

USE OF PRESSURE-VACUUM VENT VALVES FOR ATMOSPHERIC PRESSURE TANKS TO REDUCE EVAPORATION LOSS

Prepared by the Evaporation Loss Committee
of the American Petroleum Institute

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FOREWORD

Evaporation loss from crude oil and its products has long been a subject of concern to the petroleum industry. Over the years, companies have studied specific loss problems and have taken numerous steps to reduce evaporation loss. Such reduction also has helped maintain product quality and promote safety.

The pressure-vacuum vent valve is an important device, which is used to reduce evaporation loss from volatile liquids stored in fixed-roof tanks and in variable-vapor-space systems. The principles presented in this bulletin will aid engineers responsible for the selection of these vents by defining the factors to be considered. In addition, the bulletin serves to increase the awareness of operational and maintenance requirements.

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Introduction

This bulletin discusses venting of aboveground tanks used for the storage of petroleum and petroleum products at essentially atmospheric pressure (usually up to 12 in. of water pressure). Venting requirements for low-pressure (up to 15 psig) aboveground storage tanks are covered in *API RP 2000: Guide for Venting Atmospheric and Low-Pressure Storage Tanks*.

The pressure-vacuum vent valve, hereinafter referred to as a PV vent, is a device which inhibits evaporation losses while protecting the tank from the possible damaging effects of overpressure or overvacuum. When the vapor-space pressure within a storage tank exceeds the pressure set point, the PV vent opens to release vapors from the tank until the pressure is reduced below its set point. When a vacuum is formed within the storage tank, and exceeds the vacuum set point, the PV vent opens to admit air into the storage tank until the vacuum is reduced below its set point.

The use of PV vents on storage tanks will reduce certain evaporation losses from volatile liquids stored in fixed-roof tanks or in variable-vapor-space tanks and systems. It is a basic assumption that the tank and its accessories are in vaportight condition.

Sources of Evaporation Loss

The many types of losses that combine to make up the total evaporation loss are discussed in detail, and remedial actions suggested, in bulletins which have been published by the American Petroleum Institute (see p. 15). The losses discussed herein are subject to reduction by the use of properly selected, installed, and maintained PV vents.

Breathing Loss

Vapors expelled from a tank because of the thermal expansion of existing vapors, and/or expansion caused by barometric pressure changes, and/or an increase in the amount of vapor from added vaporization in the absence of liquid-level change, except that which results from boiling, is defined as breathing loss. In many installations the tank breathing loss, which fortunately is susceptible to reduction, may be the major portion of the total evaporation loss.

Breathing loss, which is common to most tanks, occurs when the limit of pressure or volume change in the vapor space is exceeded. Atmospheric pressure fixed-roof storage tanks designed for only a few inches of water pressure, or vacuum, experience a relatively large breathing loss. Well designed, installed, and maintained variable-vapor-space tanks and systems normally experience little or no breathing loss.

Filling Loss

Vapors expelled from a tank as a result of filling, irrespective of the exact mechanism by which the vapors are produced, is defined as filling loss. During filling, the rising liquid level in the tank tends to displace the vapors. Variable-vapor-space tanks and systems are designed to store most, if not all, of the displaced vapors; independent fixed-roof tanks have no such provisions. In such fixed-roof tanks the rising liquid level tends to compress the vapors, increasing the pressure within the tank vapor space until the PV vent pressure set point is exceeded, causing the vent to open and permit flow. Filling losses from fixed-roof tanks are usually higher than the filling losses from variable-vapor-space tanks and systems.

Emptying Loss

Vapors expelled from a tank after the liquid is removed, is defined as emptying loss. Atmospheric pressure fixed-roof tanks are most vulnerable to this loss. Variable-vapor-space tanks are less subject to this loss but will encounter it if the vapor-storage capacity is exceeded.

Types and Operating Characteristics of Vents

Several basic types of PV vents are currently available. They are described by the vent manufacturers as falling into three main categories:

1. Solid pallet (hard pallet to hard seat) valve.
2. Diaphragm pallet valve.
3. Liquid seal valve.

Solid and Diaphragm Pallet Valves

The solid pallet and diaphragm pallet valves are available in either a side-by-side pressure and vacuum