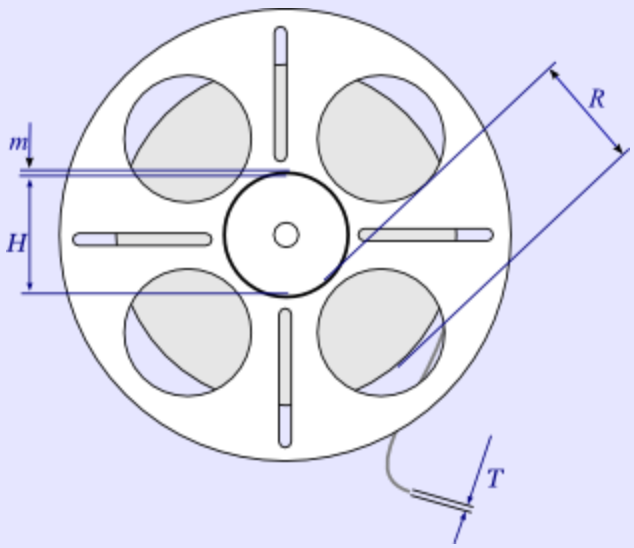
REEL QUANTITY ESTIMATE

When working with reels, for doing "pick & place" on a PCB, it is not uncommon that you wonder how many components are left on the reel. For a good estimate, you need to have four numbers: the diameter of the core of the reel (the hub), the outer diameter of the rolled-up tape, the thickness of the carrier tape and the distance that the components are spaced from each other on the tape.

For ease of measurement, what we measure instead is the distance between the *inside* edge of the hub to the outside of the roll (dimension *R* in the drawing). This is easier to measure, with calibers. The diameter is then derived from this value. Additionally, instead of measuring the outside diameter of the hub (which is difficult to do on a non-empty reel), we measure the *inside* diameter of the hub, and then add a value to determine the *outside* diameter. The value *m*, which is the thickness of the material, is an estimate, but typically a value between 1.5 and 2mm.

Roll edge to inside hub edge	*R*		
Hub inside diameter	*H*	60	
Hub material thickness (estimate)	*m*	1.75	
Tape thickness	*T*	0.8	
Component pitch (feeder holes are spaced at 4mm)		4	
Estimated quantity			

All dimensions must use the same unit. The default values in the form assume millimetres.

The thickness of the tape and the diameter of the reel hub vary from brand to brand, but a few sizes are common. For 7" reels (178mm), a common hub diameter is 60mm, but 50.8mm (2") occurs too. For 13" reels (330mm), hub sizes of 85mm and 100mm are common.

The component spacing on the tape is standardized at 4mm for small parts (0805, 0603) and a multiple of 4mm for larger components. The reason is that tape has sprocket holes on one edge for the feeder wheel to grip into and the component

spacing is a multiple of the spacing of these feeder holes. The EIA-481 standard mandates a spacing of these feeder holes of 4.0mm.

How accurate is it?

The equations are exact, but the results are only as good as the measurements. As a rule of thumb, the tolerance of a measure taken with standard calipers (with a vernier scale) should be assumed to be ±0.2mm. With paper tape having a thickness of 0.8mm, this would mean an accuracy of 25% (0.2mm tolerance is 25% of the thickness of 0.8mm).

With calipers with a digital scale, you will reach more accurate measurements and therefore a more accurate estimate. I consider an accuracy of 10% doable.

However, keep in mind that the initial start of the tape is usually empty. Some manufacturers also leave the tail part of the tape empty. A reel may therefore hold less components than calculated. (Of course, with a nearly full reel, the empty start and end of the tape are less relevant than with a nearly empty reel.)

The equations

The outside diameter of the roll is the measured value of the hub, plus twice the measured value R. Note that the measurement of R measures from the inside of the hub to the outside of the roll.

$$D=H+2R$$

The *inside* diameter of the roll is the *outer* diameter of the hub. This is the measured *inside* diameter of the hub, plus twice the material thickness.

$$d=H+2m$$

First, the number of windings on the reel is calculated. Each winding adds the thickness of the tape over the entire circumference of the reel, and so the diameter increases by twice the thickness for each winding. From the difference between the outer diameter and the inner diameter of the roll, and the tape thickness, the number of windings is easily calculated.

$$W=D-d2T$$

The roll of tape on the reel is a spiral. The length of the tape spiralled on the reel is the circumference of the average diameter, multiplied by the number of windings.

$$L=D+d2\cdot W\cdot \pi$$

Once the length of the tape is known, the number of components follows by dividing it by the pitch.

Source: http://www.compuphase.com/electronics/reelestimate.htm