

WP0229

Dodge® bushings: advantages of bushing systems

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01-21-2002



The transmission of power almost always requires the attachment of a sheave, chain sprocket, gear, pulley, etc. to a shaft. Before the advent of bushing systems, the only method of attachment available to the plant engineer was to bore a hub to the specific shaft size for either interference fit or clearance fit. These options, while viable solutions, present several problems.

Interference fit is a highly concentric, high torque mounting option that requires heating of the hub, cooling of the shaft or both to install onto the shaft. This method of mounting is a labor intensive, and often time-consuming process that requires very precise bore and shaft tolerances. It is also extremely difficult to remove the part without damaging both the shaft and part. Thus, care must be taken to ensure correct design and installation of the part on the first attempt.

Clearance fits generally require the use of a key and setscrews to transmit torque. Concentricity to the bore is largely a function of the difference in shaft diameter and hub bore. The concentricity of the bore to the outside diameter decreases with increasing clearance between bore and shaft. Also, clearance between the hub and shaft can allow for minute movement of the hub on the shaft, which can lead to a condition known as fretting corrosion. Fretting corrosion is a build-up of a corrosive film that can permanently join the part to the shaft. Clearance also increases eccentricity, which can produce vibration and limit high-speed operation.

This method of mounting is simpler and less time-consuming than interference fits, but damage to the shaft can occur. Tightening of the setscrews onto the shaft can create burs on the surface of the shaft. Because all of the torque is transmitted through the key, high, localized stresses occur at the keyway. This can lead to premature failure of the part, especially with high shock loads or reversing applications.

Another problem associated with both of these mounting options is the one-size-fits-one-shaft dilemma. Parts are bored to a specific shaft size and cannot be used on shafts of other sizes.

The advent of different bushing systems has presented more mounting options and eliminated many of the problems associated with straight-bored parts. The most common types of bushings systems are tapered bushing systems and keyless locking assemblies.

Tapered bushings use a wedging action between bushing and hub to transmit torque. Bushings are bored and keyed to accept the shaft and have a tapered outside diameter. The part being mounted has a matching taper on the inside diameter of the hub. Bolts are used to push, or pull, the bushing into the hub where a contact pressure between the bushing and hub develops.

There are several advantages to using tapered bushing systems. Tapered bushings are very quick and simple to install and dismount. The clamping force of the bushing on the shaft improves concentricity and minimizes the probability of fretting corrosion. No damage to the shaft occurs because no setscrews contact the shaft, and dismounting is quick and simple. Because each bushing size can accommodate many different bore sizes, one part can be used on many different shafts simply by changing the bushing. This benefit can result in decreased inventory of spare parts.

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And, since most tapered bushings are also available with a minimum plain bore, stocking those bushings and boring as necessary can further reduce inventory.

The most widely used tapered bushing systems are the Taper-Lock and QD*, or quick disconnect, bushing system. Both were developed in the late 1930's and offer many of the advantages of tapered bushings over traditional, straight-bored components.

The Taper-Lock bushing is a flangeless, 8° taper bushing system. The 8° taper allows the bushing to be mounted with less axial travel. The mounting bolts can only be installed in one direction, but fewer are required. Due to the lack of a flange, Taper-Lock bushings require less shaft space than QD bushings and thus lower overhung load on the shaft. Also, because there is no flange, the bushing mounts flush with the hub and there are no protruding parts to collect dust or debris. Taper-Lock bushings are available in 21 standard sizes, accommodating bores from ½" to approximately 12" and offer quick, easy installation.

QD bushings are flanged, 4° taper bushings. The mounting bolts can be installed from either end of the hub, offering a conventional- or reverse-mount option. QD bushings are generally available in 15 sizes, accommodating bore sizes from 3/8" to approximately 10". QD bushings also offer the quick, hassle-free installation shared by most tapered bushing systems.

There are a variety of other tapered bushing systems available from different manufacturers, varying mostly in taper angle. One such system is the Dodge HE & XT bushing system, offered by ABB, which is specifically designed for conveyor pulleys. HE bushings feature a 14° taper angle, and XT has taper of 2"/ft which reduces axial movement during installation and minimizes bellows stress in pulley end disks. Lowering the bellows stress on the end disks increases the operating life of the pulley.

Keyless locking assemblies represent the other main type of bushing system. As the name implies, keyless locking assemblies do not require the use of a key to transmit torque. With keyless locking assemblies, a number of bolts positioned circumferentially around the bore are tightened to bring together internal wedges that push an external ring outward towards the hub and inward towards the shaft. This produces contact pressures on the shaft and hub that can exceed normal interference fits. This type of mounting also produces an extremely concentric fit with virtually no chance of fretting corrosion. They are generally shorter in length through bore and can handle rotating bending loads. Another advantage to keyless locking assemblies is that alignment is easier, because there is no taper on the outside diameter to cause axial travel during installation.

Keyless locking assemblies are generally used on shaft sizes over 12", where tapered bushings are not an option. Some keyless locking assemblies can be specially made to accommodate bores as large as 50". Because of the number of installation bolts involved and the manner in which they must be tightened, keyless locking assemblies can require a great deal of time and effort to install and uninstall. They are also generally more expensive and require larger hubs to accommodate the extremely high contact pressures.

While straight bores are still a widely used mounting option with power transmission components, there are now many different mounting options available. Bushing systems offer a variety of choices, each with certain advantages and disadvantages. These must be weighed against each other to find out which option will work best for your particular application.

* QD is a registered Trademark of Emerson.

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