Calibrating a Torque Meter

The following document will help you calibrate that torque meter you just built or one you may have already had.

by Ken Rice

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Most of the torque meter construction articles that I’ve seen call for calibrating the finished instrument by comparing it to a known-accurate torque meter, or by using a system of measured weights and moment arms. Neither of these is easy to do with any precision. Fortunately, there is a standard engineering formula for calculating the angular deflection of a solid shaft that works nicely for determining the dial marking instead. The simple formula is:

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        C * T * L

a = ----------

        D**4 * G   ( note **4 means D * D * D * D )
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The formula shows how many degrees that a shaft will twist, given the diameter and length of the shaft, and the amount of twisting force. The parameters for this formula are described below in both US and standard units (standard in parentheses):

a = angle of pointer deflection in degrees (degrees)

C = constant: 36.5 (584)

T = torque in inch-ounces (newton-millimeters)

L = length of the music wire torsional element in inches (millimeters)

D = diameter of the music wire torsional element in inches (millimeters)

G = torsional Modulus of Elasticity for music wire in pounds/square inch (newtons/square millimeter):

Wire Size	G
less than .032 (.81)	12,000,000 (82 740)
.011-.062 (.84-1.6)	11,850,000 (81 700)
.063-.125 (1.6-3.2)	11,750,000 (81 010)
.126-.250 (3.2-6.4)	11,600,000 (79 980)

For example, one of my meters (for two to six strands of 1/4″ rubber) uses a increments of 10 in-oz each, I used the fornula like this:

$$a = \frac{36.5 * 10 * 12}{.062^{**}4 * 11{,}850{,}000} = 25 \text{ degrees}$$

The dial face was drawn with 25 degrees between each 10 in-oz marking. Carefully verifying this calibration with weights showed it to be correct.

I've also verified the suitability of the formula by comparing it to published torque meter designs, such as Cezar Banks' indoor instrument that was reprinted in the July '83 Bat Sheet.

Working from the plan measurements, the formula accurately calculates the exact calibration of the dials as shown on the plan.

The formula can be used handily in reverse for designing a torque meter. You can insert the desired amount of dial deflection, and calculate the diameter or length of the music wire needed to do the job.