An Explanation on Calculating Life Expectancy

General Lifetime Calculation:
The general life calculation used by the ball screw /roller screw industry, which is a DIN (Deutsches Institut für Normung) specification, produces a theoretical (L_{10}) life (in millions of screw revolutions) that 90% of the screws should achieve under the given conditions. The equation is as follows:

$$L_{10} = \left(\frac{C}{F}\right)^3 \text{ (million revs)}$$

L_{10} is lifetime (in millions of revolutions), C is the Dynamic Load Rating of the actuator, and F is the Cubic Mean Load seen by the actuator. If the lifetime is desired in terms of travel length or cycles, L_{10} can be converted to inches, millimeters, or cycles by simply multiplying by the lead of the screw, S, or the lead of the screw over the stroke length per cycle, $\frac{S}{D}$ respectively:

$$L_{10} = \left(\frac{C}{F}\right)^3 \times S \text{ (million mm)}$$

$$L_{10} = \left(\frac{C}{F}\right)^3 \times \frac{S}{D} \text{ (million cycles)}$$

If higher than 90% reliability is desired, however, this calculation must be de-rated. The result should be multiplied by the factors below:

0.62 for 95% accuracy
0.53 for 96% accuracy
0.44 for 97% accuracy
0.33 for 98% accuracy
0.21 for 99% accuracy

This estimation is for the travel life of the roller screw only, and is deemed reliable. It implies no guarantee or warranty. The calculation is based on the theoretical cubic mean load for the application, and assumes a properly maintained and lubricated roller screw.

Short-Stroke Lifetime Calculation:
The previous method, however, is only valid for applications requiring standard movements or long-stroke presses. With the kind of loading the screw sees in short stroke pressing applications, we see other risks of failure prior to the theoretical calculated life. This failure mode is not surface wear, but instead flaking due to sub-surface fatigue. Sub-surface fatigue may not be detectable during an external inspection and may cause a sudden unexpected flaking followed by rapid degrading of the screw's surfaces due to contamination of the lubrication.

When the movement is always focused around the same point, and occupies a distance that is less than the typical motion (use the length of the rollers/nut as a reference for this distance), different problems will arise. Recirculating the lubrication becomes very difficult with short stroke applications. As the stroke gets shorter, the life calculated by the DIN spec equation becomes less valid. Any time the rotation of a mechanism doesn't make the roller or ball rotate at least one full revolution, the wear is exaggerated. Therefore, it's more a function of cycle fatigue, than stroke fatigue. This type of fatigue causes "coining" – or localized hardening and embrittlement on the roller threads.

A conservative way to estimate the life in short-stroke pressing applications is to apply a short stroke press factor of 70%, use the max pressing force instead of the cubic mean load, and use only the pressing distance for *D*. In cases where the stroke is even shorter than the length of the screw lead, the lead must also be dropped from the life calculation. Life in these applications will be much shorter than typical stroke applications. Here's how to calculate:

If the actuator is in a pressing application, and the press is **less** than the length of the roller nut (~30-60mm depending on the unit), but **greater** than the length of the screw lead, apply the short stroke press factor (70%) in the L_{10} formula:

$$L_{10} = \left(\frac{C \times 0.7}{F_{Press}}\right)^3 \times S \quad \text{(million mm)}$$

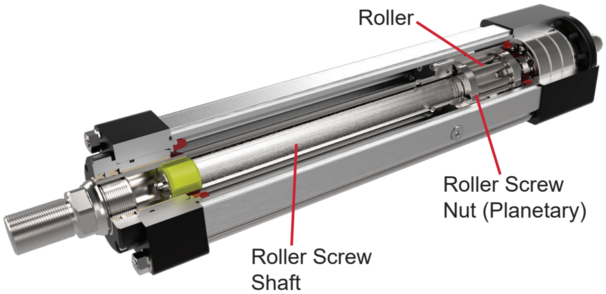
This can be converted to cycles again by simply dividing by the total distance of the press, D_{Press} (in mm/cycle):

$$L_{10} = \left(\frac{C \times 0.7}{F_{Press}}\right)^3 \times \frac{S}{D_{Press}} \quad \text{(million cycles)}$$

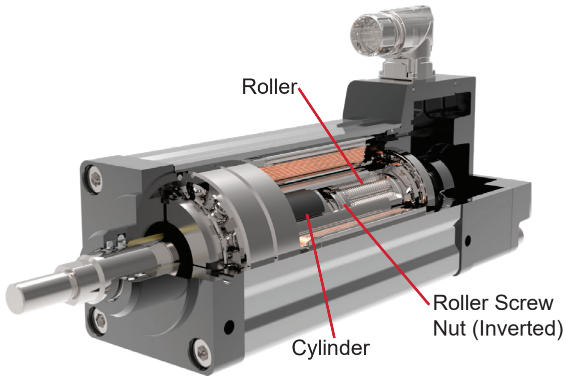
If the actuator is in a pressing application, and the press is **less** than the rollers/nut and **less** than the length of the screw lead, life should be calculated in number of cycles **without** regard to the screw lead. Therefore, the multiplication of the lead can be dropped.

$$L_{10} = \left(\frac{C \times 0.7}{F_{Press}}\right)^3 \quad \text{(million cycles)}$$

FTX Cutaway



GTX Cutaway



Example: Let's use a GSX40 in a pressing application, pushing 20,000N, with a 2.54mm lead, and a Dynamic Load Rating of 35,141N:

If pressing stroke is 100mm (> lead, > nut):

$$L_{10} = \left(\frac{35{,}141N}{20{,}000N}\right)^3 \times 2.54mm = 13.78 \text{ (million mm)}$$

$$L_{10} = \left(\frac{35{,}141N}{20{,}000N}\right)^3 \times \frac{2.54mm}{100mm} \times 10^6 = 137{,}780 \text{ (cycles)}$$

If pressing stroke is 20mm (> lead, < nut):

$$L_{10} = \left(\frac{35{,}141N \times 0.7}{20{,}000N}\right)^3 \times 2.54mm = 4.73 \text{ (million mm)}$$

$$L_{10} = \left(\frac{35{,}141N \times 0.7}{20{,}000N}\right)^3 \times \frac{2.54mm}{20mm} \times 10^6 = 236{,}293 \text{ (cycles)}$$

If pressing stroke is 2mm (< lead, < nut):

$$L_{10} = \left(\frac{35{,}141N \times 0.7}{20{,}000N}\right)^3 = 1.86 \text{ (million cycles)}$$

	Nominal Roller Length	Nominal Screw Leads
FTX095	63 mm	5, 10, 20 mm
FTX125	74 mm	5, 10 mm
FTX160	101 mm	6, 12, 30 mm
FTX215	126 mm	6, 12, 30 mm
GTX080	38 mm	2.54, 5.08, 12.7 mm