2.0 THEORY OF OPERATION OF MOTOR-OPERATED VALVES

Learning Objectives

Upon completion of this Chapter, the student should be able to accomplish the following:

1. Identify common valve types and their typical service applications.
2. Describe the mechanical components that make up rising-stem valves.
3. Describe the mechanical components that make up rotating-stem valves.
4. Describe the major electrical and mechanical components that make up common motor actuators.
5. Describe the electrical and manual modes of operation of motor actuators and trace the path of the rotational forces through the device.

Introduction

A motor-operated valve (MOV) is a combination of two separate devices, usually provided by two separate manufacturers. The valve assembly can be one of several types of mechanical devices designed to optimize a desired fluid control function, such as isolation or throttling. The actuator is an electrical/mechanical device used to position a valve assembly from a remote location. The basic parts of a valve assembly have common nomenclature regardless of the type of valve. These basic parts are the valve body, bonnet, disc, seat, stem, and yoke which are illustrated in Figure 2-1.

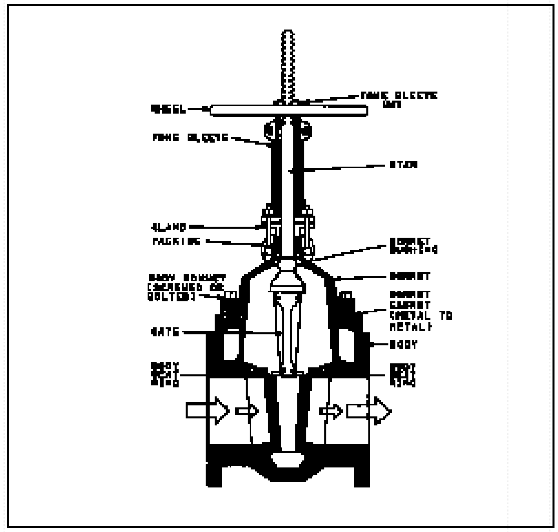

Figure 2-1 Valve Assembly Basic Parts

The valve body is the primary pressure boundary and principle structural element of the valve assembly. It provides the seat against which the disc seals off flow. It receives the bonnet through either threaded, bolted, or welded coupling and connects to the inlet and outlet piping through threaded, bolted, or welded joints. Valve bodies are either cast or forged, and machined to interface with the other valve parts.

The valve bonnet is the next principal pressure boundary part. It provides the closure head for the body and supports the stem, disc, packing, and yoke/actuator. Bonnets are either cast or forged and connected to the valve body by threaded, bolted, welded, or pressure sealed joints. In all cases the attachment of the bonnet to the valve body is considered a pressure boundary. This means that the hardware or welds are considered pressure boundary parts. In most valves, the bonnet also houses the packing or seal around the stem, preventing leakage.

The valve disc completes the pressure boundary and provides the capability to close the flow path. With the disc closed (seated) and outlet piping depressurized, full system pressure is applied across the disc. Discs are usually cast or forged and often hard-faced to provide good wear characteristics.

Seats or seat rings provide the sealing surface for the disc. In some designs, the body is machined to serve as the sealing surface and seat rings are not used. In other designs, forged seat rings are threaded or welded to the body to provide the seating surface. The sealing surfaces are often hard-faced to improve wear characteristics. Seat rings are not considered pressure boundary parts because the body has sufficient wall thickness to withstand design pressure without relying on the seat rings.

The valve stem translates the motion of the actuator into disc motion. Stems are typically forged and connect to the disc by T-slots or flexible joints. For valve designs requiring stem packing or sealing to prevent leakage, a fine surface finish is maintained on the valve stem in the area of the seal. Stems are typically not considered a pressure boundary part.

The valve yoke provides structural support for the actuator. It connects to the valve body or bonnet and is always outside the pressure boundary. The yoke reacts the torque or thrust applied to the valve stem by the actuator.

The actuator operates the stem and disc assembly. Actuators can be manual handwheels, manual levers, motor operators, pneumatic operators, hydraulic operators, or solenoid. Actuators are not considered pressure boundary parts except for certain hydraulic operated valves.

There are various types of valves used in nuclear power plants. Each of these types of valves has unique characteristics which match the requirements of its application in power plant systems. These unique characteristics exist for a given valve type regardless of the system which uses the valve.

Valves are often categorized by the motion of the valve stem and thus the motion required from the actuator. Rising-stem valves are those that are operated by moving the valve stem axially through the bonnet to push or pull the valve disc. Quarter-turn valves are those that are operated by turning the valve stem 90 degrees clockwise or counterclockwise. The principal types of valves and actuators are described in the following sections.

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