

Solid Hub-to-Shaft Connections for Precision Timing & Assembly Applications

Concentric Maxi Torque keyless hub-to-shaft connections improve high-speed motion system precision, durability and reliability.

Precision is important in many high-speed motion applications. You need precise rotational positioning and reversing in systems like robotics, medical instruments, paper handling, digital printing equipment, and many timing pulley or gear systems that use small-bore, high-speed drives.

Most of those systems benefit from hub-to-shaft connections with low inertia and high reliability. They need to support easy and robust assembly and disassembly for installation and maintenance without damaging the motor shaft.

Designs can require elimination of backlash, reduced vibration and less noise. Those systems also demand superior holding power, and the ability to handle torque with improved alignment (low run-out).

To address these and other critical design issues, you can turn to Concentric Maxi Torque (CMT) bushings from Custom Machine & Tool Co. CMT bushings are engineered to solve keyless hub-to-shaft connection problems, especially for high-speed, small-diameter applications (under 1 inch or 30 mm).

CMT bushings eliminate design and performance issues with setscrews, keyways, pins, and traditional clamp collars. They provide you with a high-torque, concentric, and easily adjustable connection, and are available in a variety of sizes (Figure 1).



Figure 1. CMT bushings are available in sizes that suit a wide range of precision motion applications.

Basics of CMT bushings

In a CMT bushing, a single easy-to-access, axially driven tightening screw forces a low-taper-angle, split bushing into a matching hub. That compresses the bushing evenly around the shaft creating a mechanical shrink fit that provides a high-strength, keyless, concentric, and vibration-free connection.

The CMT system is optimized for use with shafts with diameters from 3 to 30 mm, in high-precision motion applications. The low-angle taper ensures maximum contact surface pressure without cocking, which reduces vibration and supports higher speeds. The compact design of the CMT system eliminates the need for conventional keyways or bulky and awkward setscrew hubs, reducing inertia and saving space (Figure 2).

CMT bushings are supplied pre-assembled with pulleys to ensure precise alignment. A wide range of timing pulleys is available to suit almost every application need, including trapezoidal (MXL, XL, L, H), high torque drive (HTD) from 3 to 14 mm, Gates PowerGrip GT2 from 2 to 8 mm, plus metric profiles and custom designs.

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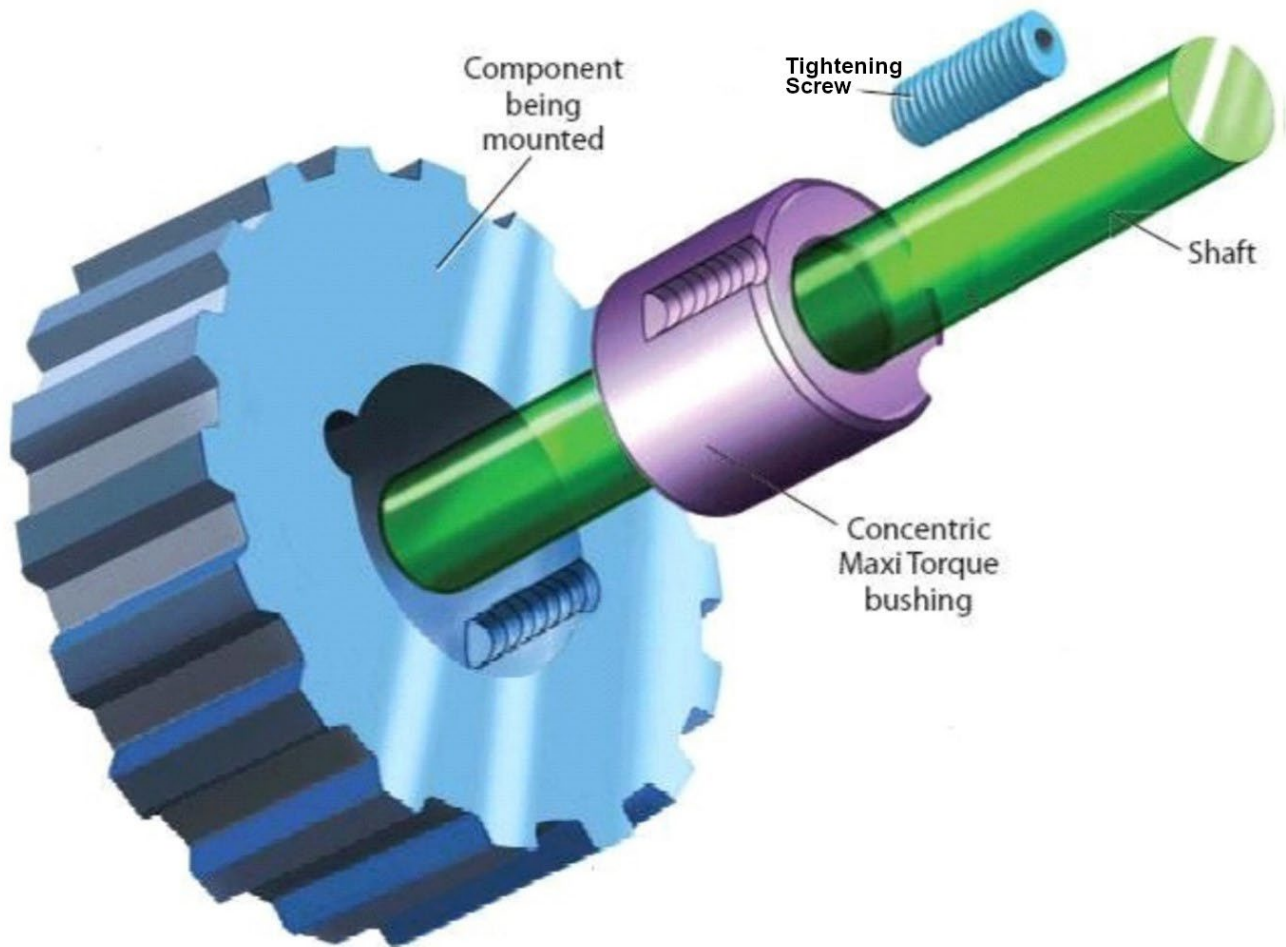


Figure 2.

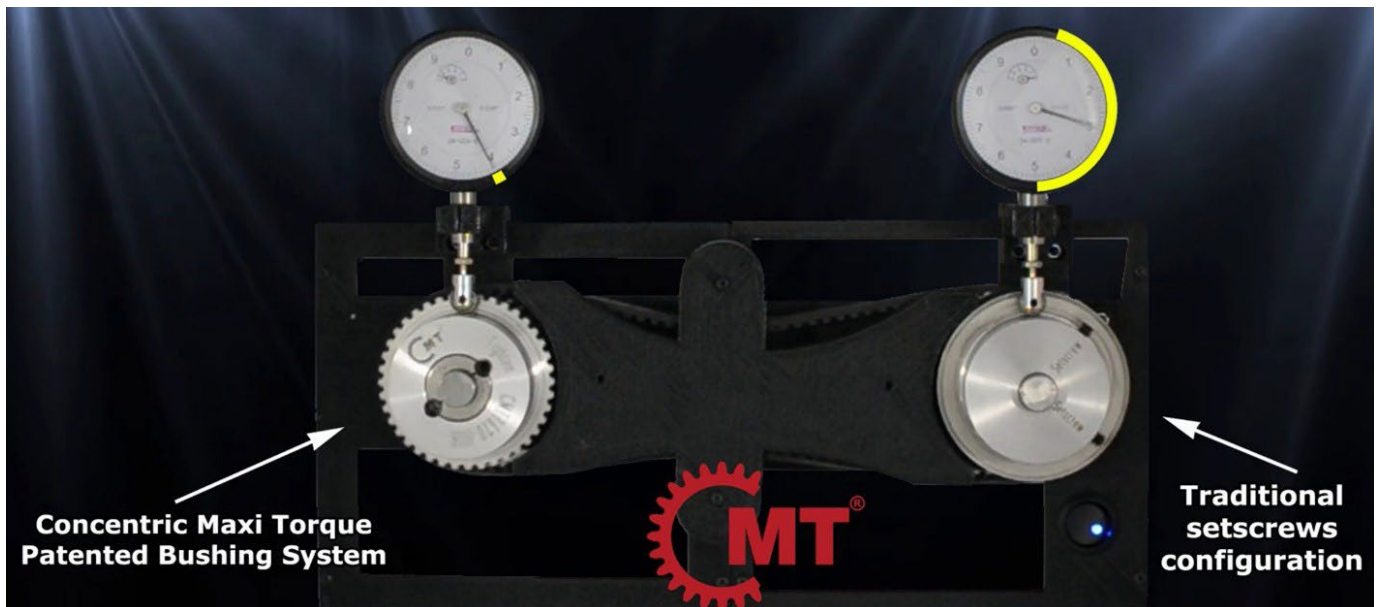


Figure 3. The CMT system delivers far lower levels of TIR (left) compared with a traditional installation using setscrews (right).

Benefits of CMT bushings

Superior hub-to-shaft concentricity is a key factor in the improved performance you'll realize when using CMT bushings. Run out, measured as total indicator reading (TIR) — sometimes called total indicated runout or full indicator movement — is a key measure of how much a shaft surface deviates from its ideal circular rotation around a central axis.

Low TIR is an important consideration when you're designing higher-speed applications to reduce unwanted vibration or wobble and extend system operating lifetimes. CMT bushings deliver a typical radial TIR approximating 0.001 inches (0.026 mm). That ensures more precise component positioning, not possible with other connection devices like setscrews, or pins and clamp collars (Figure 3).

The CMT system also supports high-speed indexing and reversing while maintaining positioning accuracy. Flexible positioning enables you to easily phase, install, and adjust drive components.

With the CMT system, you get the combination of zero backlash and high torque delivery that can be crucial for a range of applications like robotic exoskeletons, paper handling machines, precision automated medical instruments, ophthalmic lens processing machinery, and more.

Compact and light weight design reduces inertia, an important factor as machine speeds and indexing accuracy requirements continue to escalate. It can be the difference between reliable and unreliable implementation and can also increase the efficiency of the machines you design, saving energy.

CMT bushings are offered in twelve sizes with bores from 0.1250 inches (3 mm) to 1.1875 inches (30 mm) and corresponding torque capacities from 14 in-lbs. (4 Nm) to 2,795 in-lbs. (375 Nm). The wide variety of shaft bore sizes in English and metric values contribute to simplified inventory requirements and lower costs since you can use the same size component on multiple shaft diameter applications.

Assembly options like keyways require additional machining steps for the shaft, adding cost and potentially delaying machine deployment.

Relying on traditional setscrews means that you must deal with another set of tradeoffs. Setscrews can damage the shaft and tend to loosen and slip if exposed to the harsh motions associated with clutching and braking in high-speed applications. CMT tightening screws don't touch the shaft, and the sizes are designed to optimize holding torque corresponding with shaft diameters and component requirements.

By using CMT bushings, you can avoid the drawbacks of options like keyways and setscrews and quickly deliver higher-performance machines.

Dimensions & ratings

When selecting a CMT bushing for your application there are several factors to consider as shown in Figure 4. There's a wide variety of options, making the CMT system flexible and suited for a range of applications.

First is identifying the CMT bushing based on its dimensions and screw data (left-hand columns in Figure 4). Next is deciding on the required shaft diameter for the motor and application. The individual bushings are suited for from 4 to 9 shaft diameters ranging from 0.1250 to 1.1875 inches that can handle from 14 to 2,795 in-lbs. of torque.

The service factors in Figure 4 serve as divisors used to adjust the bushing's nominal torque capacity based on the specific operating conditions of the application. You can use these factors to ensure the coupling can handle shock loads, reversing, or extended running without slipping.

In addition to delivering superior operating performance and having a wide selection of parts, the CMT system supports simplified and reliable machine assembly. With the CMT keyless hub-to-shaft connection system you can design high-speed precision machines that are easy to install and maintain.



Concentric Maxi Torque Dimensions & Ratings

Concentric Maxi Torque Stock Sizes and Dimensions										Concentric Maxi Torque - Maximum Transmission Torque (in-lbs)																		
CMT Bushing	Dimensions					Screw Data				Shaft Diameter in Inches																		
	B	d	H	Hm	D*	S	Si	Ms	0.1250	0.1560	0.1875	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.6875	0.7500	0.8125	0.8750	0.9375	1.0000	1.1875			
0606	3-6/.125-.250	.373"	.250"	.265"	.551"	M2.5	1.3	6	14	20	24	33																
0609	3-6/.125-.250	.394"	.375"	.395"	.591"	M3	1.5	9	16	23	28	37																
0909	4-9/.156-.375	.536"	.375"	.395"	.752"	M3	1.5	9		25	33	43	54	65														
0912	5-9/.156-.375	.563"	.500"	.530"	.822"	M4	2	19		64	68	79	98	117														
1212	6-12/.250-.500	.688"	.500"	.530"	.975"	M4	2	19		79	98	117	120	138														
1216	6-12/.250-.500	.745"	.625"	.655"	1.054"	M5	2.5	42		138	173	207	242	345														
1616	8-16/.3125-.625	.855"	.625"	.655"	1.170"	M5	2.5	42		168	208	243	348	392	436													
1620	8-16/.3125-.625	.902"	.787"	.827"	1.240"	M6	3	68		389	468	530	698	752	875													
2020	10-20/.4375-.750	1.055"	.787"	.827"	1.417"	M6	3	68					531	698	755	879	975	1100										
2025	10-20/.4375-.750	1.140"	.984"	1.034"	1.590"	M6	3	68					538	703	760	885	980	1120										
2530	12-25/.500-1.000	1.355"	1.181"	1.241"	1.900"	M8	4	158								1115	1327	1416	1504	1593	1875	2053	2200	2347				
3036	16-30/.625-1.1875	1.575"	1.417"	1.496"	2.200"	M8	4	158													1512	1681	1770	1902	2255	2345	2433	2795

B- Bore Range (Metric/Inches)
d- Bushing Diameter (Inches)
H- Bushing Length (Inches)
D- Minimum Hub Diameter (Inches)
Hm- Hub Minimum Length (Inches)
S- Screw Size (Metric)
Si- Hex Key Size (Metric)
Ms- Maximum Screw Torque (in-lbs)

Shaft size to be (h6) or Nominal Diameter
+.0000-.0005

* Minimum hub diameter is based on a material with a yield strength of 276 Mpa (40,000 PSI)

NOTE:
S= Bushing screw size.
•Refer to Assembly Instructions for screw assembly torque.
•Chart torque is the maximum torque before slippage under ideal conditions.
•Actual torque will vary based on operating conditions screw torque and shaft size.
•Appropriate safety factors should be applied based on consideration of all operating conditions.

SERVICE FACTORS TO BE USED WITH THE ABOVE CHART:

- 1.0- Light starting and intermittent running
- 1.2- Light starting and steady running
- 1.5- Light starting and uneven running
- 2.0- Fairly heavy starting and steady or uneven running
- 2.5- Light or heavy starting and moderate shock running
- 3.0- Light or heavy starting and severe shock running, or reversing loads.

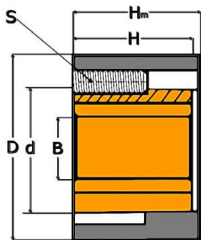
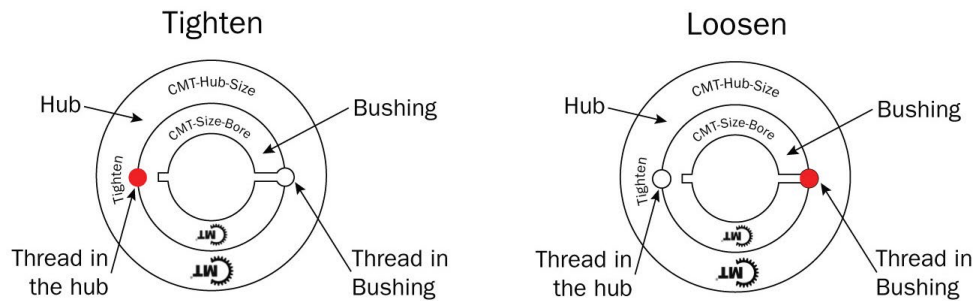


Figure 4. Concentric Maxi Torque system dimensions and ratings.

Assembly Instructions



TO TIGHTEN: insert bushing in hub as shown with half threaded hole in hub aligned with half plain hole in bushing. Insert set screw and torque to recommended value.

TO LOOSEN: insert set screw in hole opposite tightening position and torque until bushing breaks free from hub.

Figure 5. The same screw (red dots) can be used to tighten the bushing during installation (left) and loosen the bushing during disassembly and maintenance (right).

Installation & maintenance

The CMT system delivers a high level of uniform 360° clamping force. That reduces noise and vibration. Plus, machine builders and installers can make easy and precise axial and angular adjustments to suit the specific application requirements.

A single tightening screw is used for assembly and disassembly. When assembling CMT bushing systems, the screw is used to lock the low-taper angle-splitting bushing securely in place. The bushing works as wedge to implement uniform clamping pressure. That's what gives the CMT system its torque capacity.

When installing the CMT system, begin by placing the assembly on the shaft in its desired location. Next, start tightening the screw until the bushing is just beginning to grip the shaft, then move the component to the required axial and rotational positions. Finish by tightening the screw using the recommended torque.

Following this simple procedure ensures that you will have a secure, high-performance connection. The same screw is reused in a different hole to act as a jack to loosen the bushing, allowing for easy disassembly or repositioning without damaging the shaft (Figure 5).

Before working on any machinery, there are several common-sense safety procedures you should follow beginning with proper lockout and tagging. It's also important that specific procedures be followed when working with CMT bushings, including:

- Ensure that the shaft is the correct size and tolerance for the bushing bore. Use of an incorrect shaft size can cause component failure, reduction of holding torque, or the inability to assemble the components.
- Do not lubricate any of the components during assembly. All parts should slide together without lubrication.
- Use only the tightening screw supplied with the bushing. Use of an incorrect screw can result in reduced holding torque during operation and may prevent the components from being disassembled.

Summary

The CMT bushing system from Custom Machine & Tool Co. enables you to design versatile, keyless hub-to-shaft connections for precision motion control in small-diameter shaft applications that require high-speed reversing and positioning. It features a single tightening screw, low-taper-angle split bushing that provides a mechanical shrink fit, offering torque capacities from 14 to 2795 in-lbs. and approximately 0.001 inch of radial runout.

Its compact design means you can use it in space-constrained applications like robot end effectors and other compact devices and systems. CMT bushings are also suited for automated medical instrumentation, paper handling and other applications. They're ideal for timing pulleys and gears in automated equipment. The CMT bushing system also ensures superior concentricity and balance, reducing vibration and enabling higher operating speeds.

The single tightening screw simplifies assembly, including phase adjustment, and disassembly without causing shaft damage. By eliminating the need for keyways, pins or hubs, it reduces component weight in your designs, minimizing inertia and machining costs. Finally, the uniform 360° clamping pressure enhances system reliability in demanding applications.

Start designing parts today with our Concentric Maxi Torque CAD models, right from our website at cmtco.com/cad-models.

