

Cold Hard Facts:
**Five key criteria
for selecting
low-temperature
valves**

by Bob Cadwell, Business Development Manager, ASCO



A White Paper From ASCO Numatics

ASCO
numatics[™]
Right. Now.[™]


EMERSON[™]
Industrial Automation



Introduction

Specifying and consulting engineers, engineering houses, original equipment manufacturers (OEMs), and end users depend on valves to control the flow of compressed air or other fluids, and on cylinders to control motion. But the cold truth is that low temperatures can cause problems for these fluid automation devices all along the line — from selection and delivery to operation and maintenance.

Several manufacturers offer specially designed fluid automation products for environments that may experience ambient temperatures as low as -40°F (-40°C). These devices are intended for use with process valves in oil and gas, hydrocarbon, energy, refining, industrial heating, food and beverage, power, vehicular, and other applications. Most standard models are rated for reliable operation down to only 32°F (0°C).

During long, cold months in places such as Alaska, the north central U.S., Canada, the North Sea, and Siberia, fluid automation products must perform well under harsh, frigid conditions, often unattended — and frequently at remote sites that render repair or replacement more difficult than usual. Even in warmer climates, cold storage or low-temperature processing lines present special challenges for material flexibility and seal integrity. So the stakes are higher than ever when product choices are considered. Specifying and consulting engineers must be sure to get the cold hard facts about anything they buy.

This paper examines five key qualities to look for when purchasing valves, cylinders, and other fluid automation devices for application in low ambient temperatures.

1 Reliability and reputation

For valves used in low temperatures, degraded performance arises from two main causes: lack of resiliency/flexibility and dormancy.



Resiliency and *flexibility* suffer as temperatures drop. This is bad news for the elastomers in a valve disc or diaphragm, which depend on their resilient, elastic consistency to make a good seal with the valve seat. As they get colder, elastomeric polymers shrink — and also undergo *glass transition*, entering a hard, brittle, glass-like state. Both of these changes prevent consistent conformity of the disc against the seat, allowing a leak path to form.

Dormancy occurs when valves are operated at infrequent intervals (as in low-cycling applications). When a valve's O-ring seals stay in uninterrupted contact with the body or main spool of the valve for days or even months, the seal can actually adhere against the grooves or imperfections in the metal surface of its mating components. Once operated, it responds slowly, or not at all.

Both these issues threaten reliable operation of the valve. Simple steps during assembly, such as applying high-grade lubricants that maintain serviceable consistency in the cold, can help combat surface friction. High-quality valve suppliers will also address potential problems by carefully selecting elastomers that stand up to low temperatures, as well as by designing valve seals that are optimized for frigid conditions. Dormancy may be virtually eliminated with innovative construction such as replacing O-ring seals with new T-shaped seals, which present a much smaller surface area at the point of contact.

As with valves, cylinders used in low ambient temperatures can face their own issues.

When it comes to *resiliency*, cylinder seal elastomers can encounter brittleness and shrinkage, as well as different rates of thermal expansion and contraction for adjoining materials. So potential leak paths can also be a concern. The best cylinder manufacturers counter these risks by designing for minimal gap tolerances, and by selecting special cold-tested O-ring and seal materials that can retain sufficient flexibility at low temperatures.

Cylinders used in frigid conditions may also face the same *dormancy* challenges as valves, with stick and slip problems possible for surfaces that remain in contact for long periods. To fight friction and counteract dormancy, advanced models may be permanently lubricated during assembly with carefully selected low-temperature lubricants. In addition, on critical dynamic parts such as rod and piston seals, innovative manufacturers may incorporate special constructions such as spring-energized lip seals.

When considering products for duty in low ambient temperatures, users must ask prospective suppliers the hard questions about performance issues such as flexibility and dormancy. They must also evaluate each vendor's reputation and record of reliability. Consider ASCO Numatics, for example. Its valves, cylinders, and other fluid automation products incorporate the best of the design strategies above. They have provided proven service in the most challenging low-temperature environments for more than 40 years.



2 Certification and compliance

Can a given valve provide consistently safe, reliable performance in your application at -40° F (-40° C)?

For example, the following table shows similar UL and CSA testing requirements for both general-purpose and safety shutoff valves. Both agencies include testing for endurance, valve seat leakage, and external leakage. (Note that MOPD below stands for “maximum operating pressure differential” and that MSWP means “maximum safe working pressure.”)

| Test | Rated Temperature | UL 429 | | | | CSA C22.2 No. 139-1982 | | | | CSA ANSI Z21.21 CSA6.5 2005 | | | |
|-----------------------|-------------------|------------------------------|---------------------------|----------------|------------------------------|---------------------------|----------------|------------------------------|---------------------------|-----------------------------|--|--|--|
| | | General Purpose | | Safety Shutoff | General Purpose | | Safety Shutoff | General Purpose | | Safety Shutoff | | | |
| | | Nonflammable Hazardous Fluid | Flammable Hazardous Fluid | | Nonflammable Hazardous Fluid | Flammable Hazardous Fluid | | Nonflammable Hazardous Fluid | Flammable Hazardous Fluid | | | | |
| Endurance Test | Max | 3K | 50K | | 3K | 50K | | 90K | | | | | |
| | Min | 3K | 50K | | 3K | 50K | | 10K | | | | | |
| Seat Leakage | Max | n/a | | @ 1/4 PSI MOPD | n/a | @ 1/4 PSI MOPD | | n/a | @ 1/4 PSI MOPD* | | | | |
| | Min | n/a | | @ 1.5X MOPD | n/a | @ 1.5X MOPD | | n/a | @ 1.5X MOPD | | | | |
| External Leakage Test | Max | n/a | | | | @ 1.5X MSWP | | | | @ 1.5X MSWP | | | |
| | Room | @ 1.5X MSWP | | | | @ 1.5X MSWP | | | | @ 1.5X MSWP | | | |
| | Min | n/a | | | | @ 1.5X MSWP | | | | @ 1.5X MSWP | | | |

* If MOPD is equal to or greater than 5 PSI, test @ 2 in IWC MOPD.

Beyond testing to these minimum agency standards, other suppliers go on to conduct additional tests that are not agency-required. For example, they may perform tens of thousands of added endurance testing cycles. Further thermal tests may include cycles at high and low ambient temperatures, as well as in saturated conditions, wherein the temperature of the valve and the air media put through the valve are all kept at -40° F (-40° C) for extended periods, to best simulate real-world operating conditions.

A few suppliers go so far as to establish certified testing locations themselves. For instance, ASCO Numatics has become part of the UL Client Data program, performing tests to UL specifications in its regularly audited UL-certified laboratories. In fact, ASCO Numatics product lines represent the industry’s most widely tested and certified offerings for low ambient temperatures, complying with official requirements for these valves and other devices used in general purpose, safety shutoff, and hazardous applications. They carry applicable approvals from agencies, standards organizations, and equipment directives worldwide — including Underwriters Laboratories (UL), Canadian Standards Association (CSA), Factory Mutual (FM), Explosive Atmospheres (ATEX), and Gosudarstvennyy Standart (GOST). Selected constructions can produce third-party certifications including Canadian Registration Number (CRN) and Safety Integrity Level (SIL) ratings.



Other suppliers may comply with UL testing but not CSA, or may undertake no independent third-party evaluations. Particularly in cases where your organization is considering a new product or one from a supplier with which you have little previous history, user experience suggests that appropriate certification — or the lack thereof — should play a significant part in your purchasing decision.

3 Breadth and depth of offering

Many users report a strong preference for limiting their choice of supplier to organizations that offer the widest possible selection of products for low temperatures. After all, such one-stop shops provide timesaving convenience that can be important to busy planners and users. There's only one source to specify; one contact to call; one solution to keep in inventory.

In fact, to consolidate inventories or to meet worldwide specifications, some global companies specify certain low-ambient-temperature valves from a single source — and use them exclusively for a given application, even in warmer regions.

A provider with a wide breadth of these valves is also most likely to employ the latest technologies. These might include elastomer compounds that ensure integrity in frigid conditions, or new power-saving approaches for remote locations (see next section). A few suppliers even push the outer limits of valve technology, offering models rated for operation below -40°F (-40°C).

For instance, ASCO Numatics supplies the largest and most diverse selection of low-ambient-temperature fluid control and fluid power offerings in its class. These include two-way, three-way, and four-way solenoid valves; gas safety shutoff valves; manual reset valves; low-power valves; redundant control pilot valve systems; NFPA and nonrepairable cylinders, as well as knife gate actuators; filters, regulators, and accessories; and a number of other specialty devices — all rated, tested, and approved for reliable operation from 170°F (76°C) down to -40°F (-40°C). Selected constructions may even be rated for performance at ambient temperatures as low as -58°F (-50°C). (See a catalog at www.ascovalve.com/lowambient)

4 Low temperature and low power

Simultaneous with the requirements for valves and other devices that will function in low temperatures have come similar needs for devices that will also work on low power.

Users may simply appreciate lowering energy costs. More critically, in remote locations such as oil and gas transmission pipelines or extraction sites, conventional valves may



require heat tracing or protection. These and other power demands often necessitate larger, more costly power supplies such as battery charging systems or solar panels.

Therefore, some suppliers have responded with models that meet criteria both for low temperatures and low power. Besides units that draw the least possible current at all times, some newer models feature peak-and-hold technology, which typically draws 11 watts (W) just at opening, then remains open at only 0.5 W or 1 W. Any valve well-optimized for low power may enable users to specify smaller battery banks, or run the valve longer without sunlight, or merely ensure less drain on backup generators or batteries.

However, with many valve manufacturers, the intersection of low-power and low-ambient-temperature requirements may include only a few specialized models. For ordering and stocking convenience, look for a supplier with a wider range of solutions. For example, five of the seven ASCO solenoid valve lines designed to draw only 0.5 to 1.4 W are also rated for temperatures down to -40° F (-40° C).

5 Service and support

Choosing the right source for low-ambient-temperature valves is often about more than just hardware. Finding a partner with the availability and support programs you need can prove equally important.

To start, look for catalog and ordering materials that are clear and easy to use. Favor suppliers with well-organized, instantly accessible configuration and online ordering. Some suppliers let users download 2D drawings and 3D models directly into their CAD software; that's highly advantageous for OEM designers.

Explore responsiveness issues. Do valve representatives and home office technical support experts respond promptly to questions, via phone, e-mail, and chat services? Do they exhibit knowledge of low-temperature issues in your particular industry or applications? If you're part of a global organization, does the valve manufacturer match your company with robust worldwide support?

Where possible, question distributors about their relationship with specific valve manufacturers. Example: ASCO Numatics has made a major investment in training programs such as master valve schools — enabling the transfer of truly detailed manufacturing knowledge to the company's high-quality, national distributor organizations. So their distributors in your locality are much better equipped to help you make specifying and support decisions.

Perhaps most crucially, consider availability. When you need a particular fluid automation device, you often need it right now. Unfortunately, many users say that availability has become a critical weak point for several manufacturers of low-ambient-temperature valves and cylinders in recent years.



Make sure the supplier you ultimately select can provide convenient local stocking and fast delivery — ideally via a quick-shipment program that publishes high on-time delivery rates.

Conclusion

Selecting fluid automation devices for service in low ambient temperatures presents some hard challenges. Users, designers, and other specifiers must give close attention to critical issues of reliability, testing and compliance, variety of selection, low-power capabilities, and support. The result will be solutions that deliver ensured performance in the colder corners of the world for years to come.

ASCO

| Location | Phone |
|-----------------------------|-------------------------|
| World Headquarters (U.S.A.) | (1) 800-972-ASCO (2726) |
| Brazil | (55) 11-4208-1660 |
| Canada | (1) 519-758-2700 |
| Mexico | (52-55) 5809-5640 |

E-mail: info-valve@asco.com

NUMATICS

| Location | Phone |
|-----------------------------|-----------------------------|
| World Headquarters (U.S.A.) | (1) 888-Numatics (686-2842) |
| Brazil | (55) 11-4208-1700 |
| Canada | (1) 519-758-2700 |
| Mexico | (52) 55-5809-5640 |

E-mail: InsideSales@numatics.com



Other Worldwide Locations

| Location | Phone | Location | Phone |
|----------------|--------------------|----------------|------------------|
| Australia | (61) 2-9-451-7077 | Italy | (39) 02-356931 |
| China | (86) 21-3395-0000 | Japan | (81) 798-65-6361 |
| Czech Republic | (420) 235-090-061 | Netherlands | (31) 33-277-7911 |
| Dubai - UAE | (971) 4-811-8200 | Singapore | (65) 6556-1100 |
| France | (33) 1-47-14-32-00 | South Korea | (82) 2-3483-1570 |
| Germany | (49) 7237-9960 | Spain | (34) 942-87-6100 |
| India | (91) 44-39197300 | United Kingdom | (44) 1695-713600 |



ASCO Numatics and Right Now are trademarks of Automatic Switch Co. The Emerson logo is a trademark and service mark of Emerson Electric. All other brands may be trademarks of their respective holders.

© 2013 ASCO Numatics, Inc. All rights reserved.
Printed in the U.S.A.