

# Control Valves

## DESIGN & OPERATION

### Description

A control valve is a device capable of modulating flow at varying degrees between minimal flow and full capacity in response to a signal from an external control device. The control valve, often referred to as “the final control element,” is a critical part of any control loop, as it performs the physical work and is the element that directly affects the process.

**A control valve is not considered a close-off valve. A pressure surge may force a single seated valve plug open. The Terice Control Valve is a balanced equilibrium system and provides no power to tightly seat the valve plug. A separate power driven or hand actuated valve is required to ensure tight close-off when necessary.**

### Principles of Operation

A control valve is comprised of an actuator mounted to a valve. The valve modulates flow through movement of a valve plug in relation to the port(s) located within the valve body. The valve plug is attached to a valve stem, which, in turn, is connected to the actuator. The actuator, which can be pneumatically or electrically operated, directs the movement of the stem as dictated by the external control device.

#### Pneumatic/Diaphragm Actuated

Terice Pneumatic Actuators are direct acting and utilize an air signal from an external control device to create a modulating control action. The force of the air signal is received into the actuator through a top port and distributed across the full area of the actuator’s diaphragm. The diaphragm presses down on the diaphragm plate and spring return assembly, which then moves the valve stem and plug assembly downward to stroke the valve. This actuator will move to a stem-out position in the event of air signal failure. The choice of valve action (stem-In-To-Close or stem-In-To-Open) will determine its signal failure position.

#### Electric Actuated

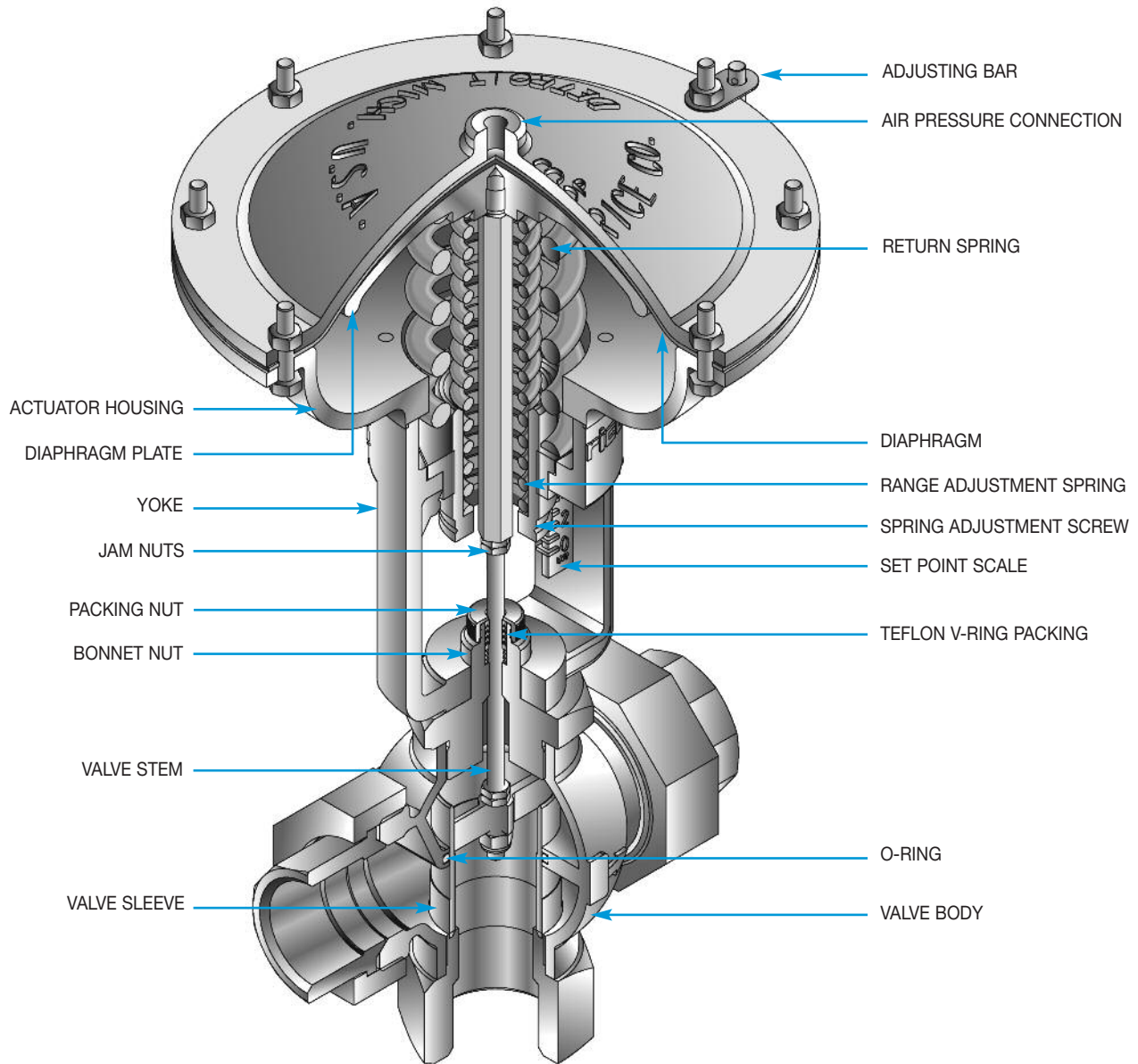
Terice Electric Actuators utilize an electric motor to generate shaft rotation. This rotation is, in turn, translated by the unit’s gear set into a linear motion, which drives the valve stem and plug assembly for flow modulation. The motor position is controlled by a 4-20mA control signal, these actuators can be specified to fail in the open (stem out) or closed (stem in) position.

### Selecting a Control Valve

Selection of a control valve is primarily dependent upon on the service conditions and load characteristics of the application.

#### Actuator

- **910 Series (Pneumatic)** – The Terice 910 Series Control Valve is designed for accurate performance within light industrial, HVAC and commercial process applications. The 910 Series utilizes a compact, pneumatic actuator. This actuator is direct-acting and features a “spring-opposed-diaphragm” design.
- **940 Series (Pneumatic)** – The Terice 940 Series Control Valve is designed for high performance in industrial, demanding HVAC and commercial process applications. The 940 Series is furnished with a heavy duty, pneumatic actuator. This actuator features a “spring-opposed-diaphragm” design and is direct-acting. The valve can also be supplied with either a pneumatic or an electro-pneumatic positioner for greater stability and increased close-off pressure capabilities.



- 940E Series (Electric)** – The Terice 940E Series Control Valve is designed for high performance in industrial, demanding HVAC and commercial process applications. It features a direct acting electric motor drive actuator, which can be used where an air supply is not available.

#### Actuator: Direct Acting

Direct Acting actuators are designed to move the valve stem to the “in” position as the control signal (pneumatic pressure or electrical signal) increases.

All Terice Control Valves should be carefully selected to meet the demands of the particular application. The information contained within this catalog is offered only as a guide to assist in making the proper selection. Selection of the proper control valve is the sole responsibility of the user. Improper application may cause failure, resulting in possible personal injury or property damage.

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### Control Valve Comparison

Consideration	910	910T	910EP	940	940E
Actuation	Pneumatic	Pneumatic	Pneumatic	Pneumatic	Electric
Control Action	On/Off	Proportional	Proportional	Proportional	Proportional
Input Signal w/o Positioner	0/15 psi	3-15 psi	3-15 psi	3-15 psi: 9-15 psi: Single Seat Fail-closed only	4-20 mA or 2-10 VDC
Input Signal with Positioner	x	x	x	3-15 psi or 4-20 mA	x
Application	Standard Duty	Standard Duty	Standard Duty	Heavy Duty	Heavy Duty
Price	Economical	Moderate	Moderate	Premium	Premium
Response Time	Excellent	Excellent	Excellent	Excellent	Very Good
Available with Positioner	No	No	No	Yes	Not Required
Close-off Pressure*	≤ 250 psig	≤ 250 psig	≤ 250 psig	≤ 720 psig	≤ 300 psig
Valve Sizes	1/2" thru 4"	1/8" thru 4"	1/2" thru 2"	1/2" thru 8"	1/2" thru 6"
Valve Styles	Single Seat Double Seat	Double Seat** 3-Way	Single Seat	Single Seat Double Seat 3-Way	Single Seat Double Seat 3-Way
Valve Materials	Bronze Cast-Iron Cast-Steel Stainless Steel	Bronze Cast-Iron Stainless Steel	Bronze	Bronze Cast-Iron Stainless Steel	Bronze Cast-Iron Stainless Steel
Trim Styles	Modified Linear	Modified Linear	Equal Percentage	Equal Percentage Modified Linear	Equal Percentage Modified Linear

\* Allowable pressure is dependent upon body material, connection and temperature of the process fluid. Please consult the Valve Pressure Ratings table.

\*\* Single Seat - 1/2"

### Valve

Terice Control Valves are available with a wide variety of valve bodies in various styles, materials, connections and sizes.

**A control valve is not considered a close-off valve. A pressure surge may force a single seated valve plug open. The Terice Control Valve is a balanced equilibrium system and provides no power to tightly seat the valve plug. A separate power driven or hand actuated valve is required to ensure tight close-off when necessary.**

**Style** – Terice Control Valve Bodies are available in single seated, double seated and 3-way designs.

- **Single Seated Valves** are an excellent choice when a higher degree of close-off is required. However, this design is unbalanced and limited in the pressure that it will close-off against. The leakage rate is approximately 0.01% (refer to Class IV) of the maximum capacity.
- **Double Seated Valves** are nearly pressure balanced and, therefore, are able to close the valve plug against higher operating pressures. However, since temperature fluctuations may cause expansion and contraction across the seats, tight close-off is not always possible. The leakage rate is approximately 0.5% (refer to Class II) of the maximum capacity. Double seated valves have a faster flow response and greater capacity than single seated valves and are recommended when tight close-off is not required.
- **3-Way Valves** are used for mixing two flows together, or for diverting a flow to or around a device (bypass). In order to produce consistent flow quantity for stable operation, the pressure drop across both flow paths (inlet to outlet) must be nearly equal.

3-Way Valves for 910 Series are exclusively of the Sleeve Type. 3-Way Valves for 940 Series are available in two styles: Plug Type (common port on the side) and Sleeve Type (common port on the bottom). The Plug Type is exclusively for use on mixing applications. The Sleeve Type is most commonly used for diverting applications, however due to its design it can also be used for mixing applications. The Sleeve Type design is constructed with an O-ring around the sleeve. The O-ring is suitable for water or glycol type service, up to a maximum of 300°F. A higher temperature viton O-ring for use with other fluids, such as oil, or for temperatures up to 410°F is available. Consult factory.

## Action

Terice Single and Double Seated Valves are available as stem In-To-Close (fail-open), or stem In-To-Open (fail-closed) for various application requirements. The action of 910 Series, bronze-bodied valves is field reversible. Terice 3-Way Valves can be specified for either mixing or diverting service.

**Terice Control Valves are NOT intended for use in applications where the media comes in direct contact with the skin or body, such as showers, baths, lavatories or wash fountains.**

### Control Valve Action

Stem Action	Fail Position*
In-To-Close	Fail-open
In-To-Open	Fail-closed

\* The electric motor actuator of the 940E Series can be specified to move the valve to an open (stem out) or closed (stem in) position in case of electrical power failure or loss of control signal.

## Body Material and Connection

Terice Control Valves are available with bronze, cast-iron, cast steel and stainless steel valve bodies. Union, flanged and threaded connection styles are available.

### Valve Pressure Ratings (psig)

Body Material	Connection	Operating Temperature									
		100°F (38°C)	150°F (66°C)	175°F (79°C)	200°F (93°C)	225°F (107°C)	250°F (121°C)	275°F (135°C)	300°F (149°C)	350°F (177°C)	400°F (204°C)
Bronze	Iron Unions	250	250	250	250	250	250	250	250	250	250
Bronze	Threaded	400	400	392	385	375	365	350	335	300	250
Cast-Iron	Threaded	400	400	385	370	355	340	325	310	280	250
Cast-Iron	Class 125 Flanged	175	175	170	165	157	150	145	140	125	—
Cast-Iron	Class 250 Flanged	400	400	385	370	355	340	325	310	280	250
Cast-Steel	Threaded	250	250	250	250	250	250	250	250	250	250
Stainless Steel	Threaded	720	670	645	620	605	590	575	560	537	515

## Trim

Valve trim is comprised of the stem and plug assembly, and the seats within the ports. 910 Series Control Valves employ either a quick-opening or equal percentage stainless steel valve plug and permanently brazed-in stainless steel seats for smooth performance throughout the life of the valve. The valve plug is both top and bottom guided to ensure positive seating alignment. Series 940 and 940E Two-Way Control Valves are furnished with an equal percentage plug design. A quick-opening plug design is ideally suited for use with an “On/Off” Controller, while an equal percentage design is typically used with a “Proportional” or “PID” Controller.

Terice 3-Way Valves use a skirt-guided stainless steel sleeve and brass seating surface to change flow direction in a linear manner within the body.

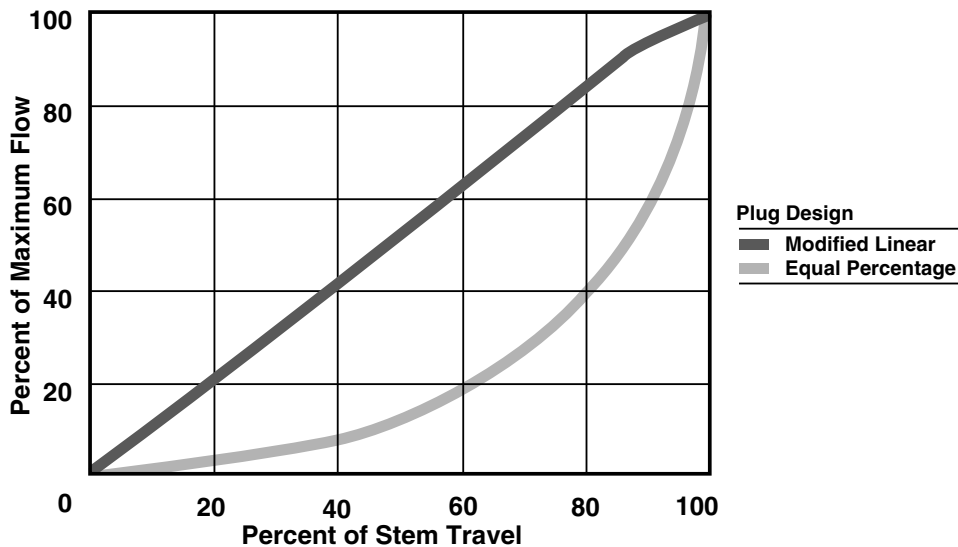
# Control Valves

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### Plug Design Availability

Series	Style	Plug Design	
		Modified Linear	Equal Percentage
910	2-Way	x	x
	3-Way	x	
940 / 940E	2-Way		x
	3-Way	x	

### Inherent Flow Characteristics



### Packing

Terice valves feature a self-energizing Teflon V-Ring packing, which reduces leakage around the valve stem. V-Ring packing is spring loaded to maintain proper compression and **does not** require manual adjustment.

### Size

The proper sizing of a control valve is one of the most important factors in its selection. A valve that is too small will not be able to provide the desired capacity during peak load conditions, while a valve that is too large may overshoot the control point and operate with the valve plug too close to the seat, resulting in undue wear of the plug and seat. The valve coefficient ( $C_v$ ) is mathematically determined through an evaluation of the system operating pressures. From this factor, a valve body with the appropriate port size can be selected. Port Sizes from 1/8" through 8" and Connection Sizes from 1/2" through 8" are available. Please consult the Valve Selection Section of this catalog.

### Valve Coefficient ( $C_v$ )

The rated valve coefficient is used to describe the relative flow capacity of the valve based on standard test conditions. Please refer to the Valve Selection Section for detailed information.

## Control Valve Availability

910 Series			Size											
Body Material	Connection	Style	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"
Bronze	Iron Unions	Single	✓*	✓	✓	✓	✓	✓						
		Double		✓	✓	✓	✓	✓						
		3-Way	✓	✓	✓	✓	✓	✓						
Cast-Iron	Class 125 Flanged	Double							✓	✓	✓			
		3-Way							✓	✓	✓			
Cast-Steel	Threaded	Single		✓*	✓*									
Stainless Steel	Threaded	Single	✓	✓	✓		✓	✓						
		3-Way	✓	✓	✓		✓	✓						

940 / 940E Series			Size											
Body Material	Connection	Style	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"
Bronze	Threaded	Single	✓	✓	✓	✓	✓	✓						
		3-Way	✓	✓	✓		✓	✓						
Cast-Iron	Threaded	Double					✓	✓						
Cast-Iron	Class 125 Flanged	Single							✓	✓	✓	✓	✓†	
		Double							✓	✓	✓	✓	✓	✓†
		3-Way							✓	✓	✓	✓	✓	✓†
Cast-Iron	Class 250 Flanged	Single							✓	✓	✓	✓	✓	
		Double							✓	✓	✓	✓	✓	✓†
		3-Way	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓†
Stainless Steel	Threaded	Single	✓	✓	✓		✓	✓						
		3-Way	✓	✓	✓									

\*Reduced port sizes are available.

†Not available on 940E Series.

## Positioner

Terice Valve Positioners (pneumatic and electropneumatic) are mechanical devices designed to provide enhanced control, stability, and close-off capability in extreme flow applications. The positioner, which is mounted to the valve's yoke assembly and linked to the valve stem, receives a signal from an external control source, compares the control signal to the actual position of the valve plug, and then sends a corrected signal to the valve's actuator, thereby positioning the valve plug for optimum flow modulation.

## Air Filter/Regulator

The Terice No. TA987 Air Filter/Regulator is recommended for filtering and regulating the pressure of plant compressed air, while delivering clean, dry air at the proper pressure to pneumatic control devices.

**Clean, filtered supply air is required by all pneumatic control systems and control devices.**

## Pipeline Strainer

A Terice Series 1100 Pipeline Strainer should always be installed upstream of a Terice Control Valve. This Y-Type strainer employs a stainless steel screen and will remove debris from the line, which will prevent jamming of the valve and extend its life.