Appendix 1 Keys and Keyways

A-1-1. Keys and keyways

A key and a pair of keyways are design and used together. A key is an element connecting a shaft and a wheel in rotation, designed with a width, *W*, a height, *H*, and a length *L*. **Figure A-1-1** shows three commonly used keys. The keyways are slots made into both the shaft and the transmission element, such as a gear, a pulley, a coupling, etc., to be mounted together, as shown in **Figures A-1-2** (a) and (b), from the worm-gear speed reducer in **Chapter 1**. A key should be assembled into the keyways of both the shaft and the transmission element, as shown in **Figure A-1-2** (c), for torque transmission.

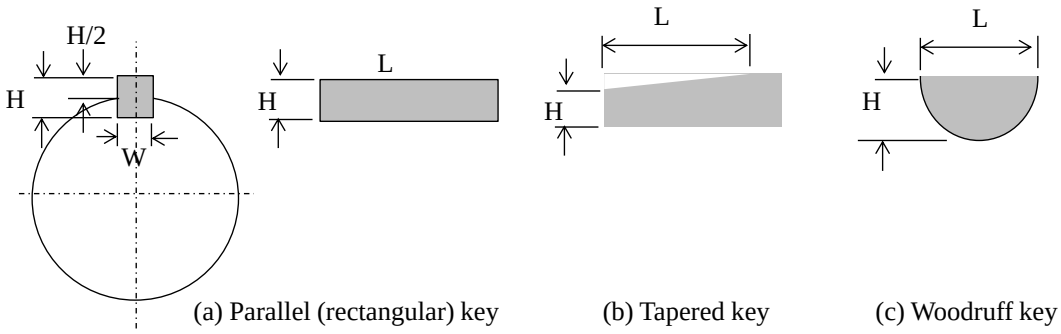


Figure A-1-1. Three commonly used keys.

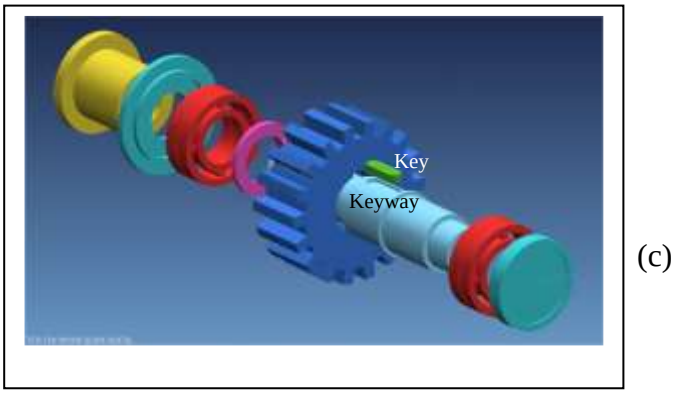


Figure A-1-2. Several keyways. (a) Keyways in the shaft and the lager worm gear shown in **Chapter 1** (note that the left one is made by a side-mill cutter while the other by a

Woodruff keyway cutter); (b) Keyway in the large worm gear; (c) 3D plot of a shaft assembly showing a key and keyways.

Drawing presentations of keyways are shown in **Figure A-1-4**, where the keyways of the shaft of **Figure A-1-2** (a) are shown in the same plane for simplicity to view both in one drawing (actually they should not be in the same plane). The Woodruff keyway at shaft diameter Φ =22 mm is milled with a Woodruff key-slot cutter (a type of side-mill cutters, **Figure A-1-4**, right) of same diameter as that of the key. The keyway in the shaft segment of diameter 18.5 mm is made by a side-mill cutter (**Figure A-1-4**, left); not the entire length is usable. Note that a round-end keyway must be cut with end-milling cutter, as shown in **Figure A-1-5**.

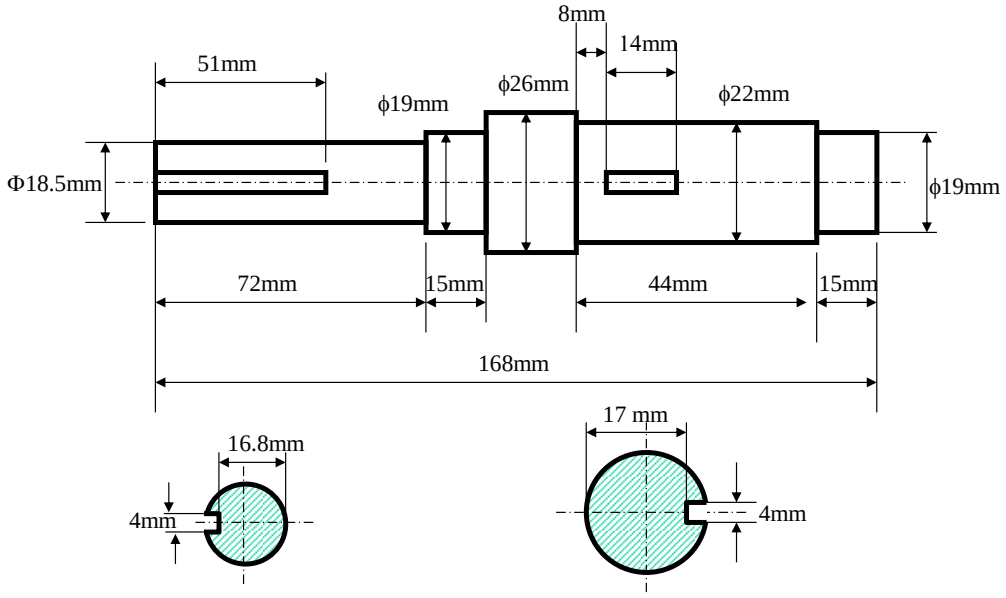


Figure A-1-3. The keyways in **Figure A-1-1** (b) plotted at the same view.

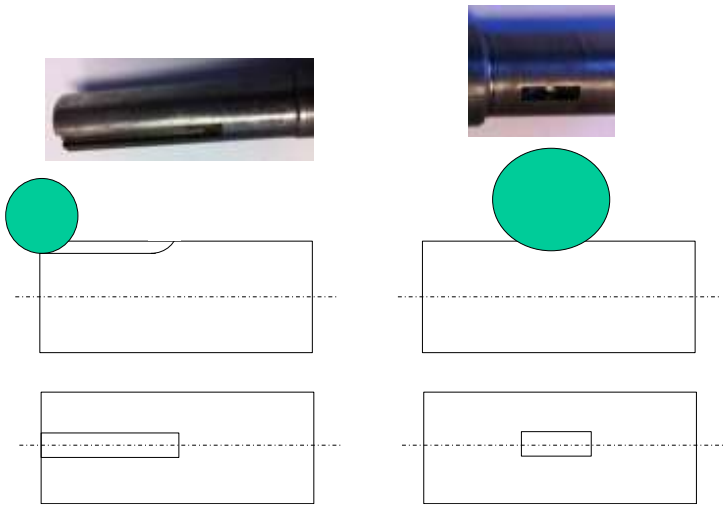


Figure A-1-4. Making a keyway with side-mill cutters; left: flat keyway, right: Woodruff keyway.

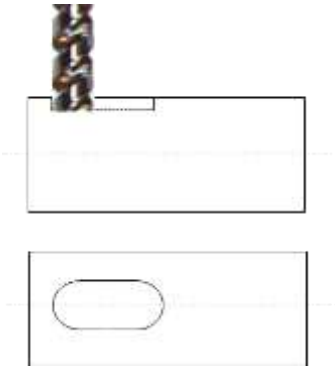
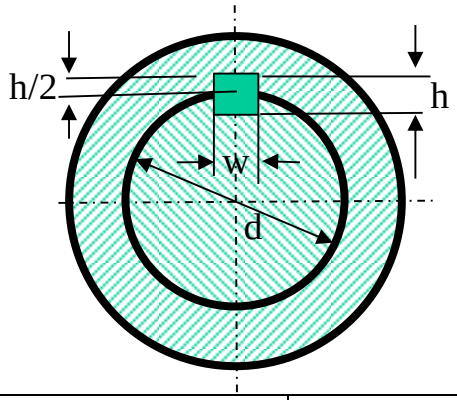


Figure A-1-5. Making a flat keyway by an end-mill cutter.

A-1-2. Key width and height

The key size should be determined based on the diameter of the shaft. The following table [Norton, 2000] listed some of the choices. The length of the key should be determined by the torque transmitted in such a way that the working shear stress does not reach the yield strength of the weaker material of the key and keyways.



Shaft diameter d (mm)	Key width W x height h
12<d≤17	5 x 5
17<d≤22	6 x 6
22<d≤30	8 x 7
30<d≤38	10 x 8
38<d≤44	12 x 8
44<d≤50	14 x 9
50<d≤58	16 x 10
58<d≤65	18 x 11

Reference

Norton, R., L., 2000, *Machine Design*, Prentice-Hall Inc.