

Question of the Month

ADVICE FOR DISTRIBUTION SYSTEMS

What Are Key Factors to Consider When Installing Large Butterfly Valves Belowground?

BY JOHN V. BALLUN AND JOHN R. HOLSTROM

When projects require direct buried installation of large butterfly valves, special installation factors must be considered to maintain valve integrity. This column reflects the views of the joint task force developing recommendations for improving industry and AWWA standards and manuals of practice to disseminate knowledge about this concern and identify potential solutions.

To function properly and provide a leak-tight seal, butterfly valves must maintain their circular shape to within at least 0.06 in. (1.5 mm) radially when subjected to static loading from the weight of the actuator, the weight of the valve, the weight of the fluid in the valve, and an external distributed vertical load of 5 psi (35 kPa) on the projected area of the body, as defined in AWWA C516, [Large-Diameter Rubber-Seated Butterfly Valves, Sizes 78 In. \(2,000 mm\) and Larger](#).

The external vertical load used for design in AWWA C516 is an evenly distributed 5-psi external load, which represents an approximate earth load equivalent to a 6-ft (1.8-m) burial depth, assuming 120 lb/ft³ density for the earth material. It's important for the purchaser to specify the exact earth load for a given installation so the valve manufacturer can evaluate the valve's body stiffness.

DEFLECTION

By design, buried flexible pipes are allowed to deflect 2 to 5 percent because

of external loads. With a large-diameter pipeline, this variance can represent several inches of vertical deflection. When the pipe and the valve are flanged together belowground, pipe deflections are transmitted to the valve and can be detrimental to the valve's integrity. The adjacent pipe connections must be supported and stiffened to eliminate the transfer of pipe loads to the valve. Where practical, the valves should be located in vaults.

In response to a request from AWWA's Steel Pipe and Stainless Steel Pipe Committee chairs, a special joint task force meeting was held at ACE 2017 in Philadelphia to discuss the issue of valve deflection and included 18 members of the AWWA Steel/Stainless Pipe and Butterfly Valve committees. The installation recommendations given in the new third edition of AWWA M49, [Quarter-Turn Valves: Head Loss, Torque, and Cavitation Analysis](#), were reviewed. M49 explains that the pipeline designer must consider the external loads on the valve, support the pipe properly, and consider use of flexible joints to absorb shear loads and thermal expansion.

SEATING IN THE FIELD

Several observed field issues with large flanged butterfly valves were discussed, including field measurements showing valve body deflections 6 to 7 times the deflection defined in AWWA C516. This amount of deflection causes the valve disc to bind or wedge against the valve body, preventing closure against the valve seat. The common denominator in these field installations was that the valves were buried with a support under the valve.

Rigidly supporting the valve was thought to result in pipe loads being transferred



Large-diameter butterfly valves represent a challenge in direct buried service because of deflection issues.

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to the valve, forcing it out of round. This distortion of the body seat inhibits a tight seal at the closed position, creates binding between the body and the disc, and may render the valve inoperable.

Meeting attendees recognized that there are no piping support methodologies in the current valve and pipe standards or manuals to address this issue. The major conclusion from the meeting was that in no case should the valve be supported directly by a saddle or foundation.

VAULT USE

Some users at the meeting suggested installing the valves in vaults with or without flexible joints to eliminate the earth and

piping loads on the valves. Other users and engineers suggested that if a valve must be directly buried, the pipe ends should be rigidly supported or both the valve and piping should be back-filled and supported with uniform, well-compacted bedding to minimize differential settlement-induced stresses. Given the potential for changes in geotechnical conditions, especially under a deep valve excavation, the supporting soil structure must be assessed.

The group consensus was that currently there are no design methodologies to prevent installation problems with deflection and distortion of large butterfly valves in buried service other than installing the valves in vaults. However,

the expense associated with large vaults may preclude their use in some applications. Also, pipe materials vary, and the geotechnical conditions at each installation will be different from one to another as well.

A FULL SYSTEM VIEW

The pipeline designer should consider the valve and the pipe as a system and analyze the piping and earth loads to ensure the pipe connections at the valve have sufficient stiffness to maintain roundness, even with deflection of the adjacent piping. Paying attention to the valve and piping system's deflection will help prevent costly field problems down the road. 