VAL-MATIC®

Butterfly Valve Manual Actuators

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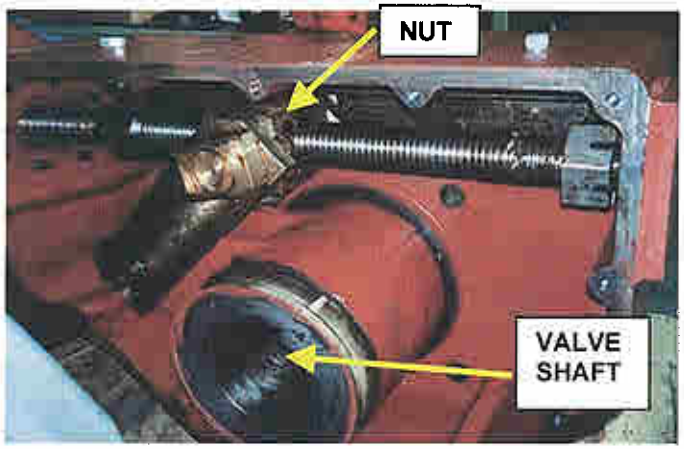
BUTTERFLY VALVE MANUAL ACTUATORS

INTRODUCTION

Butterfly valves are typically supplied with either a traveling nut or worm gear type actuator for handwheel and buried nut service. Both types are listed in the AWWA Butterfly Valve Standard, C504. Each type has some important characteristics that affect the performance of the valve assembly and should be understood before selecting the best gear for a particular application.

TRAVELING NUT ACTUATORS

The first type of actuator often provided is the traveling nut actuator. It has been around for over 50 years and is provided in two designs: the slotted lever and the link-lever. The traveling nut actuator was created to match the torque characteristics of butterfly valves, which have high seating torque. Therefore, a higher mechanical advantage at the end of travel is desirable.



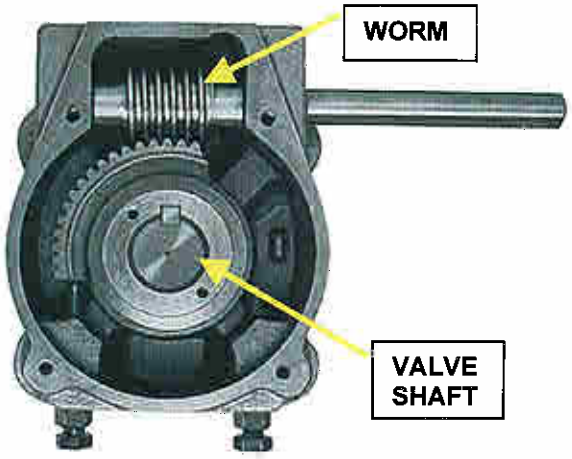
The traveling nut actuator consists of a sealed housing, threaded stem, threaded nut, link, and lever. As the threaded rod is turned with the handwheel, the nut is driven to the left and right and supported by milled slots in the housing and cover of the actuator. The nut in turn drives the link and lever. When the nut is on the left side of the housing in the photo, the link is near the vertical orientation. At this location, travel of the nut provides a small change in lever rotation. Hence, at the left end (closed position) the mechanical advantage of the actuator can be twice that in the center or right position. The traveling nut gear therefore matches the torque requirements of a butterfly valve. A traveling nut operation can vary from 10 to 100 turns and for large valves (i.e. greater than 36 in.), spur gears and bevel gears are provided.

The closed and open stops of these actuators are typically threaded nuts that are pinned to the threaded stem. Because, a high amount of torque can be resisted between two nuts jammed together and because the stop design does not apply a load to the housing, the stops are usually rated to 450 ft-lbs. This high torque rating prevents many valve failures in buried service.

Traveling nut actuators are usually constructed of an iron housing, steel links, and a ductile iron lever and are more economical that worm gear actuators. They are more economical than worm gears because the bronze worm gear is not needed and they provide their greatest mechanical advantage at the closed position to match the requirements of the valve. Traveling nut actuators are the standard actuator for most AWWA butterfly valve manufacturers. These actuators are manufactured by each butterfly valve manufacturer and designed specifically for butterfly valves.

WORM GEARS

Early butterfly valves were provided with worm gear type actuators, which feature a sealed iron housing containing a hardened steel worm that drives a large worm gear, sometimes called a segment or sector gear. Adjustable bolts are provided to limit the travel of the actuator and precisely position the valve in the open and closed positions.



Worm Gear

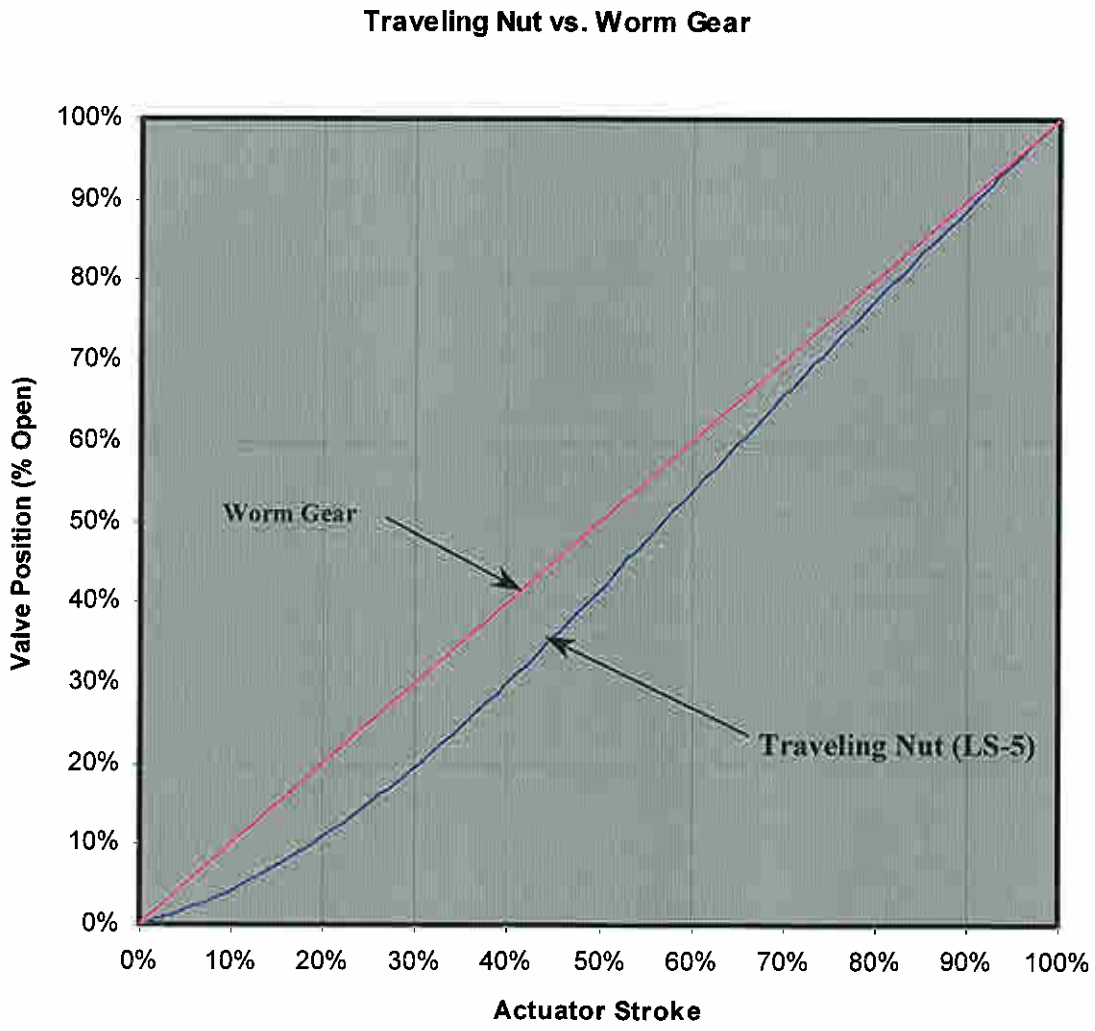
A basic worm gear converts about 20 turns of the input shaft into the 1/4 turn necessary to operate the butterfly valve. This operation translates into a mechanical ratio of about 80:1. However, with consideration to the friction in the gear faces, the efficiency of the gear is only about 30% resulting in a mechanical advantage of about 25:1. Hence, if it takes 500 ft-lbs on the valve stem to operate the valve, then the input torque needed on the actuator is only 500/25 or 20 ft-lbs. When the input torque exceeds about 150 ft-lbs or 80 lbs pull on the handwheel, spur gears are provided on the input side of the housing to provide additional mechanical advantage.

Worm gears can be provided with handwheels for above ground service or 2" AWWA nuts for buried service. For buried service, the input shaft is made corrosion resistant, the housing is packed with grease, and the indicator is replaced with a blind cover. One weakness of the worm gear is that the closed stop design is usually limited to a torque of 300 ft-lbs because all of the torque is transmitted to the housing as force against the stop bolt. When a valve is buried, maintenance workers can sometimes exceed that torque and damage the gear.

The worm gear is a reliable gear for butterfly valves and available from many alternate suppliers. However, its cost can be high when the AWWA materials of construction are specified because the worm gear must be constructed of bronze. It also provides external closed stop adjustment, which can be helpful in above ground applications.

ACTUATOR OPERATING CHARACTERISTICS

The last important consideration in selecting an actuator is the different operating characteristic of the two types. The worm gear has a linear characteristic which means that for every turn of the handwheel, the valve is rotated the same amount. The traveling nut actuator, on the other hand, exhibits "characterized closure." Characterized closure means that during the open half of travel, the valve is rotated rapidly, and during the last half of travel, the valve is rotated slowly toward the closed position. This difference in travel is because the geometry of the link and lever mechanism. The benefit of characterized closure is that the valve is closed during its last portion of travel slowly, which can reduce pipeline surges or water hammer.



CONCLUSION

In the municipal butterfly valve business, about 75% of the manual actuators provided today are of the traveling nut type. Traveling nut actuators are more economical than worm gears, withstand higher input torques, and provide characterized closure. Given all of its advantages, we expect the traveling nut actuators to continue to be the dominant actuator for butterfly valves.