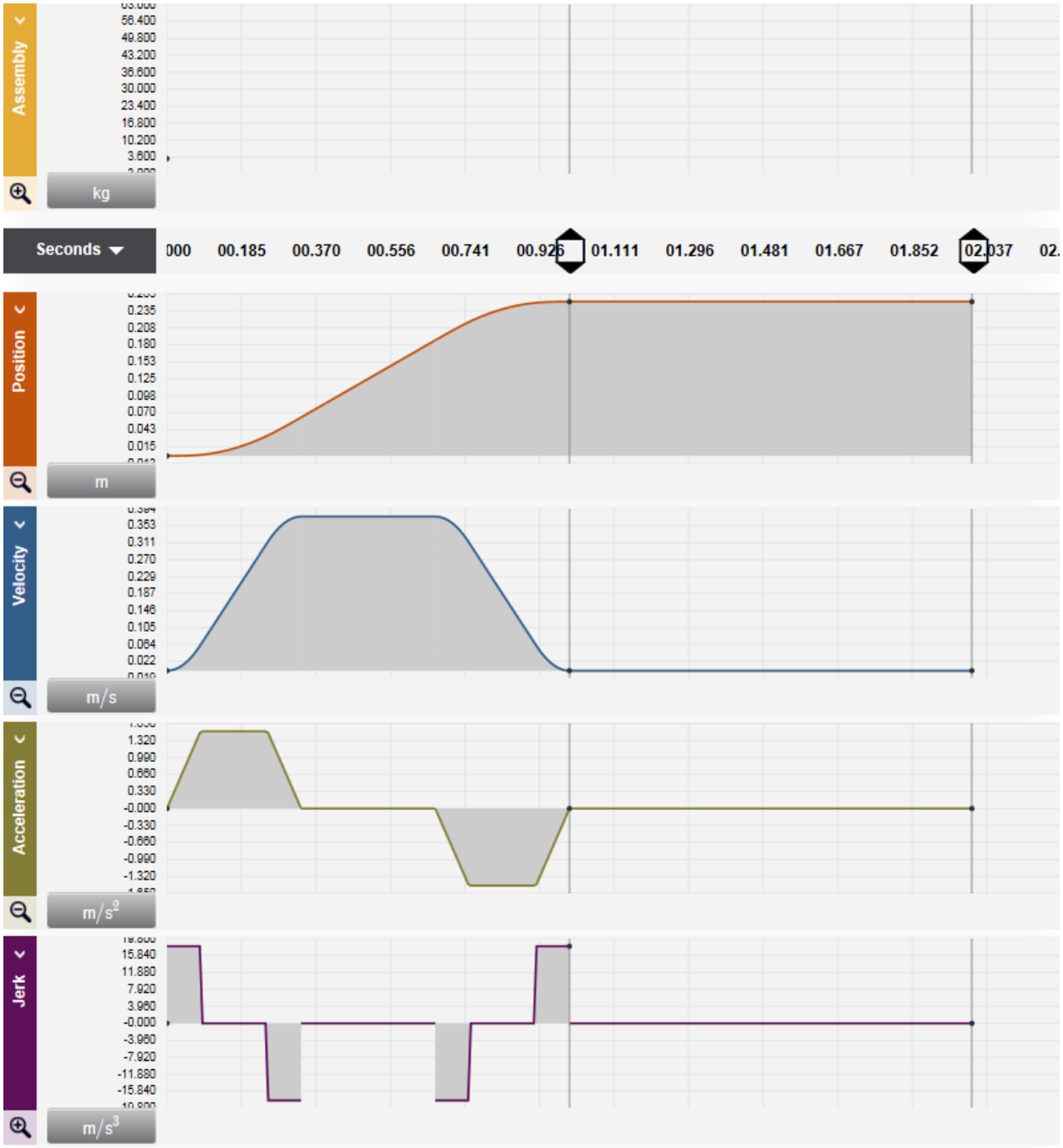
9. To expand your view, click on  . Your *Position* profile will look as follows



10. Click on the dropdown arrows near your *Velocity*, *Acceleration*, and *Jerk* profiles.

11. You should be able to view a full plot for each profile after your expand and click on  for your Velocity and Acceleration profiles.

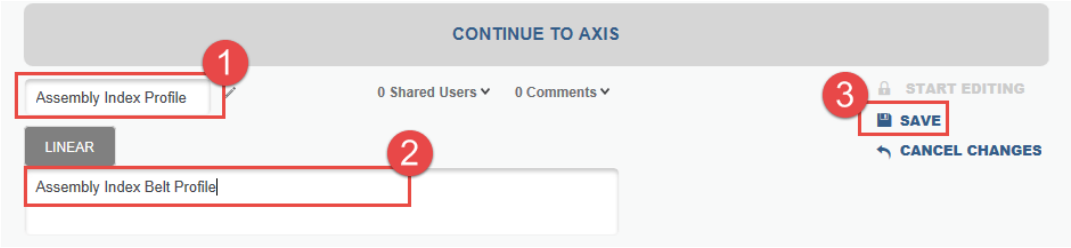
12. Your completed profile should look as follows:



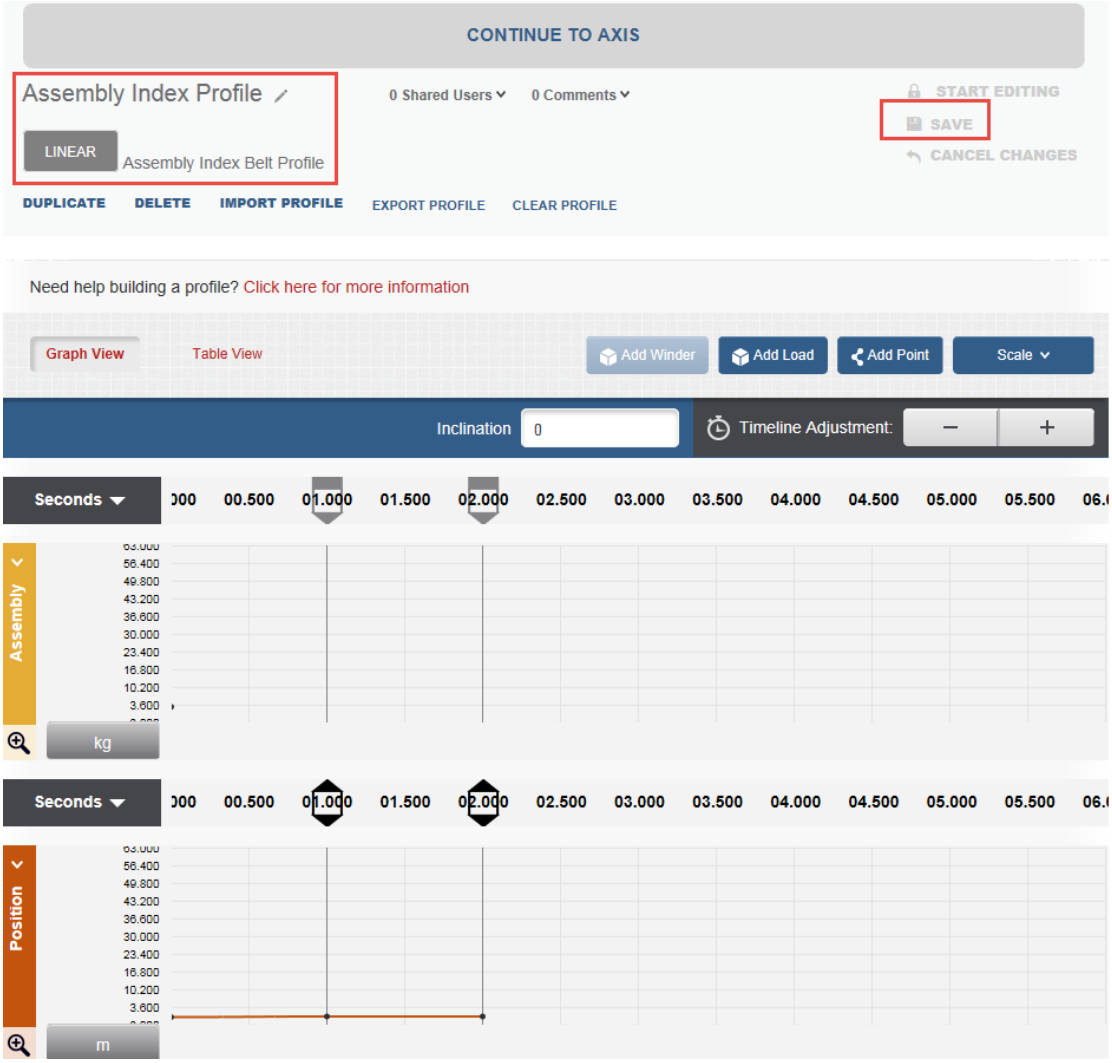
NOTE: You may notice that the *Position*, *Velocity*, *Acceleration*, and *Jerk* profiles extend to your 2 seconds but not your Assembly. Motion Analyzer is assuming your load is constant throughout the profile when you place only one point on the Load profile (applies to Force, inertia, torque, and Friction coefficient as well). If your load were to change at any segment, you will need to add the new point.

13. At this point, we will rename the profile by clicking on the pen near *Motion Profile.*

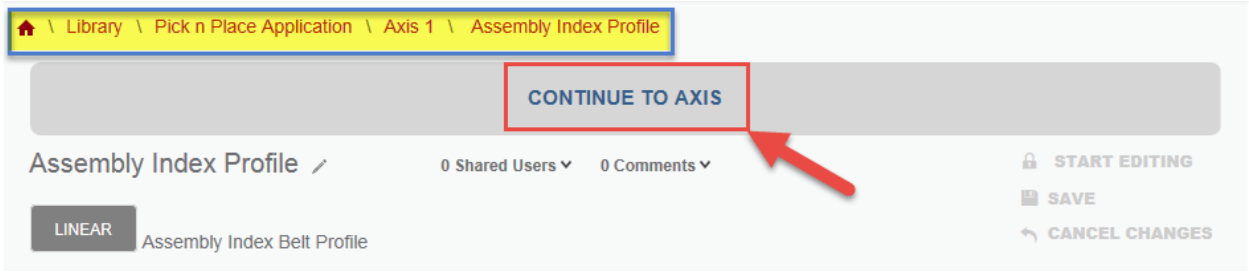
14. Enter Assembly Index Profile as your new Profile name and its description (optional). Click **Save** once done.



15. Your saved profile will look as follows

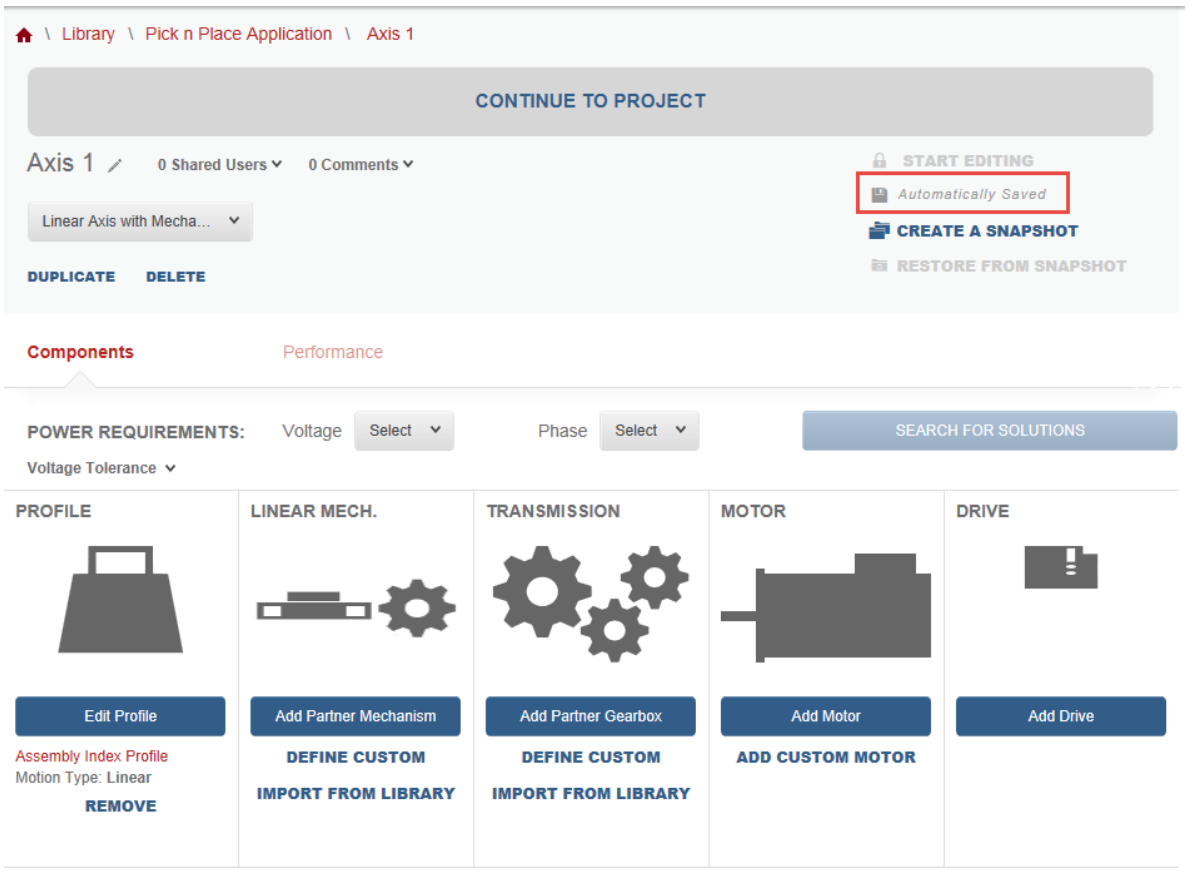


16. Click on **Continue to Axis**.

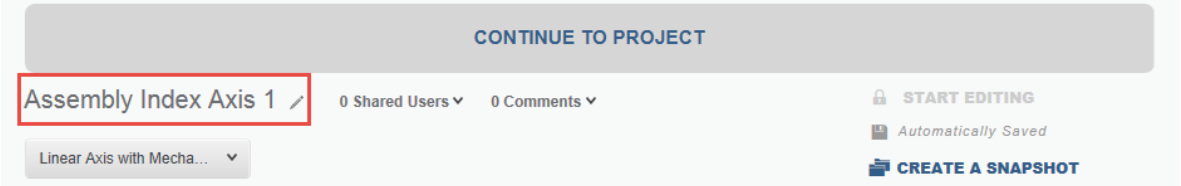


NOTE: The highlighted section links to page navigations and you can go to Home \ Library \ Poject Component Detail \ Axis Components page \ Motion Profile.

17. After clicking **Continue to Axis**, you are sent to the *Axis Components* page. You can view your components in this project and any changes made in this page will be automatically saved.



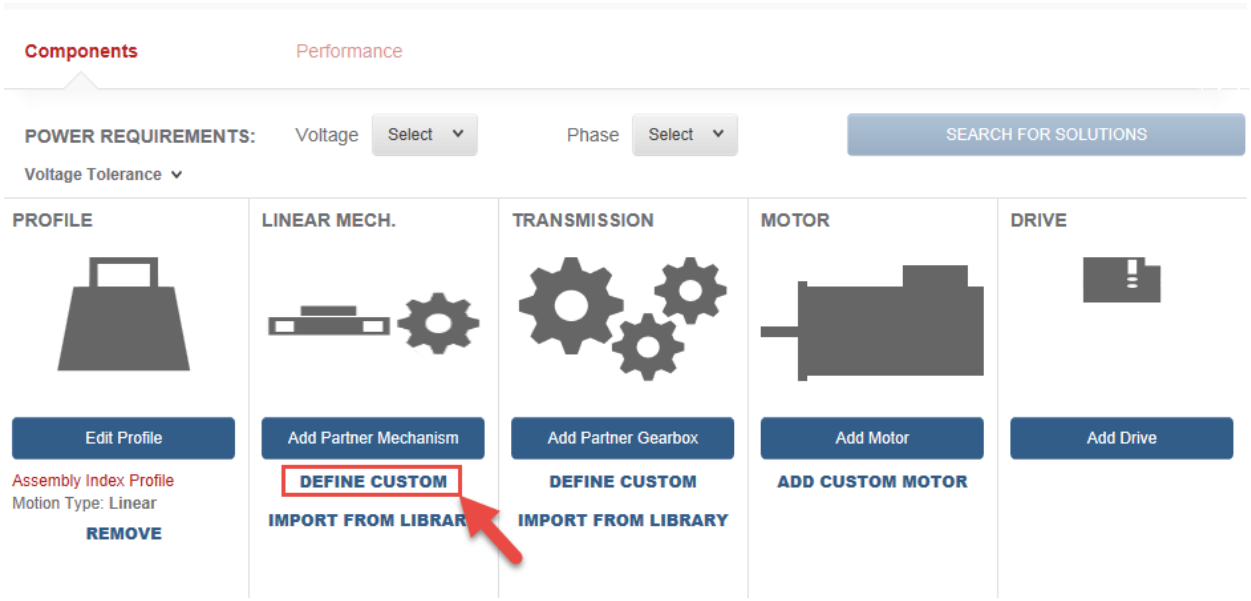
18. Change the name of your axis from Axis 1 to Assembly Index Axis 1 by clicking  to edit and save the name change.



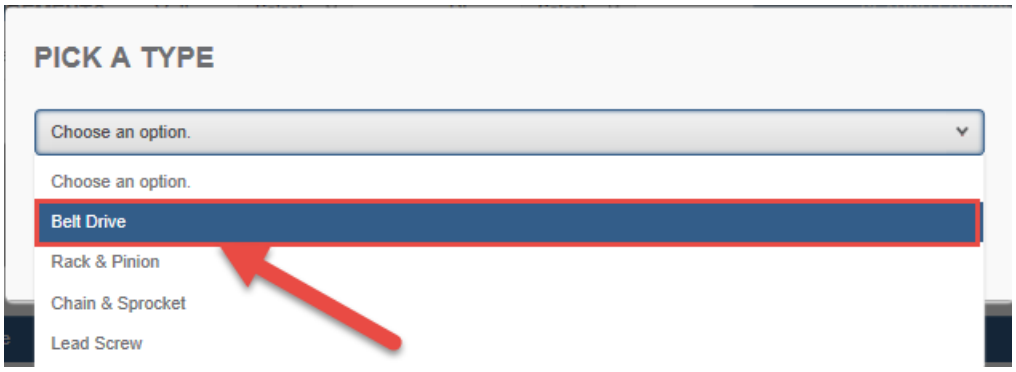
Defining your Mechanism

Now we will enter the linear mechanism data for the application. From the requirements, we know that we have 2 drive rolls and the dimensions are 100mm diameter (about 4”), 600mm long (about 24”), and material is steel. We also know our belt is 0.7 kg. The mechanism translates the rotational motion from the motor into linear motion of the conveyor.

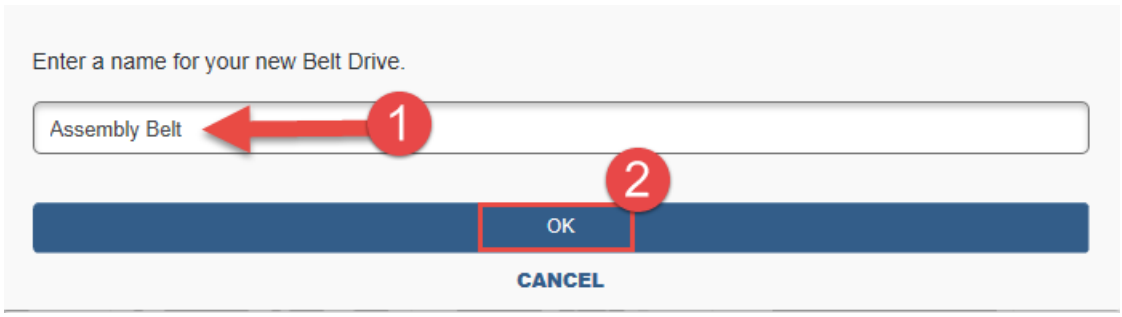
1. Click on the **Define Custom** button for the Mechanism.



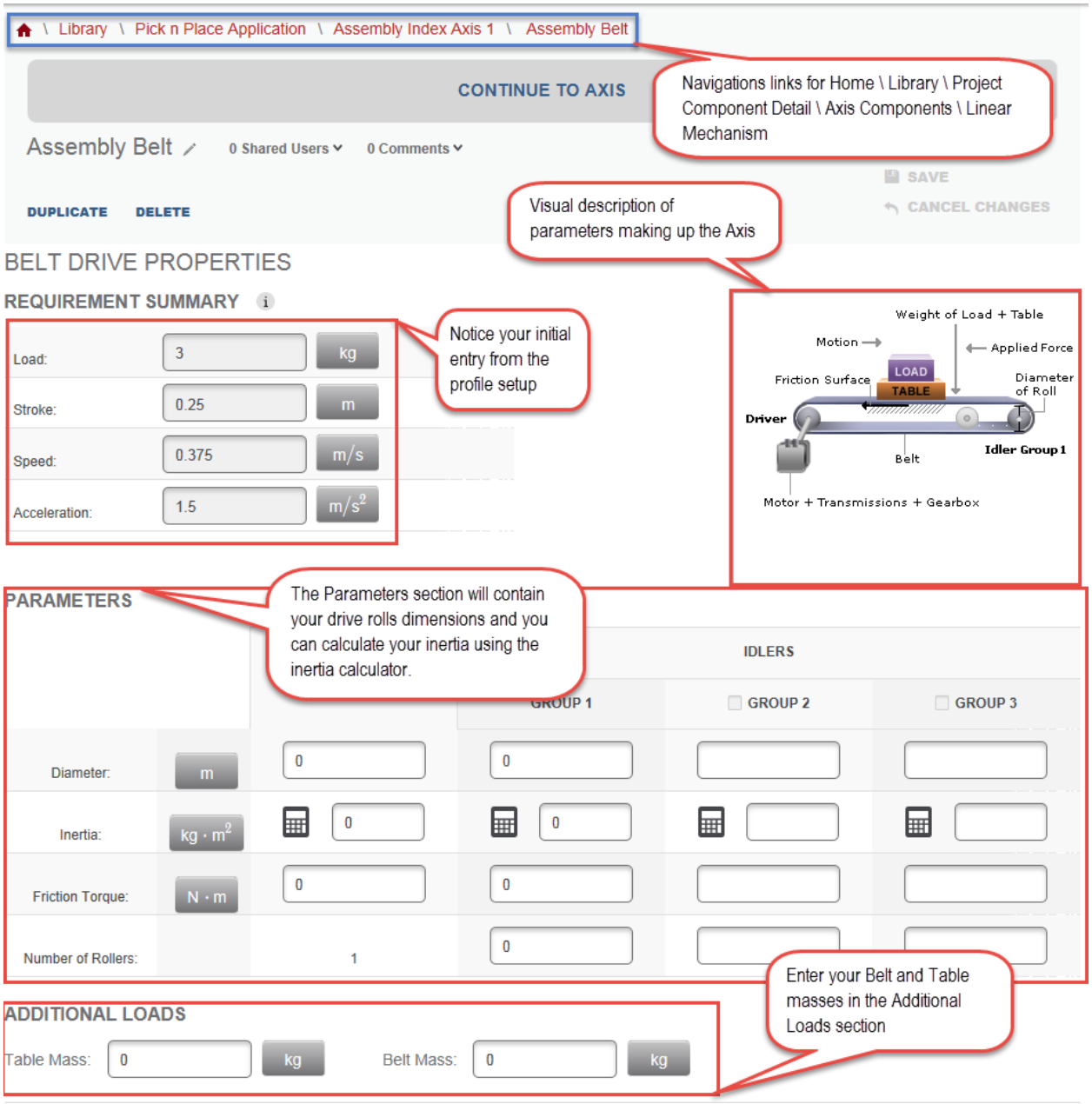
2. Select **Belt Drive** in the *Pick A Type* drop-down list, and click the **OK** button.



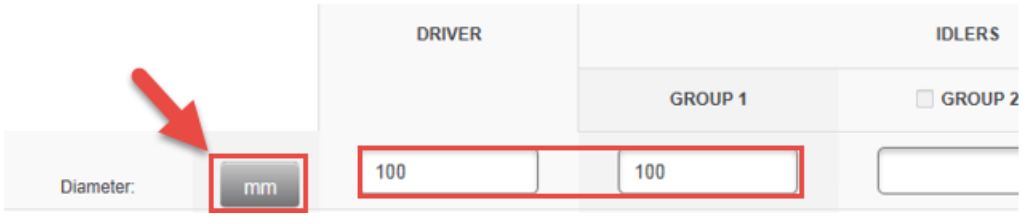
3. Enter a **Name** for the Belt Drive in the next dialog box, and click the **OK** button.



4. The Belt Drive Properties pages will open up and present the following:

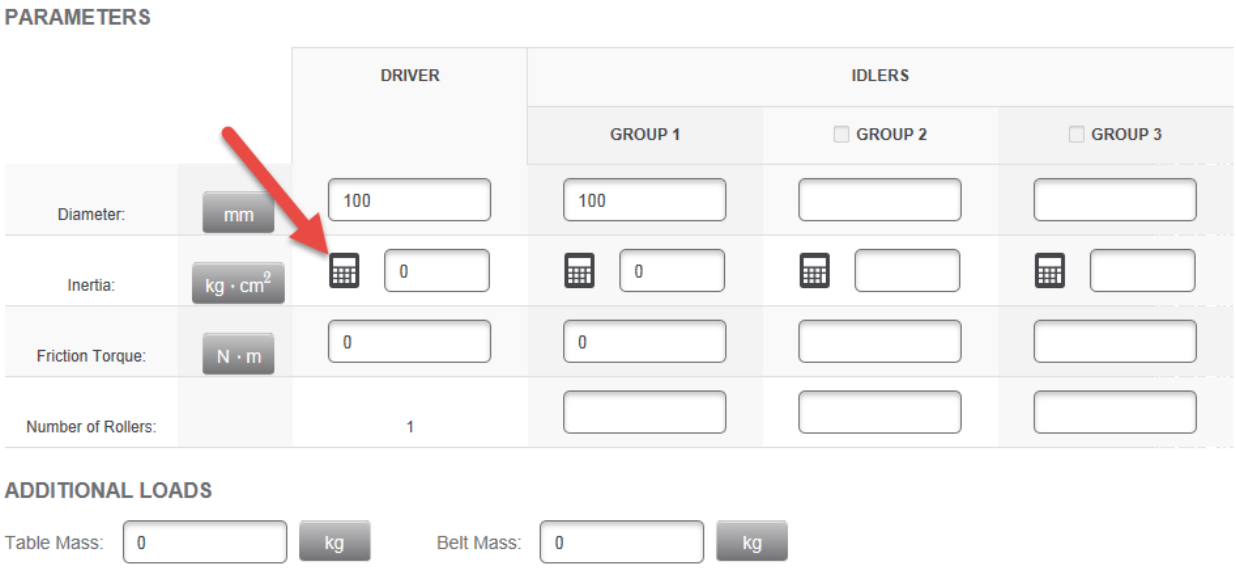


5. Change the *Diameter* units to mm and enter the value for both the driver and idlers

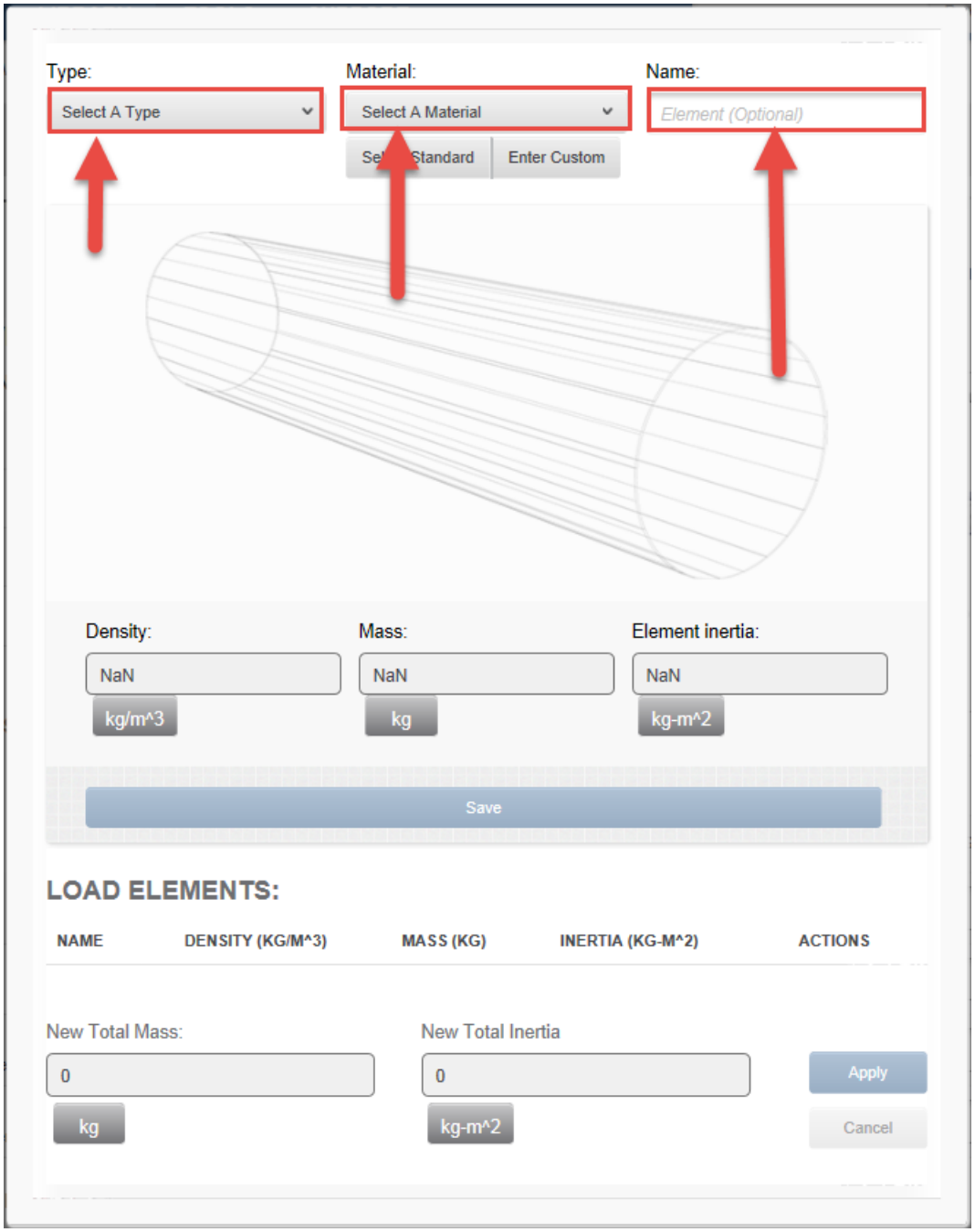


6. At this point, we will use the inertia calculator to find the inertia of the Assembly Index Belt.

7. Click on the **Inertia Calculator** button for the Driver.

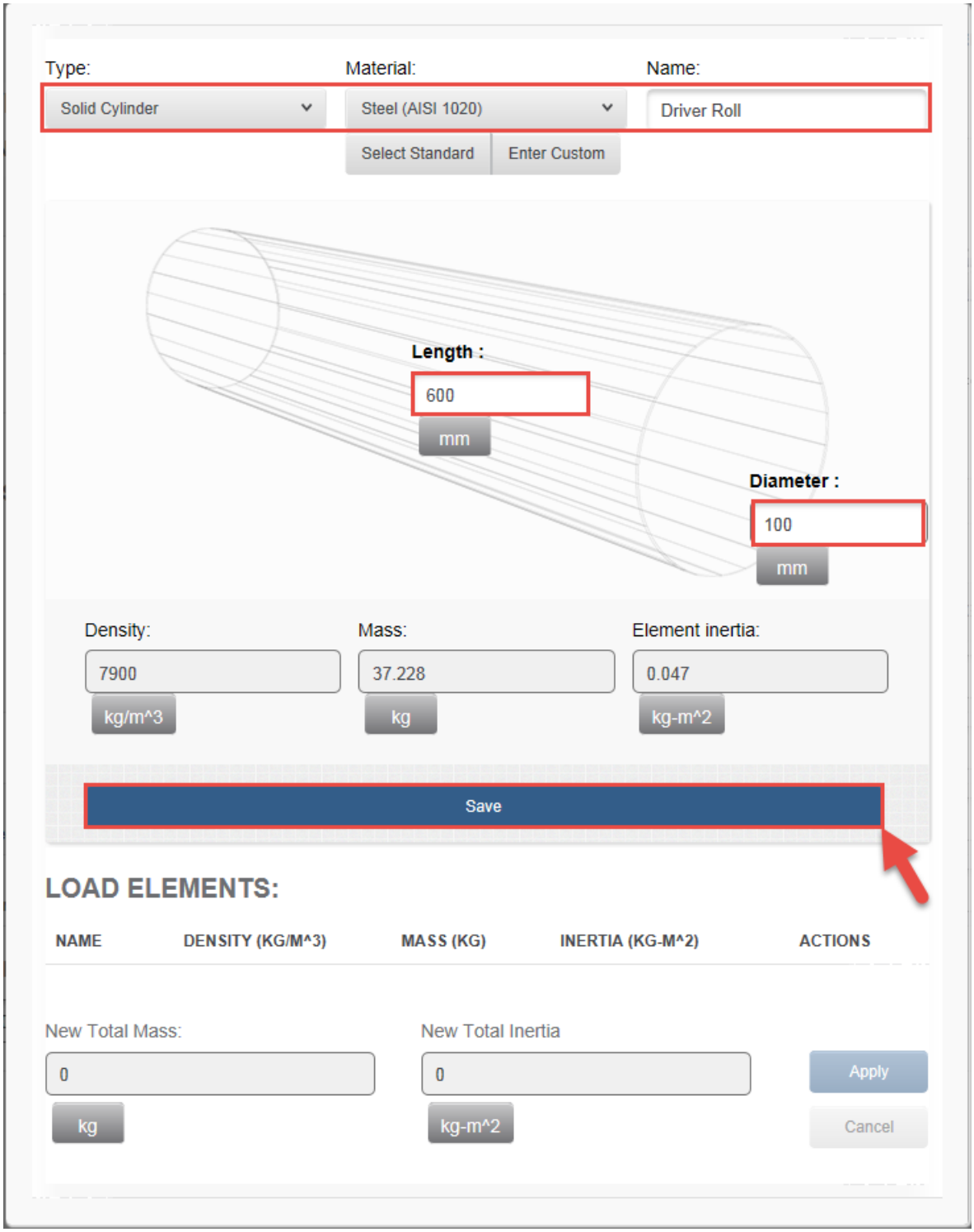


8. The Inertia Calculator tool will appear. Select **Solid Cylinder** as the Type, **Steel** as the Material and enter Driver Roll as **Name.**

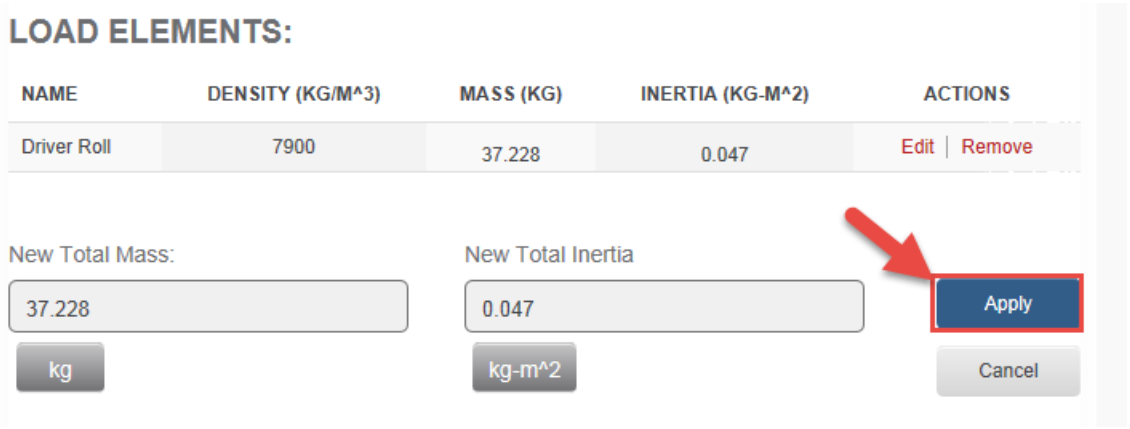


NOTE: Your Load Elements section might be already prefilled. Please delete the current values before entering the new calculations.

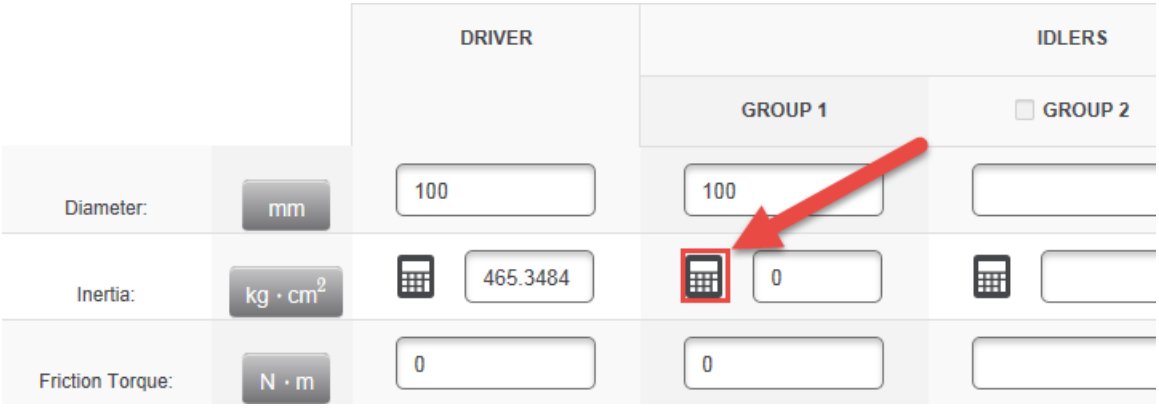
9. The length of each roll is **600 millimeters** and the diameter is **100 millimeters**. Enter this information into the calculator, and then click the **Save** button to add the inertia of the first sprocket to the Load Elements list.



10. Once you have saved your roll values, click the **Apply** button to enter the total inertia of the Driver into the properties table.

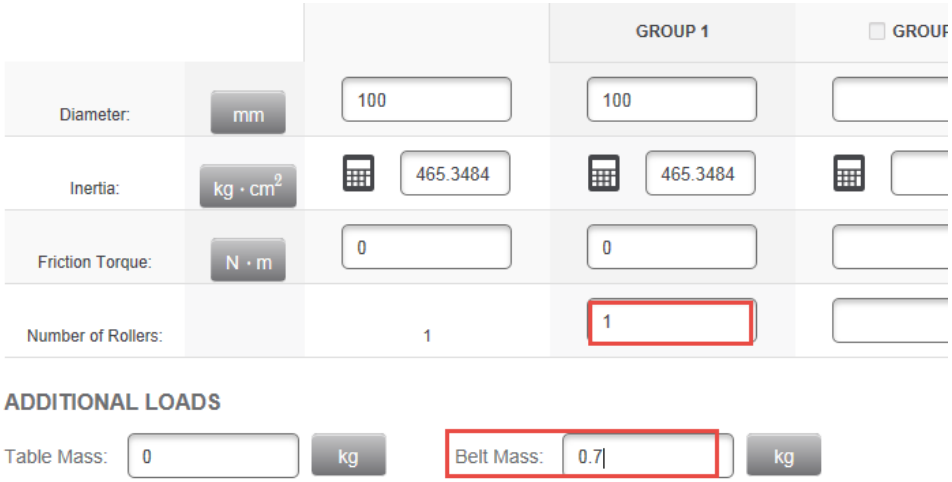


11. For this application, there is a single Idler group that has identical parameters to the Driver group, so we can reuse the inertia value that we've calculated. You can **copy** the inertia value of the Driver and **paste** it into the **Inertia field** for **Idler Group 1** or you can **click** on the calculator and hit **Apply** again on the **Idler Group 1**.

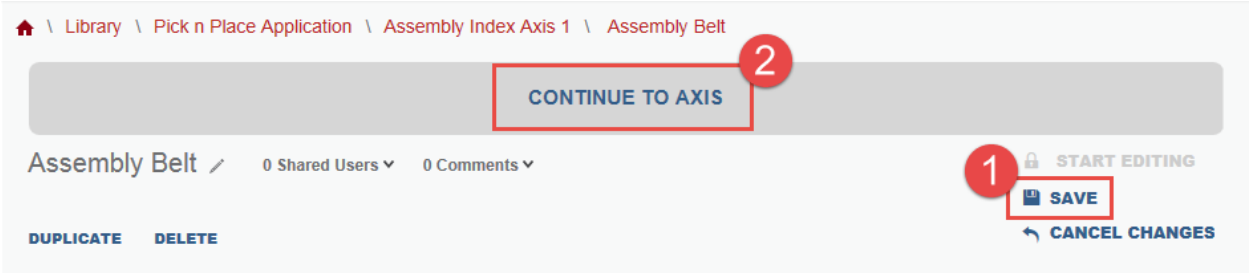


NOTE: When copying, make sure to select the entire number (the entire number is not visable in the box) by double clicking on the number.

12. Enter **"1"** as the Number of Rollers for Idler Group 1 and enter the **Belt Mass** under Additional Loads.



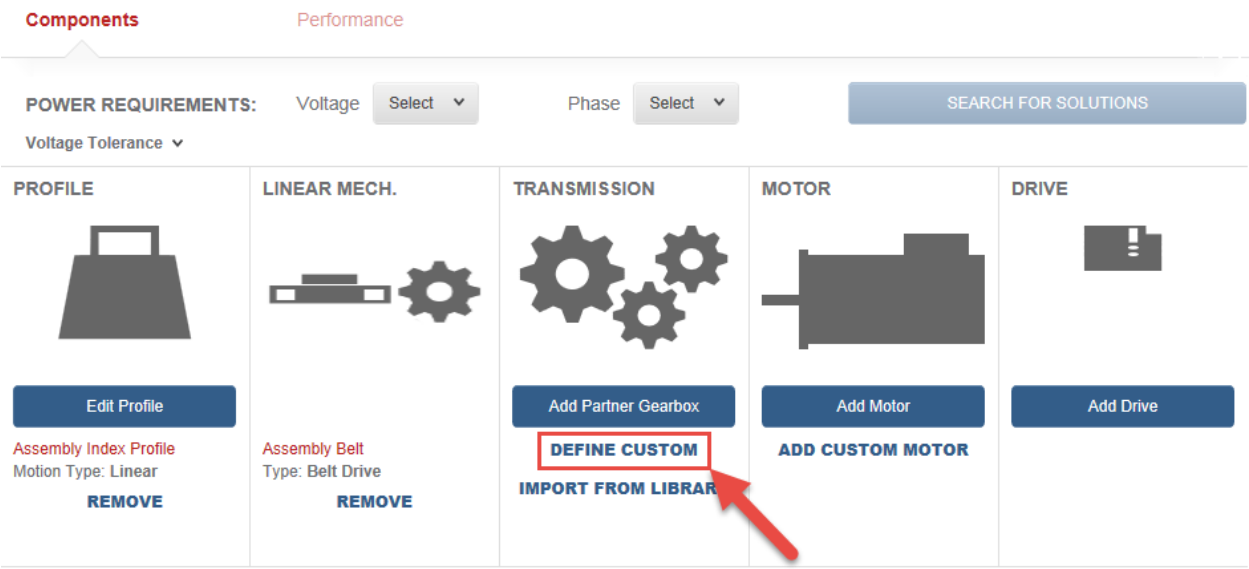
13. Once you have entered all of the data for the Belt Mechanism, click the **Save** button and then the **Continue to Axis** button.



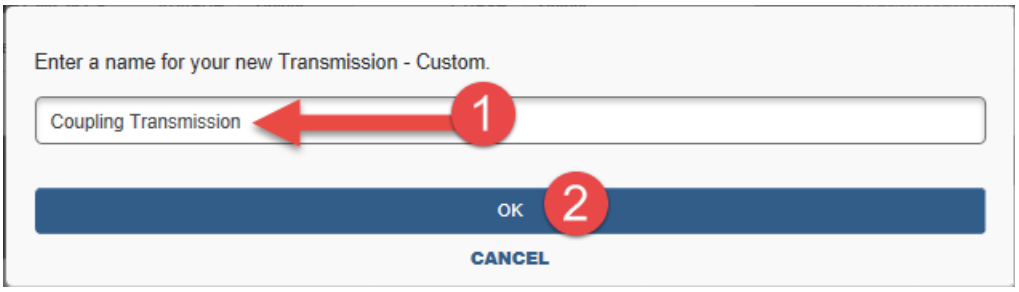
Entering Transmission Components

Now we will enter the transmission data for the application.

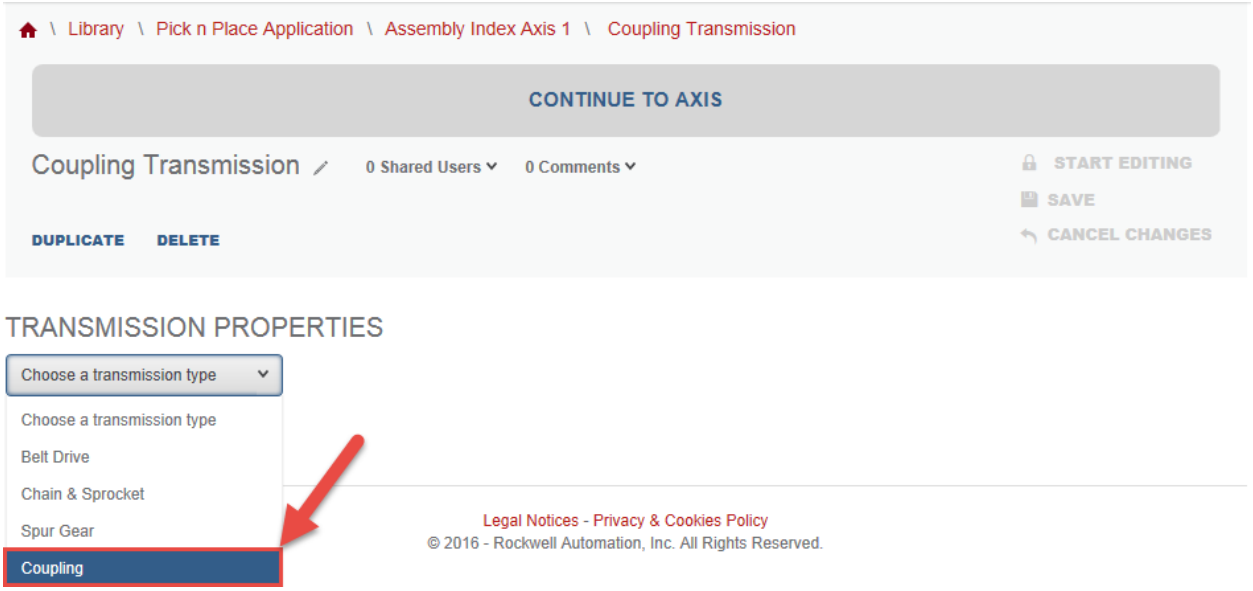
1. Click on the **Define Custom** button for the Transmission.



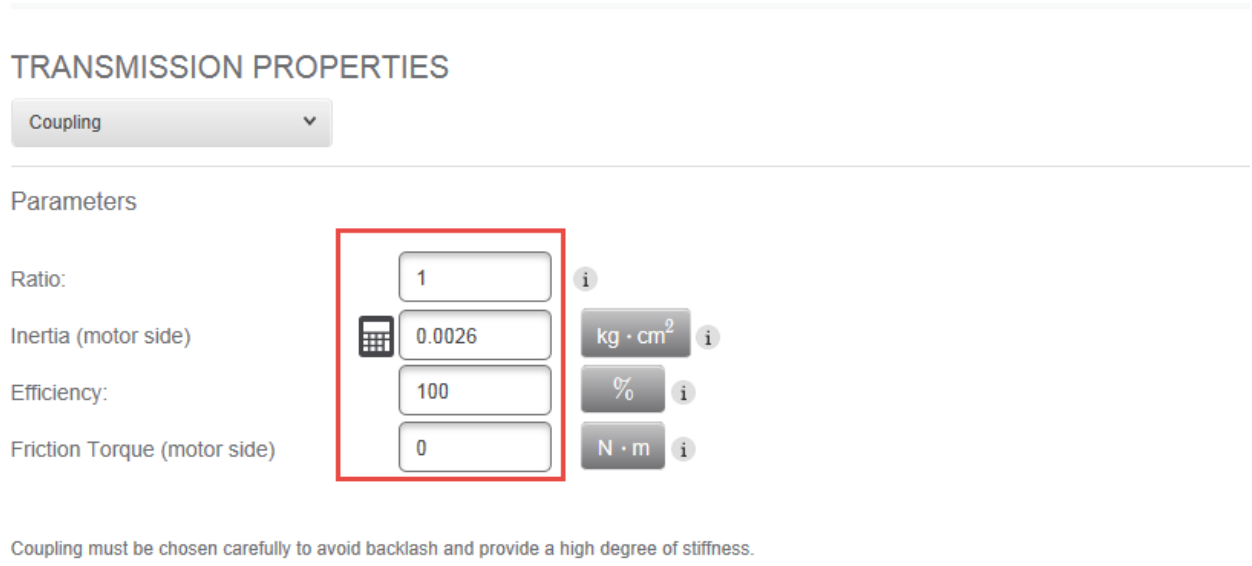
2. The first transmission we will create is the coupling. Enter a **name** for the transmission component, and click the **OK** button.



3. Select **Coupling** as the Transmission Type.



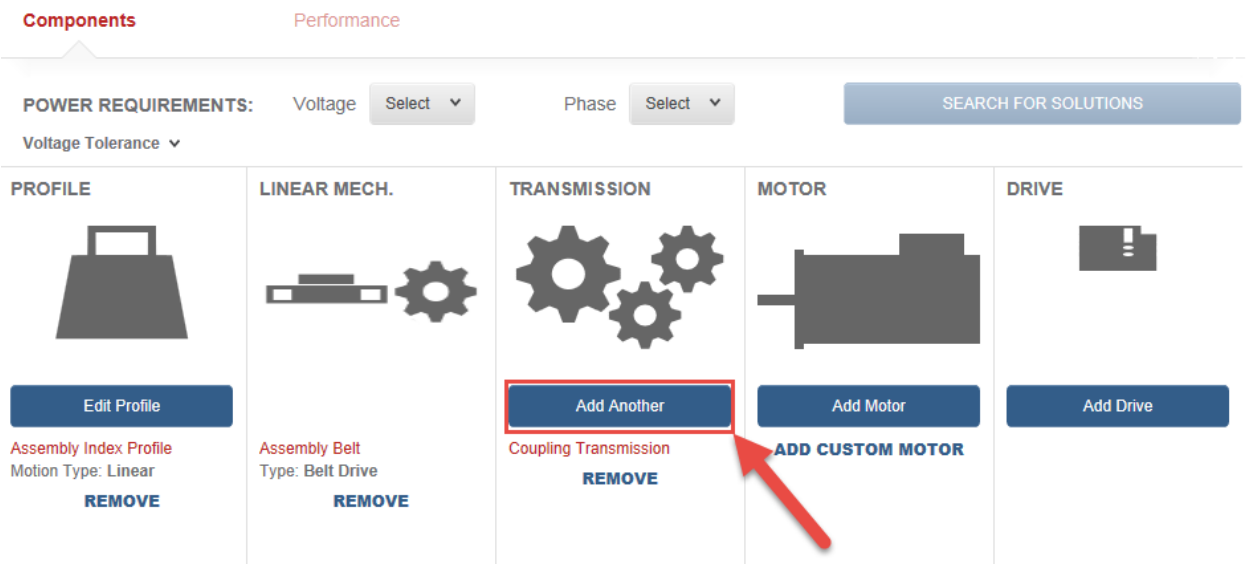
4. We are working on the motor side transmission. Enter **"1"** for the coupling transmission ratio (1 to 1 ratio), **2.6** $\boldsymbol{g \cdot cm^2}$ for motor coupling moment of inertia, and for **100%** for efficiency.



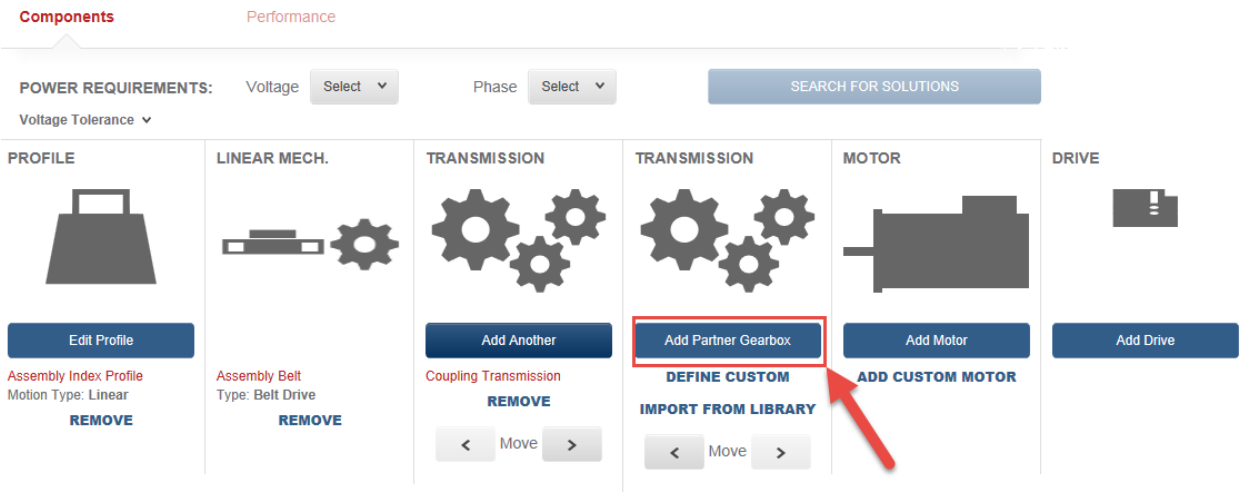
NOTE: 2.6$g \cdot cm^2$ is converted to 0.0026$kg \cdot cm^2$, you will notice that there is no $g \cdot cm^2$ units for the inertia units. Also click on the ⓘ information icon to learn more about each entry field.

5. Once the coupling data has been entered, click **Save** and **Continue to Axis**.

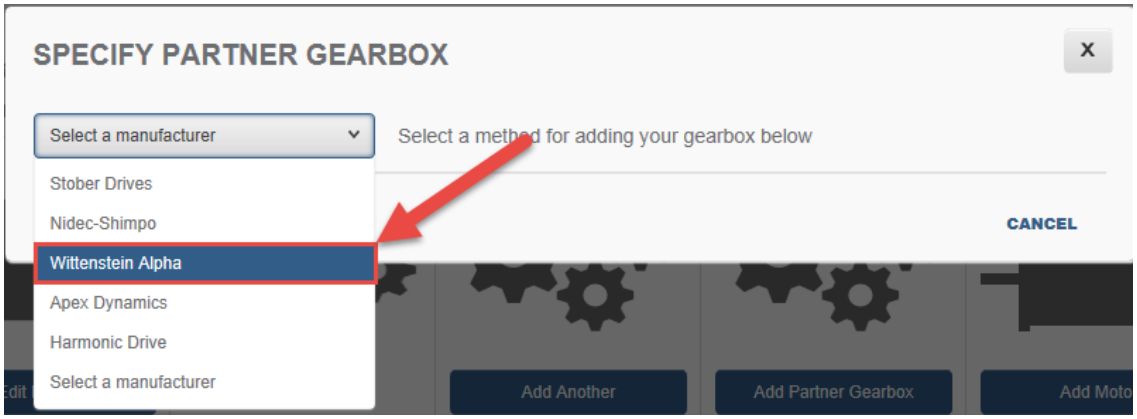
6. Now we will add the second transmission component. Click on the **Add Another** button under the Transmission heading.



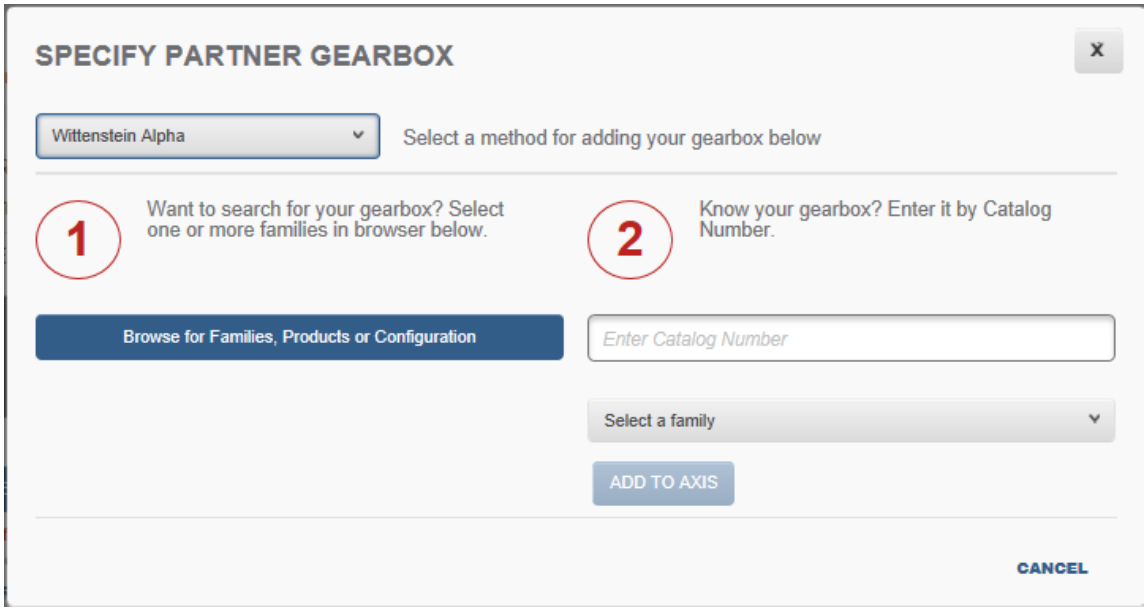
7. Since you already know that you will be using a specific gearbox, you can filter your selection during your sizing process. Click on the **Add Partner Gearbox** button for the Transmission that you just added.



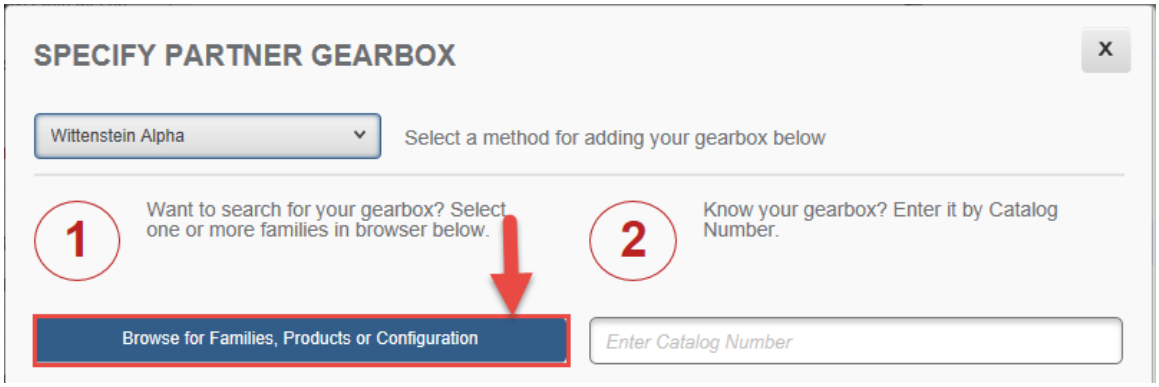
8. From the **Specify Partner Gearbox** window, select Wittenstein Alpha.



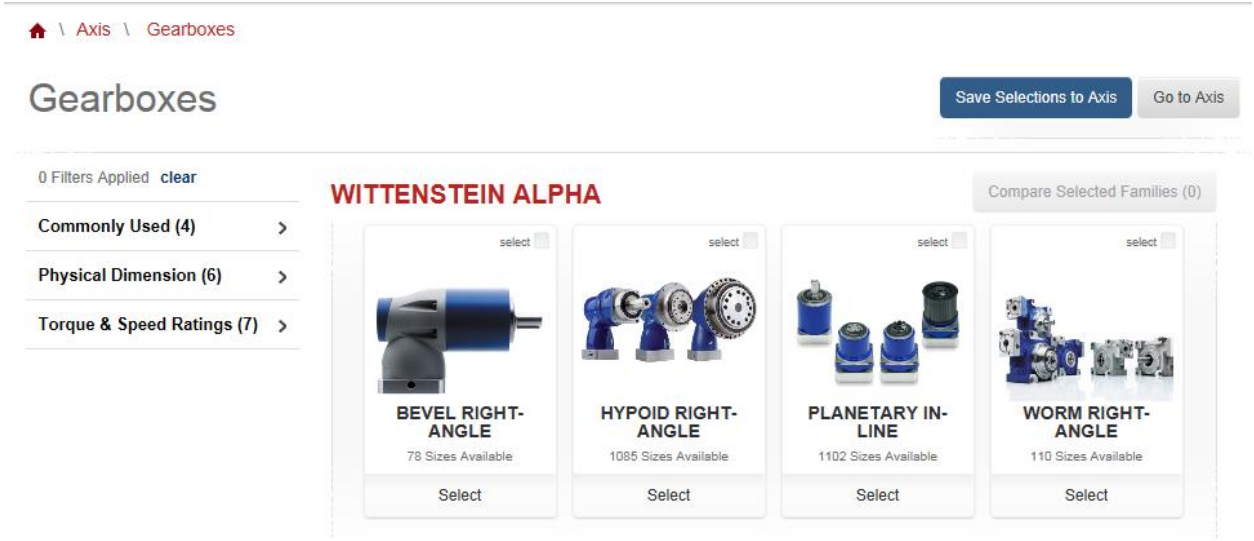
9. You will have two option on how to select your gearbox. *Option 1* would be used if you wanted to see all the Wittenstein Alpha gearbox families. *Option 2* is used when you know the specific gearbox family and its size.



10. We will select the **Browse for Families, Products or Configuration** button.

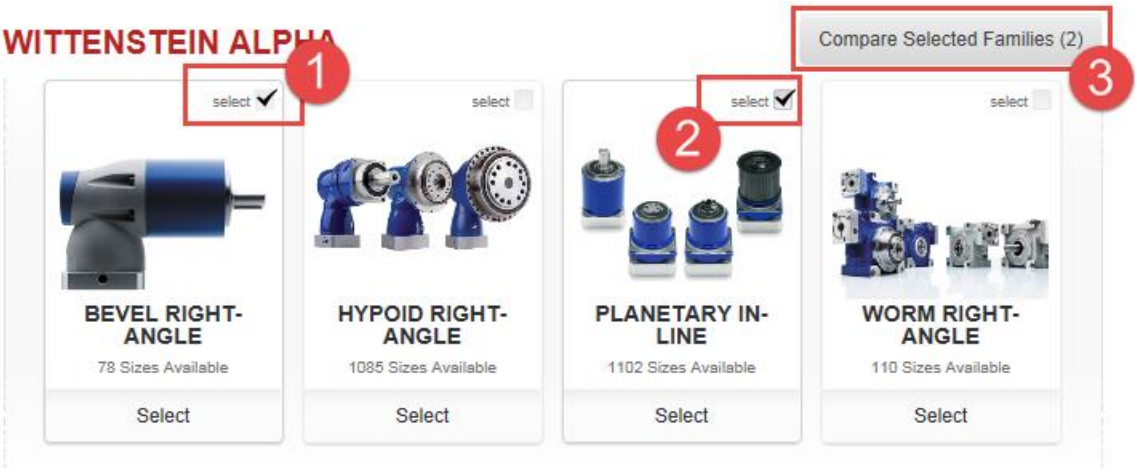


11. At the *Gearboxes Product* page, you can see the Wittenstein Alpha products available on Motion Analyzer online tool.

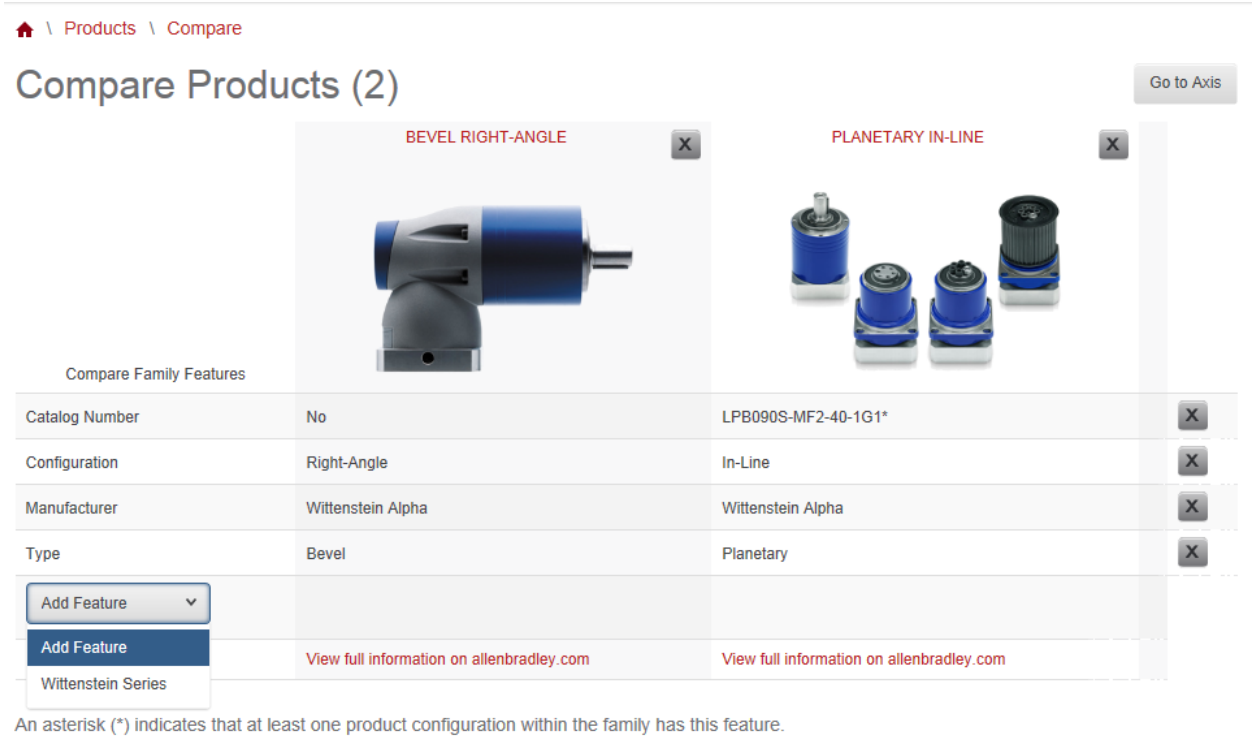


NOTE: Motion Analyzer online tool incorporates Third Party Product Integration with our Encompass Partners to provide complimentary products that integrate with Rockwell Automation solutions. This provides a whole solution under one tool.

12. We will compare two families of Wittenstein Alpha gearbox families. Select the checkmark box on Bevel right-Angle and Planetary In-Line gearboxes, then select **Compare Selected Families**.

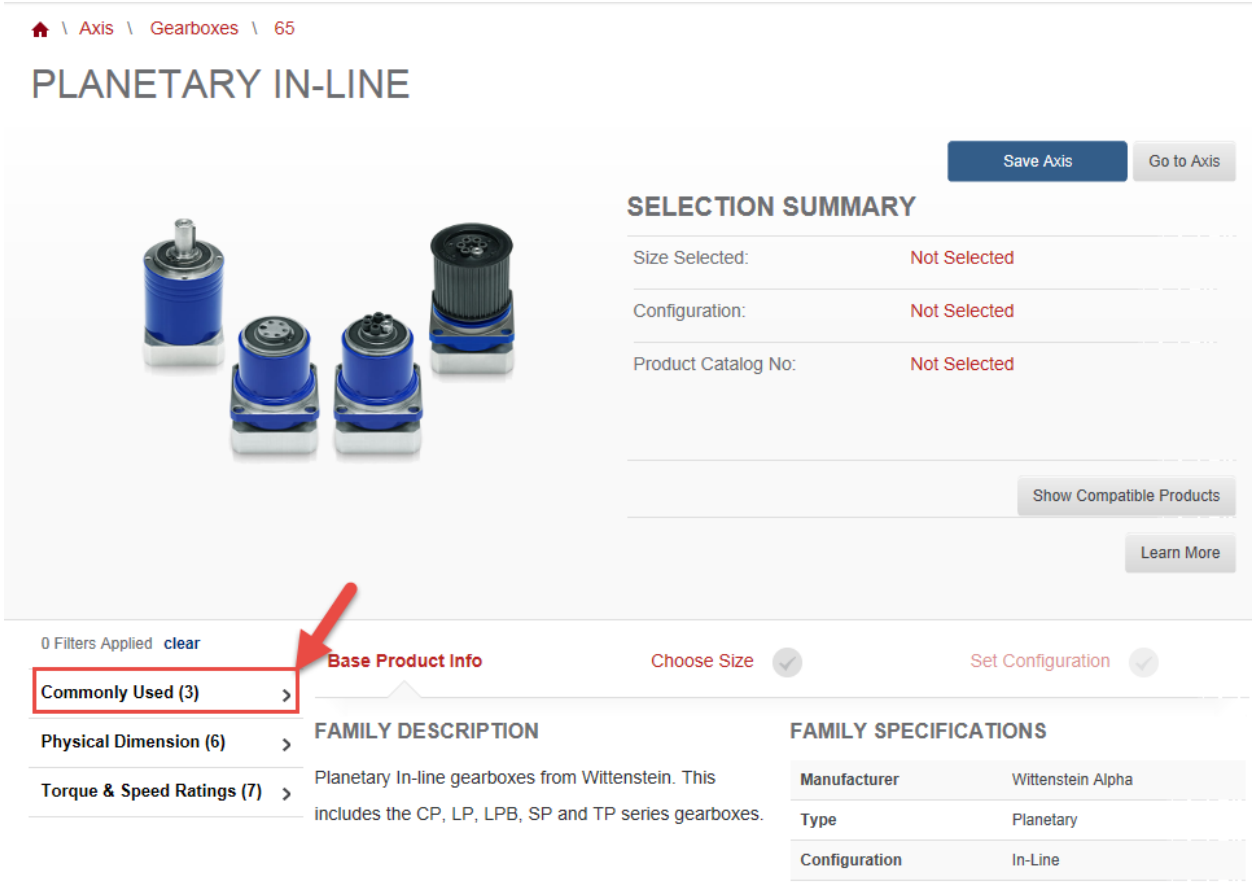


13. In the *Compare Products* page, you can compare features between different products from a single manufacturer. Click on *Add Feature* to see the remaining features to compare.

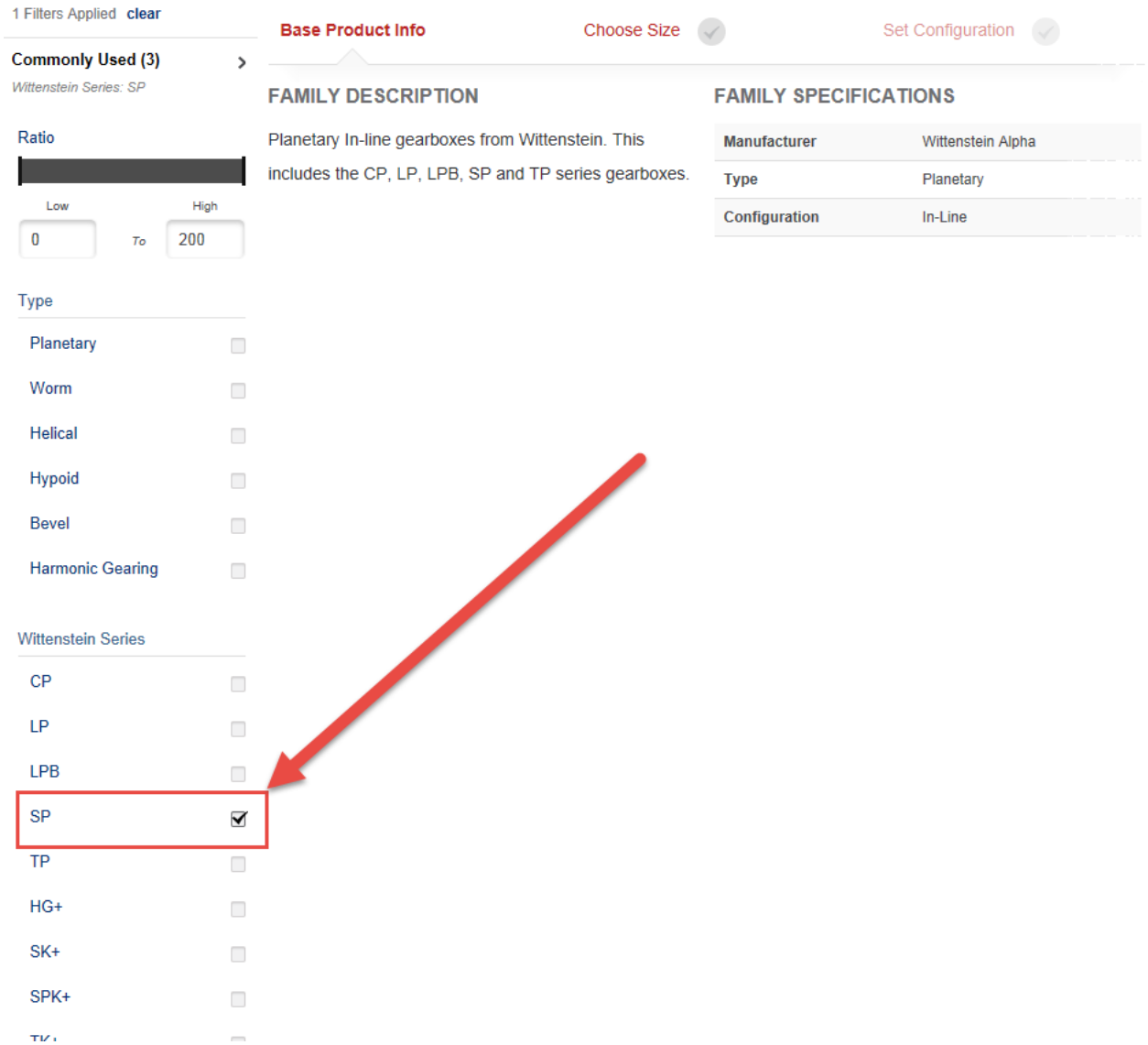


14. The Customer, *ABC Foods* indicated that they will be using Wittenstein Alpha SP+ gearheads for the original smartbelt design and prefer to use them ***if still necessary***. Click on the Planetary In-Line gearbox to filter your search to include the SP+ family.

15. At the *Planetary In-Line* product information page, we will set our filters to only include the SP series and the Planetary In-line family. Let's click on the **Commonly Used (3)**.

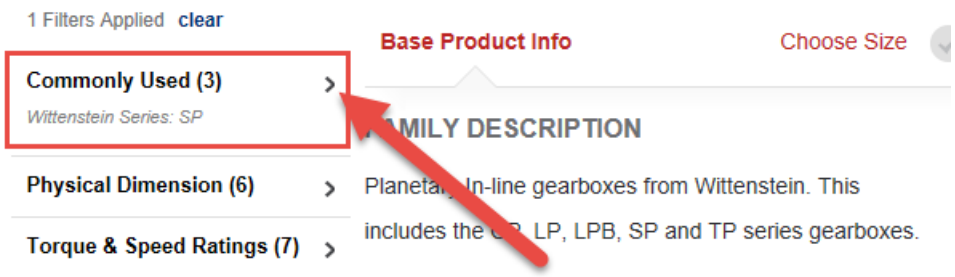


16. From the *Wittenstein Series* list, select the SP check box.

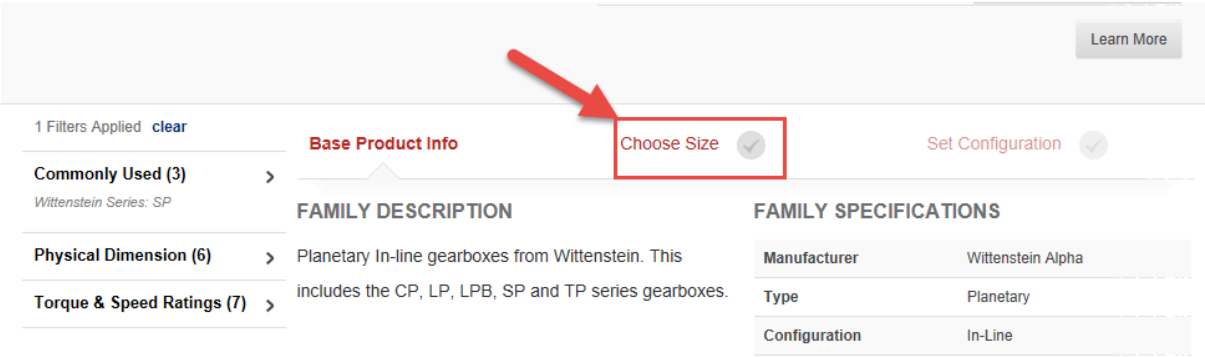


NOTE: For the gearbox filter to take effect, you do need to select the Family with the rest of your filters.

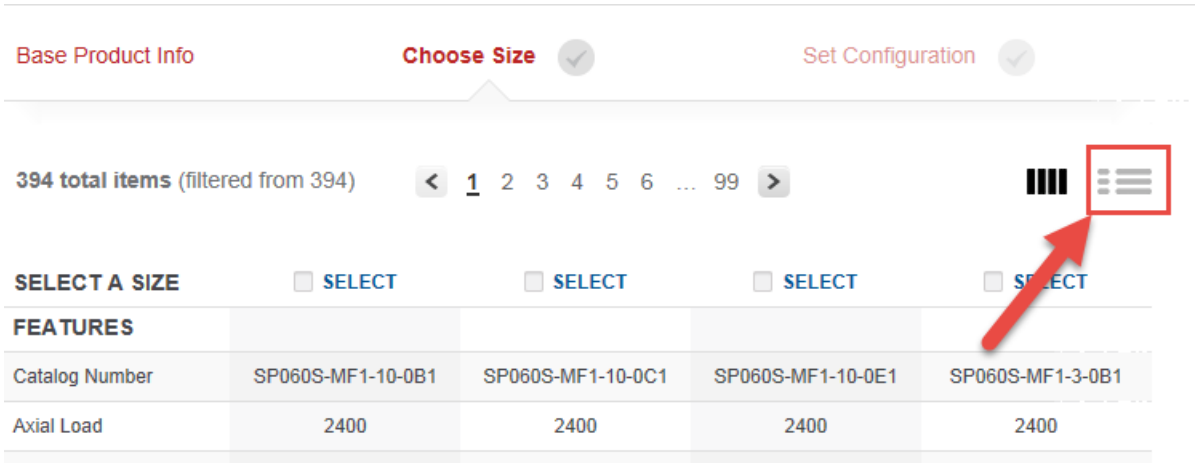
17. Your selected filter will be reflected in the **Commonly Used (3)** section. Click on **Commonly Used (3)** to retract the dropdown selections.



18. Click on the *Choose Size* tab.

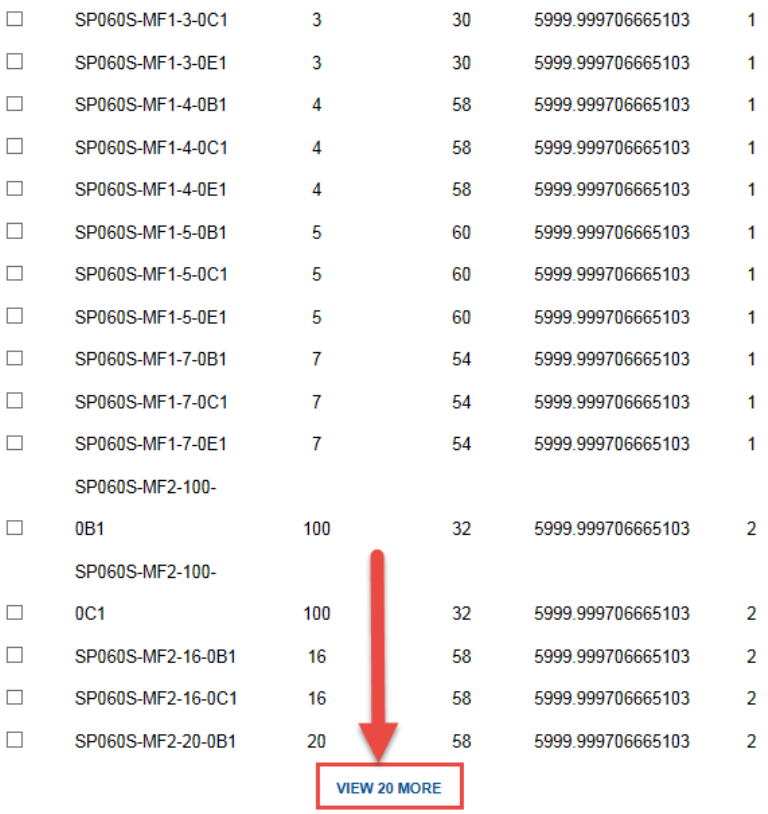


19. Even with a single filter, your selection seems to be numerous. We will change the view from *Vertical* View to *Horizontal* View.

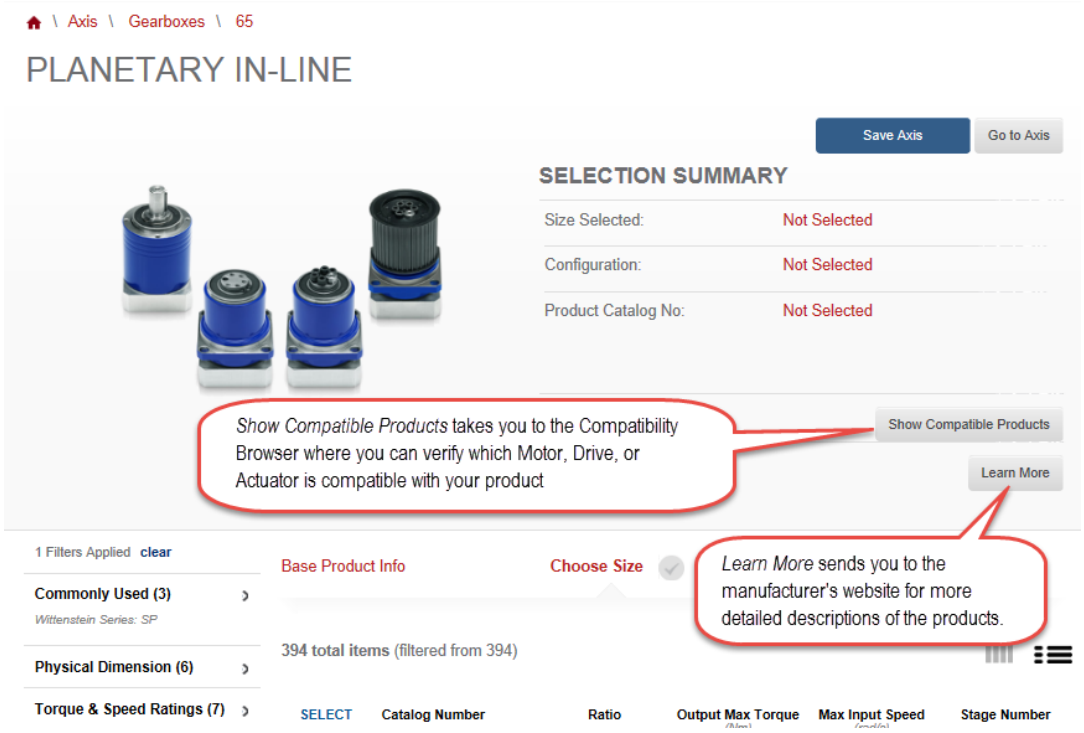


NOTE: When browsing through products, the default view is set to Vertical View, which allows only 4 products at a time. By switching to Horizontal Browse View, you can view 20 or more products at a time.

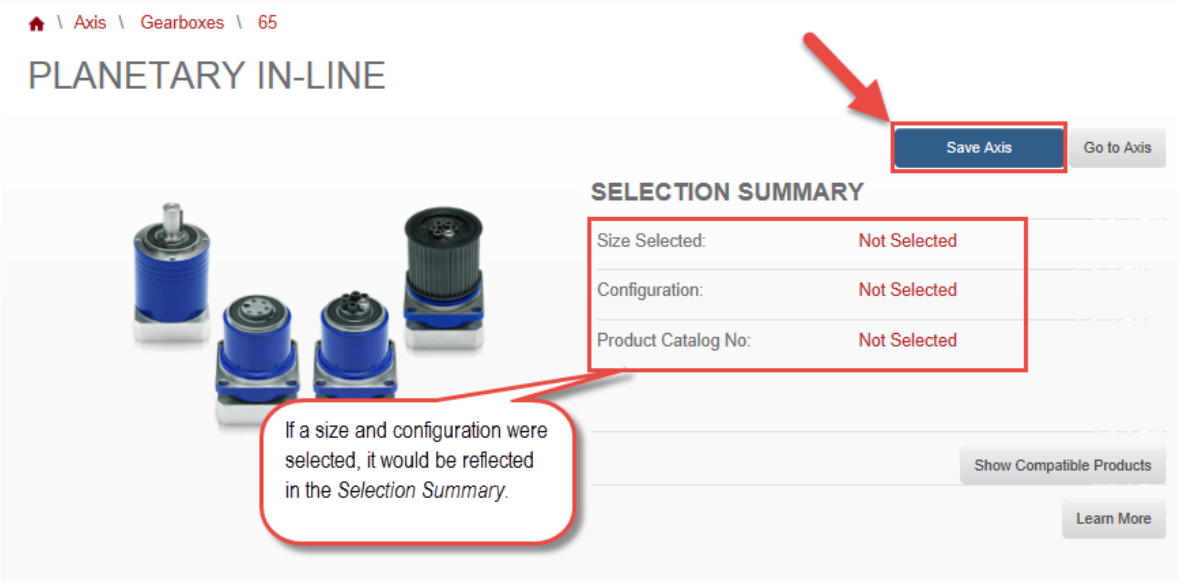
20. Scroll down the *Planetary In-Line* product information page and click on **View 20 More**.



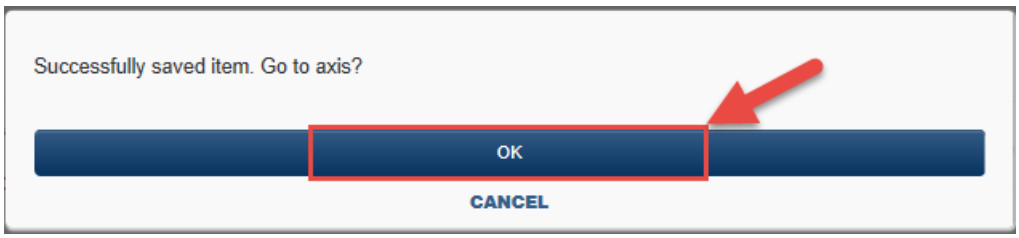
21. You can now view 40 products in the same page. We will not choose any size for this axis. Scroll up the *Planetary In-Line* product information page.



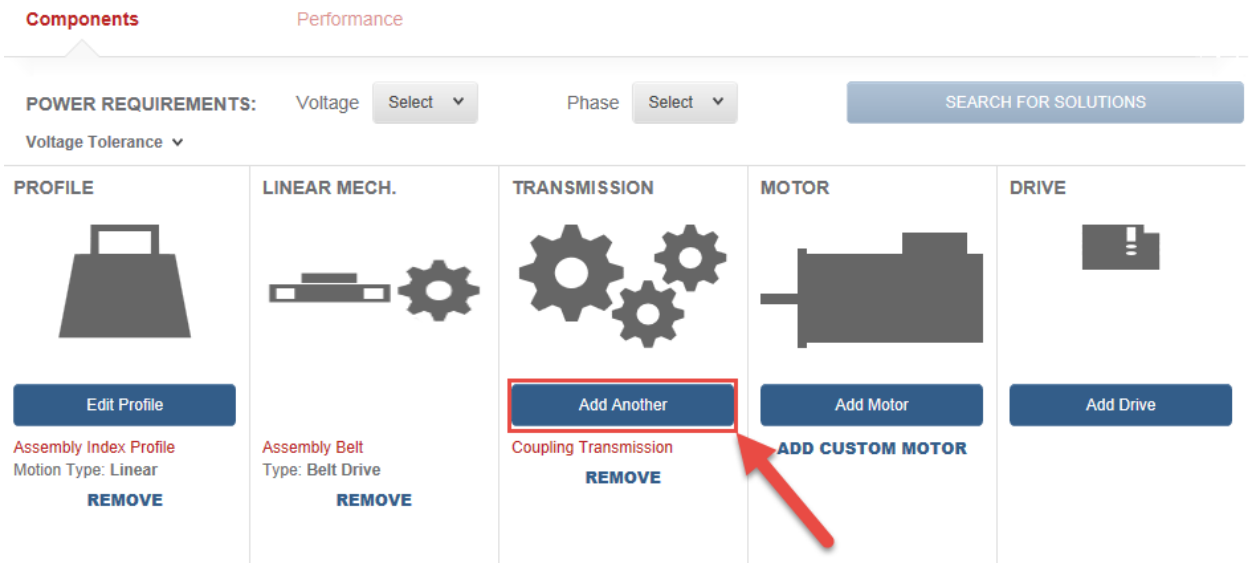
22. Select **Save Axis**



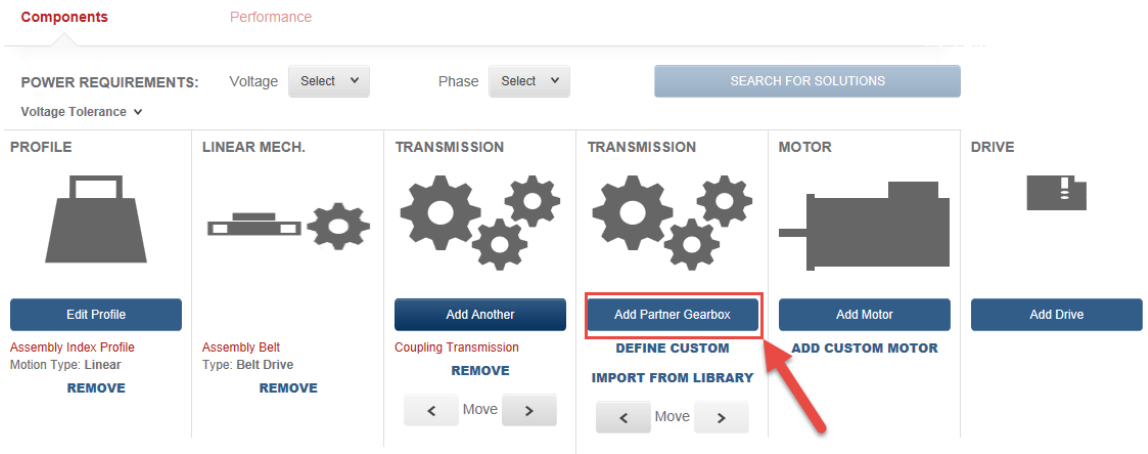
23. Clicking Save Axis will add the *Planetary In-Line* SP family to your axis components. Click **OK** to confirm your selection.



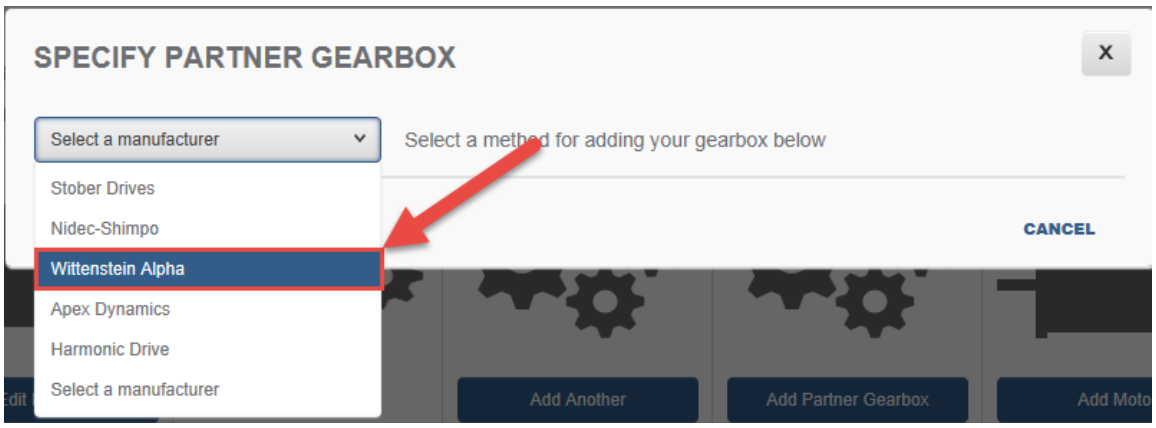
24. You are returned to your Axis Components page. As you see, the Gearbox selection has not been added. For the gearbox filter to take effect, you do need to select the Family. Click on the **Add Another** button under the Transmission heading.



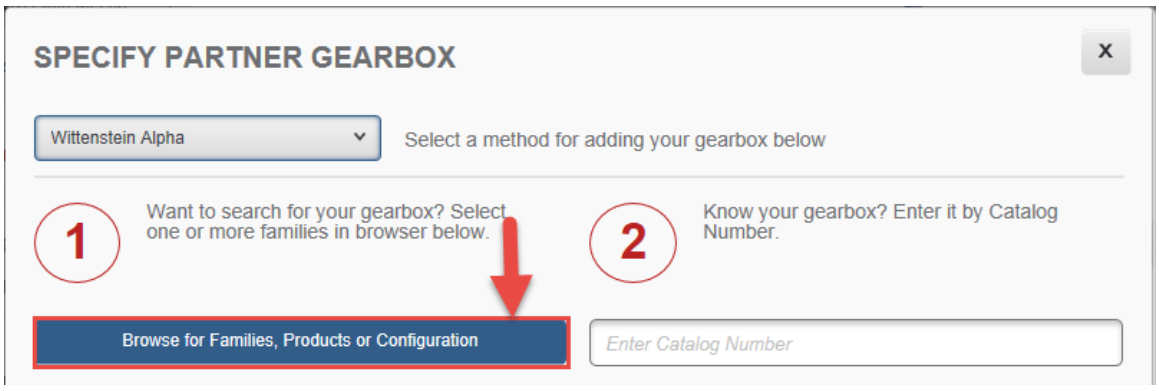
25. Click on the **Add Partner Gearbox** button for the Transmission that you just added.



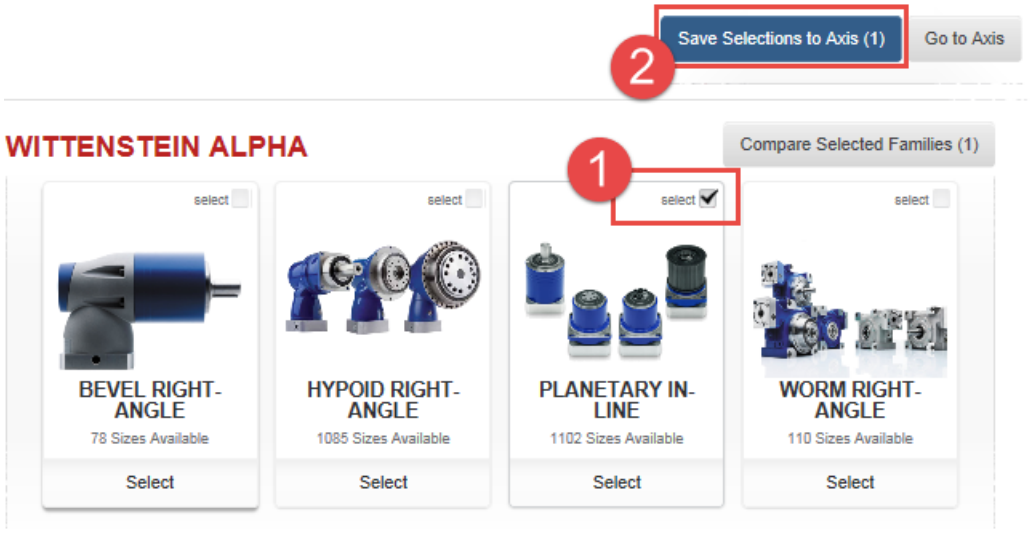
26. From the **Specify Partner Gearbox** window, select Wittenstein Alpha.



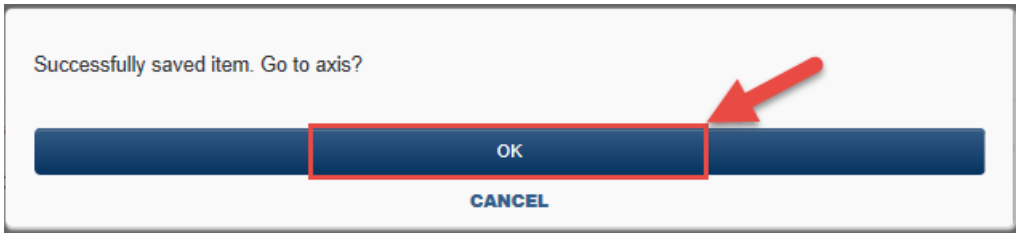
27. Select the **Browse for Families, Products or Configuration** button.



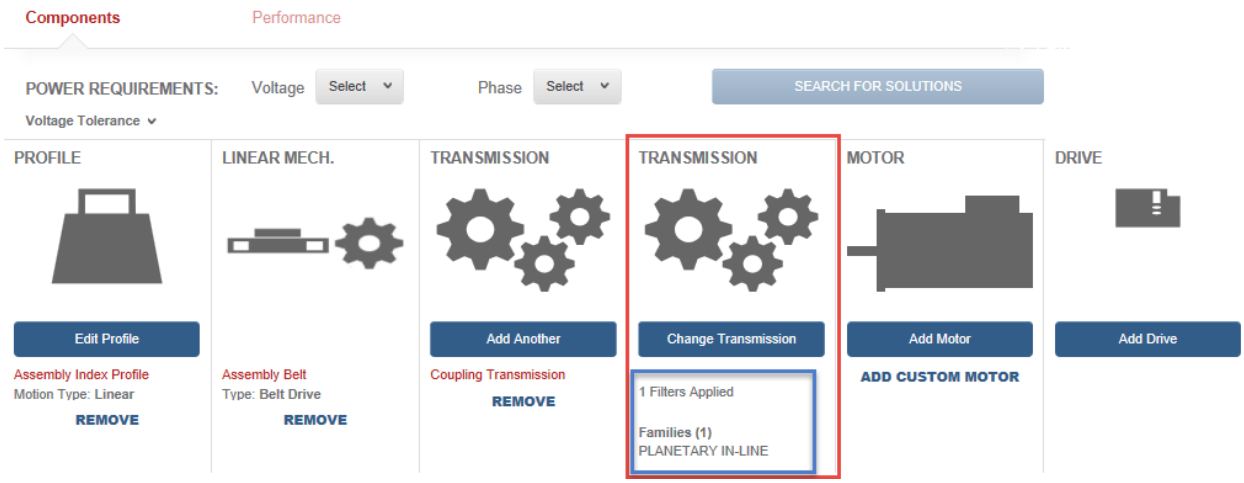
28. At the *Gearboxes Product* page, select the checkmark box on Planetary In-Line gearboxes and Click **Save Selection to Axis**.



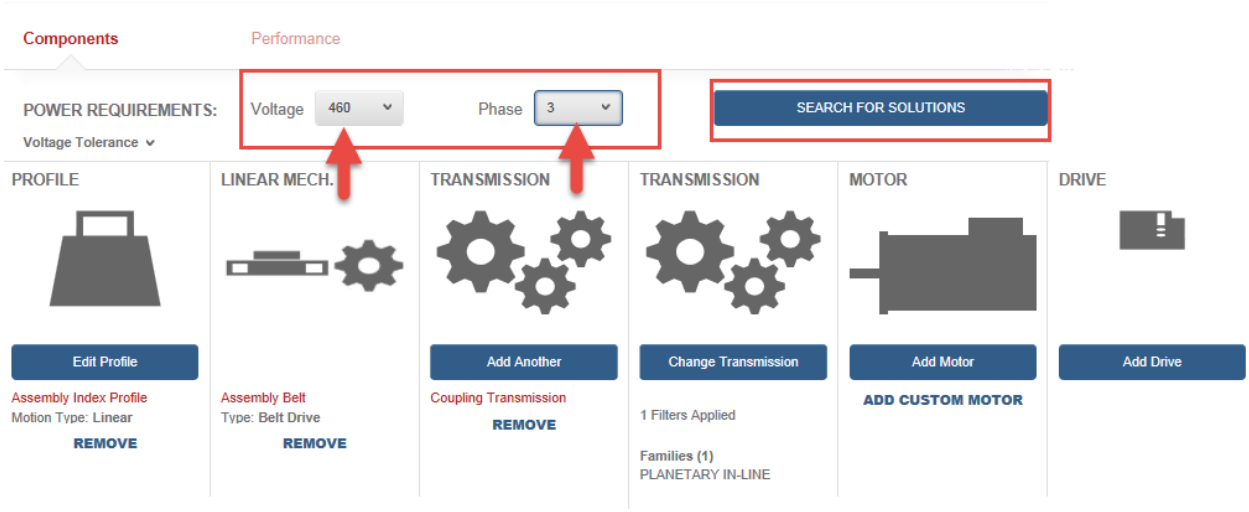
29. Confirm your selection by click **OK** on the "*Go to Axis?*" prompt.



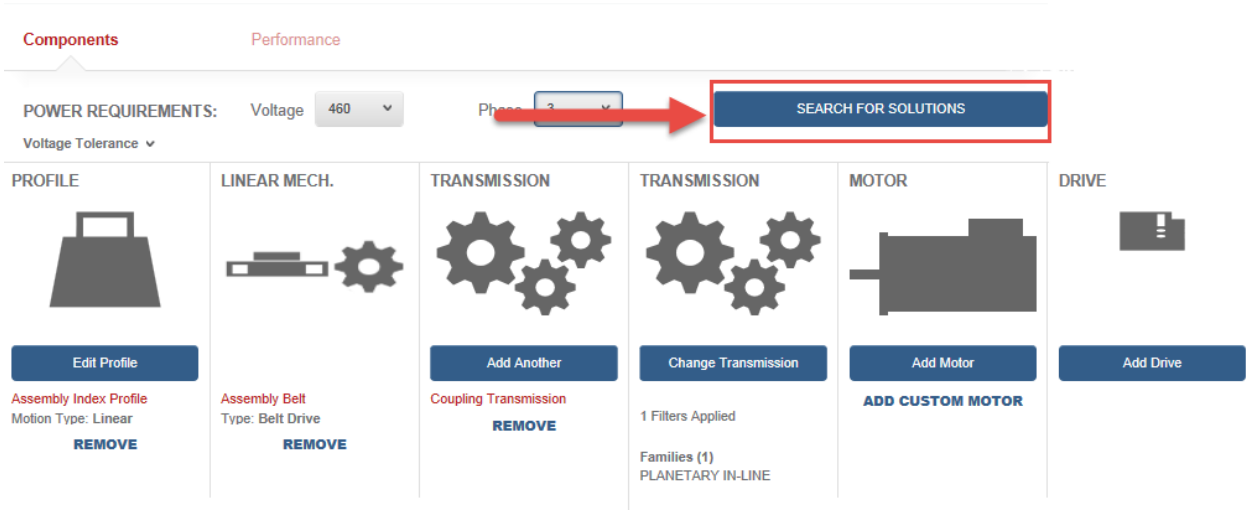
30. In the Axis Components page, your added gearbox is listed as component. At this point, we will start looking at solutions for our Assembly Index Axis 1.



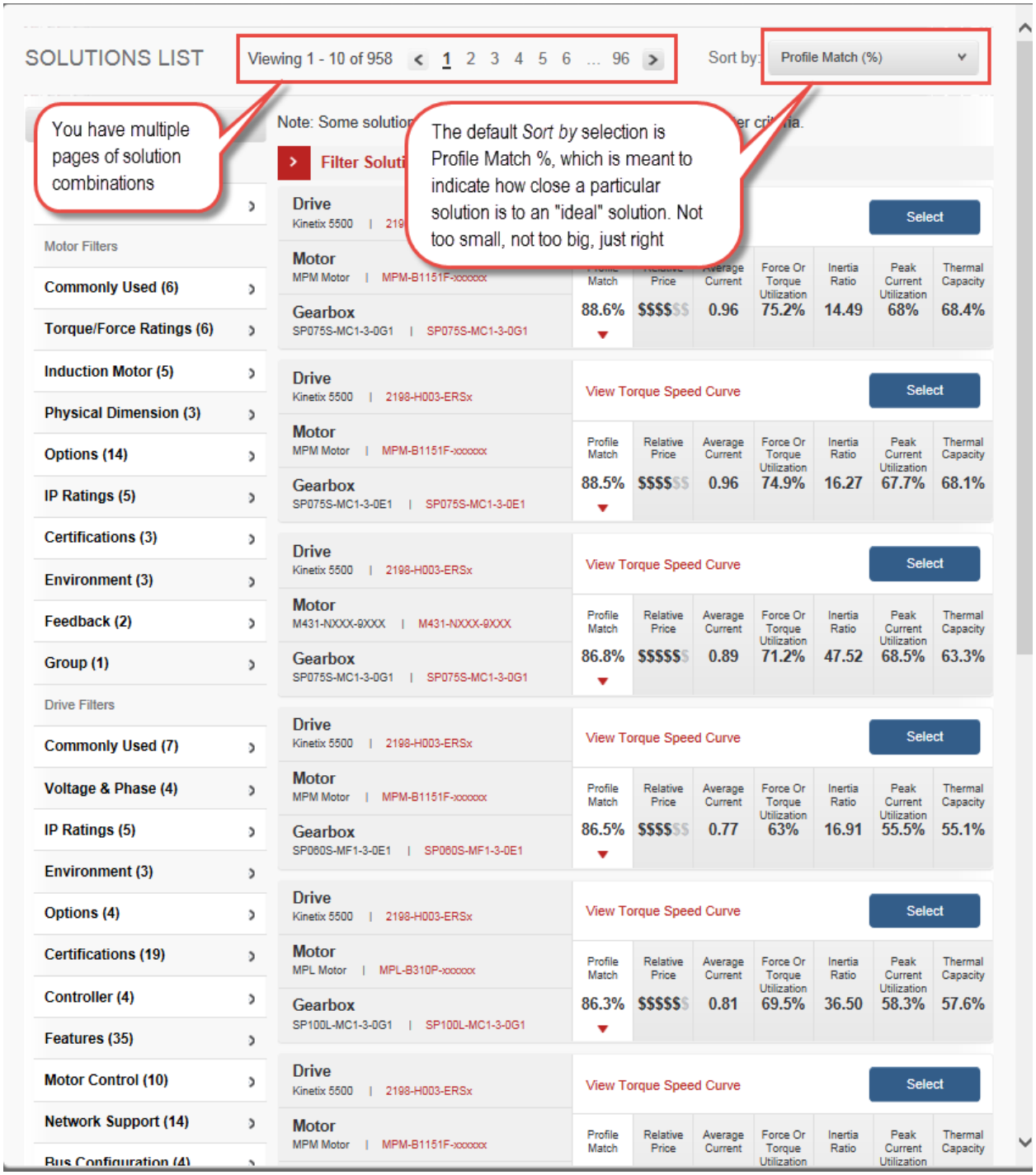
31. The customer indicated that they will be operating at 460 Volts, 3 phase. In the *Power Requirements* section, select **460** for *Voltage* and **3** for *Phase*. The **Search for Solutions** button should now be enabled.



32. Select the **Search for Solutions** button.

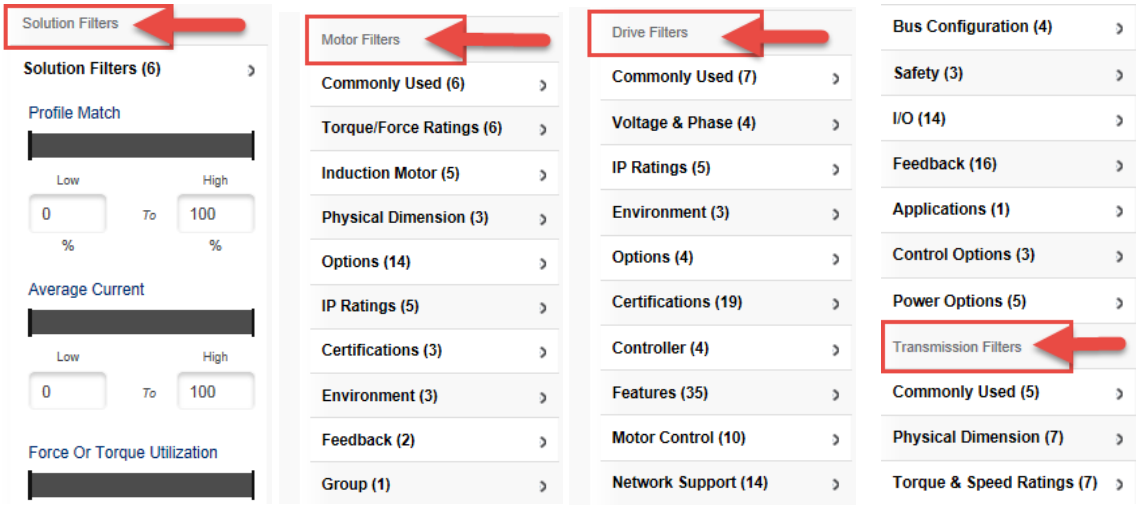


33. The *Solutions List* window will open up and Motion Analyzer will search for solutions that match to your profile.

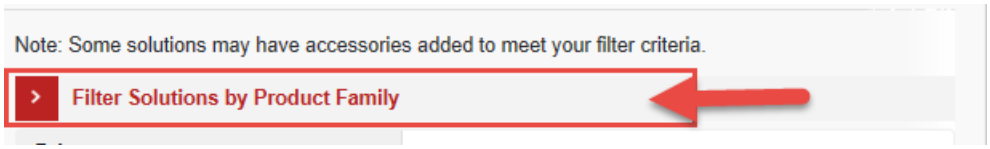


34. Let's take a second to review the *Solutions List* window.

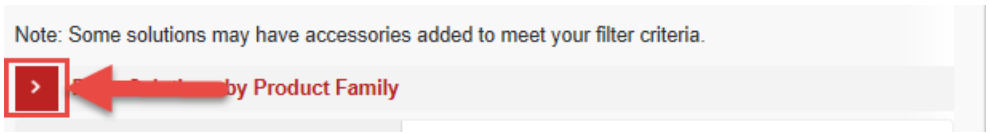
35. On the left of the *Solutions List* window, you can see a list of filters. Your filter options range from *Solutions Filters*, *Motor Filters*, *Drive Filters*, and *Transmission Filters*.



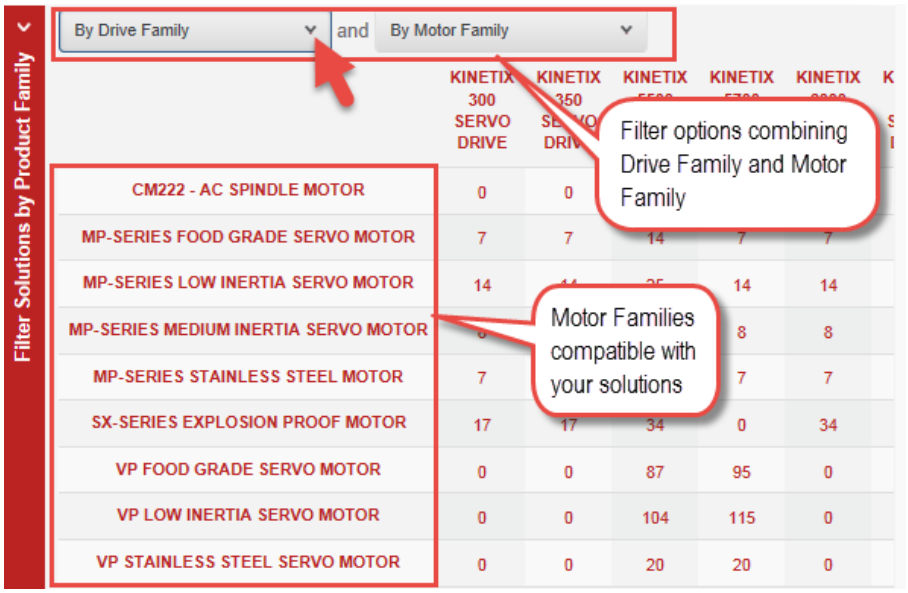
36. You can also narrow your search by using *Filter Solutions by Product Family*.



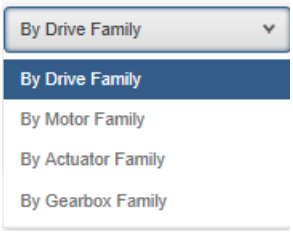
37. Click on the dropdown of the *Filter Solutions by Product Family*.



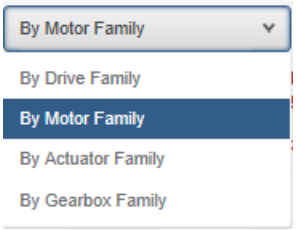
38. Review your Motor Families. Click on the dropdown for the *By Drive Family* filter.



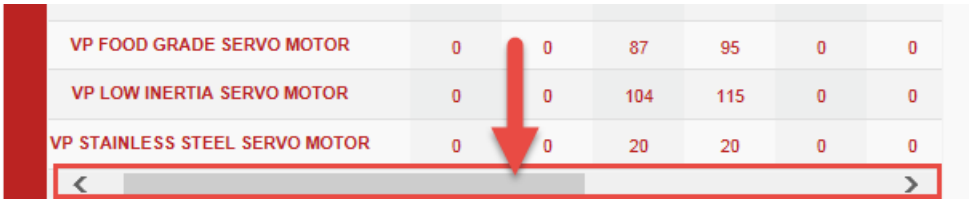
39. You can see your filter combinations for the *Filter Solutions by Product Family*. You can choose your "and" combination by *Drive Family*, *Motor Family*, *Actuator family*, and *Gearbox family*.



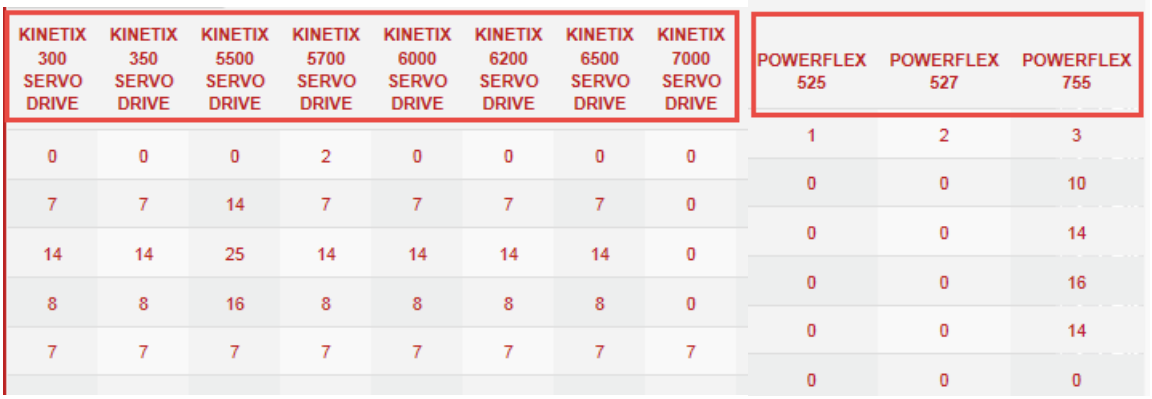
and



40. Leave the selections to *by Drive Family* and *by Motor Family*. Scroll right on the *Filter Solutions by Product Family* dropdown.



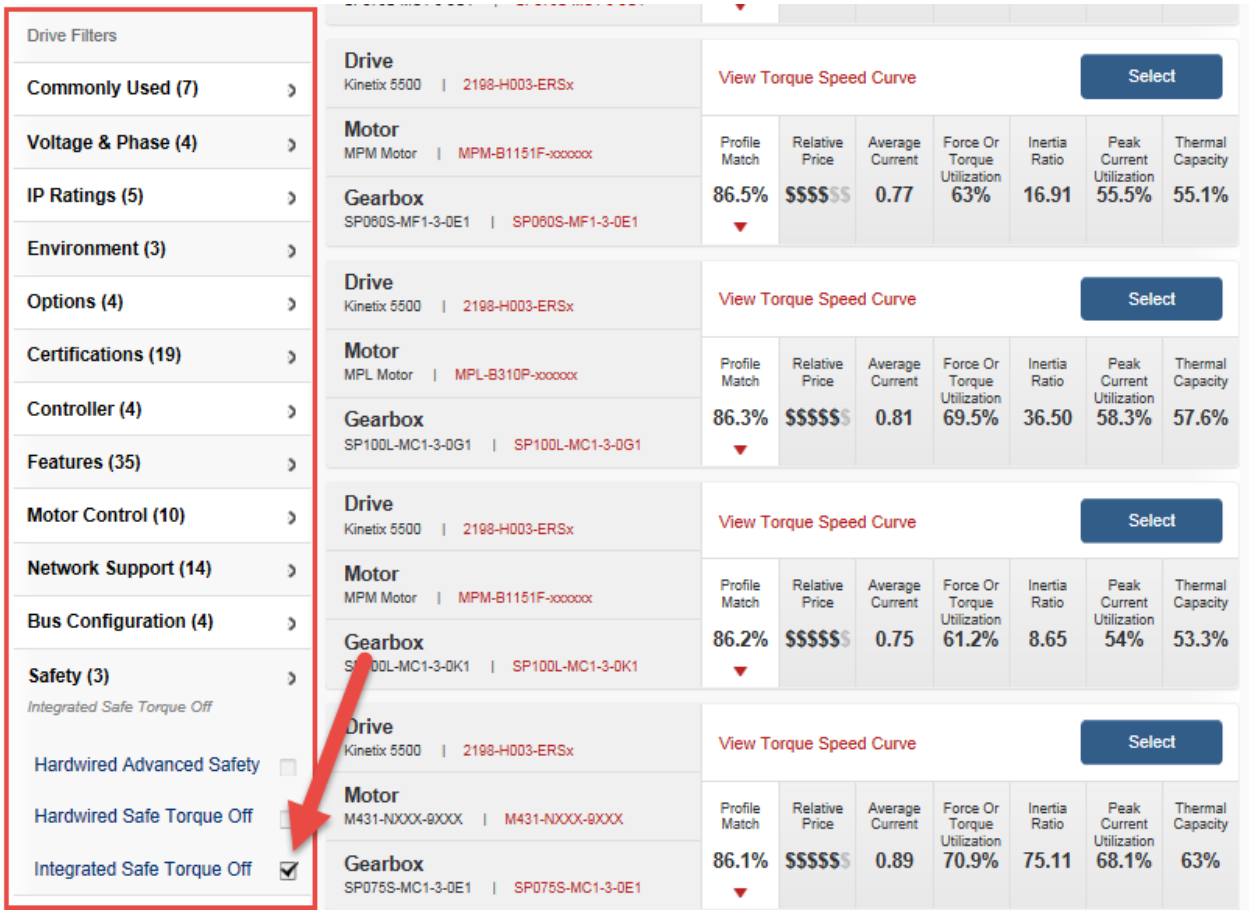
41. Your drive selections range from **Kinetix Servo Drives** to **PowerFlex VFD Drives**.



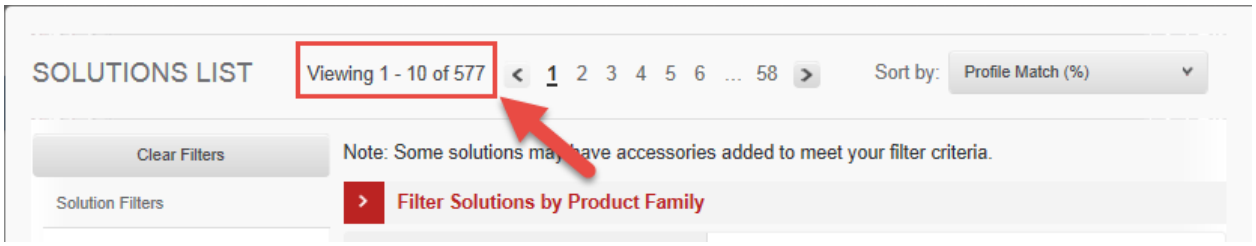
KINETIX 300 SERVO DRIVE	KINETIX 350 SERVO DRIVE	KINETIX 5500 SERVO DRIVE	KINETIX 5700 SERVO DRIVE	KINETIX 6000 SERVO DRIVE	KINETIX 6200 SERVO DRIVE	KINETIX 6500 SERVO DRIVE	KINETIX 7000 SERVO DRIVE	POWERFLEX 525	POWERFLEX 527	POWERFLEX 755
0	0	0	2	0	0	0	0	1	2	3
7	7	14	7	7	7	7	0	0	0	10
14	14	25	14	14	14	14	0	0	0	14
8	8	16	8	8	8	8	0	0	0	16
7	7	7	7	7	7	7	7	0	0	14
								0	0	0

42. ABC Foods had informed you that they attended Automation Fair to learn about CIP Safety Drive and that they wanted to take advantage of this technology. Your result should include a Drive with Integrated Safety.

43. In the *Drive Filters*, click on the dropdown for the **Safety** feature to see the three options available. Click on the checkbox for Integrated Safe Torque Off click on the **Safety**

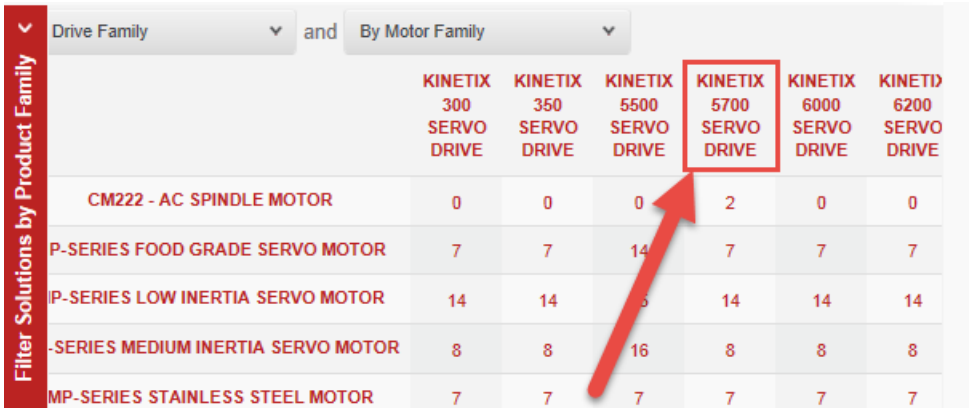


44. Your *Solutions List* is narrowed to 577 solutions. That is still a lot of products to review.



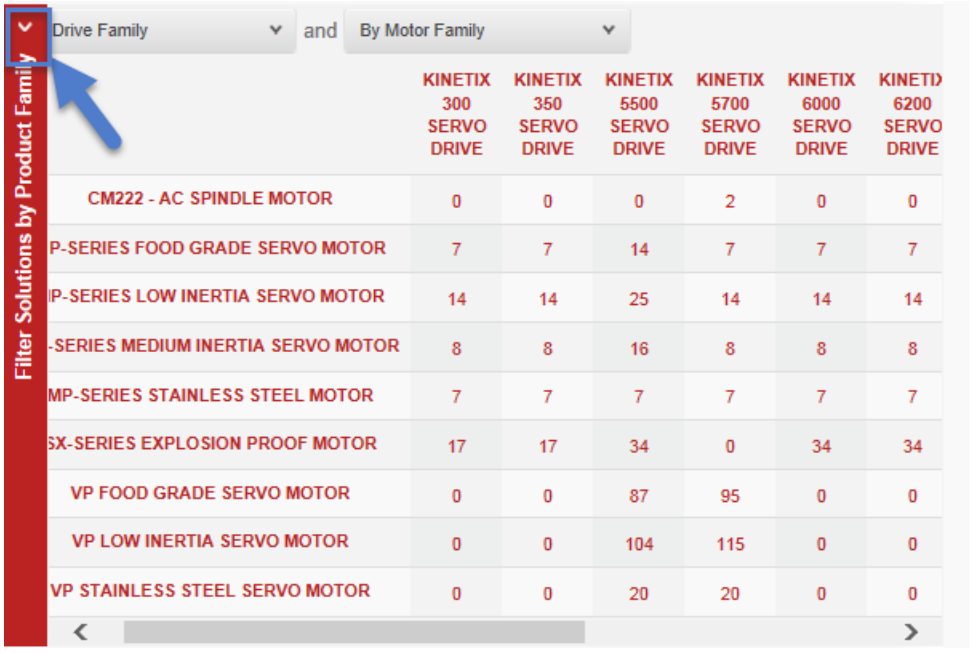
45. We can that most Drives have the Integrated Safety feature.

46. We will narrow our search to the **Kinetix 5700 Servo Drives**. The Assembly Index has two axes and since the **Kinetix 5700 Servo Drives** offers Dual Axis Inverter modules, this drive might be one of the best solutions. Click on **Kinetix 5700 Servo Drives**.



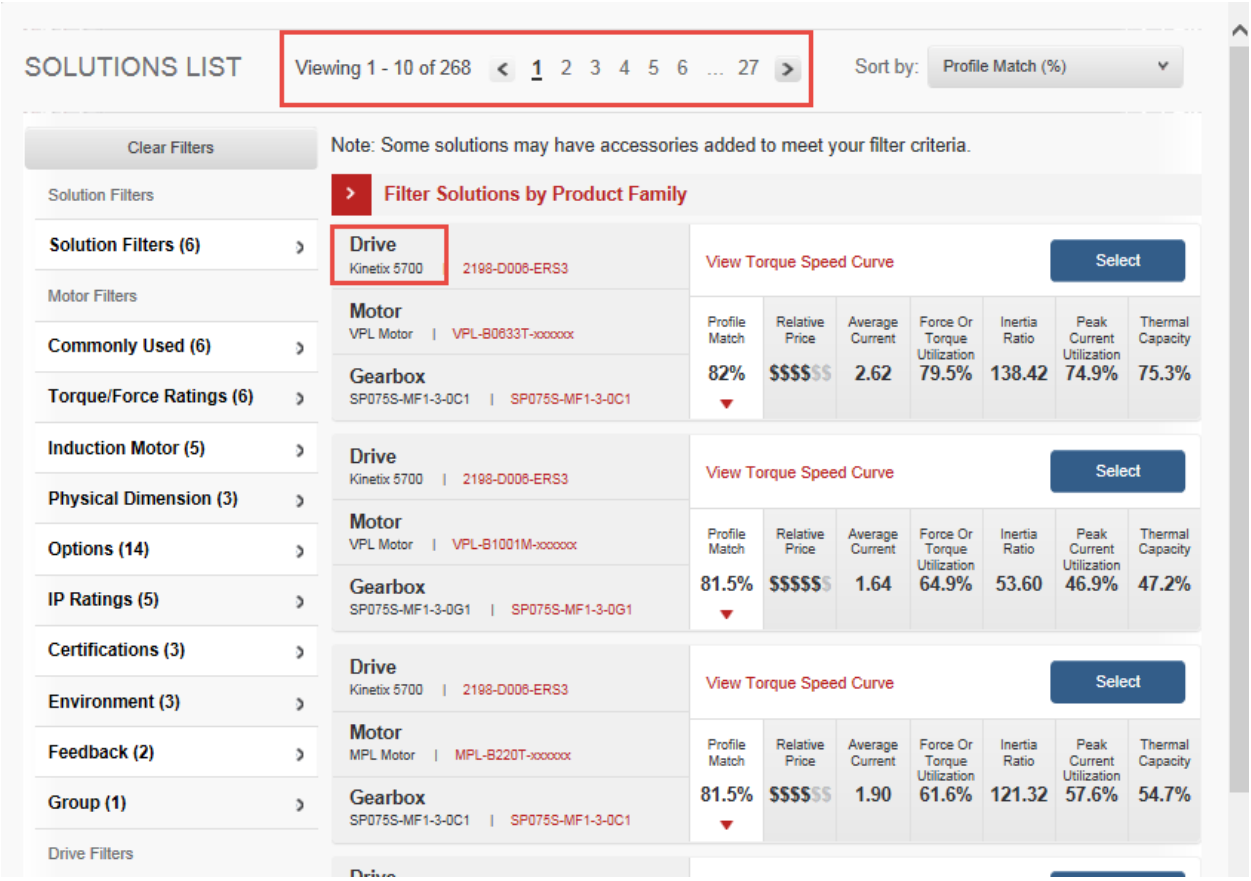
	KINETIX 300 SERVO DRIVE	KINETIX 350 SERVO DRIVE	KINETIX 5500 SERVO DRIVE	KINETIX 5700 SERVO DRIVE	KINETIX 6000 SERVO DRIVE	KINETIX 6200 SERVO DRIVE
CM222 - AC SPINDLE MOTOR	0	0	0	2	0	0
P-SERIES FOOD GRADE SERVO MOTOR	7	7	14	7	7	7
P-SERIES LOW INERTIA SERVO MOTOR	14	14	[illegible]	14	14	14
-SERIES MEDIUM INERTIA SERVO MOTOR	8	8	16	8	8	8
MP-SERIES STAINLESS STEEL MOTOR	7	7	7	7	7	7

47. Click on the dropdown section of *Filter Solutions by Product Family* to retract the filter list.

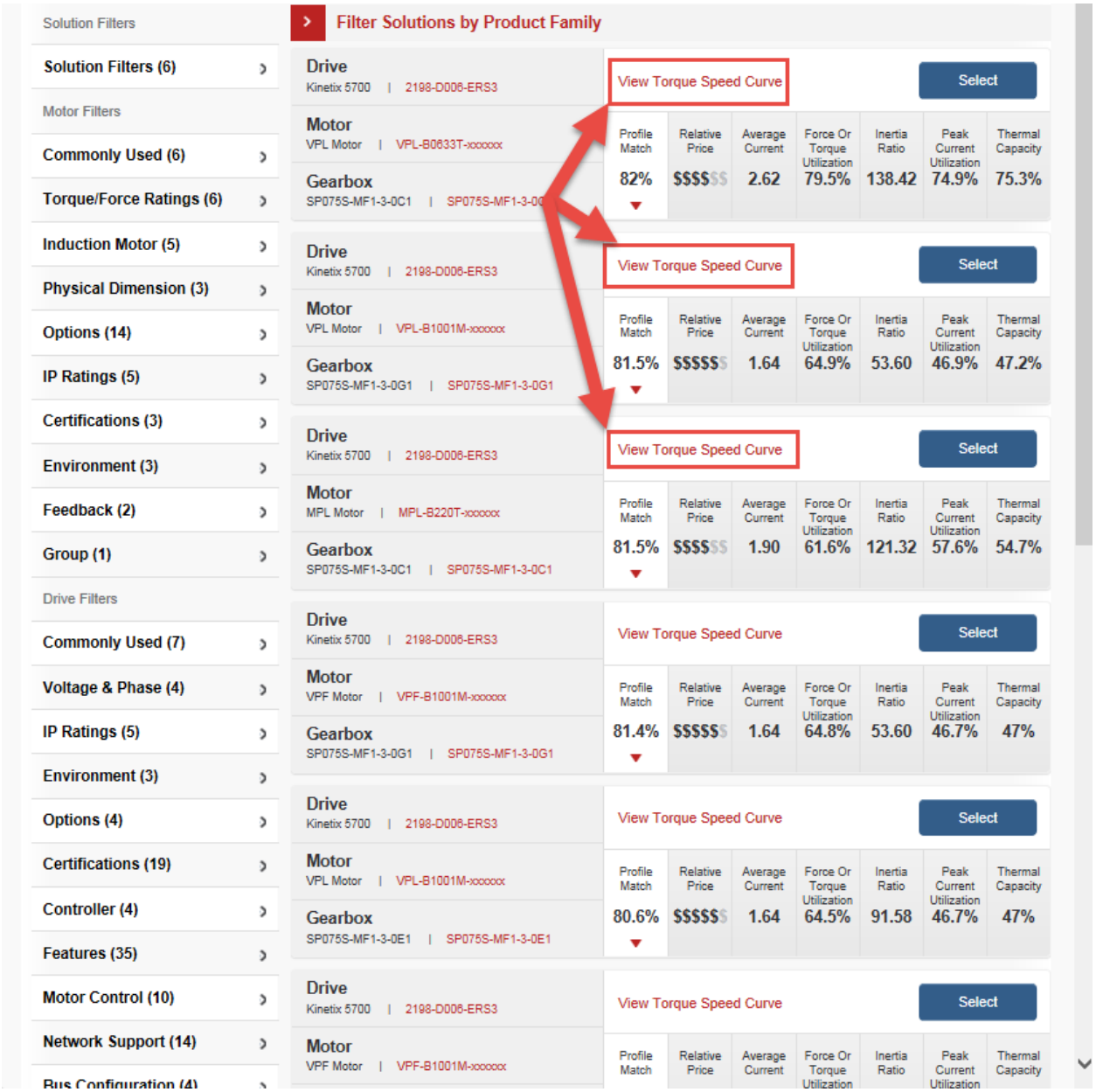


	KINETIX 300 SERVO DRIVE	KINETIX 350 SERVO DRIVE	KINETIX 5500 SERVO DRIVE	KINETIX 5700 SERVO DRIVE	KINETIX 6000 SERVO DRIVE	KINETIX 6200 SERVO DRIVE
CM222 - AC SPINDLE MOTOR	0	0	0	2	0	0
P-SERIES FOOD GRADE SERVO MOTOR	7	7	14	7	7	7
P-SERIES LOW INERTIA SERVO MOTOR	14	14	25	14	14	14
-SERIES MEDIUM INERTIA SERVO MOTOR	8	8	16	8	8	8
MP-SERIES STAINLESS STEEL MOTOR	7	7	7	7	7	7
X-SERIES EXPLOSION PROOF MOTOR	17	17	34	0	34	34
VP FOOD GRADE SERVO MOTOR	0	0	87	95	0	0
VP LOW INERTIA SERVO MOTOR	0	0	104	115	0	0
VP STAINLESS STEEL SERVO MOTOR	0	0	20	20	0	0

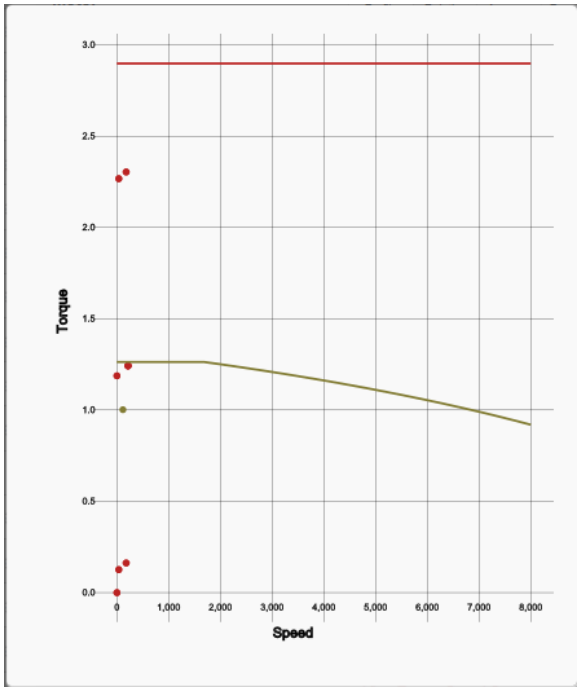
48. You can now see that your *Solutions List* moved from 577 solutions to 268 solutions of **Kinetix 5700 Servo Drives** combinations only.



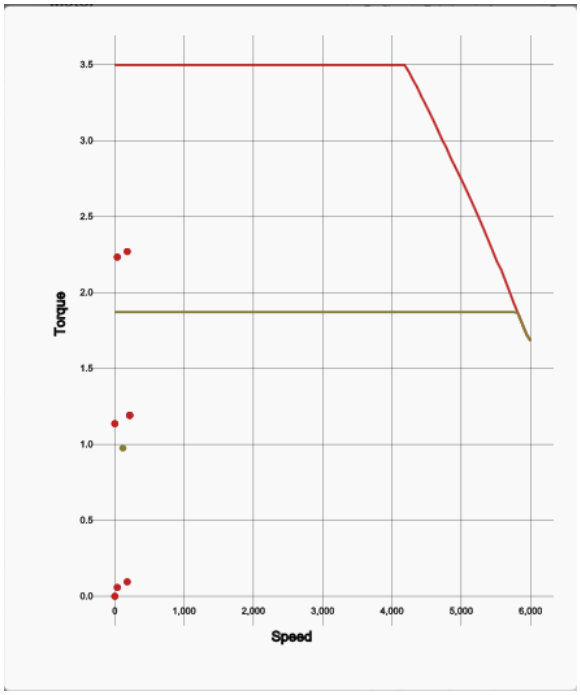
49. Click on **View Torque Speed Curve** on the first three solutions respectively to review the Torque/Speed plot. You can click away from the Torque/Speed plot to return to the *Solutions List* window.



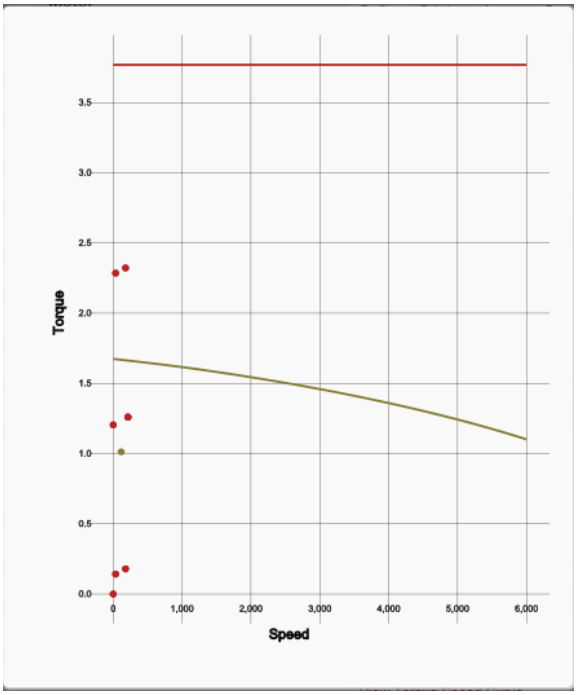
50. The three Torque/Speed plots would look as follows respectively:



First solution plot



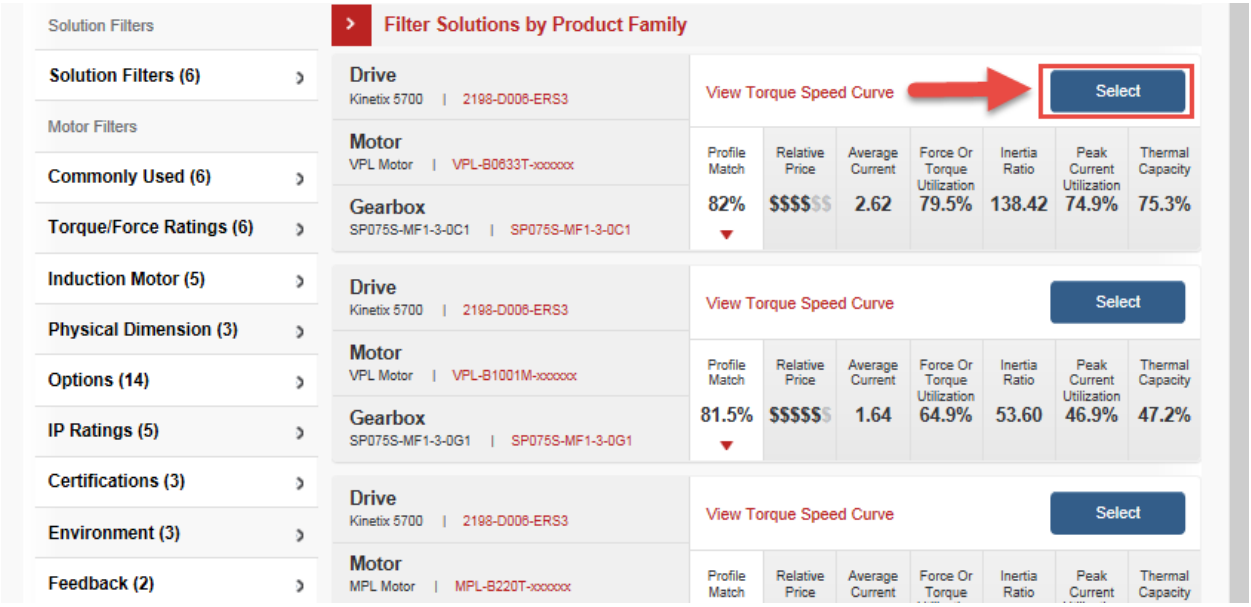
Second solution plot



Third solution plot

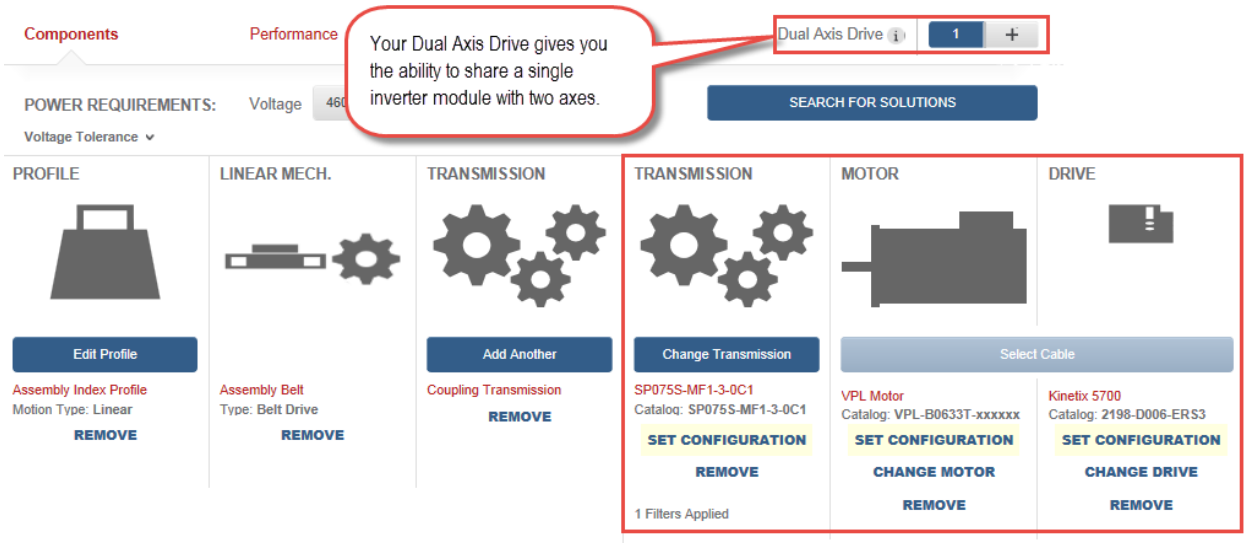
NOTE: Your Torque/Speed plots display the Drive/Motor performance versus your application demands. Our first solution passes the requirements of the application, therefore we will select it.

51. Let's select the first solution option. Click **Select** on the first option.



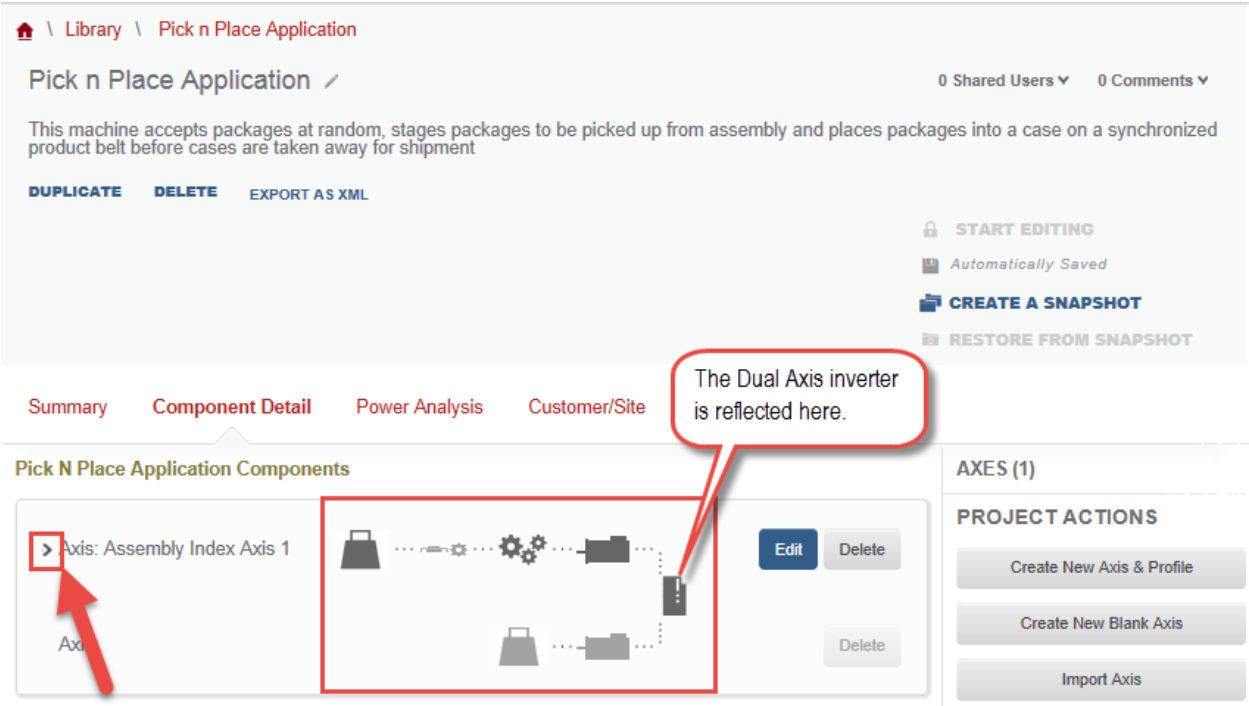
NOTE: An error might pop up once you select your drive. Just click **OK** and we can move forward.

52. As you are taken to the Axis Components page, your selected solution will be displayed.



53. Notice that your axis components are automatically saved at this point. Click on **Continue to Project**.

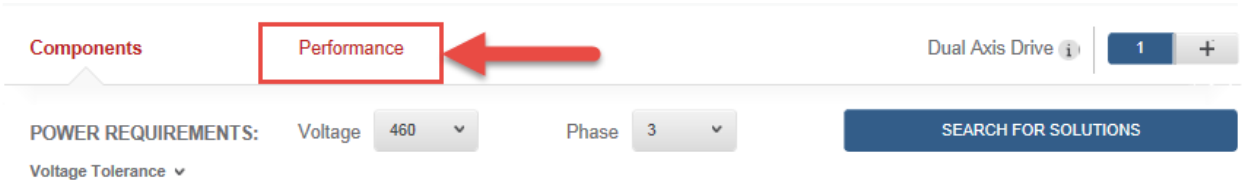
54. At your project window, you can view your *Component Detail* by axis by **clicking** on the dropdown next to your axis.



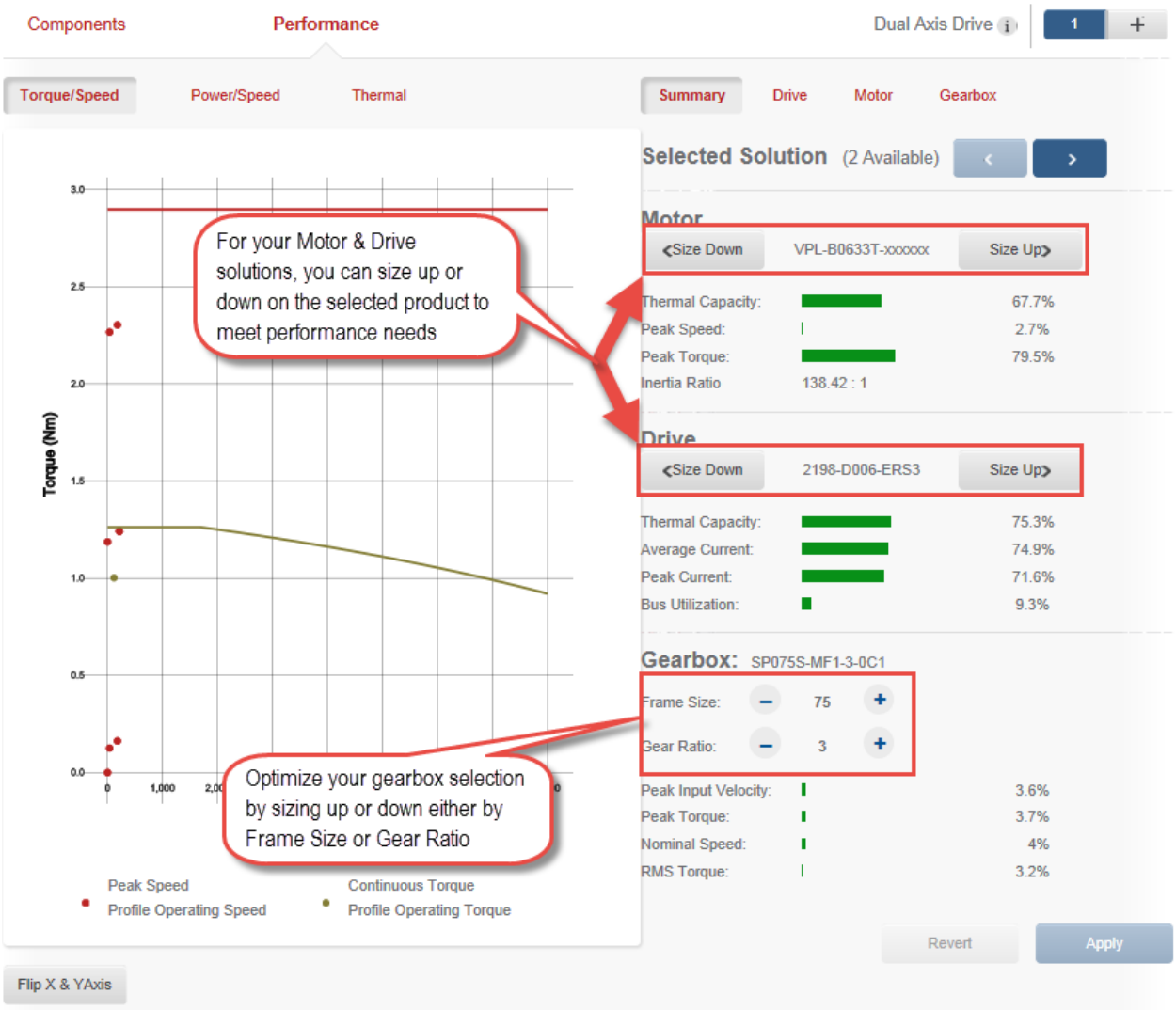
55. After clicking the dropdown of the Assembly Index Axis 1, you can see its selected components

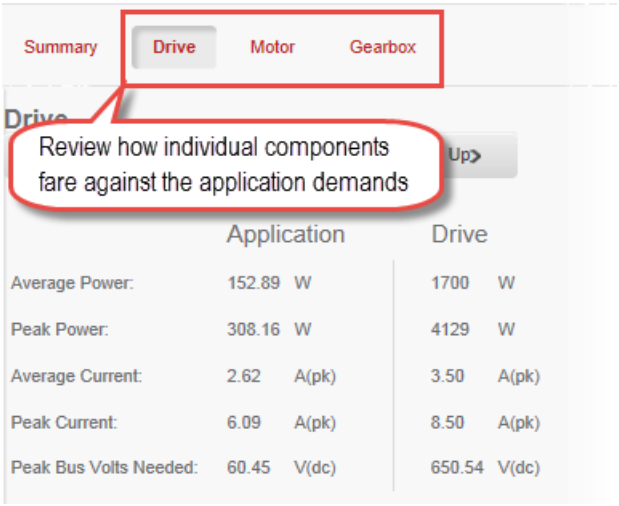
56. We will return to the *Components* page by clicking on **Edit** for the *Axis: Assembly Index Axis 1*.

57. At the *Components* page, click on the *Performance* tab to review Application vs. Components performance.

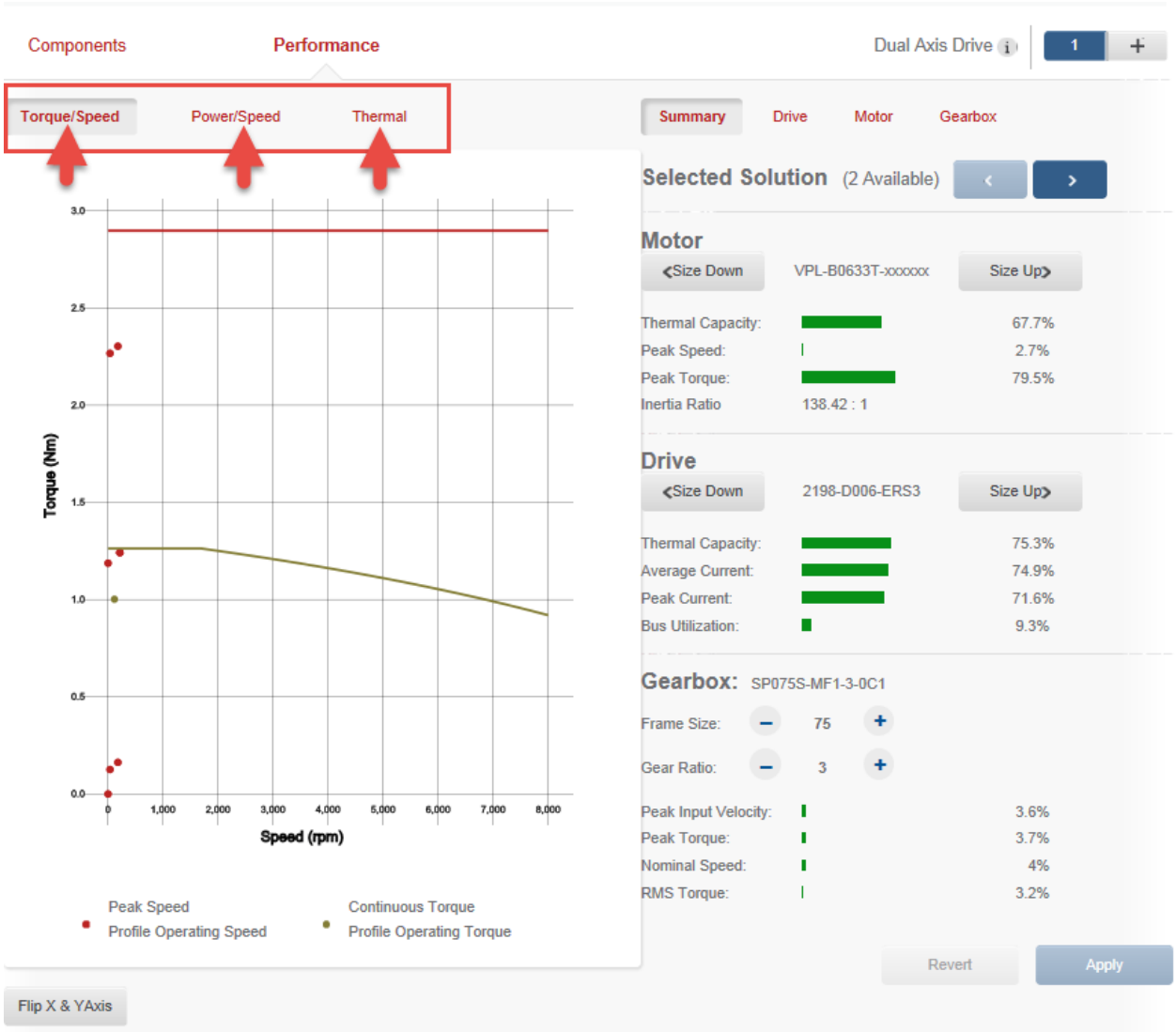


58. The *Performance* tab offers a visual interpretation of Application Needs vs Components Performance.

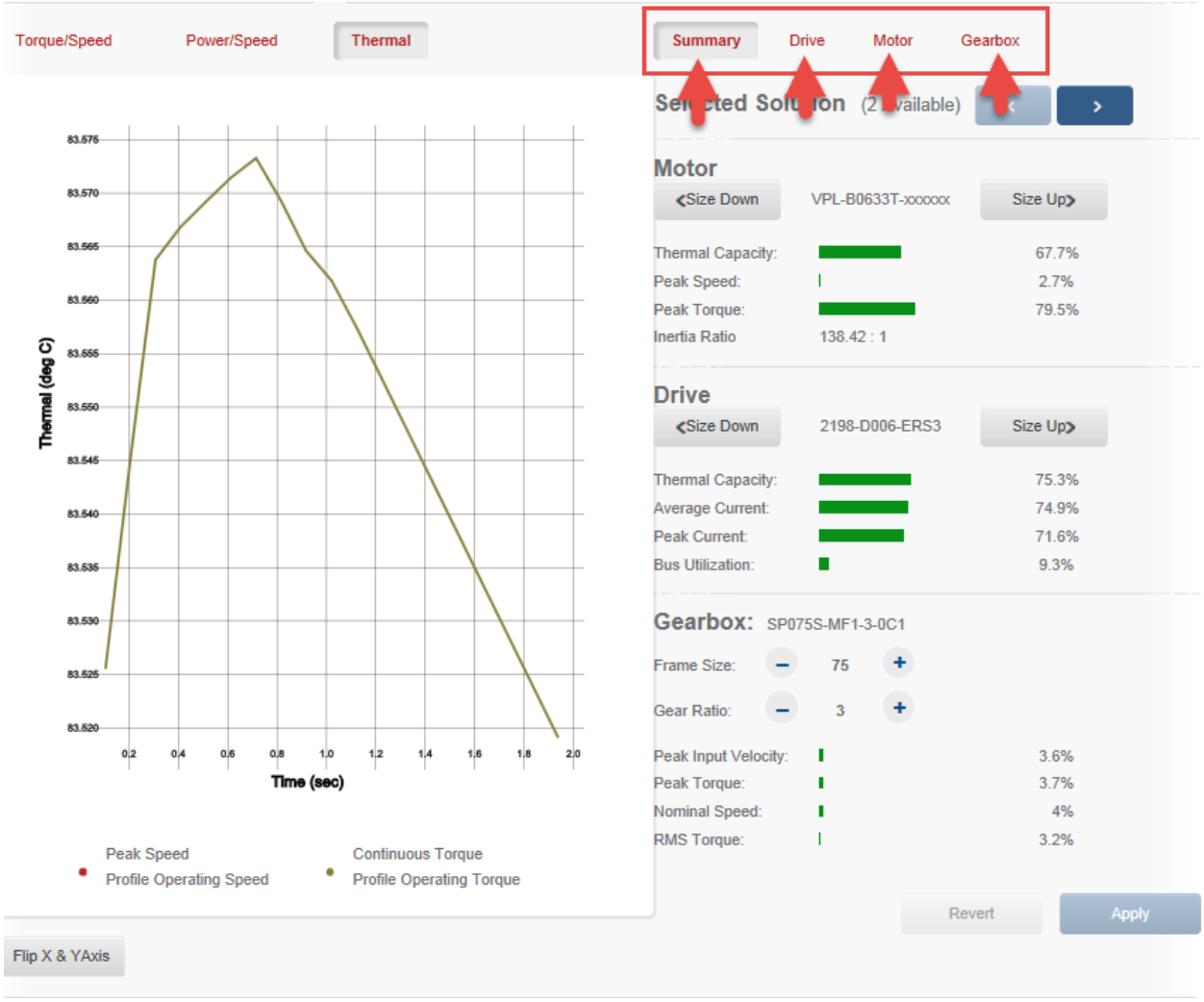




59. From the *Performance* tab, you can see your Torque/Speed plot. Take time to review the *Torque/Speed* plot, *Power/Speed* plot, and *Thermal* plot.

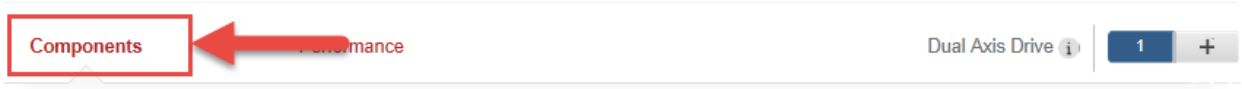


60. Once done reviewing the *Thermal* plot, Review your *Summary*, *Drive*, *Motor*, and *Gearbox*.



61. We've completed the first axis in our project and will proceed to the remaining axes. Since Assembly Index Axis 1 is the exact same axis as Assembly Index Belt 2. We will be creating a duplicate of the axis to avoid repeating the work we just performed.

62. Click on **Components** to return to the *Components* tab.



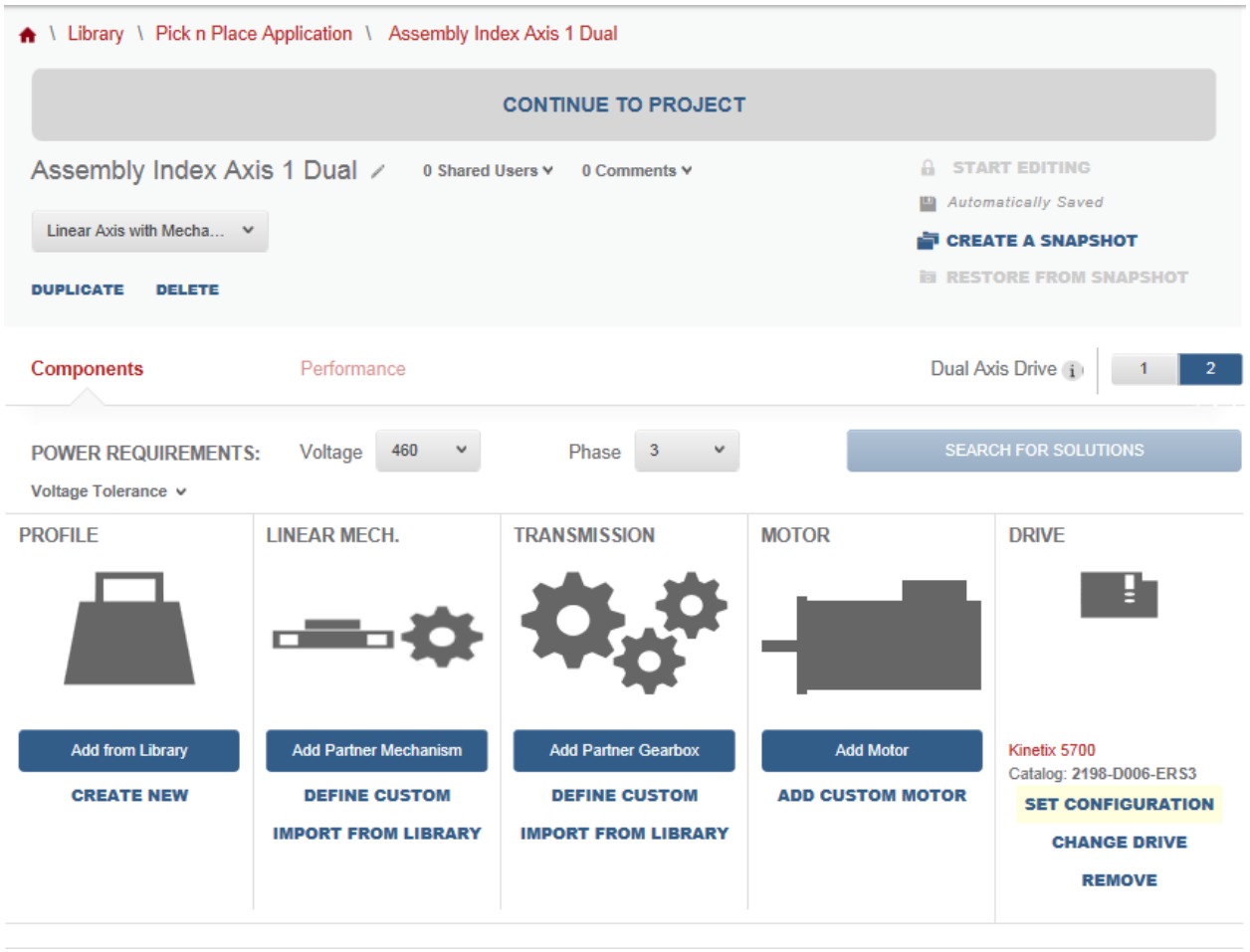
63. Click on + to add the second axis to our Dual Axis Drive.

Part B: Assembly Index Belt 2

Duplicating a Component

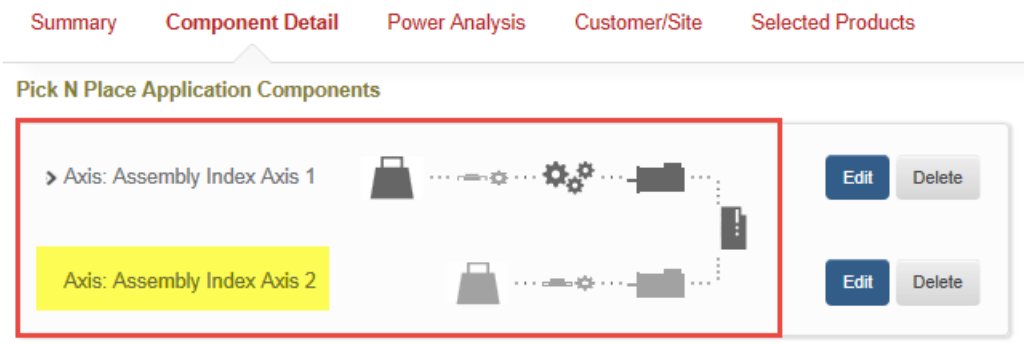
Duplicating the components of the Assembly Index Axis 1 will minimize the time taken to build another Assembly Index Axis from scratch.

1. After clicking on + to add the second axis, your new view should look as follows:

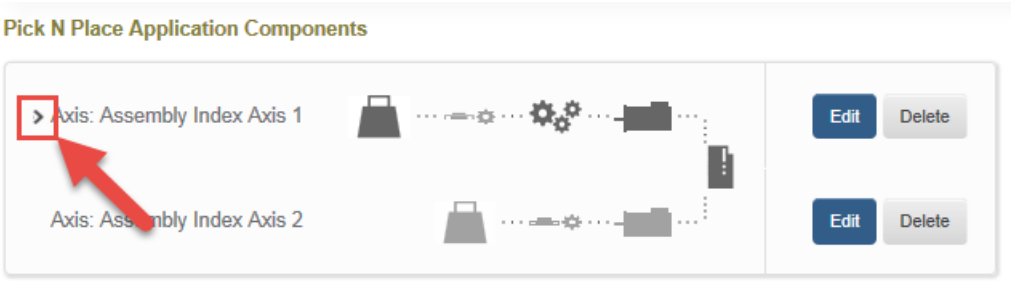


2. We will begin by renaming our axis from *Assembly Index Axis 1 Dual* to *Assembly Index Axis 2*. Click **Continue to Project** once you've made the name change.

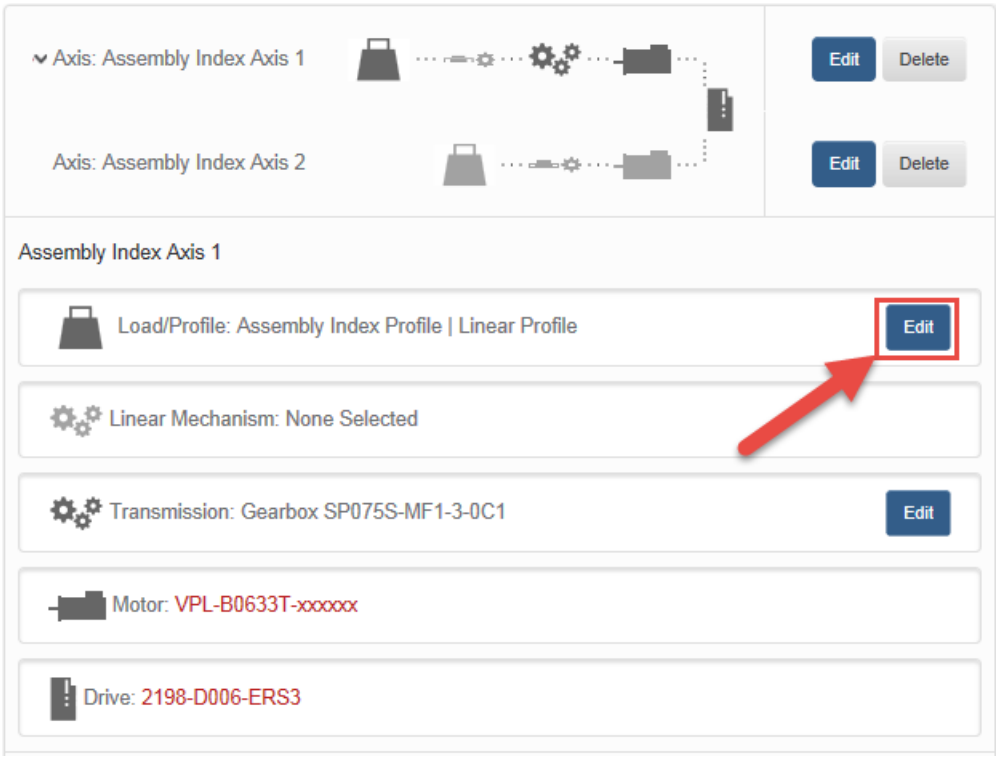
3. Your new axis will be reflected in your application components as seen here:



4. We are going to duplicate the components of the *Assembly Index Axis 1*. Click the dropdown on *Axis: Assembly Index Axis 1*



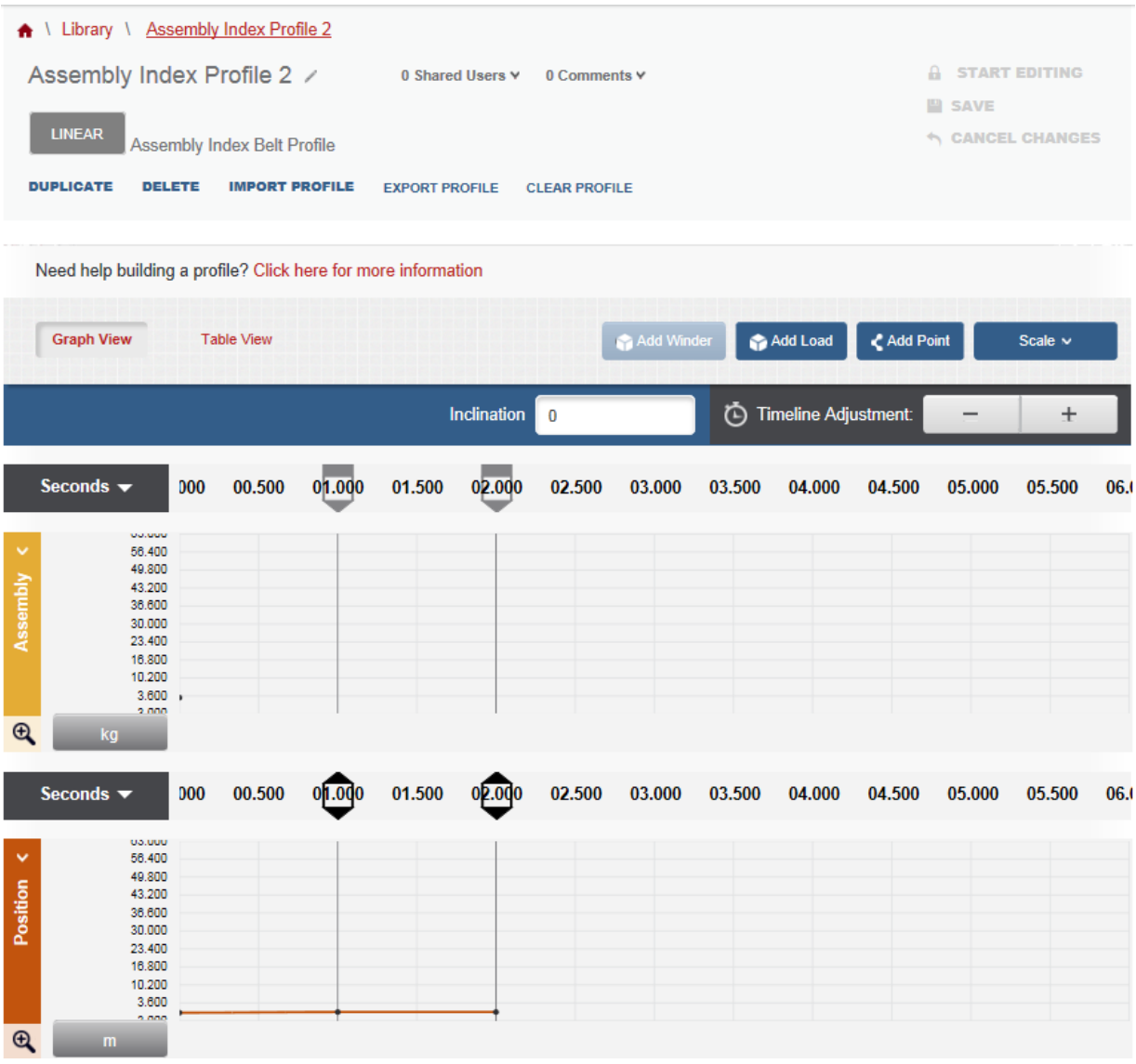
5. Click **Edit** on the *Assembly Index Profile*.



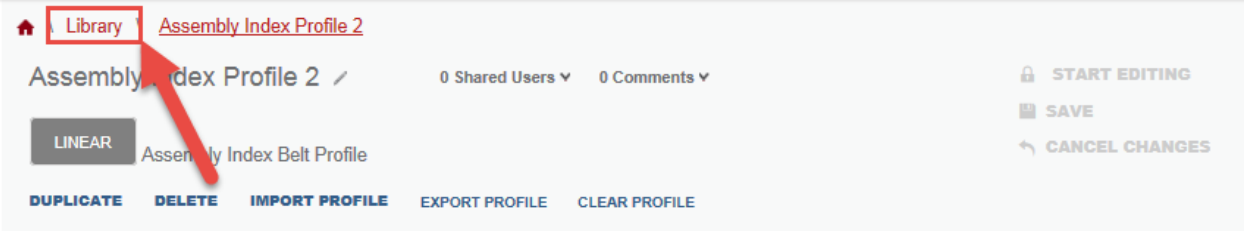
6. From the *Assembly Index Profile* page, click on **Duplicate**.

7. A prompt will ask to confirm your duplication. Rename *[Copy]Assembly Index Profile* to *Assembly Index Profile 2*. Then click **YES** to confirm your selection.

8. Your new profile will show up as a duplicated of your *Assembly Index Profile*.

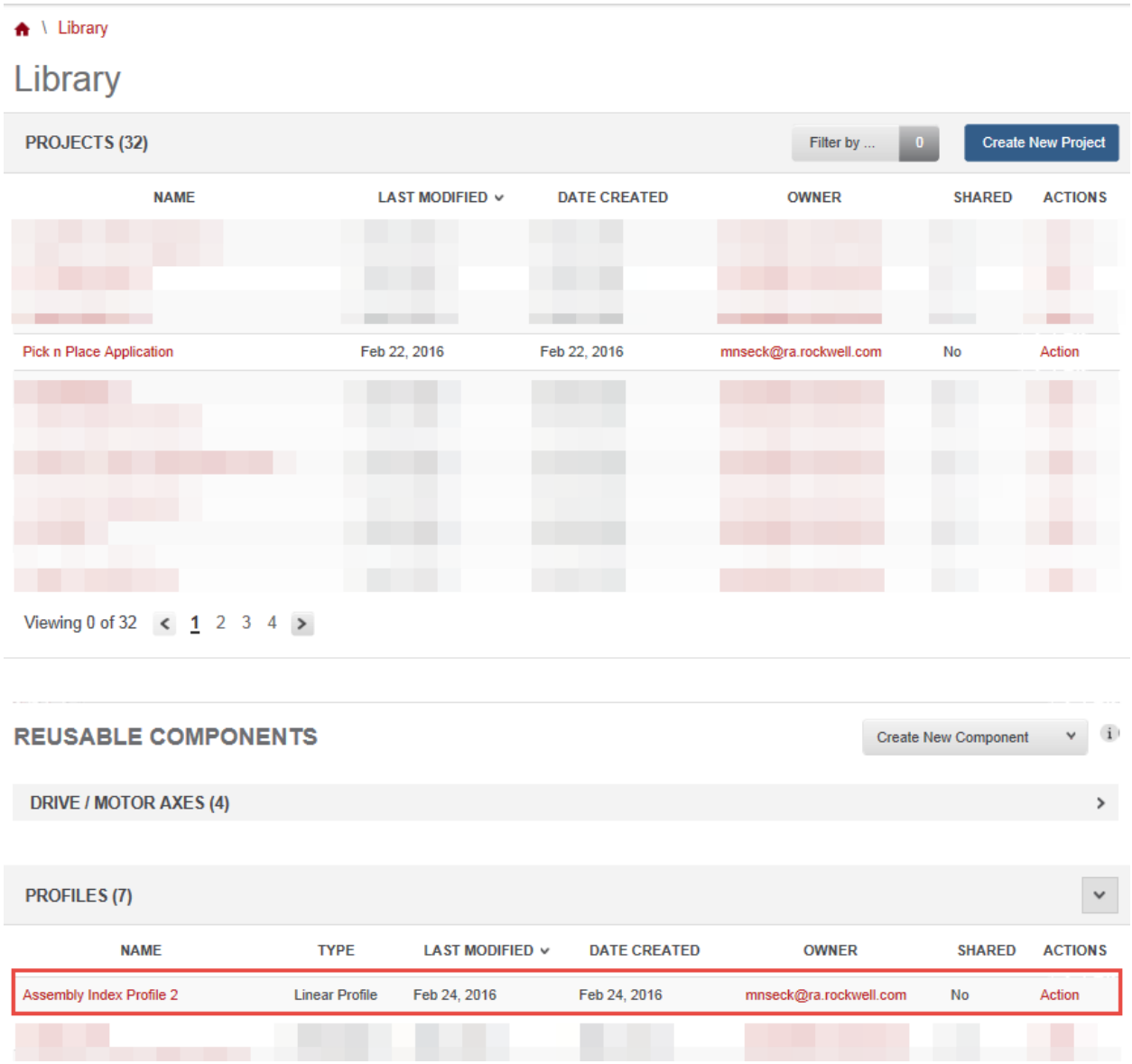


9. Right click on *Library* and click **Open In New Tab**.

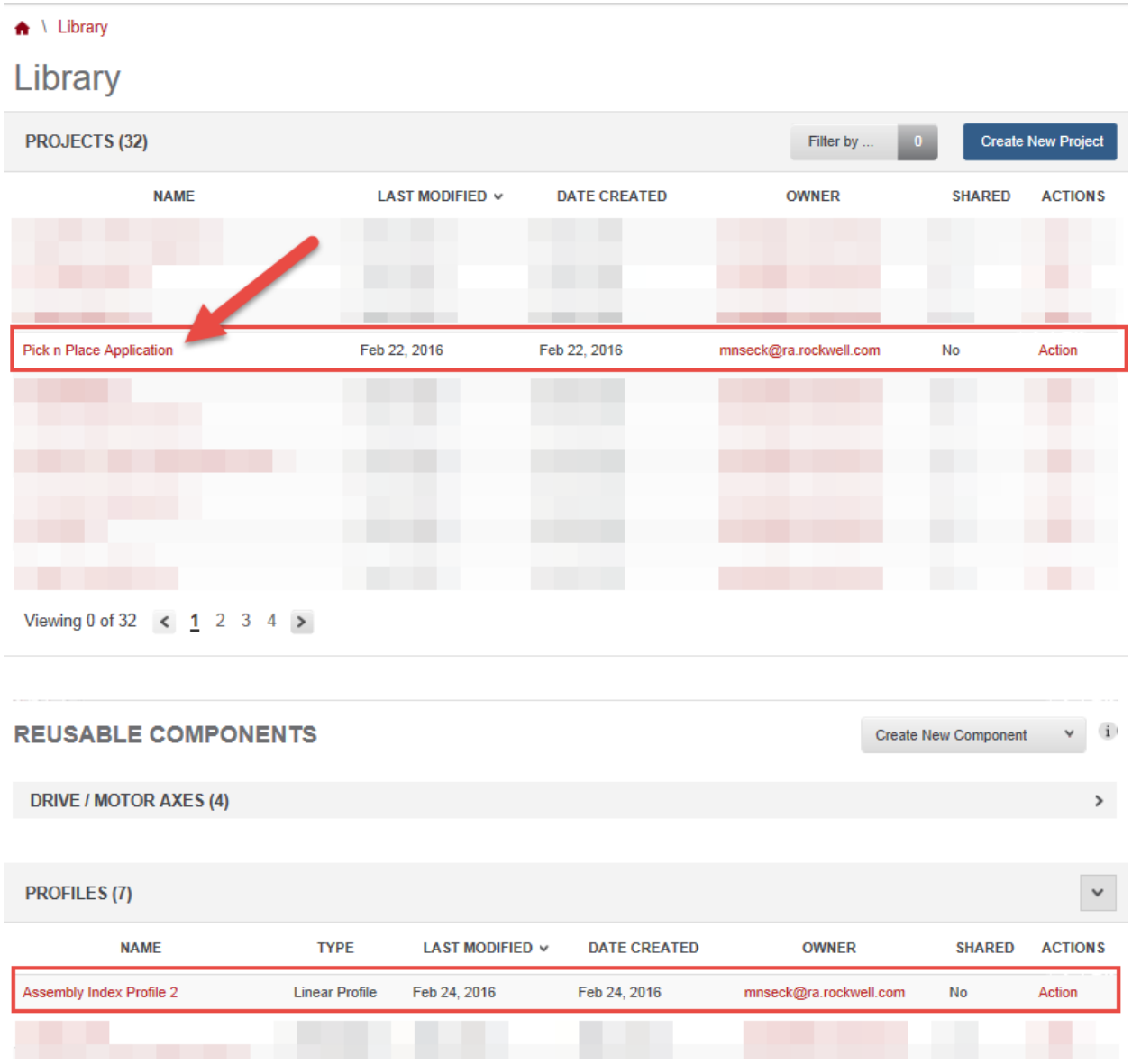


10. The new Internet Explorer tab will open at the Library page, go to the Library – Motion Analyzer tab.

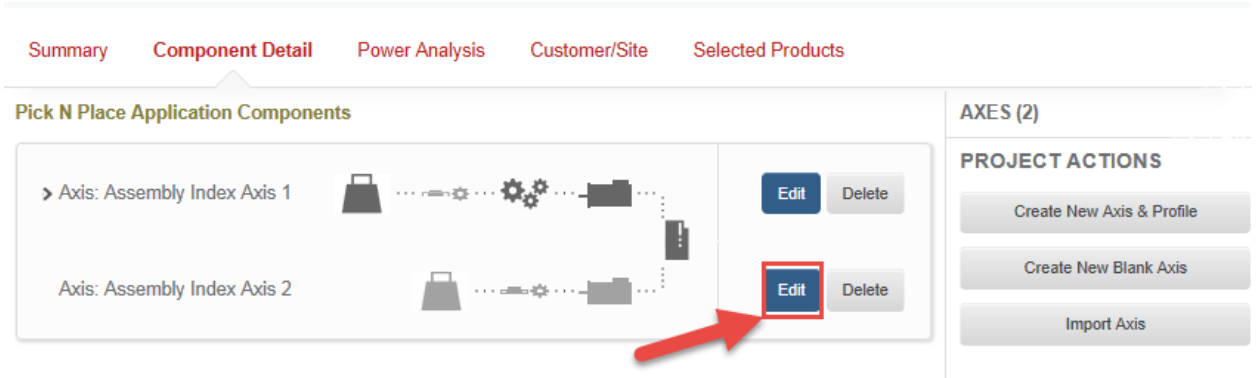
11. Your duplicated profile will show up in the Profiles Components.



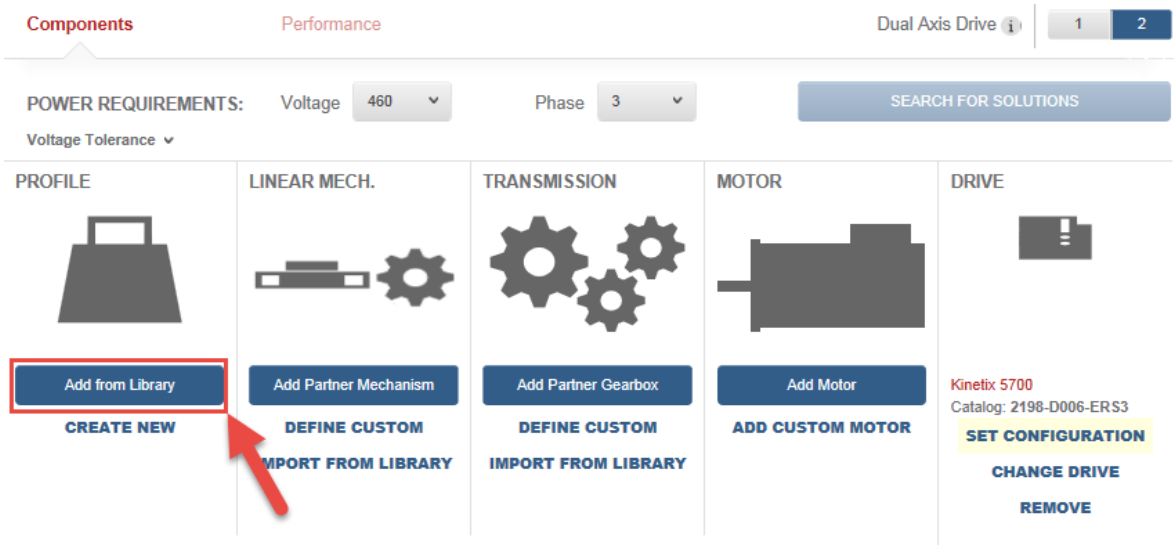
12. Click on the Pick n Place Application in your Library where we will reopen our Pick n Place Application.



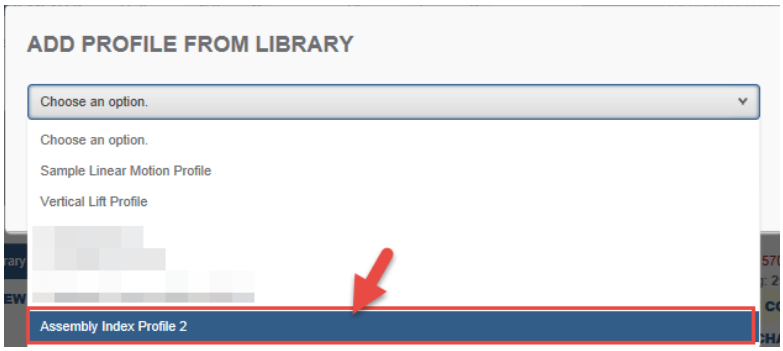
13. Click **Edit** on *Axis: Assembly Index Axis 2*.



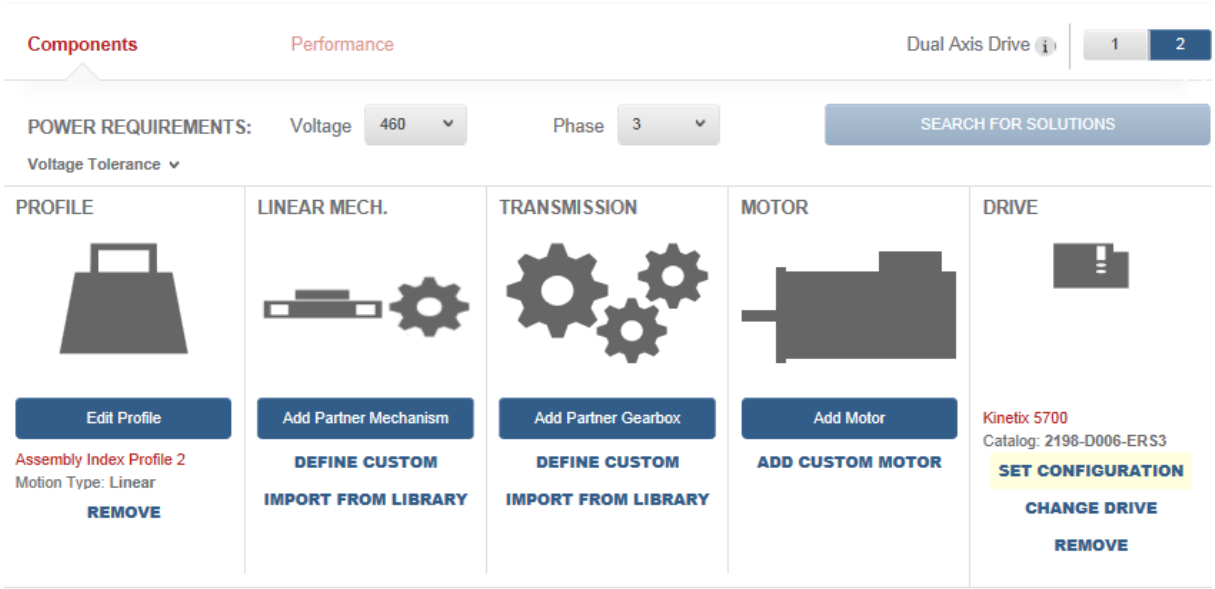
14. At the *Components*, we will add *Profile* from Library by clicking **Add from Library**



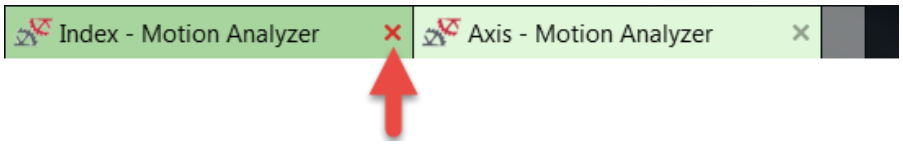
15. Add *Assembly Index Profile 2* from Library and click **OK** to confirm



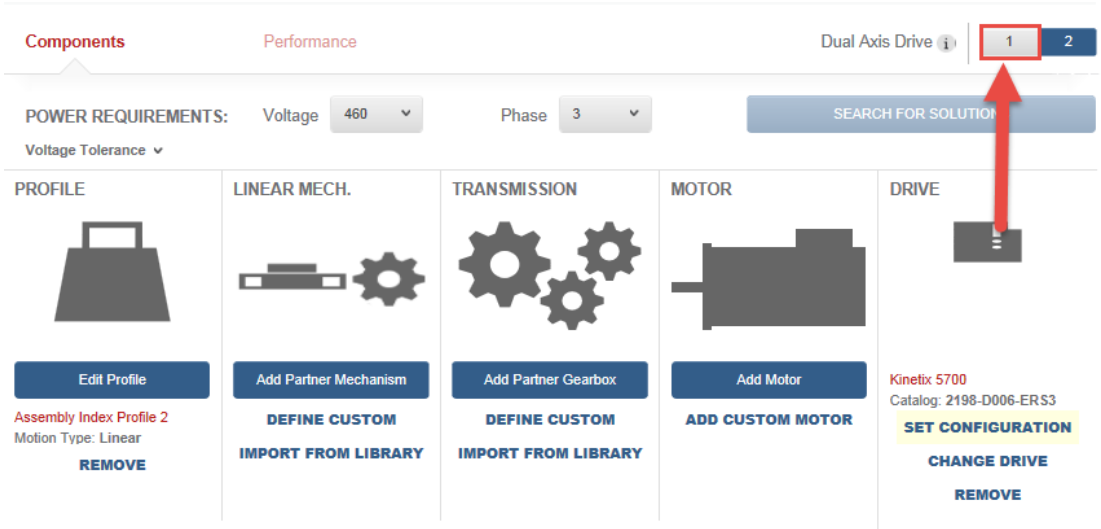
16. Your *Assembly Index Profile 2* profile component should be added and seen as below:



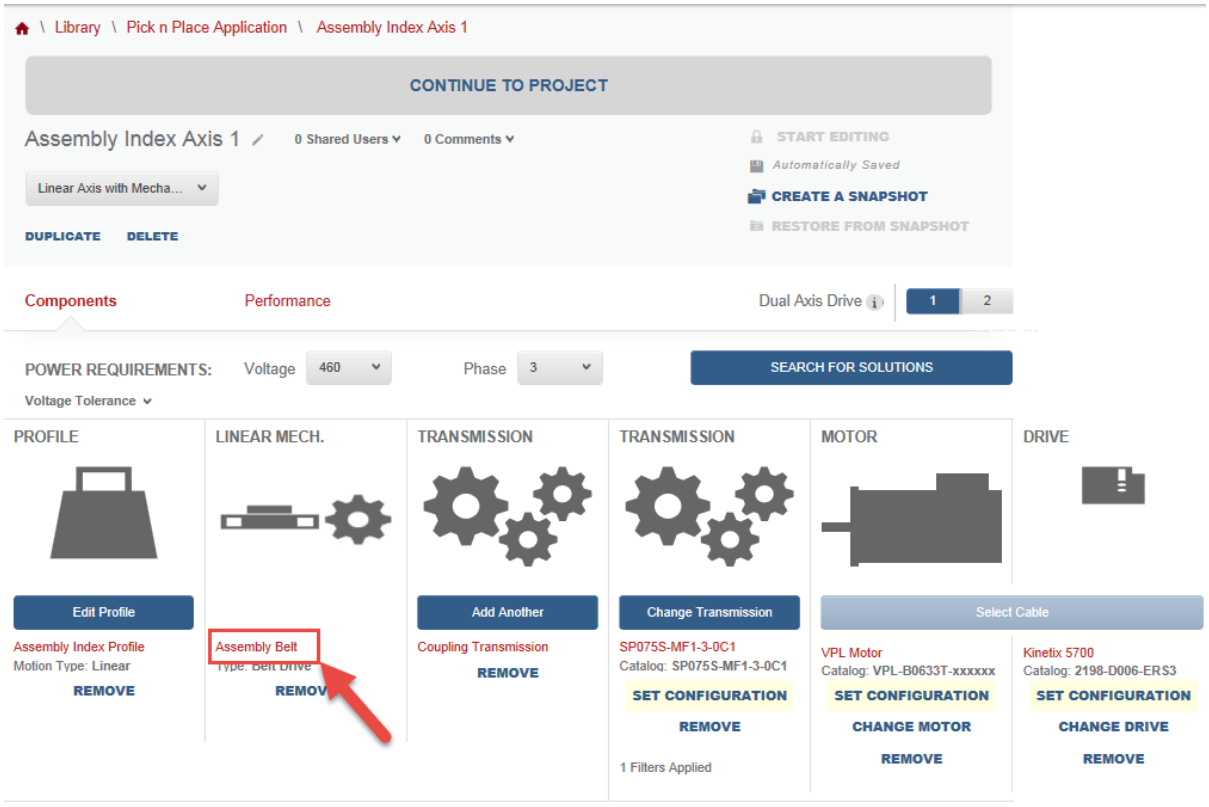
17. Close the first tab containing the duplicated profile.



18. Click 1 to open the *Assembly Index Axis 1* to copy the *Linear Mechanism* component.

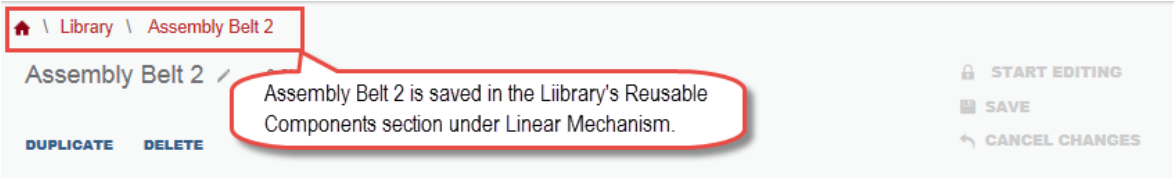


19. Right click on *Assembly Belt* to open the Linear Mechanism of *Assembly Index Axis 1* in a different tab.

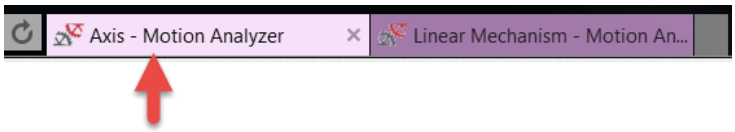


20. Click **Duplicate** to duplicate the *Assembly Belt*. **Rename** *[Copy]Assembly Belt* to *Assembly Belt 2*. Click **YES** to confirm your selection.

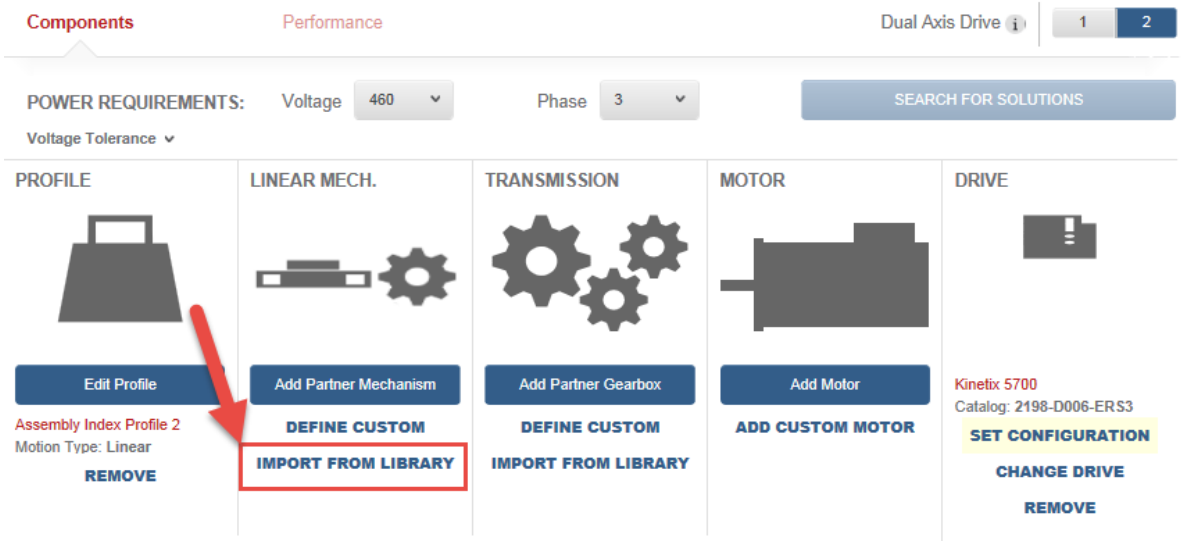
21. The new component will open.



22. We will return to the Axis tab and import the linear mechanism to our *Assembly Index Axis 2.*

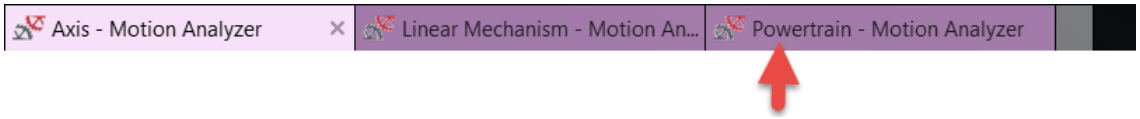


23. Click on 2 to navigate to the *Assembly Index Axis 2* and click **Import From Library** to import the *Assembly Belt 2* Linear mechanism.



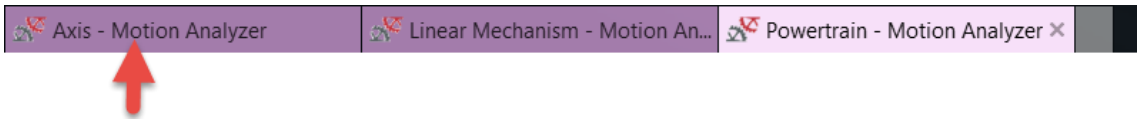
24. Select *Assembly Belt 2* from Library and then click **OK** to confirm your selection.

25. Open *Assembly Index Axis 1* (Step 18), right click on *Coupling Transmission* and select **Open in new tab**. Your Internet Explorer window should display 3 tabs. Click on the Powertrain tab.

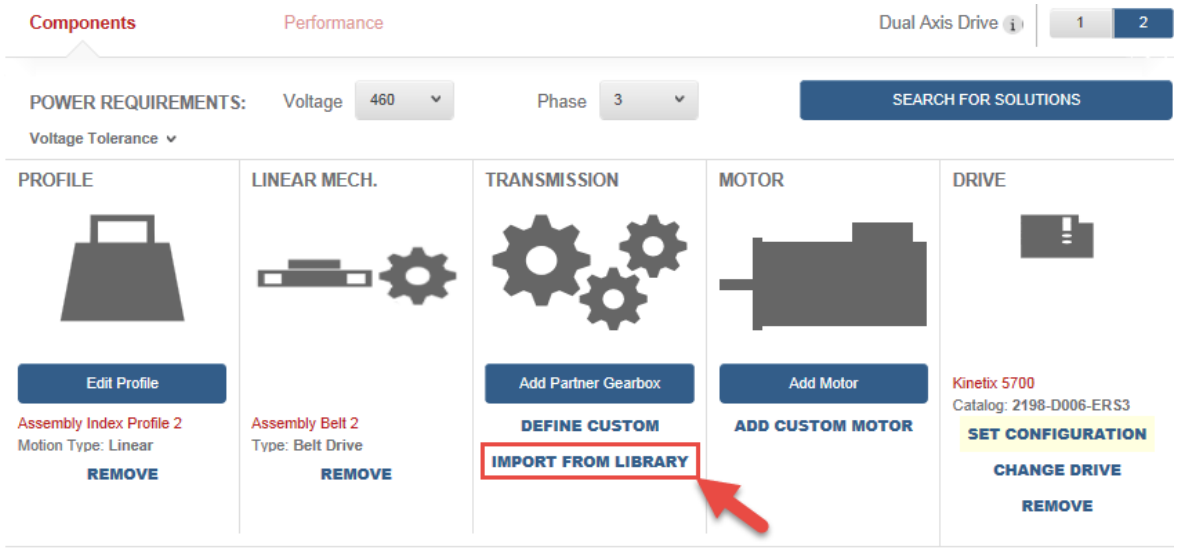


26. Click **Duplicate** to duplicate the *Coupling Transmission*. **Rename** *[Copy]Coupling Transmission* to *Coupling Transmission 2*. Click **YES** to confirm your selection.

27. The duplicated transmission will be saved in the Library's Reusable Components section under Transmission. **Return** to the Axis – Motion Analyzer tab and **close** the other two Internet Explorer tabs.

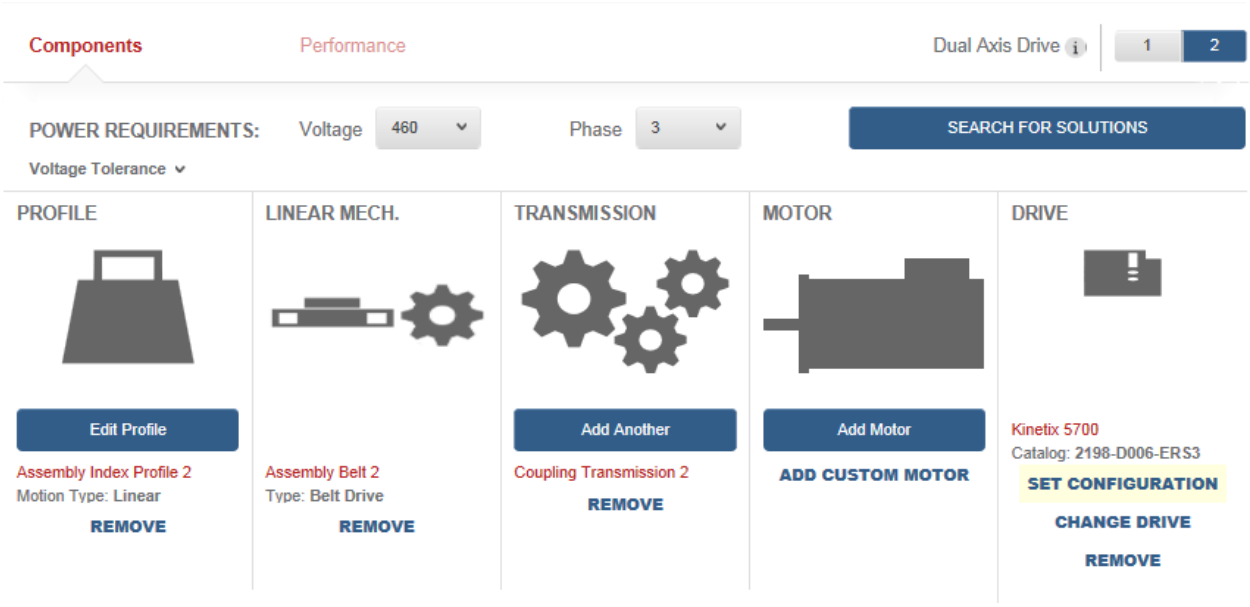


28. Open *Assembly Index Axis 2* (Step 23), and click **Import From Library** to import the *Coupling Transmission 2* transmission.

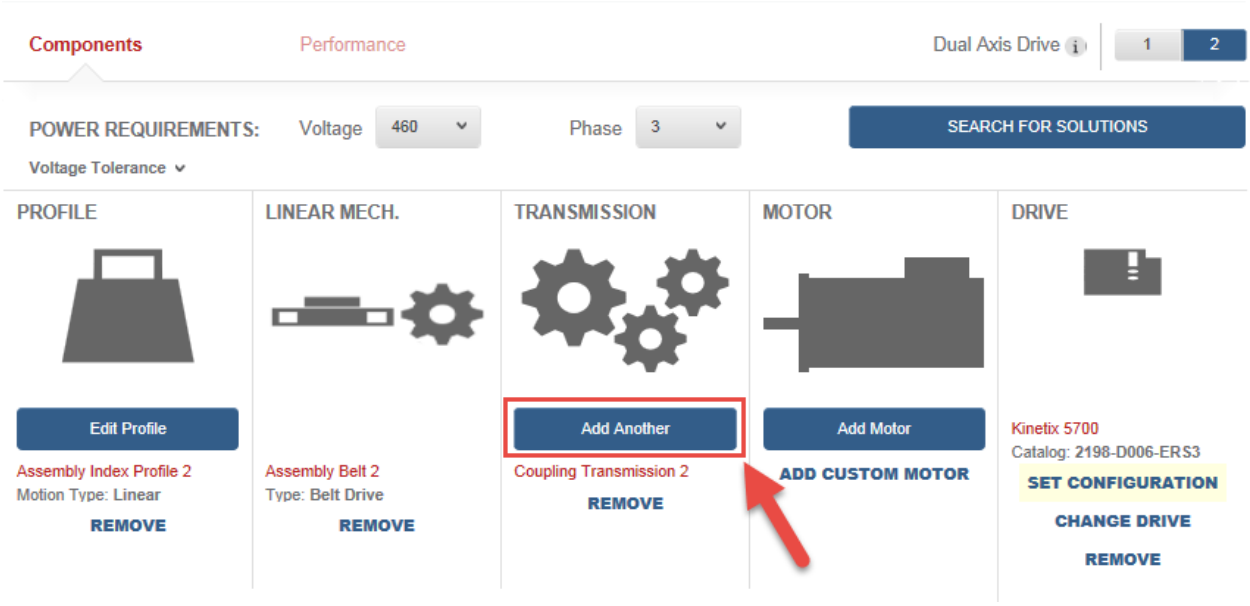


29. Select *Coupling Transmission 2* from Library and then click **OK** to confirm your selection.

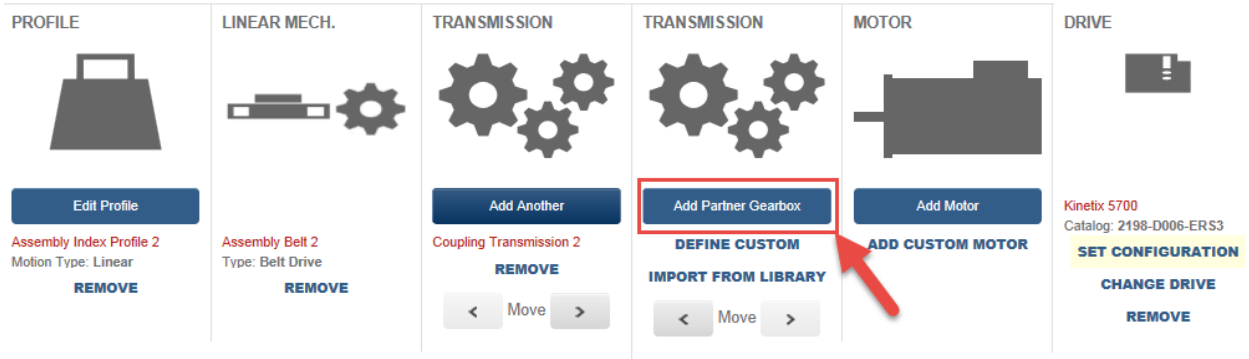
30. Your axis components should look as follows:



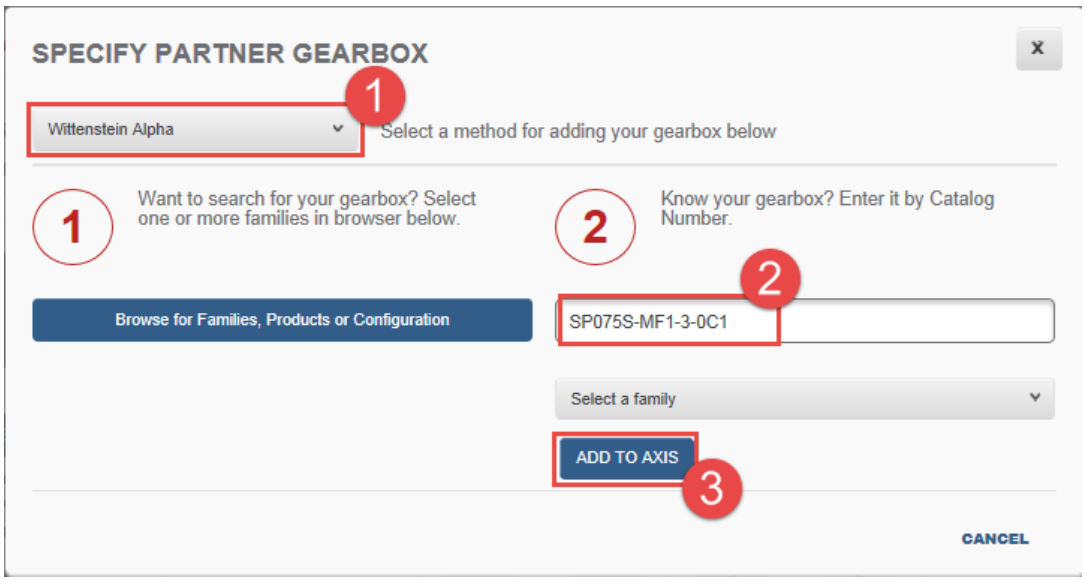
31. From the Assembly Index Axis 1, we know our gearbox is selected as SP075S-MF1-3-0C1. Click **Add Another** on the *Coupling Transmission 2* component.



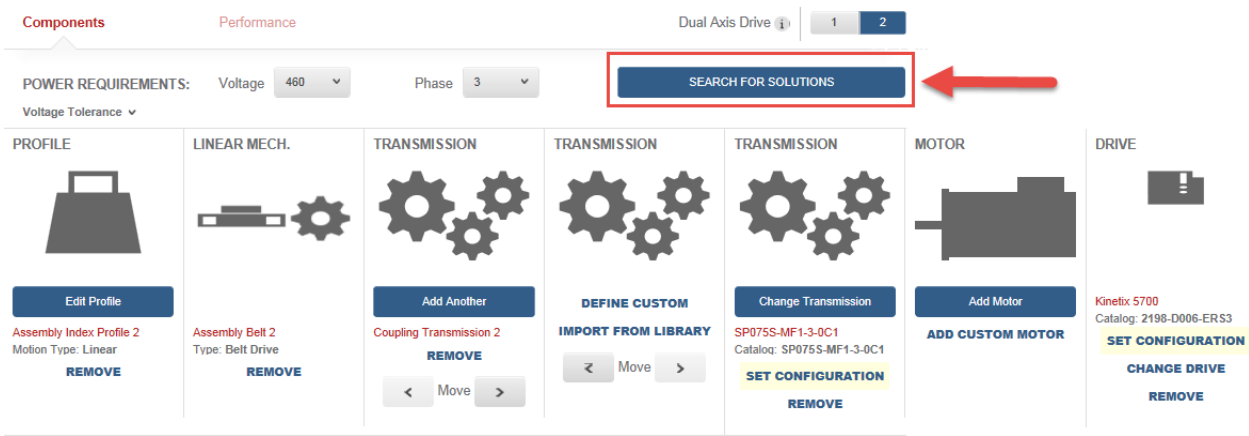
32. Select **Add Partner Gearbox**



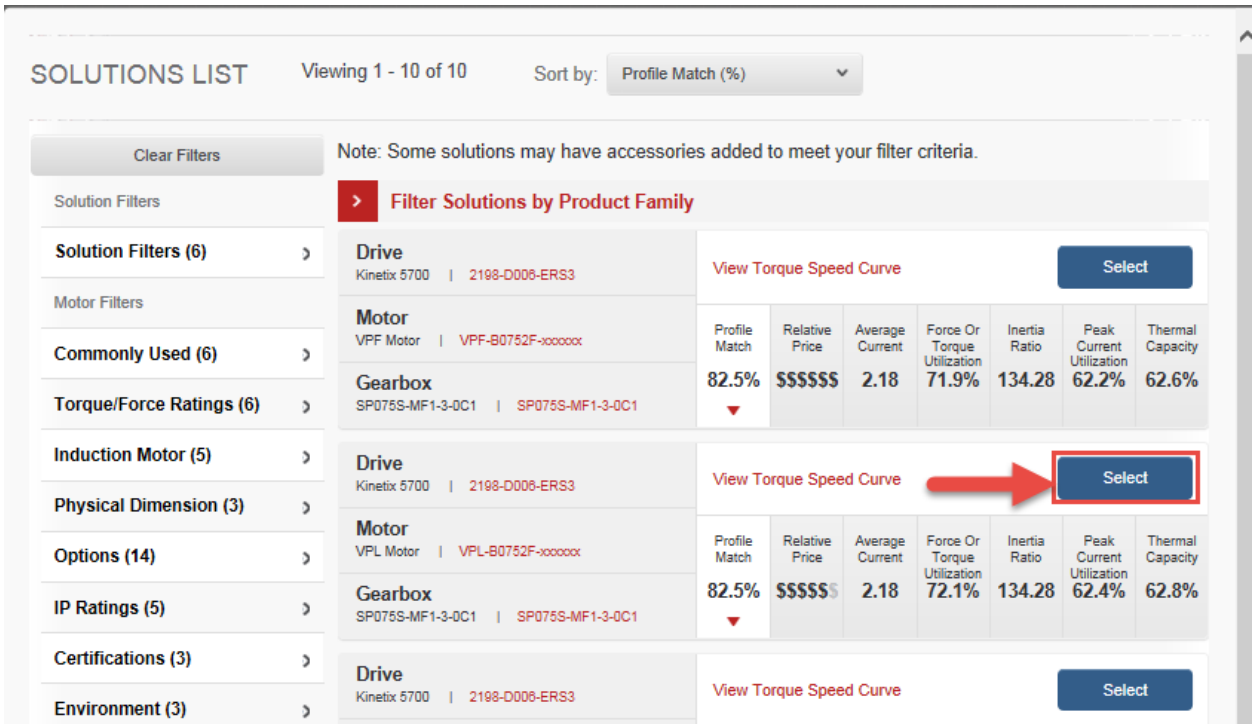
33. Select *Wittenstein Alpha* as our manufacturer, enter *SP075S-MF1-3-0C1* as the catalog number of the gearbox, and click **Add to Axis**.



34. You can select **Search For Solutions** to add a motor to your axis.



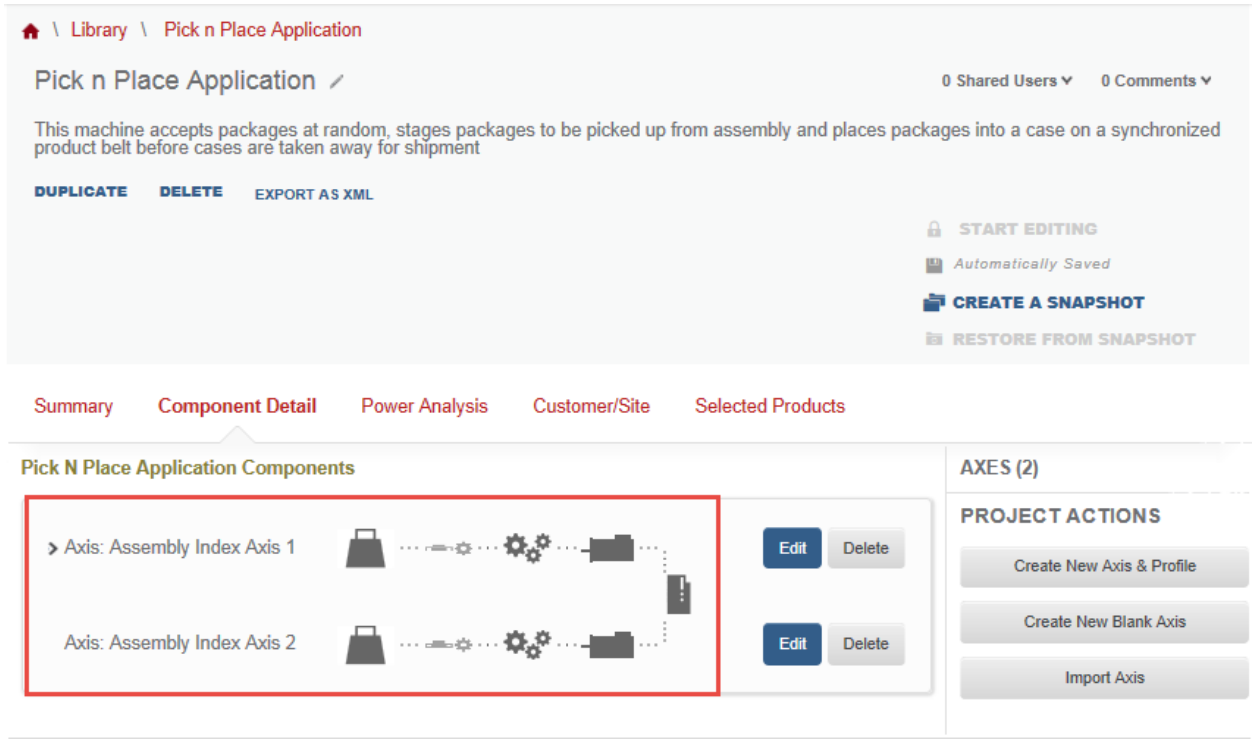
35. Your *Solutions List* will display 10 solutions, select the second Drive, Motor, Gearbox solution on the list.



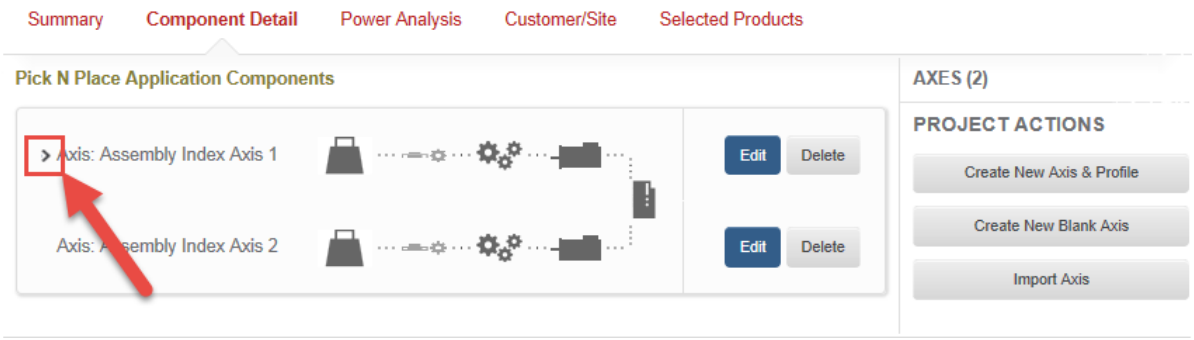
NOTE: If an error message pops up, click ok to close it.

36. You've completed the sizing and selection for your Assembly Index axes. Click **Continue to Project**.

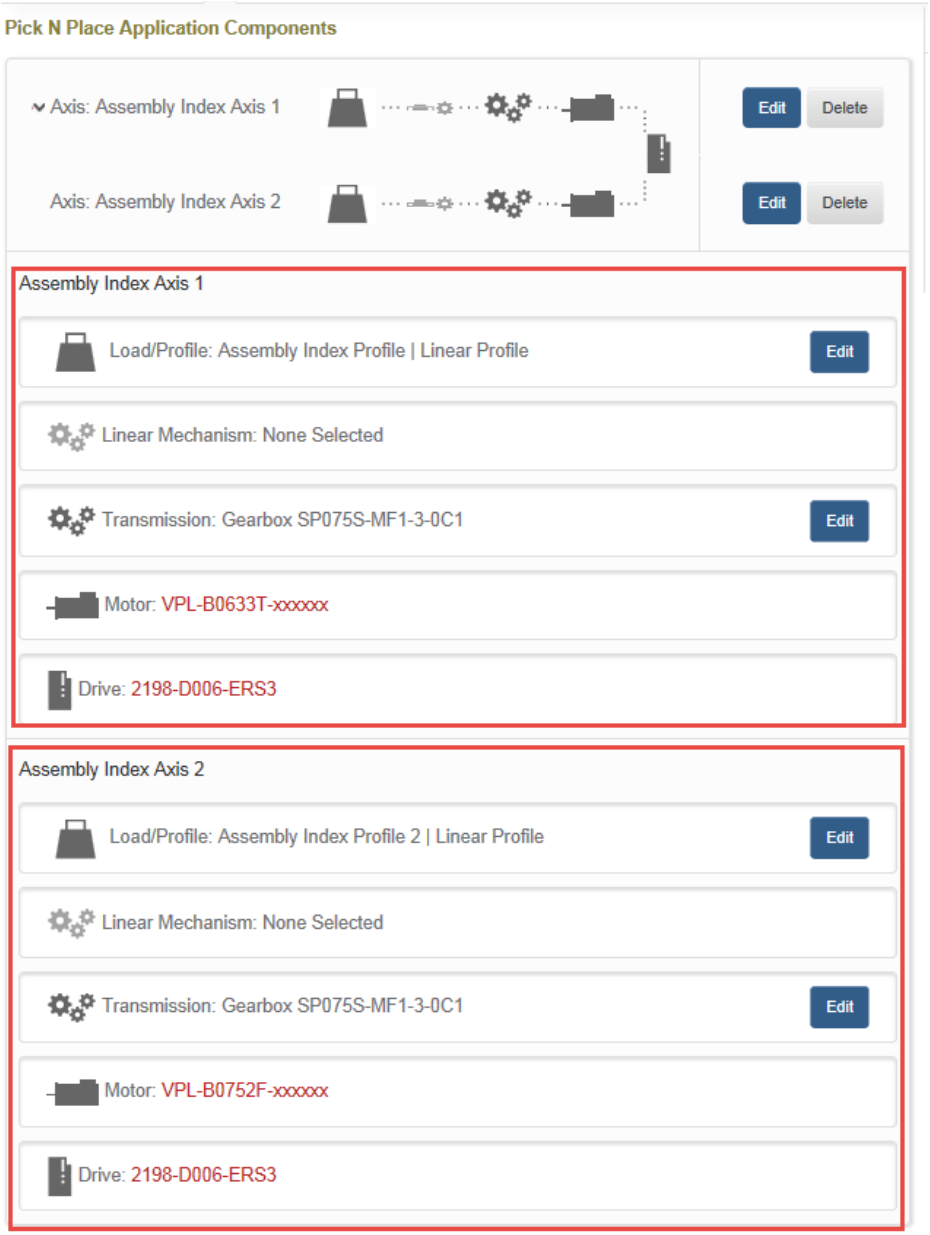
37. Your project Component Detail page will display your two axes and the dual axis inverter.



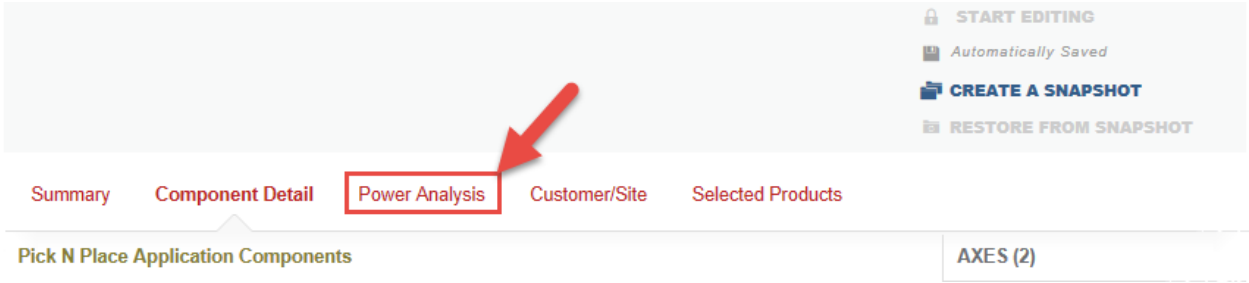
38. Click on the dropdown of the Axis: Assembly Index



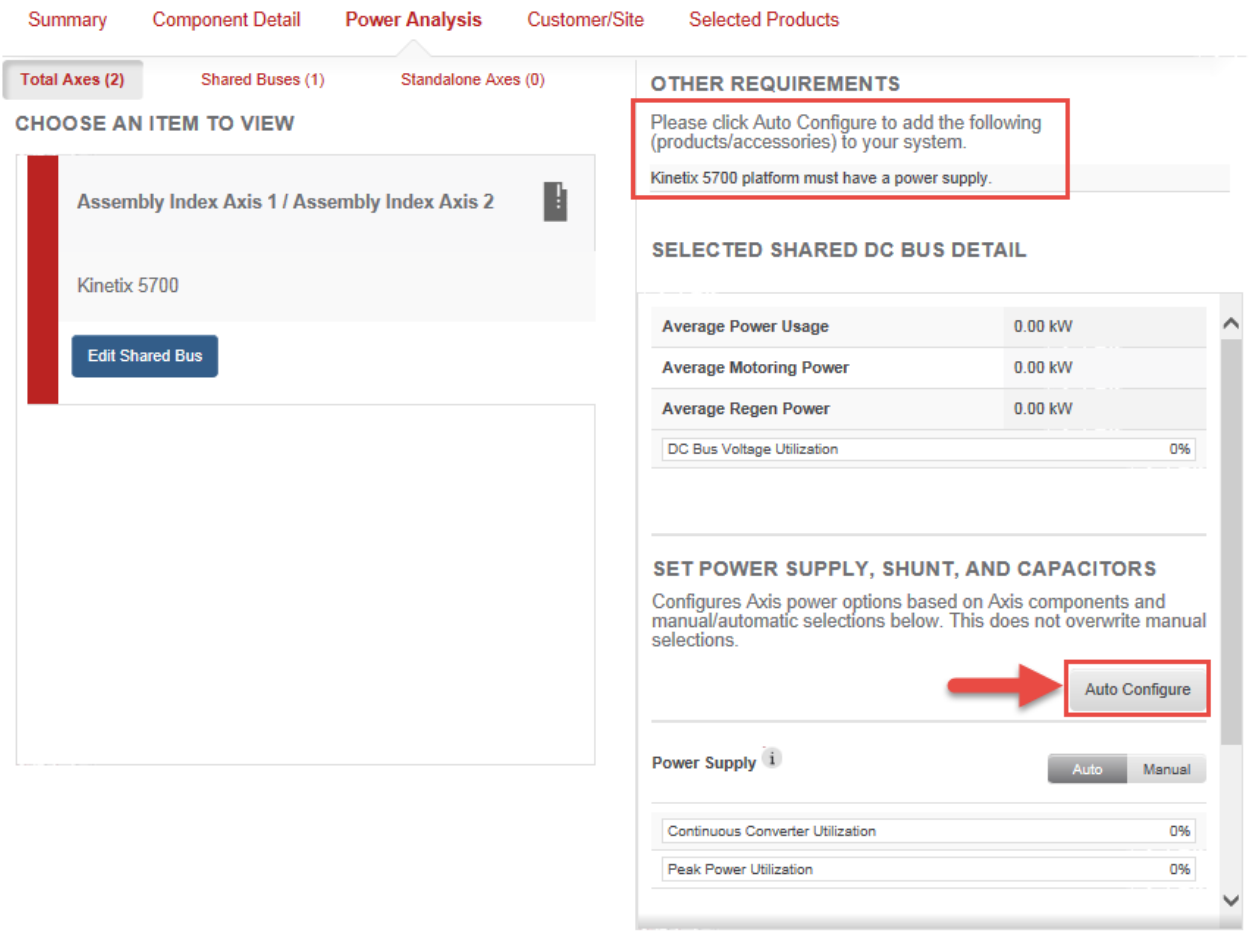
39. You can view your individual components by axis.



40. We will navigate to the *Power Analysis* tab

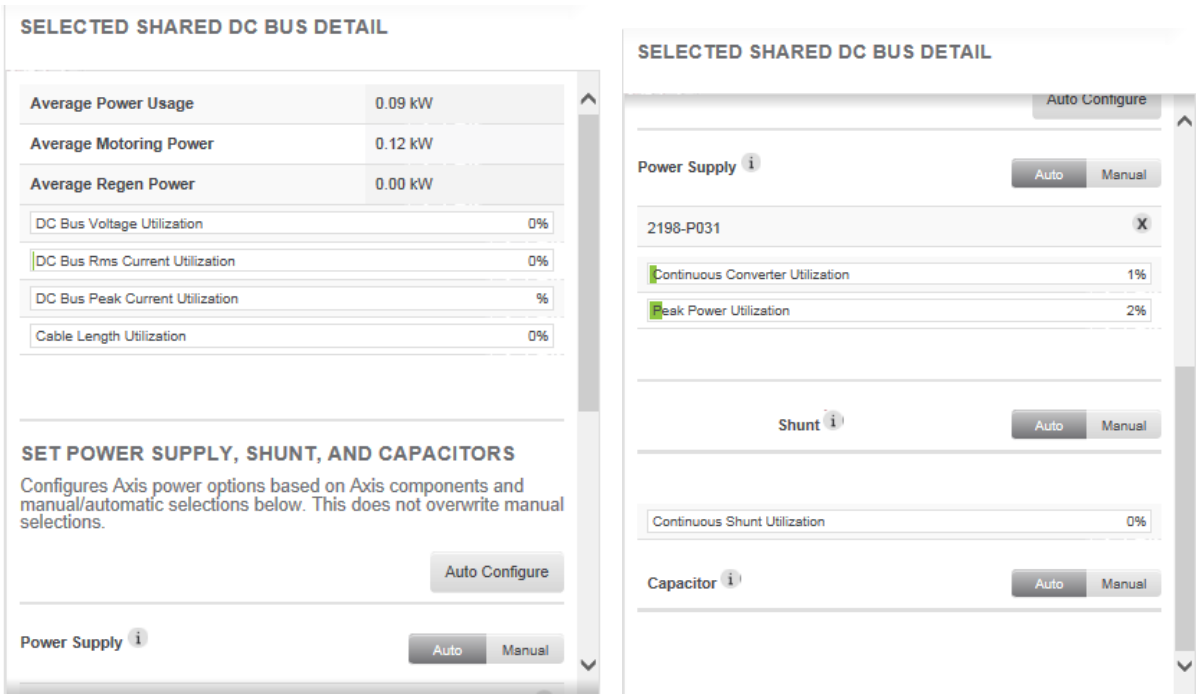


41. The calculations will be performed once you select **Auto Configure**



NOTE: The Power Analysis Guide can be found in motionanalyzer.rockwellautomation.com/Support/Resources for explanations and details of the calculations done.

42. Your calculations will be shown in the *Selected Shared DC Bus Detail* section.



43. Return to the Component Detail tab by clicking on **Component Detail**.

You've completed the first two axes of this project, five to go.

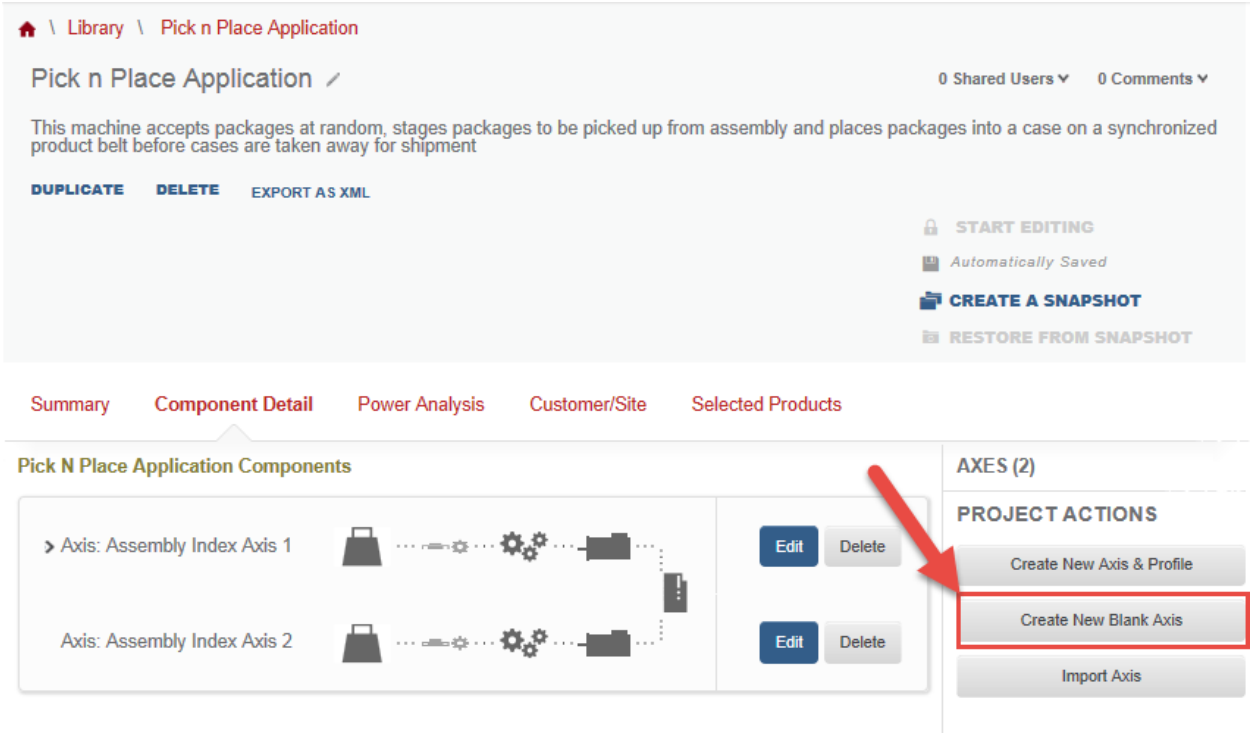
Part C: Product Index Belt

The Product Index Belt will use the axis data from the Assembly Index Belts as starting point for sizing. Be sure to enter the differences below:

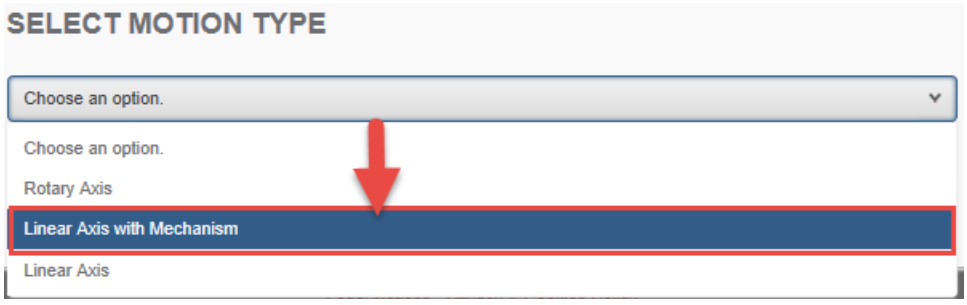
- Package weight ≤1.5kg, and four packages per case x 3 cases = 18kg total
- Belt Weight = 2 kg
- Move 250mm (about 10") in 1 sec. and dwell for 2 sec.

Creating New Blank Axis

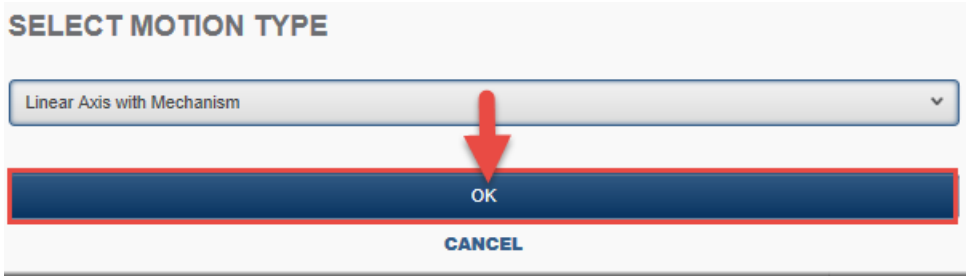
1. From *Pick n Place Application Component Detail*, select **Create New Blank Axis**.



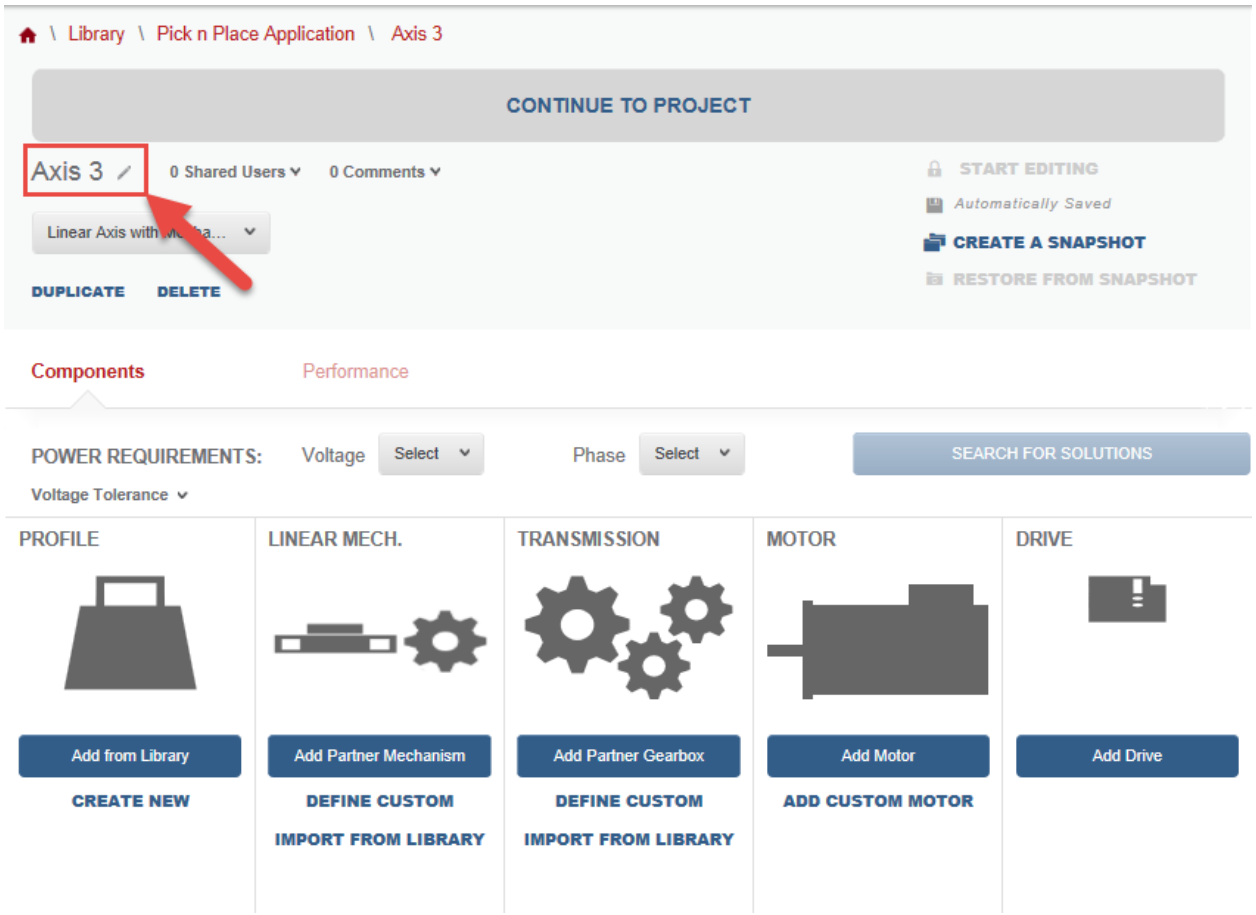
2. The Product Index axis is a linear axis with mechanism, select *Linear Axis with Mechanism* from the ***Select Motion Type*** window.



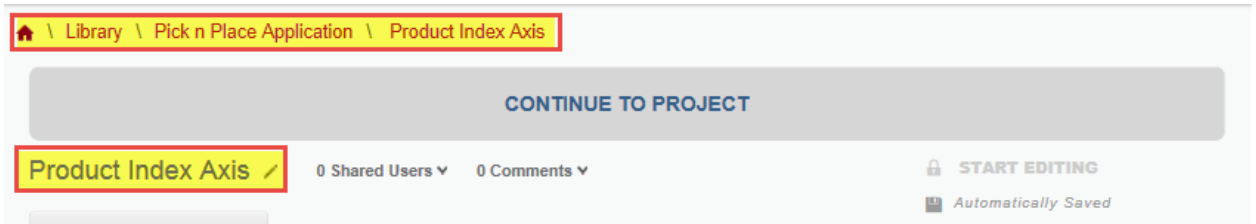
3. Click **OK** to confirm your selection



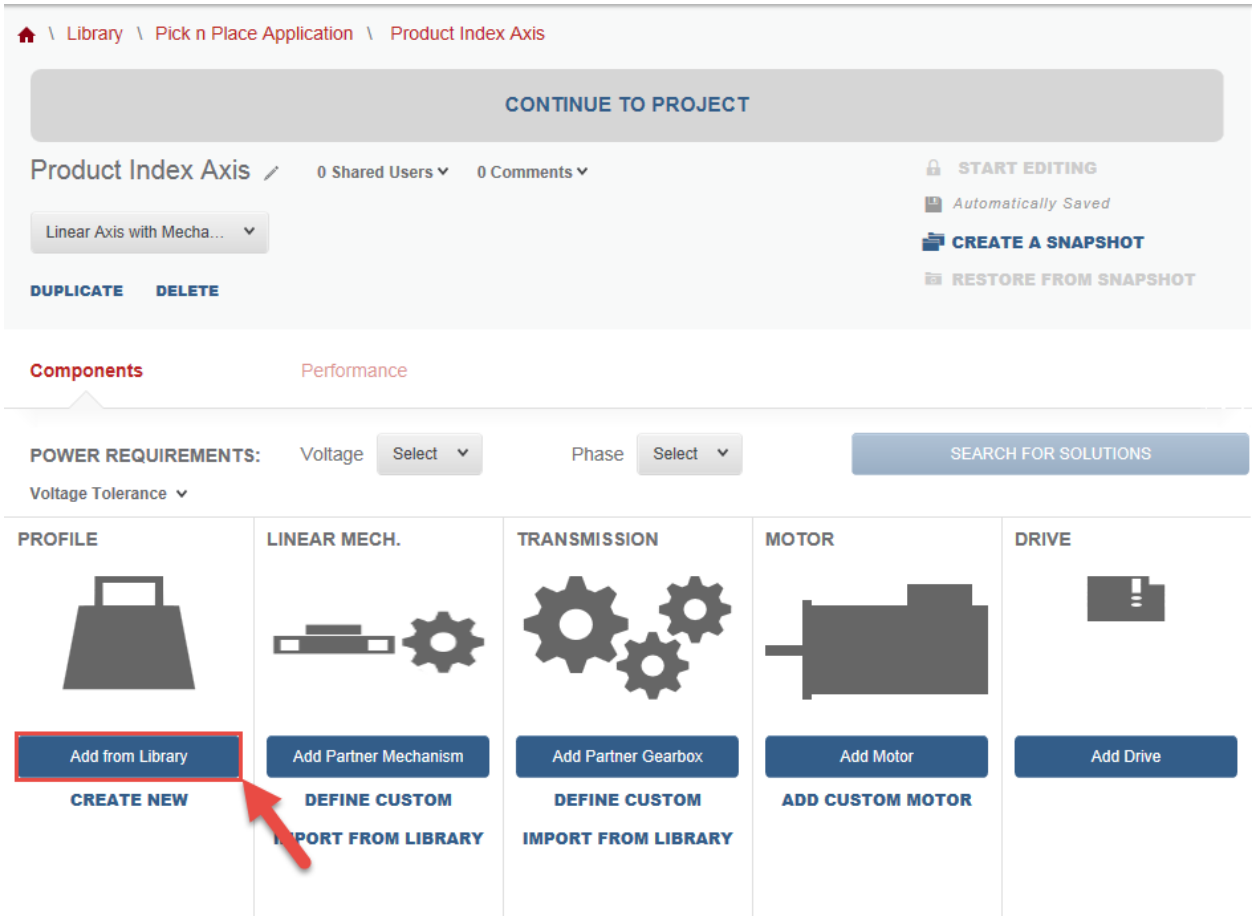
4. Your new axis will open up within the same project. Change the name *AXIS 3* to *Product Index Axis.*



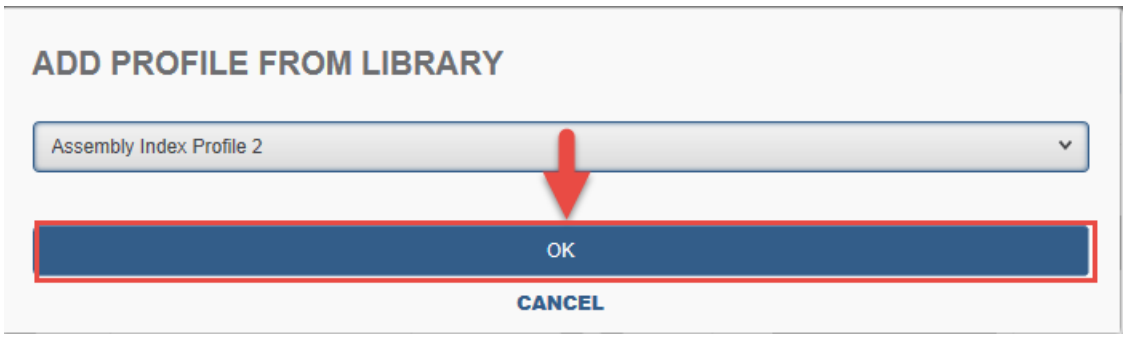
5. The name change will be reflected in two areas as highlighted below:



6. As we are using the axis data from the Assembly Index Belts, we will import the components we've saved in the previous sections. Click **Add From Library** on the *Profile* component.



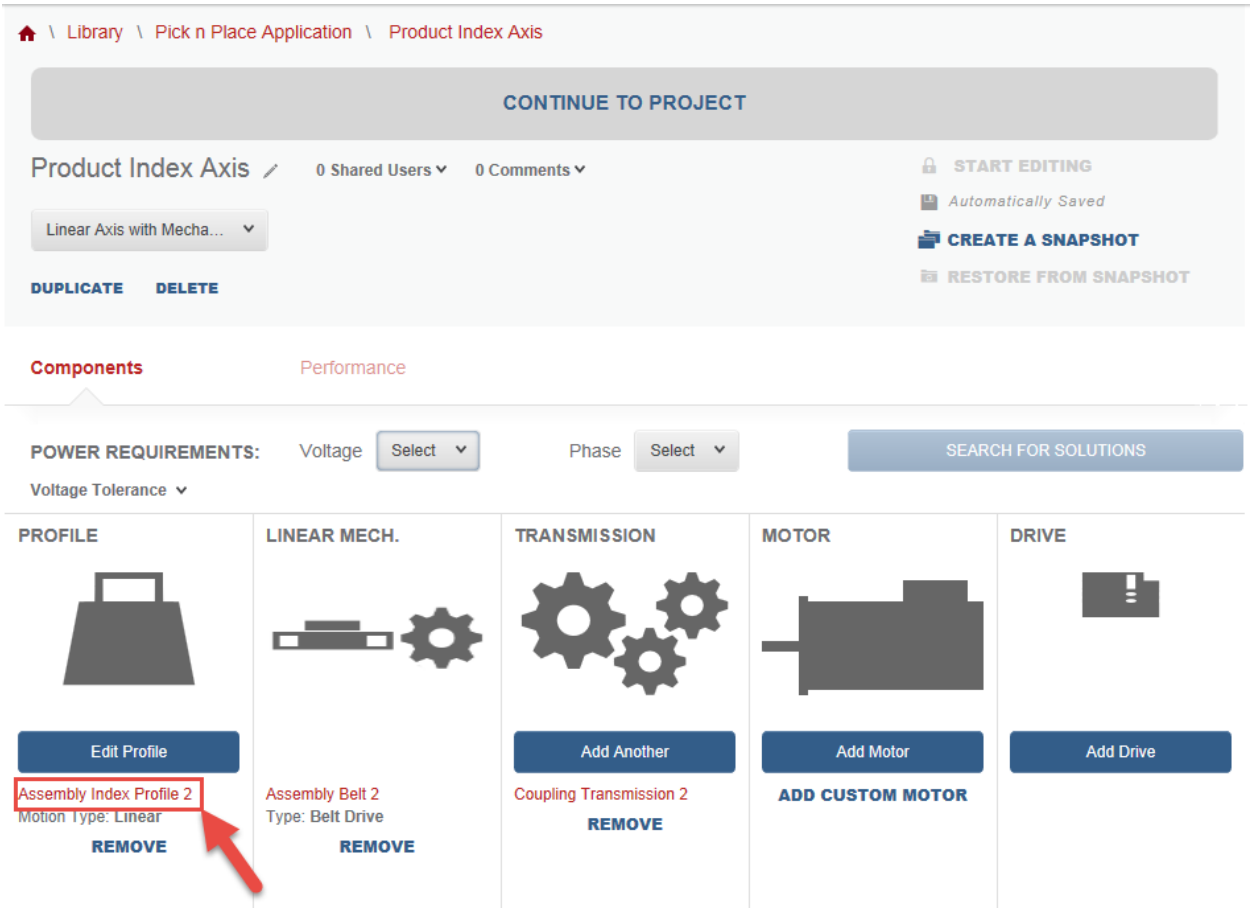
7. Select *Assembly Index Profile 2* to add the profile from Library, and click **OK** to confirm your selection



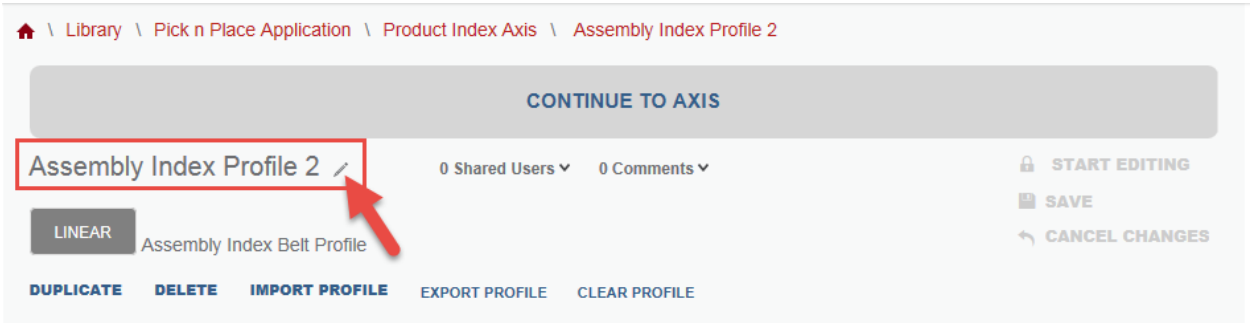
8. Import the Linear Mechanism and Transmission from Library to the Product Index Axis.

9. Once you've finished importing the components to your new axis, we will edit them to match the specifics of the Product Index Axis requirements.

10. Open the Profile component,

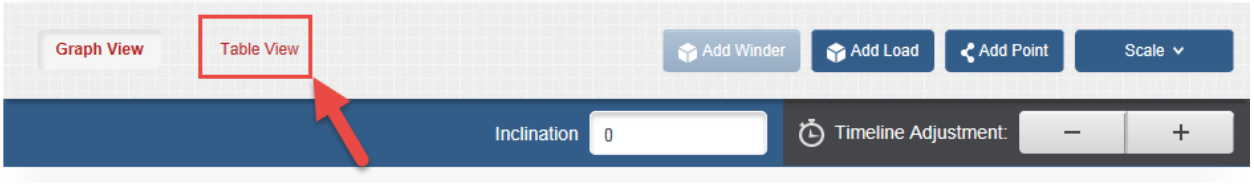


11. Rename the Profile component from *Assembly Index Profile 2* to *Product Index Profile*. And remove the description of the profile.



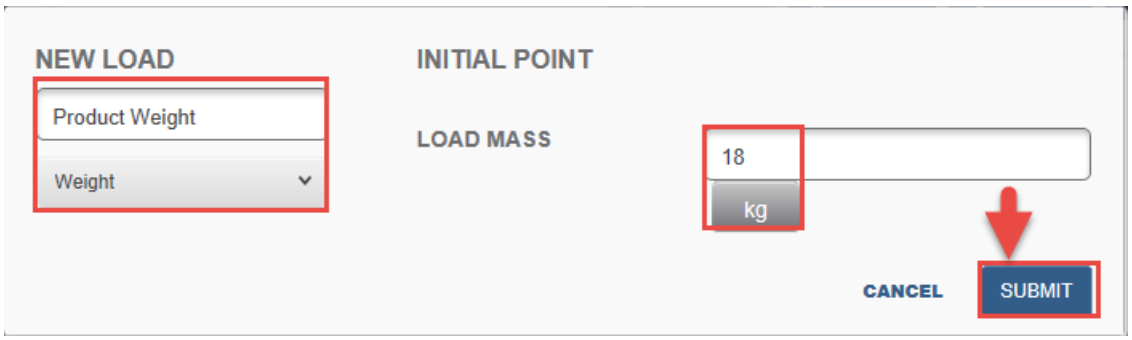
12. Click on the ✎ to edit or close the edit section.

13. Open the Table View for the profile.

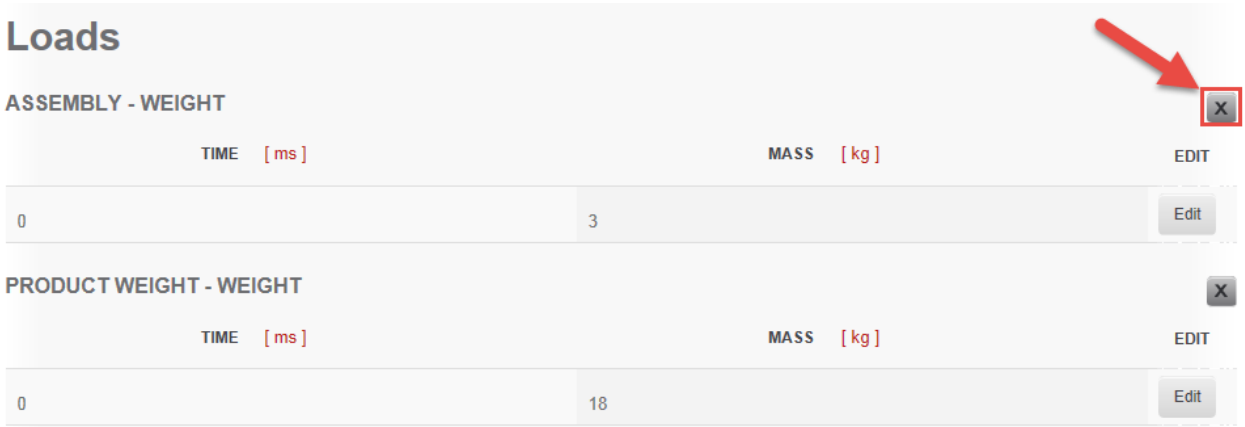


14. Select **Add Load**

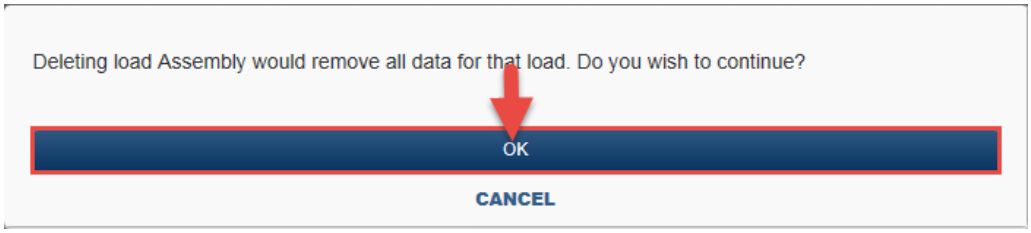
15. Make your field entries to match the image below, and click **Submit**



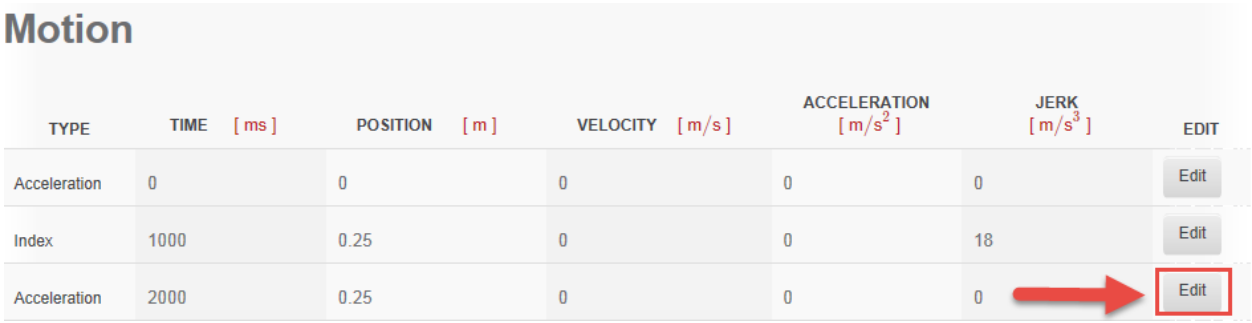
16. You will have two loads present in your profile. We will remove the Assembly load by clicking on  .



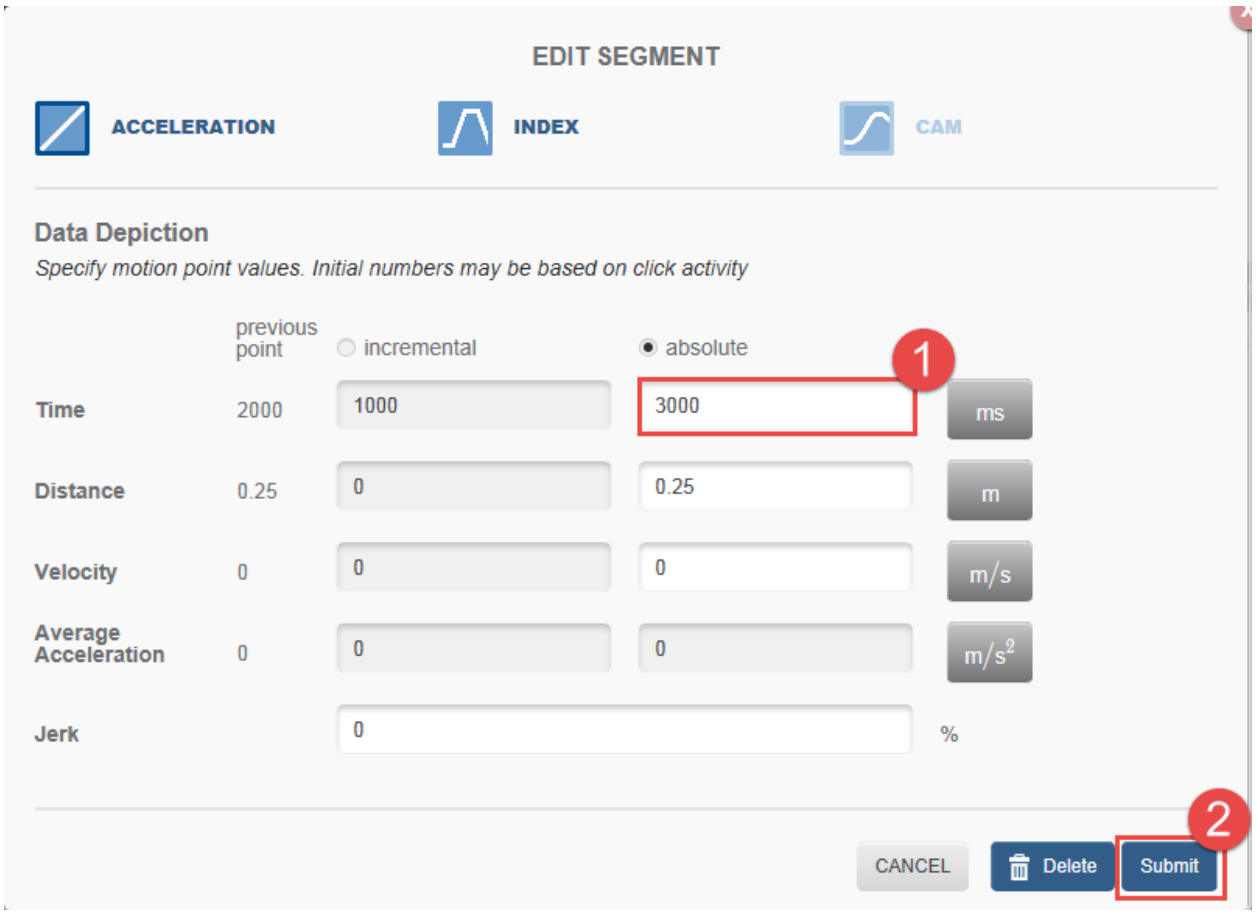
17. Confirm the selection by clicking **OK** on the prompt.



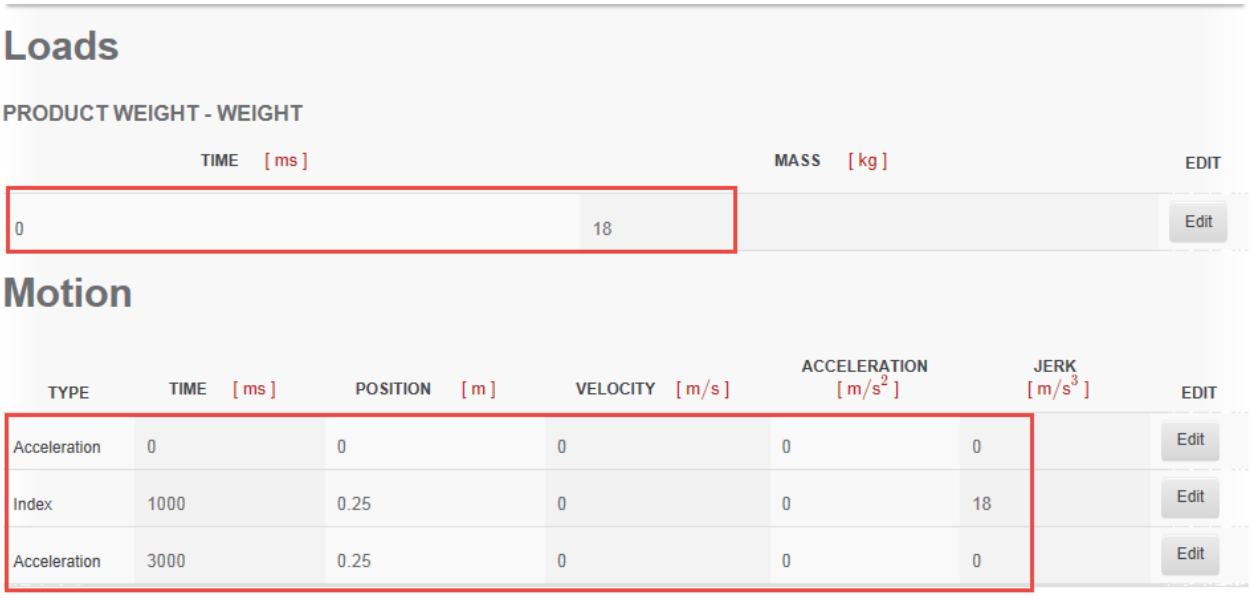
18. In the *Motion* section, we will change our dwell point to match the dwell of the Product index axis. Click **Edit** on the second acceleration segment.



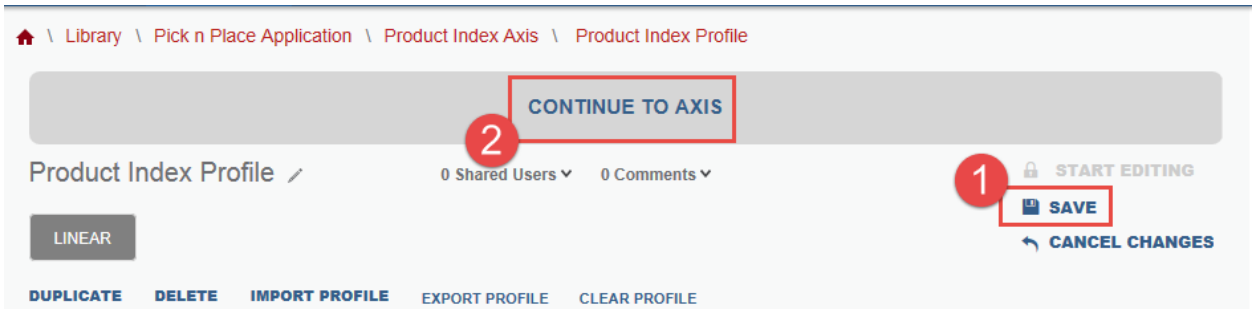
19. Change the absolute time from *2000* ms to *3000* ms. Then click **Submit** to confirm the entry.



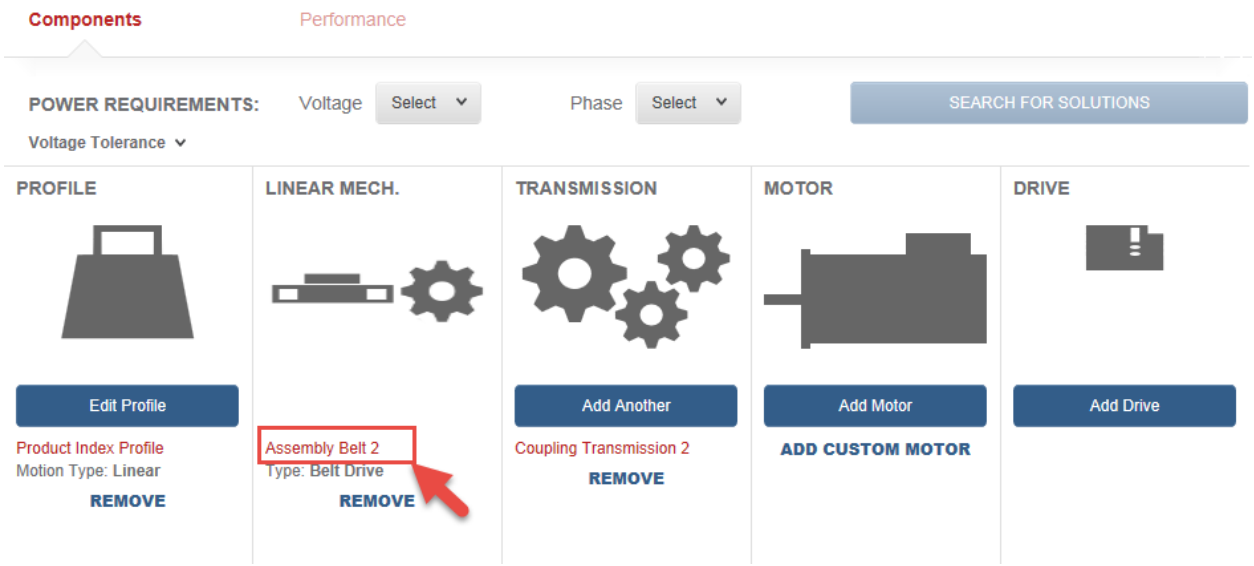
20. Your *Loads* and *Motion* should look as below:



21. Click **Save** then click **Continue to Axis**.

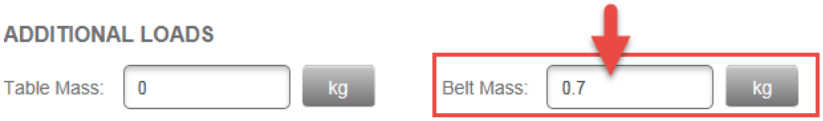


22. We will now edit the Linear Mechanism component. Click on **Assembly Belt 2** to open the *Belt Mechanism Properties* page.

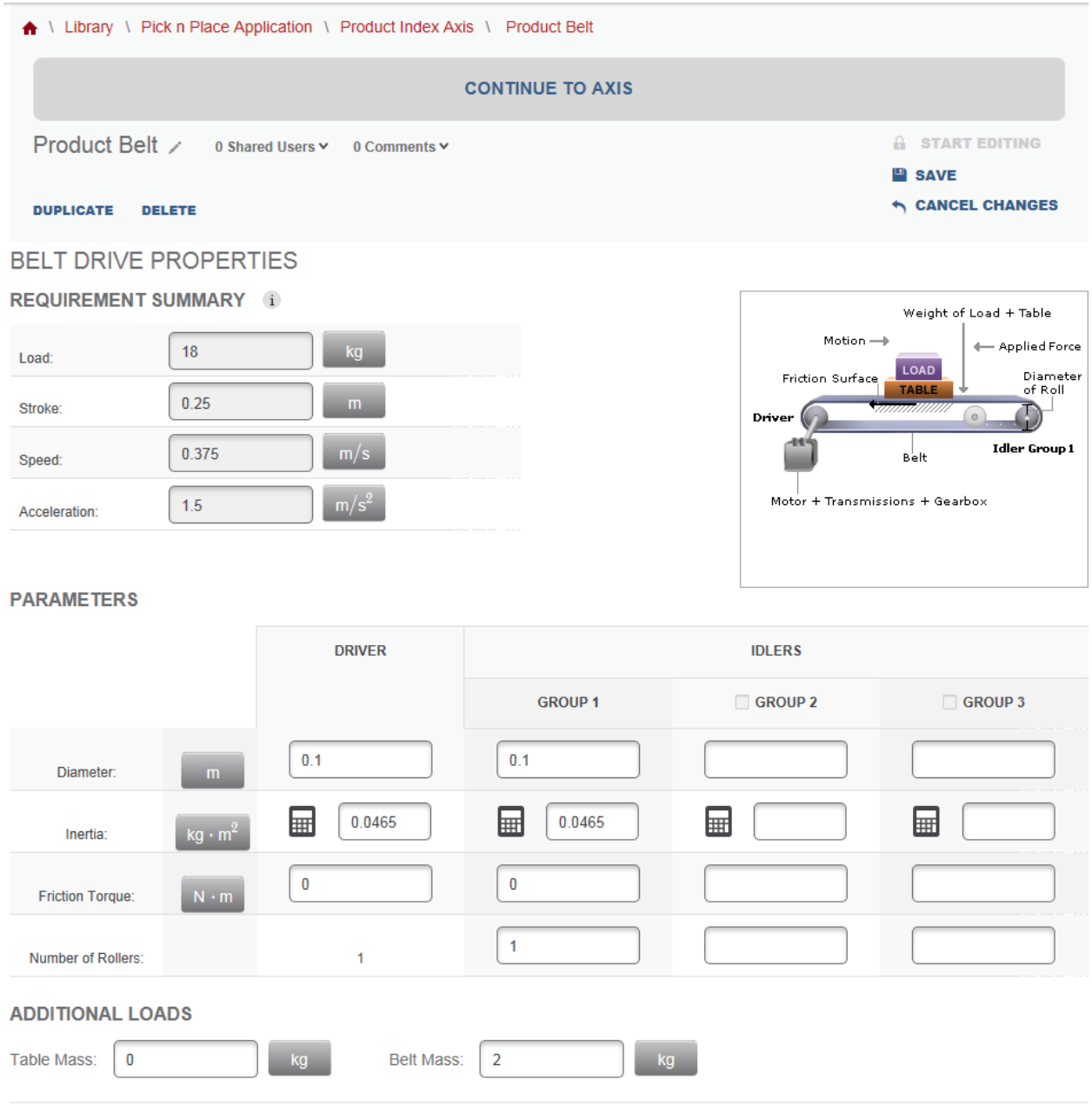


23. Start by changing the name of the Belt Mechanism from *Assembly Belt 2* to *Product Belt*. Click on 

24. After the name change, click on the pen  to exit the name field, change the belt weight to 2 kg.

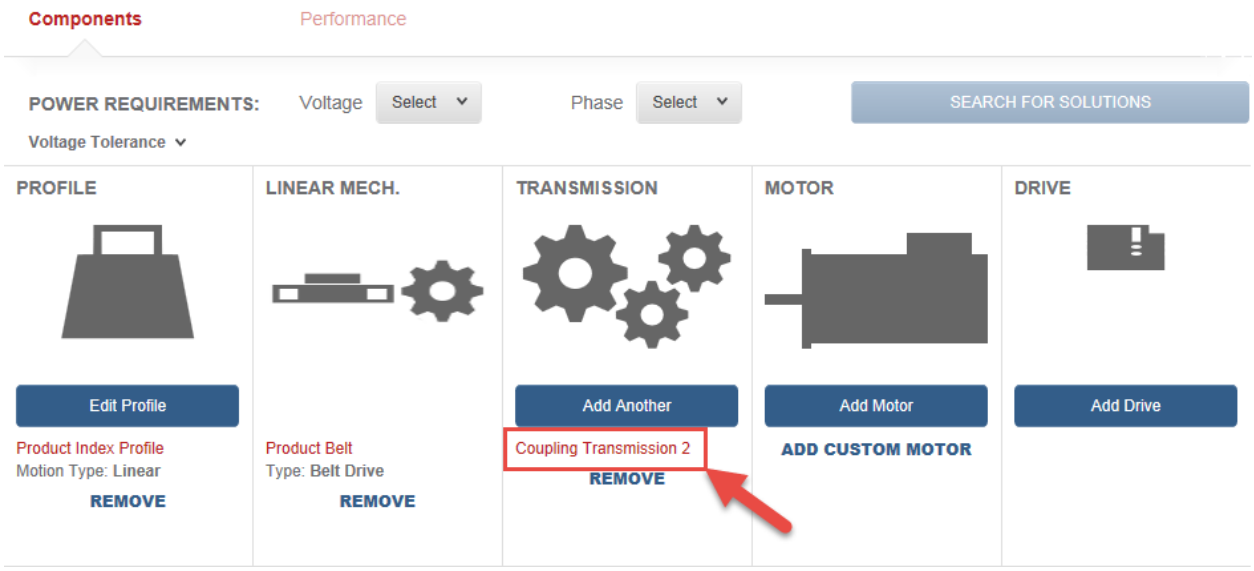


25. Your completed mechanism fields should match as the image below:



26. Click **Save** then click **Continue to Axis**.

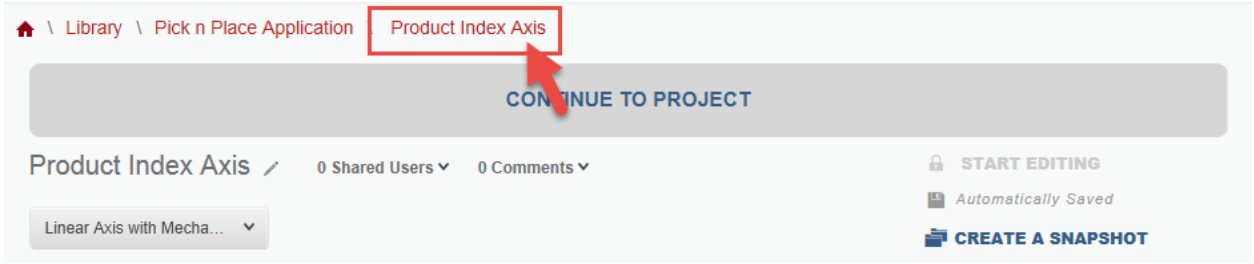
27. Click on **Coupling Transmission 2** to open the *Transmission Properties* page



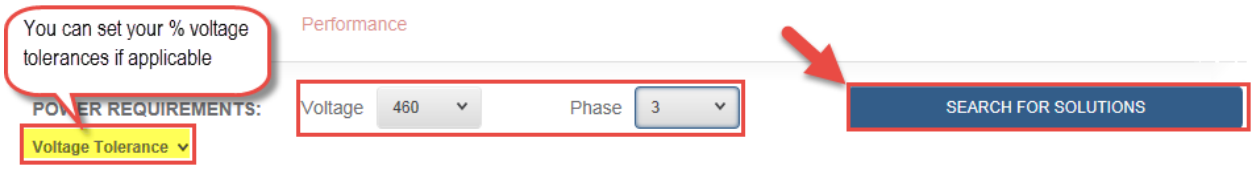
28. Change the name of the transmission from *Coupling Transmission 2* to *Product Belt Coupling*. Click **Save** then click **Continue to Axis.**

29. Add the gearbox *SP075S-MF1-3-0C1* to your axis. Follow steps 31-33 in **Duplicating a Component**.

30. Click on **Product Index Axis** to refresh your window

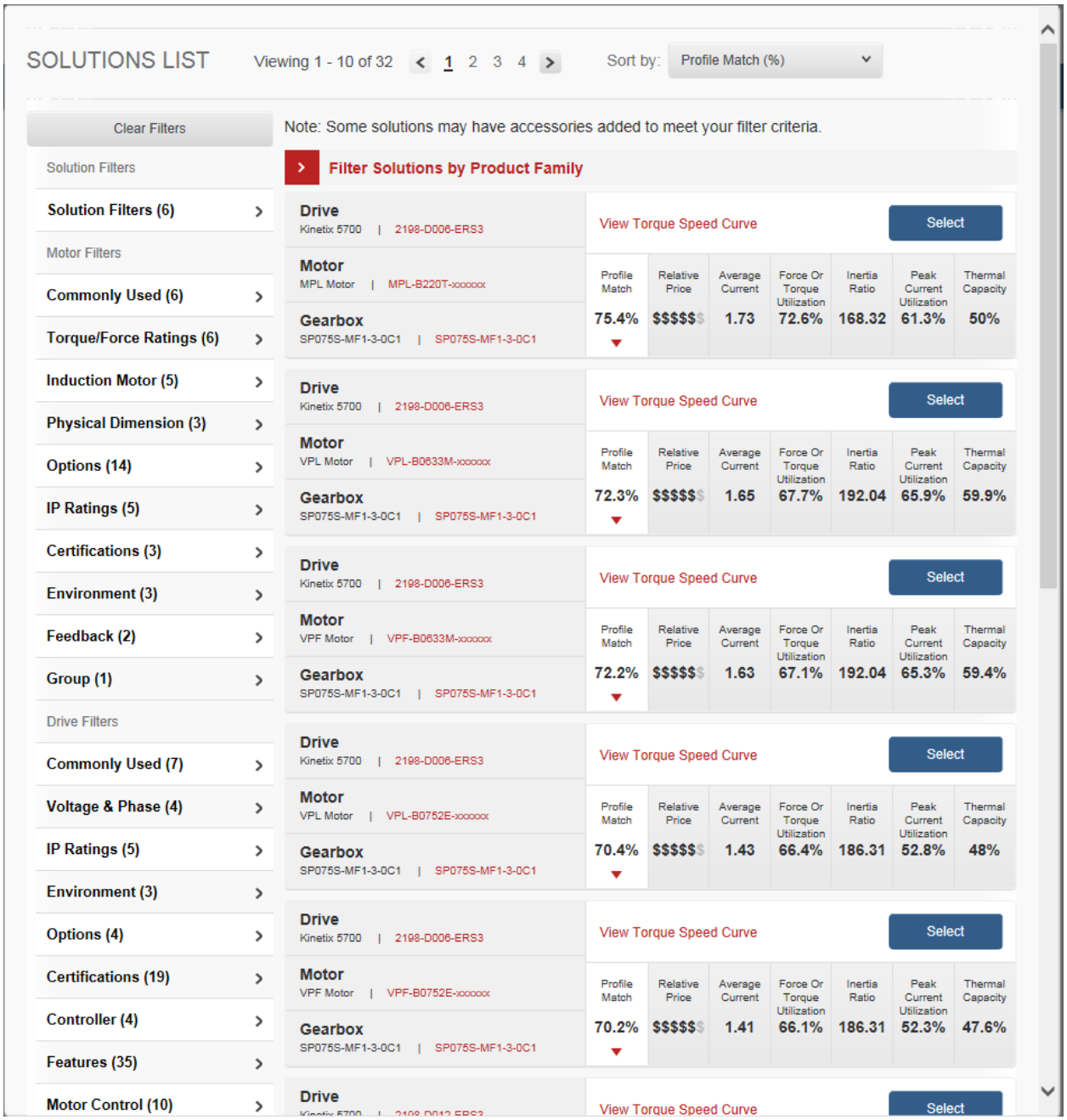


31. Set the *Power Requirements* to **460** for *Voltage* and **3** for *phase*. Now you are able to click **Search for Solutions**. Click **Search for Solutions** to find Drive/Motor solutions for your axis.



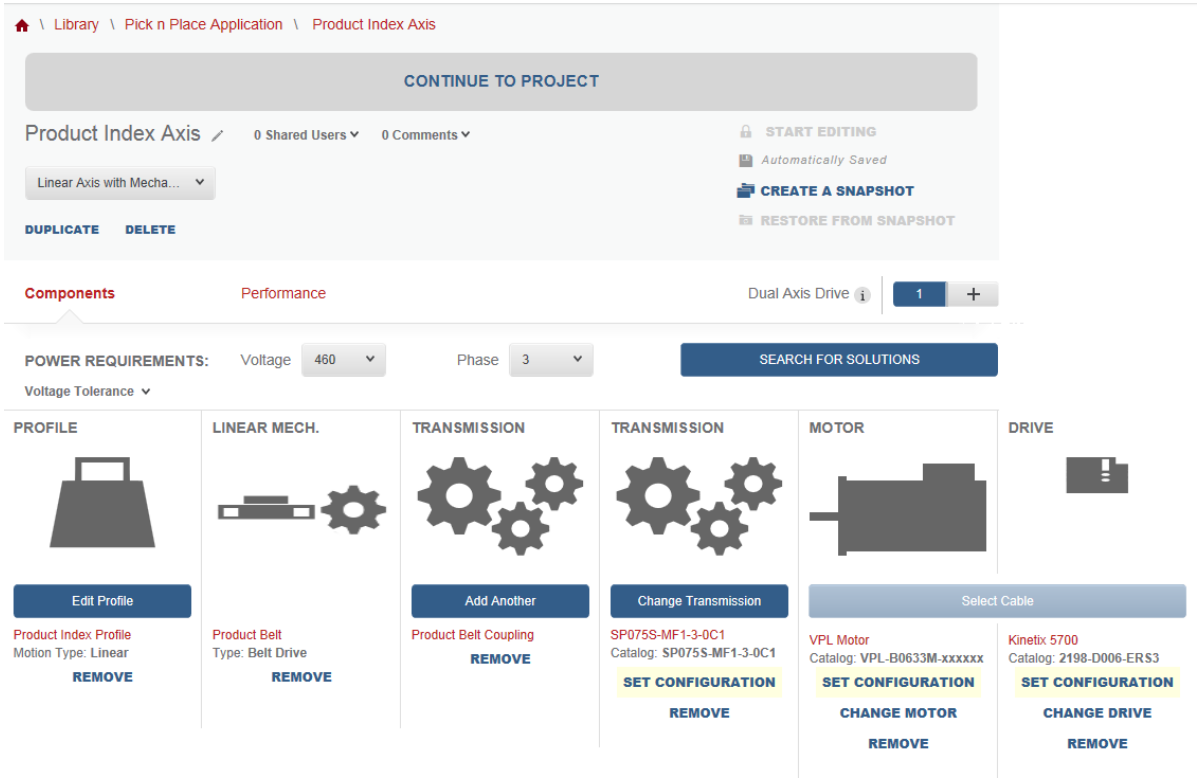
32. As done before, we are going to filter the solutions by product family and you will select to view only Kinetix 5700 Servo Drive solutions.

33. After filtering your *Solutions List* to **Kinetix 5700 Servo Drives** solutions, your results should looks as the image below:

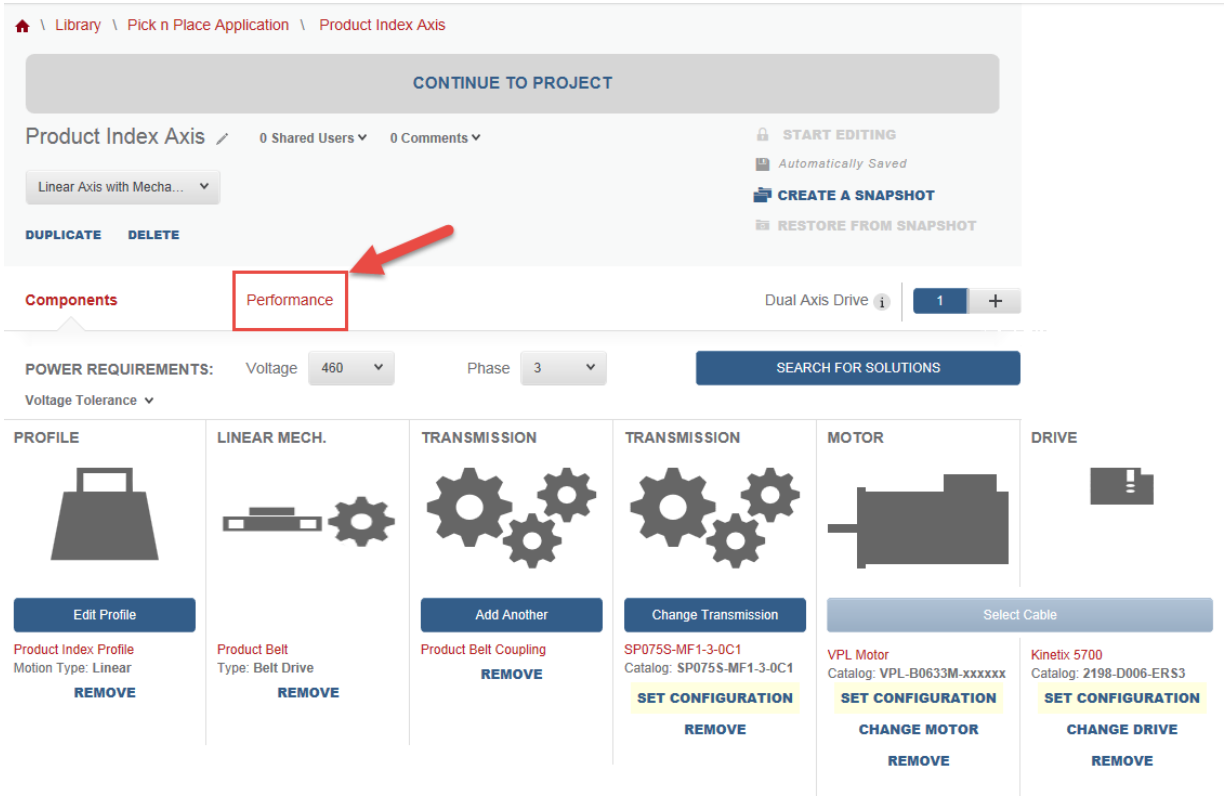


34. Select the solution with the VPL motor (2nd solution on the list).

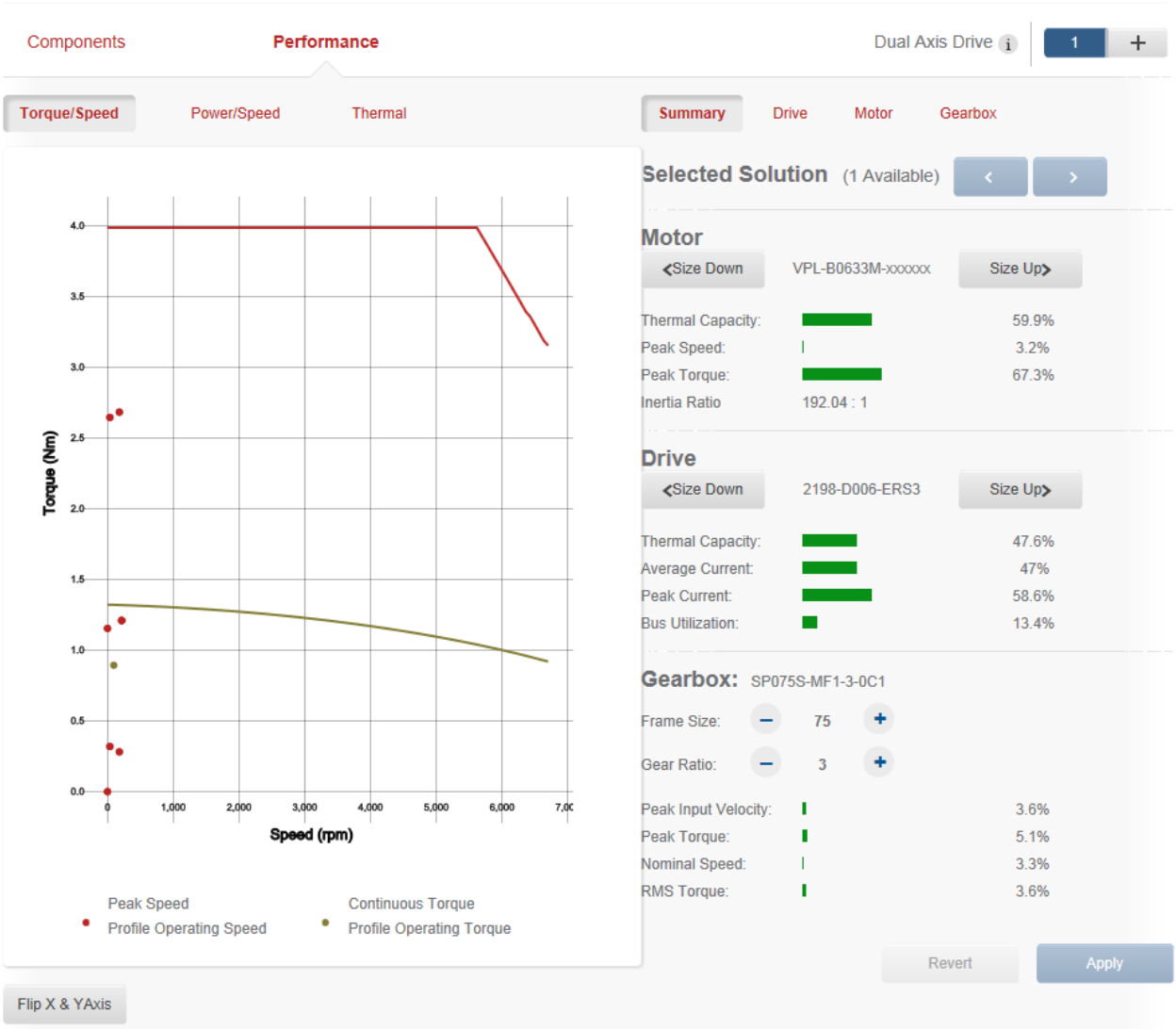
35. Your axis components should look as follows:



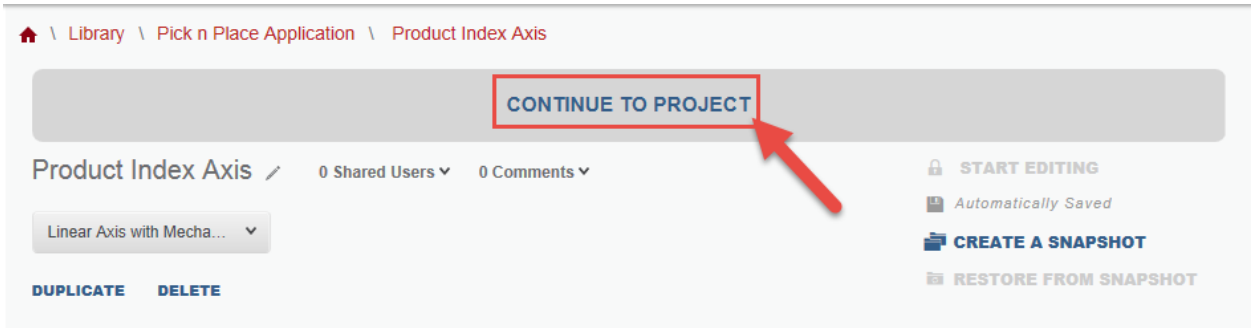
36. Click on the Performance tab.



37. You can review your Torque/Speed curve and summary of your selected solution.



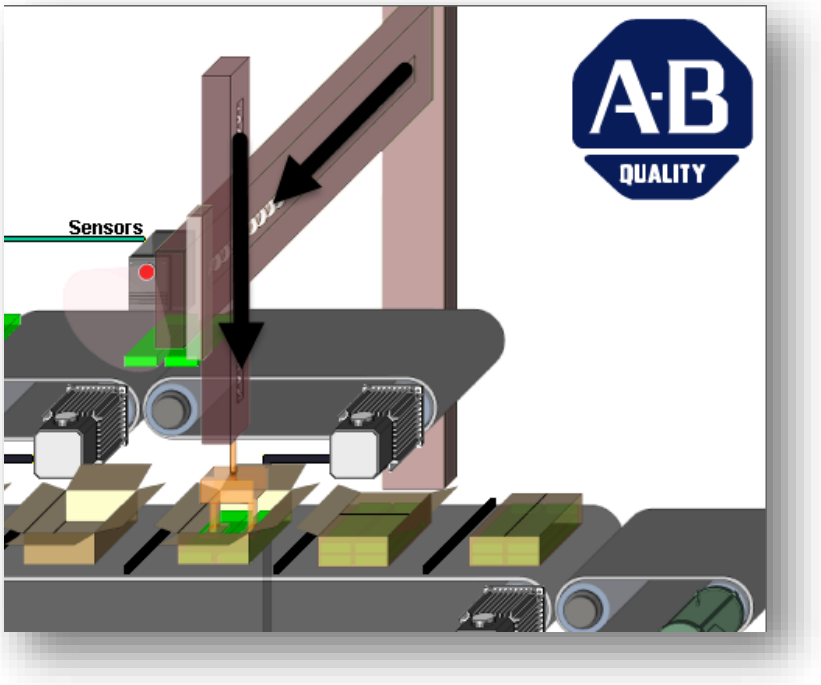
38. Click **Continue to Project**



You've completed the Belt Actuator Requirement of this project. 3 axis down, 4 more to go.

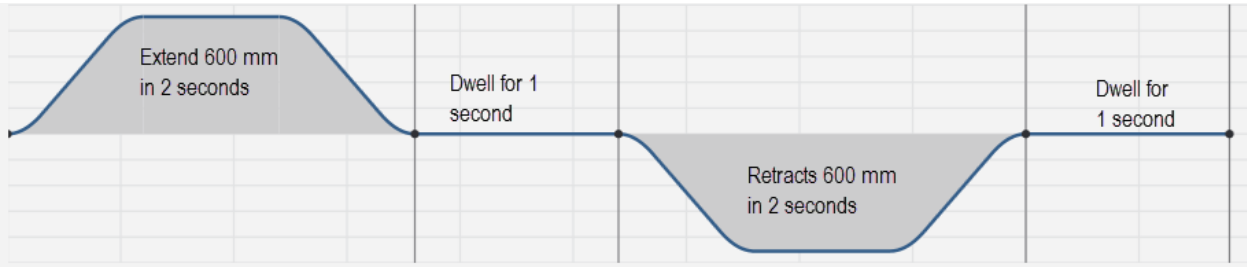
Lead Screw Actuator

The lead Screw actuator has two axes, a horizontal axis and a vertical axis, as shown in the image below.



Part A: Horizontal Lead Screw Axis

In this section of the lab, you will model an axis in Motion Analyzer for the horizontal lead screw axis and then identify an appropriate drive and motor that will meet the application requirements. You are given the following information for a new application.



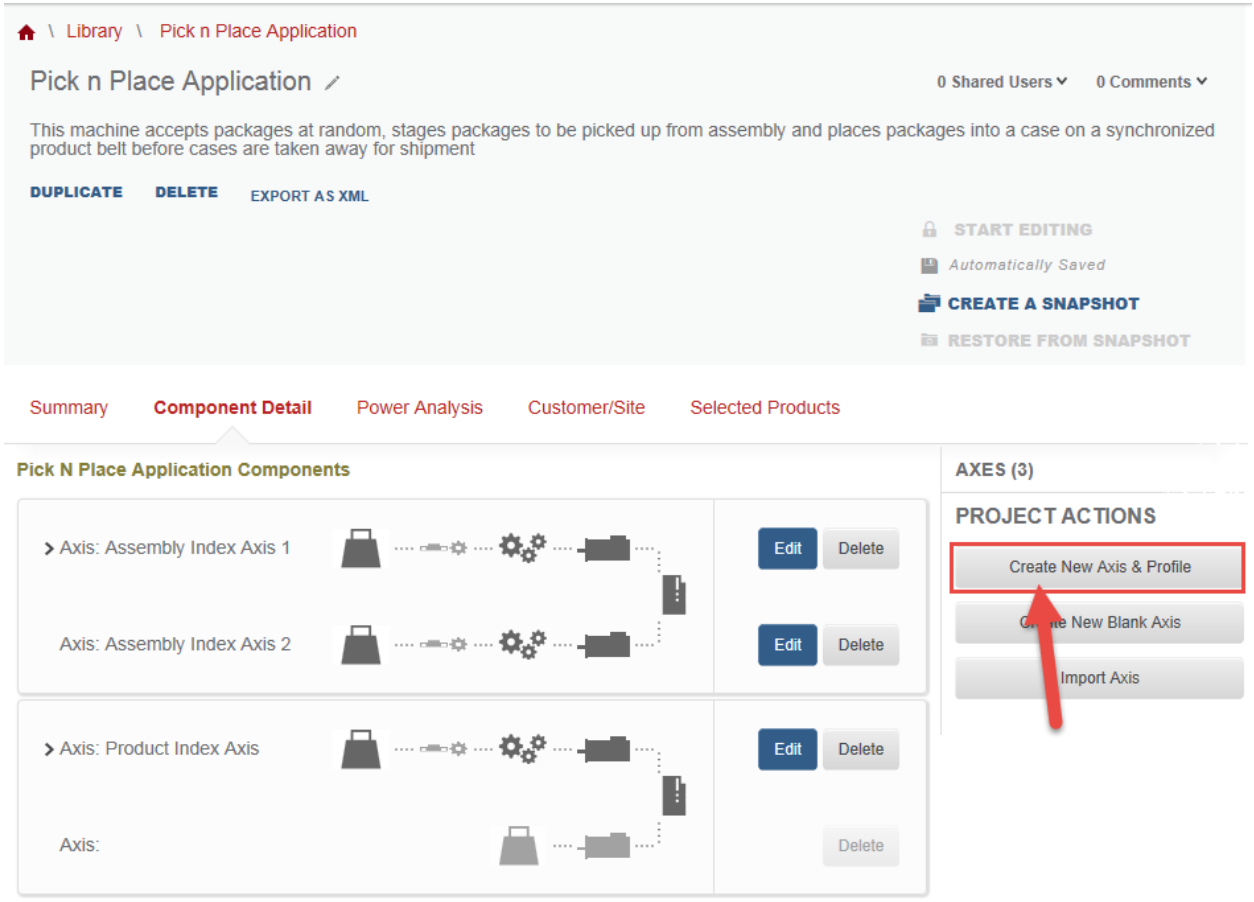
The move profile is described as "extending the horizontal actuator to transfer packages to the **Product Index Belt**, pausing for 1 second to complete the drop off, retracting the actuator back to the **Assembly Index Belt** and pausing for 1 second to pick up the next product."

You will be moving a 3kg package with a total slide mass of 45 kg at a friction coefficient of 1%. The lead screw actuators specs are: Lead = 25 mm/rev, Length = 1200 mm, Diameter = 25 mm, Material = Steel, Efficiency = 90%. The motor coupling moment of inertia is 2.6$g \cdot cm^2$.

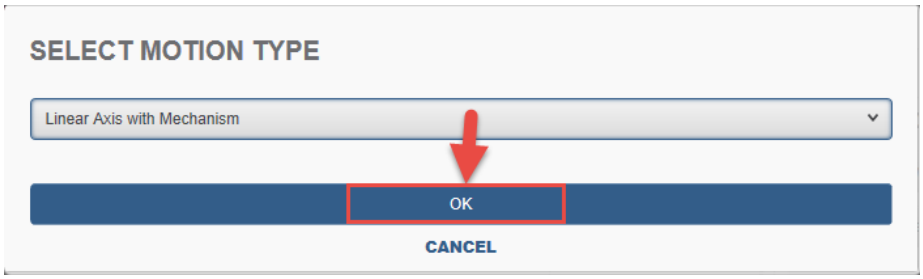
Let's walk through entering this information in Motion Analyzer online tool.

New Axis & Profile in Project Actions

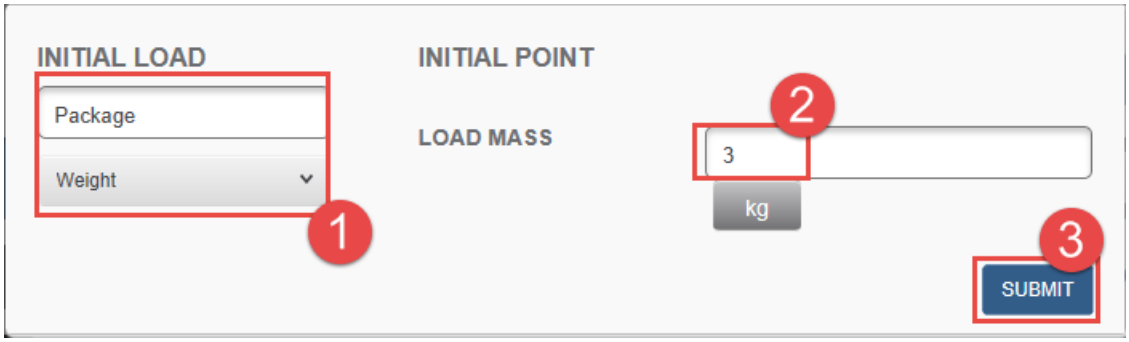
1. From the Pick N Place Application project page, click **Create New Axis & Profile**.



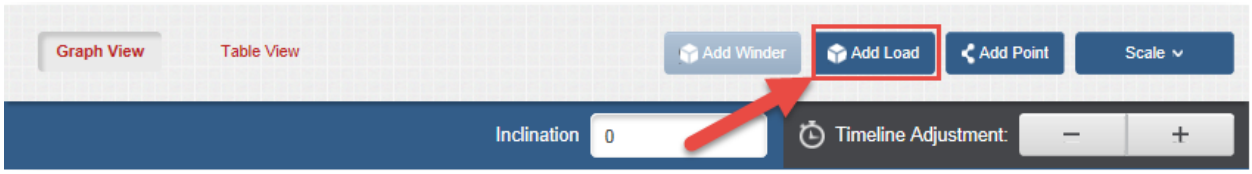
2. Select the *Linear Axis with Mechanism* motion type and click **OK** to confirm your selection



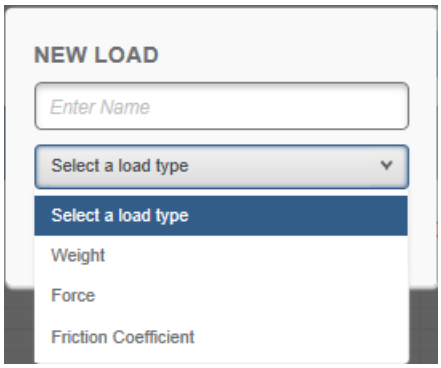
3. Set your *Initial Load* as follows:



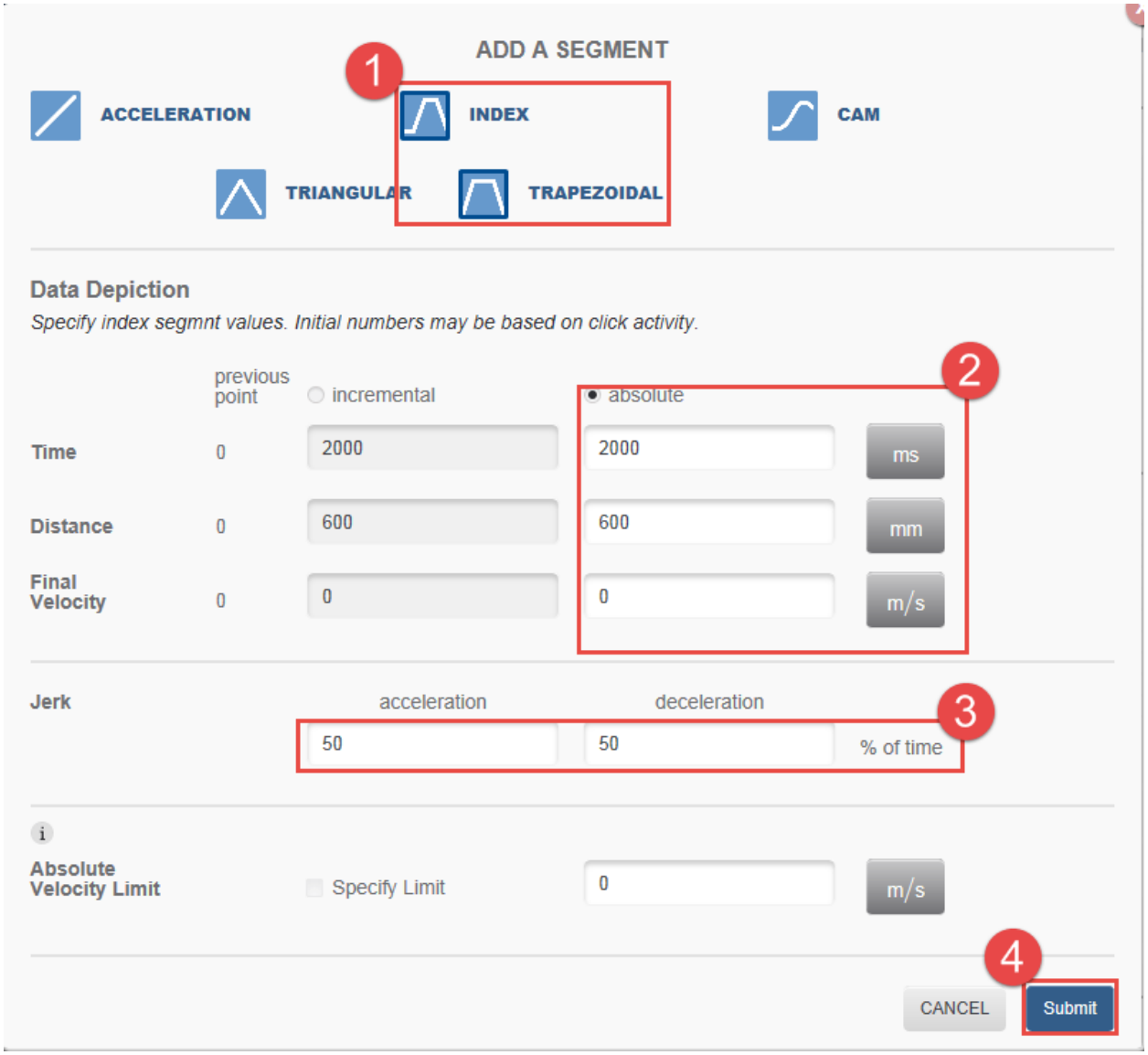
NOTE: You can add any additional load to your profile by clicking **Add Load**.



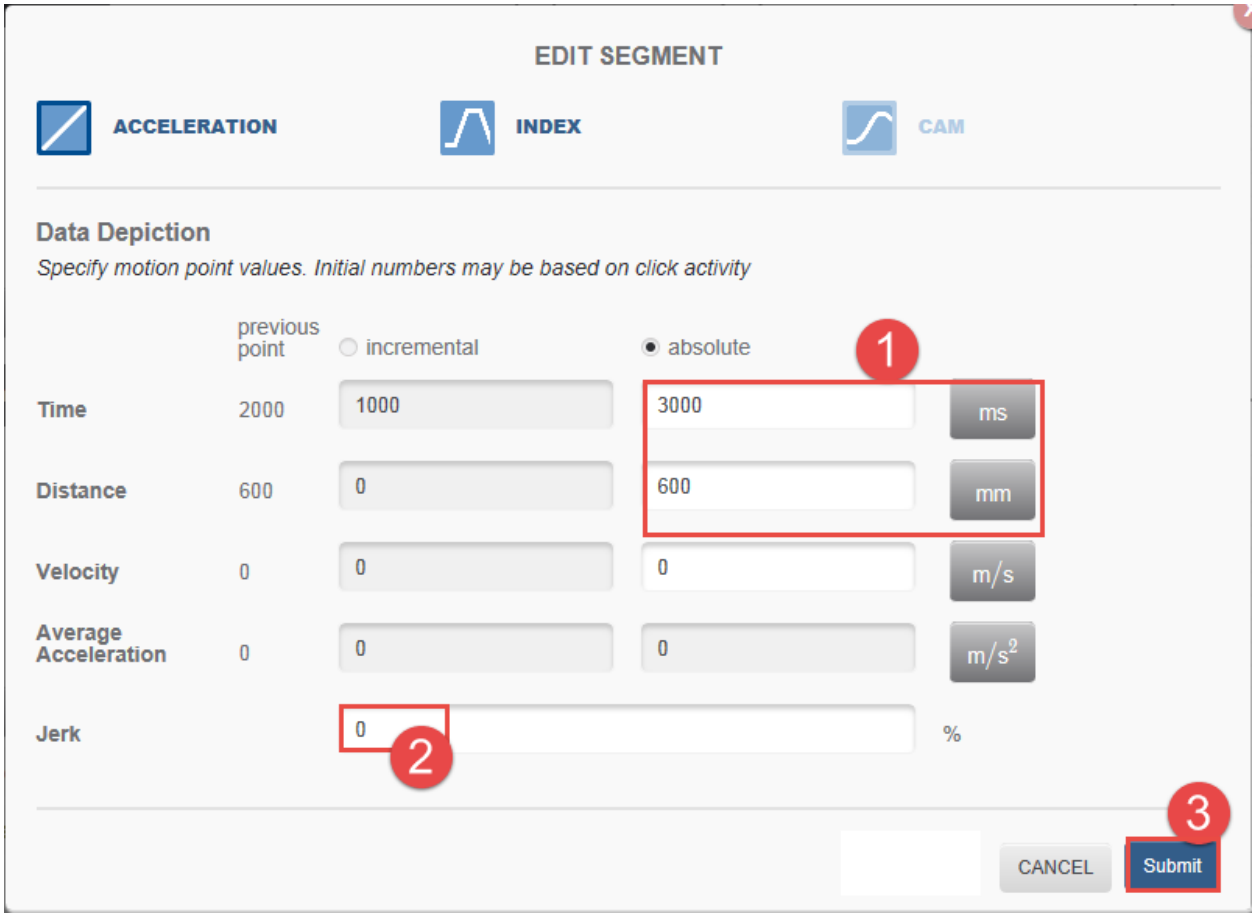
And then select the load type to be added. In our case, we could have included the friction coefficient to our load.



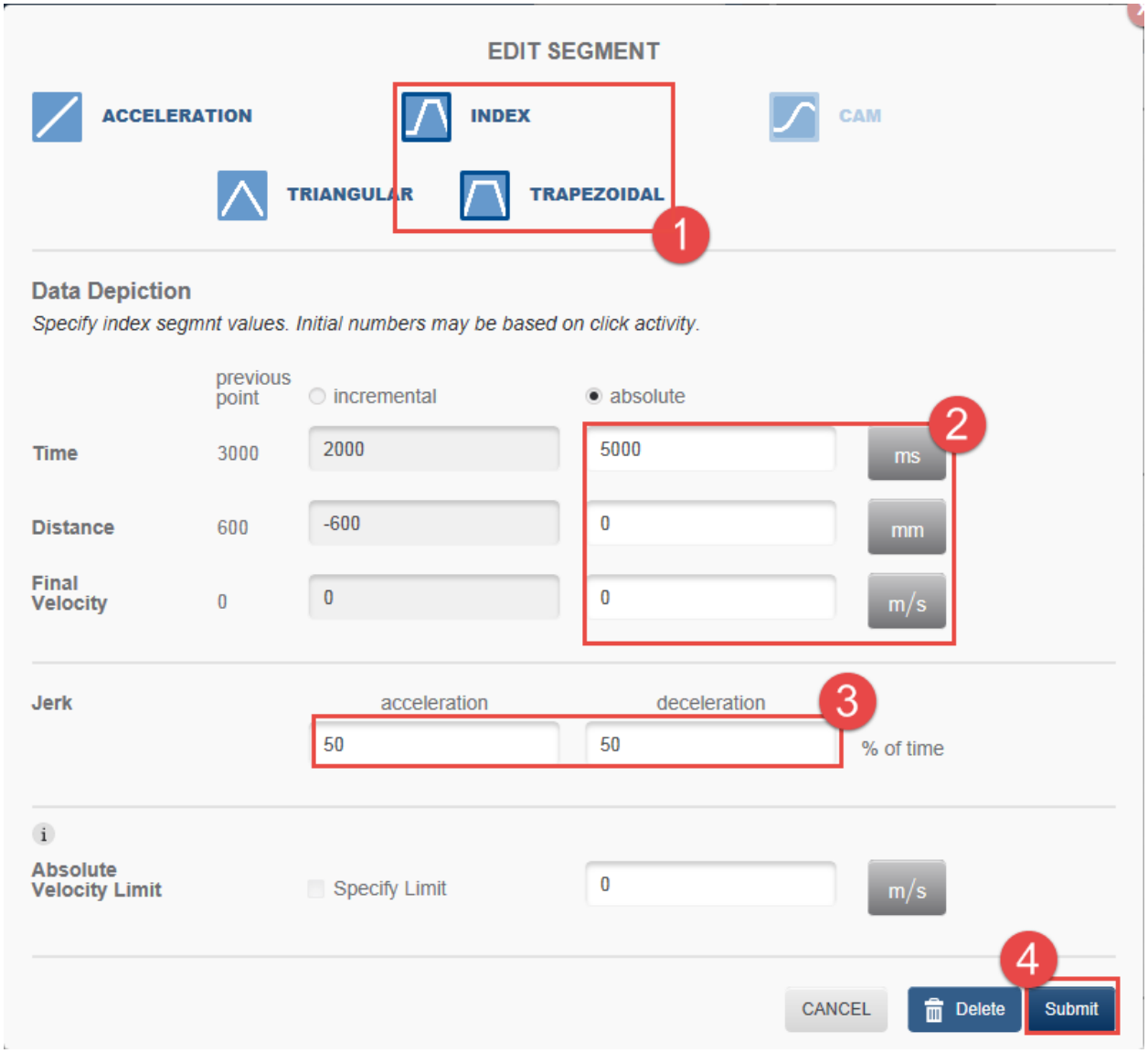
4. To enter a position profile data point, click anywhere on the **Position Plot**. The Add a Segment dialog box will appear at the Acceleration option. Select the **Index** segment and enter the values of the first point and click **Submit**:



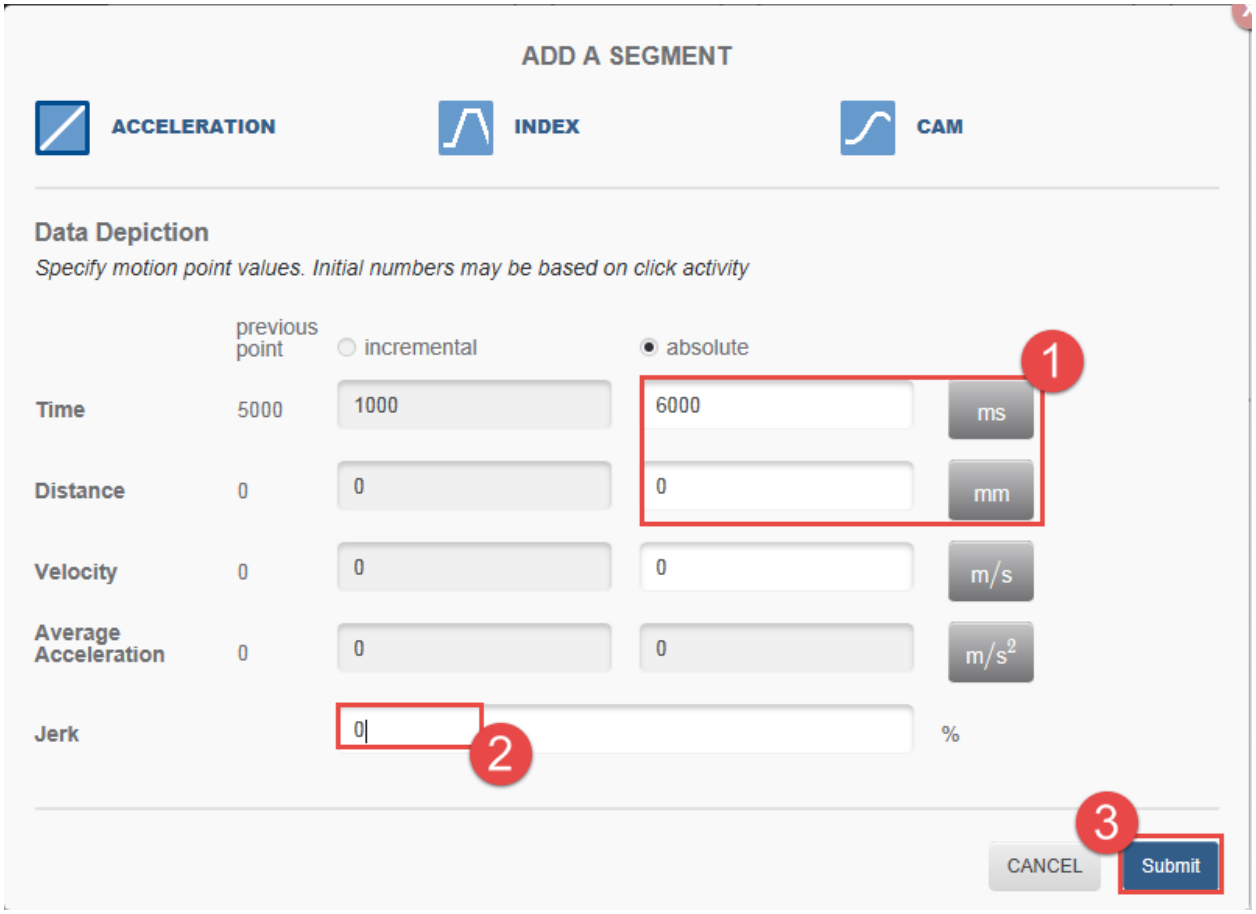
5. Let's add our second segment to the profile by clicking on the *Position* plot again. The second segment is a dwell segment, therefore we will use the **Acceleration** Segment. Enter the values to match the image below and click **Submit**



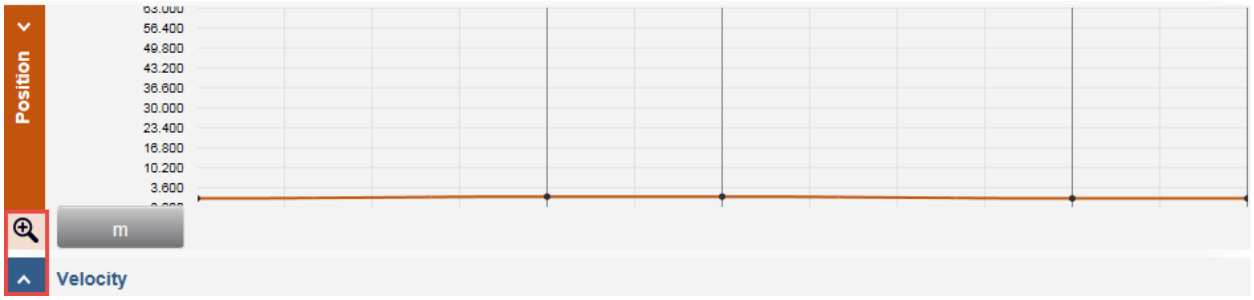
6. Now we will add the retracting segment. Click on the *Position* plot, select the **Index** segment, and enter the values of the retracting point and click **Submit**.



7. We will add the last point of the profile. Click on the *Position* plot, with the preselected **Acceleration** Segment, enter the values to match the image below and click **Submit**

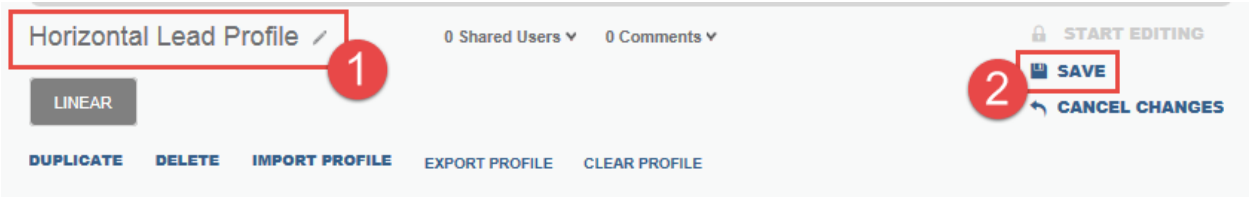


8. You've completed setting up the profile. **Zoom** in the *Position* Plot by clicking on the magnifying glass  and open the *Velocity* plot by clicking on the dropdown button next to it.



9. **Zoom** in the *Velocity* Plot by clicking on the magnifying glass  .

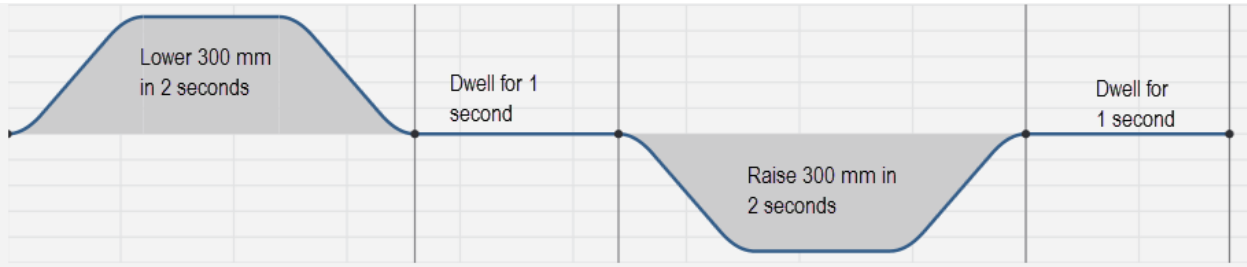
10. Rename your motion profile to *Horizontal Lead Profile*, and click **Save** to save this new profile.



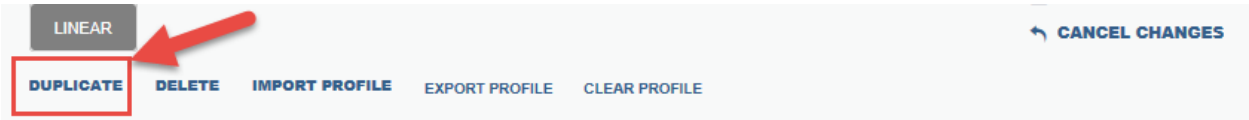
Part B: Vertical Lead Screw Axis

In this section of the exercise, you will use the axis data from the horizontal lead screw as the starting point for sizing the vertical lead screw axis, but be sure to enter the differences below:

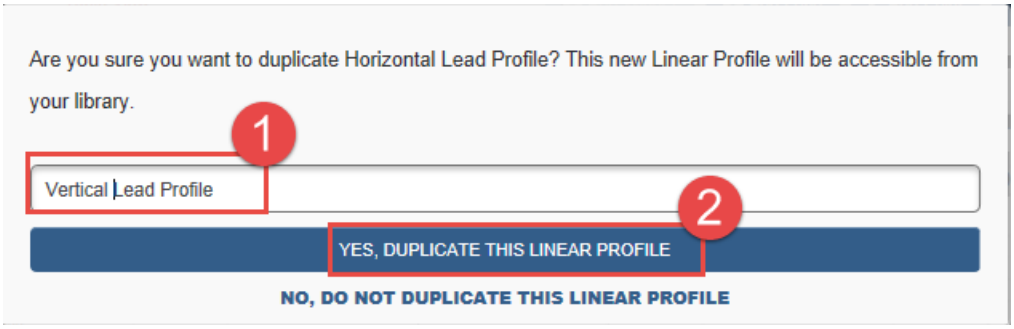
- Total Slide Mass = 25 kg (including fixtures and product grippers)
- Bi-directional move of 300 mm in 6 secs overall. See profile drawing.



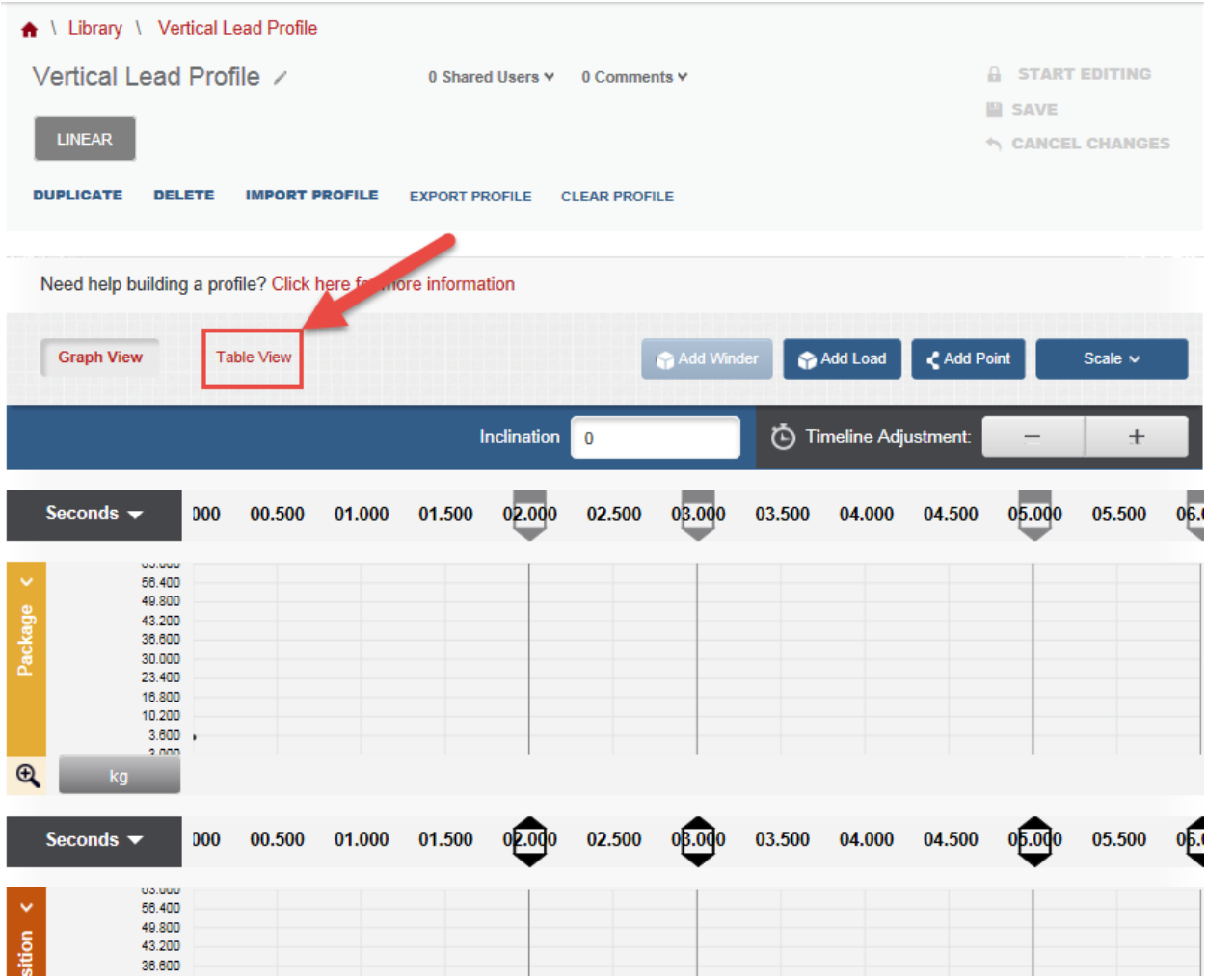
11. Since we you will use the axis data from the horizontal lead screw as the starting point for sizing the vertical lead screw axis, we will duplicate this motion profile. Select **Duplicate.**



12. Name this copy "*Vertical Lead Profile*" and click **Yes** to confirm your selection.



13. With the new motion profile opened, change the position points to match your vertical lead screw axis profile. Go to **Table View**



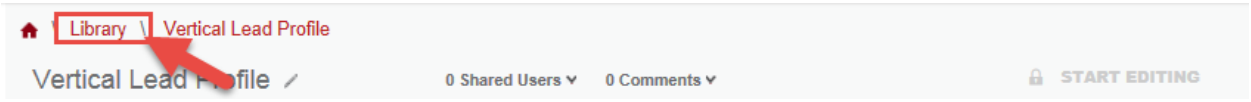
14. **Edit** the *Motion* segments to match the image below:

Motion

TYPE	TIME [ms]	POSITION [m]	VELOCITY [m/s]	ACCELERATION [m/s^2]	JERK [m/s^3]	EDIT
Acceleration	0	0	0	0	0	Edit
Index	2000	0.3	0	0	2.7	Edit
Acceleration	3000	0.3	0	0	0	Edit
Index	5000	0	0	0	-2.7	Edit
Acceleration	6000	0	0	0	0	Edit

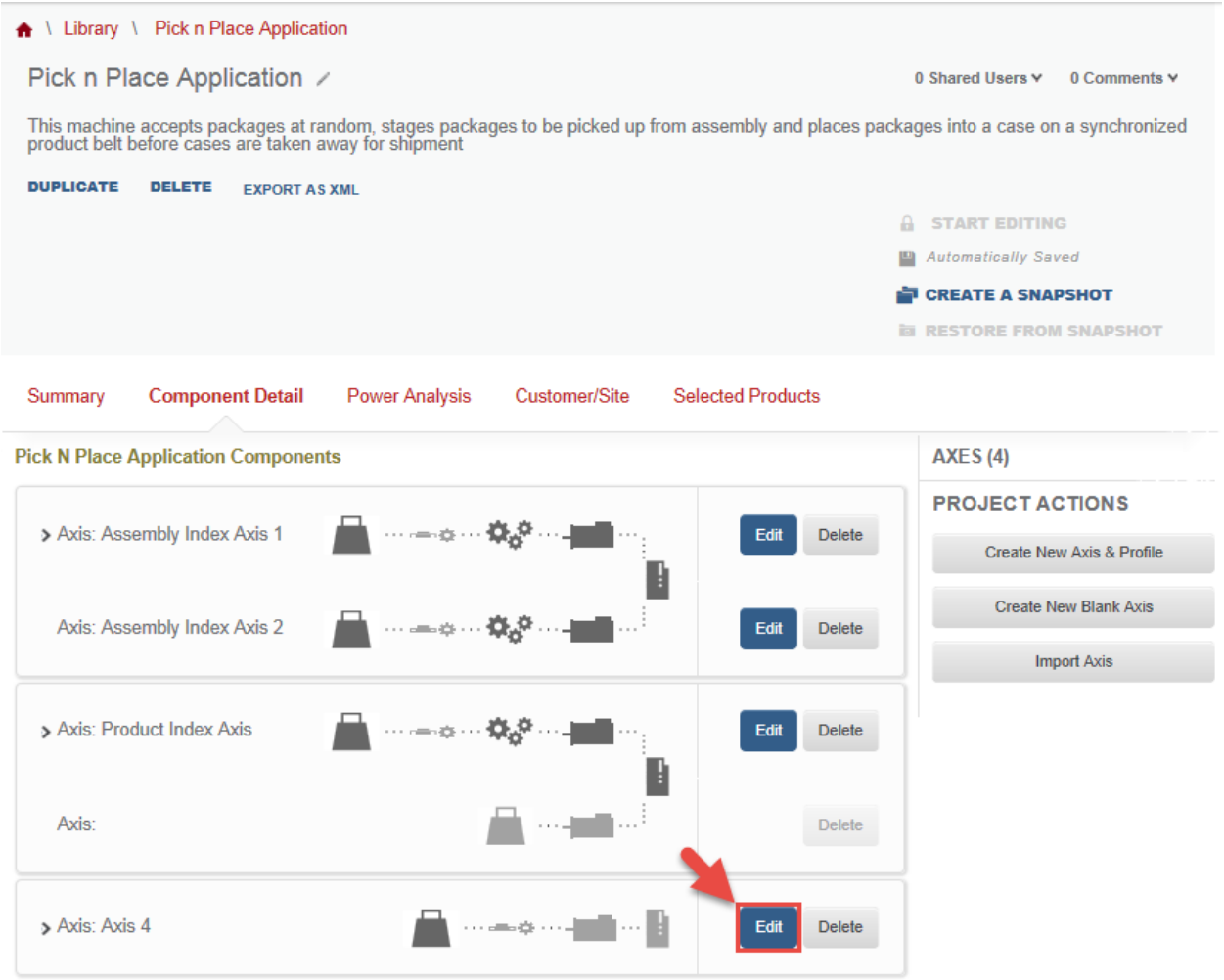
15. **Save** your changes.

16. **Return** to your Library

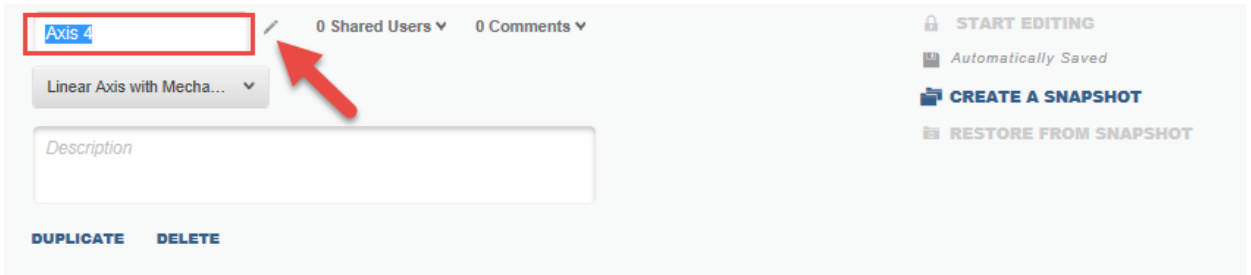


17. Reopen the Pick n Place Application

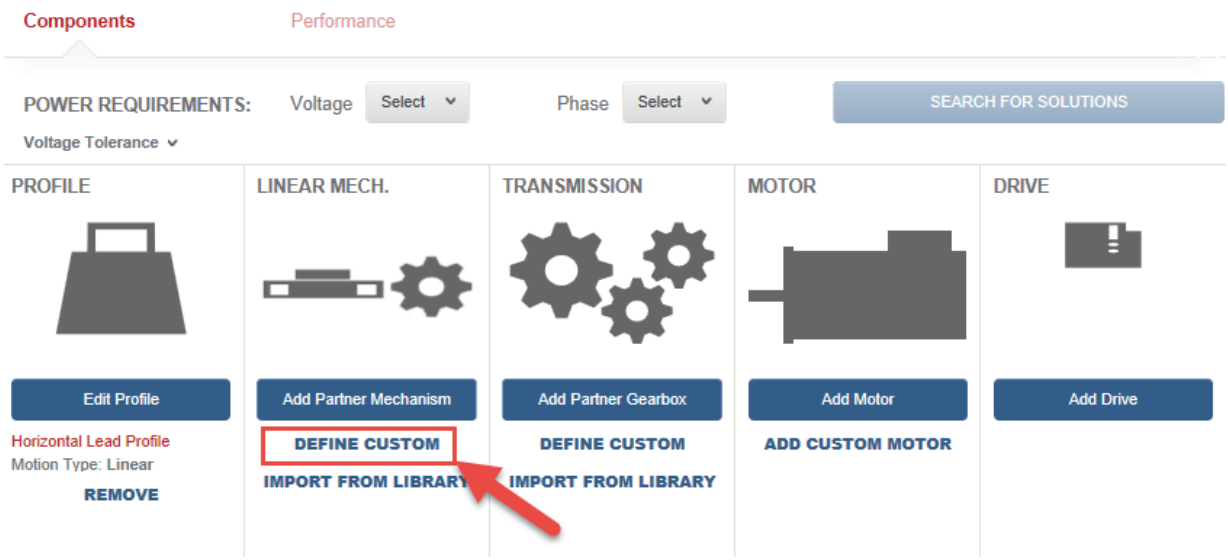
18. Click on **Edit** on Axis 4 to edit the axis components



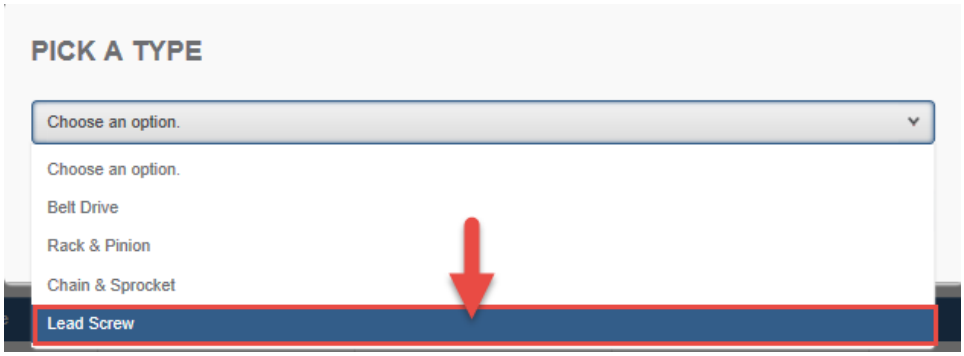
19. Change the name *Axis 4* to *Horizontal Lead Screw Axis*.



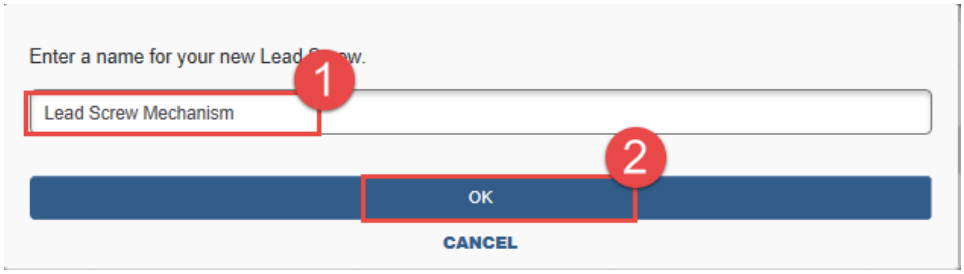
20. Define your *Linear Mechanism* by click on **Define Custom**



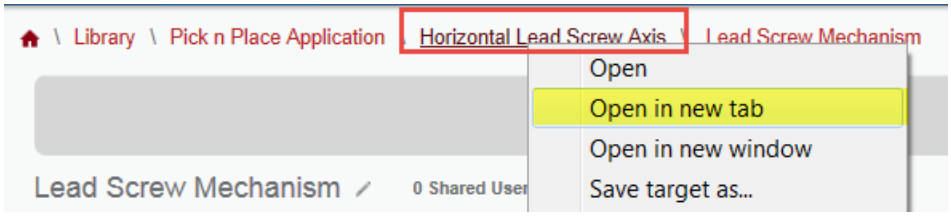
21. Select the **Lead Screw** mechanism type and click **OK** to confirm your selection



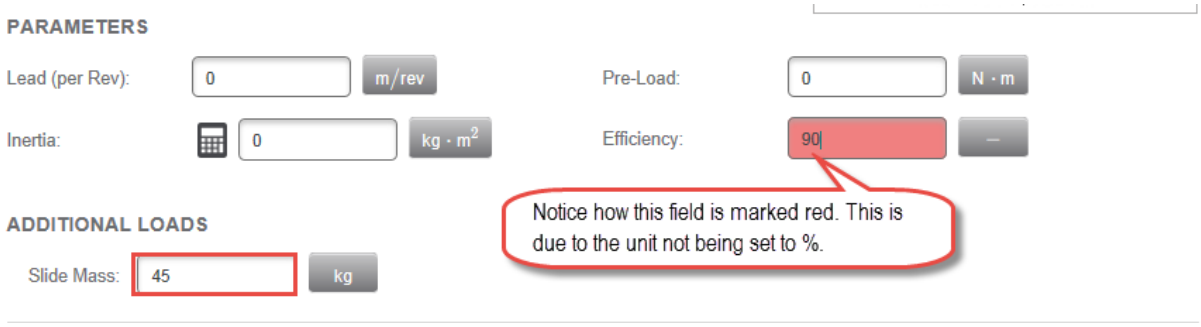
22. Enter Lead Screw Mechanism as name and click **OK** to confirm your selection.



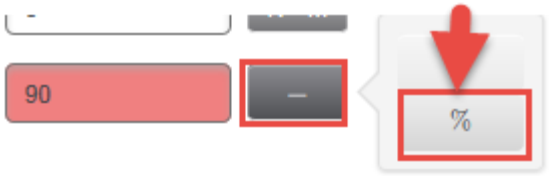
23. Before editing your *Lead Screw Properties*, **right click** on *Horizontal Lead Screw Axis* and select **Open in new tab**.



24. Enter your *Slide Mass* of **45 kg**, *Efficiency* of **90%**,

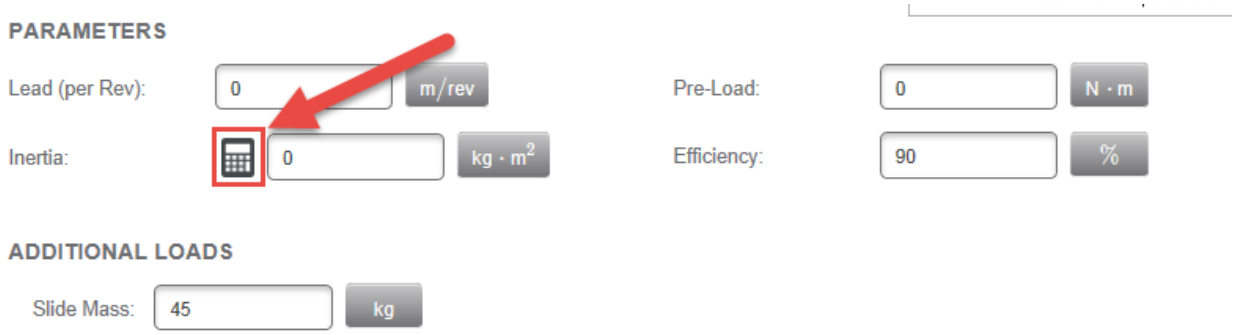


25. Set the unit of the *Efficiency* field to **%**

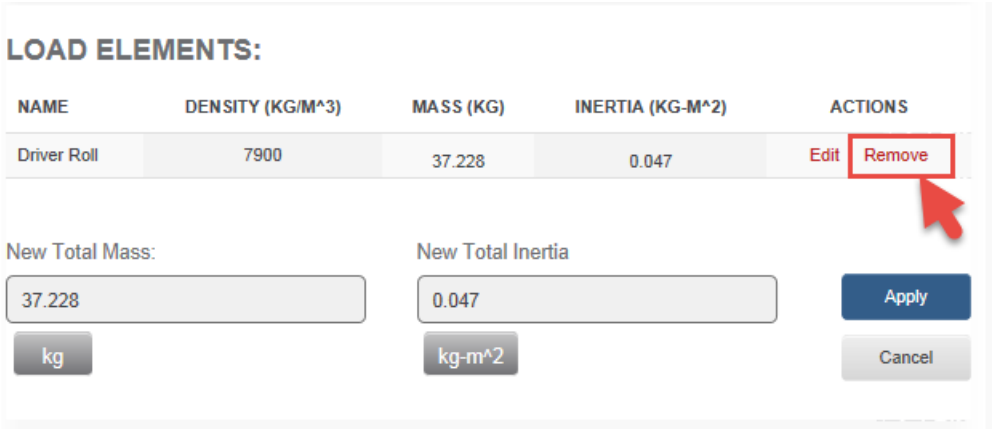


26. Re-enter the **90** for efficiency.

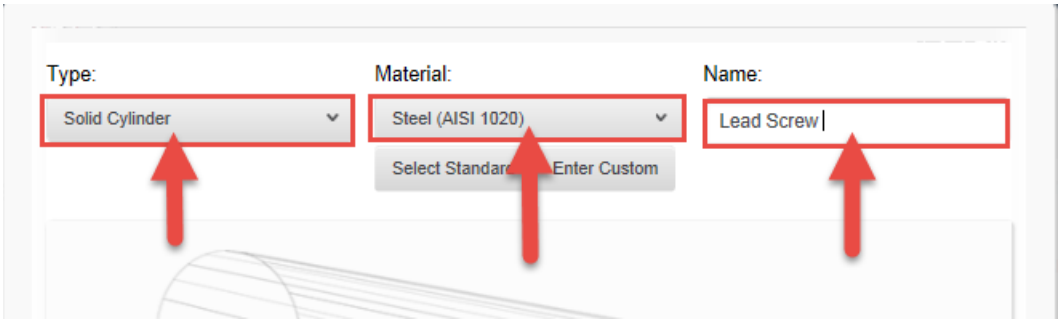
27. Click on the Inertia Calculator



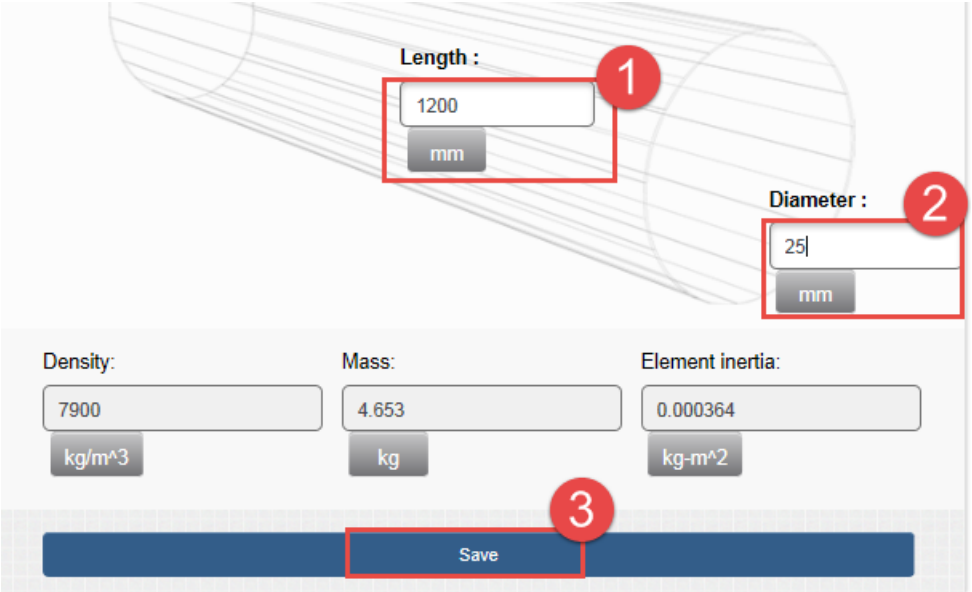
28. The Inertia Calculator will open up, you should be able to see the Driver Roll under the *Load Elements* sections. Delete this element by clicking **Remove**



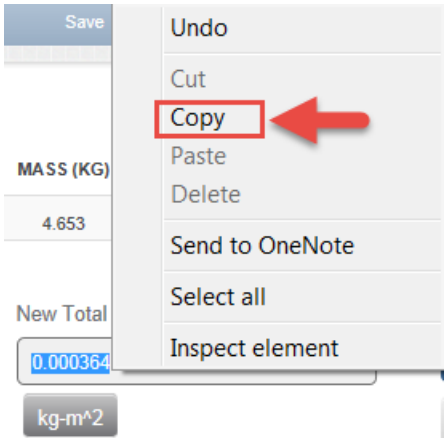
29. Set ***Type*** to Solid Cylinder, ***Material*** to Steel, and ***Name*** to Lead Screw



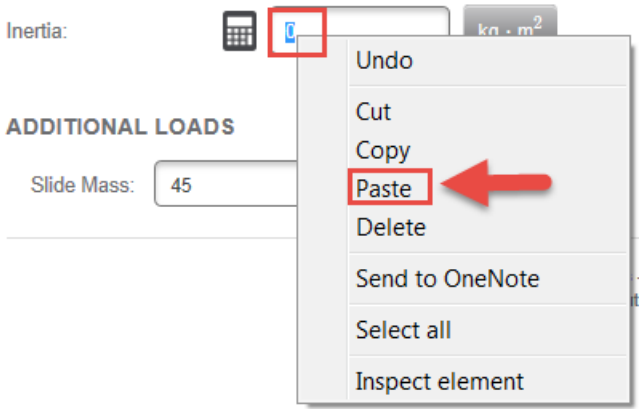
30. Enter your element's dimensions and Click **Save**



31. Once the element is saved in the *Load Elements* section, **Copy** the *New Total Inertia* value and click **away** from the inertia calculator window to exit the Inertia Calculator.

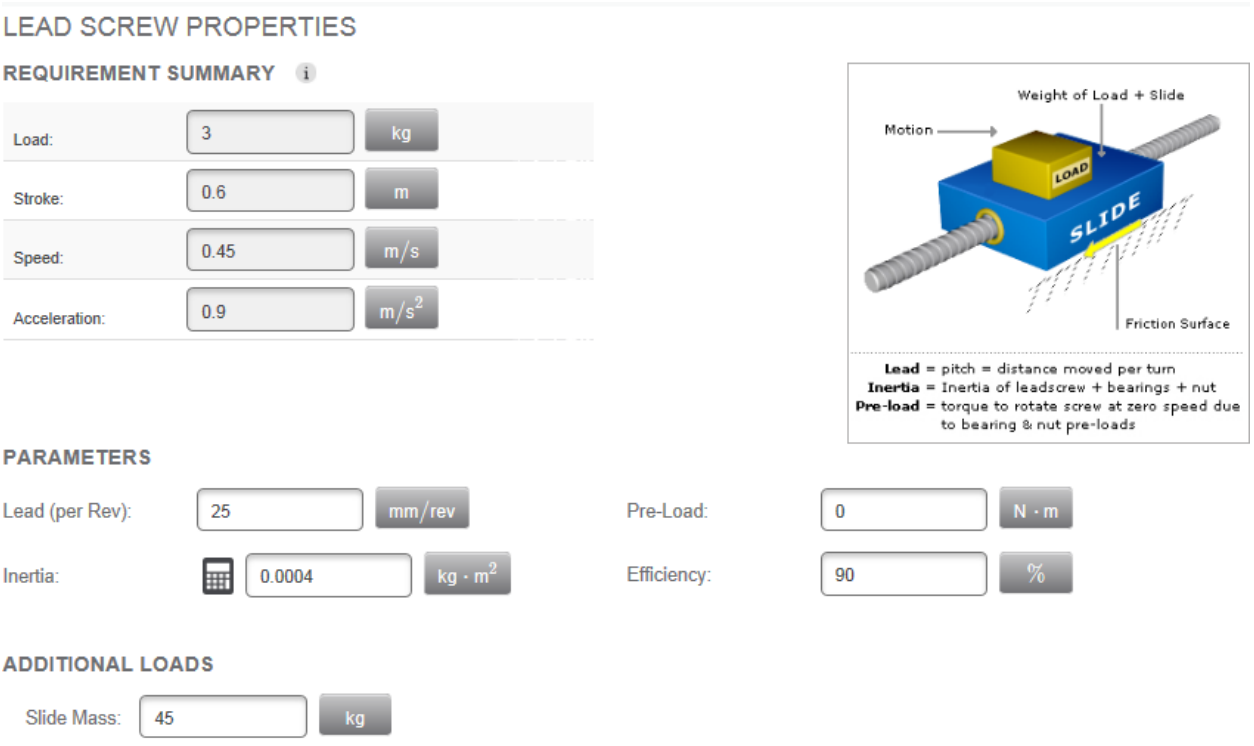


32. **Paste** the inertia value into the *inertia* field.



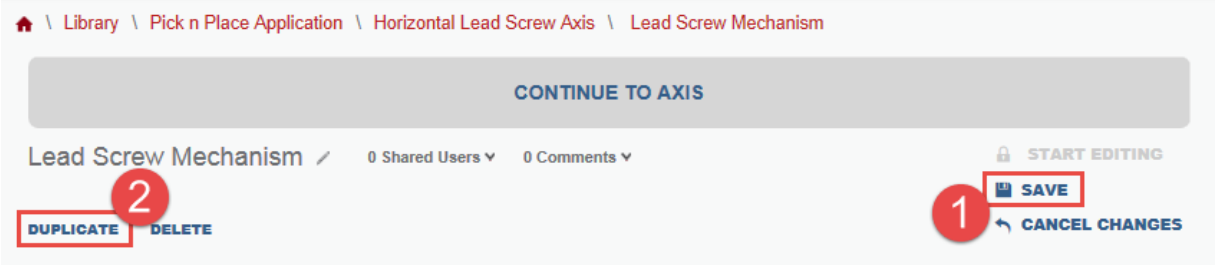
33. Enter 25 mm/rev into the *Lead (per rev)* field. Make sure to **change** the units first.

34. Your completed entries should looks as follows:

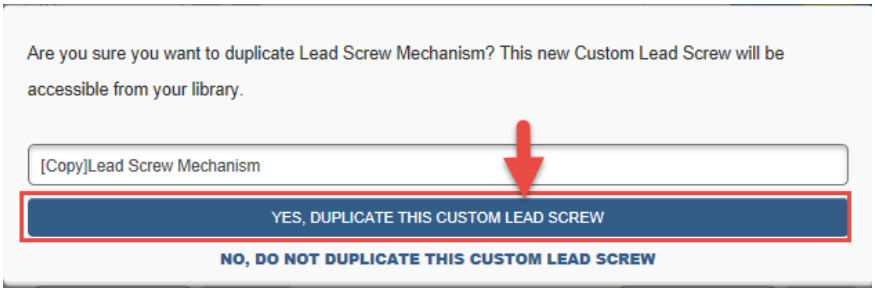


35. Verify that you have all values entered.

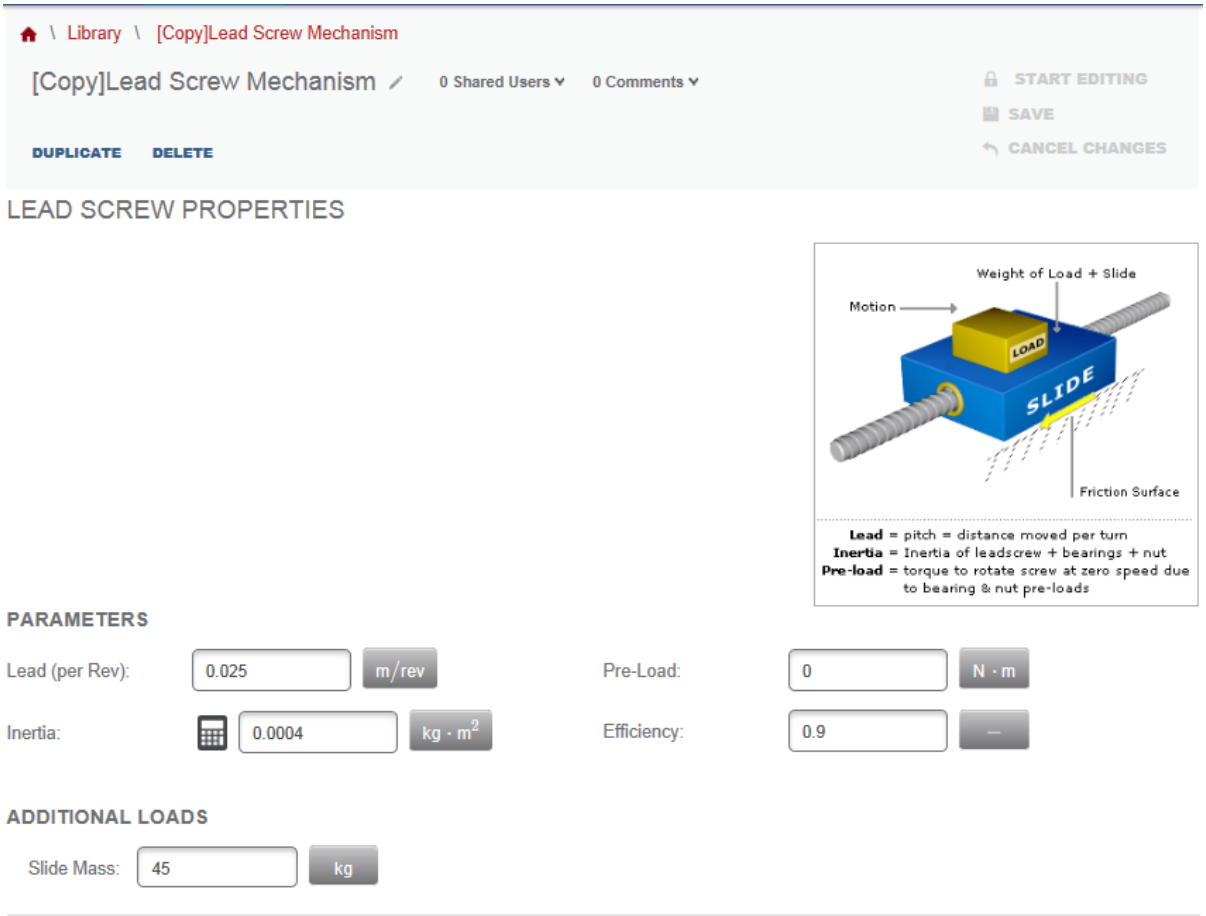
36. **Save** your changes and **Duplicate** the Lead Screw Mechanism



37. Confirm **Yes** on the pop up to duplicate the mechanism to your Library.

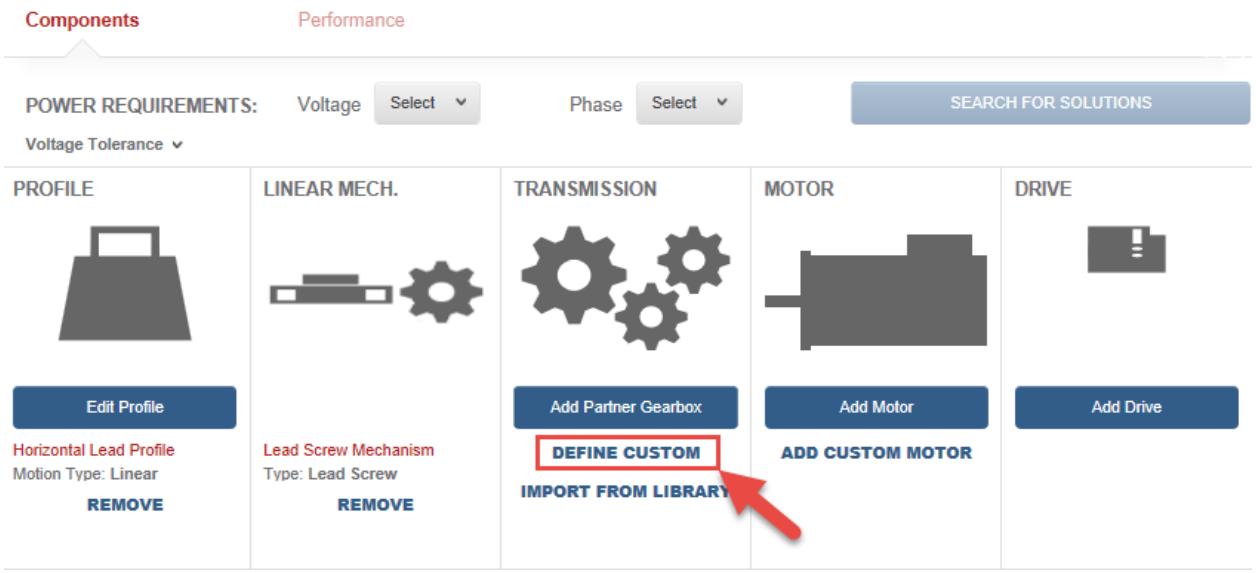


38. The [Copy] Lead Screw Mechanism duplicated mechanism will replace the original Lead Screw Mechanism window.

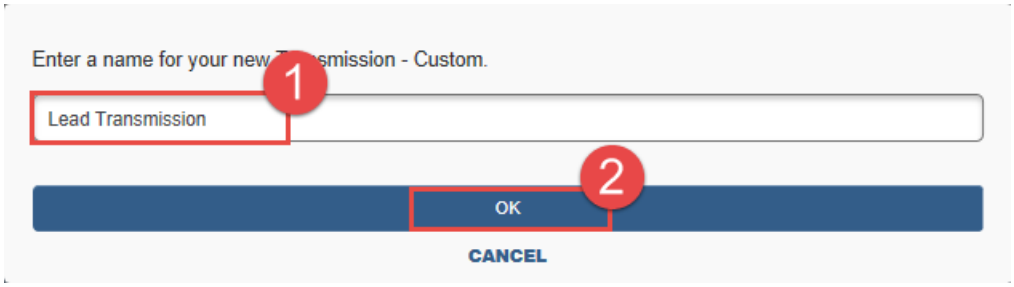


39. We will navigate to the Axis tab, which we opened earlier. You can close the linear mechanism tab

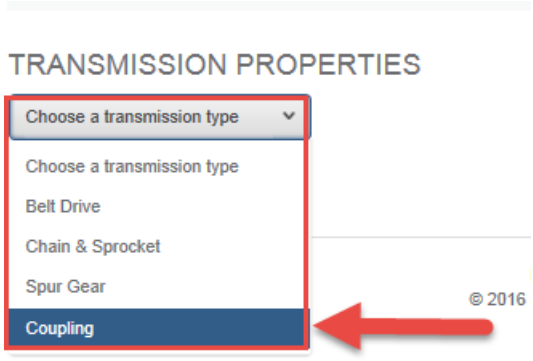
40. Click on **Define Custom** to edit your *Transmission*



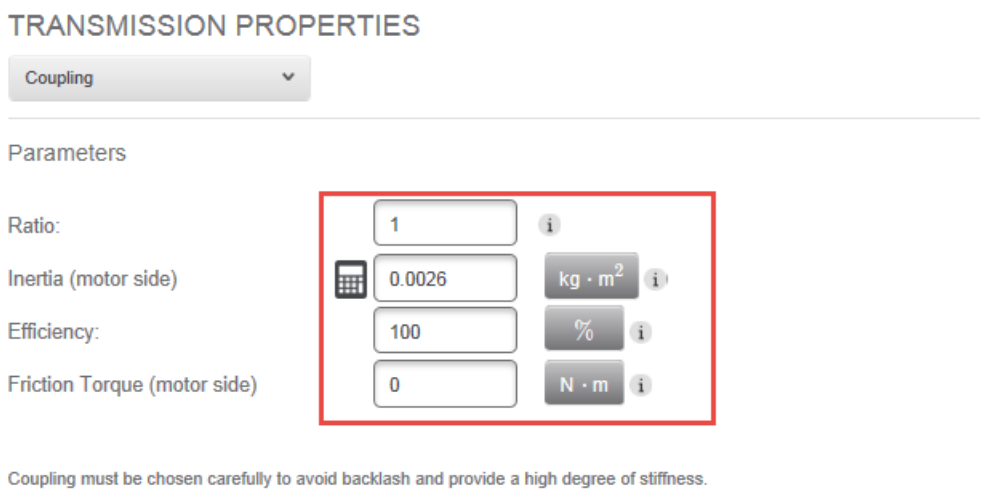
41. Enter *Lead Transmission* as name of your transmission and click **OK** to confirm your selection.



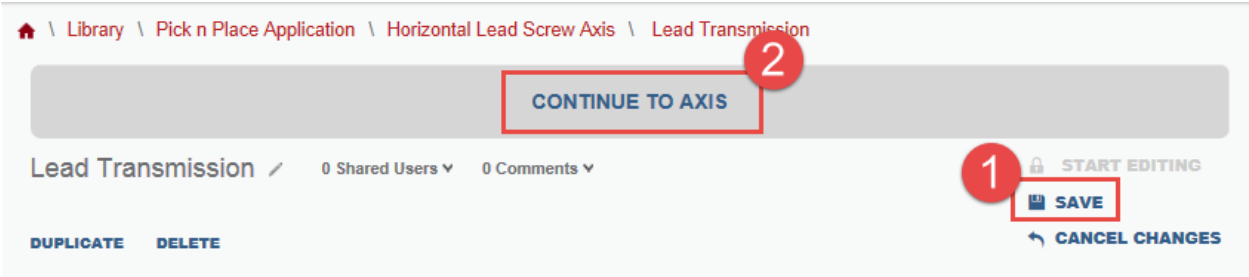
42. Select **Coupling** for your *transmission type*



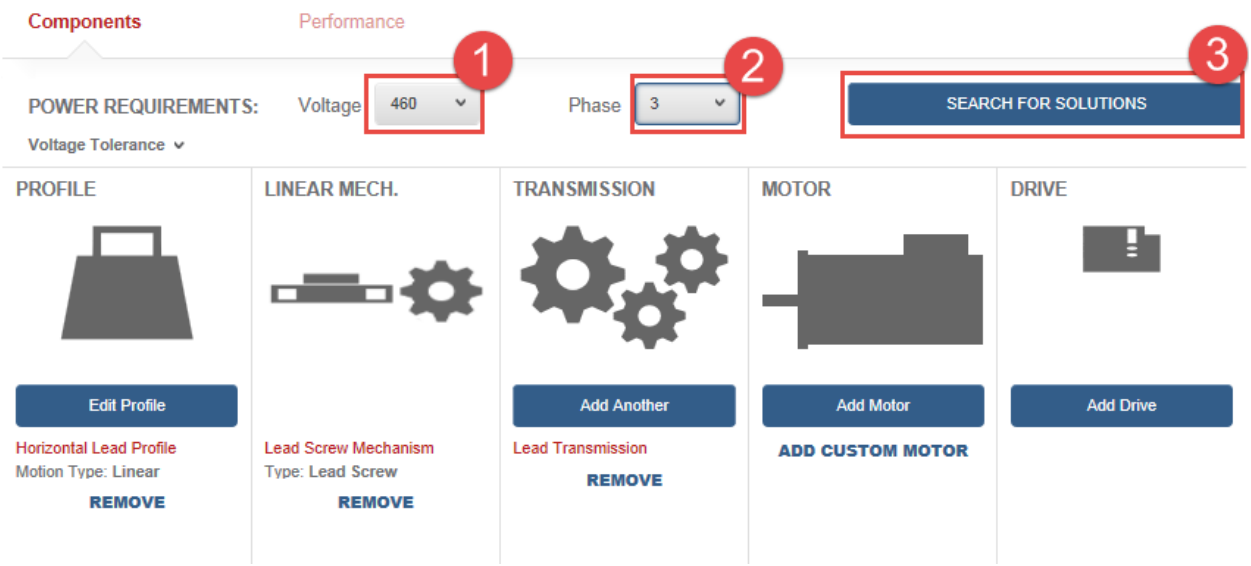
43. Enter the following values in your *Parameters* fields. Remember to change the units for the *Efficiency* field before entering your value



44. Click **Save** and **Continue to Axis**

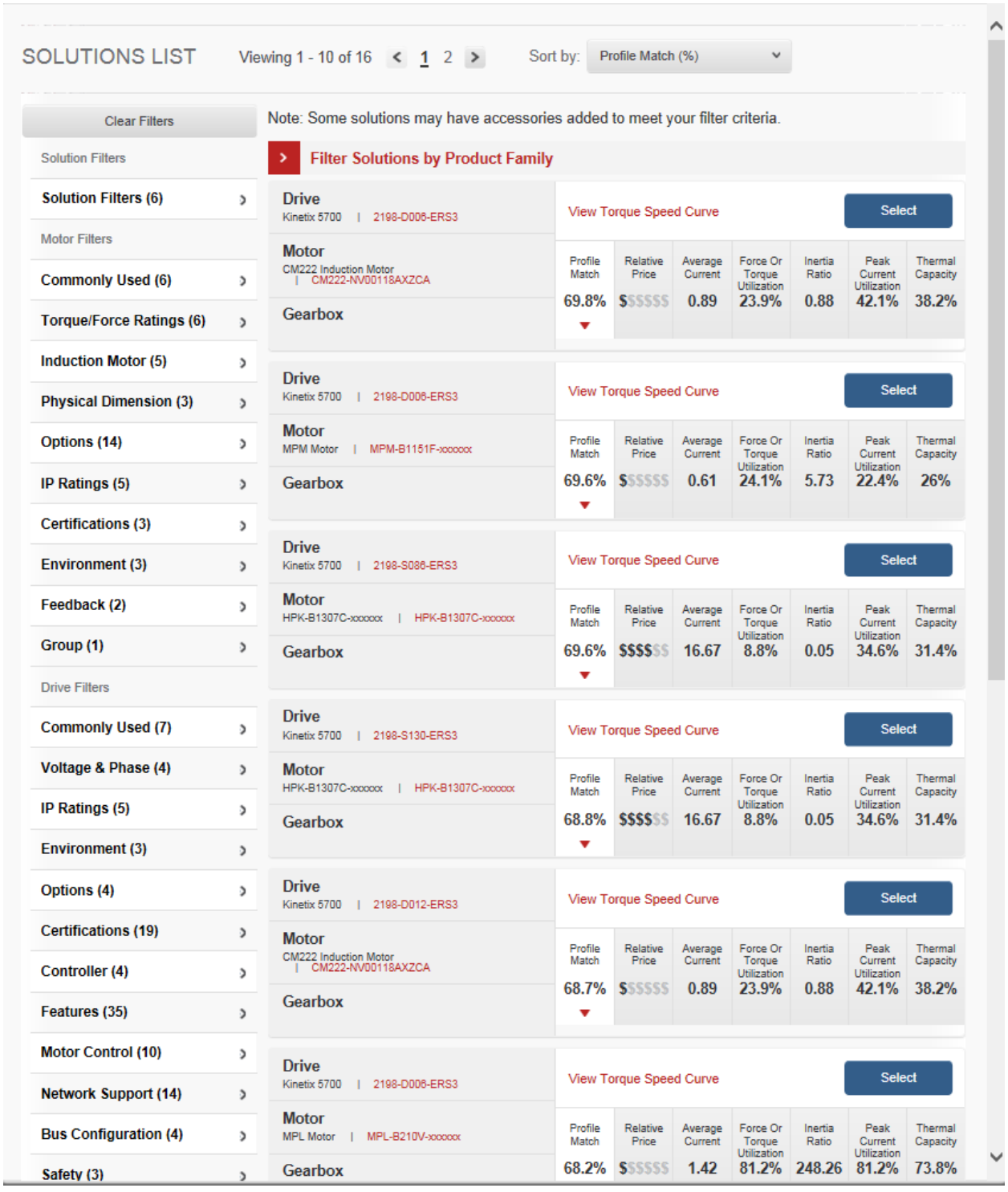


45. You've completed configuring your components. For the Lead Screw Actuator, we will not select any gearbox. In the *Power Requirements* section, select **460** for *Voltage* and **3** for *Phase*, click **Search for Solutions** once enabled.

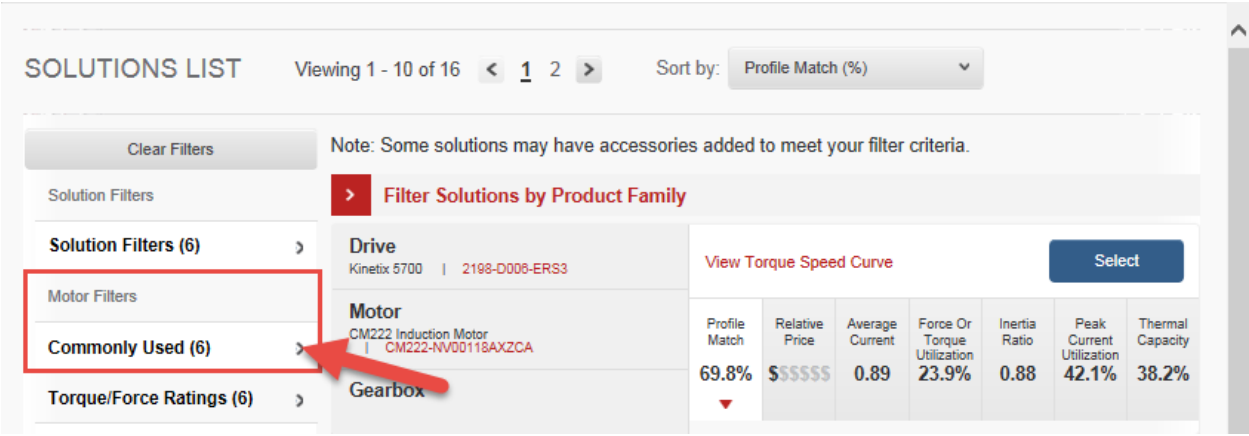


46. The *Solutions List* will open and you will have multiple combinations of Drive and Motor results. We will look for Kinetix 5700 Servo Drive results. Set the filter to show only **Kinetix 5700 Servo Drive** solutions. *Review steps 36-43 of Entering Transmission Components if not sure how to filter.

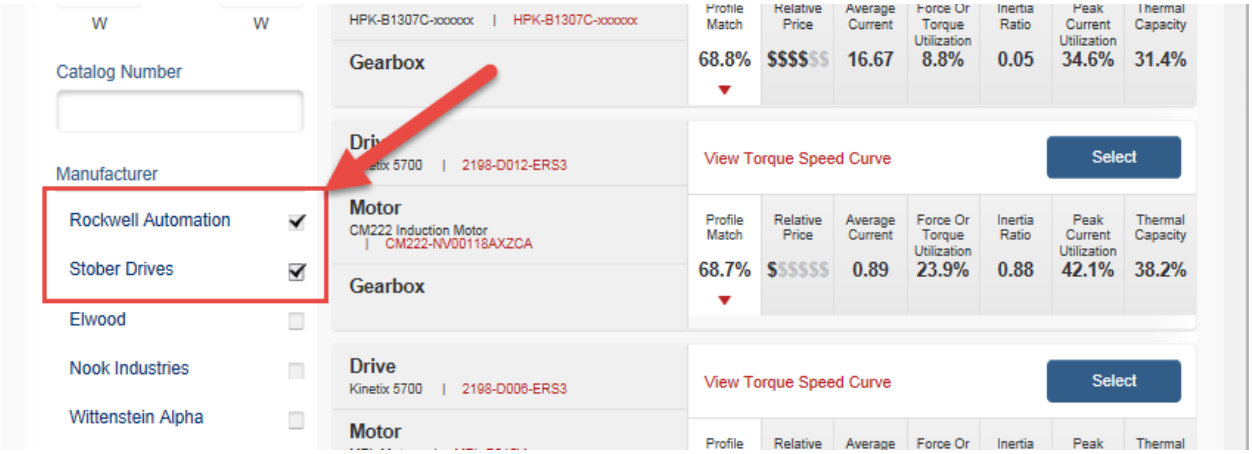
47. Your *Solutions List* should look as follows:



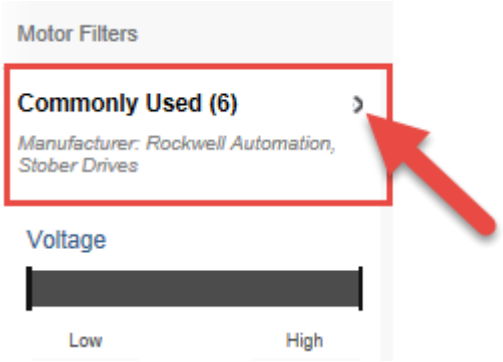
48. We will use the motor filters and only search for Rockwell Automation and Stober products. Click on **Commonly Used (6)** dropdown list.



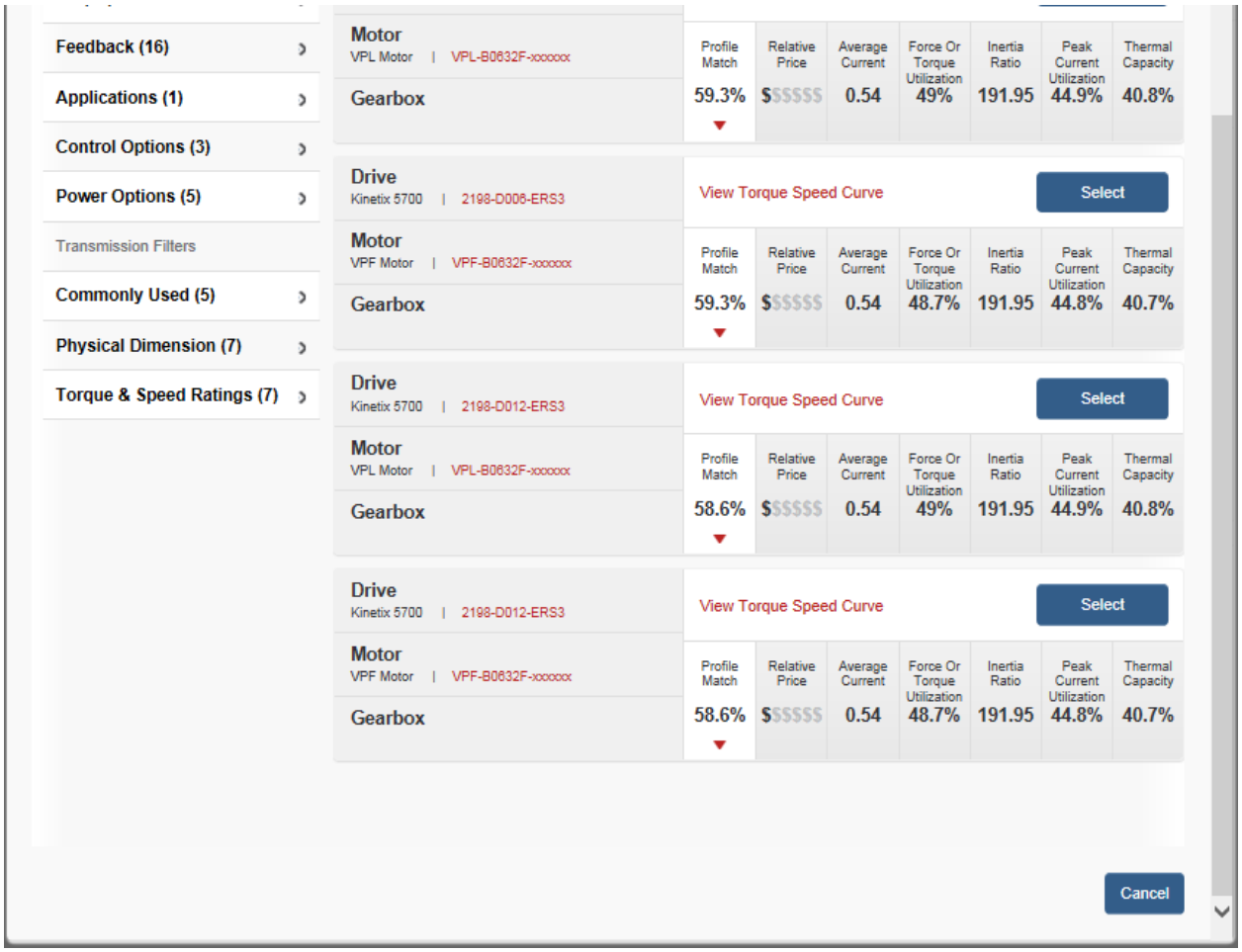
49. Select the checkmarks for Rockwell Automation and Stober in the *Manufacturer* filters.



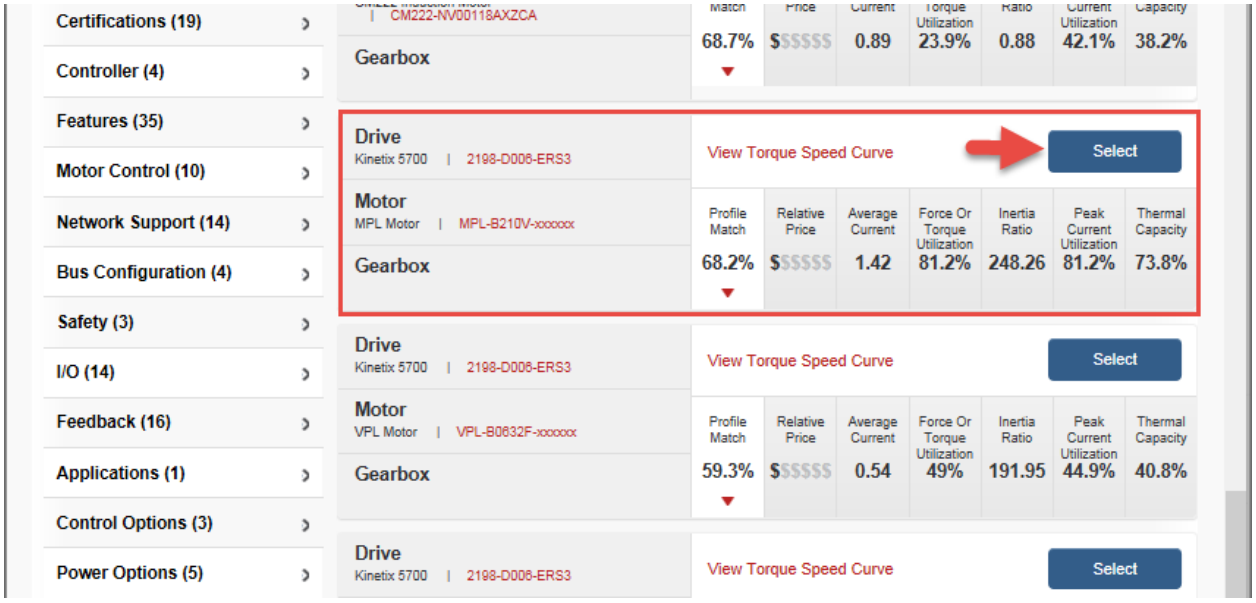
50. Click on **Commonly Used (6)** to retract the dropdown list. Notice how your filters are applied to the results.



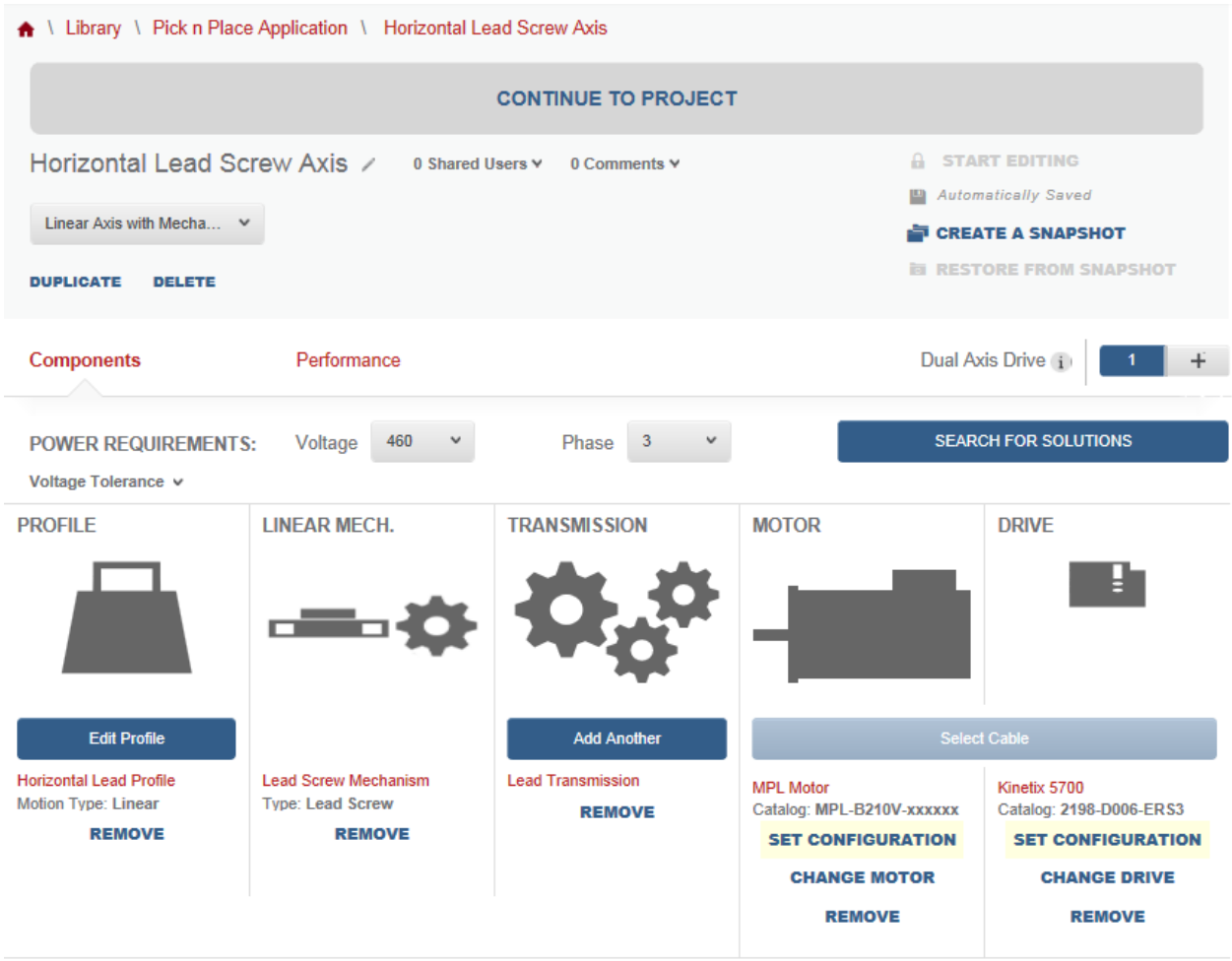
51. Scroll down the *Solutions List* window to review your results



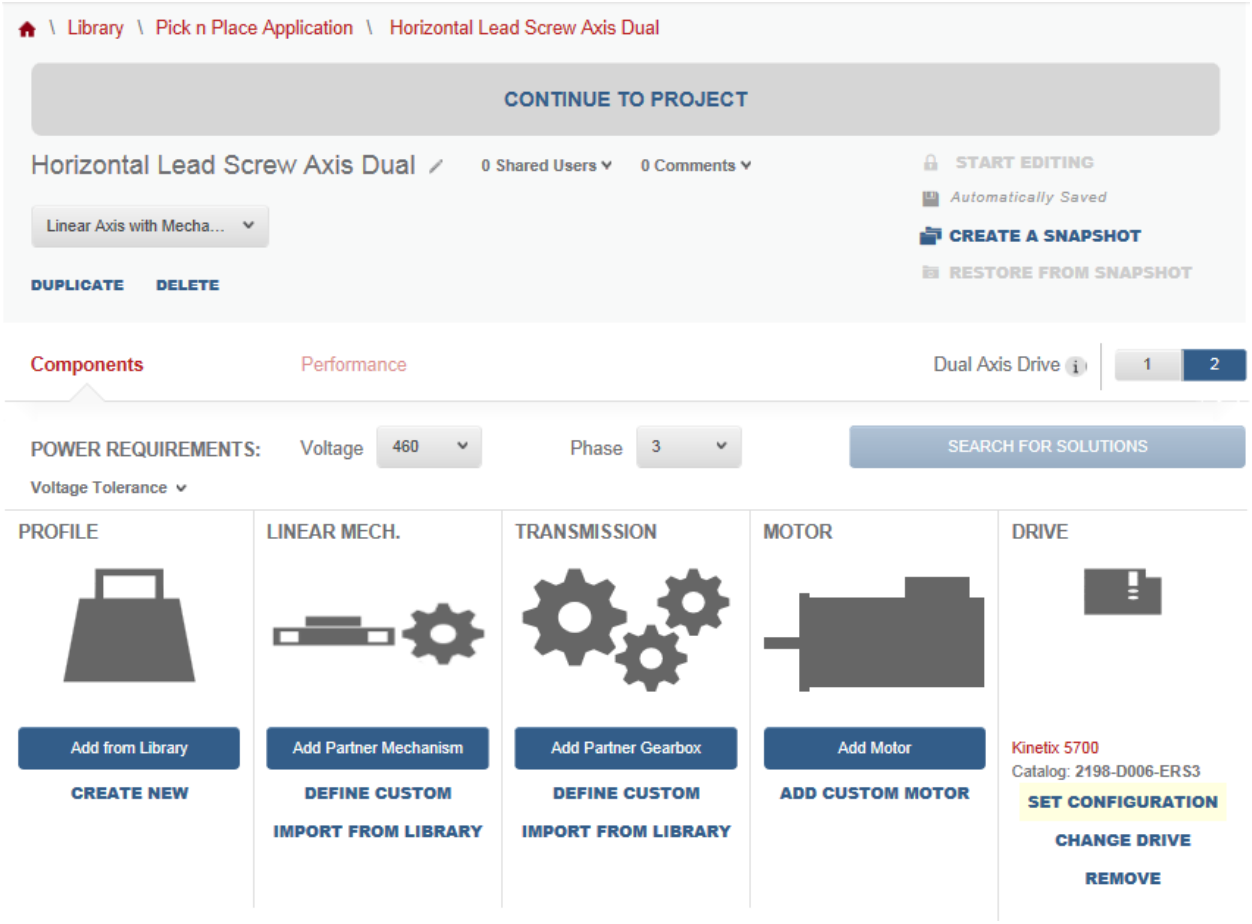
52. Select the solution with MPL motor.



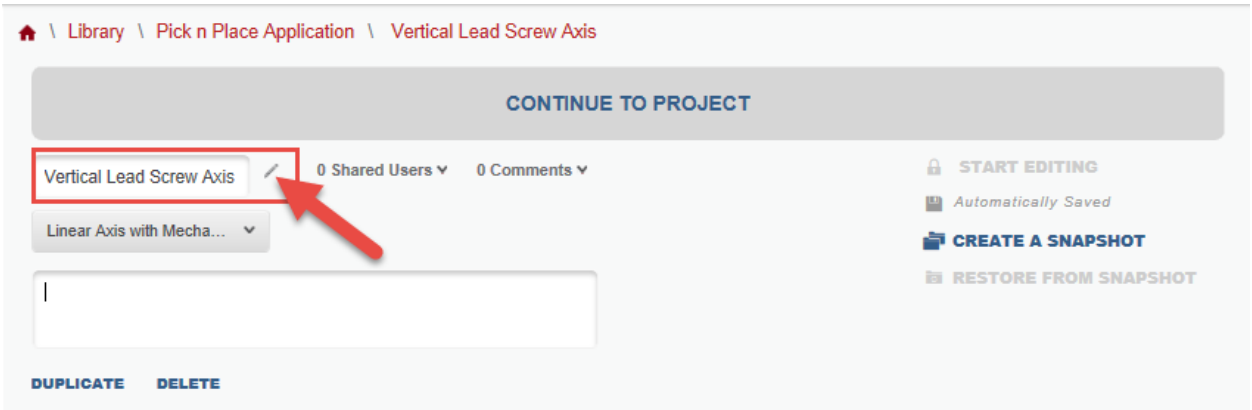
53. You've completed sizing and selecting a solution for the Horizontal Lead Screw Axis. Your components should look as follows:



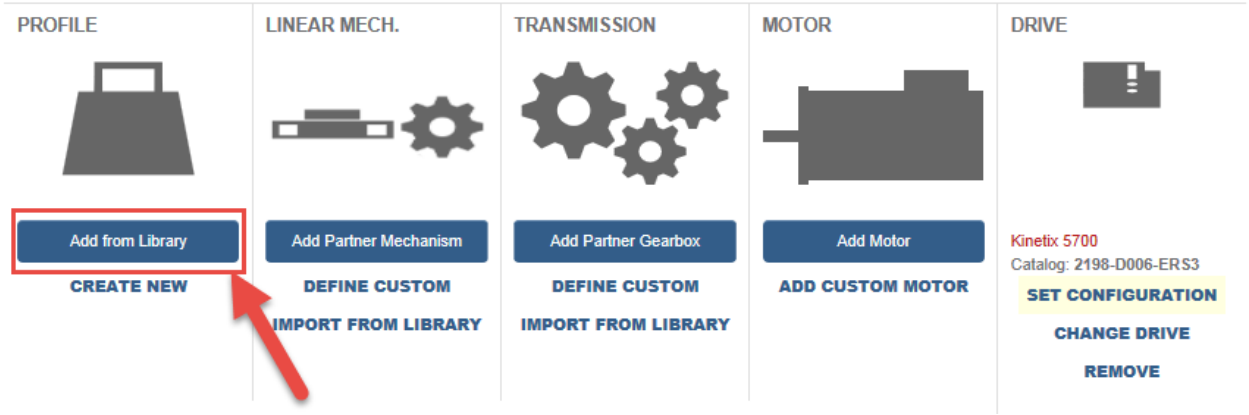
54. We will add the Vertical Lead Screw Axis to the second axis of the Dual Axis Drive. Click on + to add the dual axis. Your new axis should look as follows:



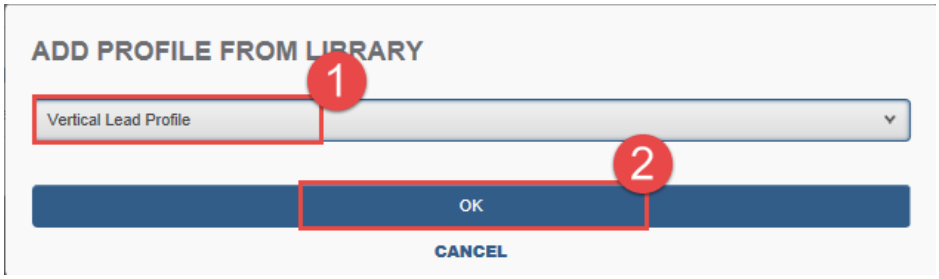
55. Let's begin by changing the name of the axis from Horizontal Lead Screw Axis Dual to Vertical Lead Screw Axis.



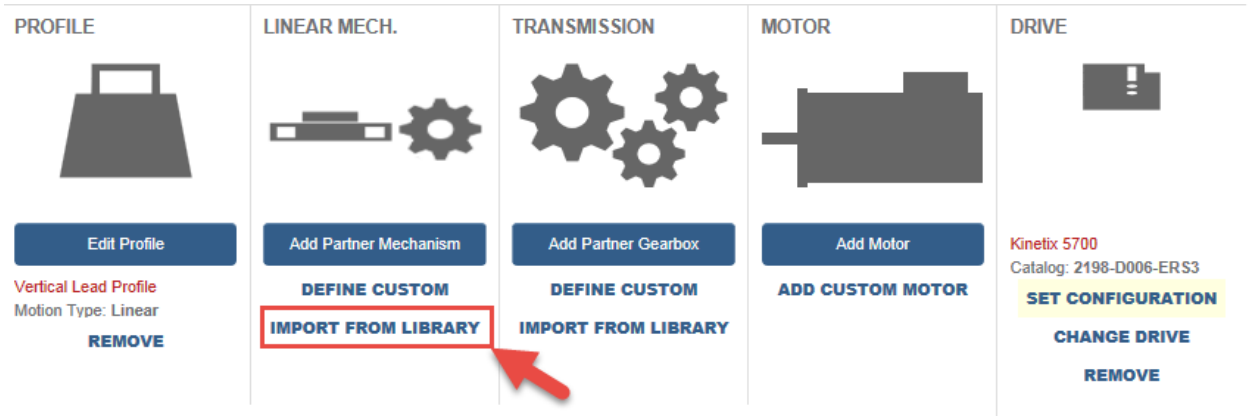
56. Once the name change has been accomplished, import the Vertical Lead Profile from Library. Click on **Add from Library**.



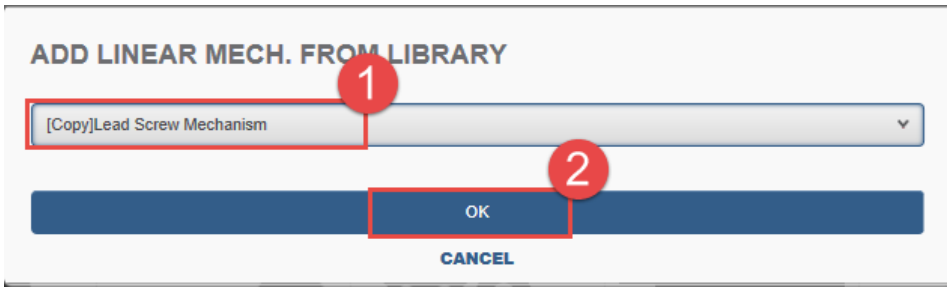
57. Select the Vertical Lead Profile and click **OK** to confirm your answer.



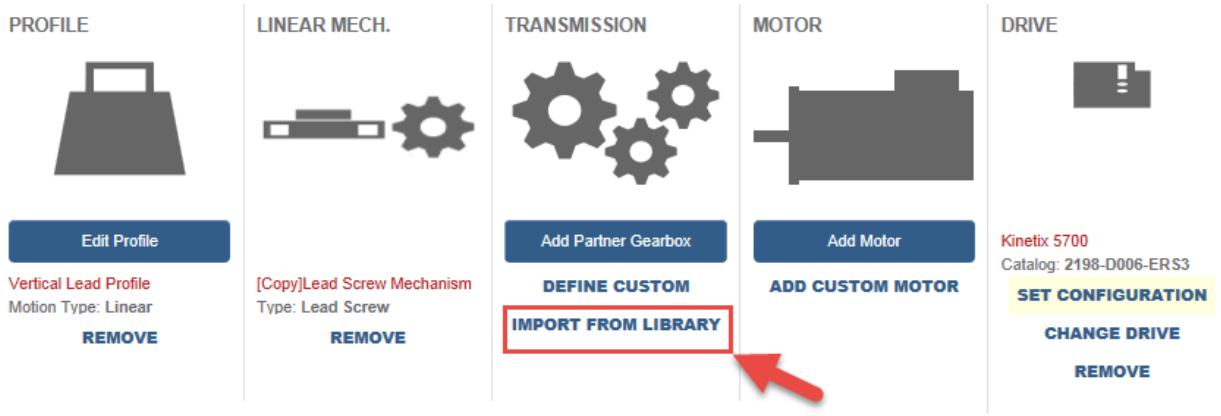
58. Next we will import the Linear Mechanism. Click **Import from Library**



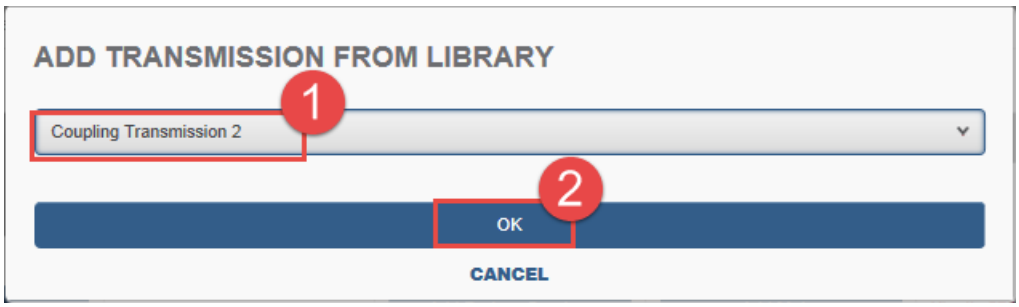
59. Select the [Copy] Lead Screw Mechanism and click **OK** to confirm your answer.



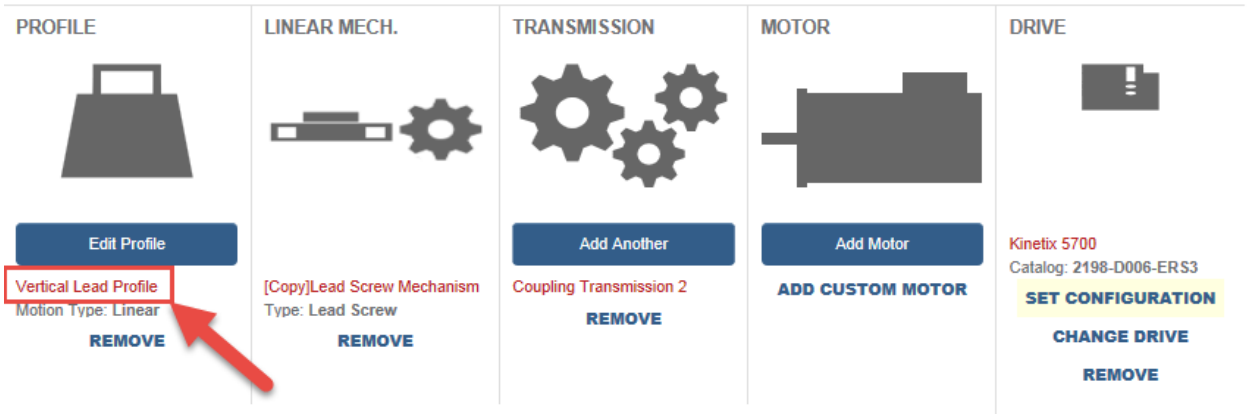
60. Let's import the Transmission since it is the same as the coupling transmission of the Belt Actuator. Click **Import from Library**



61. Select Coupling Transmission 2 and click **OK** to confirm your answer.

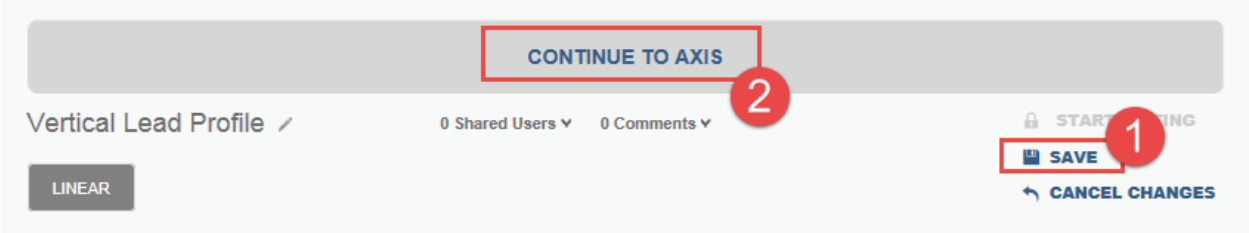


62. Before we search for solution, we will edit the Vertical Lead Profile's Inclination. Click on **Vertical Lead Profile**

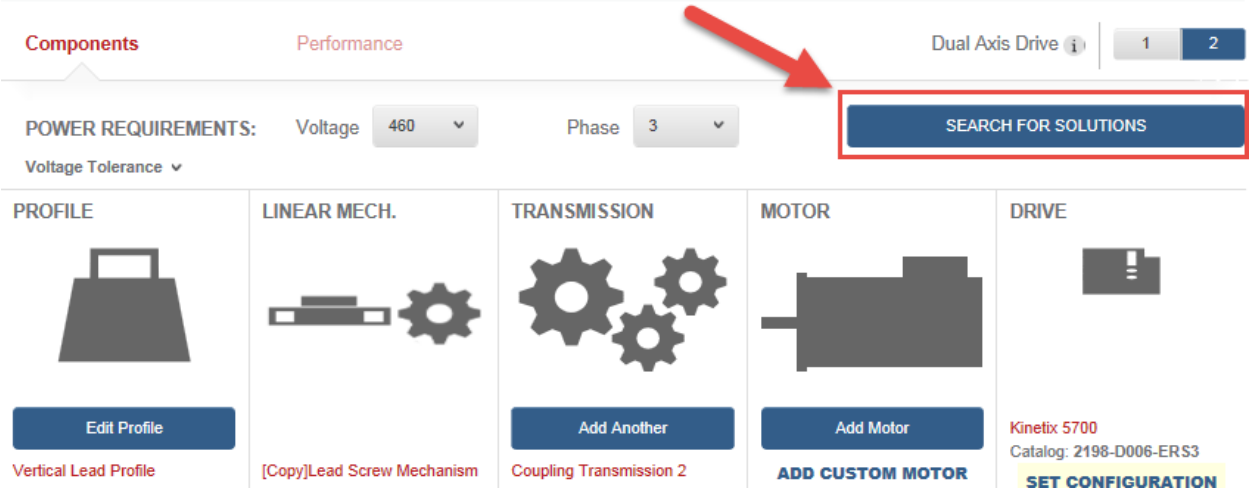


63. Since this is a vertical axis, change the Inclination from 0 to **90**.

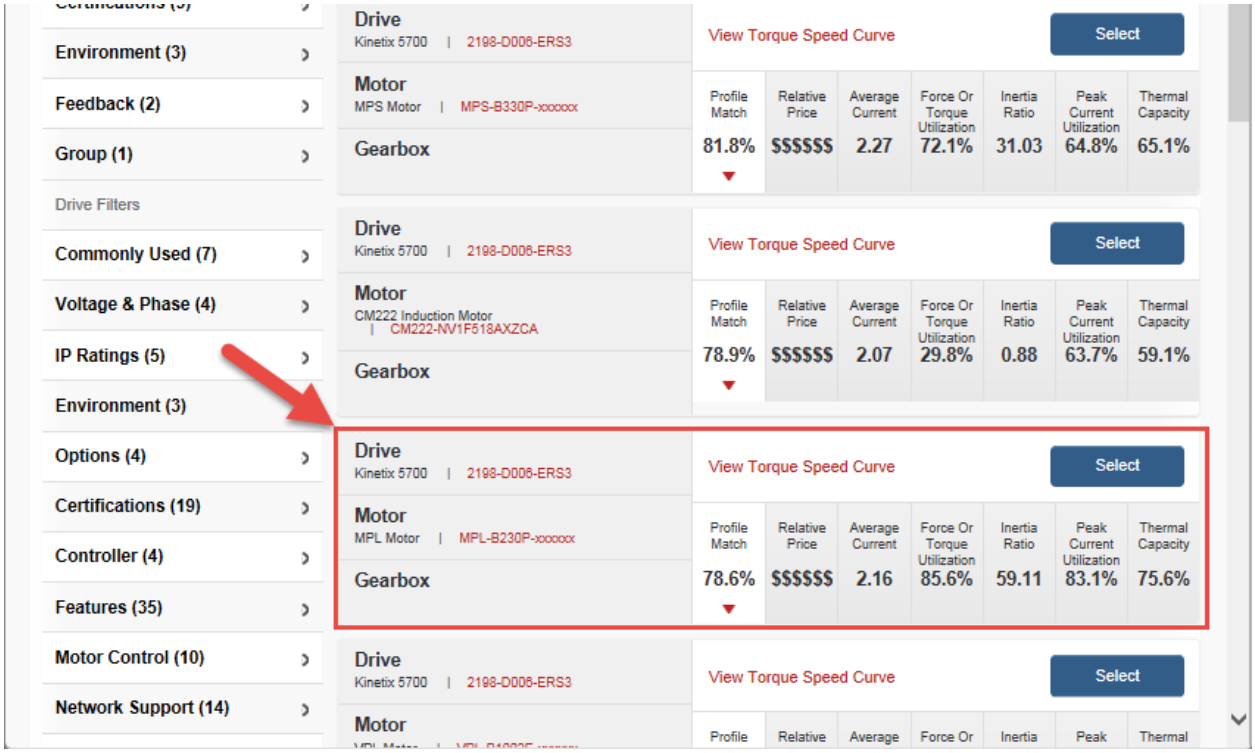
64. Click **Save** and **Continue to Axis.**



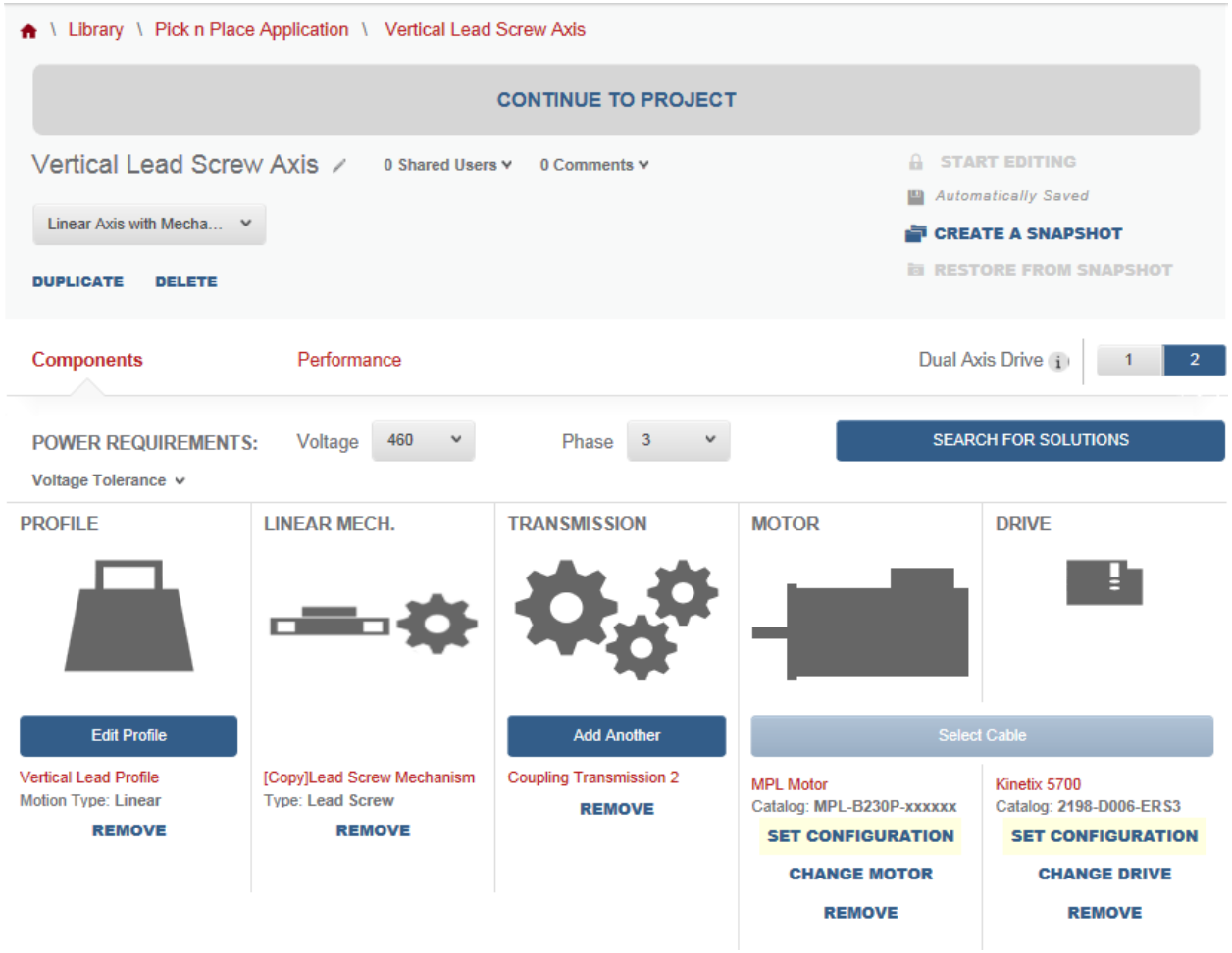
65. You can now click on **Search for Solutions**



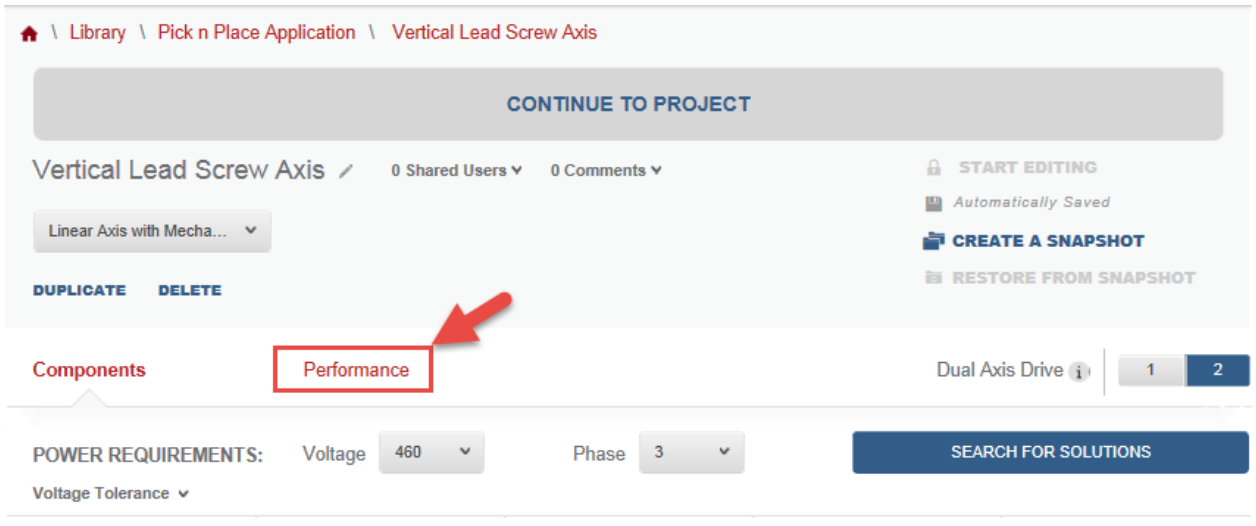
66. Find the solution that has the MPL motor and **Select** the solution.



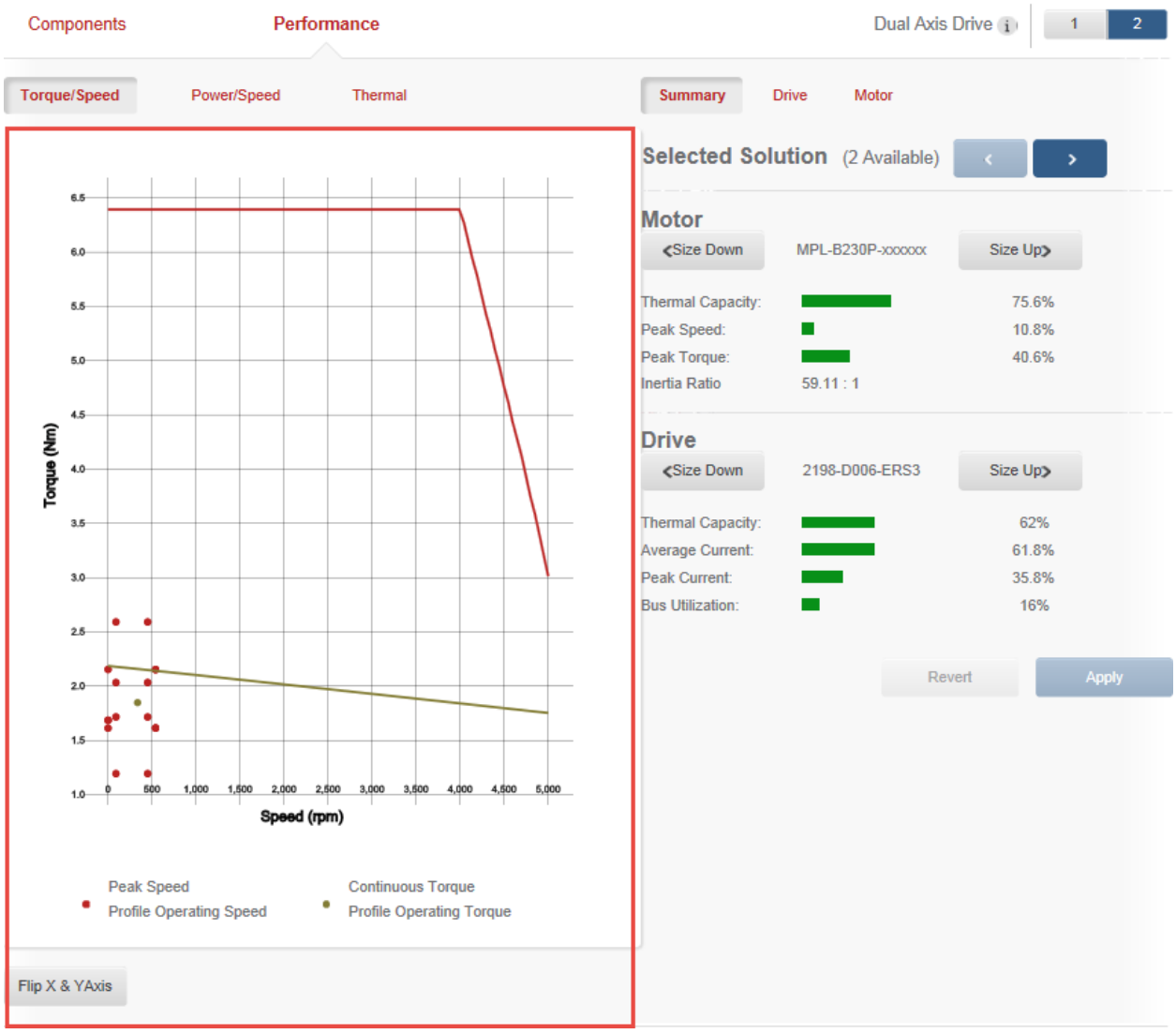
67. Your completed axis should look as follows:



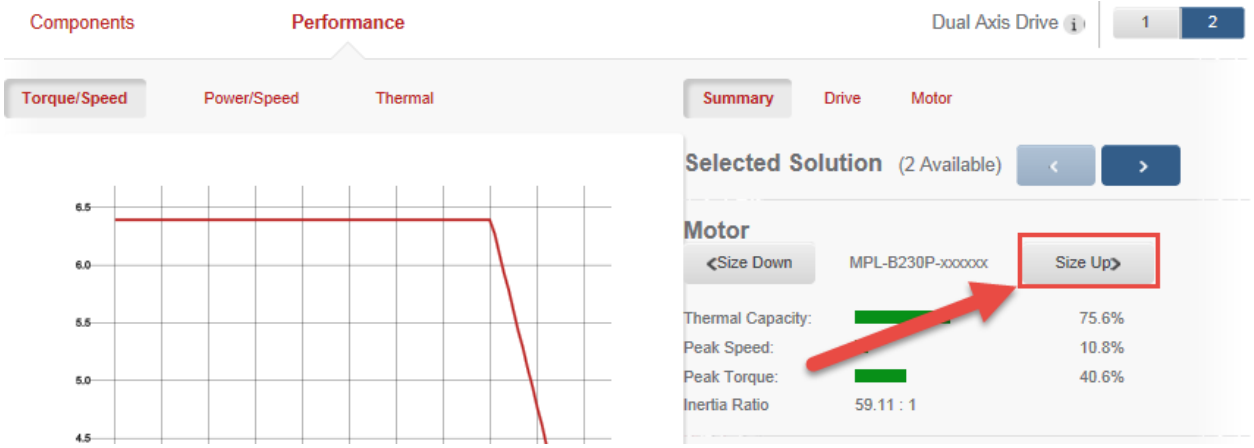
68. Click on the *Performance* tab.



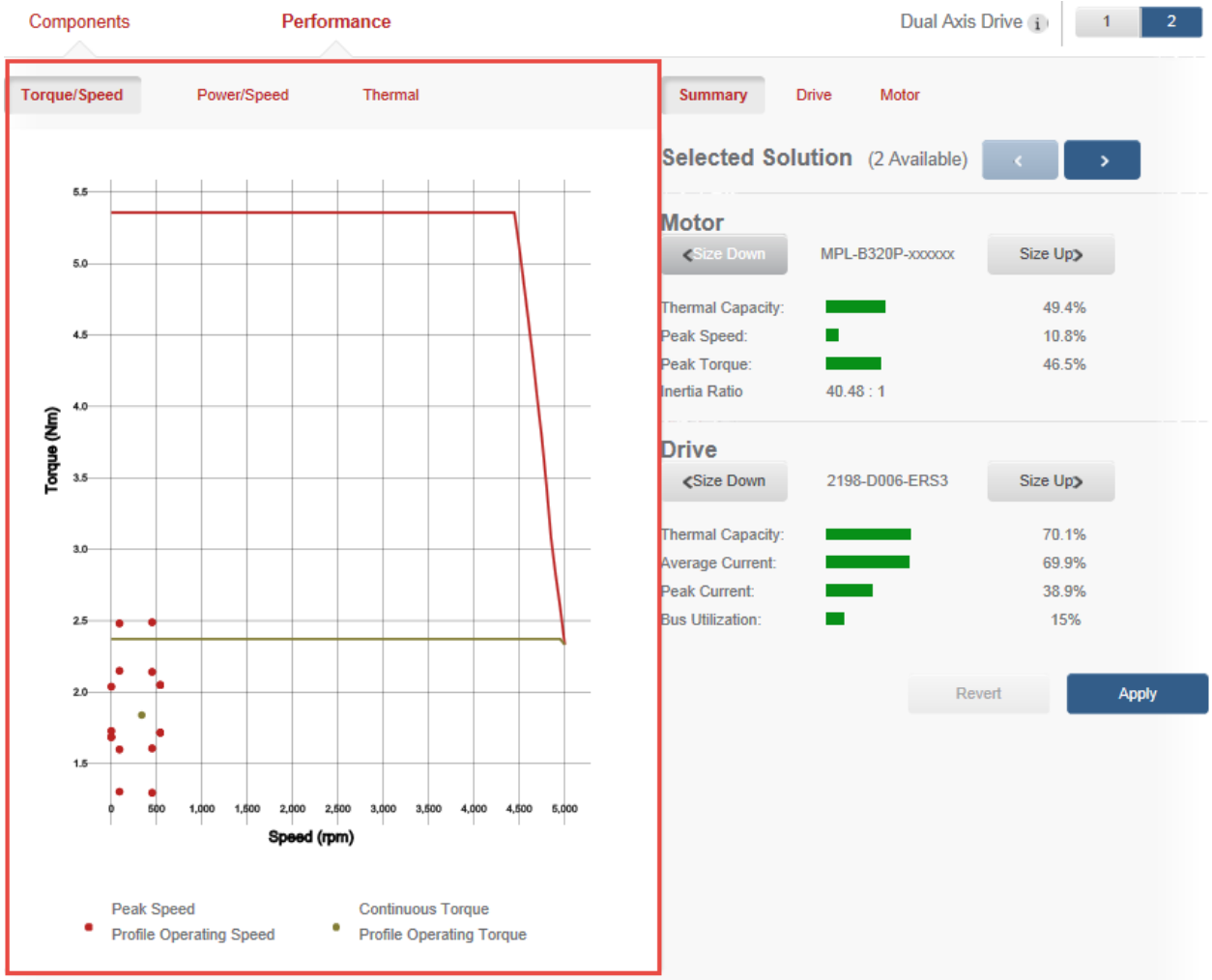
69. Your *Torque/Speed* curve should look as:



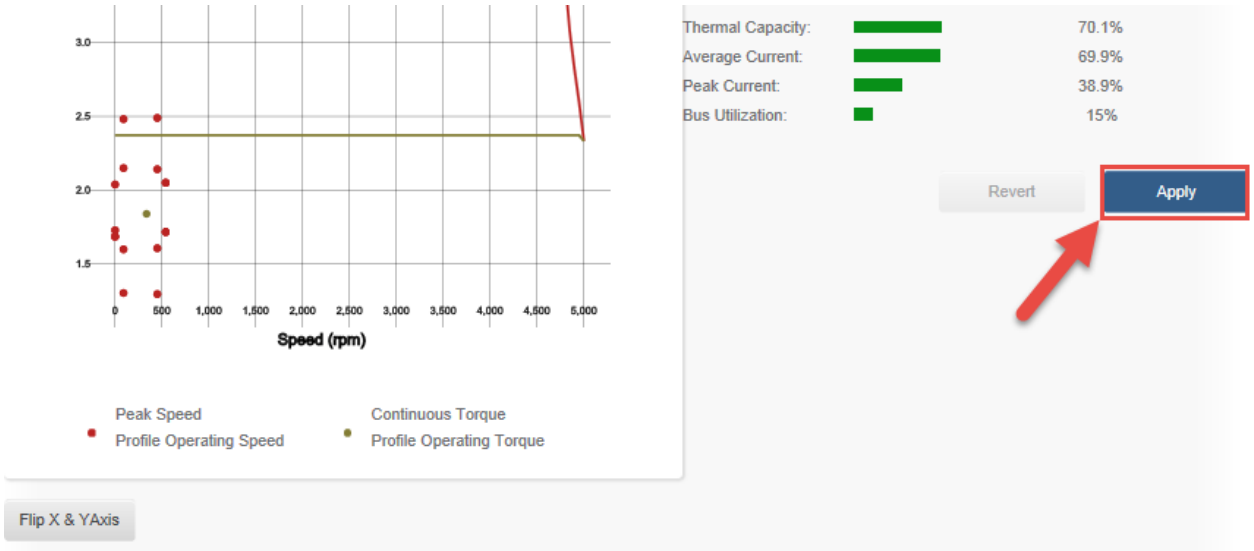
70. Click **Size Up** on the Motor



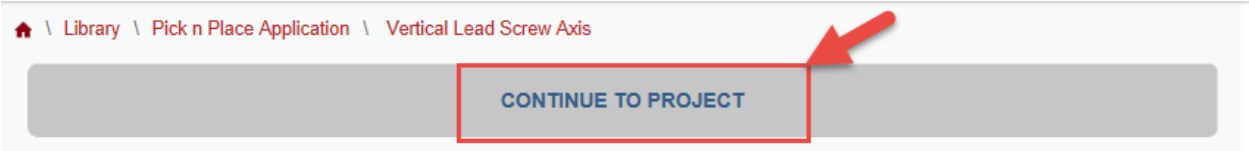
71. Your *Torque/Speed* curve should have a steady continuous torque that will not drop off. Visuals look as:



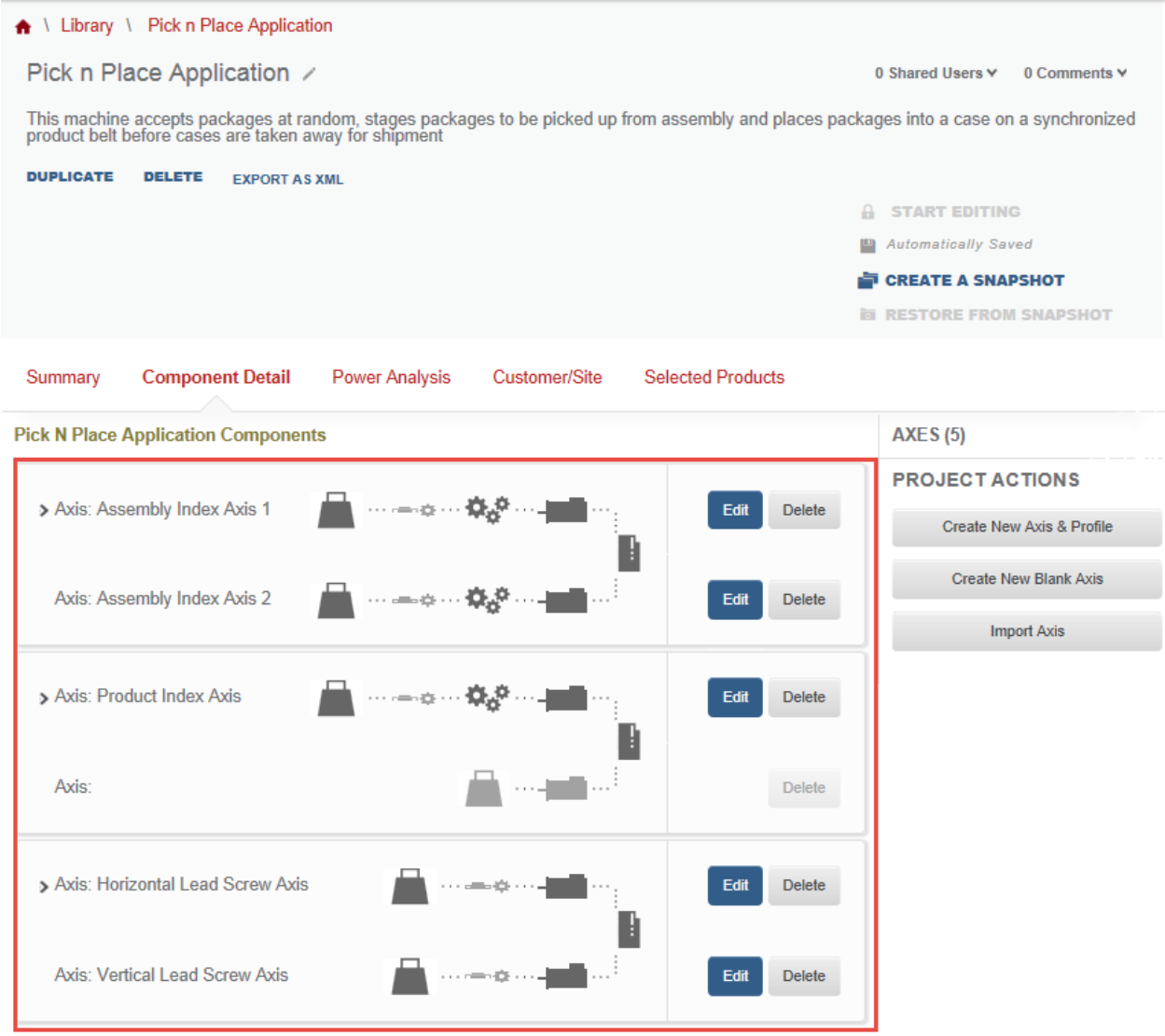
72. Apply this new motor size by clicking **Apply** on your *Summary* window



73. Select **Continue To Project** to move to the Project page



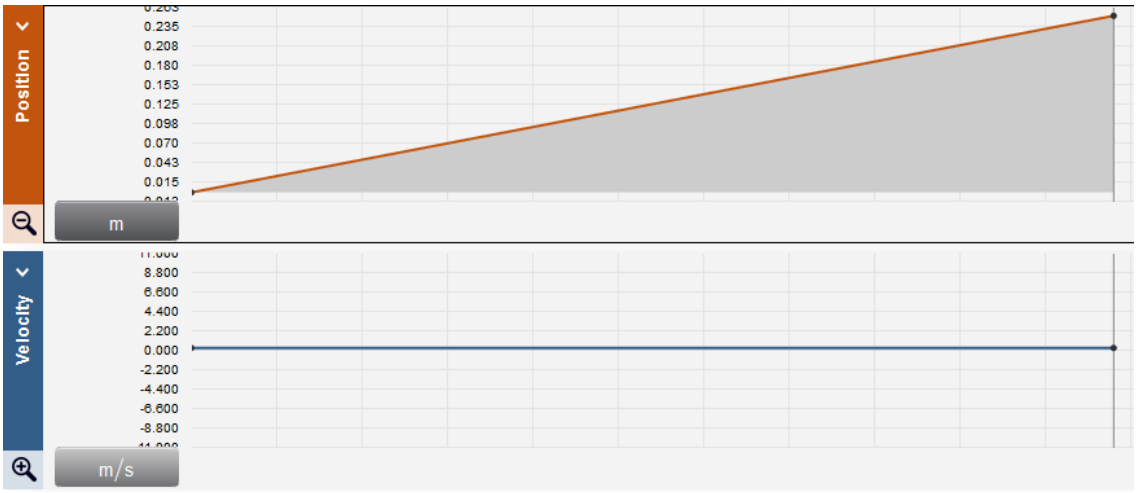
74. Your Project components should look as:



You've size and selected a solution for your Vertical Lead Axis. You've finished configuring five axes of this project, two to go.

Constant Speed Conveyor

The Infeed and Takeaway conveyors are operating at constant velocity. This means that our motion profile would be a constant velocity profile. Motion Analyzer will perform an extended constant evaluation of the move as it repeats the profile and uses the Position, Velocity, Acceleration, and Jerk to calculate the thermal utilization of the motor. Our profile will look as below:

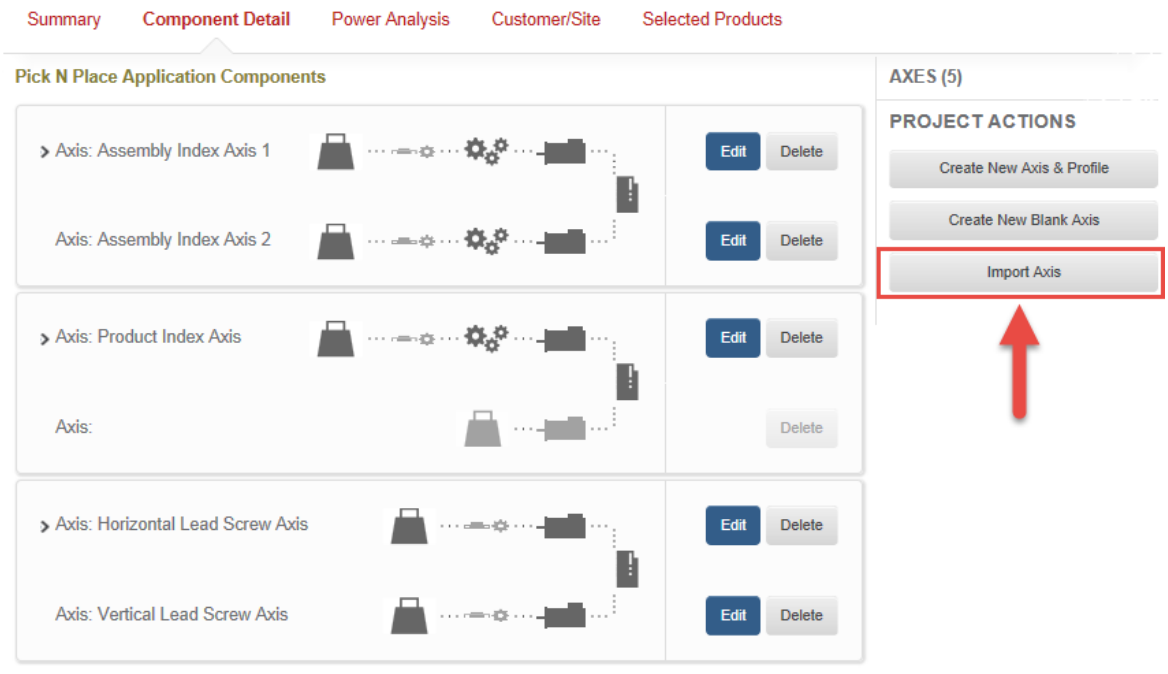


Part A: Infeed Conveyor Axis

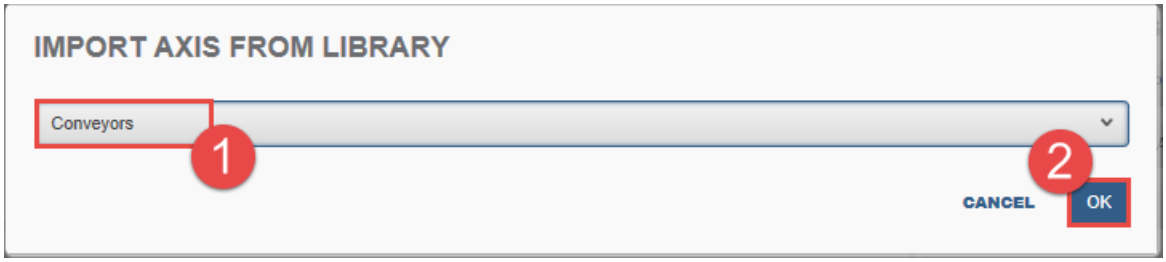
Importing an Axis

When an axis has already been created in a previous project, you can duplicate it as a component in your Library as we've done in previous steps. A Library Component can be imported and used in a newer project to save time on creating new axis components. We will import a constant speed conveyor axis into our Pick and Place application.

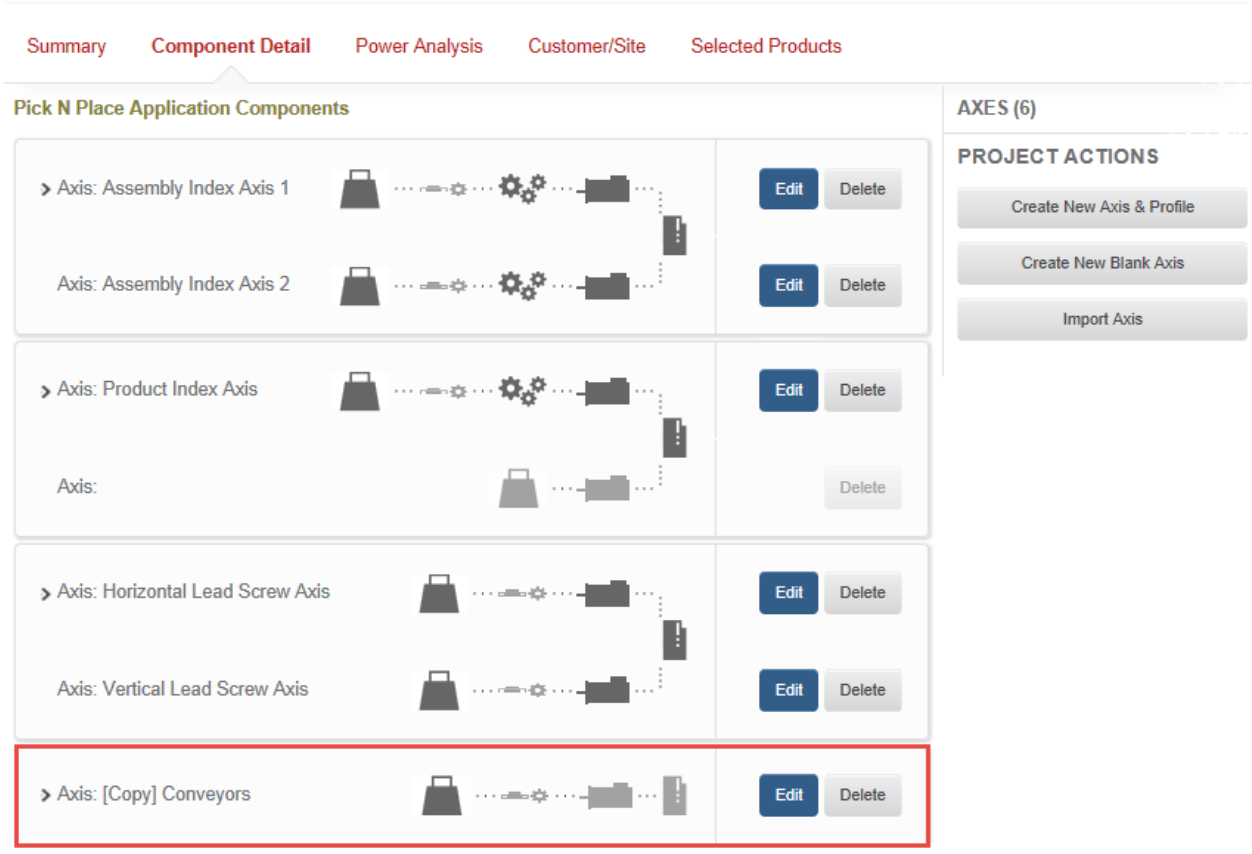
1. From the Pick n Place Application Components page, click **Import Axis**



2. From the *Import Axis From Library*, select **Conveyors** and click **OK** to confirm your selection.

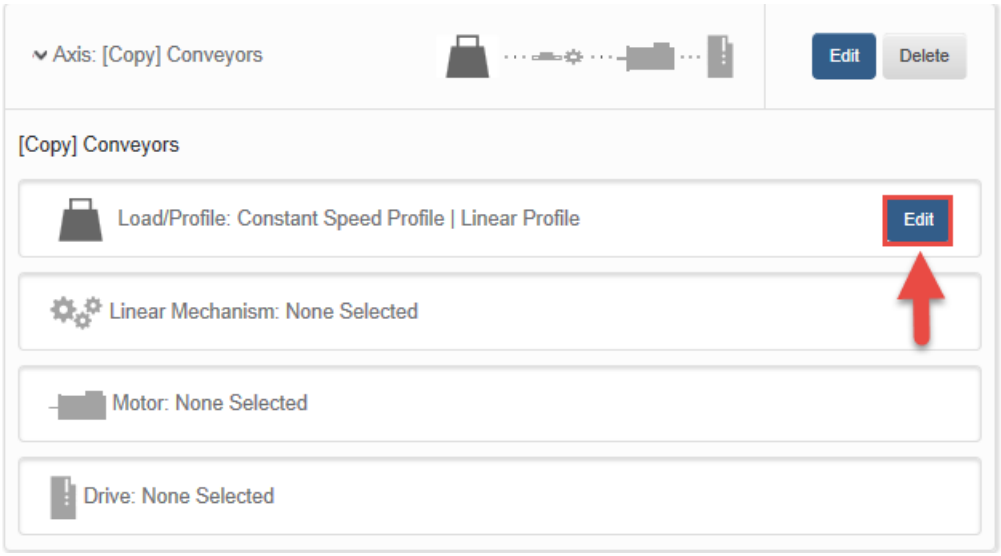


3. The **Conveyors** Axis was created and shared as a Library Component by a Motion Analyzer Support engineer. Your new axis will be displayed in the Pick n Place Application Components page.



4. Select the dropdown button on the new axis

5. Click **Edit** on the Load/Profile

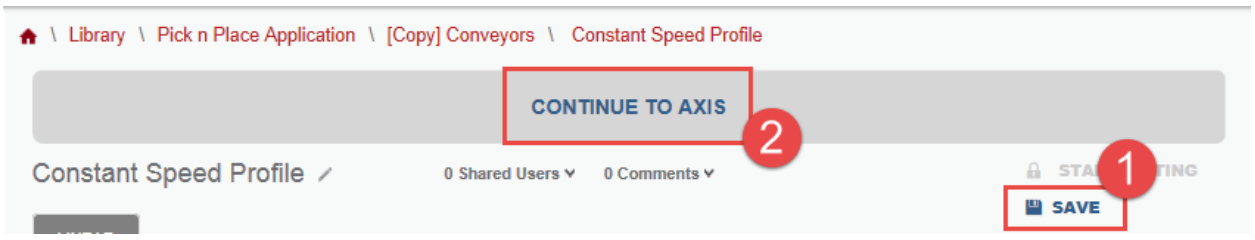


6. Go to **Table View** to edit your load

7. Click **Edit** and change the Load Mass from 0 to **3** kg.

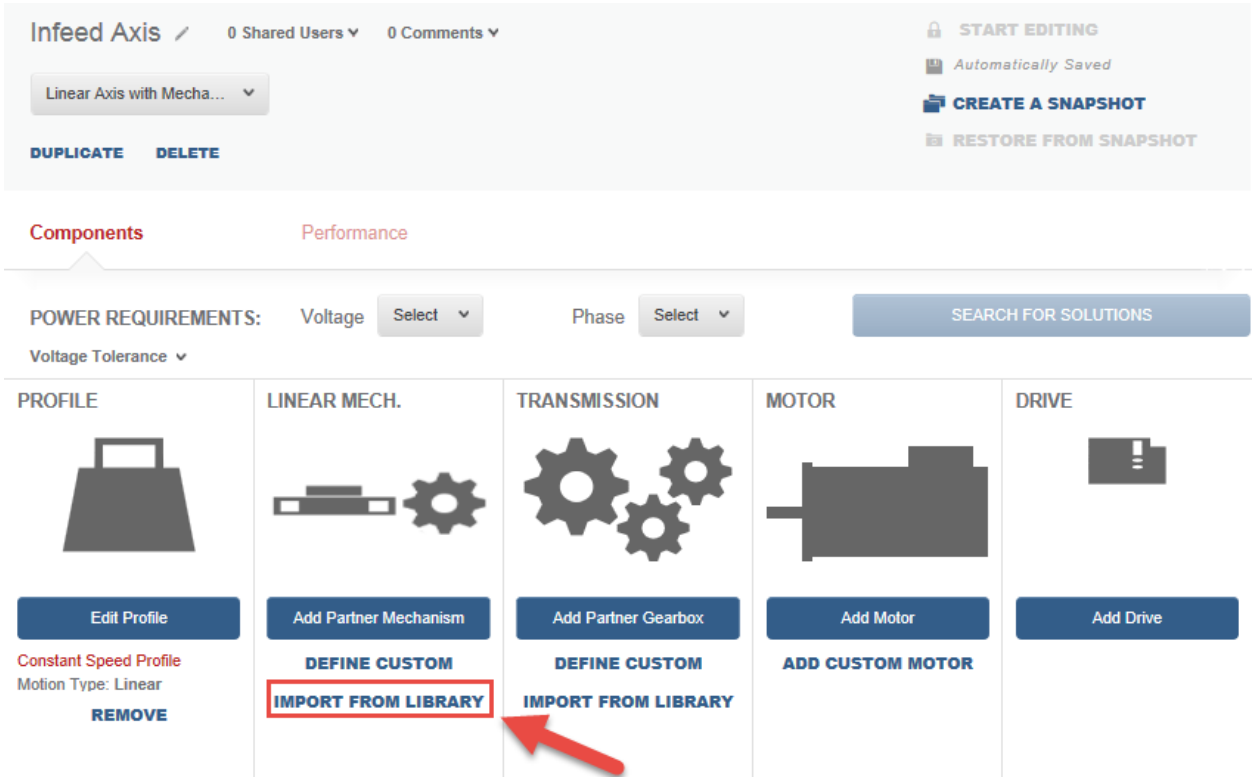
8. Click **Submit** after entering the load mass

9. Click **Save** and **Continue To Axis**

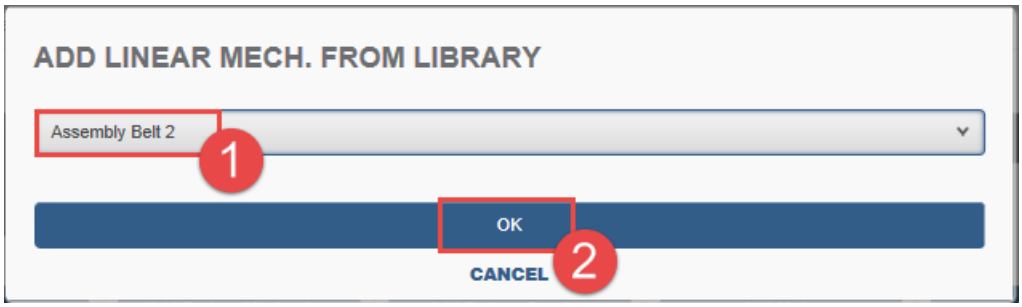


10. Change the Axis name from *[Copy] Conveyors* to *Infeed Axis.*

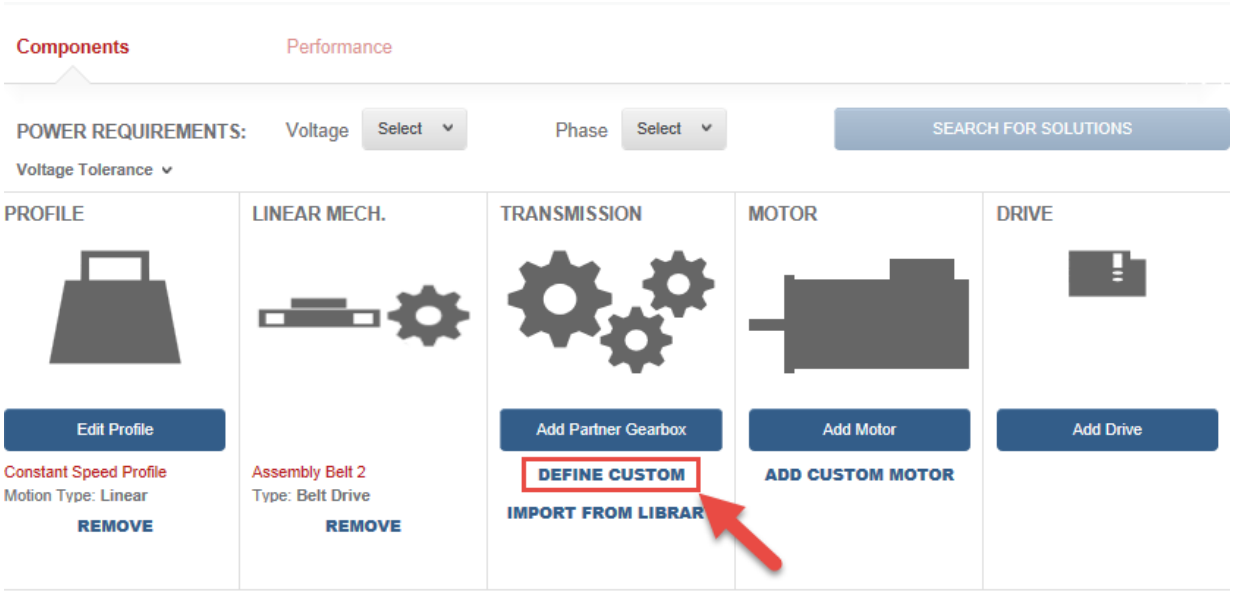
11. The drive rolls requirements for the Constant Speed Conveyor match the Assembly Index Belt drive rolls requirement. As we've duplicated the Linear Mechanism of the Assembly Index, we can import this component to our new axis. Click **Import From Library**



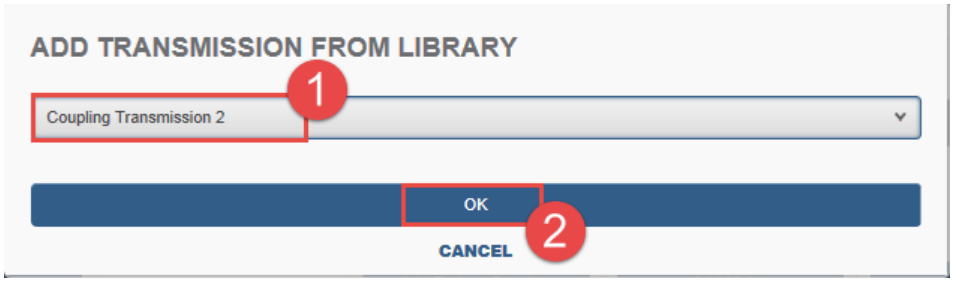
12. Select *Assembly Belt 2* and click **OK** to confirm your selection.



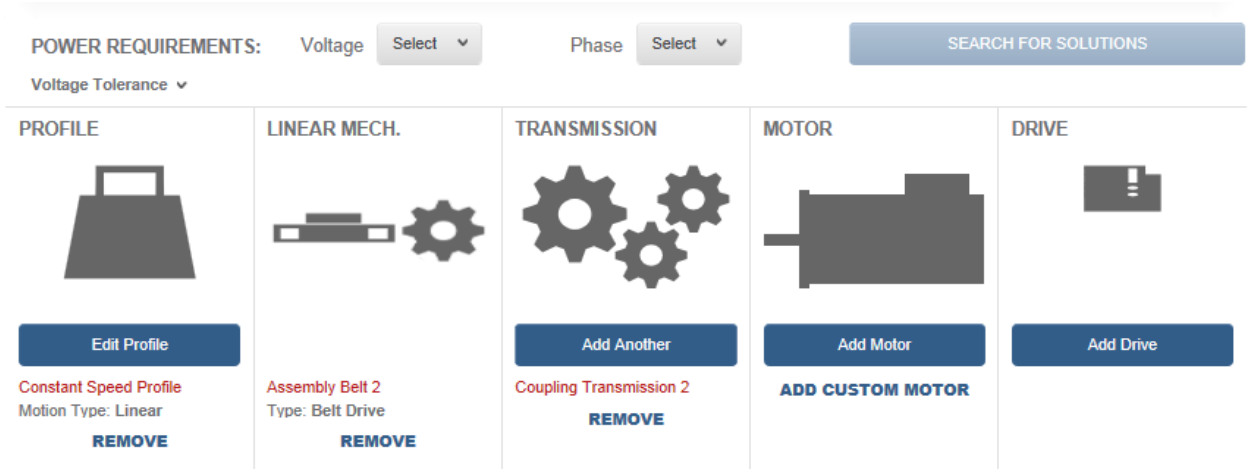
13. The *Transmission* for the motor coupling was duplicated as a component as well. Click **Import From Library** on the Transmission component



14. Select *Coupling Transmission 2* and click **OK** to confirm your selection



15. Your Infeed Axis should have the following components at this moment.



Custom Induction Motor

While you are completing this project, you are informed by the engineer from OEM Distribution that ABC Foods would like to keep their induction motors for each of the constant speed conveyors. They provided the following motor plates information for each conveyor.

Infeed Conveyor

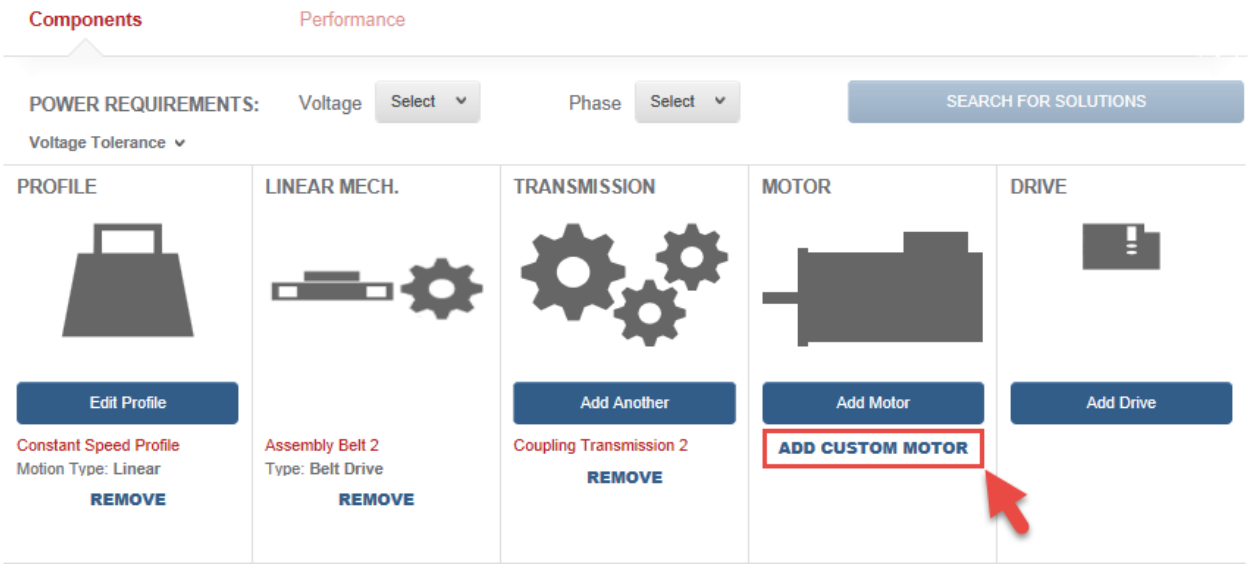
H.P.	5	Hertz	60
AMPS.	8.0	R.P.M	1785
Voltage	460	PH	3

Takeaway Conveyor

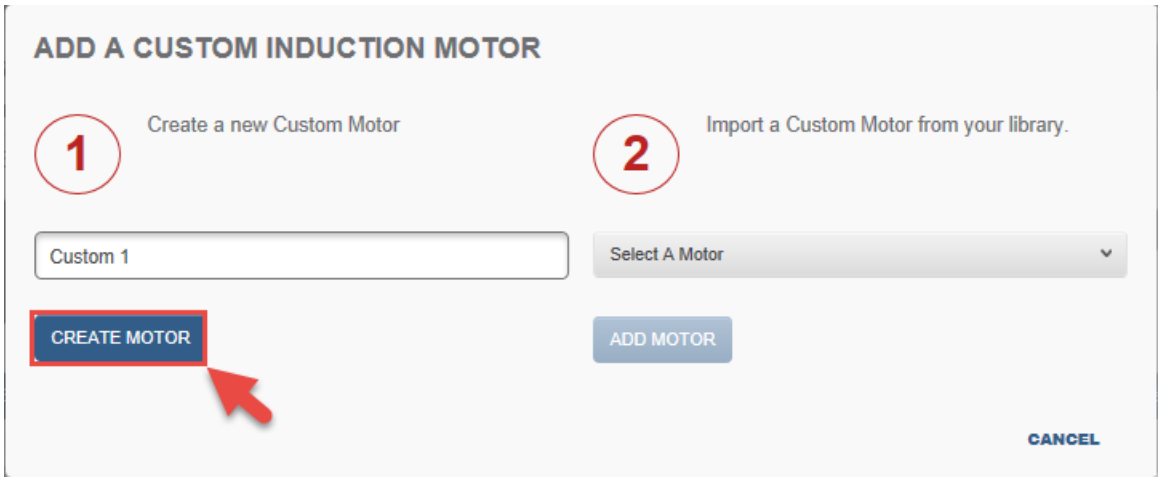
H.P.	15	Hertz	60
AMPS.	19.7	R.P.M	1760
Voltage	460		

Let's enter this information for our Infeed Conveyor motor.

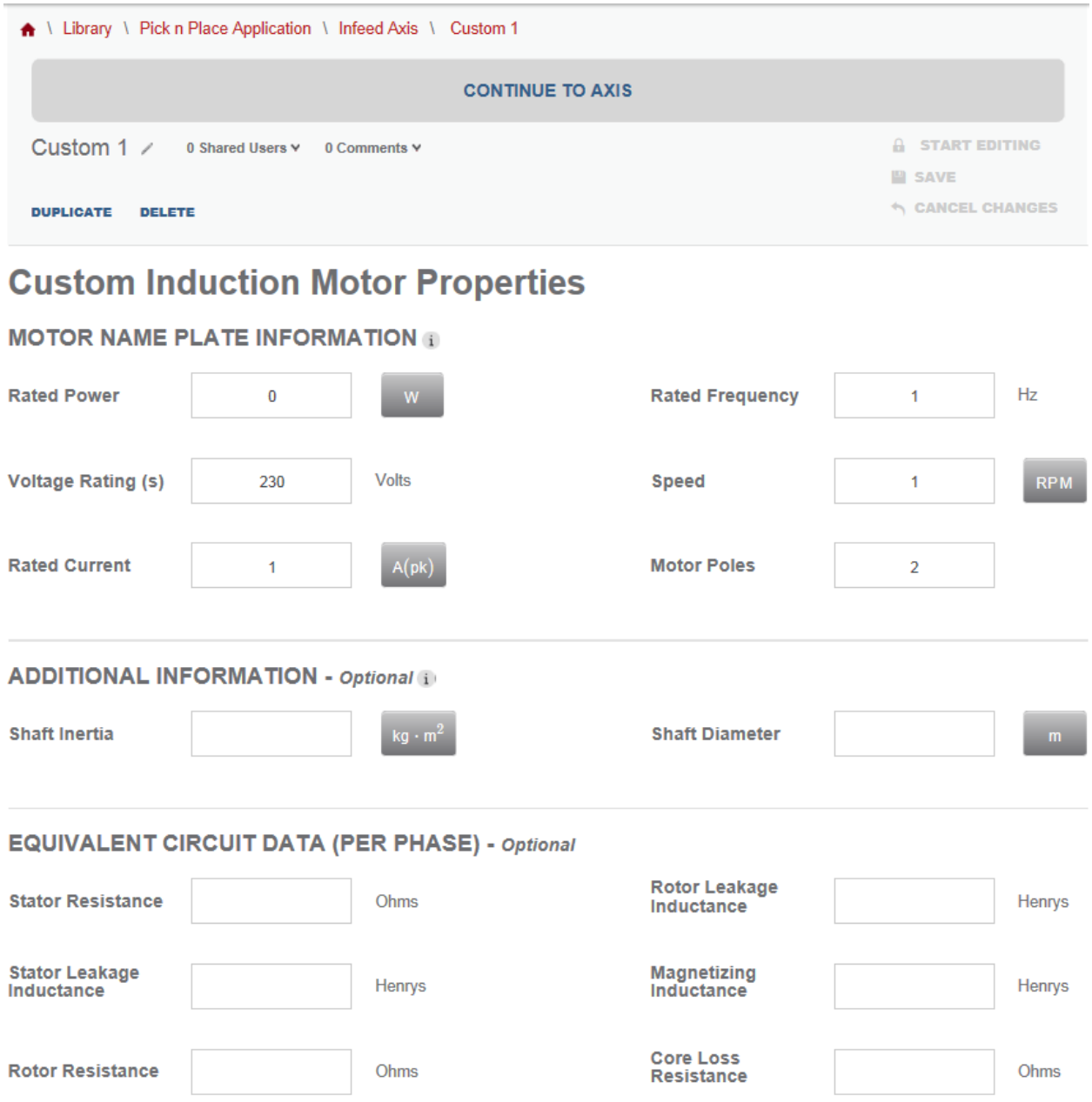
1. Click on **Add Custom Motor**



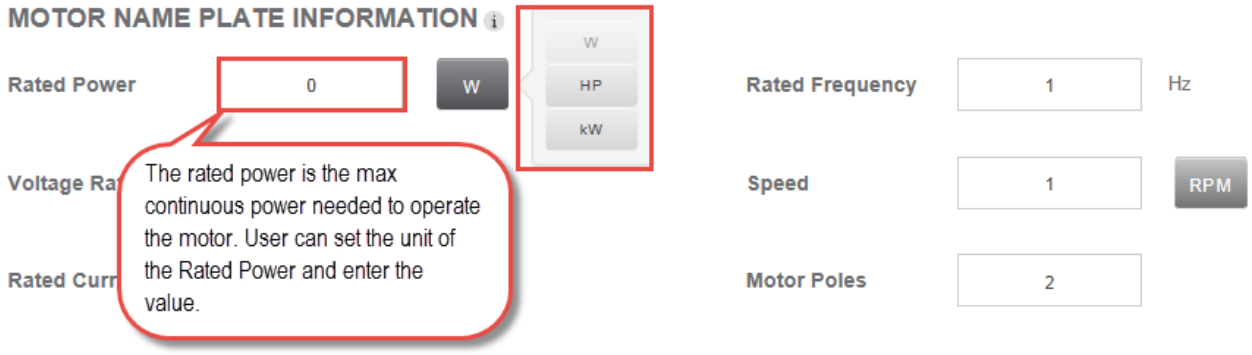
2. Enter a name for your motor and select **Create Motor**.



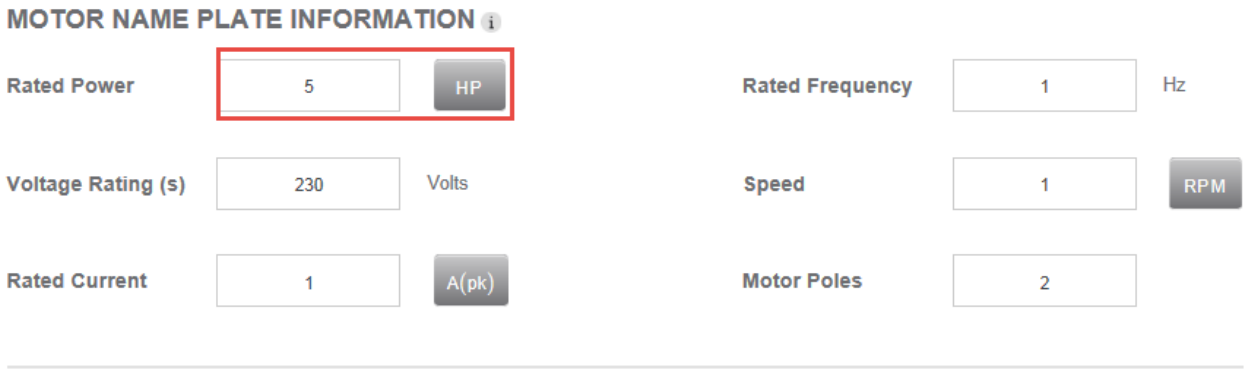
3. The *Custom Induction Motor Properties* page will look at follows:



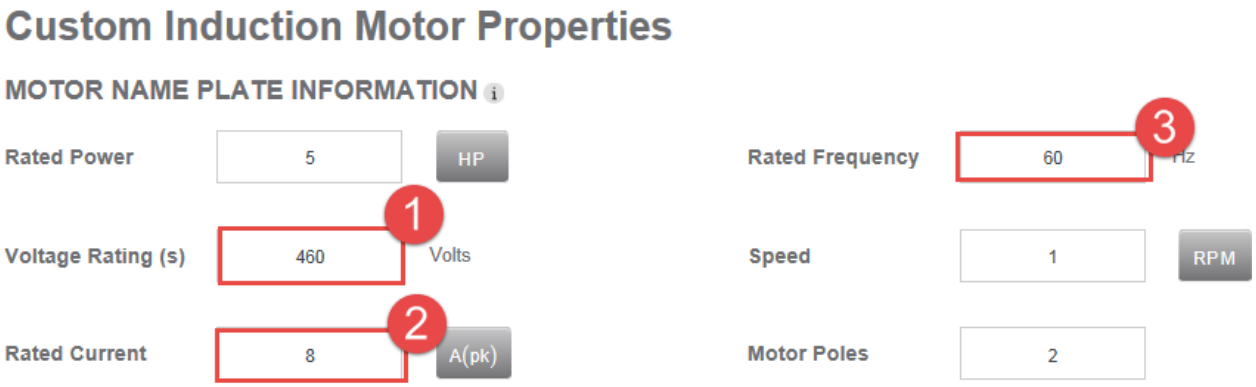
4. You will enter the information provided by OEM Distribution in the *Motor Name Plate Information*



5. Change the Rated Power unit to **HP** and enter **5** as your value.



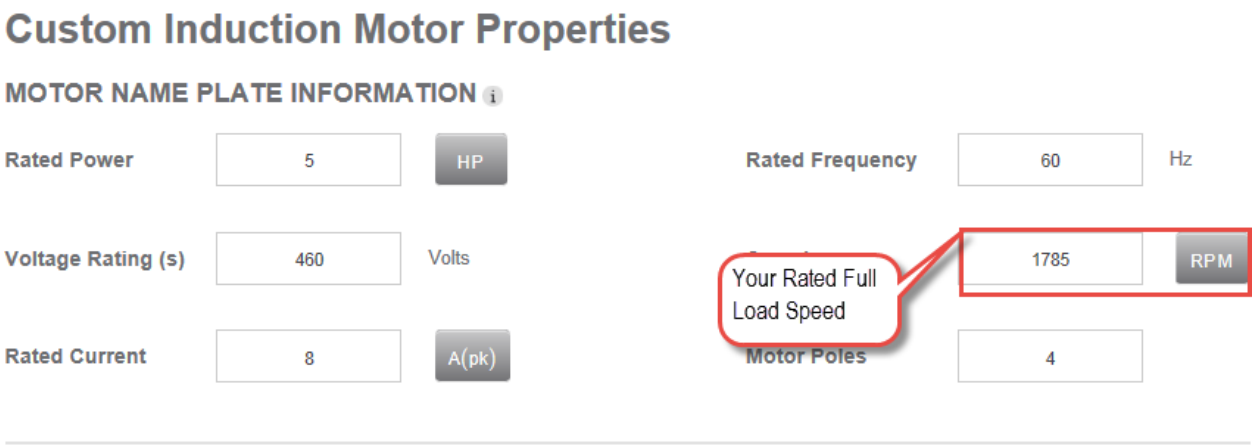
6. Change the *Voltage Rating* from 230 to **460** Volts; set the *Rated Frequency* to **60** Hz; and enter **8.0** A(pk) for the *Rated Current*. Your completed entries should look as follow:



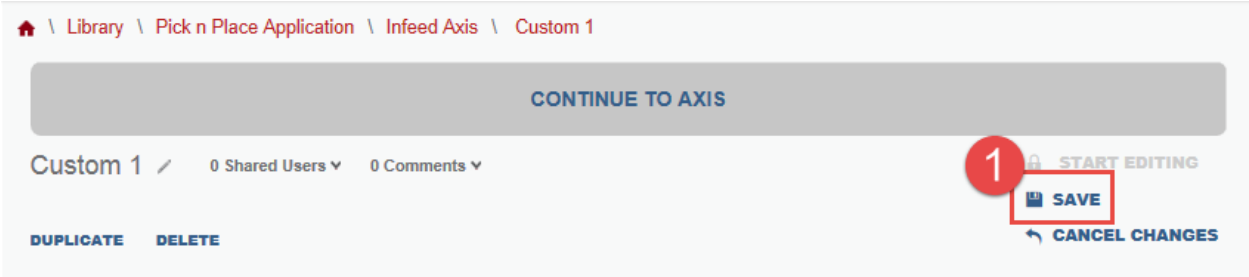
7. For the *Motor Poles*, we can calculate its value by using the formula, $poles = \frac{120*f}{RPM}$,

8. Enter **4** as your *Motor Poles*

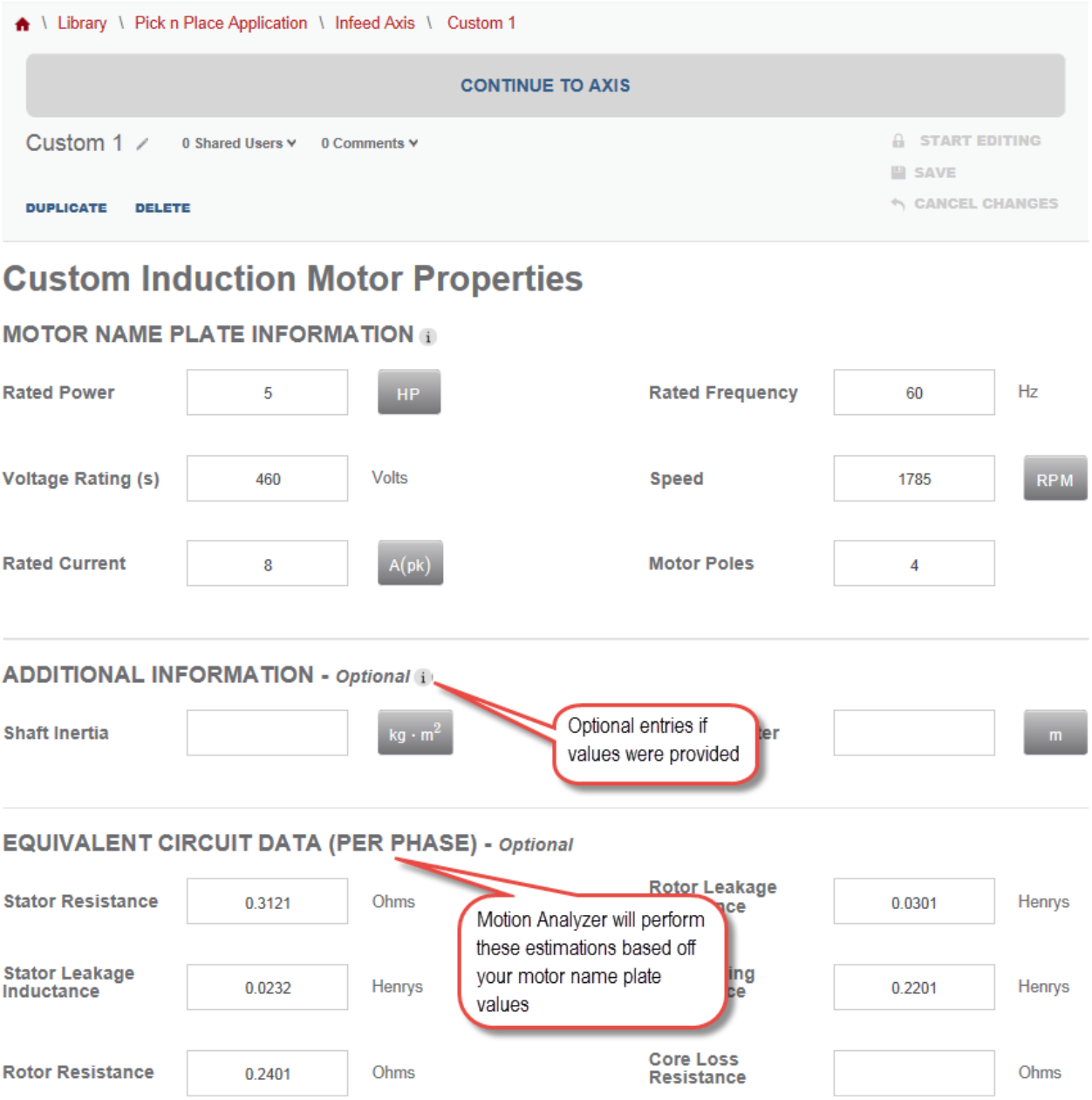
9. The *Speed* field requires your Rated Full Load Speed. This is different from the Synchronous Speed as induction motors require slip to turn the rotor. Enter **1785** as your Speed.



10. Click **Save** to save your custom motor

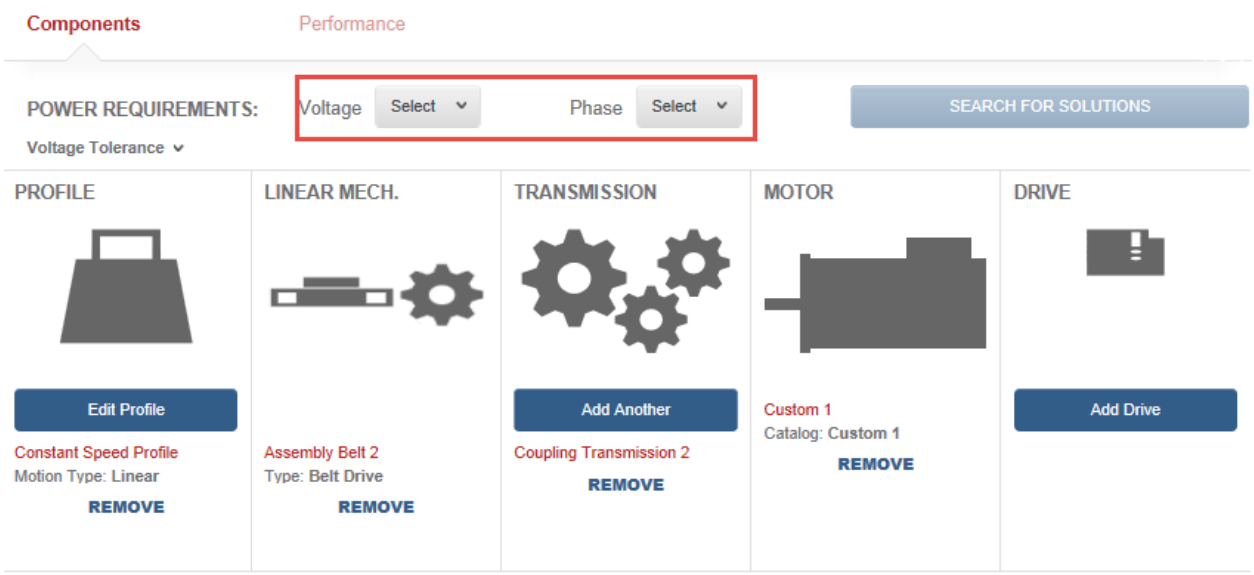


11. Your motor name plate entries should match this view:

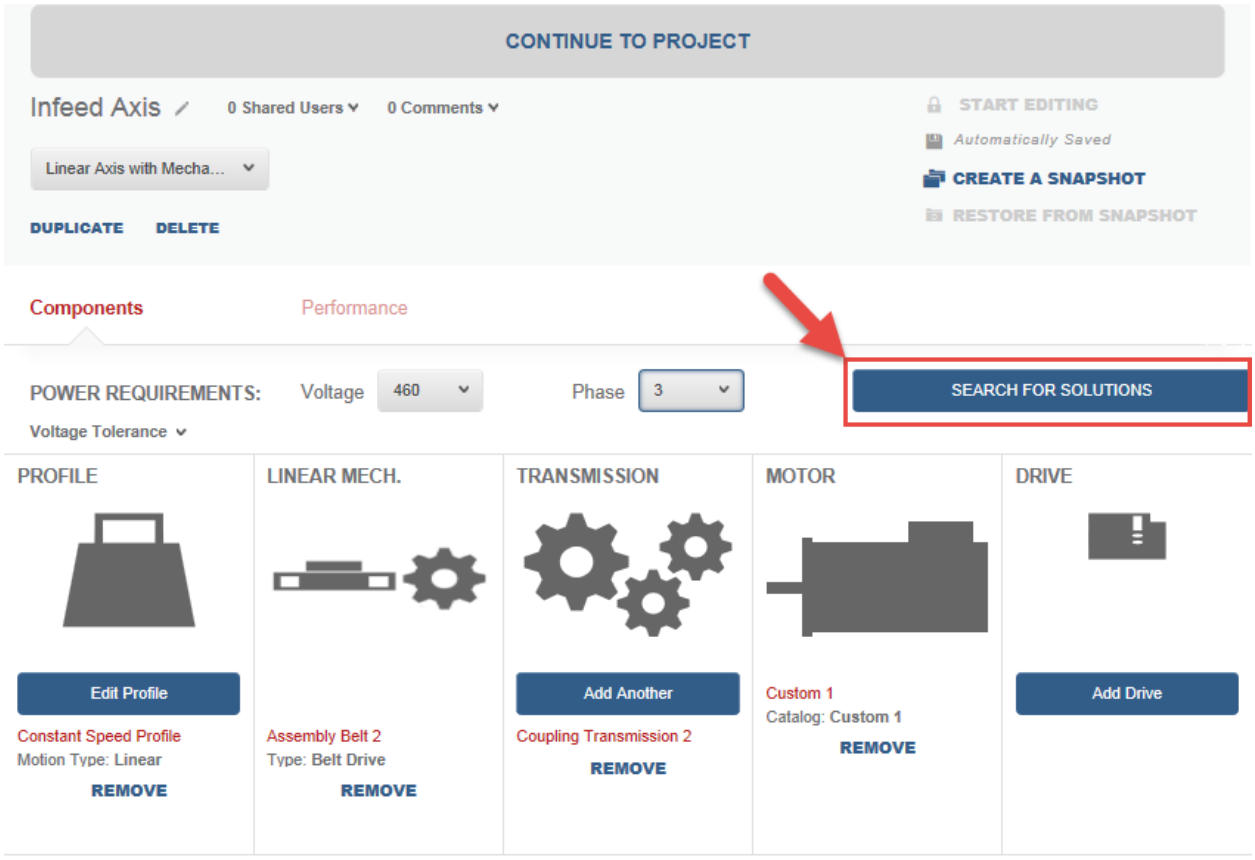


12. Click **Continue To Axis**

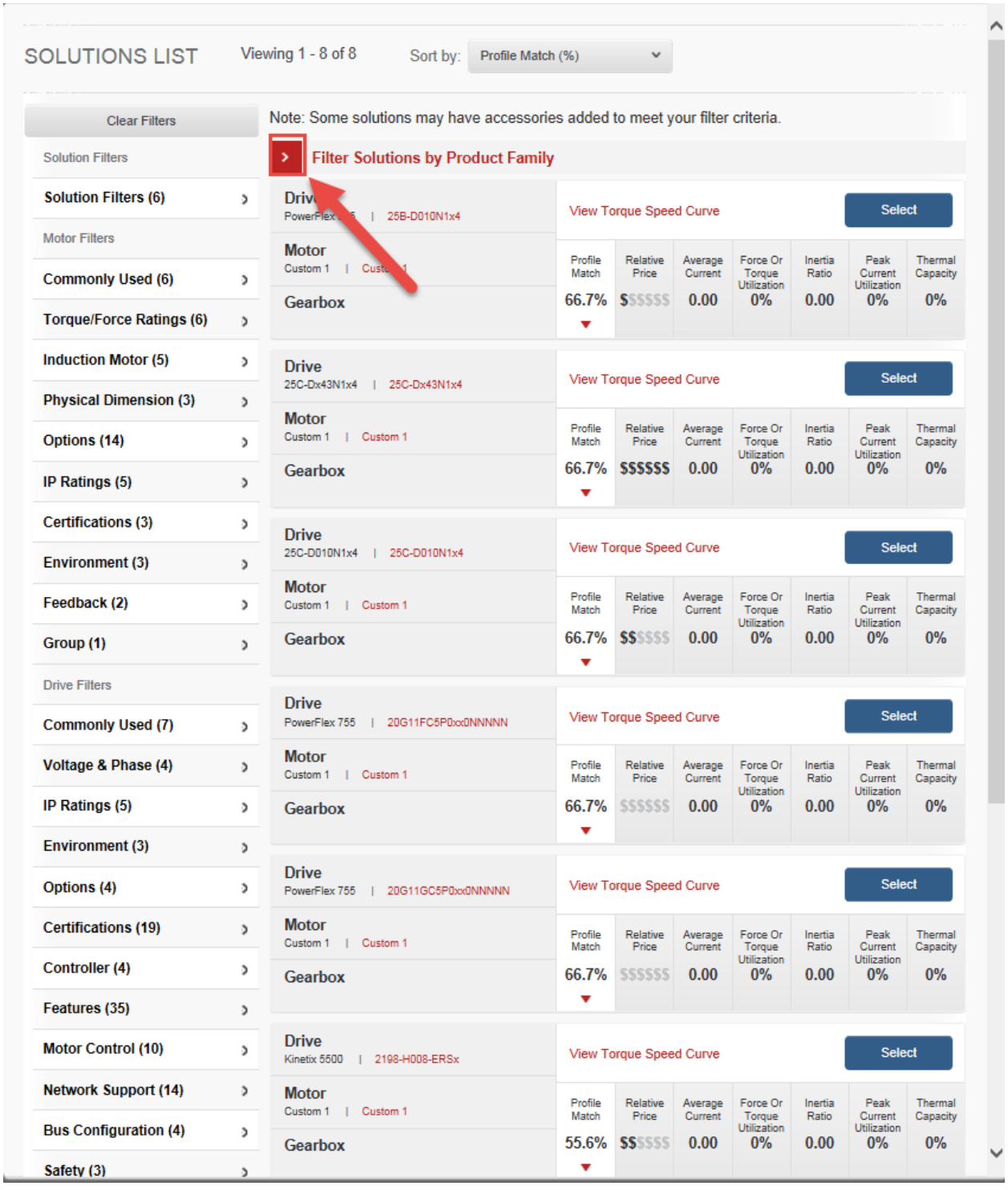
13. The Infeed Axis components have been configured. Set your *Power Requirements Voltage* and *Phase* to **460** and **3** respectively.



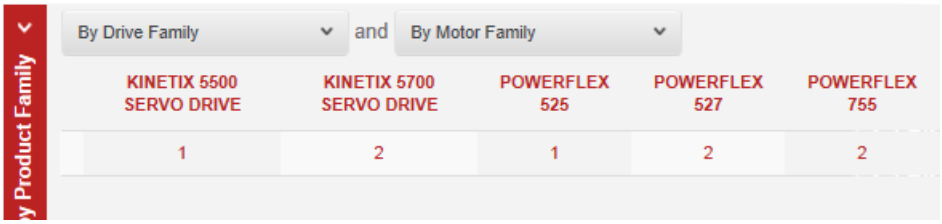
14. Click **Search For Solutions**



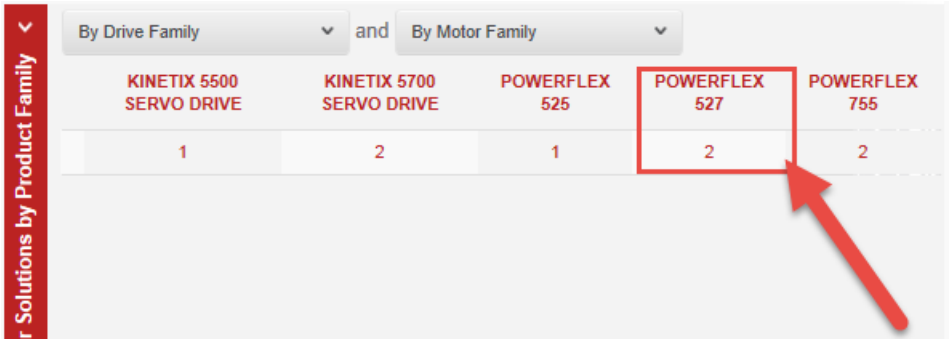
15. The *Solutions List* will provide solutions based on Drives / Induction Motor results. Click on the dropdown of the *Filter Solutions by Product Family* to view your drive solutions



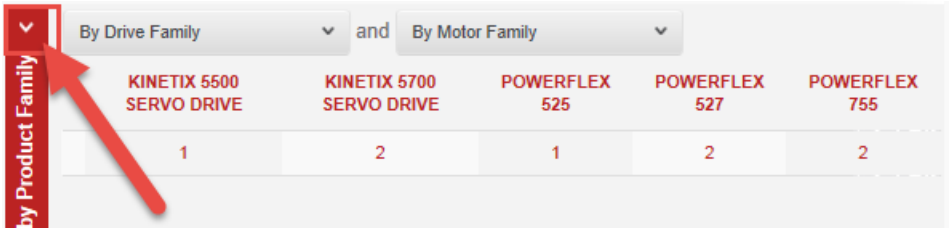
16. Your drive results include the **Kinetix 5500 Servo Drive**, **Kinetix 5700 Servo Drive**, **PowerFlex 525**, **PowerFlex 527**, and **PowerFlex 755**.



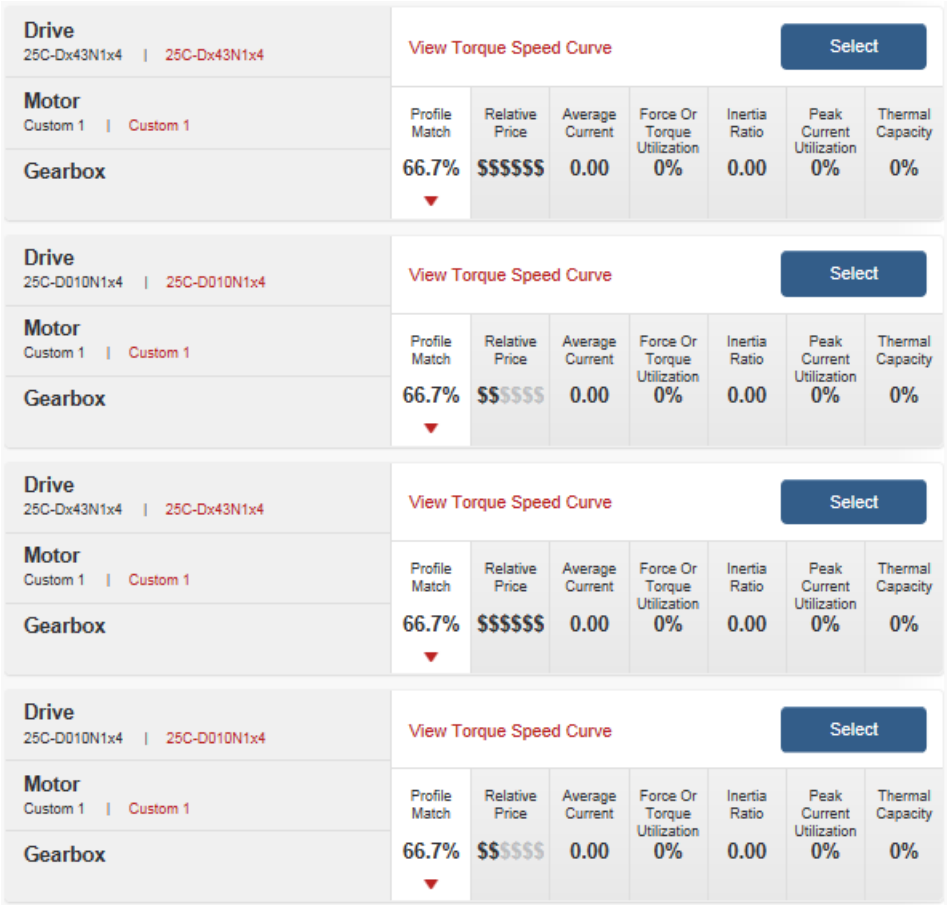
17. We will review the solutions of the PowerFlex 527. Click on **PowerFlex 527**



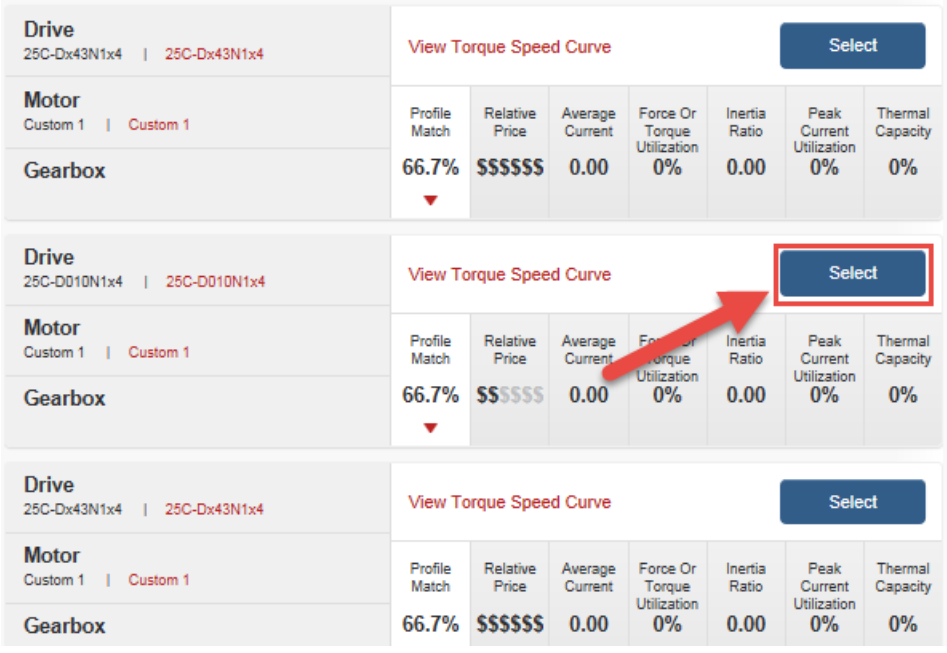
18. Click on the dropdown of the *Filter Solutions by Product Family* to retract the drive solutions.



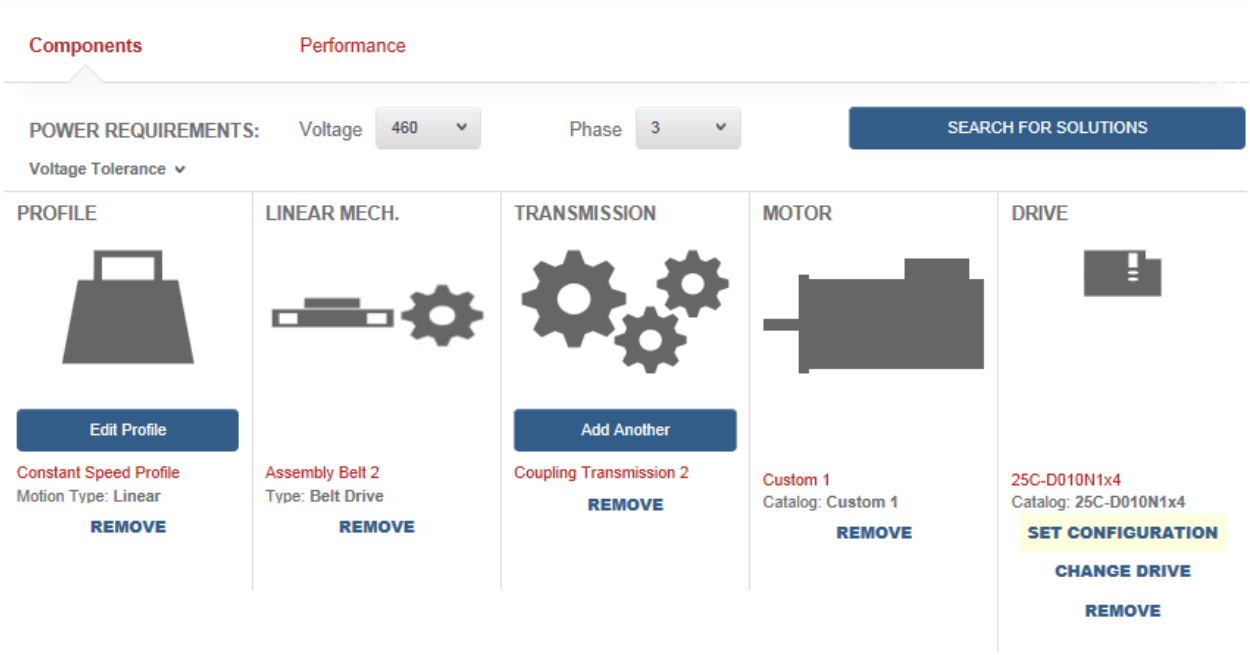
19. Your solutions list is now filtered to show only **PowerFlex 527** solutions.



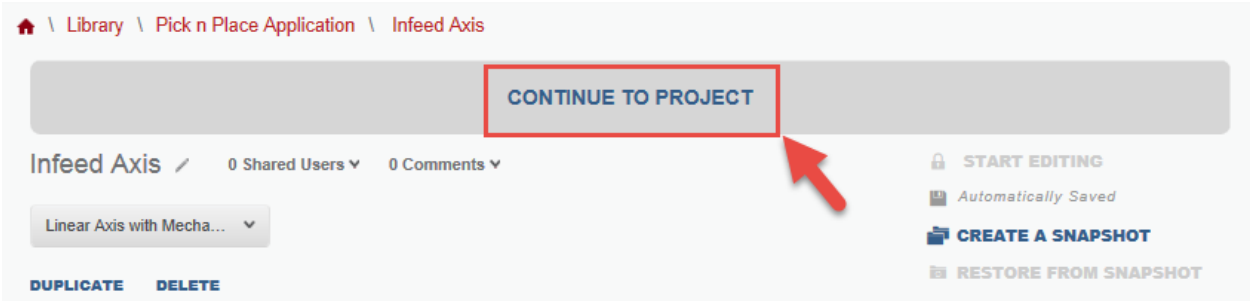
20. The PF 527 is a Component and Motion capable Variable Frequency Drive. Select the second **Powerflex 527** solution.



21. Your complete Infeed Axis components should look as follows:

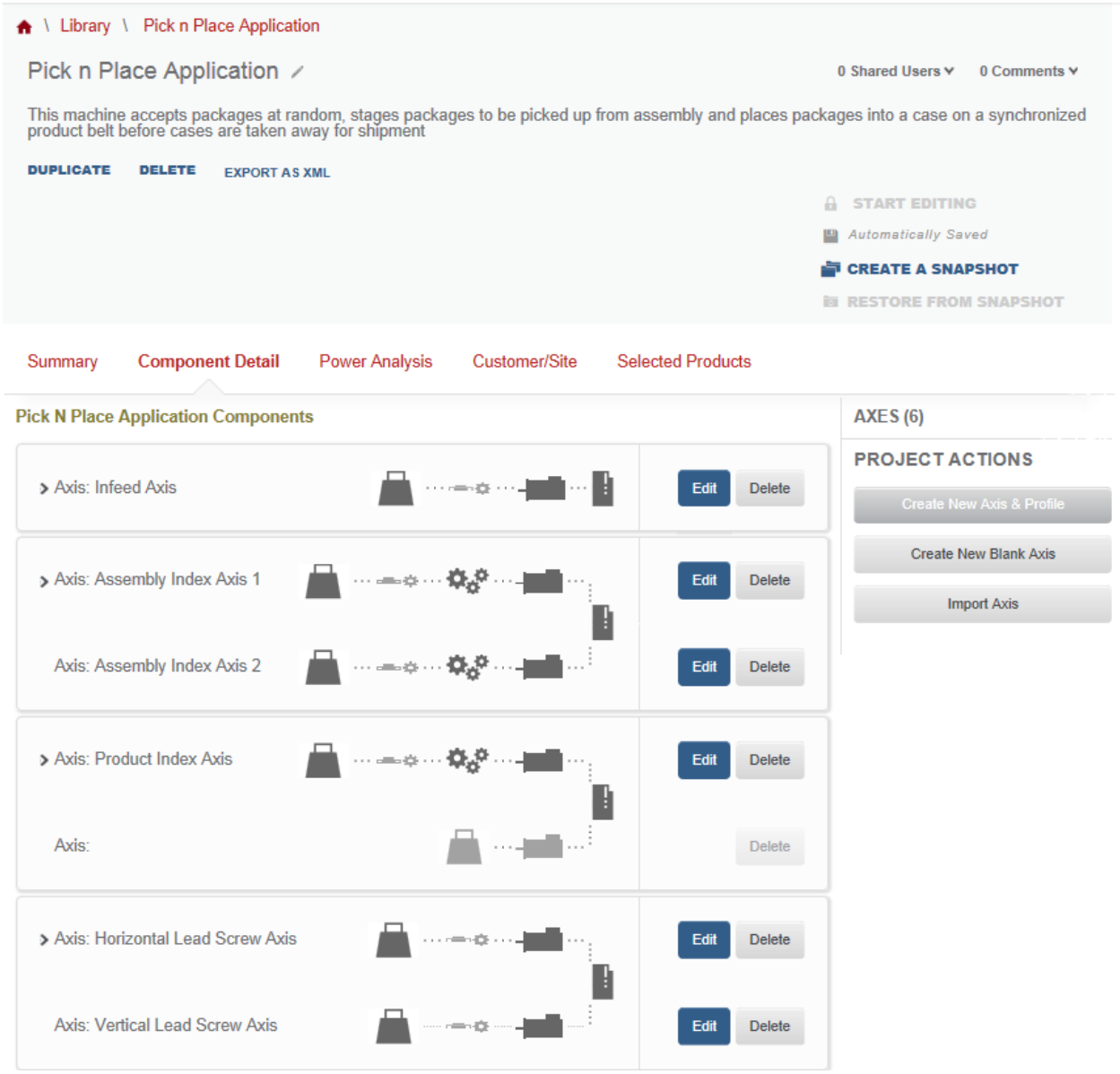


22. Click on **Continue To Project**.



Part B: Takeaway Conveyor Axis

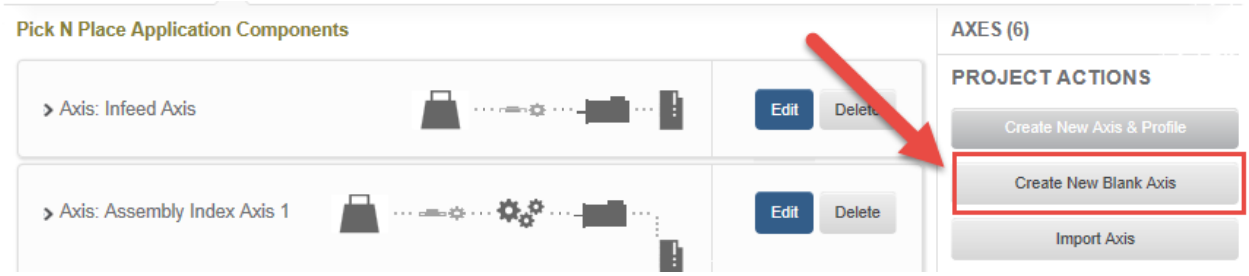
We've completed sizing and selecting a solution for our Infeed Axis. To this point, we've finished sizing and selecting solutions for the Assembly Index axes, the Horizontal and Vertical Lead Screw axes, the Product Index axis, and the Infeed axis. The Pick and Place Application components are shown below:



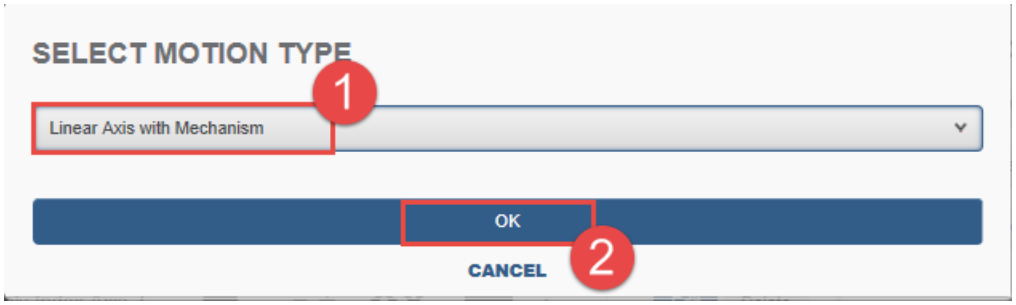
We will create a blank axis and import duplicated components from our Library to create the Takeaway Axis.

Create New Blank Axis

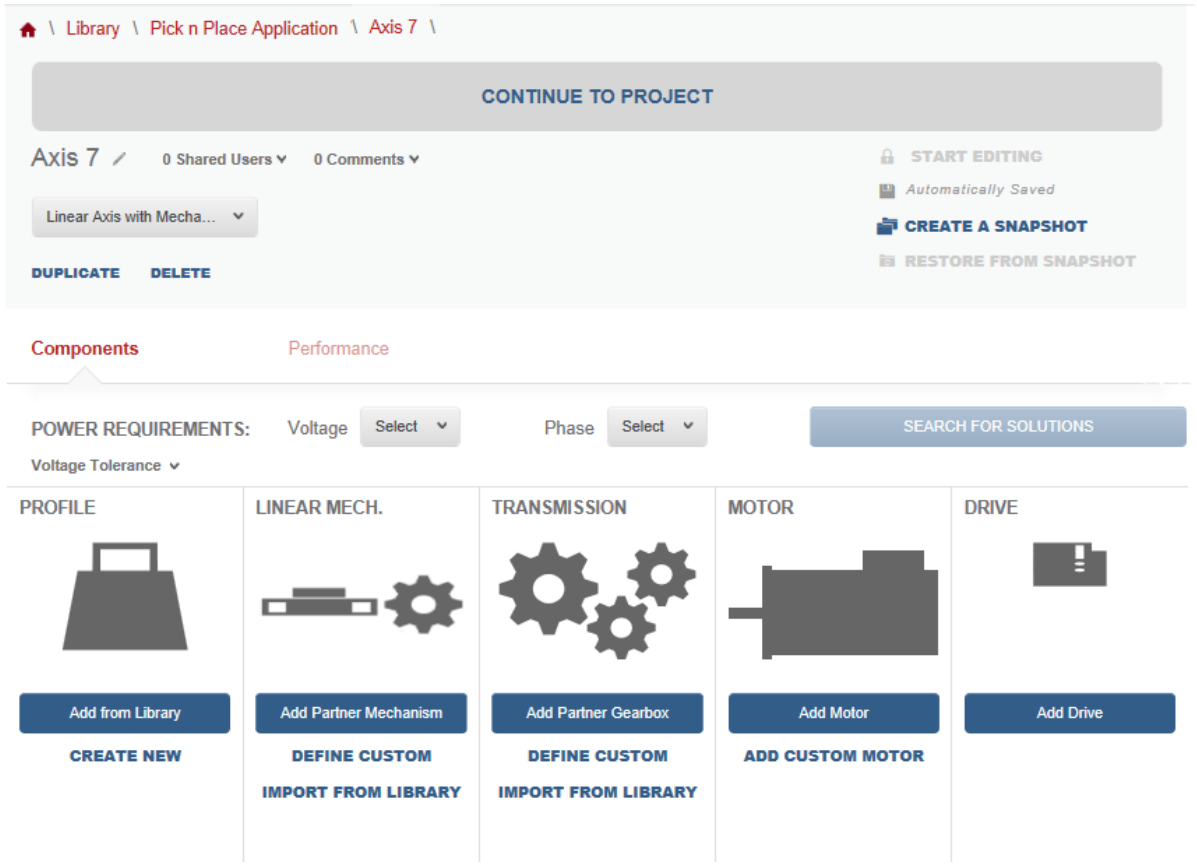
1. From the Pick n Place Application Components page, click **Create Axis**



2. Select **Linear Axes with Mechanism** for our *Motion Type* and click **OK** to confirm selection

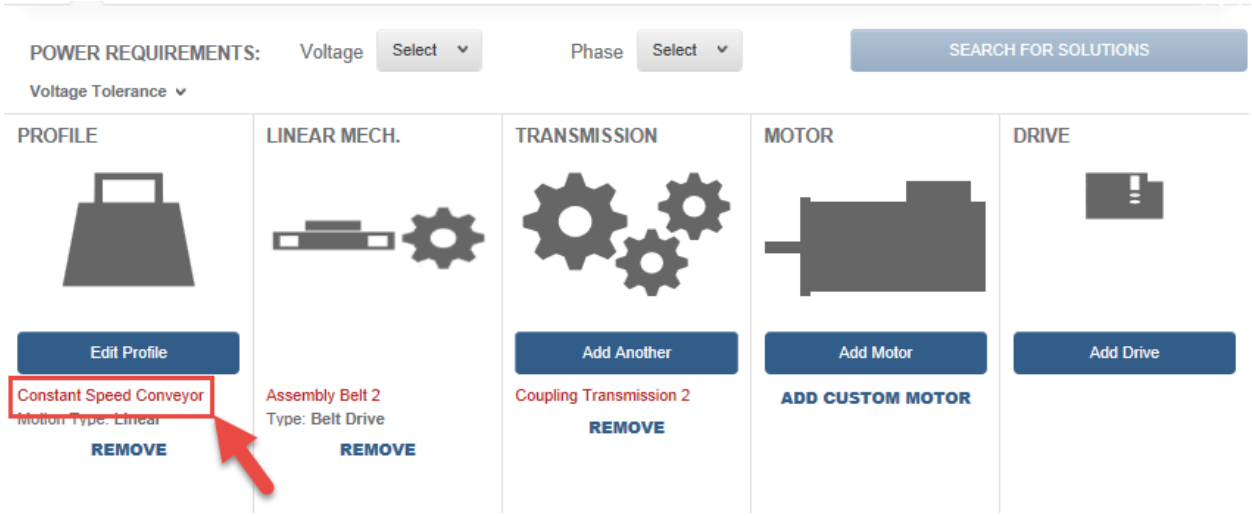


3. Your blank axis will open as such:

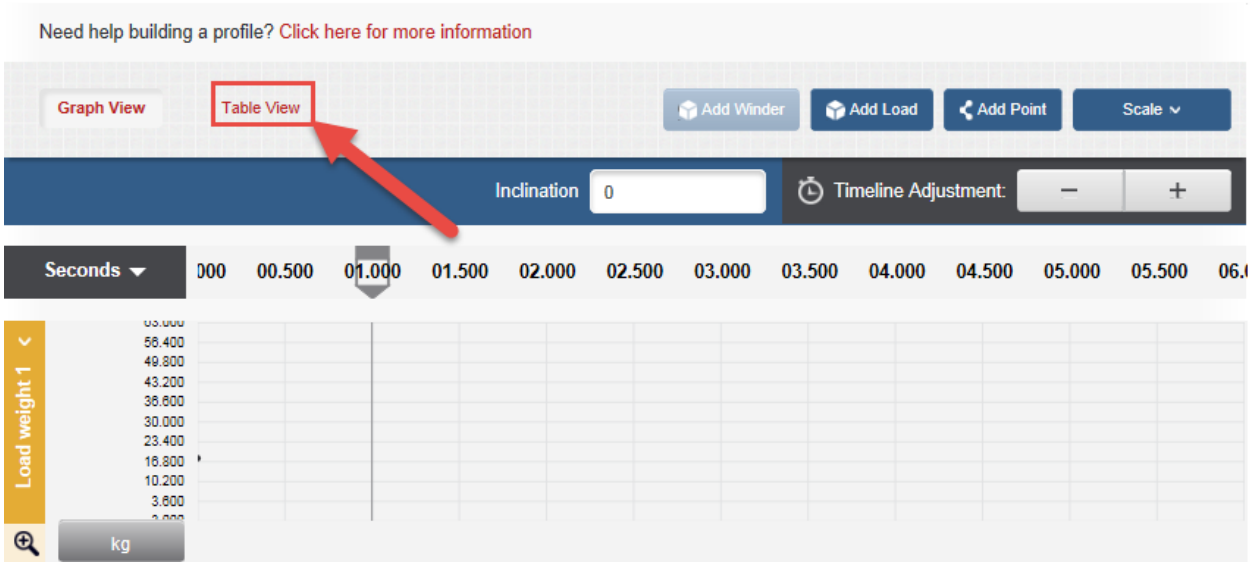


4. **Import** your Profile, Linear Mechanism, and Transmission from the Library as we've done in previous steps.

5. Once you've completed importing your components, open the Motion Profile by selecting **Constant Speed Conveyor**



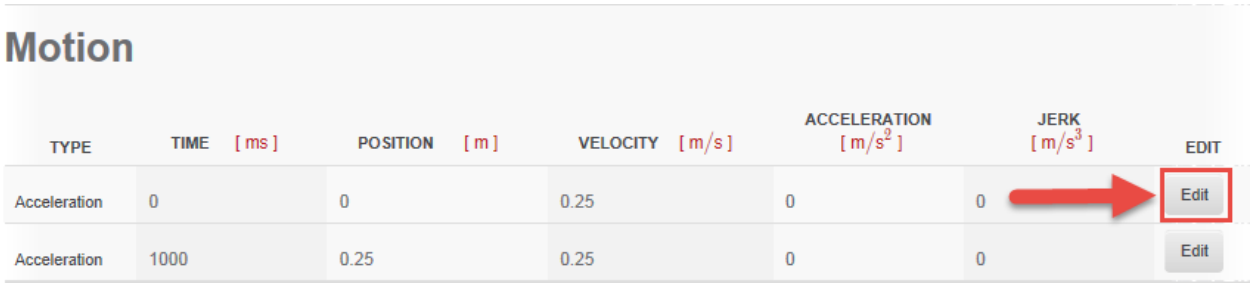
6. Go to **Table View** of your Motion Profile to edit your load



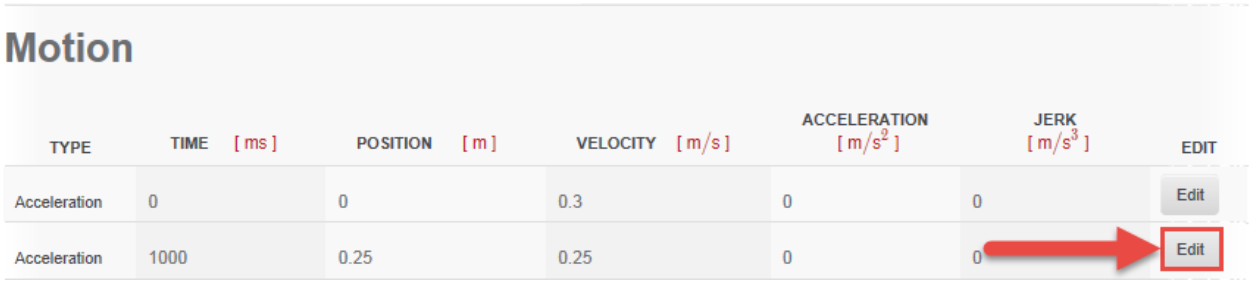
7. Click **Edit** and change the Load Mass from 0 to **18** kg.

8. Click **Submit** after entering the load mass

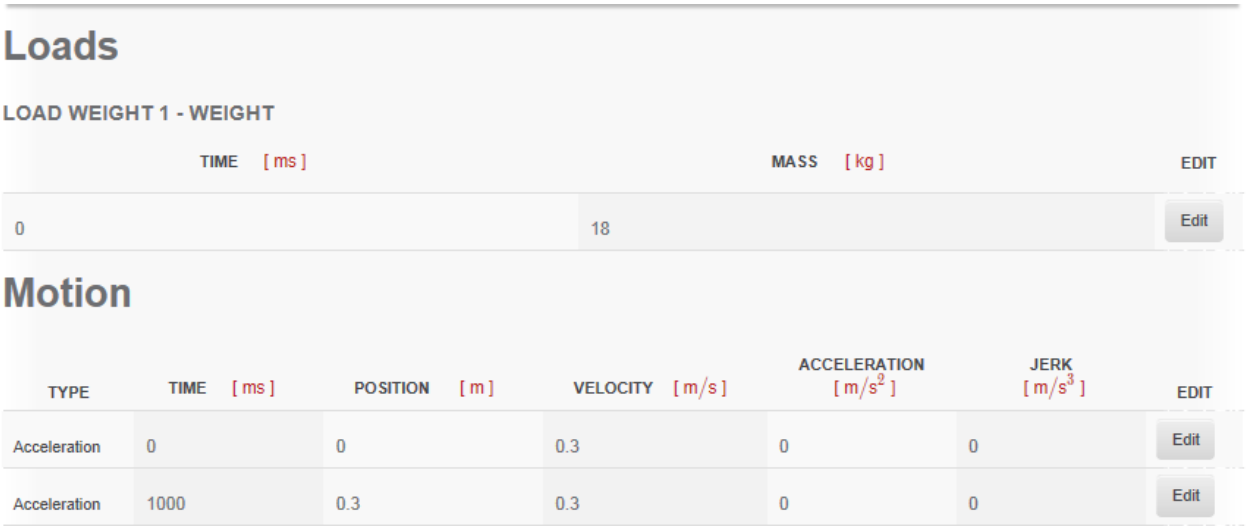
9. While in **Table View**, we will edit the profile to match the move profile of the Takeaway Conveyor. Click **Edit** and change the velocity to 300 mm/sec. Click **Submit** to confirm your change.



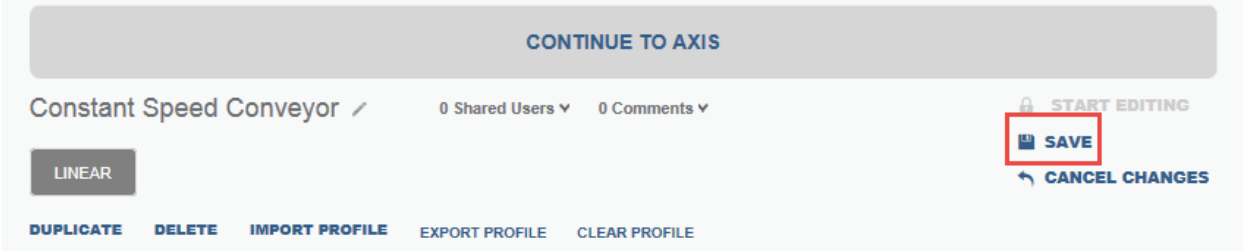
10. Repeat step 9 for the second *Acceleration* point. Click **Edit** and change the velocity to 300 mm/sec. Click **Submit** to confirm your change.



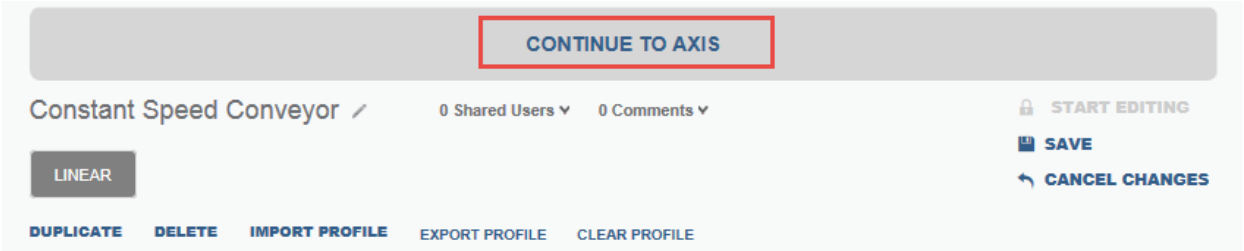
11. Your final entry points should look:



12. **Save** your profile changes



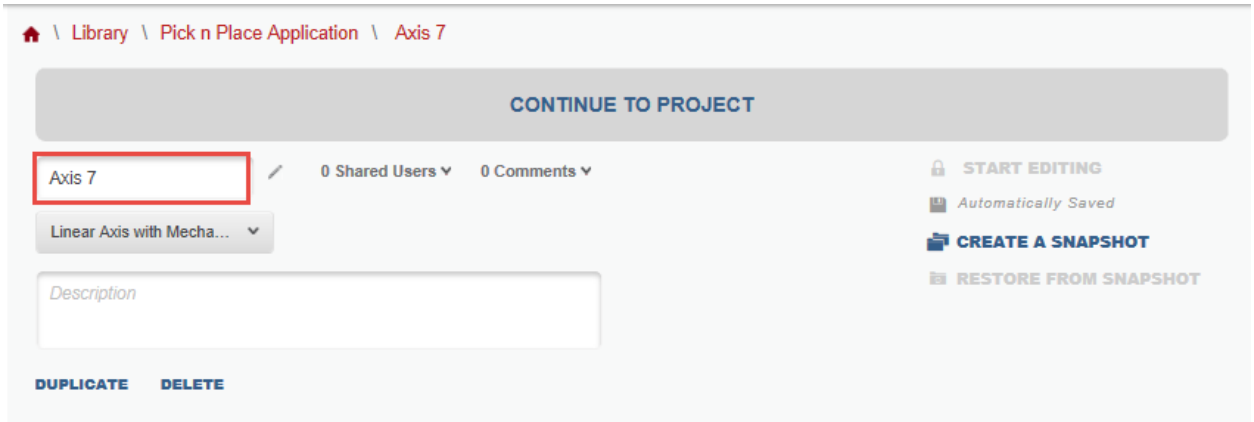
13. Click **Continue To Axis**



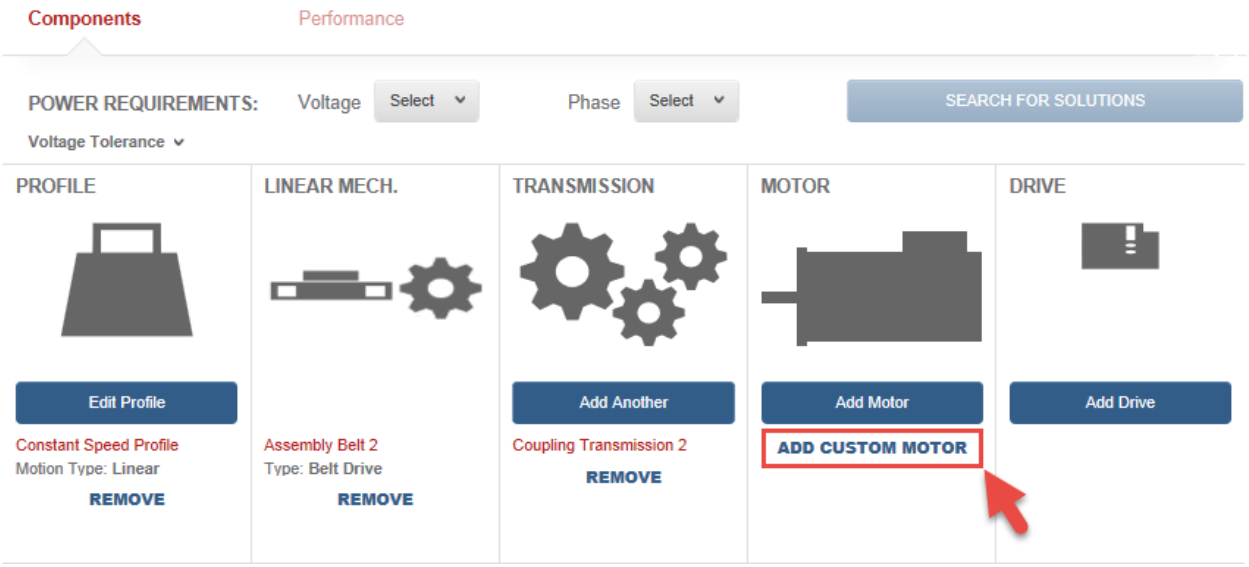
Custom Induction Motor

Let's enter the information provided for our Takeaway Conveyor motor.

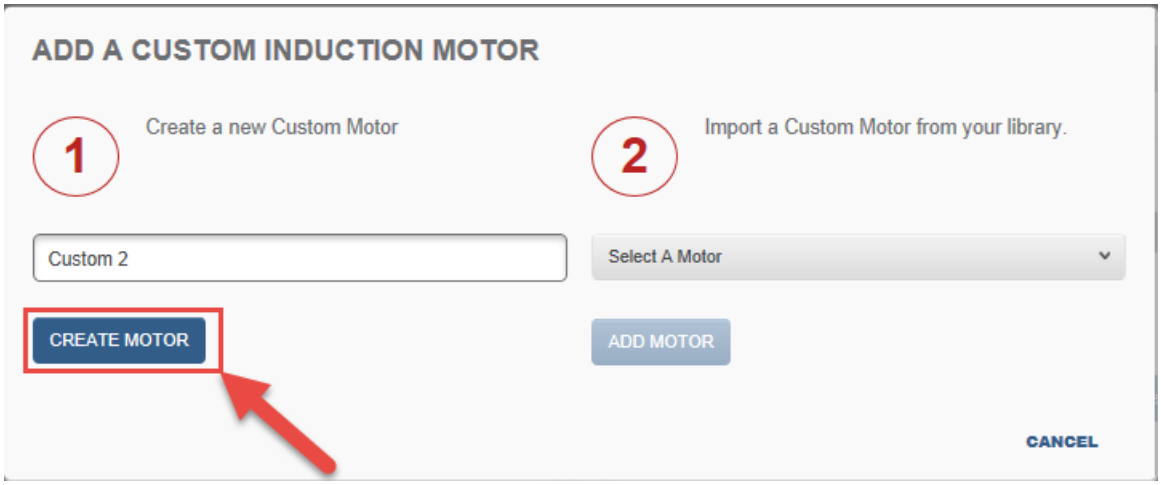
1. Change the name of your axis from *Axis 7* to *Takeaway Axis*



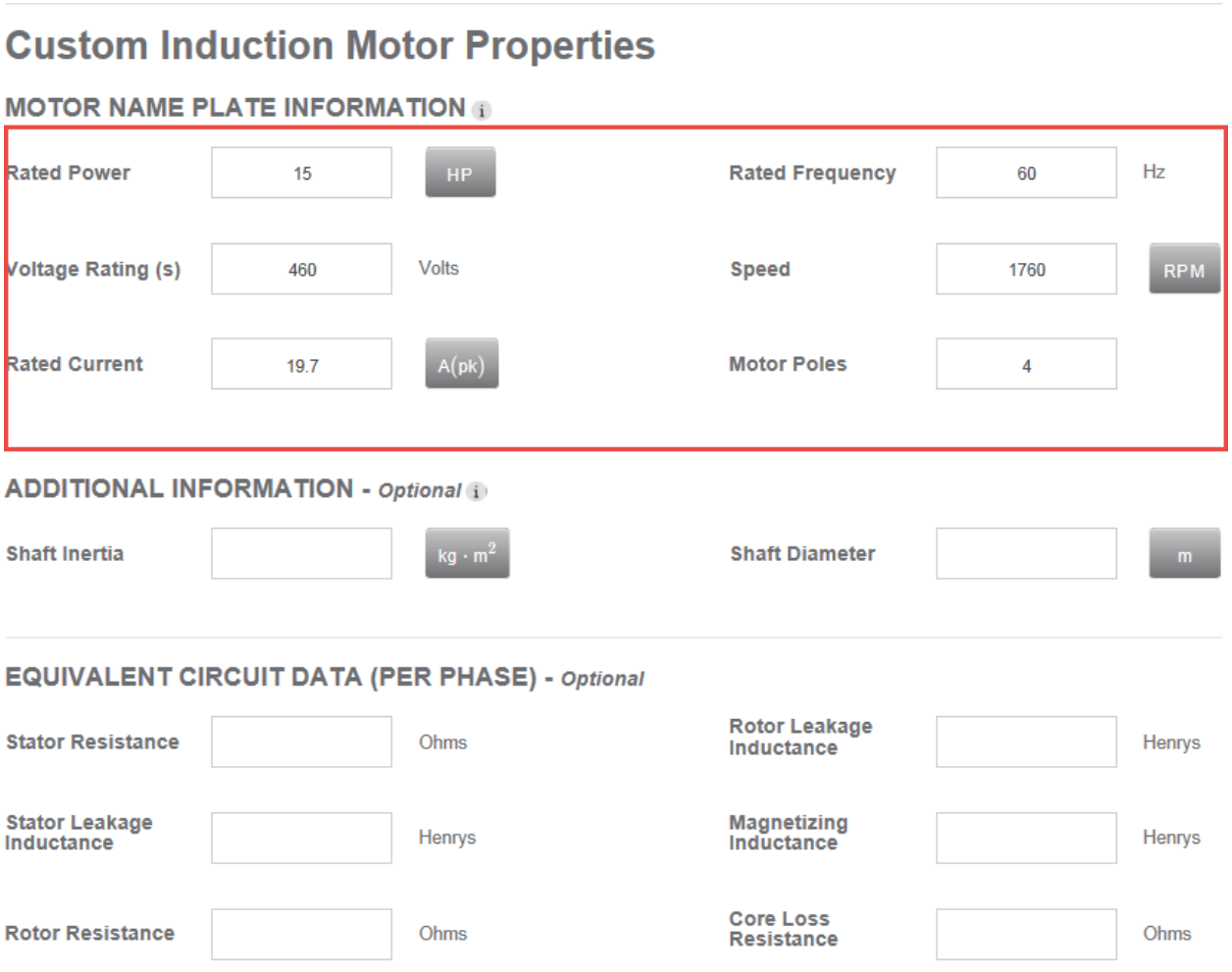
2. Click on **Add Custom Motor**



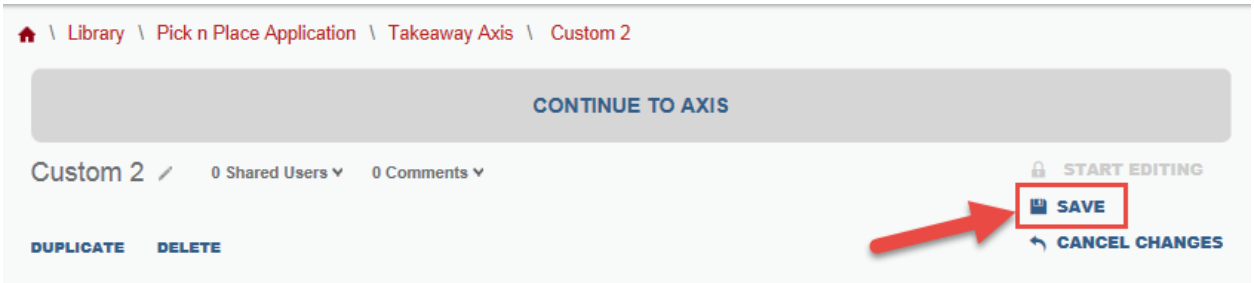
3. Enter a name for your motor and select **Create Motor**.



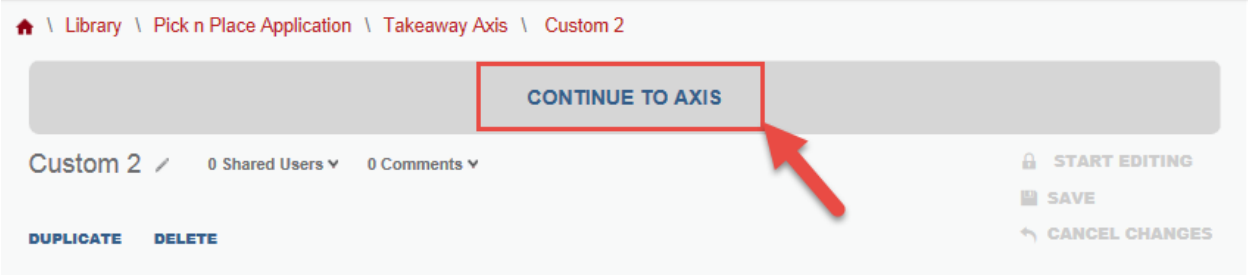
4. The *Custom Induction Motor Properties* page will open and you will enter the information provided by OEM Distribution in the *Motor Name Plate Information*.



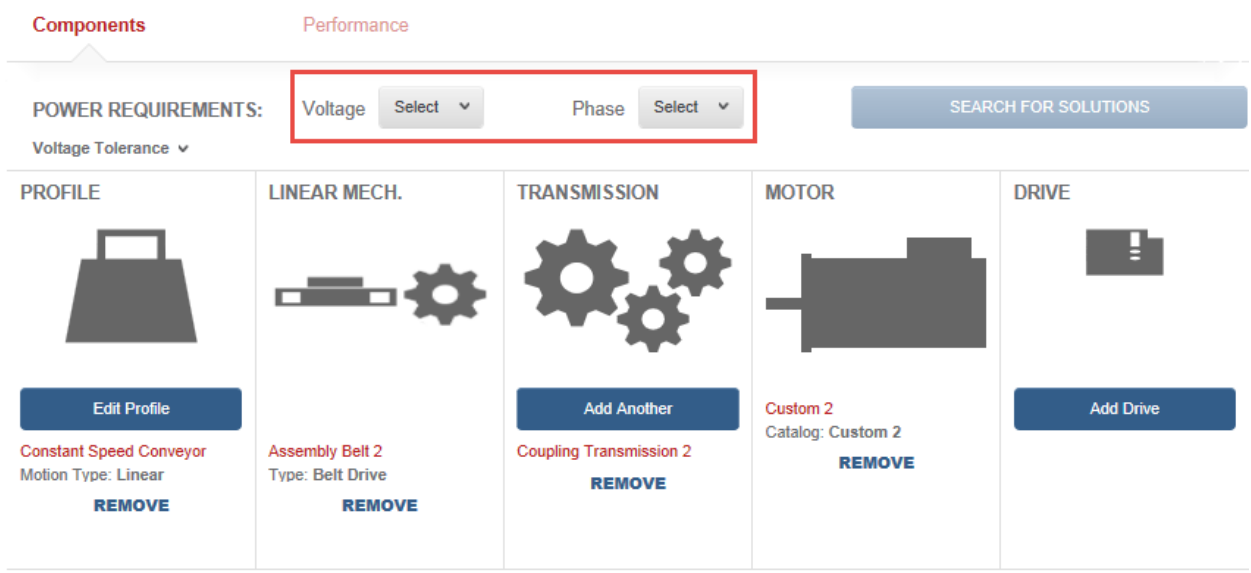
5. Note how the *Equivalent Circuit Data (Per Phase)* section is blank until you save your motor name plate information. Click **Save** to save your motor information.



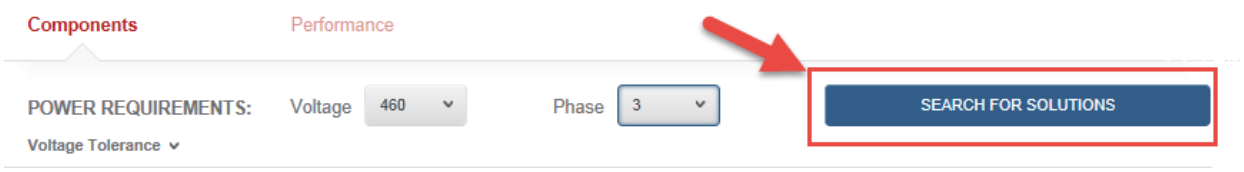
6. Click **Continue To Axis**



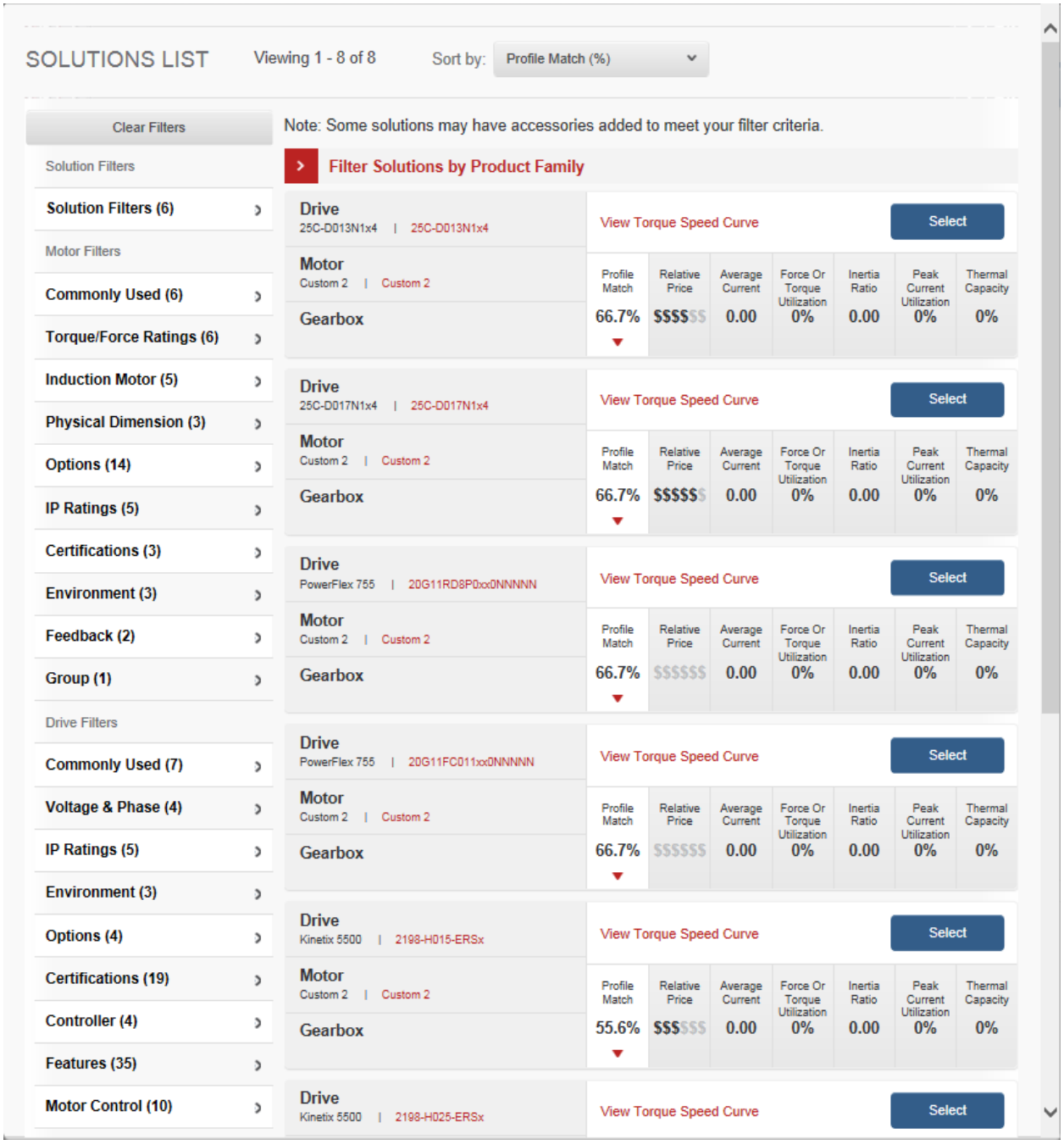
7. Set your *Power Requirements Voltage* and *Phase* to **460** and **3** respectively.



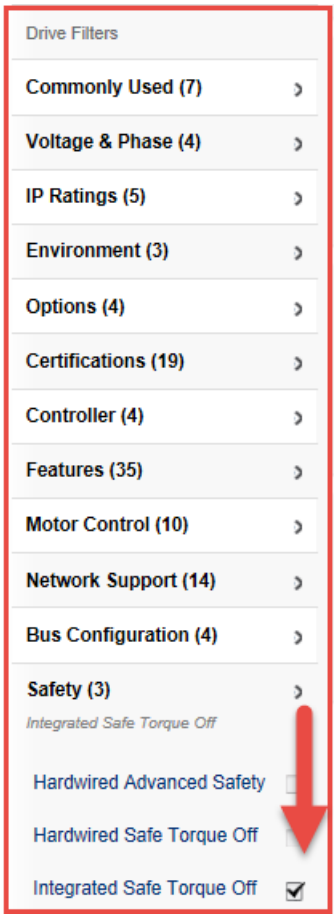
8. Click **Search For Solutions**



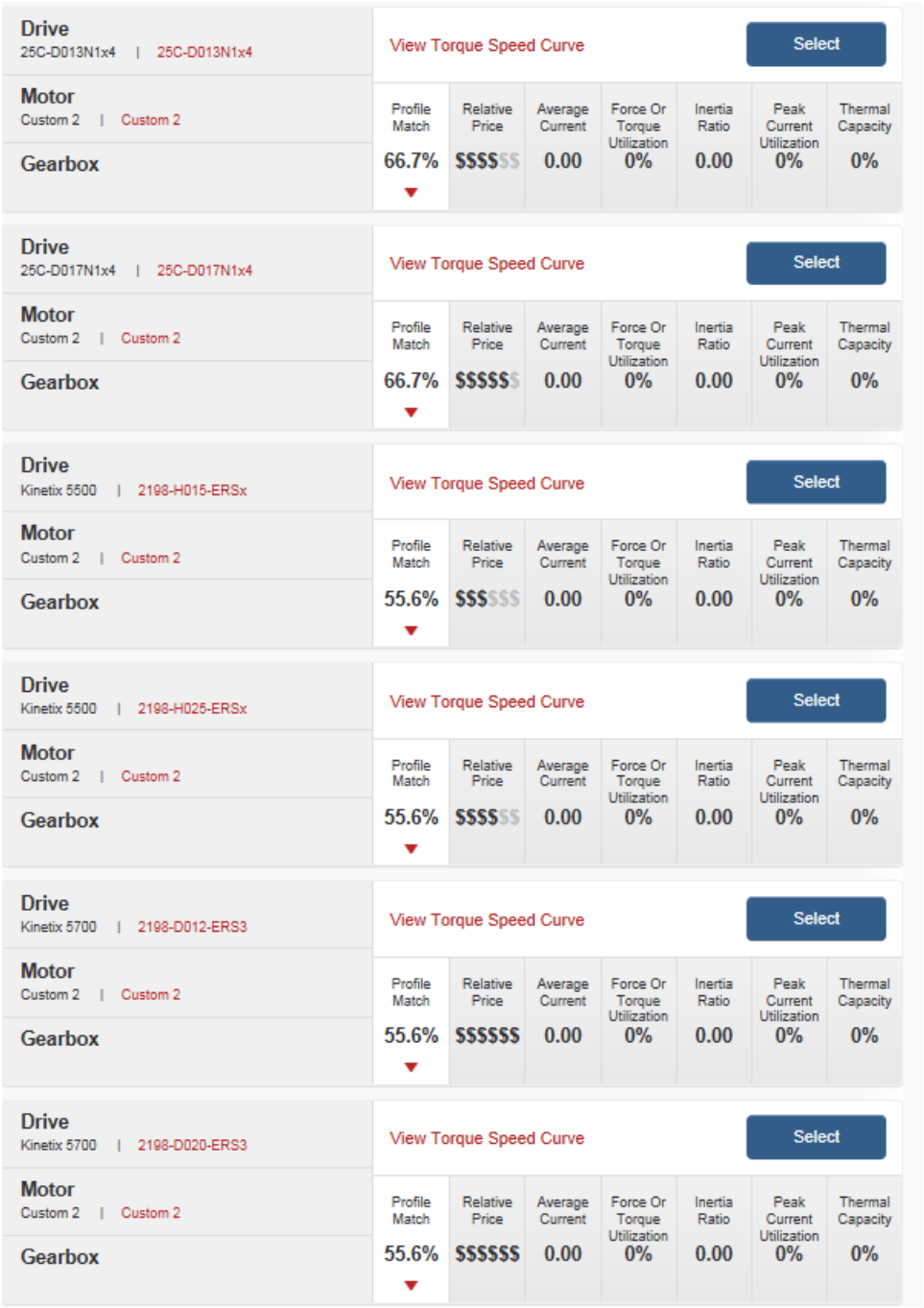
9. The *Solutions List* will provide solutions for your axis



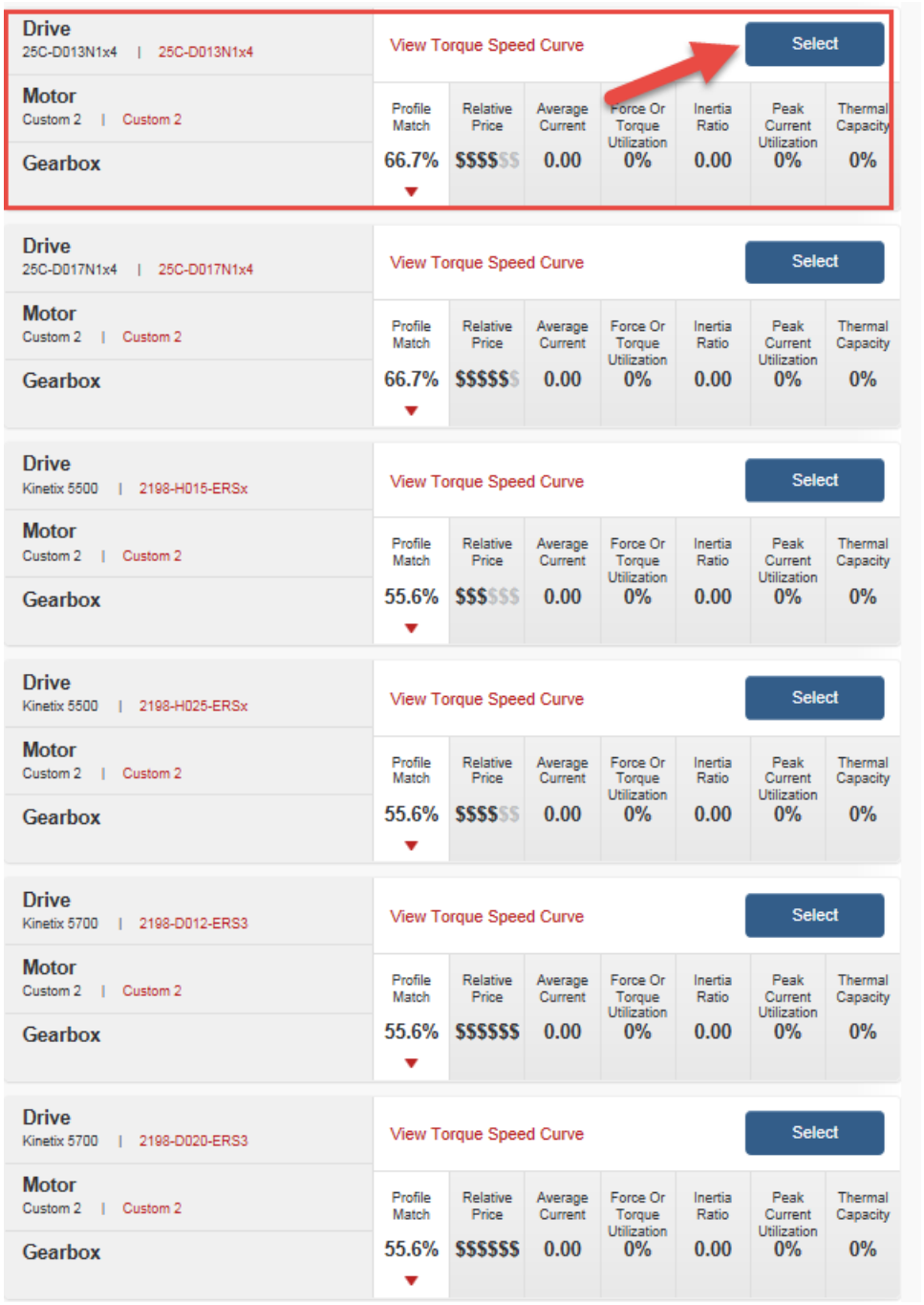
10. In the *Drive Filters*, click on the dropdown for the **Safety** feature to see the three options available. Click on the checkbox for Integrated Safe Torque Off.



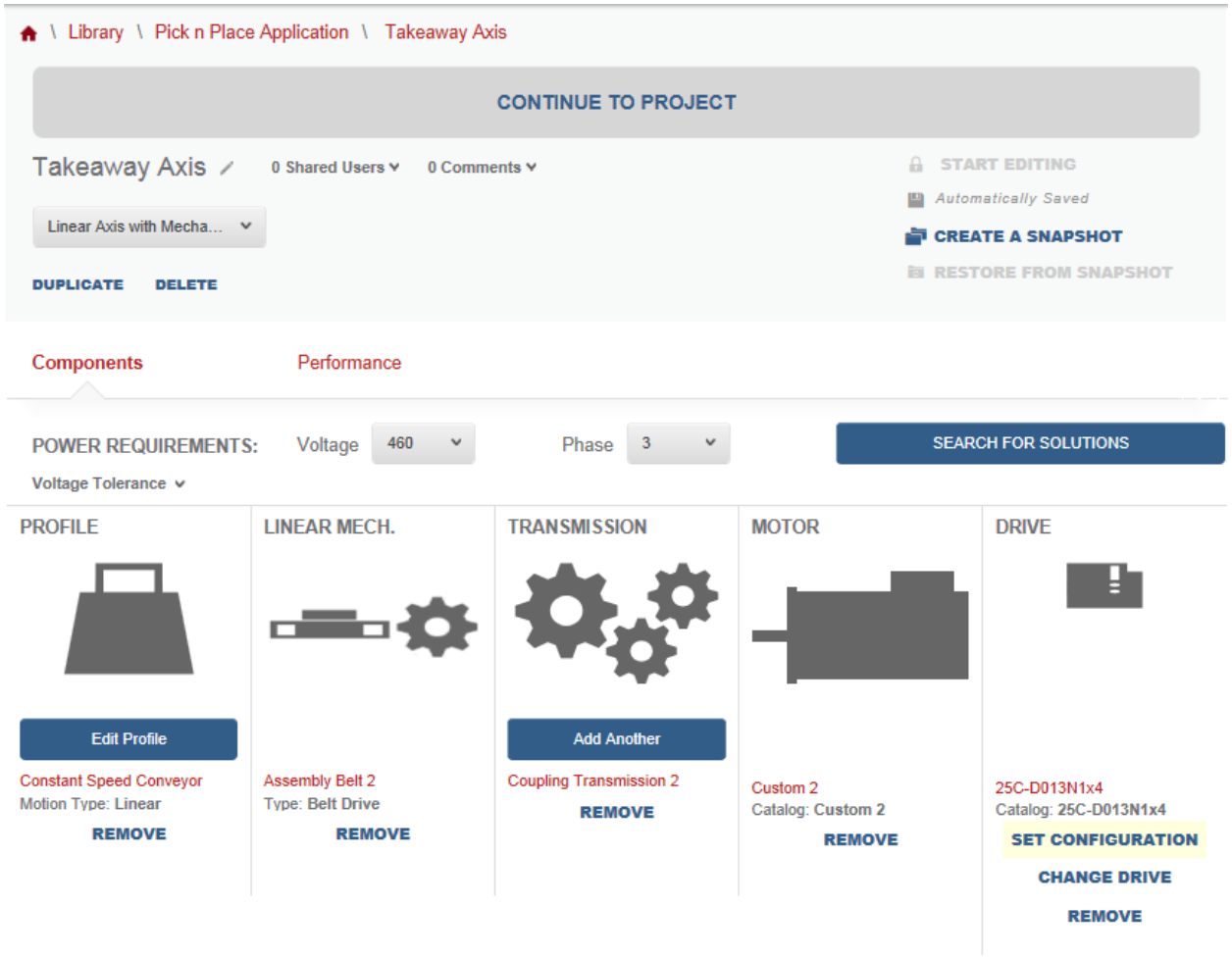
11. Your results are now limited to



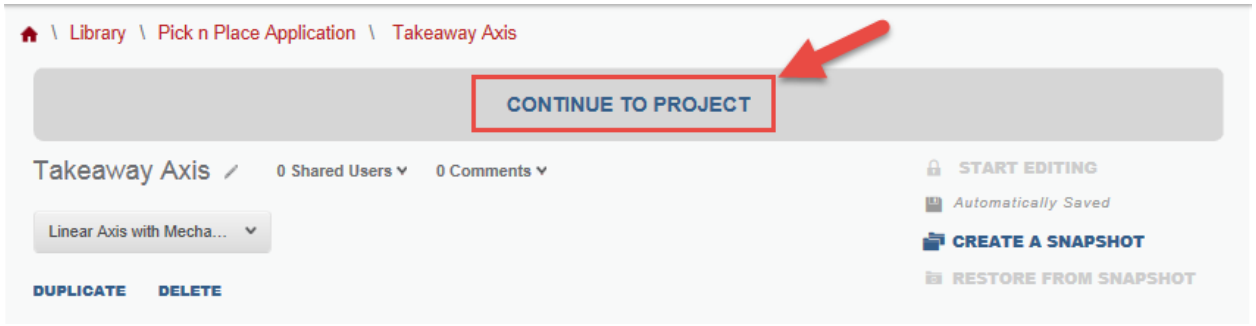
12. We will select the first solution available with the PowerFlex 527. Click Select



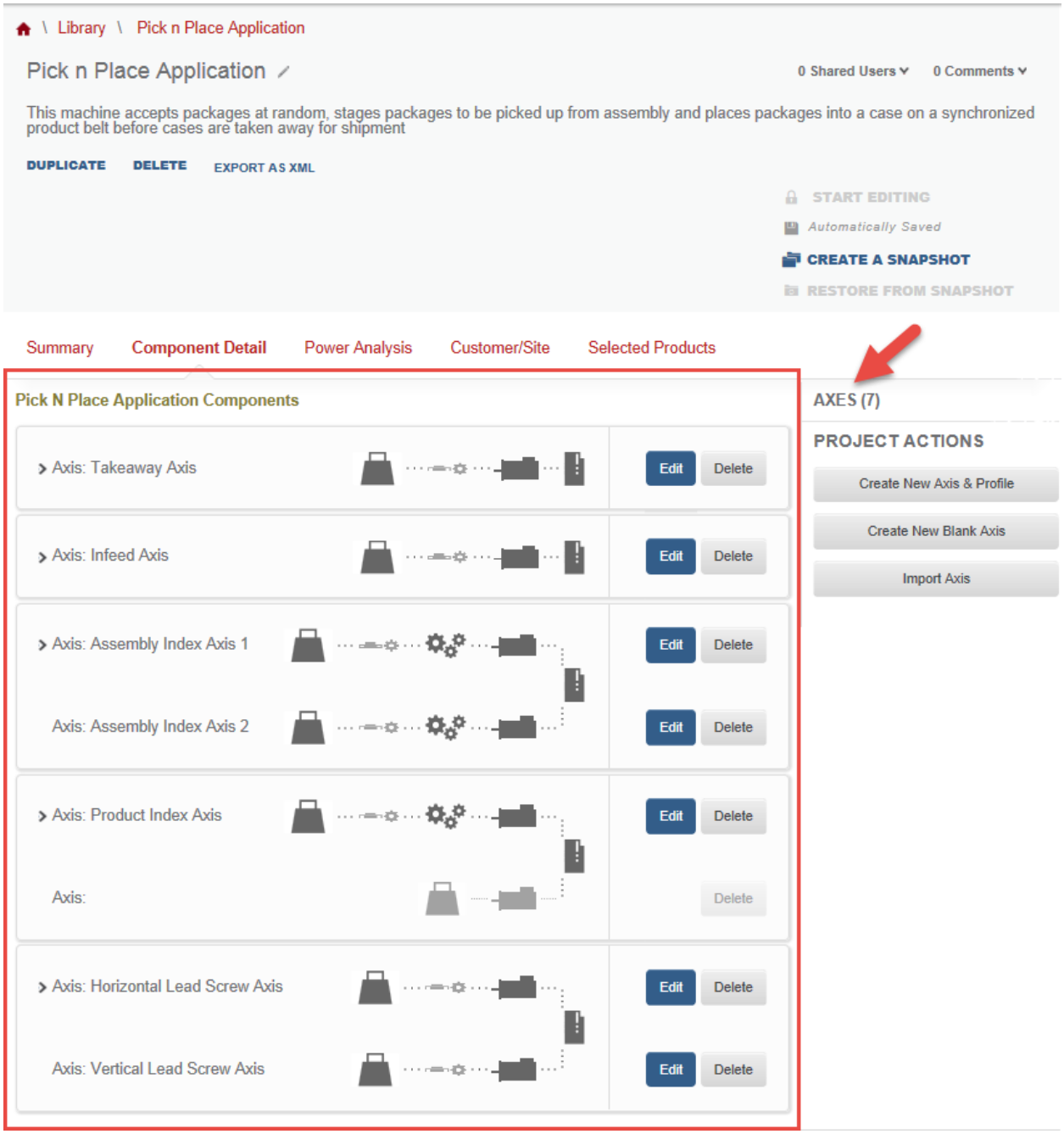
13. You've finished sizing and selecting a solution for the Takeaway Axis.



14. Click **Continue To Project**



15. Your Pick and Place Application Components will be displayed. You can review your 7 axes individually at any point



You've finished configuring the seven axes of the Pick n Place Application. On the next section, we will review the Power Analysis feature.

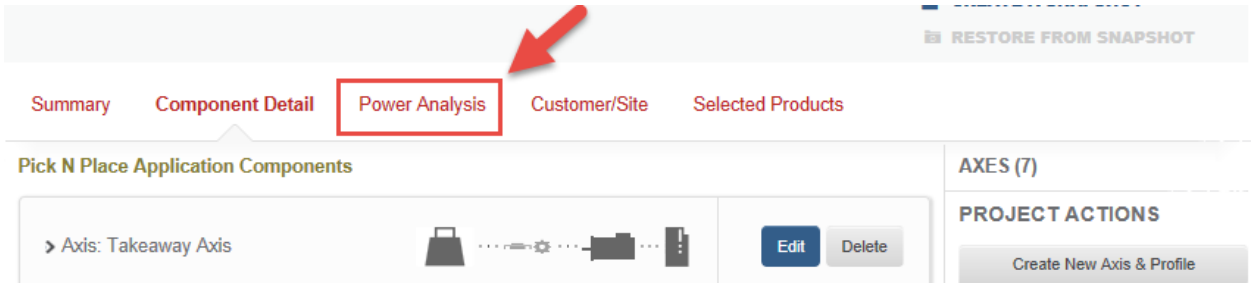
Power Analysis

You've sized and selected a solution for each of your seven axes. You have a *Profile*, entered your *Mechanism*, completed the *Transmissions*, and selected a *Motor* and *Drive*. You've reviewed the *Performance* of each axes, and are satisfied with all the **Components** in your project. At this point you want to validate your selections and decided to check the **Power Analysis** tab. Power Analysis helps you determine how to handle the incoming and outgoing power from the drive system. It calculates system parameters from the hardware configuration; aligns profiles from all axes; add power usage for all profiles to find the **Power Profile** (Total Power over time).

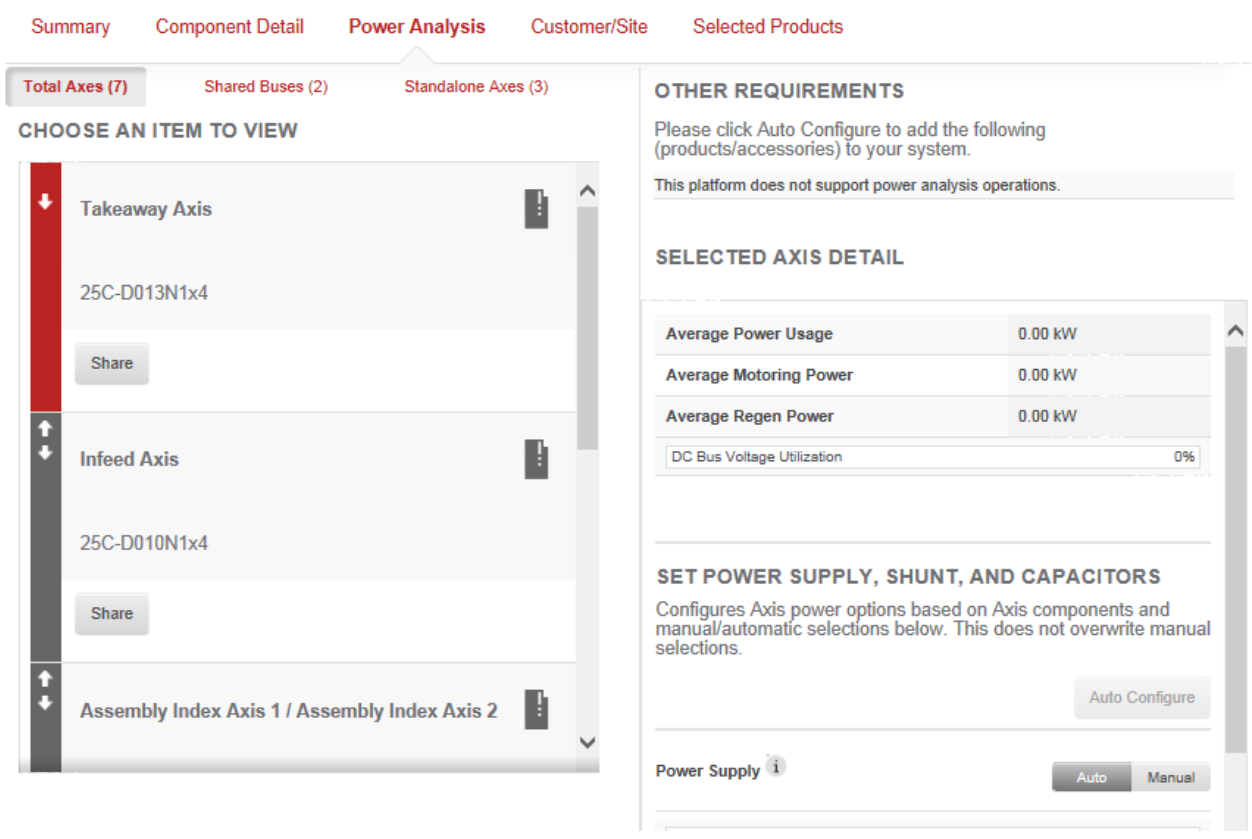
DC Bus Simulations

To view the Bus simulation,

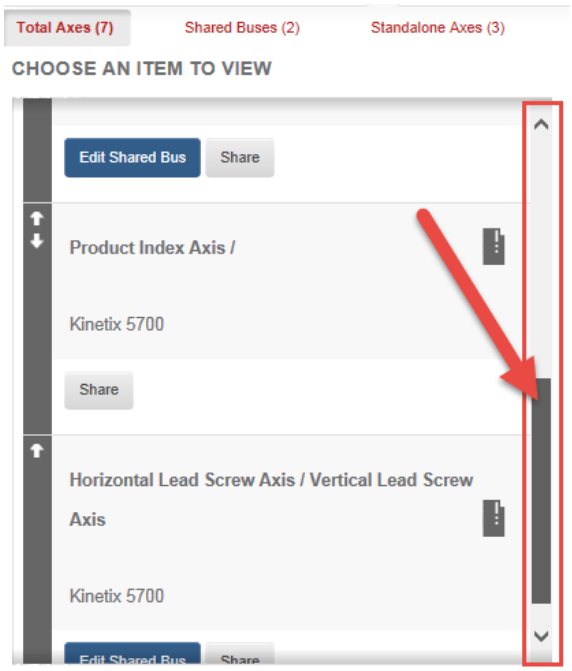
1. At the Pick and Place Application Components page, click on the **Power Analysis** tab

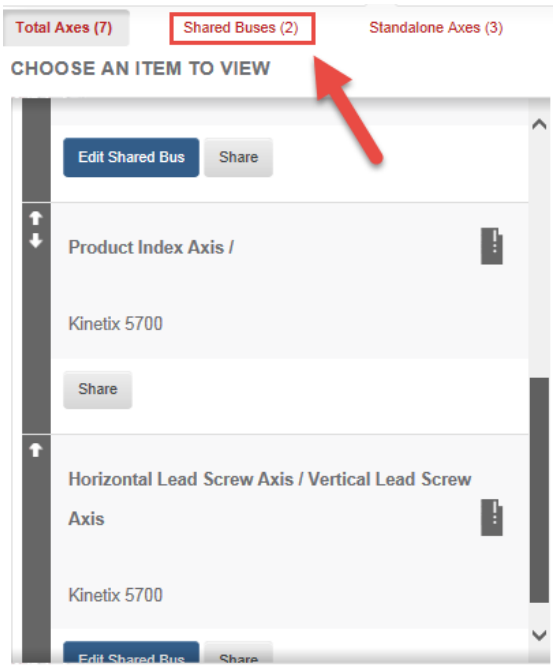


2. The Power Analysis will open

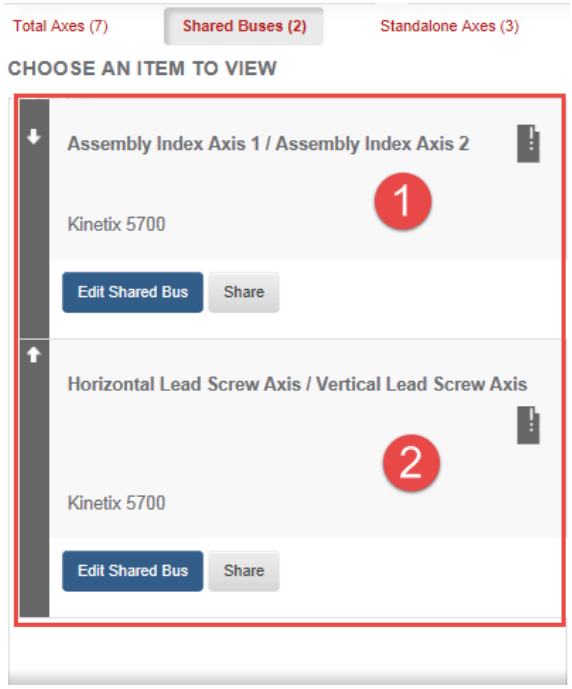


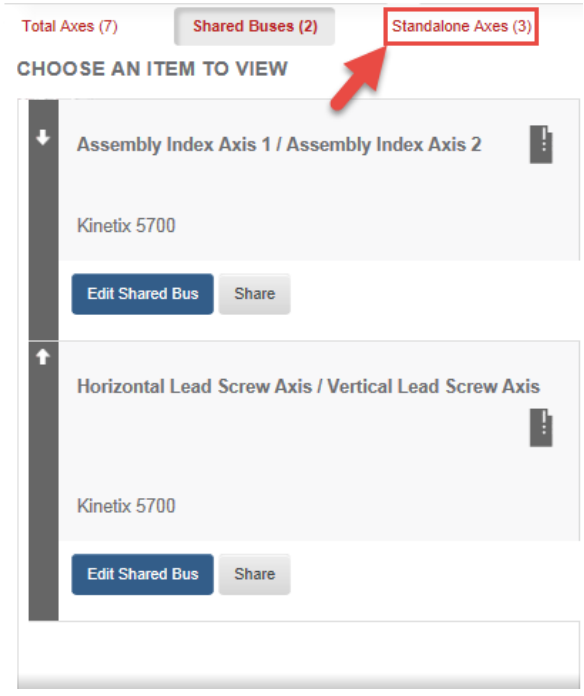
3. Under *Choose An Item To View*, scroll the window to see your axis. Click on **Shared Buses** to view which axes are on the share DC Bus



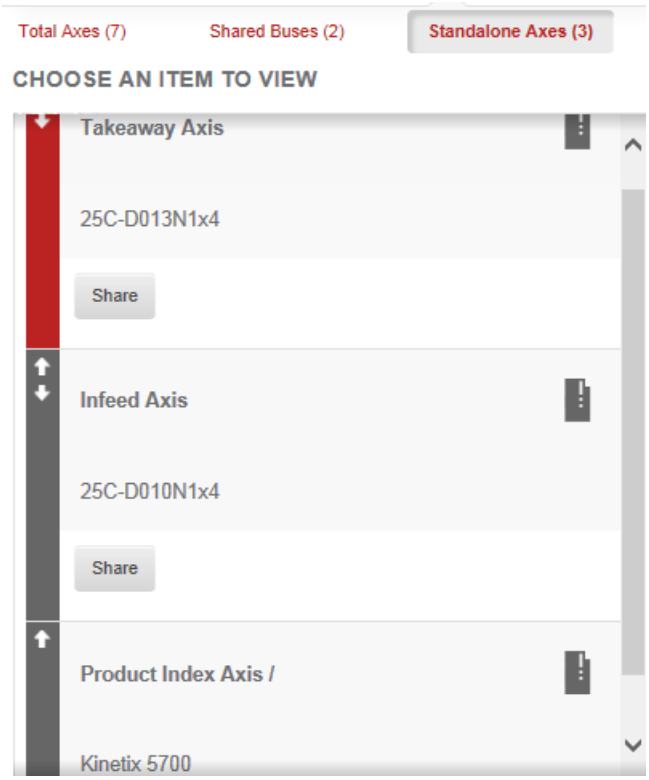


4. You can see that you have 2 dual axes drives with 2 axes each. Click on **Standalone Axes**

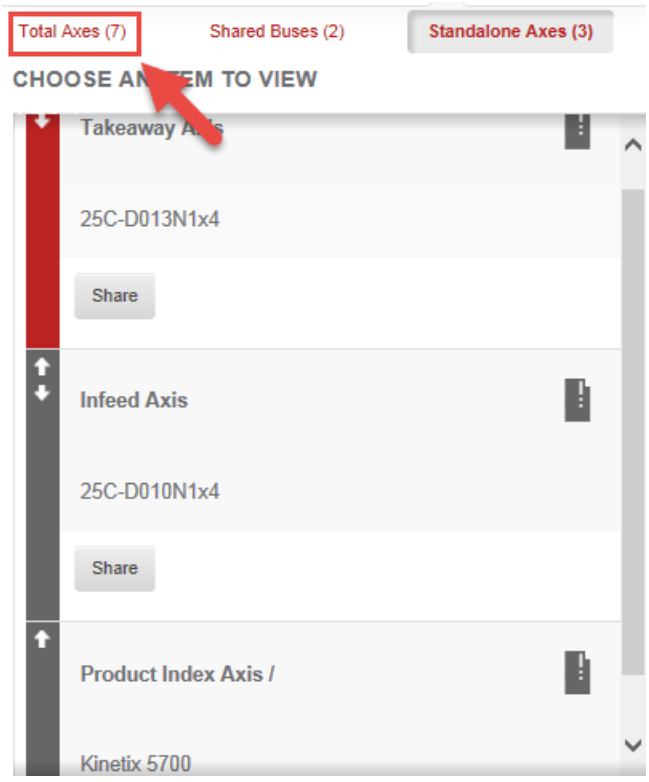




5. Your standalone axes are listed as:

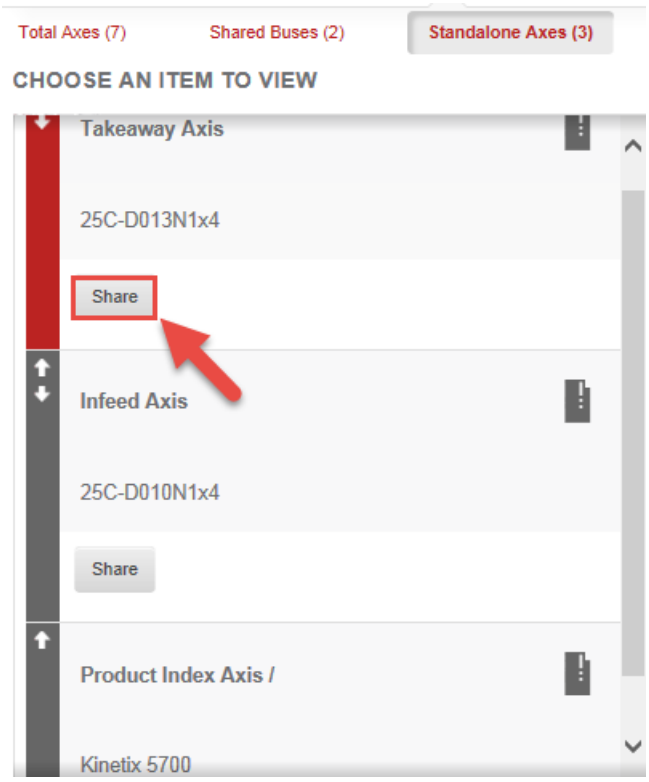


6. Return to **Total Axis**

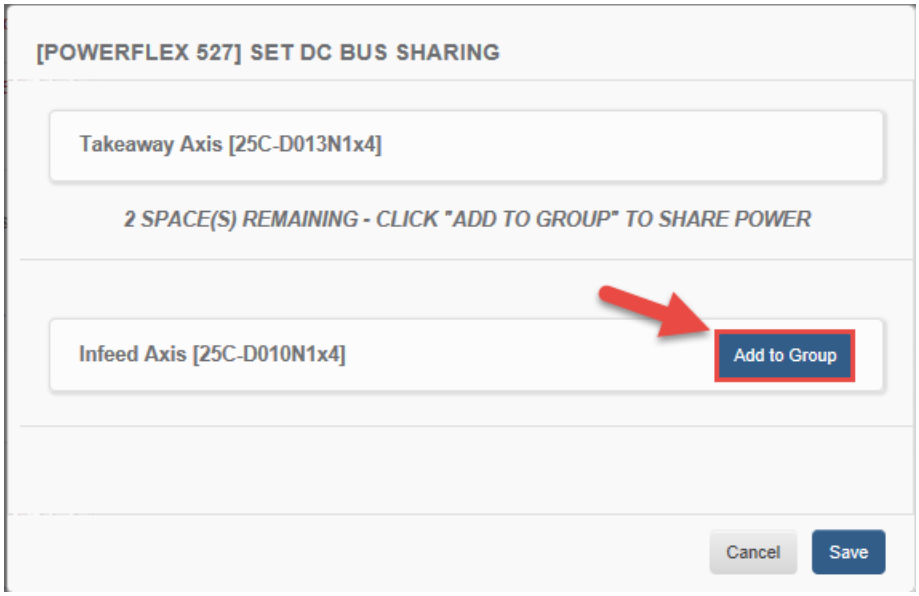


Selected Shared DC Bus Detail

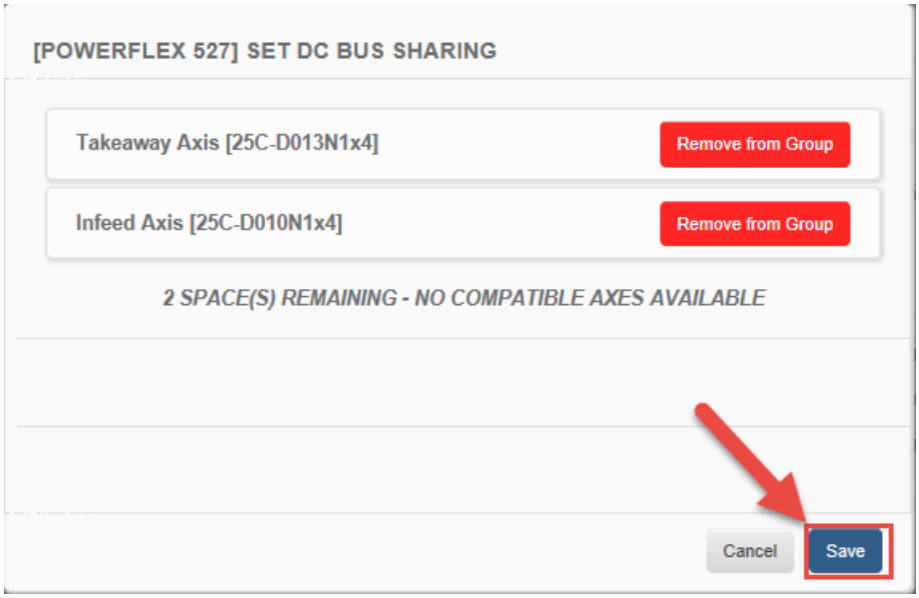
1. Click **Share** on the Takeaway Axis



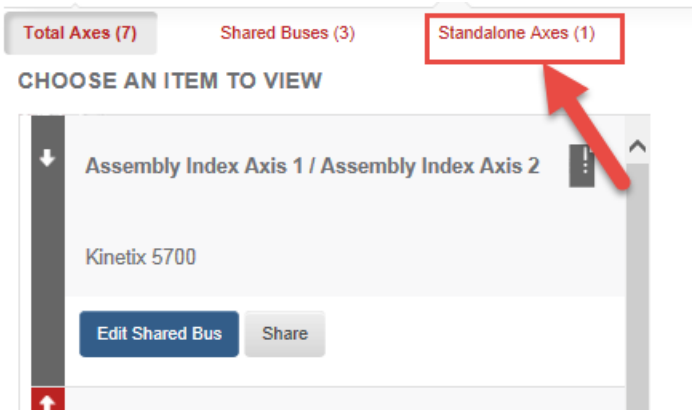
2. You can share power between the two PowerFlex drives. Click **Add to Group**



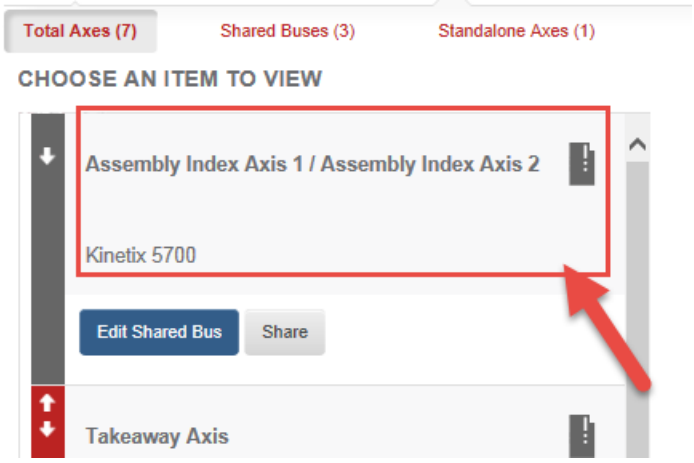
3. Once you've set DC bus sharing for your PowerFlex drives, you will see your drives in one group. Click **Save**



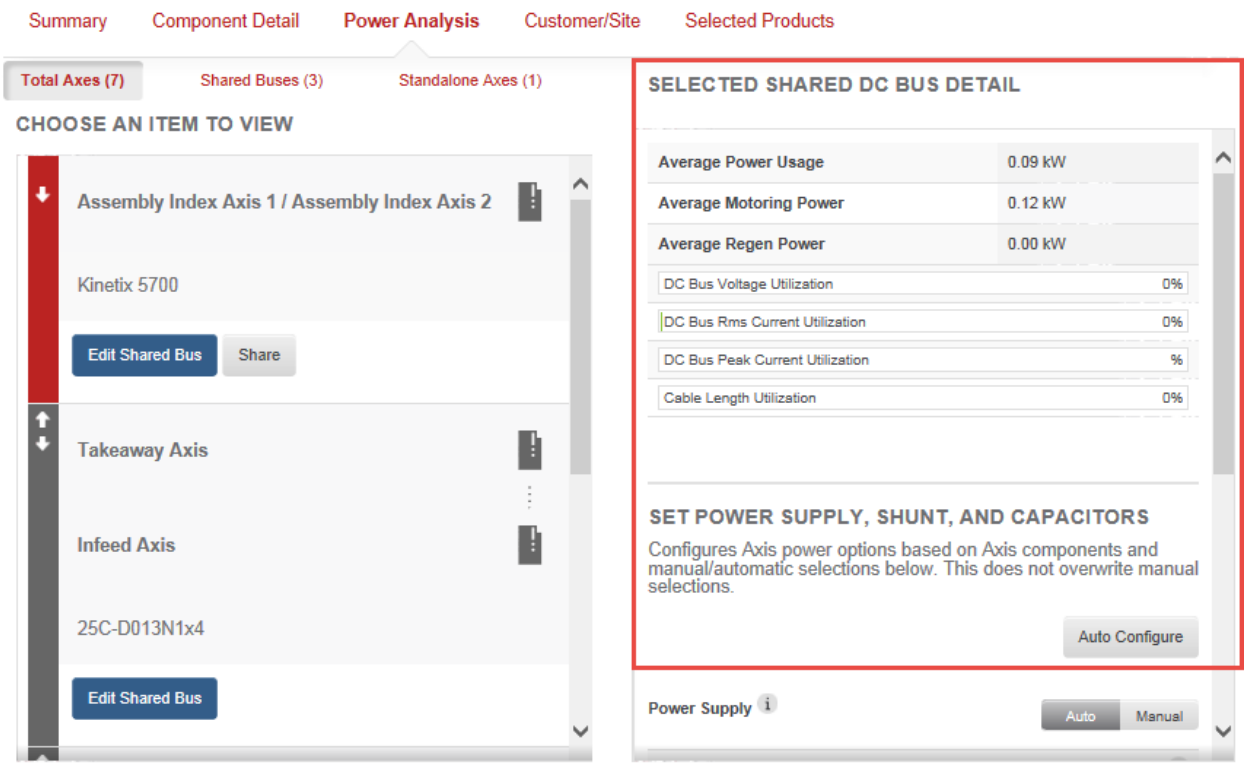
4. Notice how your number of Standalone Axes changes.



5. Click on the Kinetix Dual Axis module

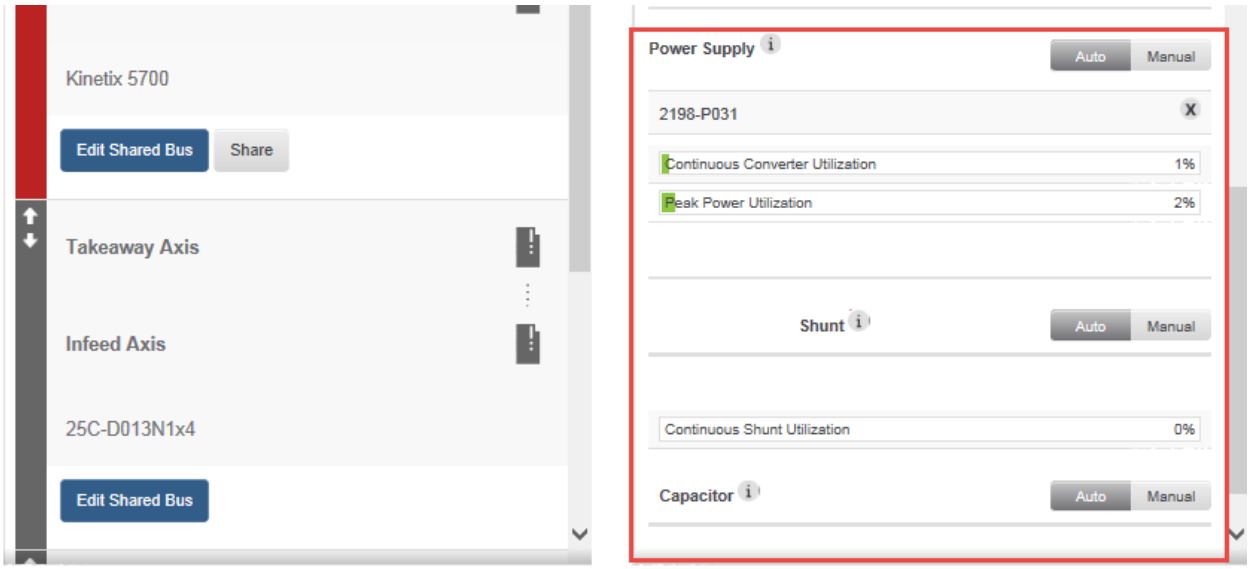


6. A Power Analysis will be performed for this axis, and you can view the results in *Selected Shared DC Bus Detail* window

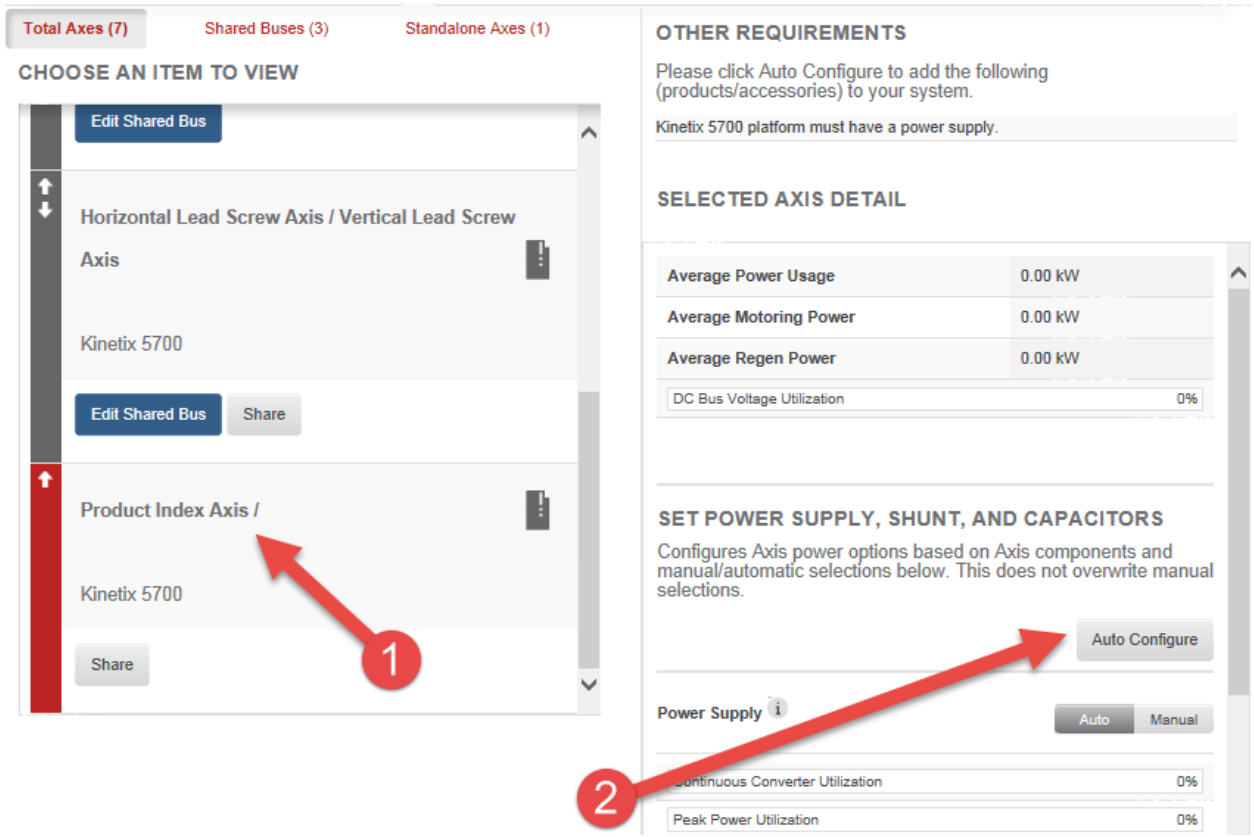


NOTE: The *Selected Shared DC Bus Detail* window will not display values for PowerFlex Drives at the moment. Only Kinetix Drives products will display power utilization values.

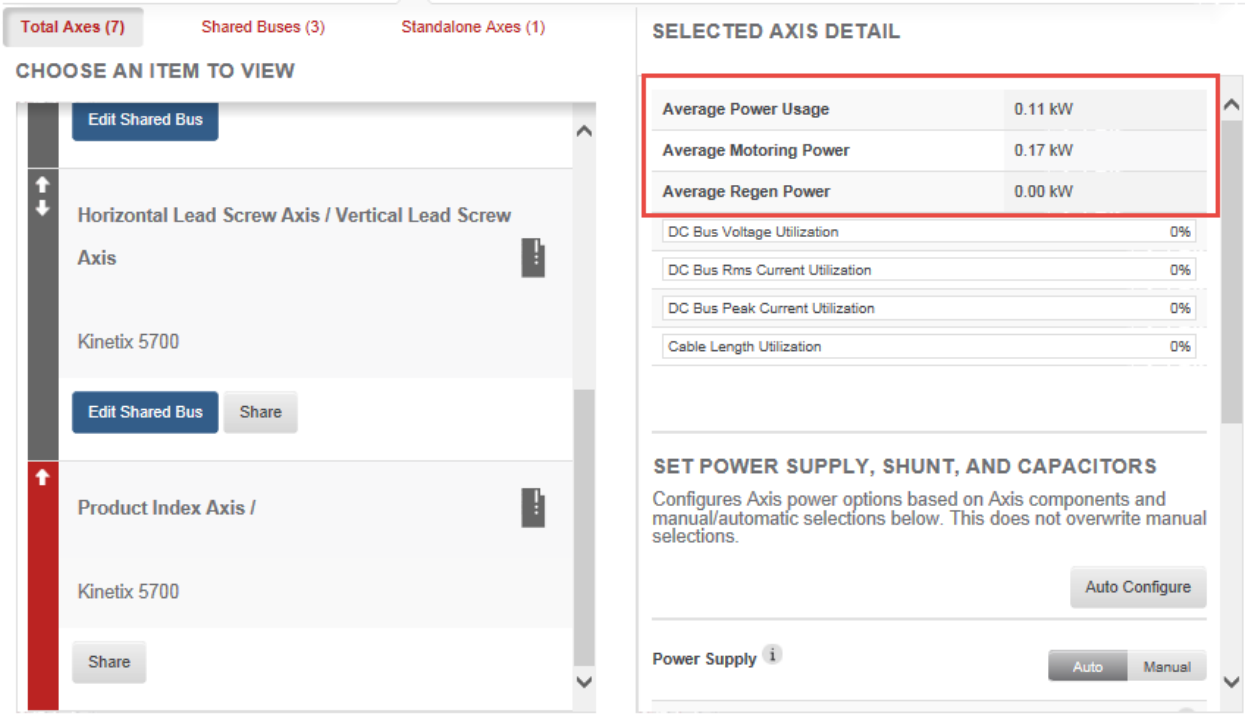
7. Scroll through the *Selected Shared DC Bus Detail* window to review your Power Supply data, shunt utilization and capacitance.



8. Check the other Kinetix drive axes' power utilization by clicking on the axis and selecting Auto Configure

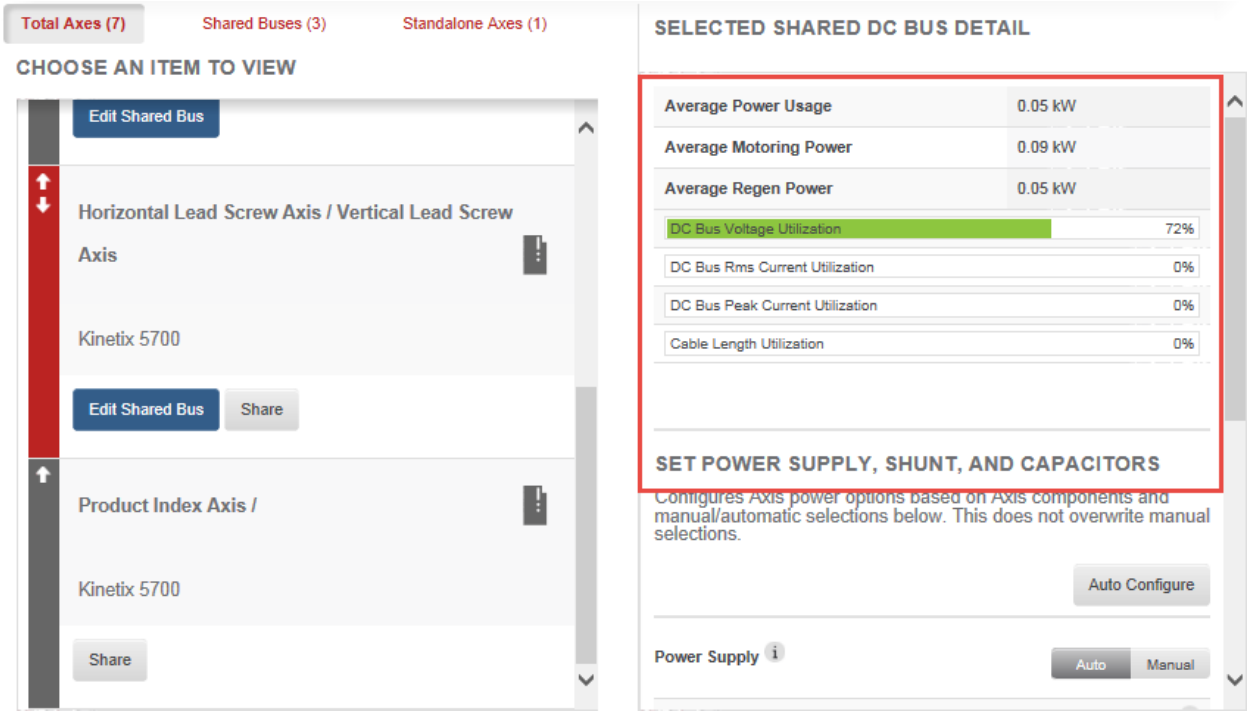


9. Your axis should display the Average Power Usage, Average Motoring Power, and Average Regen Power

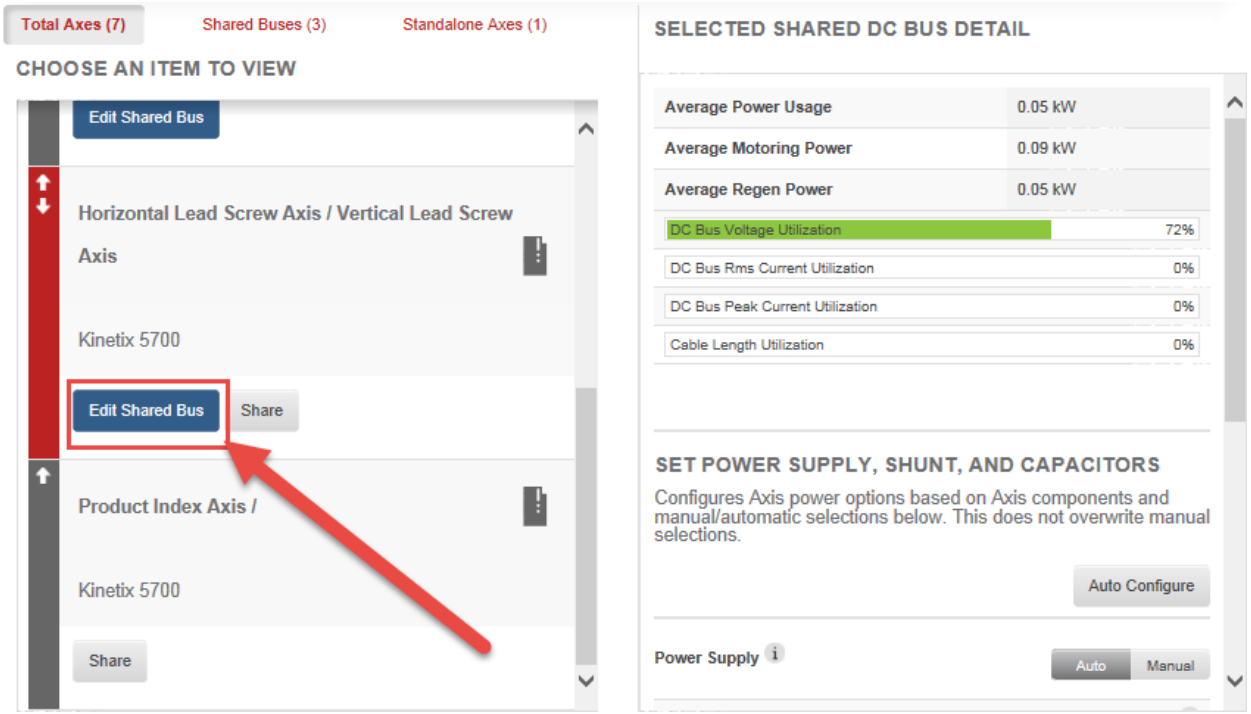


10. Repeat step 8 for our last axis.

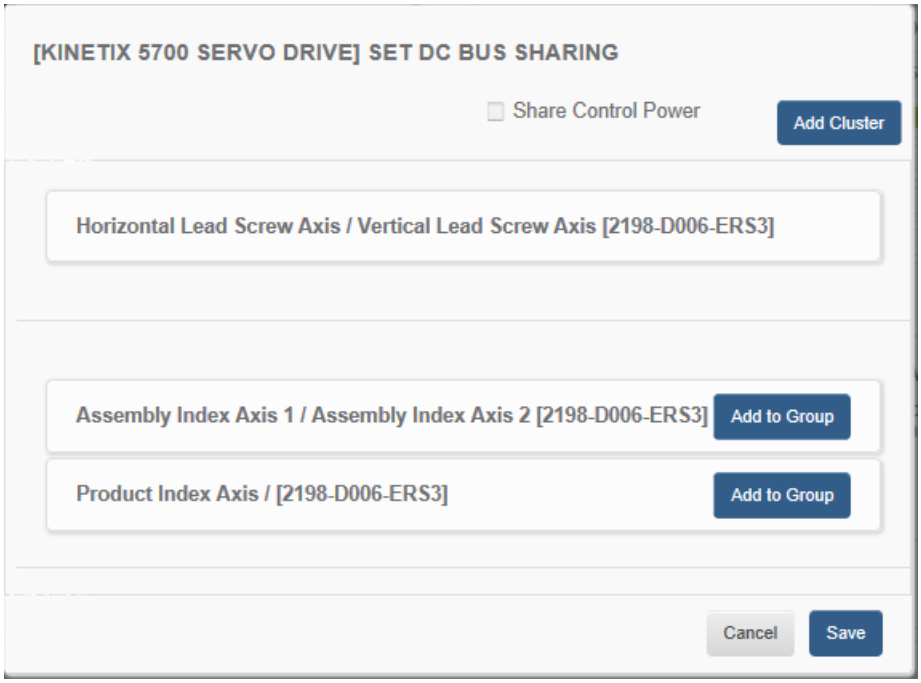
11. We see that our Lead Screw axes have more power usage. The Average Motoring Power (power from Drive to Motor) is at 0.09 KW, Average Regen Power (power from Motor to Drive) is at 0.05 KW, and the Average Power Usage is 0.05 KW.



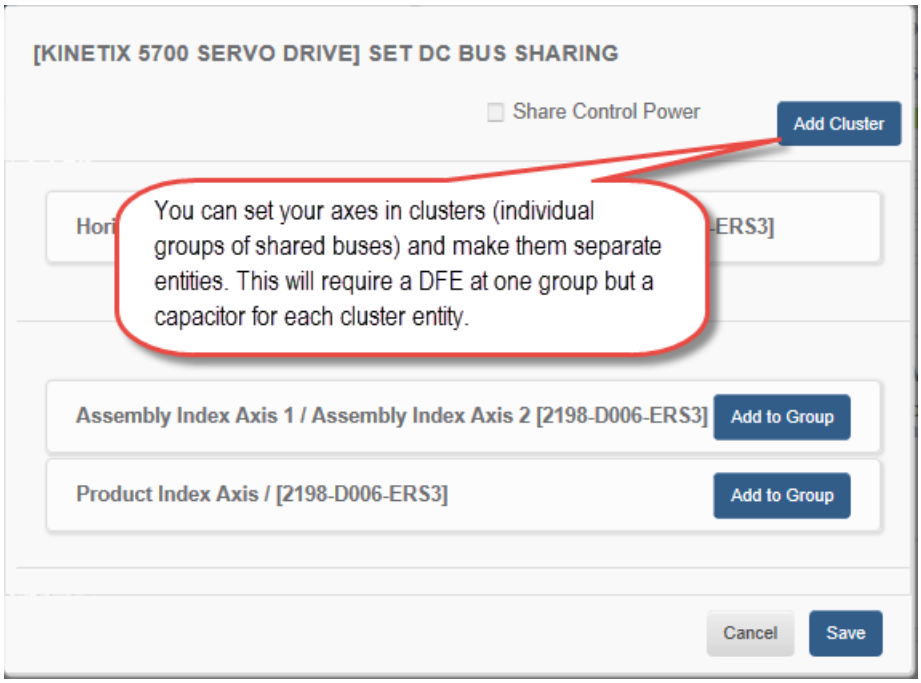
12. Click **Edit Shared Bus**



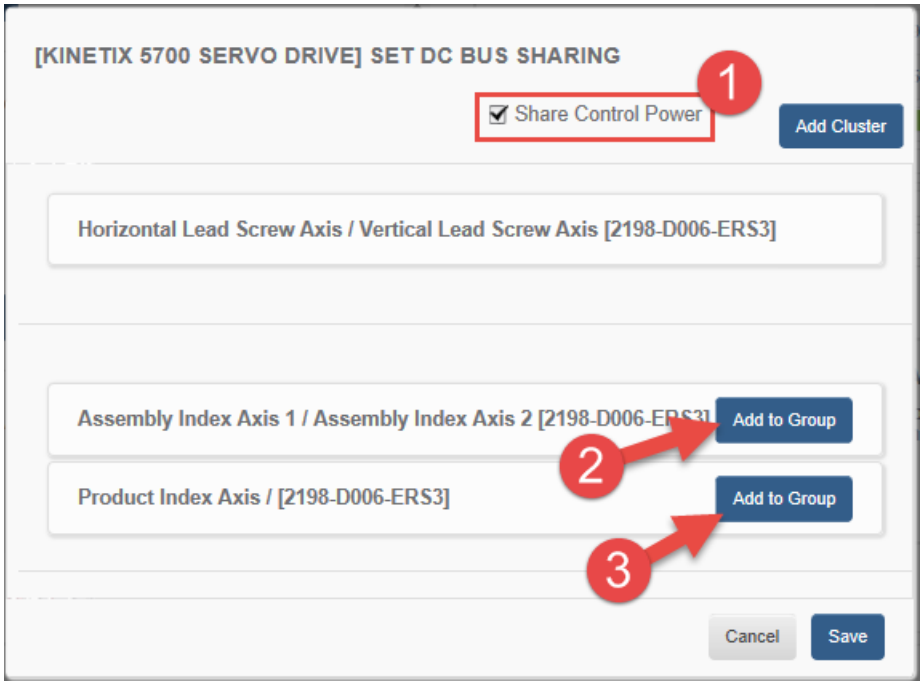
13. You can set the DC bus sharing from this window and also select to share a single control power source for all your drives.



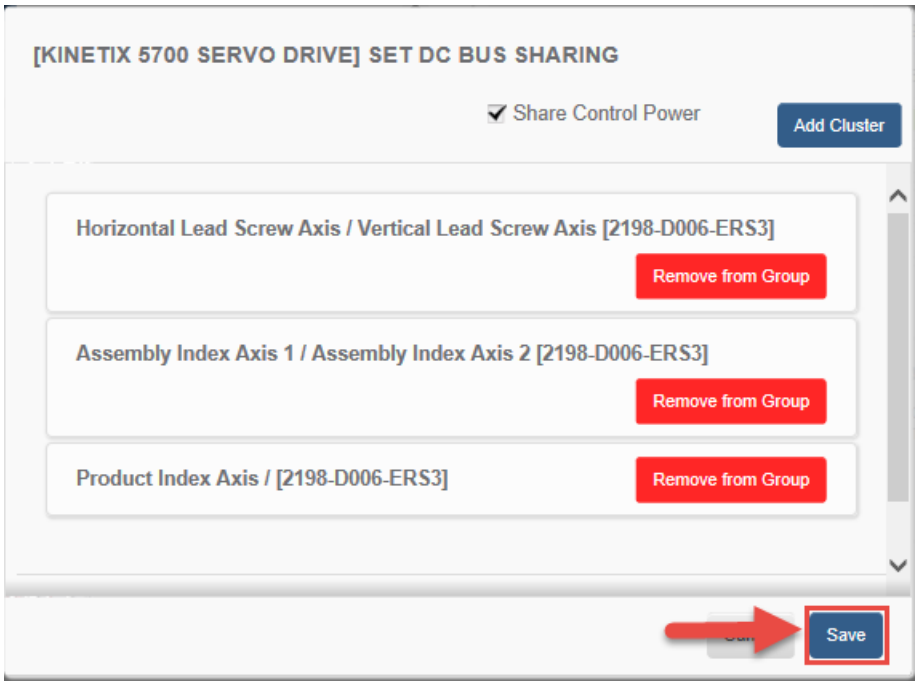
14. We will not add cluster since all axes can be shared in a single entity



15. Click on the *Share Control Power* checkbox. Click on **Add to Group** twice to add all axes on the shared DC bus.

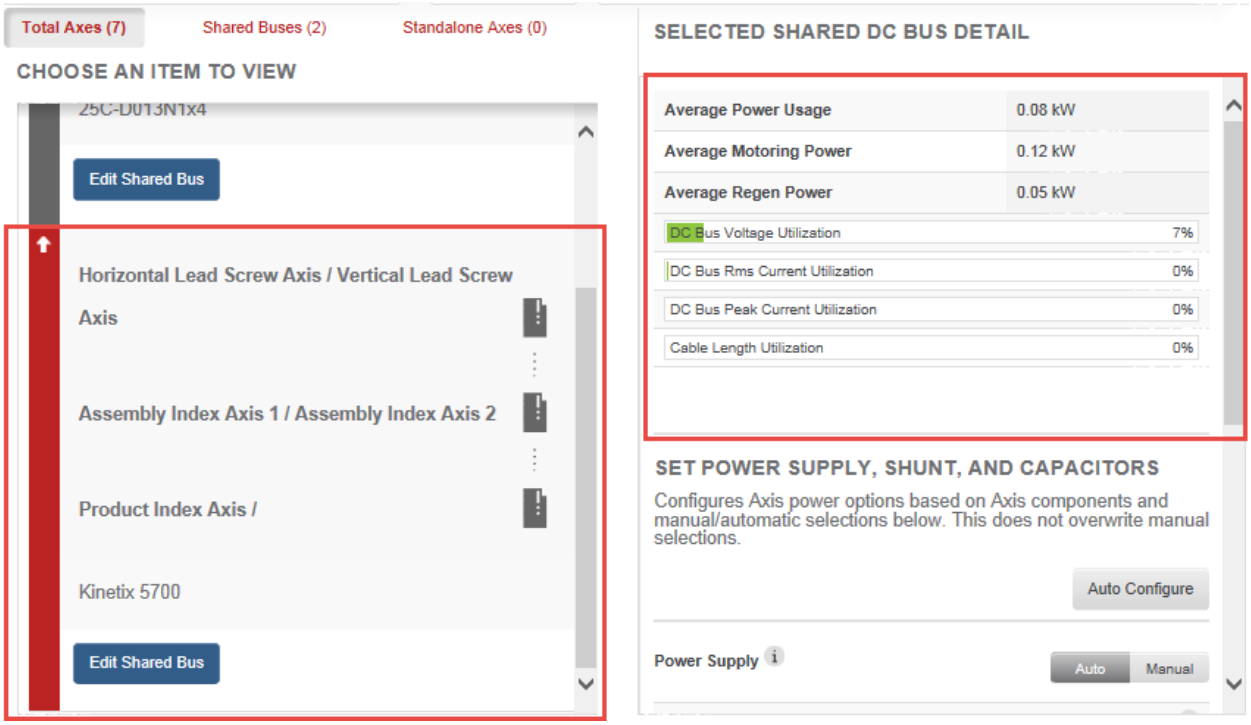


16. Click **Save** to save your configuration

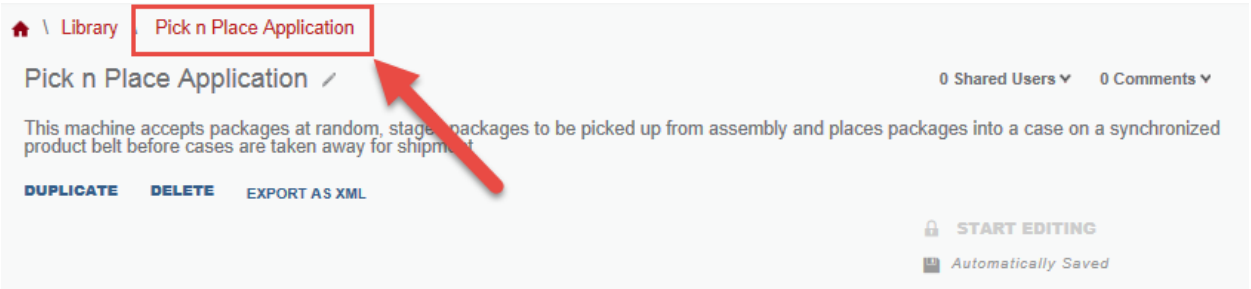


17. Motion Analyzer will update the bus simulation and recalculate power usage.

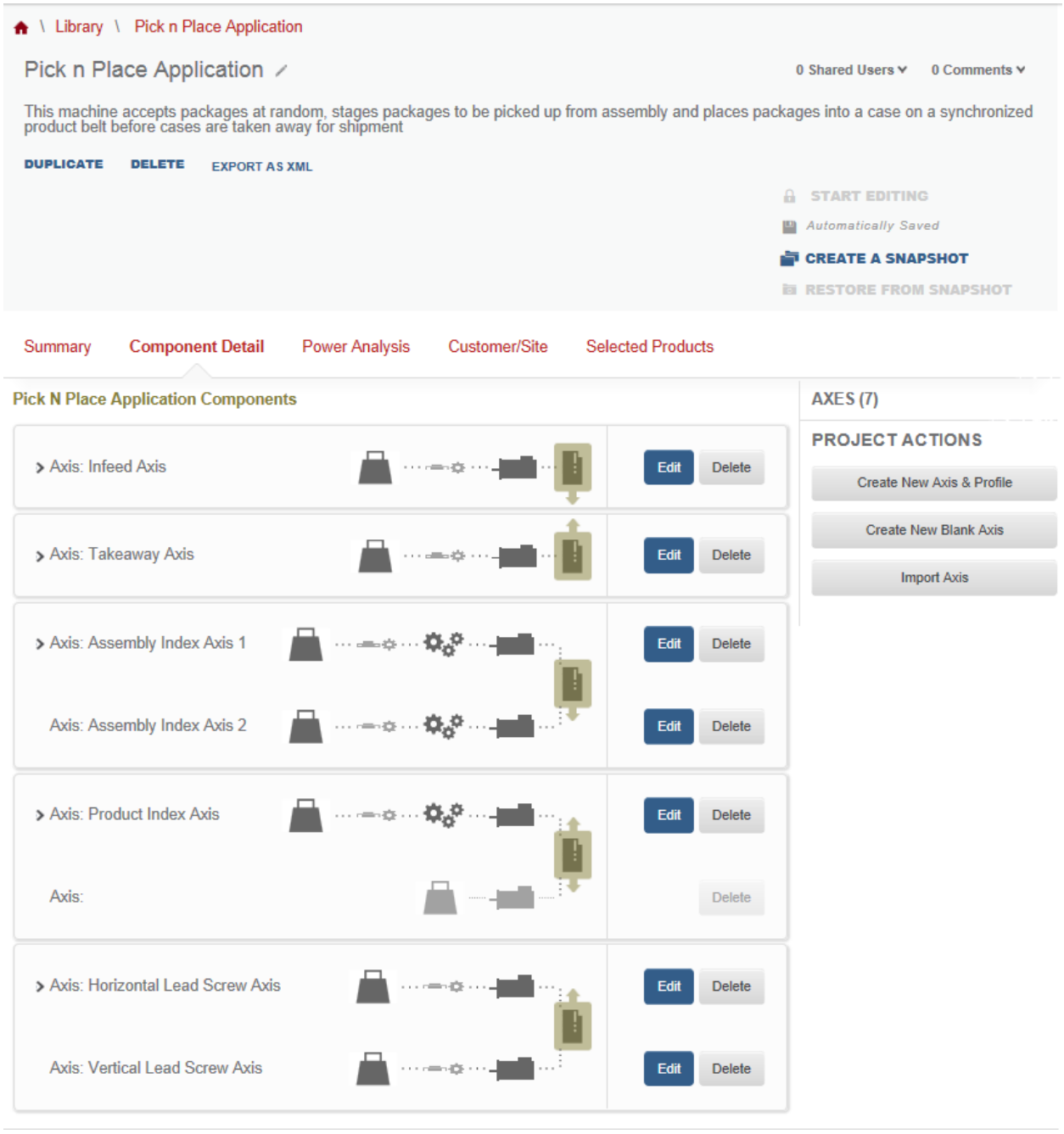
18. The completed simulation should show:



19. Return to the Component Detail page by clicking on the project shortcut



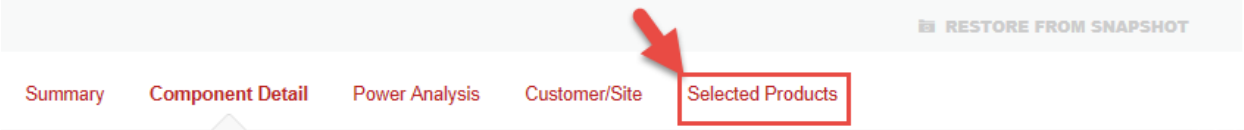
20. Your Pick and Place Application Components should show:



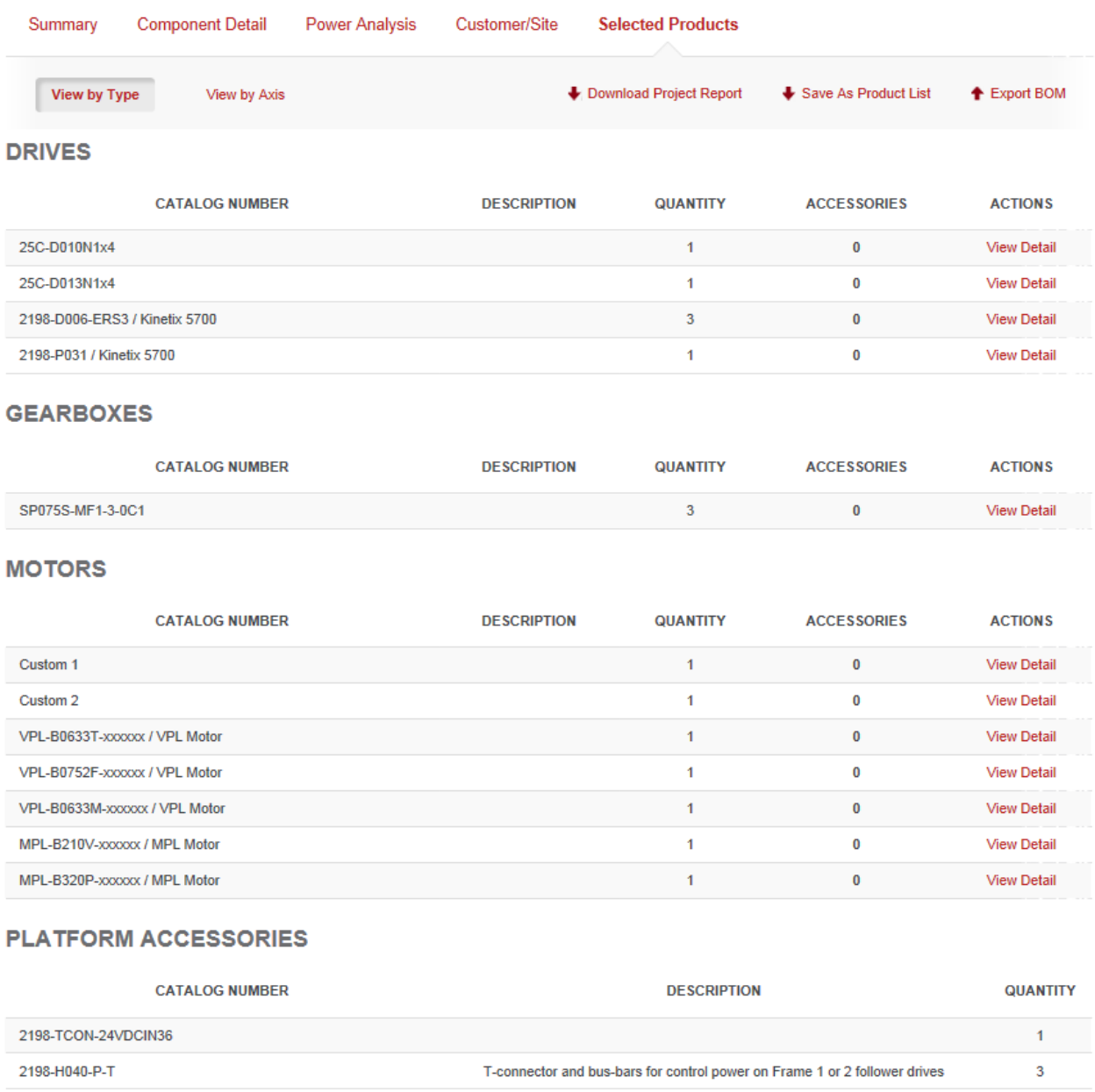
Selected Products

We will use the **Selected Products** page to review the selected products and create our *Bill of Material* and a *Project Report*

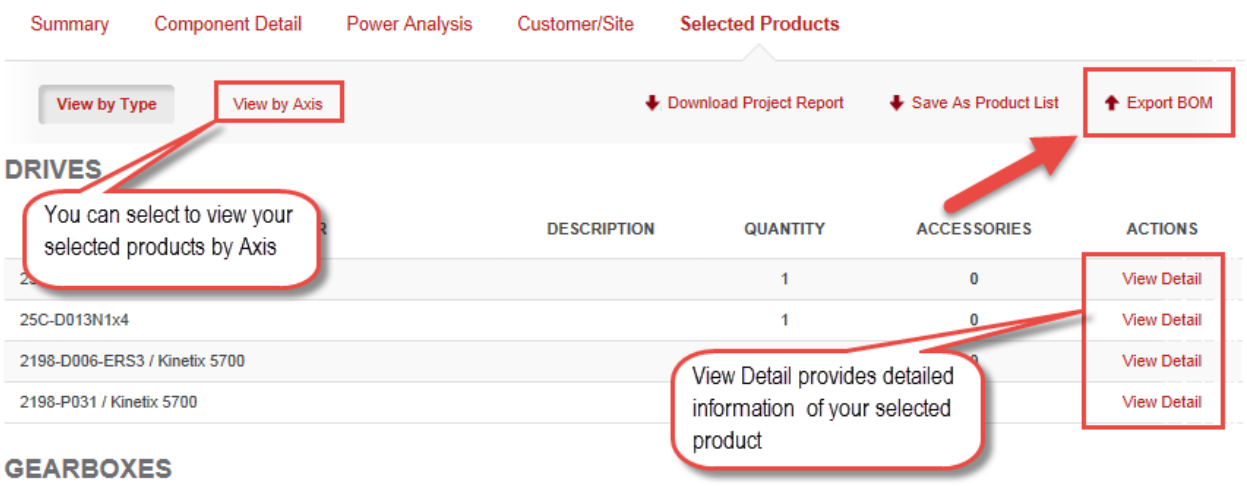
1. Click on the **Selected Products** tab



2. The **Selected Products** will be shown by type and you can view your Drives, Gearbox, Motors, and Accessories selections.

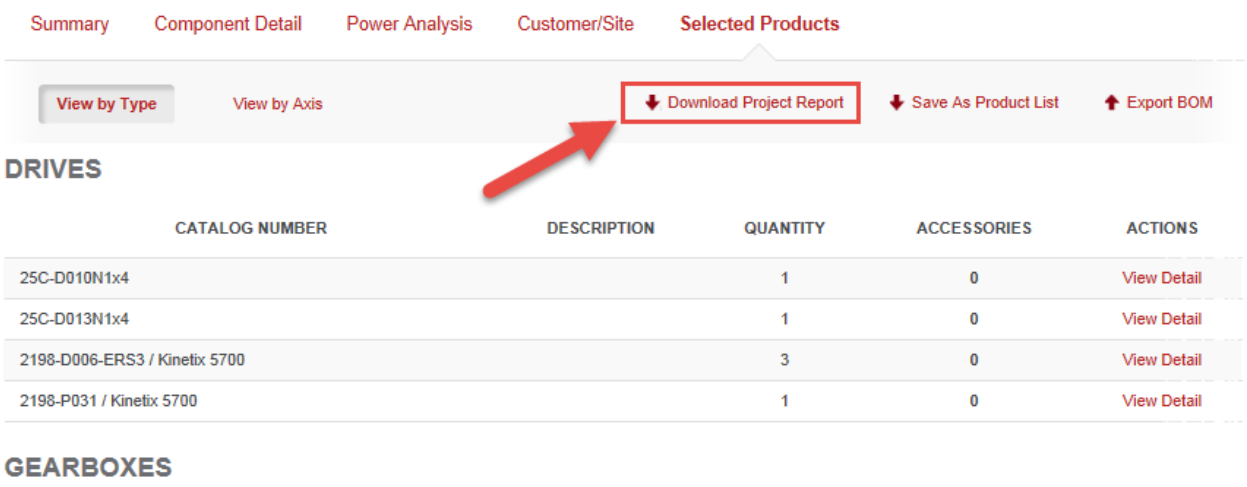


3. To create an excel file containing the catalog number of your selected products, you select **Export BOM**



4. Click **Open** to open the .csv file and review your selected products and their catalog number

5. You can also download a PDF file containing your project report by clicking **Download Project Report**

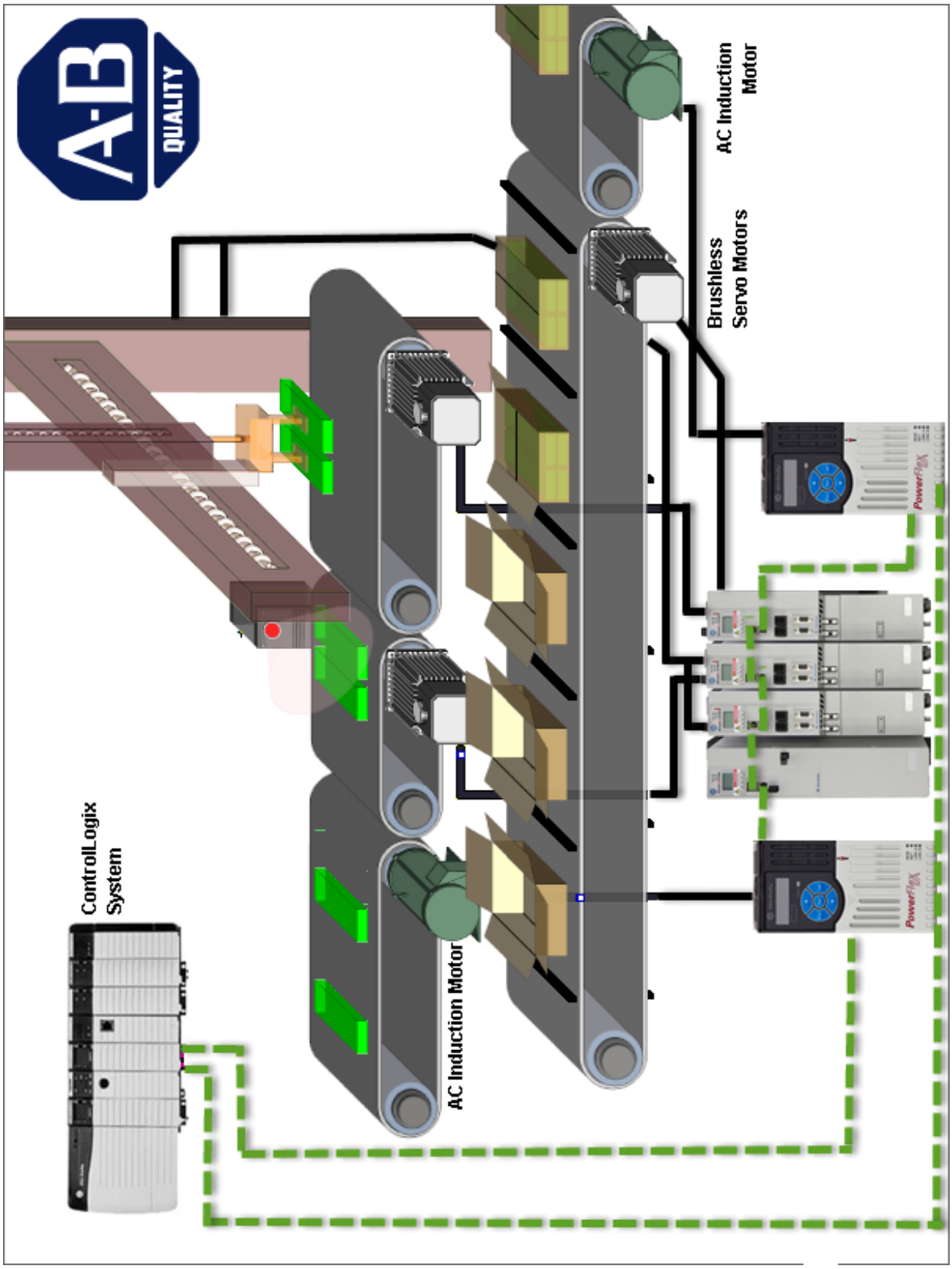


6. Click **Open** to open the .pdf file and review your project report document

7. Close both documents **without saving** them.

This section of the lab is complete

Visualization

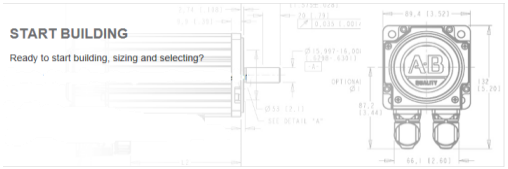


Extra

Power Cables were not selected throughout the Project. Go into each axis and add in a power cable if available. Review your Power Analysis page to see the cable utilization calculation.

Notes:

motionanalyzer.rockwellautomation.com



motionanalyzersupport@ra.rockwell.com
for support and questions.

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