Compact, Rebuildable Automated Valves for High-Pressure Switching

Application Note

Overview

Vindum CV-Series valves are compact, air-actuated valves for switching flow paths in high-pressure laboratory and pilot-plant systems. They open and close in about a tenth of a second under remote control, hold up to 25,000 psi, and are built to be rebuilt — we have been making them for about thirty years, and many of those early valves are still in service. This note describes why customers choose them and where they are used.

How It Works

A CV valve is actuated by compressed air rather than by hand or by a motor. A solenoid pilot valve sits between your control signal and the valve: a 12V signal to the pilot valve switches a stream of compressed air (75–100 psi), and that air drives a piston assembly inside the CV valve to open or close the fluid path. Actuation is fast — about one tenth of a second — and, because it is driven by an electrical signal to the pilot valve, it can be done entirely remotely. Notably, the air acts directly on the valve's internal piston, so no bulky external pneumatic dome actuator is needed.

Why Customers Choose CV Valves

- **Compact footprint.** Because compressed air acts directly on an internal piston, the CV valve needs no large pneumatic dome actuator of the kind some high-pressure valves require. The result is a small, light valve that fits easily into crowded systems and tight enclosures.
- **Robust and field-rebuildable.** The valves are built to last and to be serviced in place: when seals eventually wear, the customer can rebuild the valve in the field with a stocked seal kit and parts rather than returning it. We have sold these valves for about thirty years, and many remain in service — a strong indicator of their durability.
- **A seal material to match your fluid.** CV valves use an O-ring fluid seal, available in a wide range of materials — Viton (standard), Buna-N, UHMW-PE, AFLAS, Chemraz/Kalrez, and others — which you specify when ordering to suit your chemistry and temperature. Wetted parts are available in stainless steel or, for corrosive fluids, Hastelloy.
- **High-temperature options.** Standard seal materials cover the common temperature range. For hotter service, higher-temperature models are available with appropriate seals and special parts. Because temperature capability is set by the seal and internal materials — and higher temperatures reduce the pressure those materials can hold — the top temperature and the top pressure are not reached at the same time. The 300 °C (572 °F) ceiling applies to the 10,000 psi and lower-pressure models; higher-pressure valves are rated for correspondingly lower temperatures. The best choice depends on your fluid and conditions, so we are glad to advise.
- **Fast, remote actuation — ideal for ovens.** The ~0.1-second pneumatic actuation is driven by a 12V signal, so the valve can be operated remotely. That means a valve

inside an oven or temperature-controlled enclosure can be switched without opening the door and disturbing the temperature.

- **Remote and centralized control.** Solenoid pilot valves can be grouped on manifolds (2 to 12 stations) and actuated from a central controller. VPware can control up to 16 two-way valves through a small add-on device — including opening and closing valves automatically within a multi-step Schedule that also runs pumping rate or pressure gradients. Alternatively, any PLC capable of issuing a 12V (125 mA) signal can actuate the valves from a main control system.
- **Low dead volume for small-scale work.** The valve has very low internal volume and traps no fluid, which suits it to small-volume and microfluidic systems where dead volume matters. We have built a special ultra-low-volume version for a microfluidics customer, and can discuss similar custom needs.
- **Pulse-free pump switching.** The CV valve's original purpose: it displaces no fluid as it actuates (a constant-volume design), so when it switches between cylinders in a dual-pump system the flow stays smooth and pulse-free. This is how Vindum pumps deliver continuous flow, and the valves are well proven in the role — to the point that they are trusted by other pump manufacturers for use with their own systems.

Models and Connections

CV valves are available as 2-way on/off models and as 3-way / 4-position models, working with 1/16", 1/8", or 1/4" tubing depending on the model, at pressures up to 25,000 psi. The valves are gas-tight — they will hold a vacuum — and we stock seal kits and spare parts for every model. Custom designs are available when an application calls for one.

The 25,000 psi Valve

Our highest-pressure valve began as the fill valve for our own 25,000 psi pump. In that role it works well because the pump reduces cylinder pressure before the fill valve opens, so the valve never opens against a large pressure differential. A manufacturer of ultra-high-pressure HPLC columns then tried to use it very differently — opening it at 24,000 psi with atmospheric pressure on the other side, so the full differential drove across the seal as it opened. The first valves did not survive: the rushing fluid effectively waterjetted the metal seal. It took about two years of redesign to arrive at a valve that opens against that full differential, repeatedly, without failing. A few characteristics define this valve:

- **Holds pressure in both directions.** The valve seals against pressure from either side. This sets it apart from some ultra-high-pressure valves we studied, which hold pressure only when it comes from one direction.
- **Metal-to-metal seal.** Rather than an elastomer seal, this valve uses a metal-to-metal seal, which is part of what lets it survive repeated actuation at extreme pressure. (Because the sealing and chemical-compatibility behavior differs from our elastomer-sealed models, we are glad to talk through whether it suits a particular fluid.)
- **Low-flow, small internal path.** The internal flow path is very small, so this valve is intended for low-flow applications — on the order of 10 cc/min or less. It is a switching and control valve for ultra-high-pressure, low-flow work, not a high-flow valve.

Because opening against a full differential is the hardest version of the problem, we are now confident the valve suits other low-flow fields that combine extreme pressure with repeated switching — such as pressure-cycle and fatigue testing, ultra-high-pressure homogenization, and supercritical-fluid work. The underlying capability — fast, automated switching that holds

25,000 psi from either direction and survives repeated opening against a large pressure differential — is unusual. If your application pushes pressures this high, we would like to hear about it.

Capability Summary

The table below summarizes how CV-Series valves map to common high-pressure switching needs.

Need	Vindum CV valve capability
A compact automated valve	Small footprint — no large pneumatic dome actuator required; actuated directly by compressed air
Long service life and field maintenance	Robust design, easily rebuilt in the field with stocked seal kits and parts; many in service after ~30 years
Matching the valve to your fluid	Wide range of elastomer seal materials, specified when ordering; stainless steel or Hastelloy wetted parts
High-temperature service	Seal-limited; higher-temperature service available with appropriate seals and special parts. The 300 °C ceiling applies to 10,000 psi and lower models (top pressure and top temperature are not simultaneous)
Fast, remote actuation	Pneumatic actuation in about 0.1 second via a solenoid pilot valve (12V signal switches compressed air at 75–100 psi)
Switching inside an oven or enclosure	Remote actuation means no need to open the enclosure to change a valve position
Centralized / automated control	VPware controls up to 16 two-way valves via a small add-on device, including multi-step Schedules; any PLC issuing a 12V / 125 mA signal can actuate a valve
Low dead-volume / microfluidics	Very low internal volume with no trapped fluid; ultra-low-volume versions available
Pulse-free pump switching	Displaces no fluid on actuation (a constant-volume design) — the original use, for pulse-free pumping
Extreme-pressure service	Models to 25,000 psi, holding pressure from either direction; metal-to-metal seal, for low-flow service (≈10 cc/min or less)

CV valves integrate cleanly into automated systems. The same free VPware software that runs Vindum pumps can also control the valves through a small add-on device, and the solenoid-and-compressed-air actuation scheme works with any control system able to issue a simple 12V signal — from a standalone solenoid to a full pilot-plant PLC.

In the Field

Vindum CV valves are used for automated and remote valve control in ovens and pilot plants, low-dead-volume and microfluidic systems, extreme-pressure flow switching, and pulse-free

pump switching. Originally developed for Vindum's own pumps, they are also trusted by other pump manufacturers for use with their systems, and are in service in research and pilot-scale systems worldwide — many for decades.

> *"We … added Vindum CV automated valves … they work great and let us refill remotely without entering the X-ray station."* — Mark Rivers, CARS, University of Chicago (Advanced Photon Source). Read the testimonial

Talk to Us About Your Valve Application

Tell us what you need to switch — your pressure and temperature, your fluid, your tubing size, and how you'd like to control the valve (standalone, VPware, or your own PLC) — and we'll help you select the right CV model and seal material, or discuss a custom design if your application calls for one.

Contact: sales@vindum.com · +1 281-782-8312, ext. 1 · vindum.com/contact-us