DRAG® Control Valves for Critical Service Applications.
The DRAG® Series 100D customized severe service control valve combats noise, erosion and cavitation by forcing process fluid to follow a tortuous path of right angle turns through the trim, thus controlling damaging velocities. Available in 1” to 36” ANSI 150-2500 with flanged or butt weld ends, and globe or angle style bodies, all facets of 100D are custom-tailored to your specific application. Uses CCI piston actuator. Body materials are carbon steel, chrome moly or stainless with 410 or 316 stainless trims plus Inconel or Monel options. Temperature range is -50F to 1050F with equal percentage, linear or custom flow characteristics and a Class VI leakage rate for the soft seat and either IV or V for the metal seat version.

DRAG trims also have excellent applications as atmospheric resistors, angle inserts for venting or in-line resistor elements. The passive atmospheric resistors allow quiet venting of gas or steam to atmosphere and are available in 2” to 24” inlet sizes. Angle inserts are control valves configured as venting devices and are available in 4-12” sizes, ANSI 150-1500. In-line resistors passively control noise or cavitation downstream of shutoff or conventional control valves. Sizes: up to 24”, ANSI 150-2500.

The DRAG Series 100V & 100VS uses patented DRAG trim for moderate pressure drops; globe or angle style body available in 1” to 8” ANSI 150-900 flanged or butt weld ends in choice of carbon or stainless steels. Trim is 316 or 410 stainless with a linear flow characteristic with reduced versions available. Temperature range is -50 to 800F with a Class IV leakage rating. Uses 8000L pneumatic rolling diaphragm actuator, or pneumatic modulating actuator for 100VS.

Well-suited to either sampling or low-flow high-pressure-drop situations, Mini-DRAG uses the same disk stack technology as the full-sized DRAG valves. Sizes are 1/4”, 3/8” or 1/2” with female NPT or socket-weld ends. Max pressure is 6000 psig at 100F with a special high temp version available. Materials are 316 stainless steel and offer a -65 to 450F temperature range and linear flow characteristics. Bubble tight shutoff is standard and the valve is available with handwheel or with pneumatic modulating actuation.

Control Components Inc. is the undisputed leader in the design, development and manufacture of velocity control valves for severe service applications. This leadership is the result of our proven record of product performance, the
CCI is the undisputed leader in the design, development and manufacture of velocity control valves for severe service applications. This leadership is the result of our proven record of product performance, the knowledge gained in solving customer valve problems, and our high standards for quality which reaches through every step of the production process, and extends to support of the valves installed in your plant.

In a time when many valve companies are making impressive-sounding claims for their severe service valves, CCI offers what you need most - performance.

CCI designed, built and patented the first DRAG valve in 1967, at a time when there was no real solution to the problems of severe valve service. Since then, CCI, an IMI valve company, has built and shipped thousands of velocity control valves to customers in a wide range of industries worldwide.

Today, the DRAG valve has demonstrated to users that it is the only real solution to the demands of severe control service. Our pioneering valves are used in a wide variety of applications including fossil and nuclear power generation, oil and gas production and refining as well as chemical/petrochemical production and processing.

If you have a severe control valve application with high maintenance or operating costs, short trim life, internal leaking, poor control, excessive pipe vibration or noise; can you really afford less than the original, the real performer, the DRAG valve from the control experts at CCI!

Your nearest CCI sales representative can offer expert help in solving your specific problem application.
Until the DRAG valve was introduced, the design of control valves for handling high pressure drop liquids, gasses or steam had changed little this century.

Even today, despite widespread attempts to copy the CCI DRAG solution in other makers’ modified trim valves, process fluids still flow through some version of a single orifice (Fig. 1) or multiple area orifice. Fluid velocity through each orifice is a function of the valve pressure drop or required process differential, h.

Fluid in the valve reaches its maximum velocity just slightly downstream of the valve trim’s vena contracta or minimum flowing area. These high velocities produce cavitation, erosion and abrasion which can quickly destroy the valve. Even before damaging the valve, you'll notice excessive noise, severe vibration, poor process control and product degradation in some fluids.

Interestingly, these high velocities are an unwanted side effect of pressure reduction through the valve and aren’t treated as a design criteria in other valves until it's too late. Adding harder trim, pipe lagging or downstream chokes are costly attempts to treat the symptoms rather than the real cause of the problem.

Uncontrolled flowing velocity — a control valve’s worst enemy.
Taming process velocities.

DRAG velocity control valves from CCI solved the problem a generation ago. DRAG valves prevent the development of high fluid velocities at all valve settings. At the same time, they satisfy the true purpose of a final control element: to effectively control system pressure of flow rate over the valve's full stroke. Here's how the DRAG valve accomplishes what the others can only approach:

The DRAG trim divides flow into many parallel streams (Fig. 2). Each flow passage consists of a specific number of right angle turns — a tortuous path (Fig. 3) where each turn reduces the pressure of the flowing medium by more than one velocity head.

The number of turns, N, needed to dissipate the maximum expected differential head across the trim is found in figure 4 by changing the equation from $V_{\text{orifice}} = \sqrt{2gh}$ to a new equation:

$$V_{\text{DRAG element}} = \frac{\sqrt{2gh}}{N}.$$ 

Applying this principle to the DRAG valve's disk stack and plug as shown in Figure 5, means that velocity is fully controlled in each passage on every disk in the stack and that the valve can operate at controlled, predetermined velocity over its full service range as in Figure 6.

This is in stark contrast to valves using multiple orifice modified trims. Each orifice converts potential energy to kinetic energy, but with a startling increase in velocity. These competitive trims are also limited by design to a maximum of eight stages of velocity reduction.

In the DRAG trim, the resistance, number and area of the individual flow passages is custom matched to your specific application and exit velocities are kept low to eliminate cavitation of liquids and erosion/noise in gas service.
Your special application merits a special solution. And that’s what you get with the DRAG valve. Disk stacks for DRAG elements may be linear or characterized as in Figure 7 to provide flow characteristics that solve your specific problem, instead of having to make do with someone else’s standard “solution.”

In a linear stack, all the disks have the same number of passages, the same number of turns per passage and the same area so that flow is directly proportional to the valve’s stroke at constant differential pressure. The installed characteristics of such a valve can be selected as equal percentage, quick-opening, etc. through use of a shaped cam in the valve positioner.

In a characterized stack, all disks are not the same, but rather are chosen to provide precise variable flow over the full range of the valve. For example, in turbine bypass service, fine control is needed at low flow rates with a large flow needed at the full-open position. The modified linear characteristic called for here is achieved through the disks in the lower segment of the DRAG stack having fewer flow passages, and using more passages in the upper disks.

The disk stack in a DRAG feedwater regulator, on the other hand, provides a modified equal percentage profile to handle a wide variety of pressure drops over the valve’s flow range. The bottom 20% of the disks in the stack may have many turns to handle high pressure drop and low flow startup conditions. The middle of the element uses disks with fewer turns and more passages to handle intermediate pressure drop and increased flow requirements.

A cage on top of the disk stack allows virtually unimpeded flow with minimal pressure drop when the valve is full open. DRAG velocity control elements can be characterized for other combinations of inlet and outlet pressure over their flow range to allow precise matching to your system.

Another advantage of the characterizable DRAG trim is that it offers you savings by replacing two or more conventional or modified trim valves in certain applications. By combining different flow and pressure drop requirements into a single characterized DRAG valve, you eliminate costly parallel piping and tricky control calibration in your plant. A typical example would be combining the startup, midrange and full feedwater control valve system in a single DRAG valve.

Uncontrolled flowing velocity is the nemesis of any control valve regardless of media: liquid, gas or steam. Let's examine the more common destructive problems inherent in all types of severe service and how the DRAG valve solves them for you.
Erosion by cavitation.

When liquid pressure is reduced to or below its vapor pressure, flashing and bubble formation occur. In other control valves (Fig. 8), fluid enters at pressure $P_1$ and velocity $V_1$. As the fluid moves through the reduced area of the valve trim, it accelerates to velocity $V_2$ and its static pressure drops suddenly to $P_2$ — a level at or below the fluid’s vapor pressure $P_v$. At this point, the fluid boils. Any valve using multiple orifice trim will cause this problem, due to the uncontrolled velocities in the areas of each vena contracta.

As the fluid moves out of the throat of the valve, pressure recovery begins, converting kinetic energy back to potential energy. Full recovery to downstream pressure in indicated at $P_3$ and velocity $V_3$. When the recovery pressure exceeds the fluid’s vapor pressure $P_v$, collapse or implosion of the just-formed bubbles takes place, resulting in cavitation. The energy thus released causes local surface stresses greater than 200,000 psi (1400 MPa) which can consume even stellited trim rapidly.

For comparison, Figure 9 shows that the controlled velocity trim in a DRAG valve prevents the vena contracta pressure from dropping to the liquid’s vapor pressure (provided the outlet pressure is greater than the vapor pressure), thus avoiding cavitation.

Erosion by abrasion.

Abrasion of valve trim is caused by the washing action of a fluid or by particles entrained in the fluid. It is most severe at high pressures and high concentrations of entrained material.

Clean, dry gases usually cause no problems in a valve, but throttling even clean superheated steam can cause severe problems for all but a DRAG valve. What happens is illustrated in Figure 10.

As shown, superheated steam at a $P_1$ of 600 psia (4 MPa) and $T_1$ of 600°F (300°C) enters a valve and is let down to 50 psia (0.3 MPa).

The low pressure and high velocity inherent in flow through a conventional and orifice-type modified trim valve allows the steam to expand polytropically to point $P_2$. At this point, with velocity at its peak, the steam develops a moisture content between 12-20%. The water droplets formed here while traveling at maximum velocity, will rapidly erode valve trim and cause impingement damage to the valve body. Pressure recovery is completed in the valve outlet and the temperature reaches equilibrium, resulting in superheated steam leaving the valve at a $P_3$ of 50 psia and a $T_3$ of 515°F (270°C). The valve has achieved its pressure drop for now, but continuous formation of wet, high-velocity steam will soon result in severe trim damage.

In contrast the DRAG trim operates at a constant low velocity. The inlet/outlet and trim velocities are low, so the steam expansion through the valve is isenthalpic — going from point $P_1$-$T_1$ directly to point $P_3$-$T_3$. Steam through the DRAG valve never has a chance to develop destructive moisture. The same holds true in gas handling services where hydrate ice crystals, formed under similar circumstances, can clog non-DRAG trim with amazing speed.
Aerodynamic noise is a concern in many valve applications, but is most severe when throttling or venting compressibles. It is not uncommon, for example, to have a near-field noise level of 120 dBA during high pressure reduction in such applications and to have modified trim valves with diffusers still generating noise levels in excess of 100 dBA.

Actually, any valve whose trim allows the development of high fluid velocities will create excessive noise. One noise-producing cause in such valves is the formation of turbulent eddies in the mass flow stream. Add to this the noise from sonic shock waves that develop as the fluid reaches critical velocity, and you have one very noisy valve!

Noise generated in a control valve moves downstream virtually unattenuated. In-line mufflers and silencers have been used, but even the best of these after-the-fact devices are capable of reducing noise by only 15-20 dBA. Acoustic lagging, also resorted to in some situations only achieves about 5 dBA attenuation, must be well designed, carefully and completely installed, is costly, damage prone, and the noise may still pop up somewhere else in your pipework.

Anyone contemplating these path treatments should compare their cost effectiveness to that of the valve that controls noise generation at the source: the DRAG valve.

Because of its unique trim design which presents gradual and continuous resistance to flow, the DRAG valve holds fluid velocities well below Mach 1. DRAG valves are actually
designed to your noise specifications and are the ultimate solution to noise problems in severe service.

Probably the most severe service from an aerodynamic noise standpoint is venting high pressure gas or steam to the atmosphere. In addition to fluid-borne noise carried downstream from the throttling valve, such systems generate noise caused by turbulent mixing of the existing fluid with ambient air, resulting in shock waves around the lip of the vent. Any venting application requires careful consideration of far-field (environmental nuisance, personal health) and near-field (valve generated) noise levels.

CCI offers two methods for effectively controlling noise in venting applications. The first method involves the use of a fast-acting, pneumatically operated DRAG Angle Insert as seen at far left. A common application for this valve is venting excess steam pressure to atmosphere in order to prevent plant safeties from lifting.

In operation, gas or steam enters the valve through the inlet bore, passes up through a DRAG velocity control disk stack and is directed into the atmosphere by a shroud. A pneumatically-positioned plug modulates the available area of the disk stack bore for flow control during venting operations. Because of the velocity control inherent in the disk stack, noise is controlled. A shroud is placed around the disk stack to direct the flow away and minimize reactive loading as shown in the photo near left.

The second CCI solution to noise problems in venting applications is applicable to larger mass flows and higher temperatures. It consists of a DRAG velocity control valve coupled with a downstream DRAG resistor. The resistor also uses a DRAG disk stack and is a passive device designed to take most of the pressure drop at design flow conditions. For lesser flows, the disk stack in the DRAG valve can be easily characterized to handle the increased pressure drop while maintaining velocity control over the full operating range.

Vibrations of valve trim by unbalances, fluctuating pressure forces around the plug can be a serious problem, especially in severe gas and steam service. These forces generate axial and lateral vibrations, even at low pressure ratios if mass flow rates are high. The results are control instability, aerodynamic noise, and eventually trim and piping failure. DRAG valves prevent this condition because the disk stack performs velocity control and complete cage guiding of the plug from seat to full stroke. Also, the plug within the stack is pressure balanced to counteract axial vibration.
Control Components Inc. shipped its first valve in 1961. It was a product designed to solve a specific problem faced by a customer. And it was the result of careful planning and innovative engineering. Since then, we've designed, built and shipped thousands of high-technology velocity control valves to more than 2,000 customers in 20 industries worldwide. Each part of every valve has been made with care and precision, with confidence in the design, and with pride in the finished product.

Each valve is a quality design, custom tailored to your needs.

At CCI, quality begins with experienced engineers, aided by computer calculations and backed by continuous research and development in materials, flow and noise technologies. This way, we can accurately and repeatedly determine valve and system characteristics for various valve sizes and materials based on your operating conditions. Our Contract Engineering group uses your operating data to generate the optimum DRAG solution to your specific problem. Most customer requirements can be met by using our carefully pre-engineered, computerized design standards. Here, performance proven standardized parts are combined for a custom-engineered solution to your specific needs. Precision standards and careful workmanship result in predictable and reliable valve performance in your plant.

Quality materials for reliable valves.

Before manufacturing begins, materials are carefully inspected to verify source specifications, insuring that critical parts like valve bodies make use of optimum materials. In-process inspections and NDT procedures use sophisticated quality control equipment to insure that all design criteria are met and that fine workmanship is assured.

Precision machining of quality parts.

One of the keys to the quality of our precision parts is the use of CNC equipment. To effectively utilize this sophisticated machinery, CCI has developed a master parts programming system in which valve parts are grouped into 46 families, each with from 4 to 2000 members. With this large master design file constantly available, we eliminate potential errors and provide consistent repeatable designs and high quality parts. Whether we build a tiny sampling valve plug or a massive valve body, CCI pays close attention to every possible detail.

Quality is an important part of manufacturing processes.

Precision inspection is performed in-house at our Quality Control Laboratory, including a rigorous seat roundness measurement. Every valve seat CCI builds is checked to a tolerance of 100 millionths of an inch. Highly sophisticated water chemistry tests are used in our QA program. We also perform tensile strength tests and cross section metallurgical analysis of manufactured parts. Microscopic analysis is used in examining the structure of material and parts used in our products. We can also provide our customers with environmental qualification for valves meant for nuclear service.

Control of quality at every step.

In-process inspection and lab testing are only a part of our Quality Control story. Assembled valves are carefully calibrated, adjusted and packaged before shipment to assure specified performance. Flow coefficient (Cv) and noise testing are also performed in-house. We also offer customer source inspection — where your QA experts visit our plant to watch in-process and final inspection tests before shipping and to examine our records of materials used. Whether your application is in nuclear power or in small sampling valves, you'll receive a high quality product.

After-sale support.

It's only appropriate that the best service control valve you can buy comes with something equally important — some of the best after-sale support services available.
For the spare parts you know will work, to expert service help, to dependable field or shop rebuilds, specialized CCI staff people are there to help keep your DRAG valves operating at the performance levels you demand for years to come.

Our Spares group knows your valves — and the right replacement parts you’ll need down the line. Best of all, these are the right parts — not copies.

They’re made to original drawings and material specs, so you know they won’t let you valve — and your system — down.

When you need expert help right at your side, our Field Service people will be there — any hour of the day or night, anywhere in the world. They’ll help with the most pressing emergency repair or the most routine maintenance check;

The choice is simple.
Many valves are marketed as meeting the needs of critical / severe service. But when you want the complete solution to the gruelling conditions of severe control service - a solution built with your specific needs in mind - there's just one real choice: the DRAG valve from CCI - the first name in severe service control.

First. And still foremost.

and handle a complete filed rebuild and re-calibration or a simple spares inventory with the professionalism you — and we — can be proud of.

And when your DRAG valves have given you the service life you asked for (and usually more) you may want to consider a full shop rebuild. Many times, DRAG valves can be rebuilt to new or better performance using the latest design upgrades and materials improvements, at a price that’s far less than a new replacement valve.