The Basics Of Roller Chain Sprockets

Think of all your chain-driven machinery. Now consider the sprockets driving all those chains. Often subjected to temperature extremes, corrosive environments, harsh washdowns and/or impact loads that destroy keyways and shear teeth, sprockets tend to be ignored until a breakdown. Suddenly, you're tasked with finding the correct replacement and getting it installed so production can continue ASAP. Understanding the basics of roller chain sprockets will help you do just that (and perhaps prevent unexpected failures going forward).

In addition to helping you identify types of sprockets, the following guidelines will help you identify options that may offer improved performance and longer service life. Proper replacement at the appropriate time will reduce downtime and save you money.

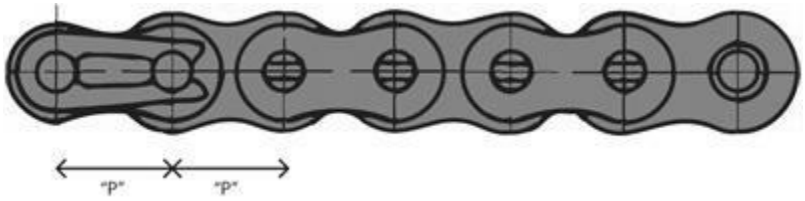


Fig. 1. How to measure chain pitch

Sprocket identification & terminology

Step #1. Chain type and pitch. . . Sprockets are designed for use with a specific chain. All chains are made to a given standard—*with ANSI being the most common in the U.S.* Each chain is identified by "pitch," which refers to the measurement from one roller-pin center to the next roller-pin center of a given chain. ANSI chain pitch is always measured in 1/8" increments. Refer to Fig. 1 for how to measure chain pitch, then see Table I for ANSI Standard Chain pitch sizes.

Standard Roller Chain			
Number	Pitch "P"	Number	Pitch "P"
25	1/4"	100	1-1/4"
35	3/8"	120	1-1/2"
40	1/2"	140	1-3/4"
41	1/2"	160	2"
50	5/8"	180	2-1/4"
60	3/4"	200	2-1/2"
80	1"	240	3"

Table I. ANSI Standard Chain Sizes

There are, of course, roller-chain standards other than ANSI, but they're not commonly used in the U.S. The second most popular is British Standard Chain, in which chain pitch is measured in 1/16" roller-pin-center to roller-pin-center spacing increments.

After determining the chain pitch, note the number of chain strands used in the application: single strand, double strand, triple strand, etc. The sprocket selected for the application needs to match the chain—*i.e., double-strand chain runs on a double-strand sprocket. (Refer to Fig. 2.)*

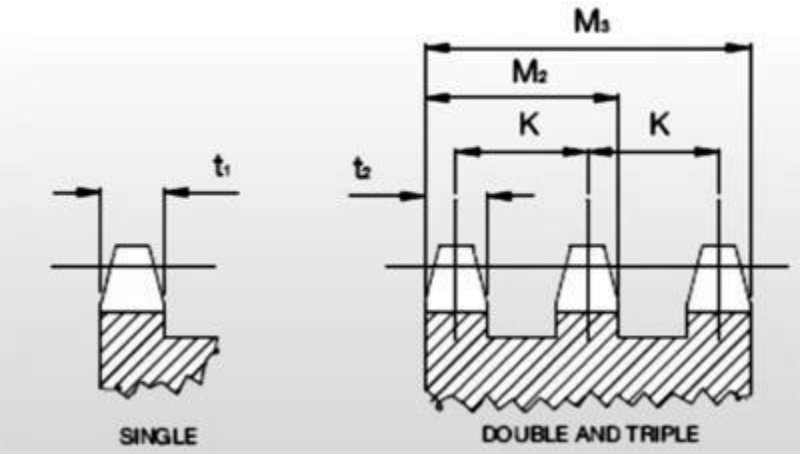
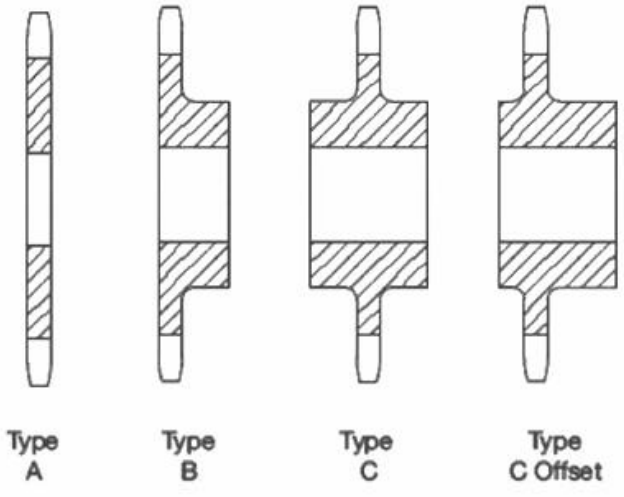


Fig. 2. Single-strand and Multi-strand tooth profile

Step #2. Sprocket hub style. . . While there are unlimited arrangements, a vast majority of roller chain sprockets fall into one of these major styles: no hub (A-style); a hub projection from one side (B-style); or hub projections from both sides of the sprocket (C-style). (See Fig. 3.)



Step #3. Number of sprocket teeth or sprocket diameter. . .

The easiest way to determine the number of teeth is simply to count them. Sometimes, however, the teeth are totally worn away. In this event, the caliper diameter may assist in identifying the sprocket.

The term "caliper diameter" refers to the dimension measured from sprocket-tooth valley to sprocket-tooth valley on the opposite side of the sprocket. This dimension measures the diameter of the sprocket plate not including sprocket teeth. On sprockets with odd number of teeth, the measurement would be taken from the valley of one tooth to the valley as close to 180° on the opposite side of the sprocket. (See Fig. 4.)

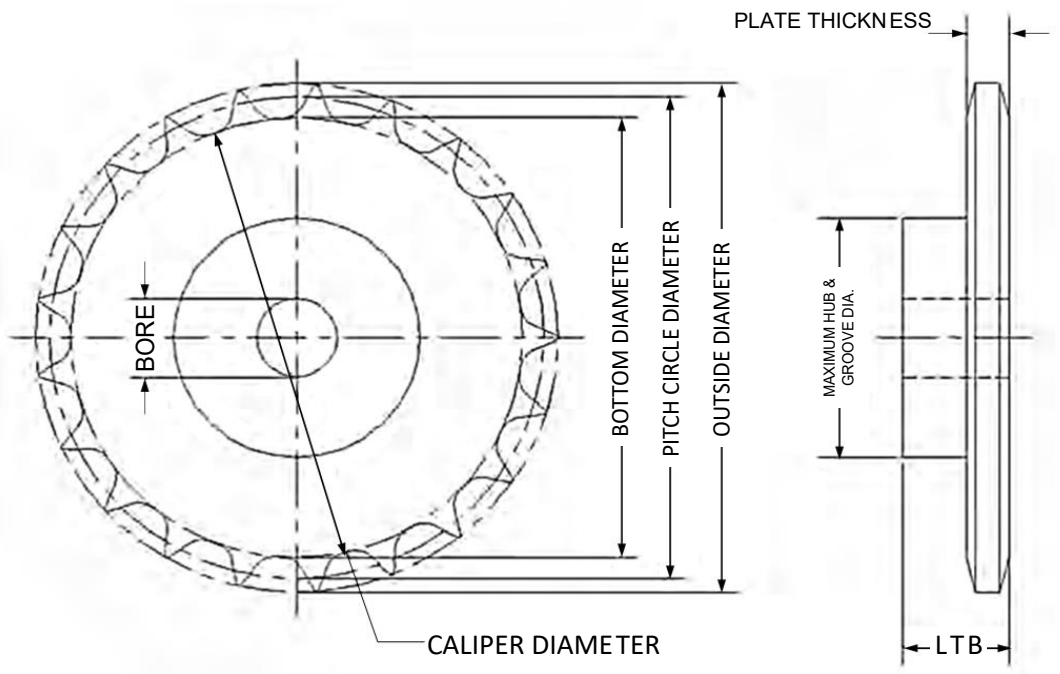


Fig. 4. Primary sprocket dimensions

Step #4. Hub diameter on B- and C-style sprockets. . . The outside diameter is known as the "hub diameter," which is typically specified by the sprocket supplier. Hub diameter determined by the size of the sprocket bore, the keyway used and the requirement to maintain a sprocket-wall thickness that will withstand the forces required of the application. (Refer again to Fig. 4.)

Step #5. LTB (length through bore). . . "LTB" refers to the inside hub diameter and the length to which it is machined. This length must be long enough to accommodate the proper-size keyway to withstand shear and torque stress induced by the rotating shaft. (See Fig. 4.)

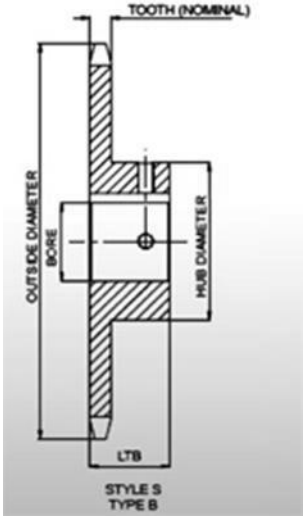


Fig. 5. Sprocket with keyway and two set screws.

Step #6. Sprocket bore. . . This term pertains to the inside diameter of the sprocket and how it is secured to the shaft.

- The term "plain bore" is associated with A-, B- and C-style sprockets, where there is no special machining performed to accommodate keyways or set screws, only a hole to accommodate shaft diameter. Plain bore sprockets typically require additional machining before installation.
- The term "finished bore" is associated with B- and C-style sprockets, where the inside diameter of the hub is machined to accommodate a specific shaft diameter: This configuration includes a standard keyway and set screws. (U.S. Tsubaki provides two set screws to ensure additional clamping force.) Finished bore hubs can also be machined to non-standard yet specific requirements depending on the needs of the application. (A standard finished bore sprocket is shown in Fig. 5.)
- "Maximum bore diameter" is another term that's associated with B- and C-style sprockets. It refers to the maximum bore size to which a sprocket can be machined without compromising structural integrity, yet still be capable of accepting a standard keyway. This measurement is normally listed in a vendor's catalog.

Step #7. Keyway dimensions and set-screw locations. . . Typically, the sprockets are secured to the shaft using an ANSI standard dimensioned keyway and one or more set screws. The ANSI standards provide a keyway of specific length, width and depth for a given shaft diameter. **See Fig. 6** for a partial listing of common keyway dimensions. It is possible that your application not match this standard. If this is the case, you will have to measure or reference the proper-size keyway and supply this information to your sprocket supplier.

A set screw is used to prevent axial movement of the sprocket; if one is used, the placing is usually above the keyway. This location keeps the sprocket from moving along the shaft and stops the key from moving. To better hold the sprocket in place, U.S. Tsubaki incorporates two set screws as the standard. Located at 90° to the keyway, the second set screw provides additional clamping force, as well as reduces the side forces the key receives, which leads to longer service life.

Diameter of Shaft	5/16 - 7/16	1/2 - 9/16	5/8 - 7/8	15/16 - 1-1/4	1-5/16 - 1-3/8
Keyseat Width x Depth	3/32 x 3/64	1/8 x 3/64	3/16 x 3/32	1/4 x 1/8	5/16 x 5/32
Diameter of Set Screw	8 - 32	10 - 24	1/4	5/16	5/16

Fig. 6. ANSI keyway and set-screw specifications.

Step #8. Hardened-tooth sprockets. . .
As the chain contacts the sprocket, frictional wear of the tooth and pocket occurs. With each rotation, every sprocket tooth contacts the chain. Sprockets are typically stamped from plate, pressed from powder metal or machined from bar stock. The hardness of the tooth directly relates to sprocket life. A sprocket with a “hardened tooth” may last three times longer than a softer sprocket. Some manufacturers charge extra for this option.

Step #9. Other common sprocket variations. . .

Fig. 7. QD sprocket and bushing

Fig. 8. Taper-LOCK sprocket and bushing

Fig. 9. Split sprocket

Fig. 10. Double-single sprocket

Fig. 11.
Ball-bearing idler sprocket

Bushed sprockets: At times, a bushed sprocket is used in applications where higher working loads are prevalent. Sprockets with tapered bushings will fall into the QD®, Split-Taper or Taper-Lock ® families. QD and Split-Taper bushings are flanged and commonly utilize large anchor bolts around the circumference of the flange to retain itself to the sprocket **(Fig. 7)**. Taper-Lock bushings are similar in that they incorporate a split through the taper to provide a true clamp on the shaft. These bushings are retained to the sprocket with a series of set screws on the OD of the bushing (parallel to the shaft **[Fig. 8])**.

Steel split sprockets: These sprockets **(Fig. 9)** are cut through the entire diameter for ease of installation and removal. The sprocket halves are held together by bolts on either side of the hub. This particular style is normally available in chain pitch sizes of 40 through 240, and bore diameters of 3/4" through 6", depending on chain pitch selected.

Double single sprockets: This type of sprocket **(Fig. 10)** is used in applications where two or more items are powered by a common drive shaft. The space between the sprocket plates is wider than a multi-strand sprocket, and allows two independent strands of chain to engage without contacting each other. With this type of sprocket, each strand of chain may exit in a different direction than the other— i.e., one strand exiting toward the ceiling and the other running parallel to the floor.