Morse Tapers

©Trevor Pope (tpope AT iafrica.com) – Dec 2006, updated Dec 2018

This updated article was prompted by Tom Howden who requested a live centre for his lathe. He was unsure what size he needed.

If you look at most modern wood turning lathes, you will see examples of Morse Tapers. The headstock and tailstock have conically shaped holes on the centre axis. These holes are sized to standard sizes, to allow tooling to be changed and interchanged between machines. To fit into these tapered sockets, centres, chucks and drills can be used as needed.

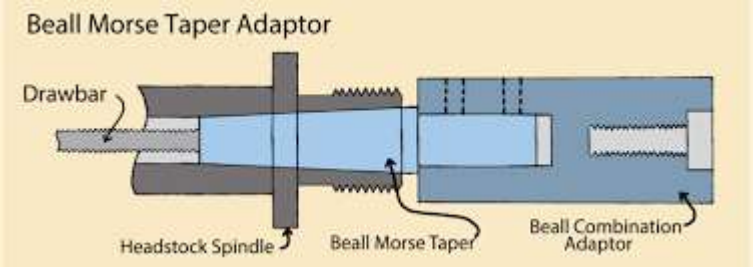
There are a number of standard tapers used in machines. In the woodturning world, Morse Tapers are almost universally used. Morse tapers are one of a class of "self-holding" tapers. The means it is a narrow angle taper (about 1.5º) designed to hold in the socket by friction alone and will not easily fall out. There are other standard tapers used in other applications such as milling machines.
The tapers are designed to accurately hold a tool in the right position, yet be easily removable. Depending on the design of the machine, to remove the tool, a wedge can be knocked in from the side such as a drill press; or a knockout bar from the opposite end of the spindle (see the Jet and Nova lathes in the WWA clubhouse).

If you look at the table of sizes taken from my Machinery's Handbook (16th Ed) below, you can see there is a wide range. Unfortunately, the dimensions are given in inches, due to the age of the book.
(In the US, they still like their inches, even up to today. Fine Woodworking magazine still uses feet and inches and fluid ounces…)
There is a range of sizes to suit different applications, but you will probably only see the #2 MT on modern woodturning lathes. The #1 MT was used on Coronet and Record lathes and some small pen-turning lathes. On larger metal turning lathes, you will commonly find #3, #4 or #5 MT sockets. My Colchester Chipmaster has a #4 ½ MT socket on the head stock and #3MT on the tailstock.

Some people feel that the #1 MT in the Record is too small, but in practise it is quite strong enough for the application of this lathe. The Morse Taper sizes are carefully arranged in sequence so that only one size will fit in a socket, to prevent misapplication: The next size up will not fit at all, and the size below is completely loose. You can see this in the table: the small end size "D" for a particular size is larger than the big end size "A" of the size below, so it won't fit in at all.

For severe applications, you will notice a tang on the end of the taper that is designed to engage in a slot to prevent the taper from turning under load. In milling machine applications, a draw bar is used to pull and hold the taper into the socket. This is important, because with cyclic sideways loading from a cutter as it turns and cuts, the taper can actually work loose, because there is no axial loading to keep the taper in the socket.
This is also important with a wood lathe. If some sort of cutter or chuck is mounted in the headstock, and there is no axial pressure to hold it in place, a drawbar must be used. If you inspect some Morse tapers supplied with Jacobs type chucks, you will see a threaded socket at the

small end of the taper. This is intended to take a drawbar. A length of "all-thread" threaded rod can be inserted through the headstock and used to pull the taper snug.

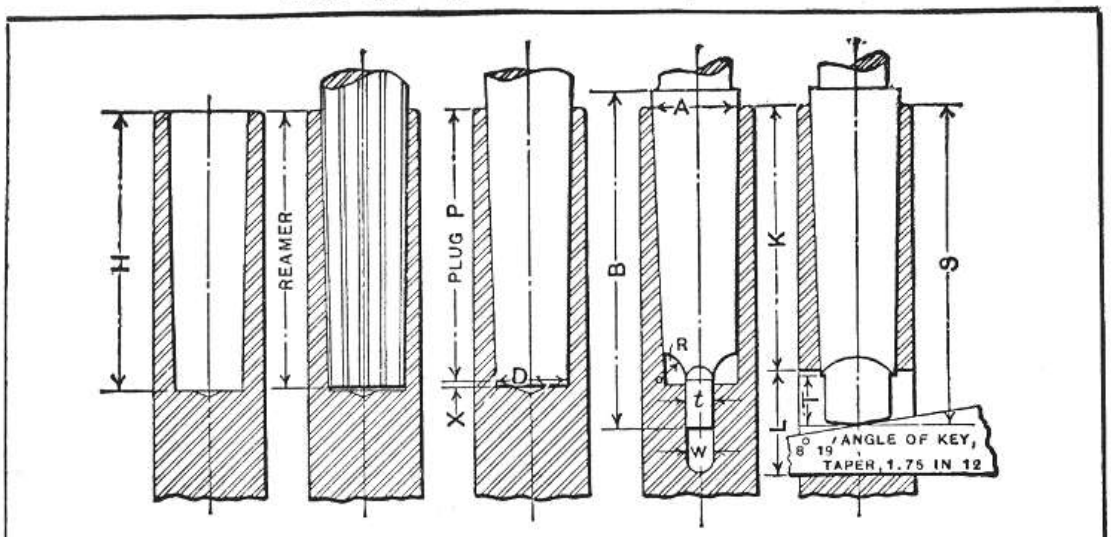


When installing a tool with a taper into a socket, it is important to remove any dust or swarf from the taper and the socket to ensure that the taper locates properly and does not spin in the socket. If it does spin, it is likely to pick up burrs and damage the socket, ruining the accuracy of the machine. Tools such as drive centres are relatively easy and cheap to replace. However the socket usually forms part of the lathe spindle or the tailstock and is expensive to replace, so it is important to avoid damage, such as may be caused by the taper spinning in the socket.

If you wish to fit a different size taper to a machine, such as a #1 MT into a #2 MT socket, there are adapters available.

Extensions are also available, which can be useful when drilling deep holes. Toolquip keep a range of these. (www.toolquip.co.za). The adapters and extensions have a slot in the side as shown in the pictures, into which a wedge can be tapped to aid removal.

Table 1A. Morse Standard Taper Shanks



No. of Taper	Taper per Foot	Taper per Inch	Small End of Plug *D*	Diameter End of Socket *A*	Shank		Depth of Hole *H*
					Length *B*	Depth *S*	
0	.62460	.05205	0.252	0.3561	2 1/32	2 7/32	2 1/32
1	.59858	.04988	0.369	0.475	2 9/16	2 7/16	2 3/16
2	.59941	.04995	0.572	0.700	3 1/8	2 15/16	2 5/8
3	.60235	.05019	0.778	0.938	3 7/8	3 11/16	3 1/4
4	.62326	.05193	1.020	1.231	4 7/8	4 5/8	4 1/8
5	.63151	.05262	1.475	1.748	6 1/8	5 7/8	5 1/4
6	.62565	.05213	2.116	2.494	8 9/16	8 1/4	7 3/8
7	.62400	.05200	2.750	3.270	11 5/8	11 1/4	10 1/8

For more information see https://en.wikipedia.org/wiki/Machine_taper