VectisDYO™

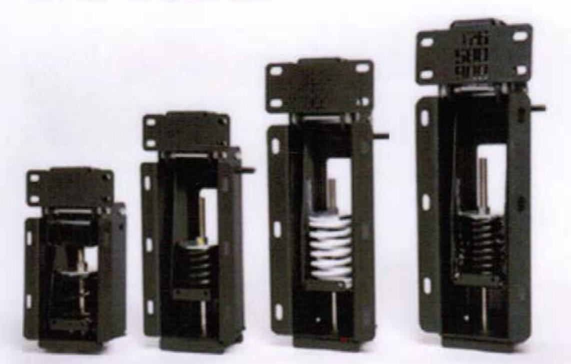
Design Your Own

Counterbalance Hinge

Information Booklet

We build it.

And ship the custom counterbalance hinges YOU designed to you in 2 weeks.

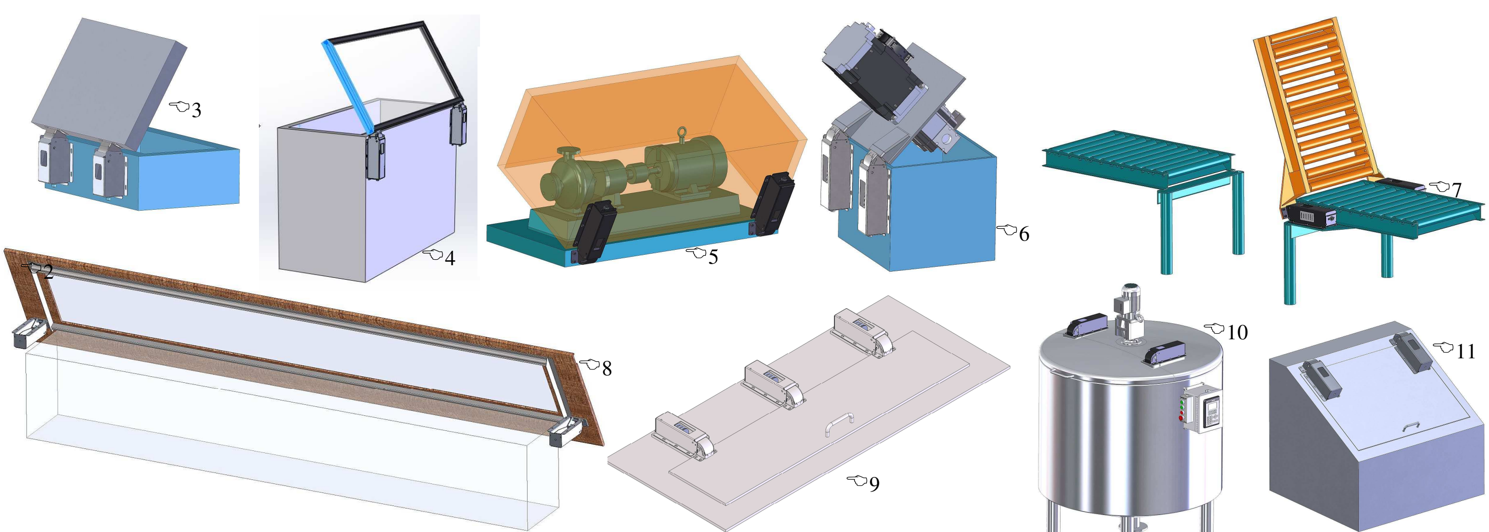


Leveraging Controlled Balance

What is a Vectis Flex™ Couterbalance Hinge?

Vectis Flex™ Counterbalance Hinges comprise a family of 4 standard spring loaded hinge mechanisms intended for low quantity applications. They are designed to counterbalance a wide range of loads that pivot up to 90 degrees about a horizontal axis. During their manufacturing process, **Vectis Flex**™ Counterbalance Hinges are tailored to apply specific torques at specific angles to match your unique counterbalancing needs.

Some examples of typical **Vectis Flex**™ Counterbalance Hinge applications are represented below:



Order a customized counterbalance hinge tailored to meet your unique needs

Step 1: Define the lid (or load) you wish to counterbalance

Before your **Vectis Flex**™ spring counterbalance hinge is manufactured, you get to simulate any number of possible configurations and see graphically how each configuration would interact with the load you wish to counterbalance. Start by opening the online **Vectis DYO**™ design tool at:

http://www.vectiscounterbalance.com/vectis/

Online, define the lid or load you wish to counterbalance by entering just 3 values: your load's Lid Weight plus your load's Horizontal Distance and Vertical Distance. The "Distances" refer to the location of your load's center of gravity (C.G.) relative to the pivot axis ***when your load is in the "0 degree" (closed or lowest) position***.

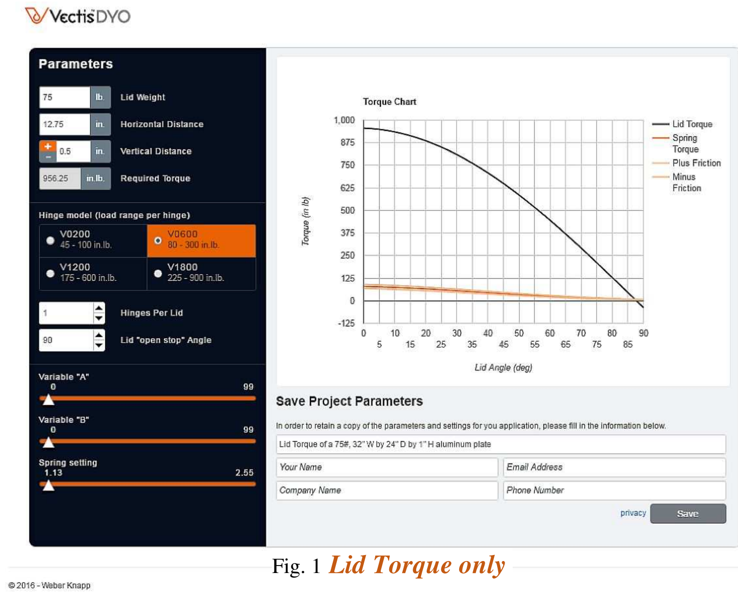


Fig. 1 ***Lid Torque only***

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Note: In this example, the C.G. of the lid (or load) goes "over center" at about 88 degrees. At lid angles above 88 degrees this lid would tend to self-open rather than self-close as indicated by the black Lid Torque line showing negative Lid Torque values between 88 and 90 degrees.

Based on this information, the online **Vectis DYO**™ (Design Your Own) tool automatically plots a black line on the graph representing the gravity induced self-closing torque of your lid or load at all angles of rotation from 0 to 90 degrees (see Figure 1 above).

Step 2: Select the basic Vectis Flex™ hinge size that best suits your application

Based on the values entered in ***Step 1:***, the **Vectis DYO**™ app calculates the approximate torque required to lift your lid/load from its 0 degree (closed) position and displays this value for your convenience in the Required Torque text box.

You can use the Required Torque value to make an initial guess about which **Vectis Flex**™ counterbalance hinge model might be appropriate and how many hinges might be required per lid.

In the case of the lid/load defined in the example above, the Required Torque is 965.25 in.lb. Looking at the torque ranges of the (4) **Vectis Flex**™ models available (V0200, V0600, V1200, and V1800), it looks like a pair of V1200s might work well.

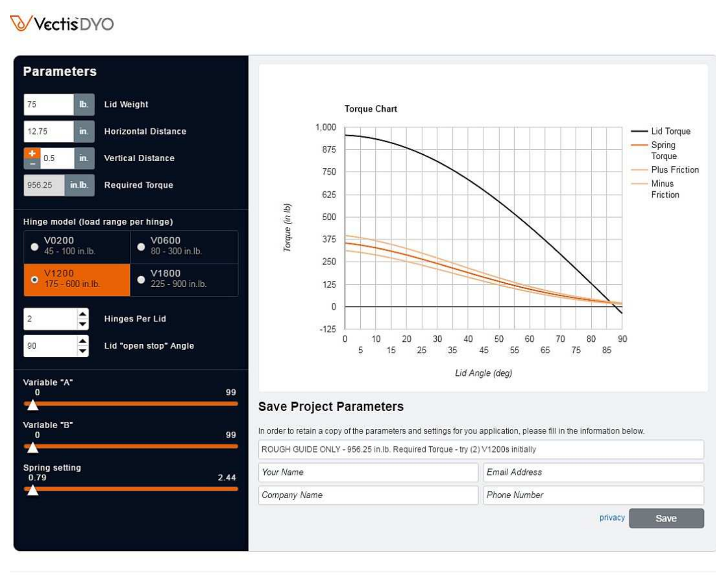

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Fig. 2 ***Roughly match model & Hinges Per Lid to Required Torque***

Remember: Any variable or input in the **Vectis DYO**™ app can be changed again and again at any time throughout the design process so it is not essential that the right value is selected initially

Step 3:
Determine the number of hinges needed to support your lid or load

A typical lid will require 2 or more hinges to provide adequate mechanical support. Occasionally 1 hinge will do for a light/narrow load. When deciding how many Hinges Per Lid should be used for your application, 14 several factors should be weighed. Often mechanical mounting considerations like size of the hinge or supporting the middle of an unusually long lid are important. Of course, very large lid/loads can require several **Vectis Flex**™ hinges just to provide the spring energy needed to counterbalance the heavy weight. Care must be taken to keep the pivot axis centerlines of multiple hinges aligned.

Step 4:
Simulate the counterbalancing action you wish to achieve

The orange Spring Torque Curve line on the graph in the **Vectis DYO**™ app represents the spring based opening torque applied by the selected number of customized **Vectis Flex**™ Hinges per Lid. By inputting or adjusting a few additional parameters on the **Vectis DYO**™ app, you can position the orange line above, on, or below the black line at different angles to control the amount of spring based torque that will be applied to counteract your lid or load at each angle (see Figures 3 & 4). 15

VectisDYO

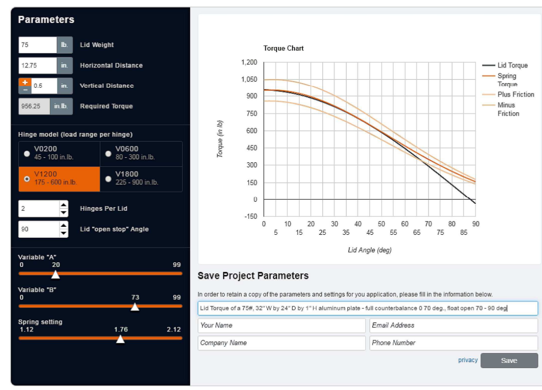

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Fig. 3 ***0 to 70 deg. full counterbalance action***

VectisDYO

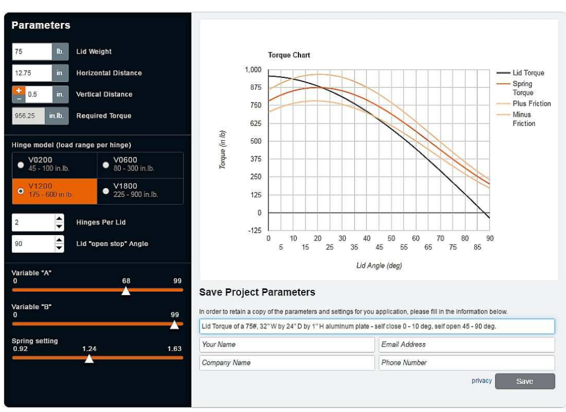

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Fig. 4 ***0-10 deg. self-close, 45-90 deg. self-open***

Note: In addition to the spring based counterbalancing action represented by the darker orange line, the lighter orange lines approximately represent a controlled friction band built into your hinge. This friction helps hold your load in place. In areas where the black Lid Torque line is between the light orange lines, the lid or load will tend to remain stationary.

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Remember: **Vectis DYO**™ inputs and variables are interactive so changing one value may alter or limit other values. Like any iterative process, it is important to evaluate multiple design combinations before choosing the best solution. Experiment!

Step 5:
Designate the built in open stop angle of your hinge

In the **Vectis DYO**™ app's Lid "openstop" Angle input box, ***simply type in the open stop angle desired***.

Not all counterbalance hinge applications require 90 degrees of rotation. You must specify a Lid "openstop" Angle between 45 and 90 degrees. This angle will be permanently cut into your hinge when it is manufactured.

There are many situations where it is desirable to limit your lid or load's travel to less than the full 90 degree rotation range. Typical reasons for limiting rotation might include keeping a lid's handle within convenient 17 operator range or avoiding other obstacles in the area of your rotating load. You also may wish to prevent an uncontrolled "float open" condition. Sometimes limiting unnecessary rotation allows internal spring resources to be allocated for better counterbalancing action in the more critical range of lid or load rotation.
The built in open stop is more than capable of withstanding normal spring and static weight loads. However, if excessive external or inertia based loads are anticipated in your application, supplemental external support must be provided.

Step 6:
Save your custom counterbalance hinge design and order as many hinges as you need

To save a record of the parameters and counterbalancing action depicted by the graph displayed by the online **Vectis DYO**™ app, fill in your contact information and name your design in the "**Save Project Parameters**" block in the lower right corner of the online **Vectis DYO**™ app. Then record the current version of your design, by clicking the Save button at the lower right on the screen. An email will automatically be sent to you containing the parameters and graph of your current design. Use a unique "Project/Design Name" each time you save to distinguish between different versions or iterations of your design.

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When you are satisfied that your selections and adjustments are optimized to meet your needs, or after working out the best solution together with a Vectis representative, it's time to place your order. The new **Vectis Flex**™ website is being continuously enhanced and will soon provide secure online ordering. In the meantime, and at any time in the future we will be happy to take your order and arrange payment through any of the contact methods listed in the orange box below.

Remember: Vectis™ sales and application engineering personnel are eager to assist you at any stage of your design. Business hours are 8AM to 5PM EST Mon. - Fri. Contact info:

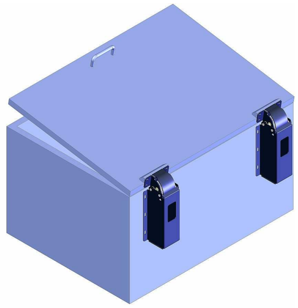
- T. 716.485.2111 or 800.828.9254 x 263
- F. 716.484.9142
- E. vectis@weberknapp.com

Please don't hesitate to reach out to us if any questions arise. We're always happy to help.

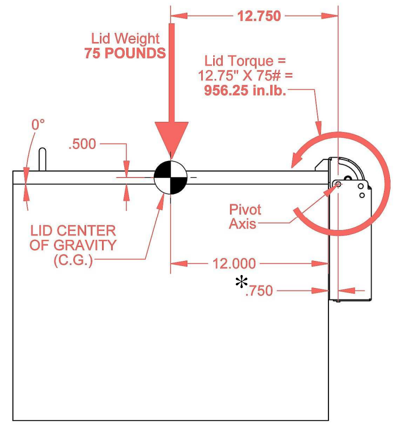
Small quantities of Vectis Flex™ hinges, custom manufactured to provide the specific spring torque curve you specify using the Vectis DYO™ (Design Your Own) app, will be shipped to you within 2 weeks of the date you place your order.
It's that easy!

What is Lid Torque?

Consider the simple box with hinged lid pictured below. Gravity acting on the lid induces a **TORQUE** about the hinge axis that tends to slam the lid closed or, at some angles, may cause the lid to open further. The Lid Torque at any angle of the hinged lid or rotating load is a function of the weight of the lid/load multiplied by the Horizontal Distance between the object's center of gravity (C.G.) and the pivot axis.



Assume the example lid pictured here is a solid plate of aluminum, 32" wide by 24" deep by 1" thick, weighing 75 pounds. The center of gravity (C.G.) of the lid would be in the geometric center of the lid, ½" up from the bottom surface and 12" away from the back edge of the lid. Remember, the pivot axis is an additional ¾" beyond the back edge and on the same plane as the bottom of the plate*.



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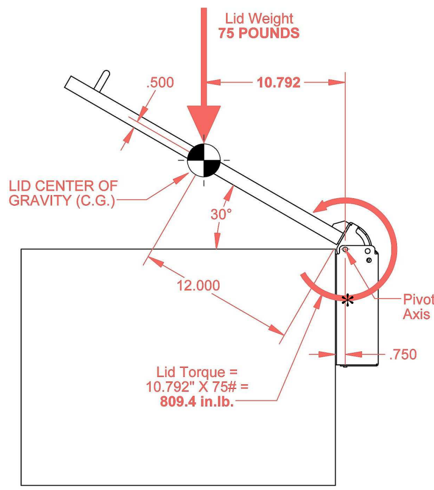
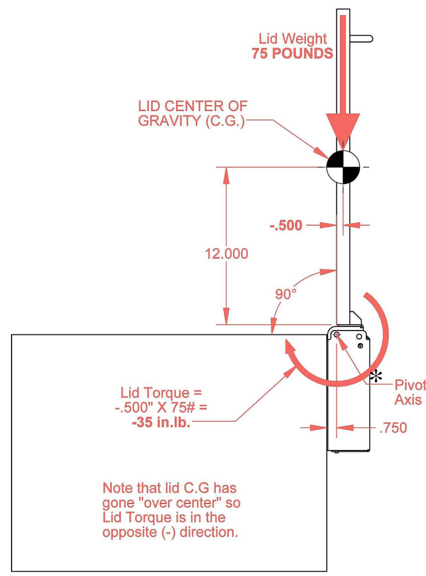
When this lid is closed (0 degrees open), the lid center of gravity (C.G.) is a **Horizontal Distance** of **12.750**"* from the hinge pivot axis and a **Vertical Distance** of **+.500**" from the axis. Notice that in this example, the C.G. is above the hinge pivot axis so the Vertical Distance is positive (**+**). If the C.G. were below the axis, the **Vertical Distance** would be considered negative (-).

Once the weight of your lid and the location of its C.G. is established at the 0 degree (closed) angle, the **Vectis DYO**™ app automatically calculates the Lid Torque at all other angles and draws the black Lid Torque curve on the graph.





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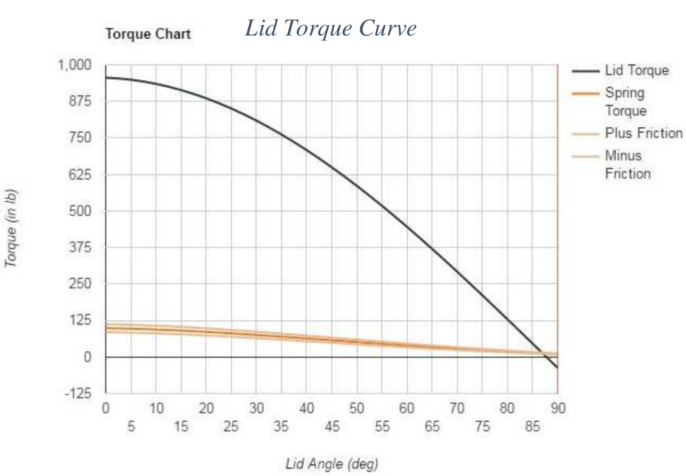
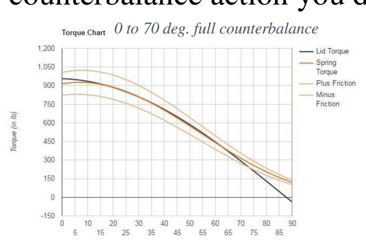
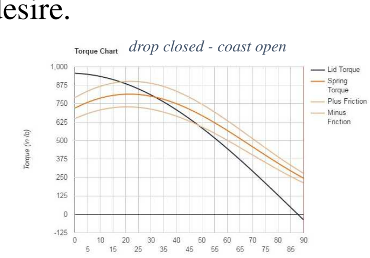
All 3 Lid Torque curves below represent the gravity induced torque of this example lid at all lid angles between 0 (closed) and 90 degrees (open). Entering just the **75#** **Lid Weight**, **12.75" Horizontal Distance,** and **+.500" Vertical Distance** at the lid's 0 degree (closed) position allows the online **Vectis DYO**™ app to plot the Lid Torque at all angles providing a visual reference for defining your desired **Vectis Flex**™ hinge counterbalancing action.



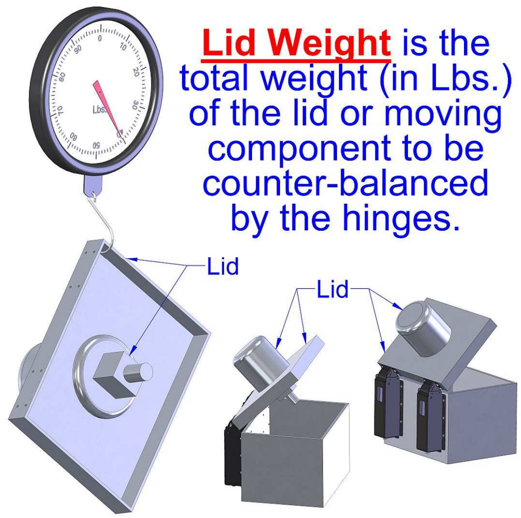
Why is this important?

With the Lid Torque curve defined, the other **Vectis DYO**™ app parameters can be adjusted to position the orange Spring Torque curve relative to the black Lid Torque curve (as in the examples below) to specify the counterbalance action you desire.





How to determine Lid Weight (and C.G.)



Vectis Flex™ counterbalance hinges are often used to support heavy lids. With some exceptions, they can also be used to support relatively light lids as well as access covers, trap doors, housings, lift gates, machine modules, or any number of other loads, large and small, that hinge up and down around a horizontal axis.

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Determining the actual weight of the lid or load that is being counterbalanced is a fundamental factor in selecting the right **Vectis Flex**™ counterbalance hinge and tailoring its Torque Curve to provide the counterbalancing action your application requires. Ideally, determining the "Lid Weight" is simply a matter of removing the entire lid or rotating load, if it already exists, and weighing it using a good scale.

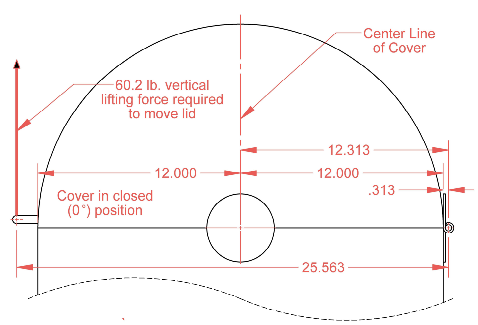
Modern CAD systems can easily predict both weight and C.G. within your design quite reliably before your device is even built. **Vectis Flex**™ counterbalance hinges and CAD design work very well together. The more accurate the "Lid Weight" variable entered in the **Vectis DYO**™ app, the more reliable the prediction of your counterbalancing action will be.

> Many CAD designers prefer to include the counterbalance hinge in the overall design early on. Simplified CAD models of the 4 sizes of **Vectis Flex**™ counterbalance hinges are available in several standard formats that can be easily incorporated into your overall CAD model from the beginning of the design process. If the wrong hinge size is initially chosen, the CAD model of a more appropriate sized **Vectis Flex**™ hinge can easily be substituted at any time.

Fabrication shops or individual craftsmen working without sophisticated CAD systems can also take advantage of **Vectis Flex**™ counterbalance hinges. Weight (and also CG) of your lid can still be easily predicted using hand sketches with dimensions, knowing the density of the components making up your lid or hinged load, and then applying some simple arithmetic. In some cases, not even this effort is required.

Example: Measuring weight of installed lid

For instance, if you are considering replacing currently installed hinges with **Vectis Flex**™ counterbalance hinges on an existing lid, housing, or piece of machinery, pretty good estimates of weight and C.G. can often be made without even removing the lid, housing or hinged piece, etc. Taking some force and dimensional measurements without removing the rotating component can often do the trick. ☜23

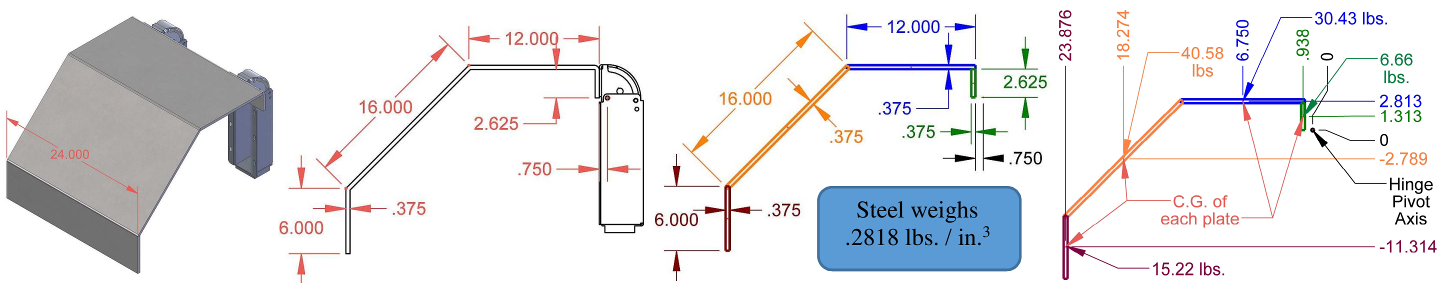


As an example, the hinged cover pictured above on the left has a handle in the front but is awkward and heavy to manually open. It is uniformly fabricated out of ¼" steel. Perhaps it's an ideal candidate for a pair of **Vectis Flex**™ counterbalance hinges but we need to know its weight and C.G. to find out for sure.

Consider the drawing above on the right depicting an end view of the same cover in the closed position. Using a force gage, it is found that 60.2 lbs. of vertical force is required to begin opening the cover from its closed (0 deg.) position. Using a tape measure, it is learned that the horizontal distance from the center of the hinge axis to the handle where the vertical force is applied at the handle is 25.563". With these 2 measurements we know that it takes 60.2 lbs. X 25.563" = 1538.9 in.lb. of torque about the hinge axis to overcome gravity and begin opening the cover.

Since the cover is basically bisymmetrical around its center line (ignoring hinge and handle weight) we can assume the center of gravity of the cover falls somewhere on that center line which is 12.313" from the hinge axis. To find the Lid Weight without removing the hinges, we can reason that the unknown weight of the lid ☜24 pushing downward at the C.G. (center of gravity) which is 12.313" from the hinge axis, is creating the 1538.9 in.lb. of torque about the hinge axis. By dividing the 1538.9 in.lb. by the 12.313", we can calculate that the Lid Weight acting on the lid at its C.G. must be very close to 125.0 lbs.

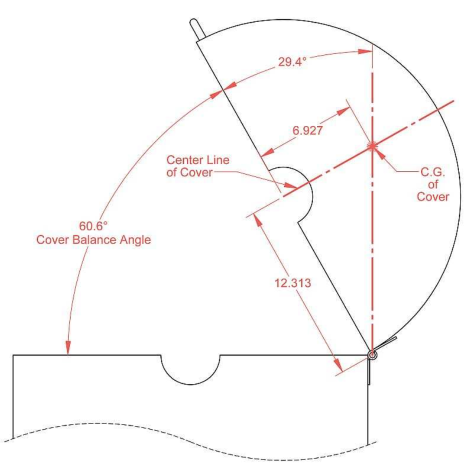
Predicting Lid Weight & Center of Gravity (C.G.) using simple calculations



Width		Depth		Thick		Density		Weight		Horiz.		X-torq	Weight		Vert.		y-torq		
24.00	X	2.63	X	0.38	X	0.2818	=	6.66	X	0.94	=	6.24	6.66	X	1.31	=	8.74		
24.00	X	12.00	X	0.38	X	0.2818	=	30.43	X	6.75	=	205.43	30.43	X	2.81	=	85.61		
24.00	X	16.00	X	0.38	X	0.2818	=	40.58	X	18.27	=	741.54	40.58	X	-2.79	=	-113.18		
24.00	X	6.00	X	0.38	X	0.2818	=	15.22	X	23.88	=	363.39	15.22	X	-11.31	=	-172.17		
								92.89				1316.61 / 92.89	=	14.17			-190.99 / 92.89	=	-2.06
Lid Weight =		92.89				Horizontal =		14.17				Vertical =	-2.06						

It is often possible to consider a single lid/load as individual pieces whose weight and C.G. are easy to calculate separately. Instead of the single formed lid shown on the left, picture it as 4 separate rectangular plates, each 3/8" thick and 24" wide. Multiply each plate's width, depth, thickness, and density to determine the weight of each part. The sum of these weights is the Lid Weight. The C.G. of each simple part can be easily located with a little math. To find overall C.G., sum the horizontal distance from the hinge axis to each plates C.G. and divide the sum by the total Lid Weight. The same process applies for the vertical distances. See the math example in the spreadsheet above. ☜25

Determining Center of Gravity (C.G.) using a measurement method



In this example we've already determined the weight of the cover without removing it from the machine, but we still need to know where its center of gravity is. Actually, we already know how far the C.G. is horizontally from the hinge axis when it's closed. We just aren't yet ☜26 sure where it is vertically on that centerline.

If we carefully raise the cover to the angle it best balances at over the hinge, we can assume that, at that balance angle, the C.G. of the cover is directly above the hinge axis. Measuring the opening angle at the balance point gives us the information shown in the diagram on the left.

Knowing that the C.G. is on a line through the hinge axis that is 29.4 deg. from the bottom of the cover and that the C.G. also lies on a line perpendicular to the bottom of the cover that is 12.313" from the hinge axis, we can find the intersection of the 2 lines and the vertical location of the C.G. relative to the hinge axis. Starting with the equation…

$$Tan\ 29.4° = \frac{C.G.vertical\ dim.}{12.313"}$$

we can reason that the C.G. Vertical Dimension = 6.927" in this example. ☜27

Other methods of determining Lid Weight and C.G.

Lid closed = 0 degree open angle

There are many ways to determine the Lid Weight, Horizontal Distance, and Vertical Distance inputs that are needed to represent your unique rotating load in the **Vectis DYO**™ app. Here's another method that can be used if the rotating load you wish to counterbalance currently pivots about simple hinges but cannot be easily removed for weighing and measuring.

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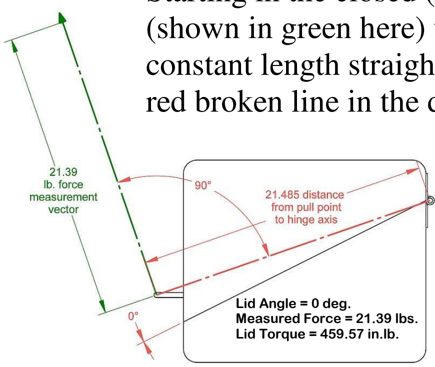
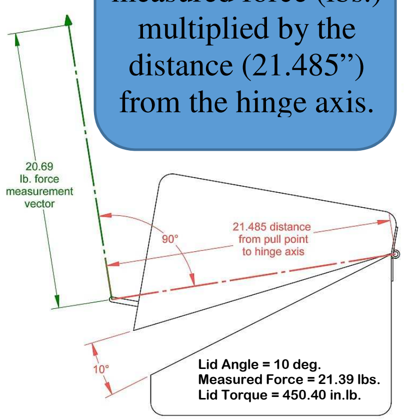
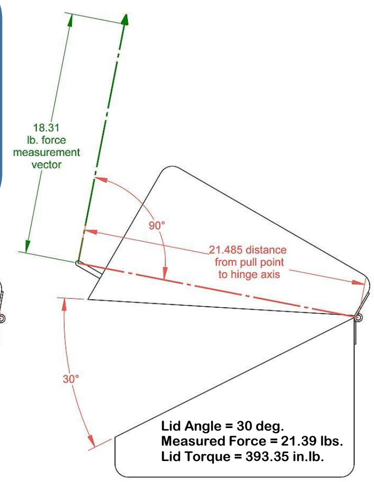
Starting in the closed (0 Degree) condition, determine a pull line (shown in green here) that is perpendicular to an imaginary constant length straight (red) line stretching from the pull point to the hinge axis, as shown by the red broken line in the diagrams below. The force gage pull point can be at the handle, an edge, or any other convenient fixed attachment point on the rotating unit. Try to choose a force gage attachment point that is as far away from the hinge axis as possible to maximize the accuracy of your readings.

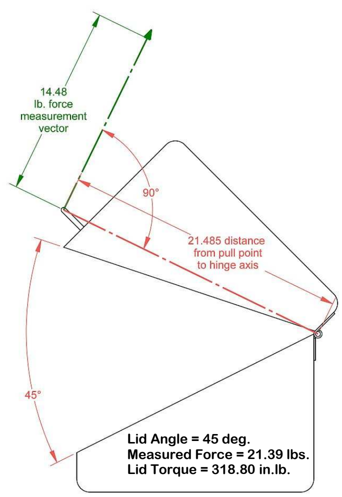


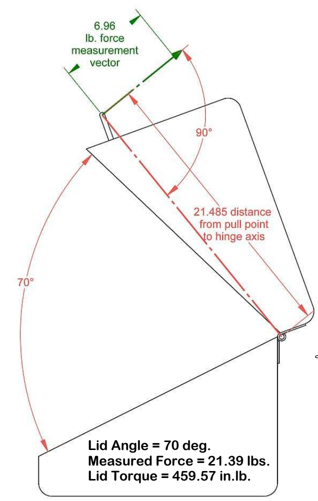
Remember: Each force reading will be taken while pulling at a different angle that remains perpendicular to the imaginary red line **DO NOT PULL STRAIGHT UP – FOLLOW THE ROTATION**

Lid Torque = measured force (lbs.) multiplied by the distance (21.485") from the hinge axis.









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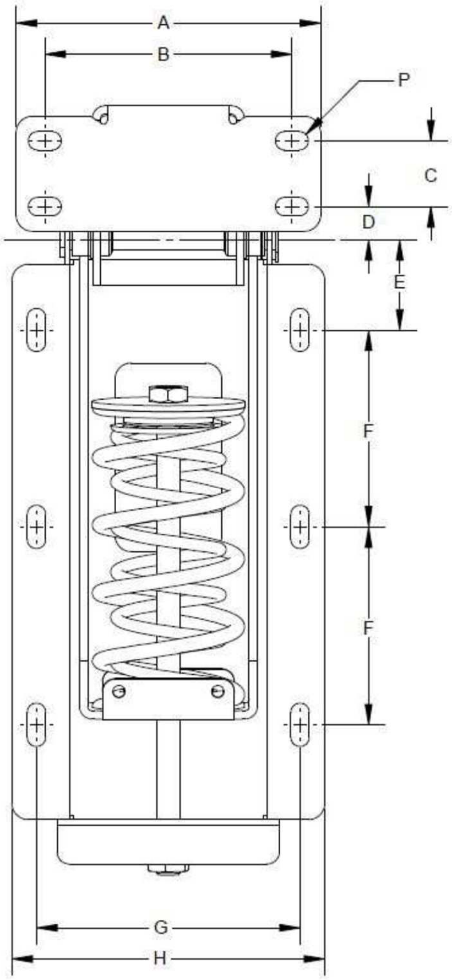
Force Reading	Lid Angle	Lid Torque
21.39 lb.	0	459.57
20.96 lb.	10	450.40
18.31 lb.	30	339.35
14.84 lb.	45	318.80
6.96 lb.	70	149.49

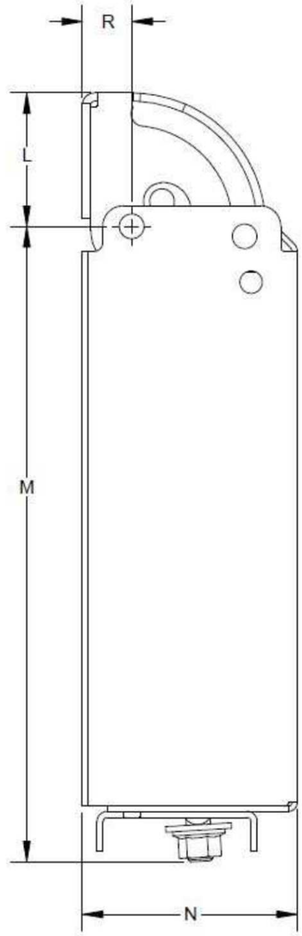
Starting in the closed (0 degree) position, take force readings at several lid angles. Try to cover as wide a span of angles as possible. Within reason, more readings lead to a more accurate result based on averaging. The angle at which each force reading is taken at is not important as long as the actual angle and force reading are measured accurately and at the same angle.

Based on the force and angle readings taken and the torque values calculated at each reading angle, the Lid Weight, Horizontal Distance, and Vertical Distance values can be derived for your rotating lid or load. These derived values can then be entered into the **Vectis DYO**™ app in order to begin the design of your customized **Vectis Flex**™ counterbalance hinges. You can do the math yourself or pass your table of readings on to a **Vectis Flex**™ engineer who will return your derived Lid Weight, Horizontal Distance, and Vertical Distance based on your data using the method of least squares. ☜30

Other methods of determining your Lid Weight, and C.G's Horizontal Distance and Vertical Distance are also possible.

Physical Characteristics





	V0200	V0600	V1200	V1800
A	4.500	4.625	5.313	5.313
B	3.625	3.750	4.250	4.250
C	0.875	1.000	1.500	1.500
D	0.500	0.500	0.625	0.625
E	1.375	1.375	1.375	1.375
F	3.000	3.000	4.000	4.000
G	4.000	4.000	4.375	4.375
H	4.500	4.750	5.250	5.250
L	1.750	2.030	2.712	3.063
M	6.938	9.652	11.328	12.513
N	3.141	3.267	3.656	4.062
P	Ø 0.210	Ø 0.280	Ø 0.343	Ø 0.343
R	0.750	0.750	0.750	0.750

* ALL DIMENSIONS ARE IN INCHES

Product Specifications

The full line of high-quality **Vectis Flex**™ springloaded counterbalance hinges are purpose built for a wide range of indoor and outdoor applications. They are made from rugged UV resistant powdercoated steel, stainless steel, and other appropriate materials. These hinges are built to last more than 100,000 open and close cycles in temperatures ranging from below freezing to 110° F.

During our manufacturing process all four Vectis Flex™ models - V0200, V0600, V1200, and V1800 – are tailored to meet your specific requirements based on your online Vectis DYO™ design tool selections.

CNC operations are used during our manufacturing process to cut critical internal geometry based on your Variable "A" and Variable "B" selections. The (45° to 90°) Lid "open stop" Angle setting you select using the **Vectis DYO**™ online design tool is also permanently cut into your **Vectis Flex**™ hinge. Your Spring setting selection is preset at the factory as well, but spring adjustment (only) can be altered in the field within specified limits.

Orders placed for small quantities of factory tailored **Vectis Flex**™ hinges will be shipped to you in just 2 weeks. Payment for small orders by credit card is encouraged. Alternative payment methods may be negotiated.

Weber Knapp warrants all **Vectis Flex**™ springloaded counterbalance hinges to be free from physical defects in material and workmanship for a period of (1) year from the date of original purchase. If you discover a defect covered by this warranty, we will repair or replace the product at our option.

Contact us for additional information

- Weber Knapp Co. 441 Chandler St. Jamestown, NY 14701
- Vectis Sales Department: Marsh Brugge
- T. 800.828.9254 x 263
- F. 716.484-9142
- E. vectis@weberknapp.com