

Boilers and Unfired Pressure Vessels

rupturing pressure of the disk so that it is necessary either to replace it or clean it with a solvent

The condition of these disks should be checked frequently to see that they are clear. It must be remembered that when the disk ruptures, all pressure is relieved from the vessel. This could result in complete loss of product or spoiled in-process material.

A rupture disk must function within ± 5 per cent of its specified bursting pressure at a specified temperature. Disks may be installed between a spring-loaded safety or relief valve and the pressure vessel in order to prevent unnecessary corrosion of the valve and to prevent it from becoming plugged by the contents of the vessel. These multiple installations must be in accordance with the ASME Code, Section VIII.

Various designs of rupture disks are available.

Vacuum breakers. It is just as important to protect a pressure vessel from collapsing under a vacuum as it is to protect it against bursting from overpressure. Several safety devices provide such protection.

The mechanical vacuum breaker, similar to a spring-loaded safety valve, has a spring set at a predetermined vacuum.

The weight-balanced vacuum breaker (using a weight suspended from a fulcrum attached to the gate) is generally used on pressure vessels working intermittently on pressure and vacuum. If the vacuum exceeds the setting of the weight on the fulcrum, the breaker then opens.

In some vessels which work ordinarily under pressure, but in which a vacuum may occur because of rapid cooling (as when steam condenses), a check valve may be installed with a flap or valve disk facing into the vessel. Whenever a vacuum occurs, the check valve disk opens automatically.

Water seal. A water seal is used on pressure vessels that operate on low pressure or slight vacuum, such as alcohol stills and gas holders. A water seal is a U-pipe filled with water, with one end connected to the pressure side of the vessel and the other vented to the atmosphere.

Since the vessel operates under a pressure of only a few pounds, the degree of pressure

can be regulated by the height of the water in the vent pipe. If the pressure rises above the set limit, the water is forced out of the pipe, thus relieving the pressure.

Vents. In many processes, pressure must be relieved before the pressure vessel can be opened. An easy means of relieving this pressure is to vent it to the atmosphere. Condensate tanks, which operate under very low pressure or no pressure at all, but in which excessive pressure can build up, should also be equipped with vent pipes and safety valves.

Vent pipes should be large enough in diameter to relieve the contents of the vessel before excess pressure can build up. A vent pipe should preferably be installed with a U-bend at the atmospheric discharge to prevent dirt from clogging the pipe. Care should be taken to direct the flow away from the vessel in case of fire, so it will not impinge on the metal.

Vent pipes must also be protected in cold weather—vapor may freeze as it leaves, rendering vents inoperative as safety devices. If a vent pipe is so placed that it may freeze or become clogged by dirt, a relief valve should be installed on the pipe as added protection.

Regulating or reducing valves. Some vessels are operated under steam pressure much lower than that obtained from the boiler or steam transmission line. A regulating or reducing valve reduces high-pressure steam to that required for a specific operation.

There should be a safety valve on the low-pressure side of the reducing valve. The relieving capacity of the safety valve should be sufficient to assure that the pressure on the vessel that is being fed the steam will not exceed its safe working pressure in the event the reducing valve fails.

To provide protection for all pressure vessels in a battery of the same type, one reducing valve and one safety valve may be installed in the main steam line. This is the usual method in the case of steam-jacketed kettles in which ordinary pressures do not exceed 10 to 25 psi. Safety valves should be so connected that there is no stop valve between them and any vessel they protect.

Autoclaves and interlocks. Autoclaves,