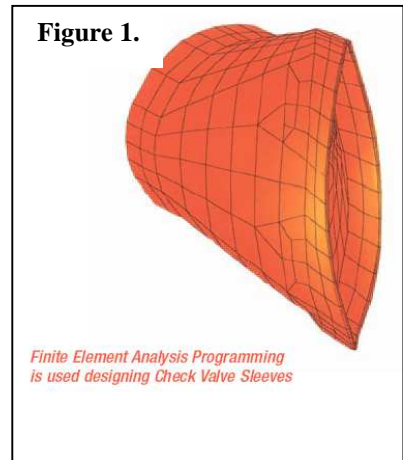


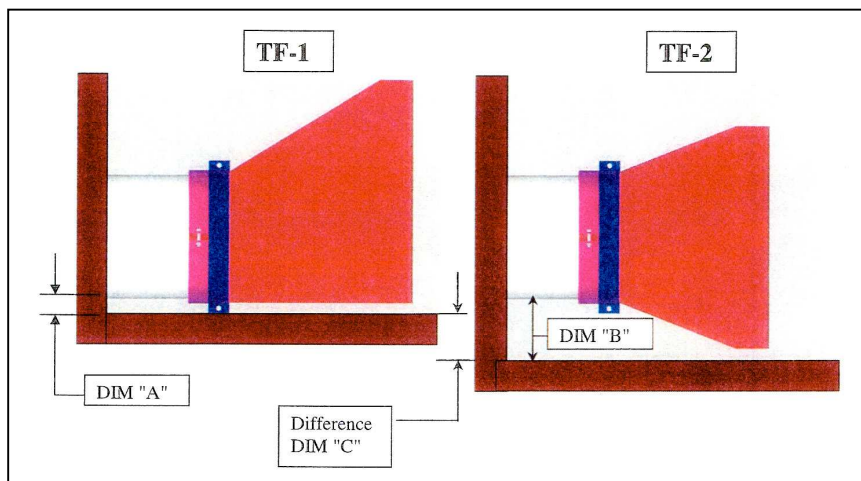
Tideflex Valve Installation Requirement

Tideflex Technologies, a division of Red Valve Company, invented and pioneered the market for using Tideflex check valves (duckbill valves) for back flow prevention. With tens of thousands of check valves along with documented testimonials from end users and government agencies such as The Army Corp of Engineers and the US EPA, Red Valve Tideflex check valves have proven to be the most cost effective means to preventing back flow.

Since the inception of Tideflex in the early 1980's, continual research and development has been done via Finite Element analysis (Figure 1), independent hydraulic testing and extensive field studies and validation to improve the performance and design of Tideflex check valves. One significant design improvement was Red Valve's introduction of the TF-1 eccentric/flat bottom style Tideflex in 1997.



One of the long-standing issues regarding the TF-2 (Slip-On) and Series 35 (Flanged) style Tideflex Valves is the requirement for additional bottom clearance due to the bill or sealing area of the valve flaring equally above and below the valve. The TF-1 requires significantly less bottom clearance than a TF-2 as illustrated in the table below. Vaults and manholes can be much smaller resulting in significant savings in excavation and concrete costs or the sizing of precast vaults. The TF-1 produces a very small "sump" compared to that of a TF-2. The TF-1 also minimizes the amount of sand and sediment that can get trapped in the vault. Normal flow velocities will scour the sump of a TF-1 which is not possible in the TF-2 installation since the sump is required to be much deeper.



Another major benefit of the TF-1 is the valve allows the invert of the pipe to be lower since it does not require as much bottom clearance. This results in a greater hydraulic capacity of the outfall because the slope of the pipe is increased, which maximizes the amount of driving head available to pass flow.

To gain bottom clearance when installing Tideflex, many customers would rotate the TF-2, Tideflex check valves up to 30° from vertical. These customers later told us that their check valves distorted and leaked. As we analyzed this means of installation, we discovered:

- Rotation beyond 45° was required to get the bottom of the bill near the bottom of the pipe
- ANY rotation compromised the structural integrity of the valve due to an unequal distribution of the valve and water weight.

With extensive field observations, we found that rotating the valve from vertical resulted in the bill of the valve gapping open which results in the valve not being able to seal and prevent backflow (Figure 2).

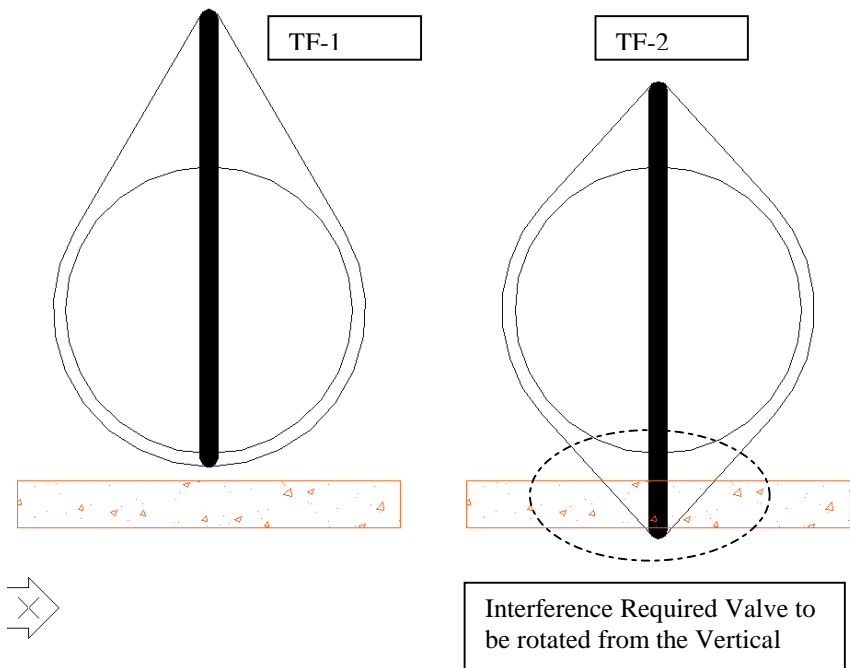


Figure 2.

Another observation made was when a valve was submerged with no pressure upstream. Considerable distortion of the bill was discovered from buoyancy effects on the projected surface area of the rotated bill resulting in leakage.

The TF-1 (Slip-On) and Series 35-1 (Flanged) flat-bottomed Tideflex Valves were developed to minimize the amount of bottom clearance required. More importantly, this configuration allows us to keep the bill in the vertical position and eliminate the possibility of the valve distorting and gapping open.

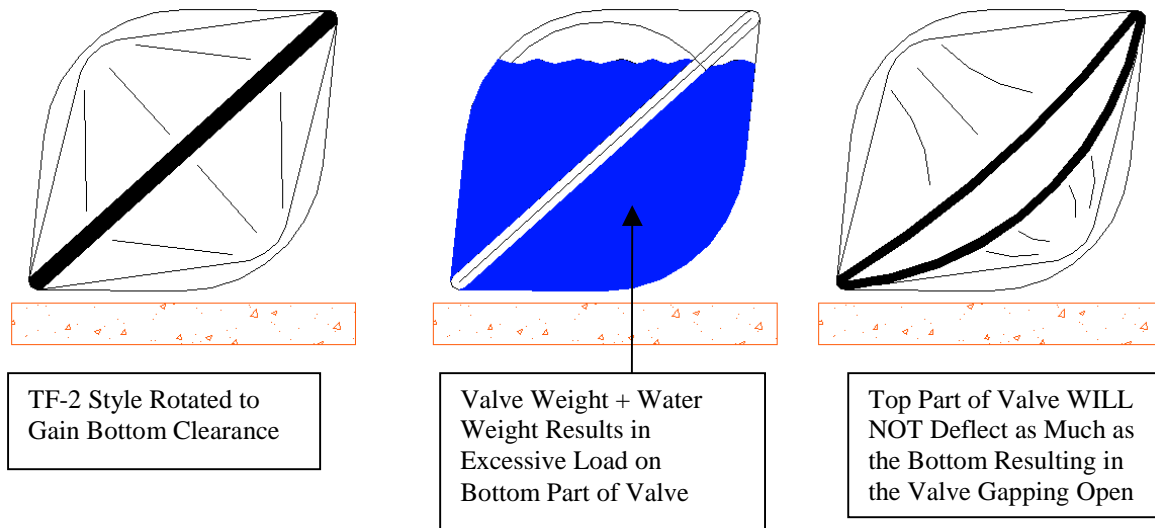
The following illustration shows the interference problem with TF-2-style valves:



The following table shows the valve weight and the weight of water inside the valve. Note, how the total weight is expressed in tons.

PART & WATER WEIGHTS				
SIZE (INCHES)	TF-2 WEIGHT (POUNDS)	WATER WEIGHT (POUNDS)	TOTAL WEIGHT (POUNDS)	TOTAL WEIGHT (TONS)
24	130	637	767	0.3
30	220	1072	1292	0.6
32	300	1380	1680	0.7
36	560	1801	2361	1.1
42	800	2702	3502	1.6
48	1027	3855	4882	2.2
60	1660	7556	9216	4.1
72	2620	13968	16588	7.4
84	3880	18411	22291	10.0
90	4664	23030	27670	12.4

The following illustration shows the problem that rotated valves experience due to their own weight and the weight of the water:



CONCLUSION:

It is Red Valve's recommendation for applications which have minimal bottom clearance that TF-1's be specified. Tideflex Technologies has already been thru this evaluation, and confidently can state that rotating Tideflex to achieve bottom clearance does not work. Allowing a Tideflex or any other duckbill valve to be rotated from the vertical position WILL LIKELY RESULT IN FAILURE.