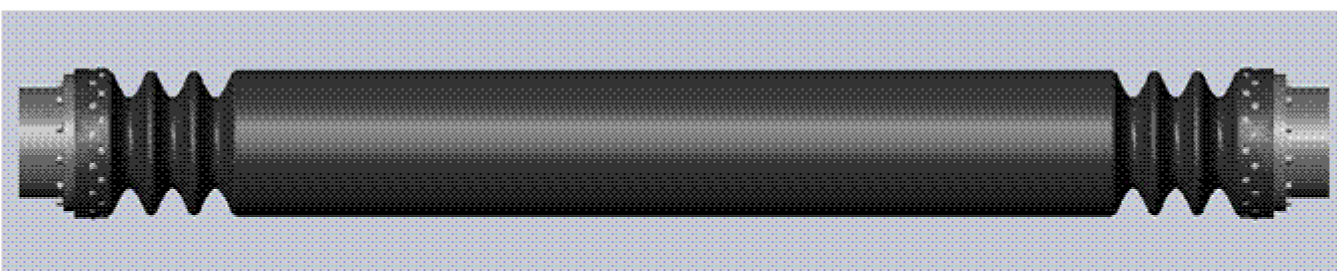
LTI Cooling Tower Drive Shafts

Highlights:

- Outstanding performance evolved from a helicopter heritage
- Designed specifically for cooling tower duty
- 100% fully integral carbon fiber epoxy construction. No flex element corrosion concerns
- Stainless flanged interface standard
- One piece construction. No need to re-balance – ever!
- Lengths up to 14' (4.3m)
- Lightest solution in the world! No more struggling with cranes. LTI shafts are typically 50 -75% lighter than all competing technology (including those with carbon fiber spacing tubes)
- Highly engineered solutions incorporate industry leading torque density, motion accommodation and zero-growth spacing tubes. As part of a paradigm shift in flexible drive trains LTI has incorporated a Coefficient of Thermal Expansion (CTE) close to zero such that even 14 ft long drive shafts do not unacceptably load flex elements under thermal load
- LTI flex shafts are maintenance free and constant velocity[1]

The driveshaft transmits power from the output shaft of the motor to the input shaft of the gear reducer. Because the driveshaft operates within the tower, it must be highly corrosion resistant, lightweight for easy installation and well balanced for high speed operation. Transmitting full motor power – including stall torque - over significant distances it must also accommodate parallel offset of the end faces due to structural movement of the tower (including thermal growth) and imperfect installation. This parallel offset or lateral deformation results in an equal and opposite bending moment / rotation in the flex elements at each end with consequential high cycle fatigue considerations.



Specifications and selection data are subject to change without notice.

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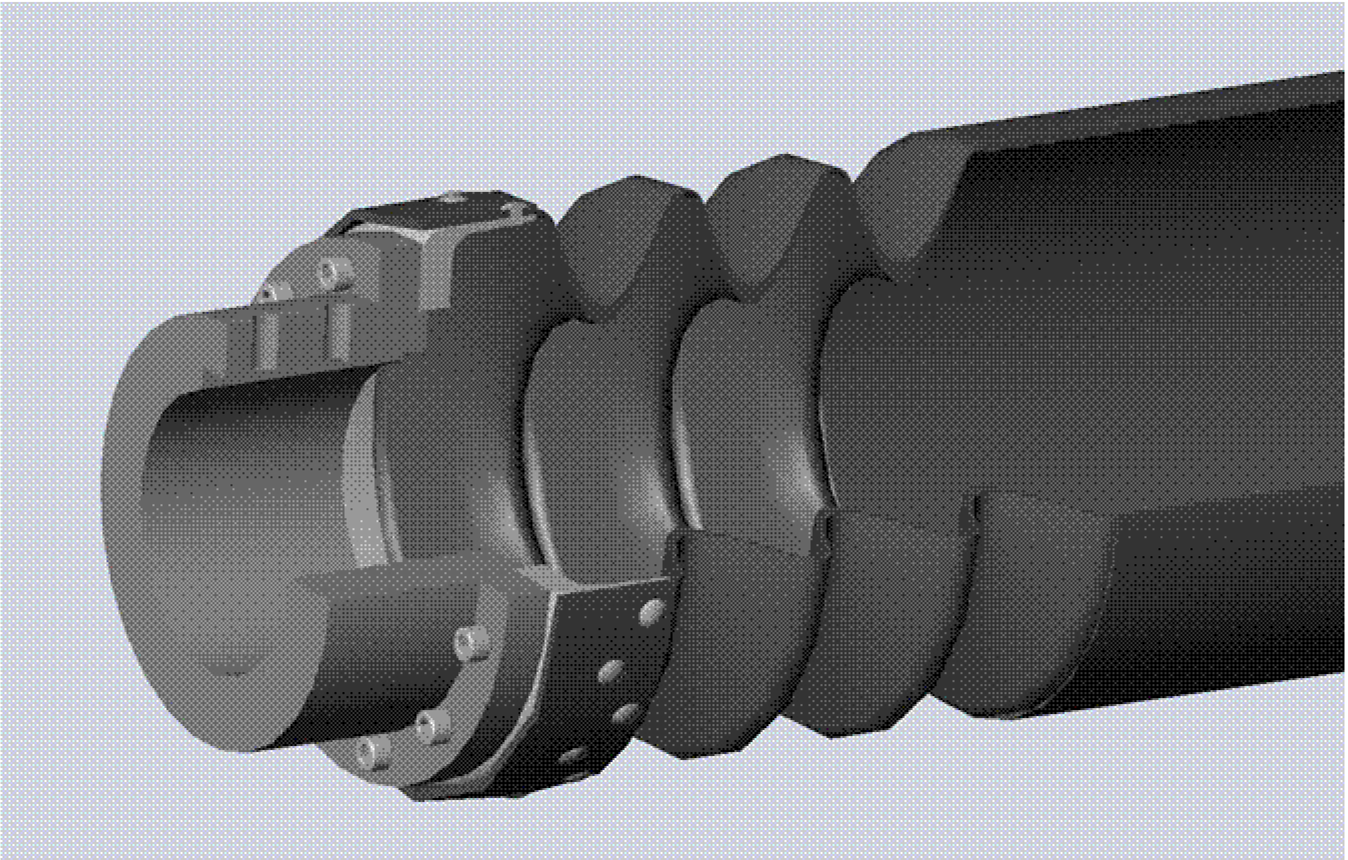
Weight

No cranes, reduced part count, no need to re-balance – ever! Designed to provide infinite fatigue life

The LTI family of highly engineered cooling tower flex-shafts builds the flex elements integrally into the shaft without the additional split-lines and fasteners usually required. This feature removes the prospect of losing shaft balance where these large numbers of parts traditionally came together. Additionally, the LTI integral solution improves shaft reliability and provides for very large weight saving - much of which comes from the obsolescence of the lumped masses where bolted split lines used to be – even the longest and highest power LTI shaft can be installed by hand without the need for cranes.

Resonance

LTI flex-shafts allow high operational speeds below resonance in bending for two reasons: First, the extremely low mass per unit length of the spacing tube and secondly the ability to make the spacing tube the same diameter as the flex elements. This important difference arises because of the avoidance of bolted split lines between flex elements and spacing tube such that socket / wrench access to nuts and bolts is no longer required at this location. Conventional, assembled, shaft/coupling solutions usually design for sub-critical operation below the 'whirling' or 1st bending natural frequency but very often must pass through the 1st axial natural frequency to reach operational speed. LTI integral composite drive shafts are typically sub-critical for each of axial, torsional and bending resonance.



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Torque & Misalignment

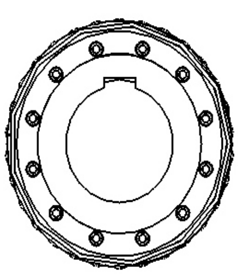
LTI Cooling Tower drive shafts are competitive with all competing technology in torque density. Torsional buckling thresholds are always more than 100% above operational torque limits. The LTI Cooling Tower series are 400, 600, 800 and 1000 - emanating from initial tooling sizes of 4 inch through 10 inch diameters. Shaft selection may be dictated by motor size and required torque or by bending natural frequency when the shaft is long. Axial motion and torque limits are constants for each series while parallel offsets possible, weight, and natural frequencies are functions of the length required. Almost all non-aerospace applications of flexible drive shafts require power transmission while the end faces are forcibly misaligned but still parallel to each other. The enforced lateral translation of the end face results in a fully reversed bending fatigue cycle occurring once per shaft revolution with equal and opposite bending rotations at each end of the shaft and an associated constant shear force. Historical practice with conventional technology has been to provide a limit angle permissible at each end and to use the spacing tube length to calculate the resulting allowable parallel offset. LTI's line of highly engineered, fully integral flex shafts provides the allowable offset directly.

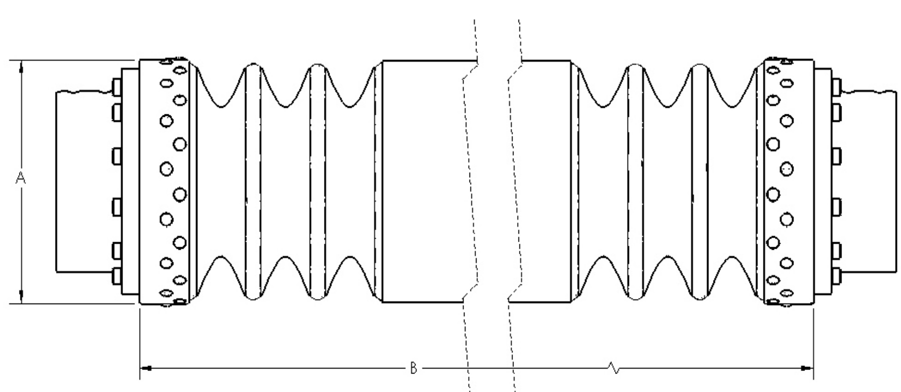
It should be noted that while LTI composite flex shafts are capable of larger misalignments than other constant velocity[1] couplings this is usually not the best design solution because of a phenomenon referred to as geometrical non-linearity. Essentially this means that some of the torque transmitted by the rotating spacing tube is converted to bending in the flex elements at each end and for high torques this can result in early, quasi-static, failure of the flex elements in any technology. Differentiation between technologies is found in weight, natural frequencies, part-count, reliability, torque density, and cost.

Series	Axial Stiffness	Bending Stiffness	Axial Motion Limit	Torque Continuous Operating	Torque Peak Overload	Maximum Diameter (A)
	Lbf/in	In.lbf/rad	in	In.lbf	In.lbf	in
CT400	2,650	4,650	0.04	3,833	11,500	4.268
CT600	2,650	9,675	0.06	10,333	31,000	6.280
CT800	2,650	17,200	0.08	21,666	65,000	8.292
CT1000	2,650	27,700	0.10	39,333	118,000	10.304

Table 1 Cooling Tower Drive Shaft Properties Independent of Length

1. High maintenance gear couplings, universal joints and others where sliding contact exists between separable parts result in both wear / lubrication requirements and non-constant velocity. LTI's diaphragm type flex elements are both maintenance free and constant velocity (rpm in = rpm out).





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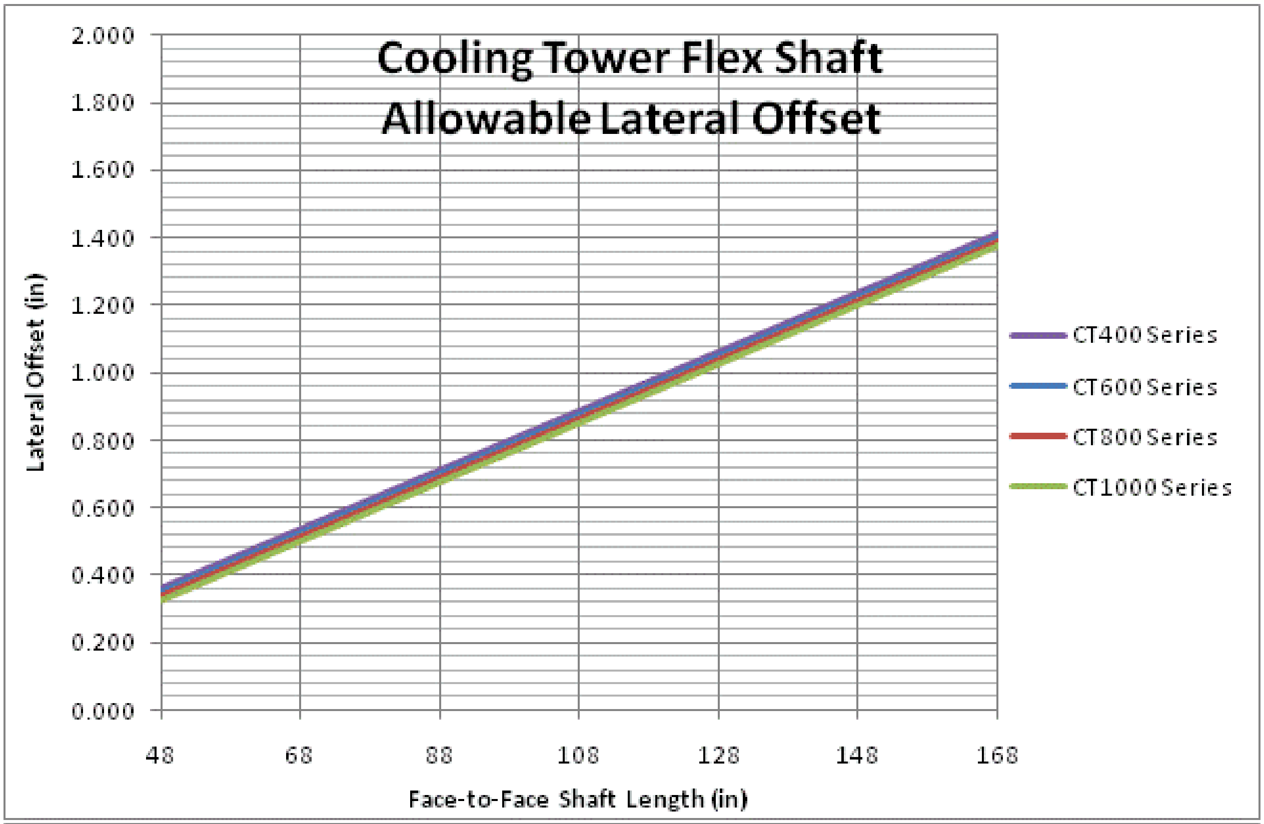

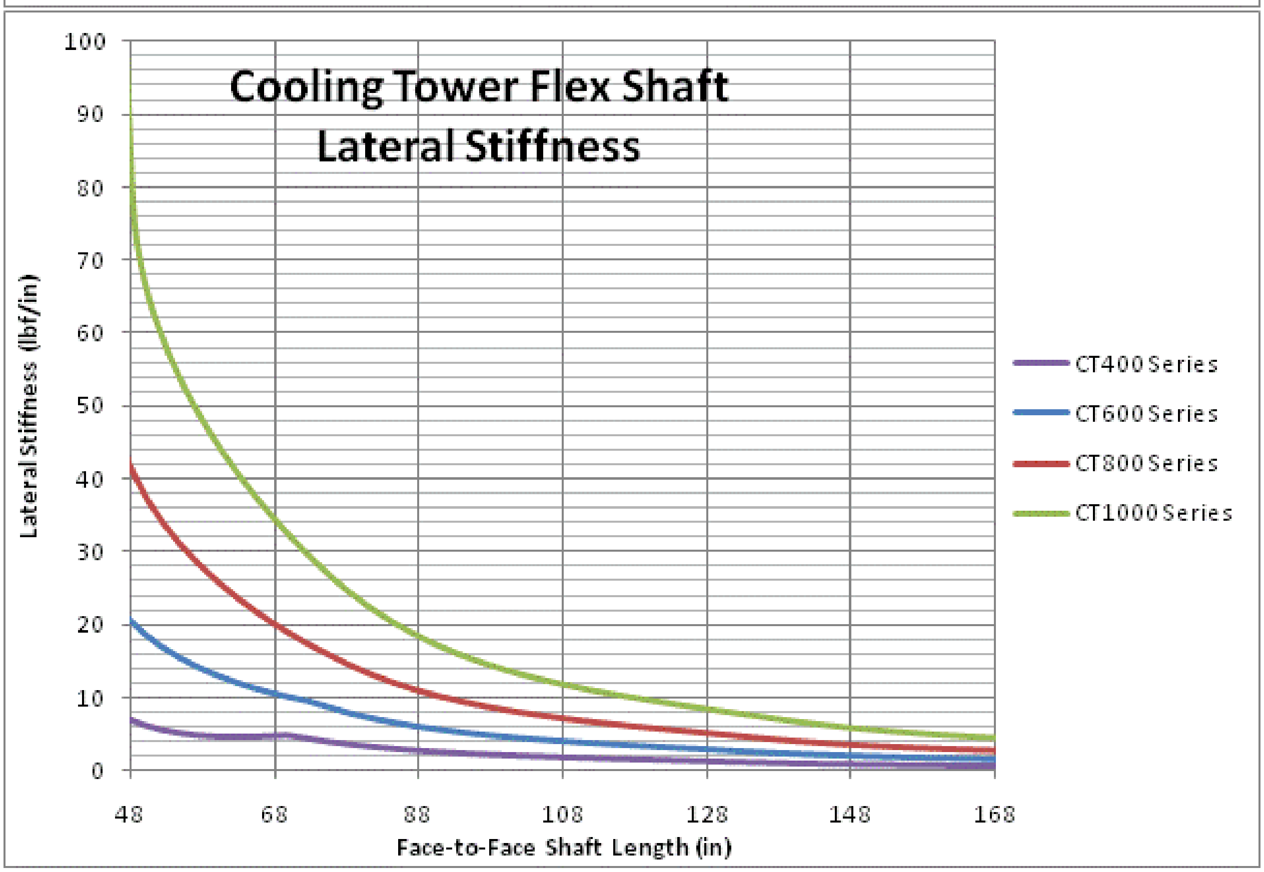

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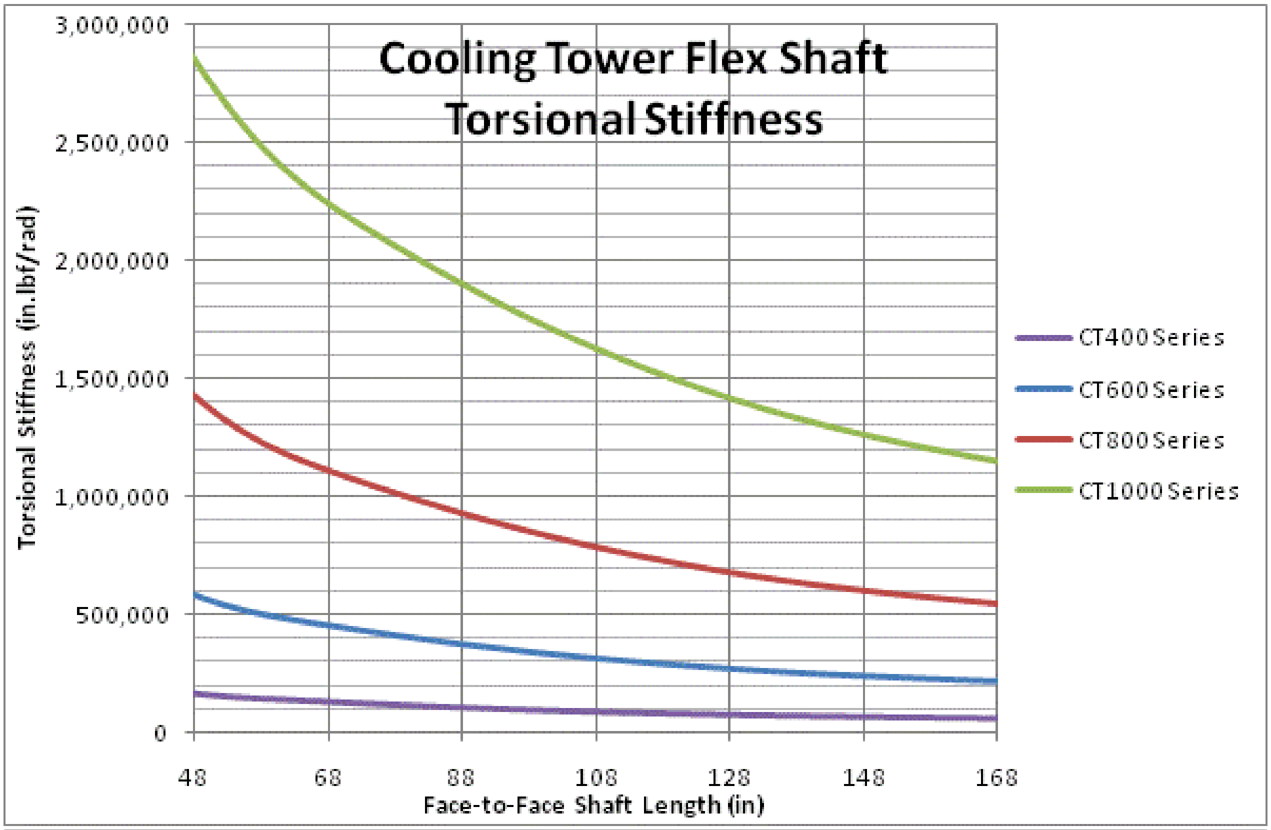

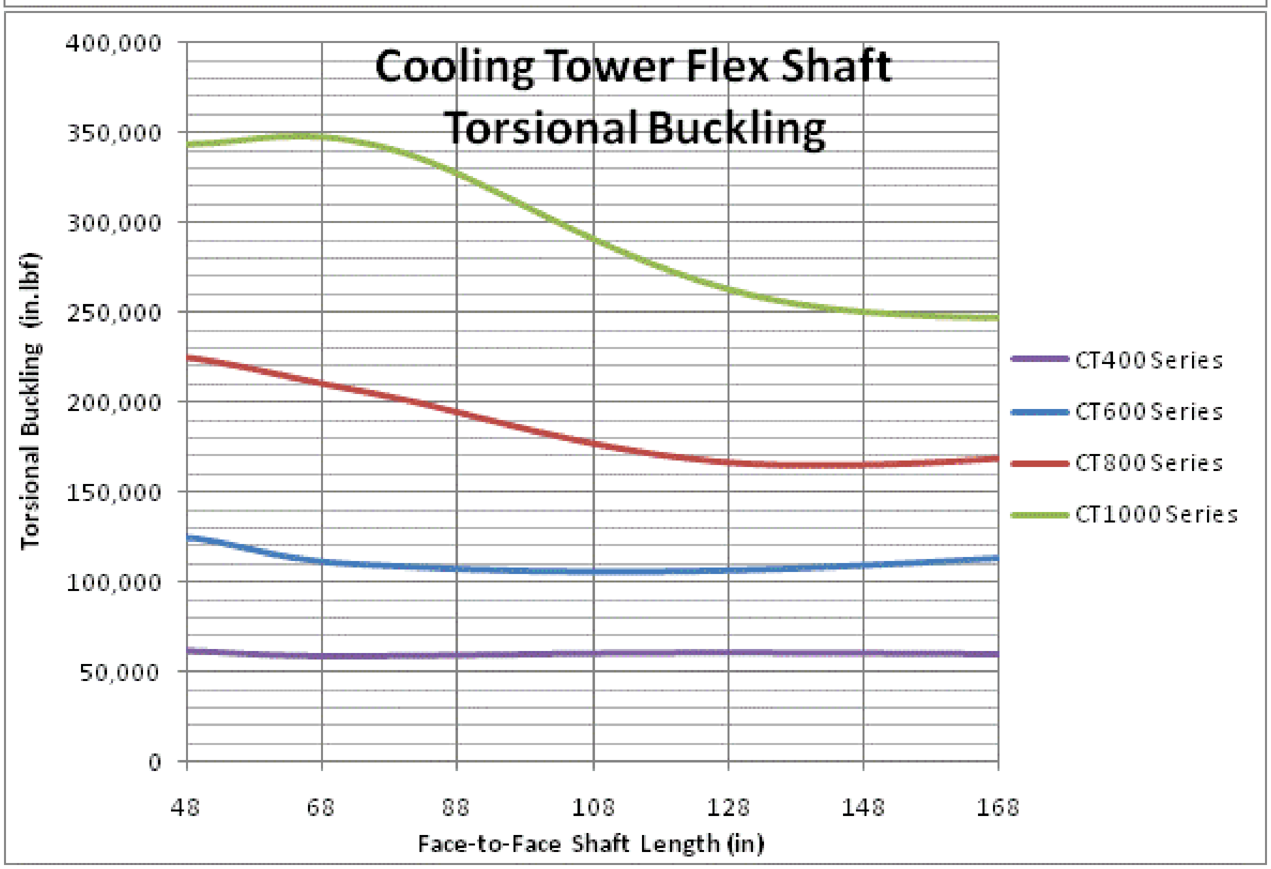

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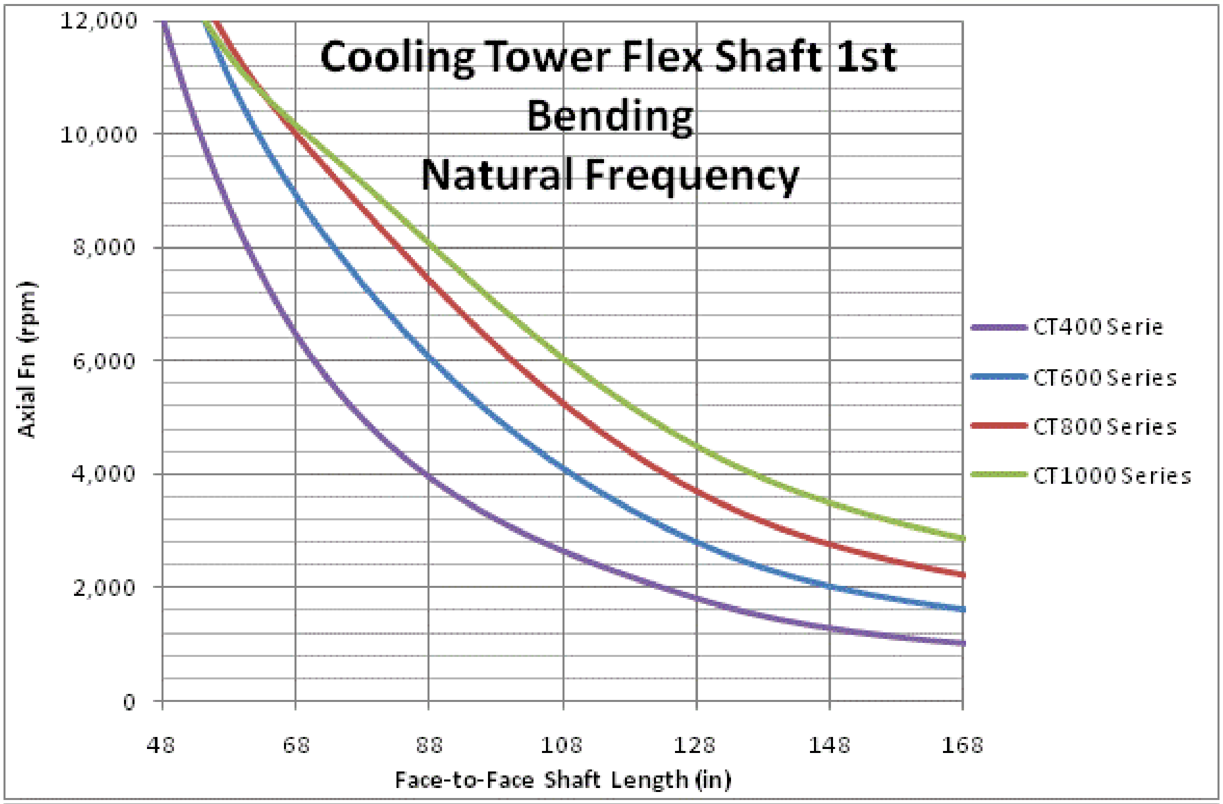

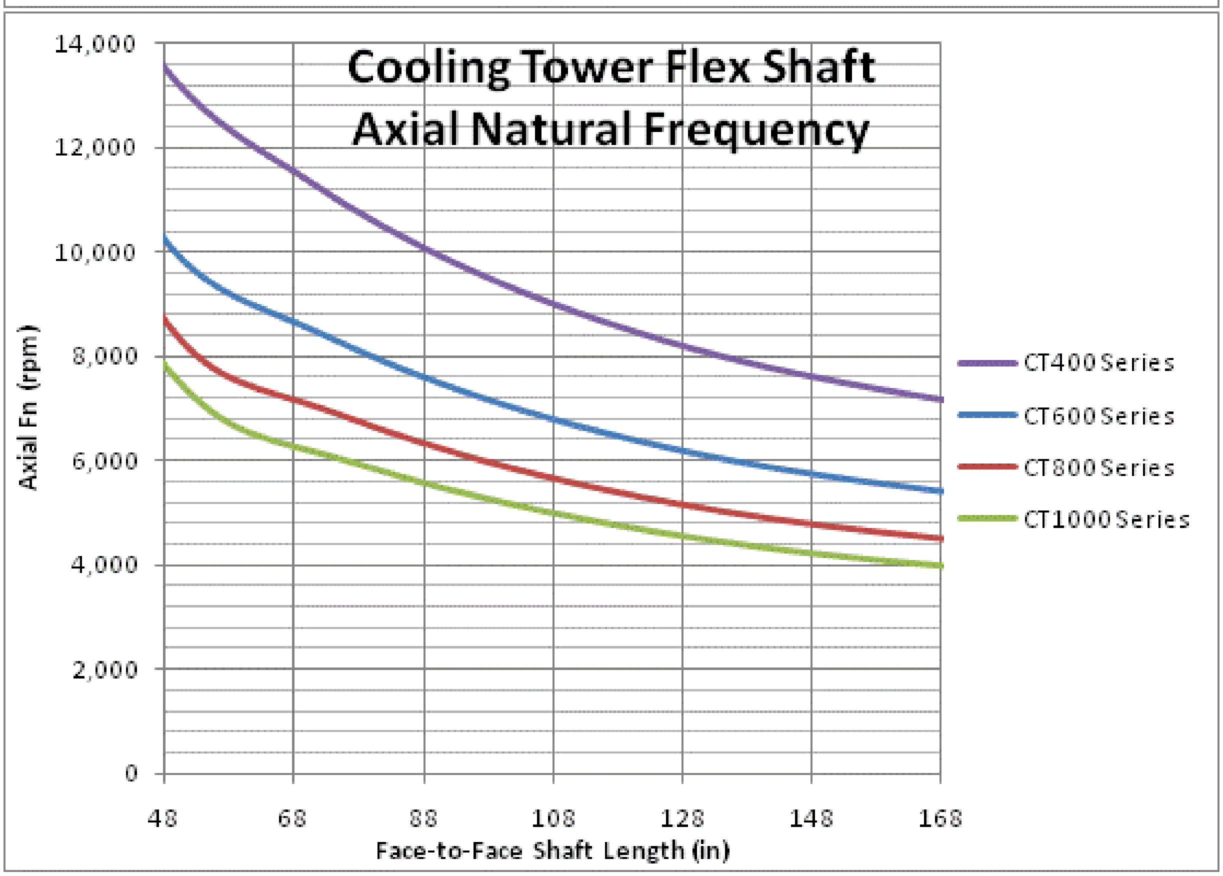

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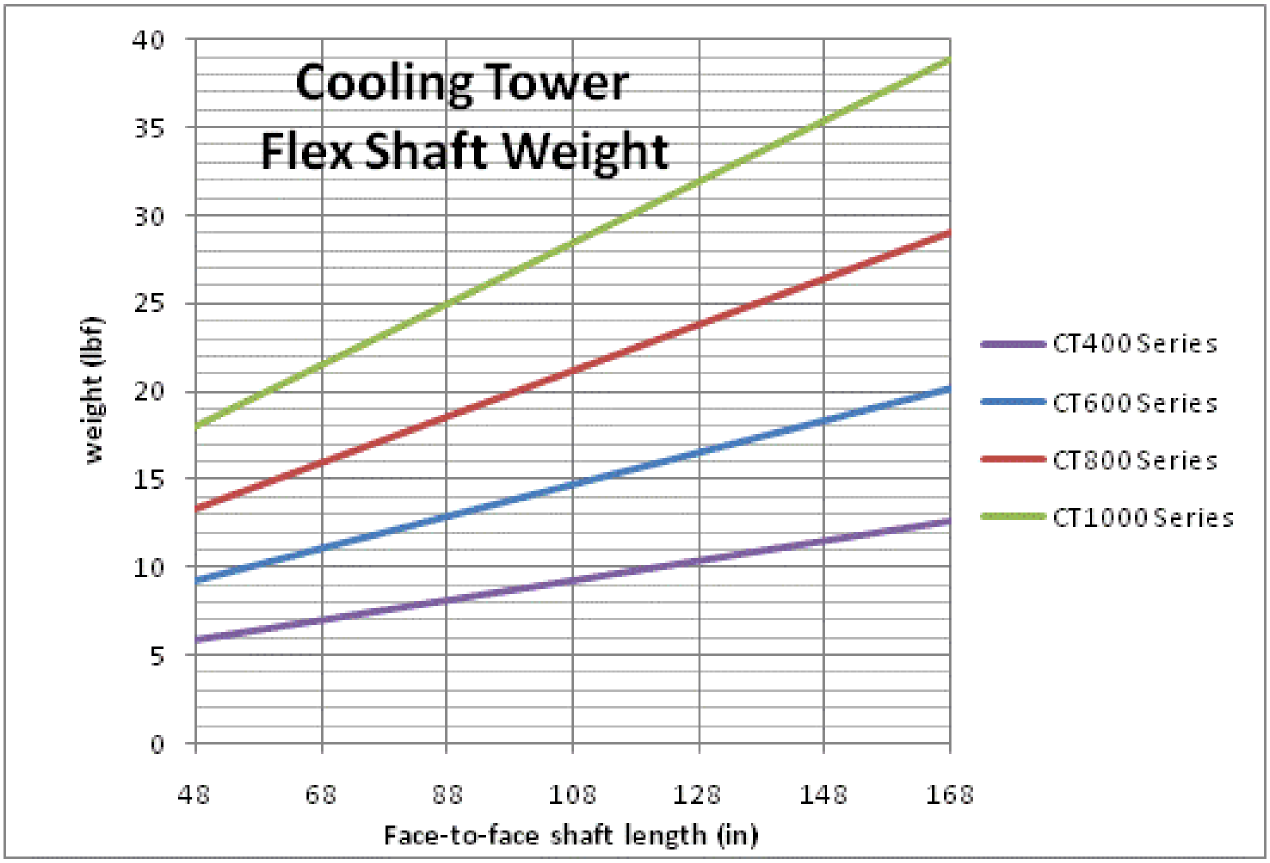

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