White Paper

Rigging and Lifting of Large Valves

Table of Contents

Introduction

Lifting heavy and large loads is challenging enough. But when you add the complexity of large valve geometries, extensions, and oddly shaped actuators, great care and understanding is required to perform safe load lifting operations, both in the factory and on the job site. This article will explain many of the challenges involved with lifting large valve assemblies weighing several tons and illustrate the industrial rigging equipment and lifting operations typically used for large valves, see photo of a 48-inch valve being installed in Norfolk, VA. The purpose of this article is not to provide comprehensive training on rigging, but instead to increase awareness of the special risks and care required to safely perform lifting operations for large valves.

Valve Characteristics

FIGURE 1. Installation of 90-inch Butterfly Valve

Rigging is defined as connecting a load to a source of power so that it can be lifted and moved safely and predictably. In order to rig a large valve, a basic understanding of valve construction must be understood. As shown in Figure 1, most large valves consist of a body, a closure member that either rotates or translates in the body, and an external actuator, which is used to operate the closure member. The body typically includes a flange with bolt holes that can facilitate lifting. If the valve is being installed with the actuator removed, the closure member must be secured from rotating or translating, which will shift the load. The interior of the valve is not to be used for lifting. Do not lift valves with straps, cables, or chains through the valve interior or the precision machined seating surface could be damaged (AWWA). When moving a valve with a forklift, it is important to protect the valve flanges from scrapes or gouges. The flange surfaces are machined to accept and seal to pipe gaskets and should not be treated like structural beams. It is recommended to lift large flanged butterfly valves with eyebolts or rods through the flange holes and large gate valves with straps around the valve body.

FIGURE 2. Unloading of a 36" Pipeline Valve
(Courtesy of United Valve)

Valves are surprisingly heavy. The 90-inch butterfly valve assembly shown in Figure 1 weighs 24,000 pounds or 12 tons. It is not an item that can be moved around with a typical forklift truck or backhoe. Significant 20 to 40-ton crane power is required to handle large valves. It is also important to note that the center of gravity of the valve varies with the location of the closure member and the relative weight of the actuator. While it is logical to rig to the centerline of the valve, doing so may place the load out of balance. The center of gravity must be estimated, and the slings or cables connected in such

a way as to balance the load. In Figure 2, the lifting slings are placed toward the actuator on this 36-inch pipeline valve to balance the load.

While it is tempting to simply connect the crane hook to any accommodating surface on the valve, the actuator or handwheel should never be used to lift a valve. They are not designed to support the weight of the valve. Figure 3 illustrates how NOT to lift a gate valve. Figure 4 illustrates wrapping the valve with rigging the slings to the body of the valve. Note that if the valve flanges were used to lift this 60-inch gate valve, its tall center of gravity would make the lift unstable and dangerous.

Valve Rigging Equipment

There are many common pieces of rigging equipment commonly used with valves. It is dangerous to simply insert the crane hook into the nearest flange hole or cavity of a valve. Valves can be made of grey iron, which can be brittle, and may not support the high localized stresses from a crane hook. The connection to the crane hook is typically made with a combination of shackles, synthetic slings, wire rope slings, and chain slings. It is recommended to employ a swivel eye bolt or hoist ring to connect to a valve flange as shown in Figure 5. These devices are simply inserted into two or more flange holes and automatically align to the lifting strap angle to prevent damage to the strap or the eye bolt. Alternatively, bars of diameter equal to the bolt holes can be inserted into opposite flange holes for lifting.

FIGURE 3. How NOT to lift a Gate Valve
(Demonstration by United Valve)

Large valves are easily flipped over with swivel rings. A large butterfly valve can be lifted and stood up on its edge. Then the swivel rings can be inserted into one side of the valve's flange face and re-lifted. The valve will then swing form the vertical and can be lowered down flat to the ground on the other side. Needless to say, the valve in figure 5 would need to have the closure member rotated to be within the interior of the valve laying length if not fully closed before laying the valve on its edge. Some valve closure members extend beyond the flange face even when fully closed. Hence, it is always advisable to have wood blocking under the flange faces before setting the valve down on the ground.

FIGURE 4. Hoisting a 60-inch Gate Valve
(Courtesy of J&S Valve)

FIGURE 5. Use of Swivel Rings to lift a 144-inch Butterfly
(Courtesy of United Valve)

As shown in Figure 4, large nylon straps are used around the valve body for lifting. It is important to note that many valves have sharp edges as part of the body geometry, especially adjacent to flange faces. Slings must be padded or protected from sharp edges. Moreover, depending on how the strap is attached and at what angle will affect is load carrying capacity.

Safety

There are several publications from OSHA and organizations like the Mechanicals Contractors Association of America available to train personnel and provide for safe lifting practices and instructions on the use of rigging equipment. Figure 6 presents some of the common safety tips for lifting heavy loads.

SAFETY CHECKLIST FOR HOISTING		
How	**H**	heavy is the load?
What are the	**O**	operating limitations of the crane and rigging?
When was the last	**I**	inspection performed?
How will	**S**	sling angles affect lifting capacity?
Have you performed a	**T**	test lift to check stability?
Move the load with	**S**	smooth and steady actions.
Is the	**A**	area clear of personnel and obstructions?
Can the load be	**F**	flown and landed safely?
How will the	**E**	environment affect the safety of the lift?

FIGURE 6. Safety Guidelines for Hoisting (Hennepin)

The list reminds us to check the adequacy and condition of all equipment used. It is important to know your valve's weight and center of gravity. Similarly, the capacity of all of the lifting equipment must be confirmed. Make sure the lift zone and movement area is clear of personnel, power lines, and other equipment. But let's face it; valves are often handled outdoors in muddy trenches and horrible weather. These conditions affect the safe procedures and the strength of some equipment, such as fabric slings. It is best to work smoothly and with care at all times no matter the conditions.

By understanding the special characteristics of valves and following safe rigging and lifting practices, we can all have many successful valve installations.

References

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