SPOKE CALCULATOR

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Hub Settings

Custom Hub

Flange Diam.	58	mm
Flange Spacing	57	mm
Dishing Offset	3.5	mm
# Spokes	36	
Axle Length	135	mm
Hole Diam.	2.5	mm
Paired Holes	10,1	mm

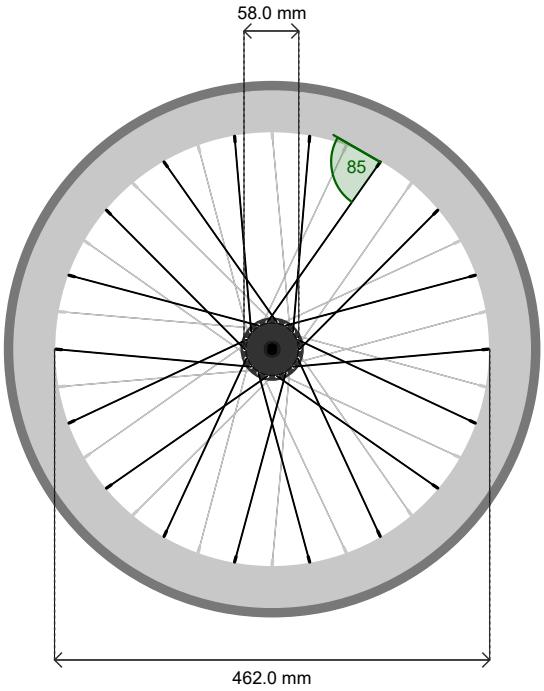
Rim Settings

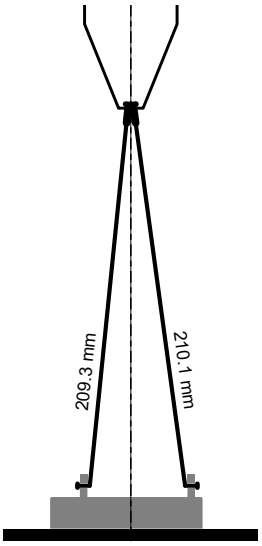
Custom Rim

Nominal Diam.	26" (559)	
ERD	462	mm
Left Offset	1.5	mm
Right Offset	1.5	mm
Rim Width	49	mm

Lacing Options

Cross Pattern	2	
Left Elbow	Out / In	
Right Elbow	Out / In	
Swap Spokes		
Hub Shift	0	mm





Left Spoke Length	Right Spoke Length	Spoke Angle	Tension Ratio
209.3 mm	**210.1 mm**	**84.9 °**	**57 : 43**

222585 spoke calculations made so far!

Hub Settings

The drop-down menu at the top has the parameters for a large number of popular hub motors, so if your motor is on this list then you should be set. If your motor is not listed, or you aren't totally sure, then you can easily measure all of the necessary parameters with vernier calipers.

- **Flange Diameter:** This is the diameter of the circle of spoke holes on the motor flange. It is the distance measured from the center of one hole to the center of the hole farthest away on the same side of the motor.
- **Flange Spacing:** This is the distance between the left and right spoke flanges, as measured from center to center.
- **Dishing Offset:** This is the distance between the midpoint between the spoke flanges and the midpoint of the axle. If it is zero, then the hub is drawn with the flanges centered on the axle and requires no dishing. Rear motors often have the flanges shifted to the left to allow space for the cogset, and require a negative dishing offset here to account for that. Front hubs with disk brakes often have their flanges further to the right to leave room for the disk caliper, and so have a positive dishing offset.
- **# Spokes:** Almost all hub motors are drilled for 36 spokes. That's a bit unfortunate, since most conventional rims these days have 32 holes. This calculator assumes that the number of holes in the rim matches the number on set here for the hub.
- **Axle Length:** This only affects the length of the axle that is drawn in the edge view diagram for visual reference, it does not enter into the spoke length calculations.
- **Hole Diam:** This is the diameter of the spoke hole in the hub flange. Some motors are drilled out to >3mm for 12g spokes, while hubs meant for just 14g spokes are usually ~2.5mm.
- **Paired Holes:** Put a check in the "Paired Holes" checkbox if the motor does not have a uniform hole pattern but instead groups the spoke holes in pairs of 2, and then type in the measured distance between adjacent paired holes.

Rim Settings

The dropdown menu has all the rim types that we stock here at GRIN. If you are using a 3rd party rim, then usually there is no problem looking up the ERD and offset specifications from the manufacturer or measuring them yourself. There is also comprehensive table of rim data at the **FreeSpoke website**.

- **Nominal Diameter:** This is just the nominal bike wheel size (26", 24", 700c etc). It is only used for drawing purposes, and does not affect the spoke length calculations.
- **ERD:** This is the most essential measurement for determining the spoke length required for a particular rim. It is the diameter from where the very end of the spoke should sit in the laced up wheel. Generally speaking that is at the back of where the nipple fits in the rim. YPedal had a decent photo page illustrating **how to measure rim ERD yourself**.
- **Left Offset:** This is the distance from the center of the rim to the left side spoke holes. If the rim holes are all in a row, then it would be left at 0mm
- **Right Offset:** This it the distance from the center of the rim to the right side spoke holes. If the rim holes are not staggered, then it should be left at 0mm.
- **Rim Width:** This is the outer width of the rim and only affects the way that the rim is drawn in the edge view diagram, it is not involved in the spoke length calculations. However, wide rims (>30mm) will almost alway have a left and right spoke offset.

Lacing Options

Even with a given rim and hub motor, there are still several ways you can go about lacing up the wheel, many of which will affect the required spoke length.

- **Cross Pattern:** Most hub motors are laced with a single cross pattern. There is no point at all in having 2 or more crosses with the large flange diameters of most hub motors, and doing so will usually result the spoke entering the rim at a very difficult angle. Small geared hubs can be laced into large diameter (>26") rims with a double cross pattern OK, and large direct drive motors in small (<=20") rims usually can only be laced radially with 0 cross. If you have a motor with paired spoke holes, then a 0 cross pattern still has a spoke angle for transmitting torque, and there is no need for even single crossing the spokes.
- **Left Elbow:** This determines if the left spokes have their elbow inside the flange or outside the flange. With the elbow outside, you get better triangulation from the spokes and a slightly longer spoke length as well. We generally recommend elbows outside except in cases where you have a small rim diameter or need to facilitate dishing by having all left elbows in, and all right elbows out.
- **Right Elbow:** This determines if your right side spokes have their elbows on the inside or outside of the flange.
- **Swap Spokes:** If you check this box, then it will lace spokes from the right rim hole to the left hub flange, and from the left rim hole to the right flange, resulting in a 'X' in the edge view drawing. This step can increase the side to side triangulation of the spokes, though rims are not normally designed to be laced in this fashion and we've had some strange results attempting to build up fatbike rims this way.
- **Hub Shift:** Use this field to shift the hub left or right relative to the rim. If for instance you require a 5mm spacer on the right axle to fit a larger freewheel than what the motor was designed for, then you could do a 2.5mm hub shift to the left in order to properly center the hub as it will be on the bicycle.

Results

The Spoke Calculator shows not only the theoretical left and right spoke lengths, but also the tension ratio and spoke angle into the rim.

- **Left/Right Spoke Length:** Although the calculator shows to the nearest 0.1mm, in practice your spokes can be +- 1mm from the optimum length and still work just fine, and +-2mm will still function but it's less than ideal. So if the left and right spokes differ by only 1mm or so, then you might as well order all spokes the same length.
- **Spoke Angle:** This is the angle between the spoke and the tangent line of the rim. Generally speaking, if the angle is more than 80 degrees then it can be laced with relative ease. If the angle is less than 75 degrees, then the spoke nipples will have some difficulty in angling in the same direction as the spokes, and you may need to either put a bend in the spoke so that it enters the rim a bit more radially, or drill out the rim holes slightly larger so that the nipples have more freedom to pivot. Angles less than about 70 degrees are quite problematic and best avoided.
- **Tension Ratio:** This shows how the tension is distributed between the left and the right spokes. In a heavily dished wheel, you can sometimes have upwards of 80% of the tension in the more vertical spokes. The further this ratio deviates from 50:50, the more you put all the wheel tension on just one side of the spoke set, and the more likely you are to break those spokes.

Wheel building

There are many good print and online references for lacing bicycle wheels. Many will defer to **Sheldon Brown**, Brandt's **Bicycle Wheel Book**, and others. However, a lot of the points and details with a conventional bicycle hubs don't necessarily apply to hub motors with their much larger flange diameter. For more information on wheel building please see our **wheel building page.**

This web application is produced by Grin Technologies / ebikes.ca, as a result of much hard work from Shivan, Samson, and Justin. Last updated March 2015.