

Secret Ingredients for Great Wine Coolers:

Selecting valves to improve process cooling in winemaking and other industries

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A White Paper From ASCO

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Introduction

Several types of valves are used to control cooling in the fermentation stage of industrial winemaking. The wine cooling process itself is fairly straightforward. But examining that process may highlight how valves can function as surprisingly important ingredients in improving a wide variety of cooling applications.

Such examination may help users select the right valve types to help perform cooling throughout a range of industries.

This report outlines a typical “wine cooler” process, and suggests tradeoffs and advantages involved in optimum valve selection.

The process

Production in most industrial-scale wineries follows a similar pattern. Productive seasons vary according to the climate of the winemaking region involved.

Let’s consider a successful winery in northern California. After the long, quiet growing season comes the *crush*, or processing period. In September or October, crews pick the grapes via mechanical harvester. Plucking them off the vine, this harvester deposits the grapes into tubs on semitrailer trucks. When full, a truck is driven onto the crush pad, where its contents are tipped into a crusher/destemmer. This perforated, rotating drum holds back the stems, but allows skins and juice to gush out, for transfer to — and a long, productive rest in — the fermentation tanks.

For red wines, the inner grape material, or *must*, stays in the tanks with the skins, so the resulting wine will retain more of the skins’ color and character; it’s pressed off at the end of the fermentation period. By contrast, the makings of white wine are separated from the skins immediately, so the wine assumes a lighter color and flavor. Wine typically ferments for 30 to 45 days, finally transferring into barrels for aging in October or November. (Wines may age for from 1 month to 5 years or more, depending on intended



quality. Red wines especially benefit from longer stays in the barrel.) Finally, the wine is bottled and shipped — for the consumer’s appreciation, and the winemaker’s profit.

Fermentation may only be a single step in this process, but it’s a critical and chemically complex one. In the fermentation tanks, naturally occurring or added yeasts transform sugars in the grape juice into alcohol (as well as into carbon dioxide, which dissipates into the air). This chemical reaction also produces a fair amount of heat, which can have a negative effect on the end product.

In fact, both the speed of this process and the taste of the wine itself are significantly affected by this most important variable: temperature.

So constant, reliable control of fermentation temperature is the critical mission of a winery’s process cooling equipment. And it takes just the right valve to ensure optimum temperature control.

The cooler

Like winemakers everywhere, the managers at the vineyard in our example need to keep their wine at a given temperature, so that fermentation may proceed as the winemaker wishes. Industry-wide, the required range is typically 71° to 77° F (22° to 25° C) for reds, and 59° to 64° F (15° to 18 °C) for whites.

At this vineyard, the current fermentation processing equipment was installed in 2013. When planning their process, managers chose a fairly standard design. Each of 52 stainless steel tanks has a capacity of 30,000 gallons/113,562 liters of fermenting wine. Each tank is wrapped in a dimpled, stainless steel thermal jacket. Liquid media — propylene glycol, favored because it is nontoxic and because of its well-known heat-transfer properties — flows through the jacket, cooling the tank and its contents. The glycol is then

pipied up above the tank. There it runs through a gas-powered chiller, and then flows back down through the jacket again, in a repeating cycle.



Winery fermentation tanks with thermal jackets



A resistance temperature detector (RTD) probe on the front of each tank reports the temperature to a programmable logic controller (PLC). This opens or closes a valve to allow or prevent the flow of glycol around the jacket, thus increasing or decreasing the tank's internal temperature.

Note that wineries wishing ultimate control — those producing more expensive vintages, or perhaps larger volumes — may go further. They employ double jackets on each tank and add gas-powered heaters, so they can not only cool but heat the wine to their exact specifications.

The valves

The industry has several choices of valve type for thermal regulation of fermentation.

Diaphragm valves

This particular winery has chosen a product favored by the industry for decades: solenoid-operated diaphragm valves. Sourced from solenoid valve leader ASCO Numatics, the valves used here are known for routinely reliable performance. They also feature low electrical consumption, and are relatively low-cost. This type is by far the commonest solution still found in wineries today.

One possible drawback is common to every example of this valve type, due to two factors. First: by design, a diaphragm valve's bleed hole must be about four times smaller than its pilot hole. Second: when glycol's temperature falls to around 32° F (32° C), it starts to solidify. Unfortunately, these two characteristics may occasionally interact. Result: bleed hole plugging. When this occurs, a maintenance person must go out, shut the cooling line down, and tap the valve with a hammer to clear the glycol plug from the hole. In some cases, a stubborn plug necessitates dismounting and disassembling the valve to enable clearing the opening before reassembly and restart are possible.



ASCO diaphragm valve

Ball valves

Some wineries, particularly the highest-volume enterprises maintaining the largest (50,000 gallon/189,270 liter or more) tanks, choose to avoid diaphragm valves by using ball valves. Like other winery solutions for these applications (except diaphragm valves), ball valves are air-operated. They possess no bleed holes to open or close, thus avoiding the glycol plugging problem.



Unfortunately, ball valves are relatively expensive. Depending on their configuration, each is usually two to three times more costly than a typical fermentation cooler diaphragm model. And while they may avoid unscheduled maintenance for plugging problems, ball valves' design includes integral seals with a relatively short operating life. So users must regularly schedule tedious, costly maintenance intervals to repack seals approximately every 50,000 cycles.

Angle-body piston valves

About a decade ago, valve manufacturers began applying a third solution to winemaking fermentation cooling applications. In some wineries, angle-body piston valves have become the preferred alternatives to both of the above valve types. These valves are air-operated, and allow tight shutoff in both directions.

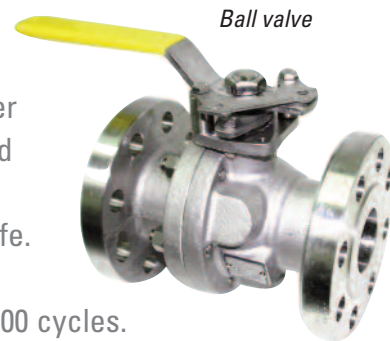
Unlike diaphragm valves, they are direct-acting, with no bleed holes to clog. (As old valve hands put it, "You could run *chocolate* through those things!")

While slightly more expensive than equivalent diaphragm models, angle-body piston valves are only about one-third the cost of ball valves. And their service lives make them the uptime champions in this application. They last up to *10 times longer* than ball valves!

Direct-acting temperature control valve

Within the last decade, leading valve manufacturer ASCO Numatics introduced an exclusive, application-specific answer for temperature regulation systems in wine production. It was developed in France in conjunction with some of the world's most prestigious vineyards, and has subsequently been applied by an increasing number of North American wineries. Like ball valves and angle-body piston valves, this solenoid temperature control valve is air-operated and direct-acting.

It's proven particularly useful in wineries that demand the highest-precision control. As mentioned above, these may employ double jackets using both coolers and heaters. The product basically comprises two valves in one body, with six ports to allow both feed and return of media. So the same valve can control both hot and cold glycol flows.



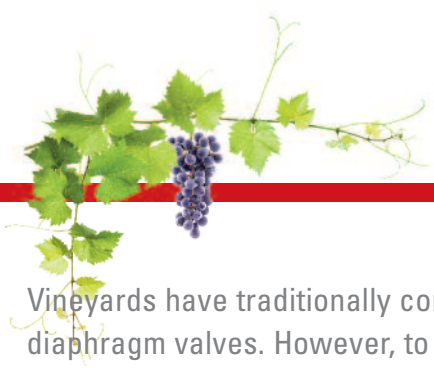
Ball valve



ASCO angle-body piston valves



ASCO direct-acting temperature control valve



Vineyards have traditionally controlled double jackets using arrays of up to four diaphragm valves. However, to prevent backpressure from opening the valves, this arrangement requires putting four check valves in front of the four diaphragm valves. It also demands extensive wiring and fairly complicated installation work by a mechanical contractor.

By contrast, each of these new ASCO valves replaces up to four diaphragm valves and four check valves, and runs on a single air line. It also eliminates the familiar glycol plugging problem. This innovative, specialized valve is of course priced higher than its alternatives. However, savings in space, ease of installation and service, and simplicity may make it ultimately the most economical choice.

Used in these systems, this newer valve narrows the *deadband*, or range wherein heating or cooling control inputs produce no effect. Thus the winemaker can manage fermentation temperature to a fine degree, hoping to get faster fermentation and/or to produce a better quality of wine.

Note that this newer valve may be the right choice in a variety of cooling applications where requirements are less straightforward than usual.

In some wineries, it also controls micro-oxygenation of fermenting room vats to aid stabilization, maturation, and molecular mixing, so that each batch achieves high quality and optimal taste. Elsewhere, it's used for habitat cooling in the poultry industry, keeping large numbers of chickens in the most comfortable temperature range to encourage maximum egg production.

In fact, this specialized mixing valve might be considered in any industrial situation that demands maintenance of thermal media at two different temperatures for supply to one location.

The future

Given the motivations that underlie consumption of their product, there's a saying in the wine industry: "When everybody else's business is good, the wine business is good. When everybody else's business is bad? The wine business is even better."

The northern California winery mentioned above has had excellent results from the cooling system now running its 52 fermentation vessels. Its managers are currently scheduling an expansion to add 52 more tanks. When it comes to valves for fermentation temperature control, they plan to consider their selections carefully.



It's the same for managers of cooling applications across a wide range of industries. They all know that the right valves from the right manufacturer will install easily, decrease downtime, cut maintenance costs, reduce total cost of ownership, provide long service life — and ensure precise, reliable control for the finest, most profitable product.

Takeaways

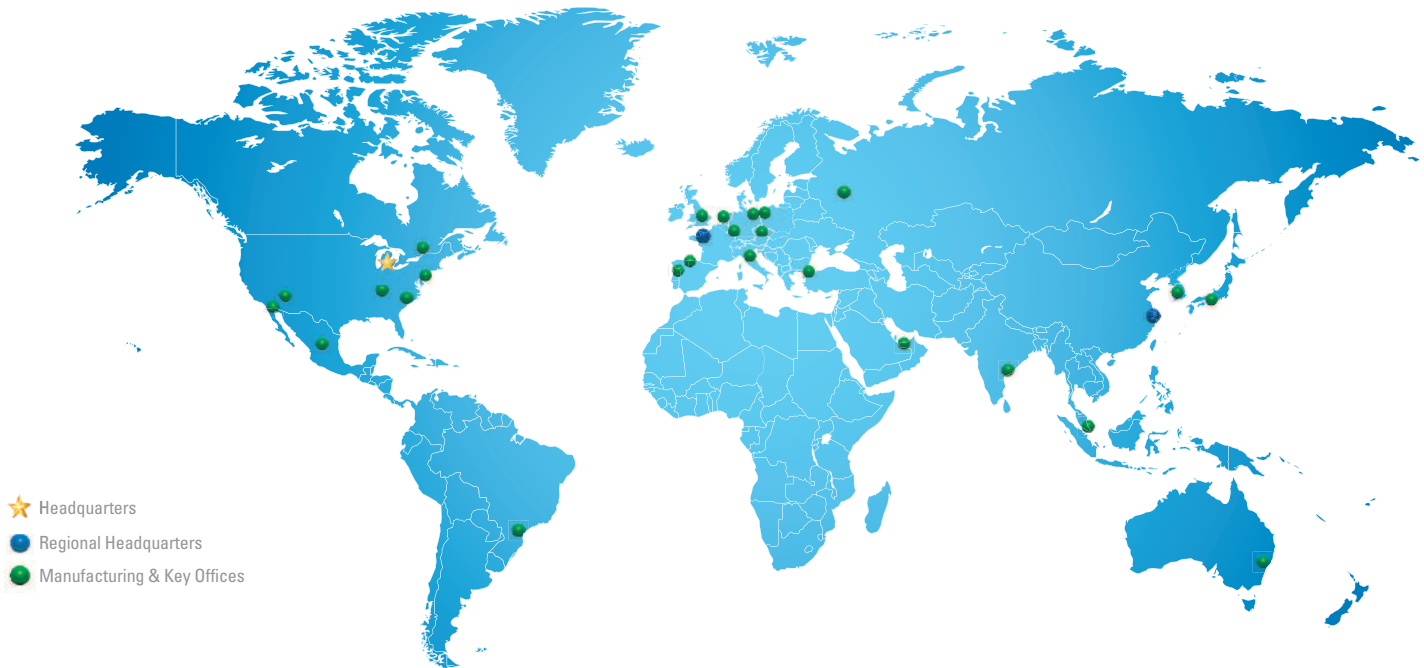
- Users face multiple choices in selecting valve types for any type of industrial cooling application
- ***Diaphragm valves*** are popular and affordable; may encounter plugging problems
- ***Ball valves*** avoid plugging; are relatively expensive and maintenance intensive
- ***Angle-body piston valves*** are slightly more expensive than diaphragm valves; offer exceptionally long life
- Exclusive ASCO ***direct-acting temperature control valve***, though initially expensive, provides ultimate economy and most advanced control

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