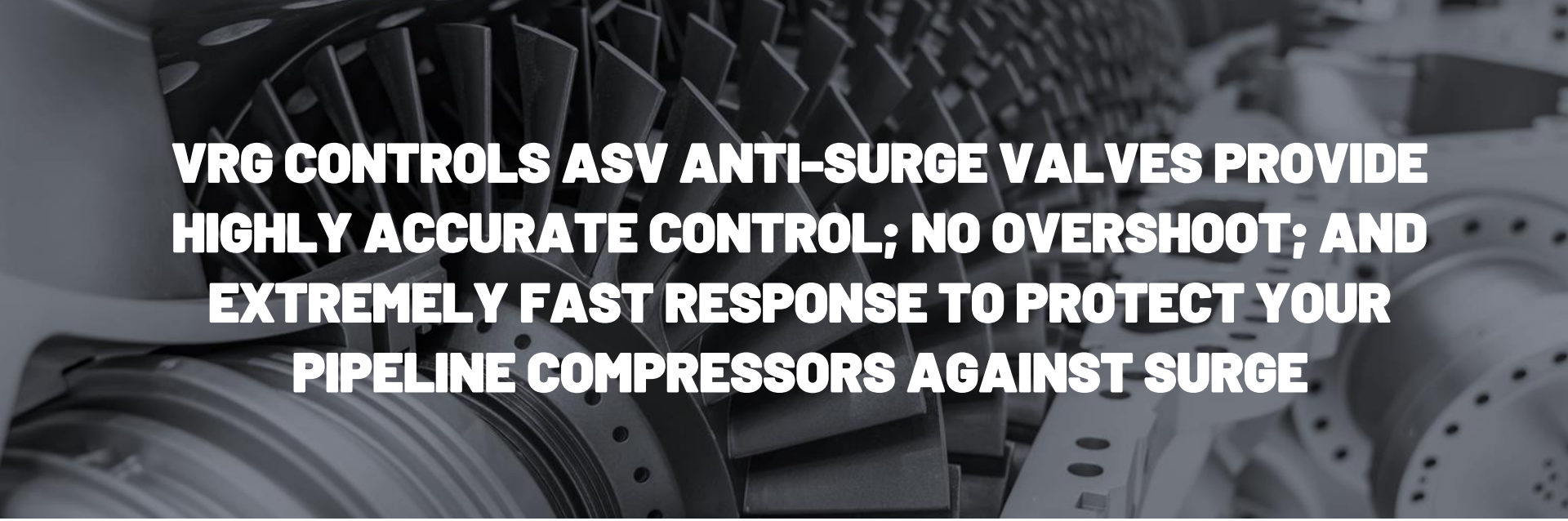
ASV ANTI-SURGE VALVES

VRG CONTROLS



VRG CONTROLS ASV ANTI-SURGE VALVES PROVIDE HIGHLY ACCURATE CONTROL; NO OVERSHOOT; AND EXTREMELY FAST RESPONSE TO PROTECT YOUR PIPELINE COMPRESSORS AGAINST SURGE

A **centrifugal compressor station is used to boost the pipeline pressure for effective natural gas transportation**. Each compressor is typically **equipped with an ASV Anti-Surge Valve which prevents potential damage** to the centrifugal compressor caused by surge conditions.

When gas flow through the centrifugal compressor drops to very low volumes the compressor is challenged in its ability to compress the gas. This phenomenon is referred to as the **surge condition**. A **high performance control system is applied to avoid surge conditions**. The **primary component of this system is the ASV Anti-Surge Valve**. The ASV remains closed during normal compressor operation. The ASV is required to open very rapidly connecting the gas compressor inlet and outlet, thereby mitigating surge occurrence and preventing costly damage to compressor components.

Proven Technology with Advanced Control Technology

To prevent damage to the natural gas compressors, VRG Controls manufactures reliable, fast-acting control valves. The control instrumentation to **open the ASV Anti-Surge Valve in less than 1.0 seconds.** The same high-performance control instrumentation provides **highly accurate valve position with minimal overshoot and excellent repeatability during Recycle Mode, Surge Mode or compressor Start Up.** VRG Controls ASV's provide the fastest response of any "surge valve" in the market and exceed performance requirements of most pipeline compressor manufacturers.

Anti-Surge Valves are critical components in a compressor Anti-Surge Control System. **Poor performance of an ASV Valve can adversely affect pipeline compressor operation**, the environment, and your bottom line. VRG Anti-Surge Valves provide top-of-the-line performance to reduce maintenance costs and maintain compressor "up time." Our technologies combine control valve technologies proven over the past 50+ years in tandem with the latest, high performance control instrumentation.

COMMITMENT TO THE ENVIRONMENT

Industry Leading Anti-Surge Performance with ZERO Steady State Emissions

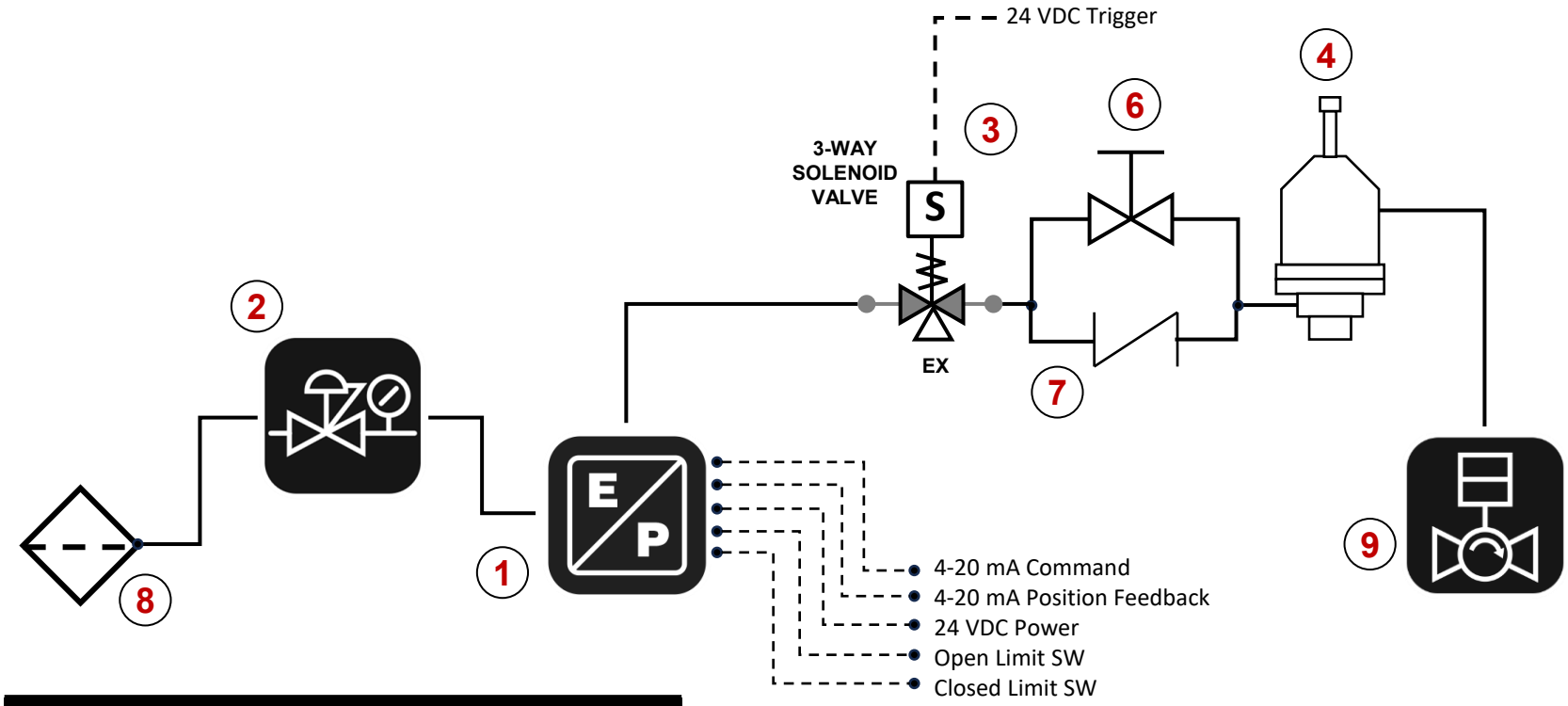
* Image may differ from actual product

ZERO STEADY STATE EMISSIONS

VRG Controls engineers and manufactures high performance control valve positioners and accessories for use with natural gas control valves. Our RCVC Red Circle Valve Controllers represent the **next generation of high-performance valve positioners** designed to provide industry leading Anti-Surge performance with **ZERO steady state emissions**. Our products lead the industry in non-bleed / low-bleed technology development with performance and operational advancements that set them apart from the competition, minimizing air compressor runtime and maintenance.

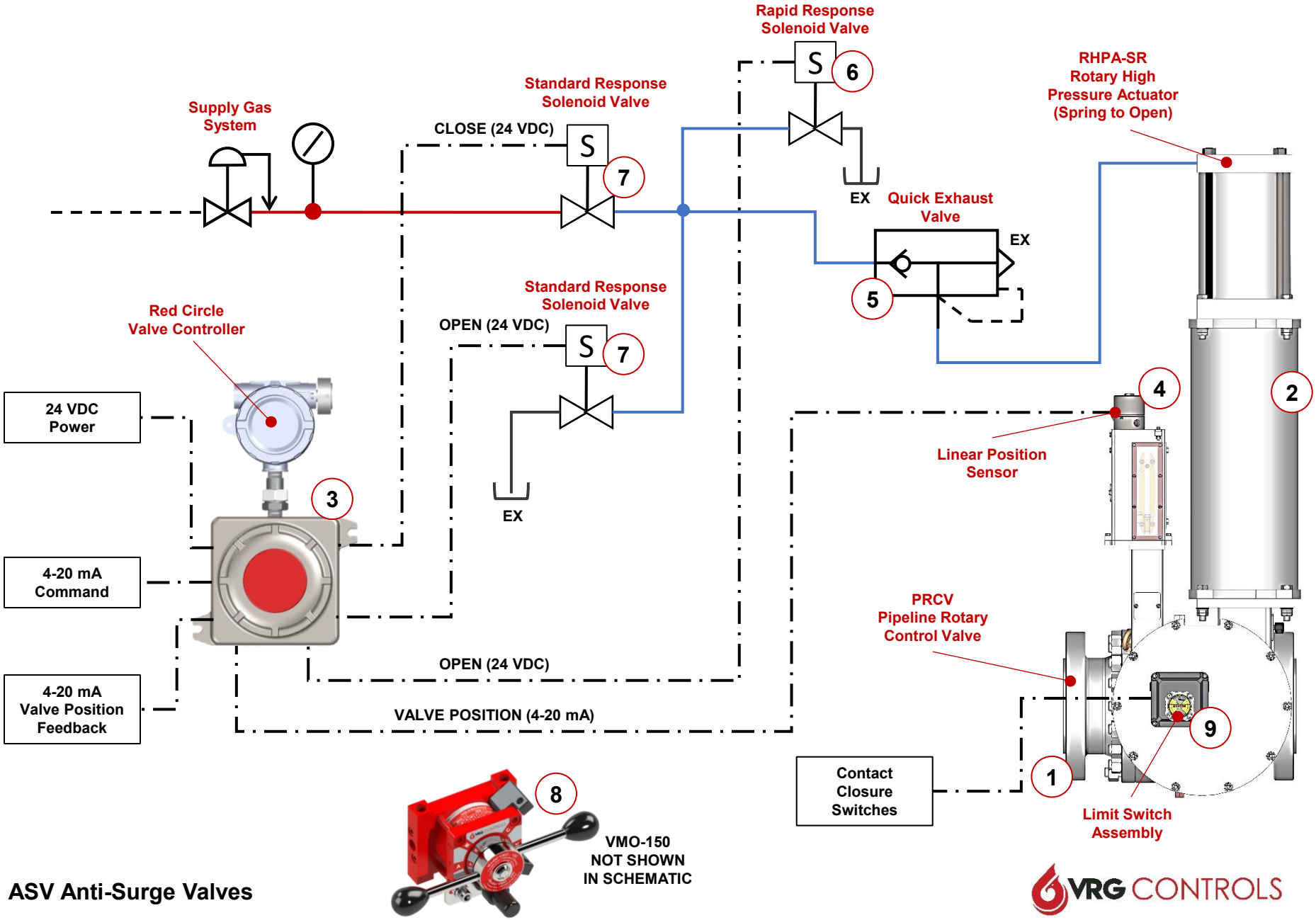
VRG CONTROLS

Anti-Surge Assembly - Typical Specifications



ITEM	DESCRIPTION
1	RCVC Electro-Pneumatic Positioner
2	Supply Regulator
3	3-Way Solenoid Valve 24 VDC
4	RC Exhaust Booster
5	Balluff BTL7 Position Transmitter
6	Adjustable Needle Valve
7	Check Valve
8	Filter
9	VRG ASV Control Valve

ASV Control Schematic

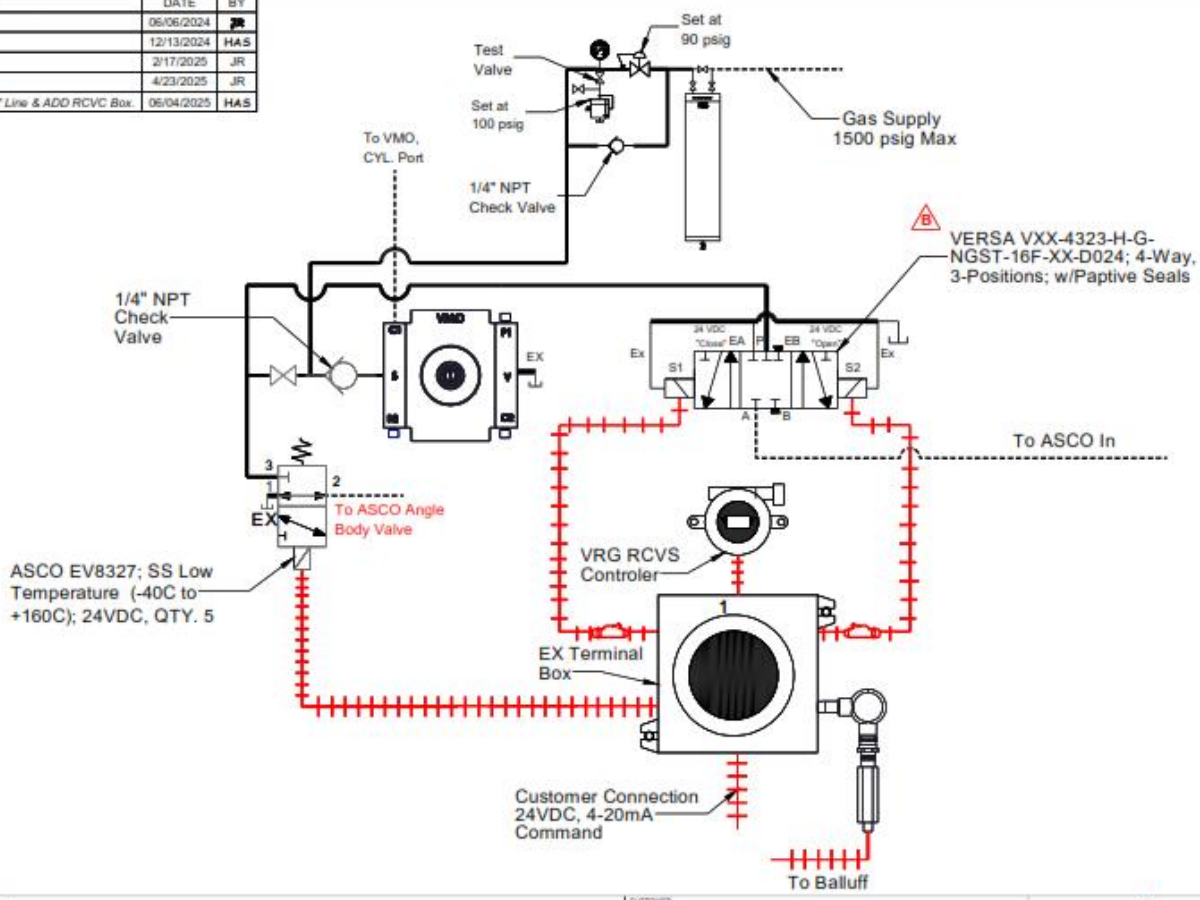


ASV Anti-Surge Valves

VRG CONTROLS

Anti-Surge Assembly – VRG Instrumentation Schematic

REV	DESCRIPTION	DATE	BY
A	FIRST RELEASE	06/06/2024	JR
B	ADD VERSA VXX-4323-H-G....	12/13/2024	HAS
C	Removed an ASCO valve	2/17/2025	JR
D	Changed Ball valve placement	4/23/2025	JR
E	On Sheet#2: Make Solid Line & Extend 1" Line & ADD RCVC Box.	06/04/2025	HAS



1/4 NPT FULL PORT BALL VALVE
1/4 NPT INSTRUMENT BALL VALVE
1/4 NPT M & F NEEDLE VALVE
1/4 NPT FIELD CONNECTION
1/4" TUBING OR 1/4" NPT FITTING CONNECTION
3/8" TUBING
1/2" TUBING
EL. CONDUIT

NOTE:

1. Valve Will Open on Loss of 4-20 mA Signal and 24 VDC and Power Gas.
2. Valve is Spring to Open and is Shown in Full Open Position.
3. To Operate VMO Close (5) 1" Ball Valves.
4. RCVC Controller is Nonebleeding in Close, Open and Steady State Positions.
5. 1" NPT Tubing.
6. 24 VDC ASCO Valve Connection is Connected to Terminal Strip in Terminal Box at Factory.
7. CLIENT TAG: BISON XP - ARNEGARD CS ASV.

CUSTOMER	TC Energy
PROJECT	BISON XP - ARNEGARD CS ASV
JOB#:	24-1627
PO#:	4500591015
VLV #:	BV6-106F3-HM1
CD#:	CD-5151

VRG CONTROLS

TITLE: 10-600 PRCV-STHM RF VP Anti Surge and D12x12-sr5222 FOPT AG RHPA with RCVC Left hand

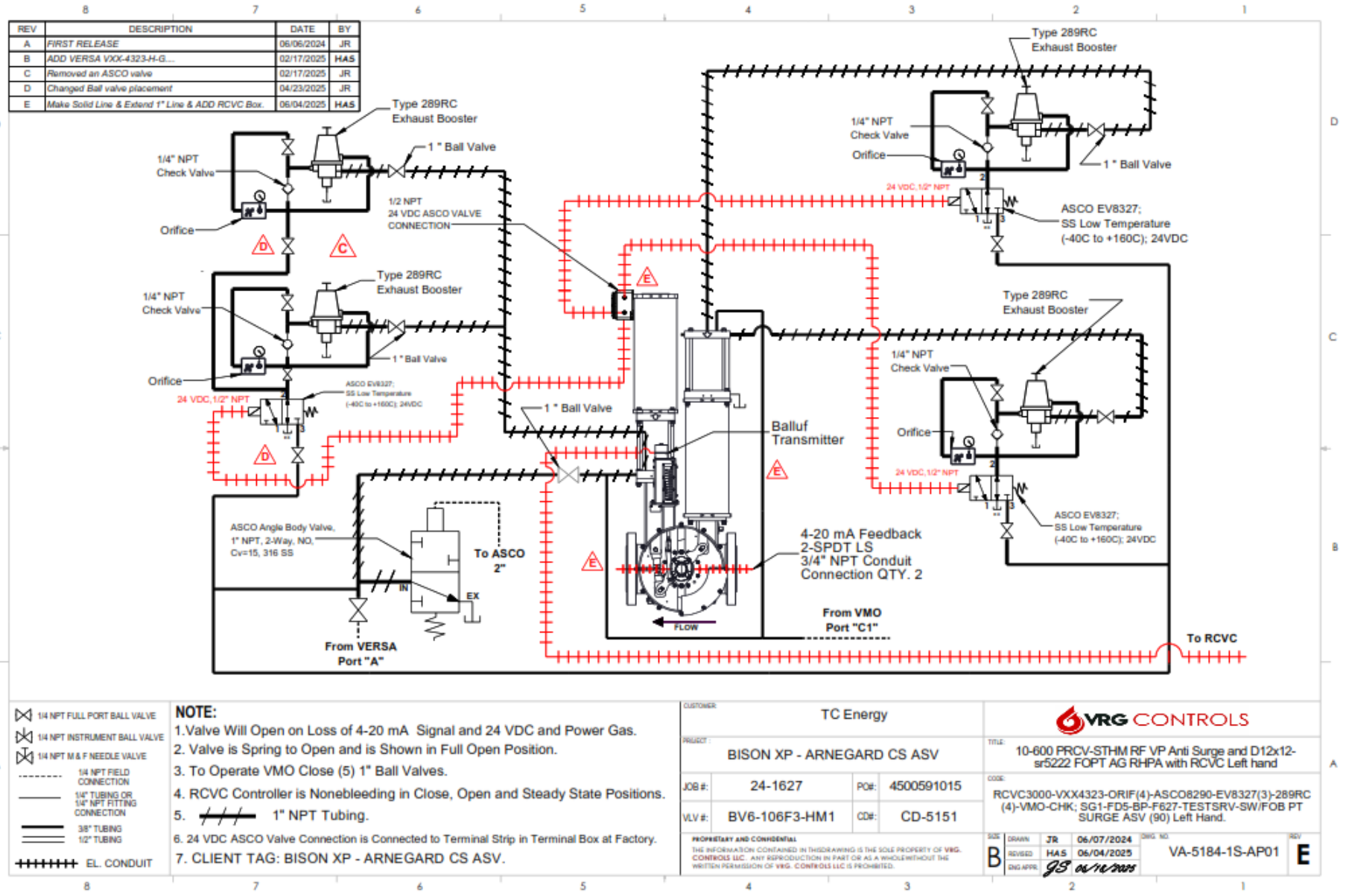
CODE: RCVC3000-VXX4323-ORIF(4)-ASCO8290-EV8327(3)-289RC (4)-VMO-CHK; SG1-FD5-BP-F627-TESTSRV-SW/FOB PT SURGE ASV (90) Left Hand.

SIZE				DWG. NO.	REV
B	DRAWN	JR	06/07/2024	VA-5184-1S-AP01	E
	REVISED	HAS	06/04/2025		
	ENG APPR.	JB	6/11/2025		

ASV Anti-Surge Valves

VRG CONTROLS

Anti-Surge Assembly – VRG Instrumentation Schematic



ASV Anti-Surge Valves

VRG CONTROLS

ASV Anti-Surge Valves - PRCV

Specifications:

Control Valve(s):	PRCV Pipeline Rotary Control Valve (Surge Spec.)
Actuator Type:	RHPA-SR Rotary High Pressure Actuator – Spring Return (Surge Spec.)
Pressure Ratings:	ANSI Class 150 – 2500
Sizes:	4 in to 16 in (Typical)
End Connections:	RFFE*, RTJ, Weld End
Temperature Range:	-20°F to +350°F (-29°C to 177°C) standard
Performance:	Meets or Exceeds Current Typical Turbines Design Requirements

Industry Standards Available:

- ASME B16.34 Compliant
- PED 27/23/EC EU Pressure Equipment Directive
- ATEX Dir. 94/9/EC Equipment for use in Explosive Atmospheres
- CRN Canadian Registration Number
- NACE MR0175 Petroleum and Natural Gas Industries

ASV Anti-Surge Valves – Red Arrow Axial Flow

Specifications:

Control Valve(s):	Red Arrow Axial Flow Control Valve (Surge Spec.)
Actuator Type:	LHPA-SR Linear High Pressure Actuator – Spring Return (Surge Spec.)
Pressure Ratings:	ANSI Class 150 – 1500
Sizes:	6 in to 24 in (Typical)
End Connections:	RFFE* & RTJ
Temperature Range:	-20°F to +350°F (-29°C to 177°C) standard
Performance:	Meets or Exceeds Current Typical Turbines Design Requirements

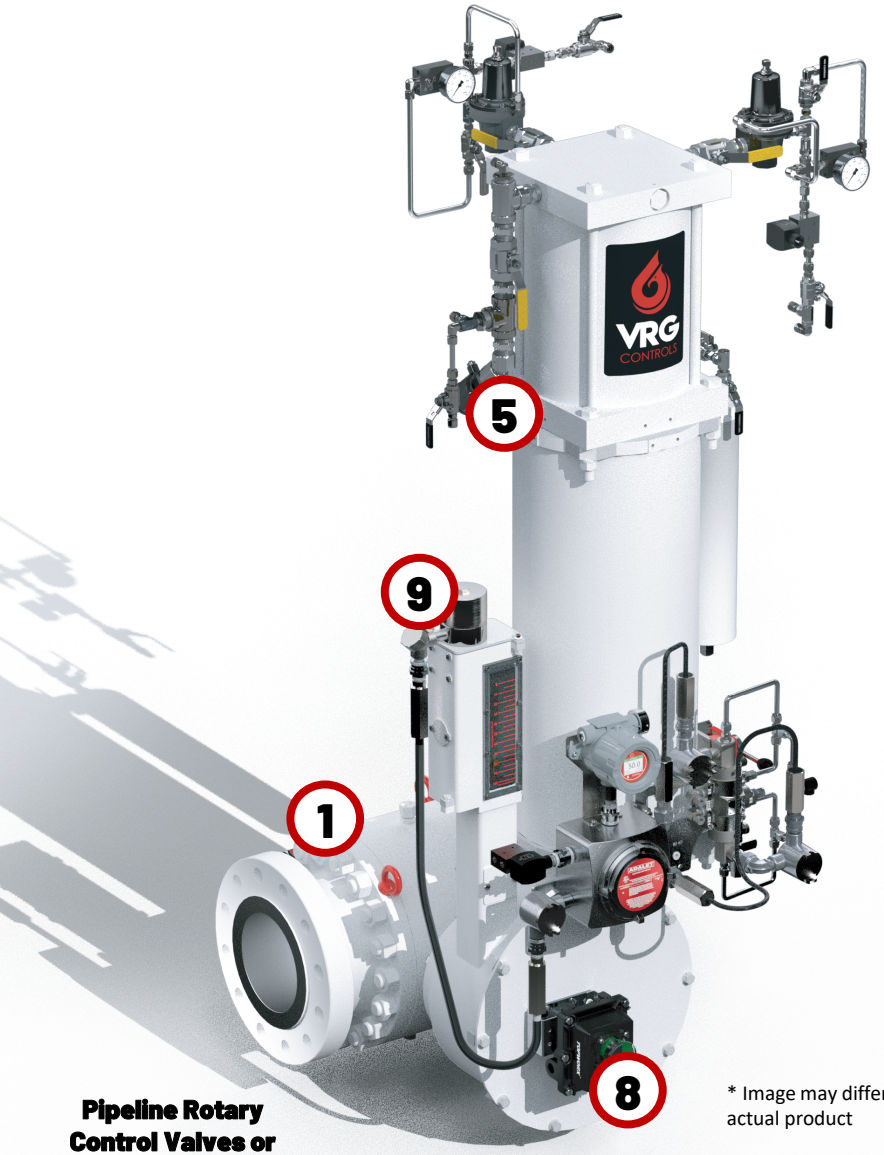
Industry Standards Available:

- ASME B16.34 Compliant
- PED 27/23/EC EU Pressure Equipment Directive
- ATEX Dir. 94/9/EC Equipment for use in Explosive Atmospheres
- NACE MR0175 Petroleum and Natural Gas Industries

ASV Anti-Surge Valve – Primary Components

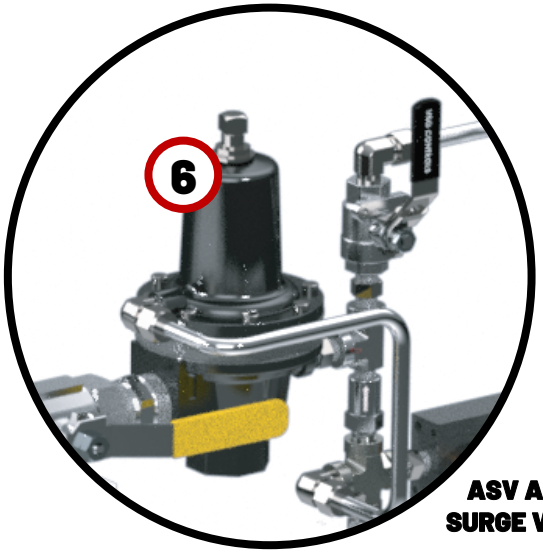
1. VRG PRCV or Red Arrow Control Valve (Surge Spec)
2. VRG RHPA-SR or LHPA-SR Piston Actuator (Surge Spec)
3. VRG Red Circle Valve Controller (RCVC)
4. Balluff BTL Linear Position Sensor
5. Fisher 289RC Exhaust Booster
6. ASCO Angle Body Rapid Response Valve
7. VERSA VXX-4323 Standard Response Solenoid Valve
8. VRG Valve Manual Override (VMO)
9. Rover Valve Position Status Monitor

ASV Anti Surge Components



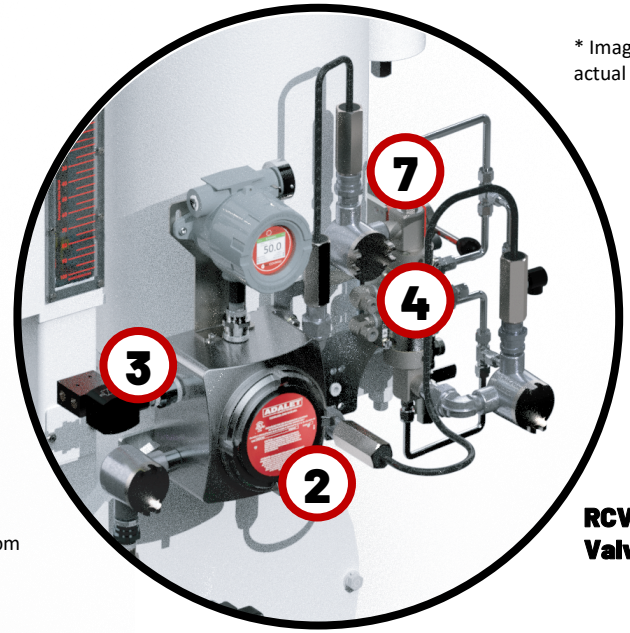
Pipeline Rotary Control Valves or RED ARROW

* Image may differ from actual product



ASV ANTI-SURGE VALVE

* Image may differ from actual product



RCVC Red Circle Valve Controller

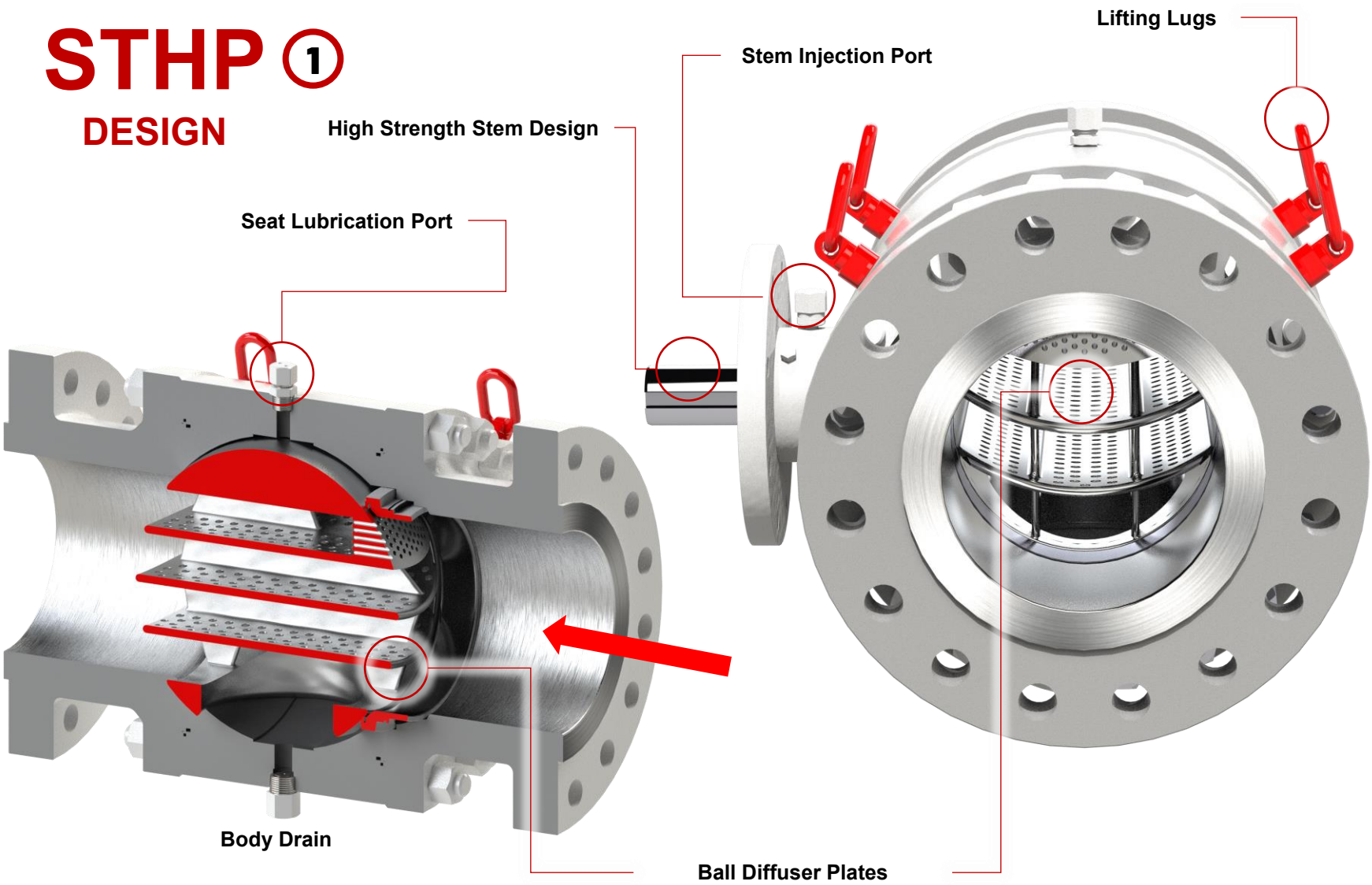
ASV Anti-Surge Valves

VRG CONTROLS

PRCV-STHP Stealth Trim – Upstream Bore View and Cutaway

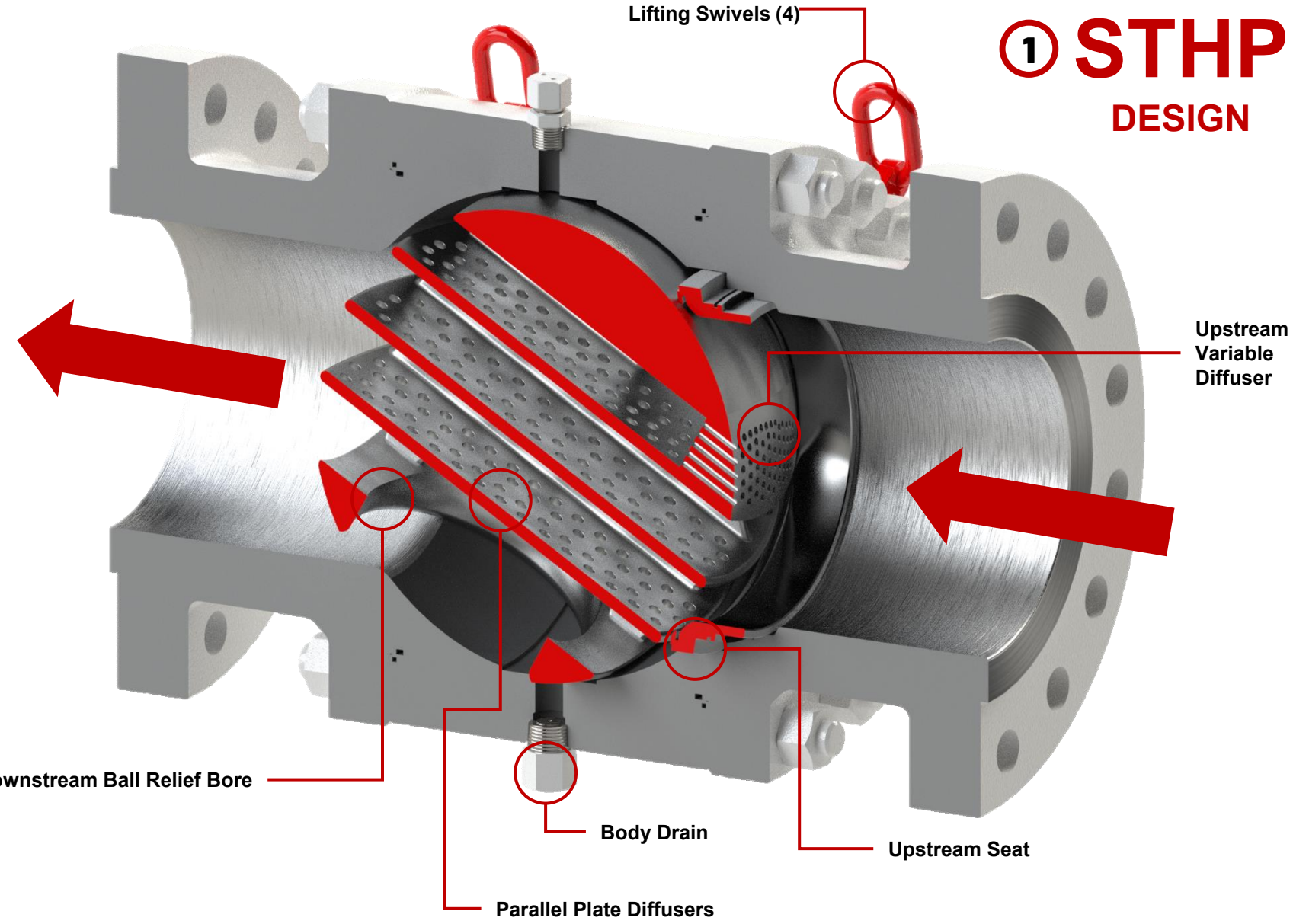
STHP ①

DESIGN

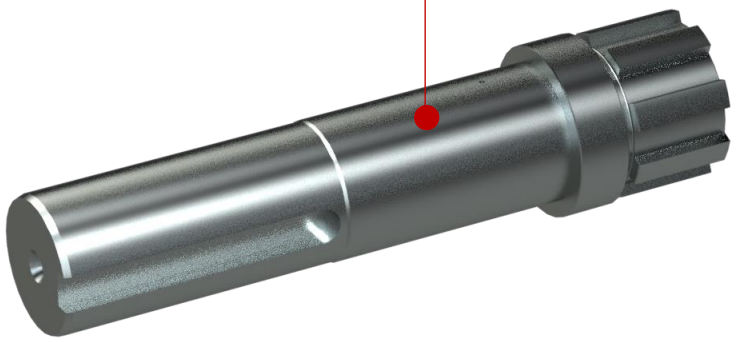


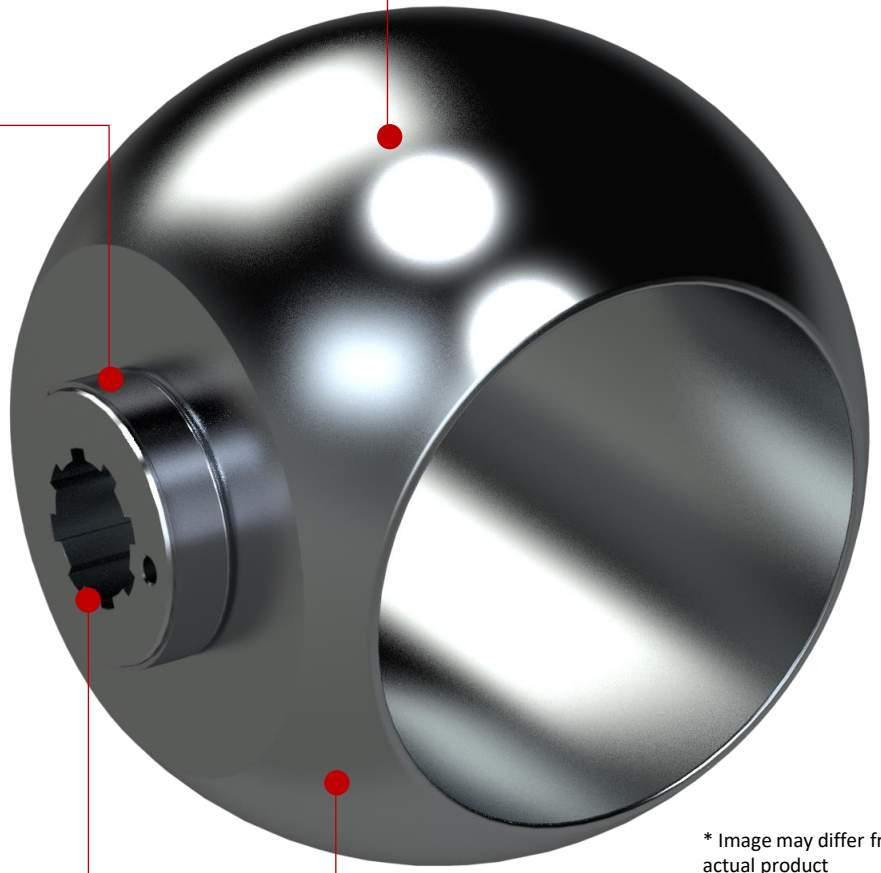
VRG CONTROLS

PRCV-STHP Stealth Trim – Cutaway View



New VP Series – Top Quality Performance at Competitive Price





3.0 mil ENP
Ball & Seat Rings

Composite POLYGON MRP
Trunnion Bearings

High Performance 17-4PH
Stainless Steel Stem

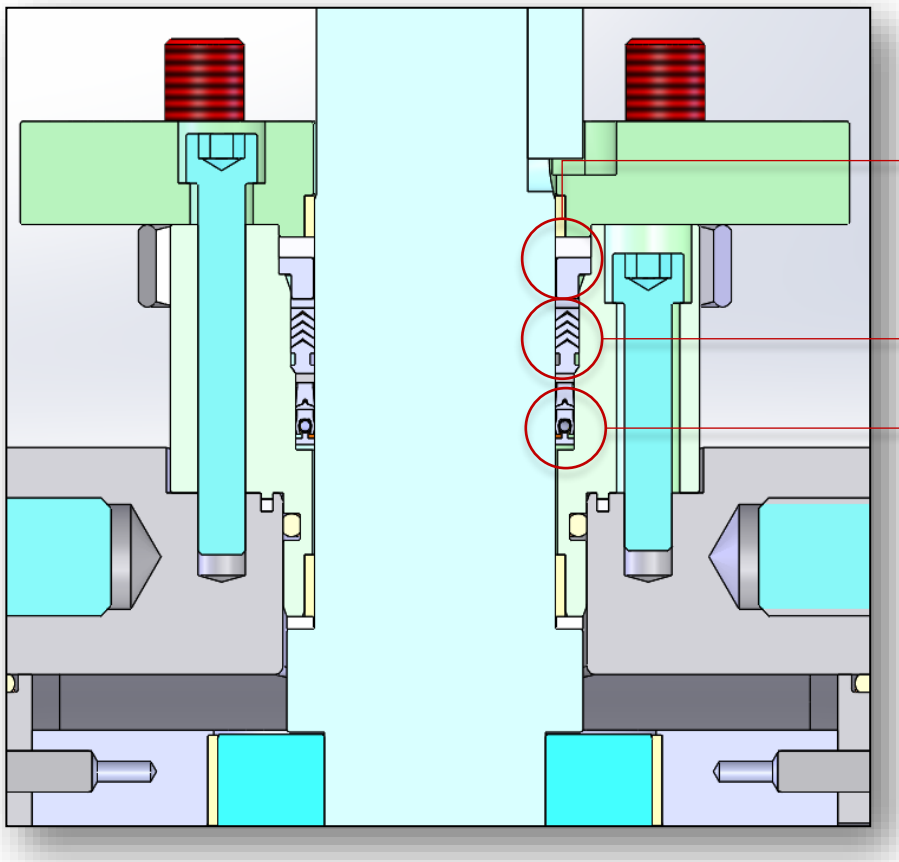
High Integrity Splined
Steam & Ball Connection

High Strength
F60 Carbon Steel Ball

* Image may differ from actual product

PRCV-STHP High Performance Stem Seal Design

Stealth Trim – Upstream Bore View and Cutaway



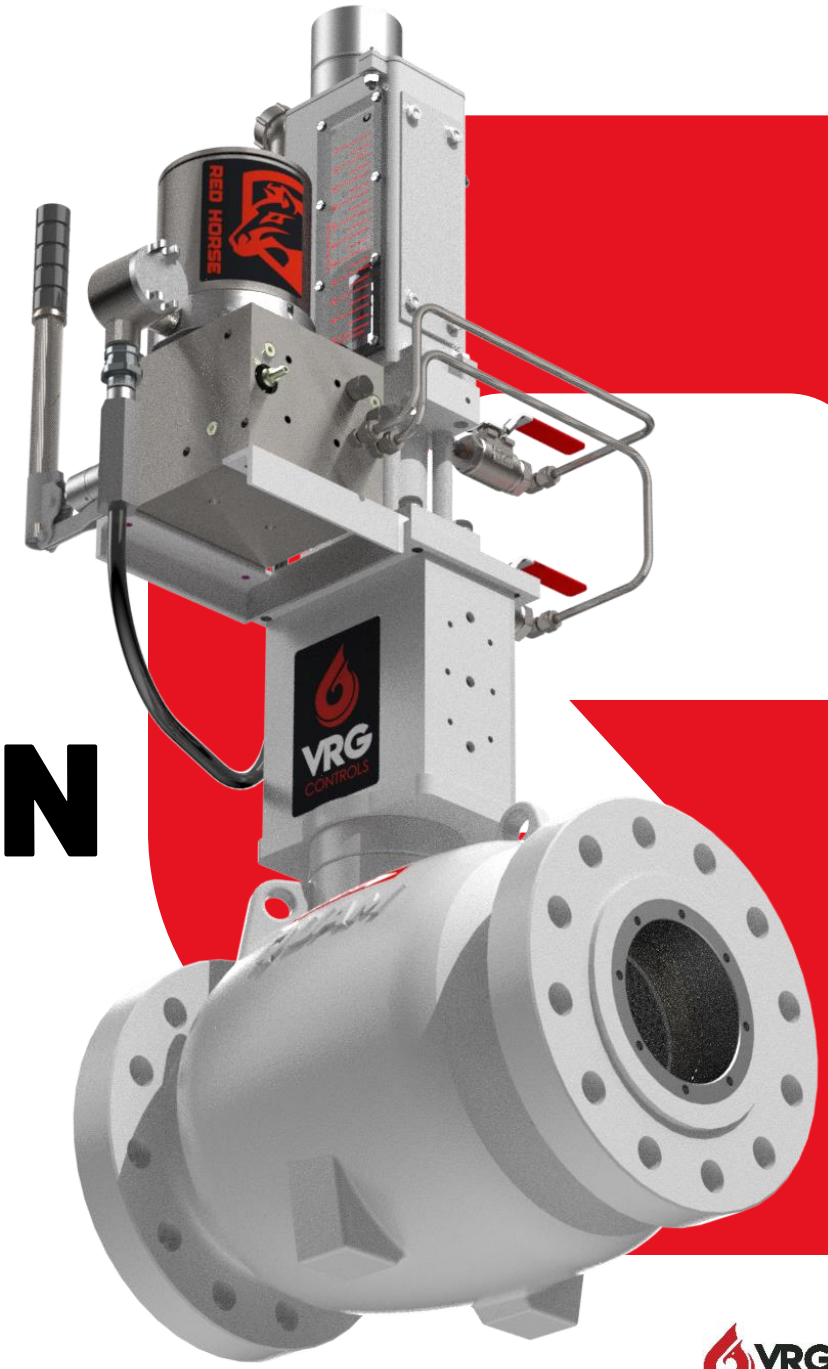
High Performance V-Pack
Stem Seal Configuration

STHP
DESIGN

High Performance V-Pack
Stem Seal Assembly

RED ARROW

POWER MEETS PRECISION



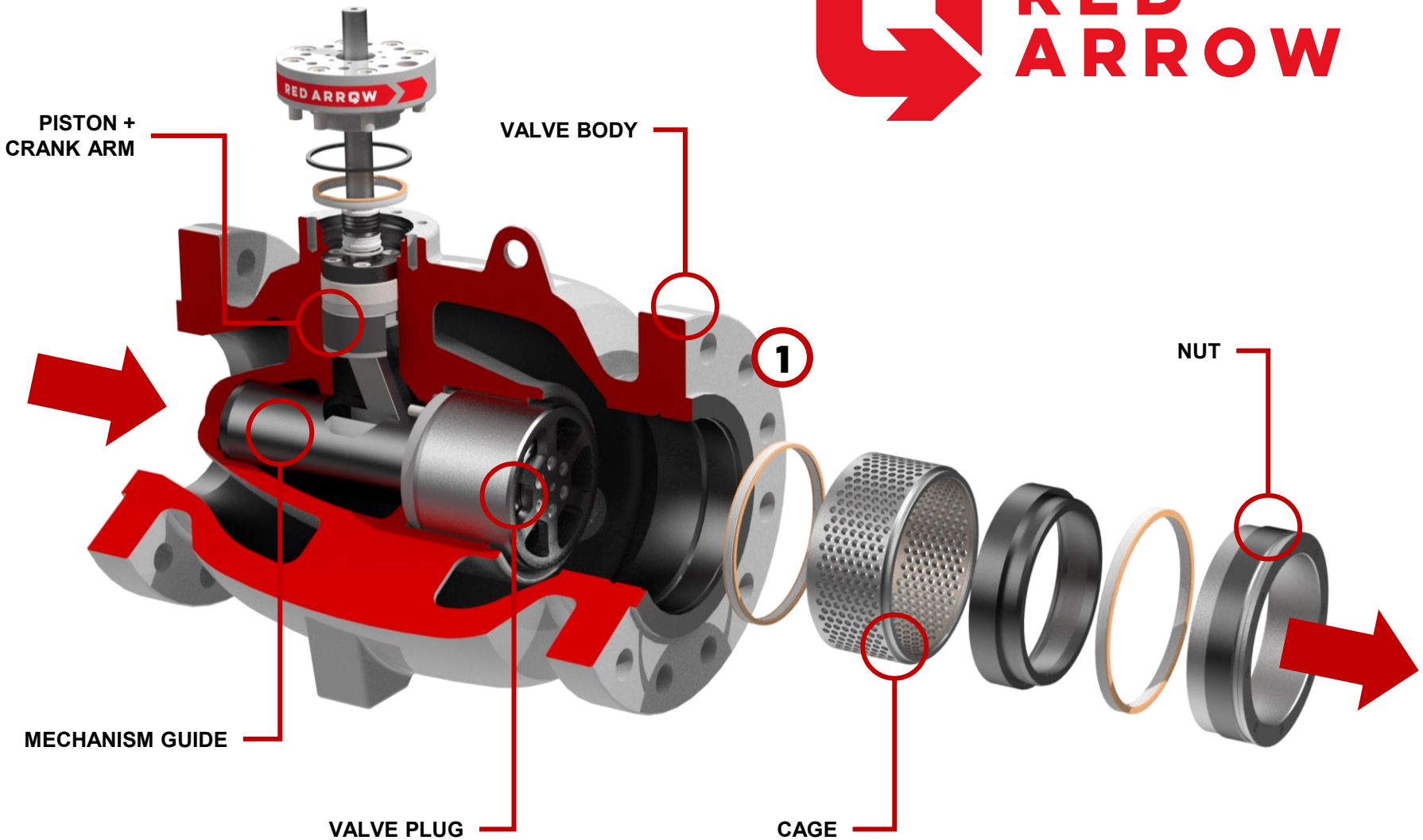
HIGH CAPACITY AND NOISE ATTENUATION SOLUTIONS FOR NATURAL GAS PIPLINES

SOLUTION SHAPED BY QUAM

QUAM VALVOLE

ASV Anti-Surge Valves

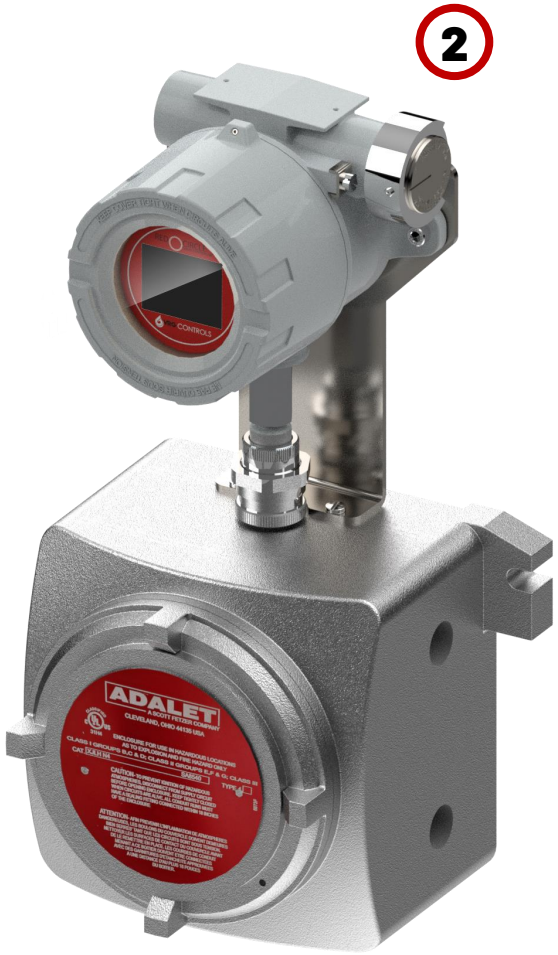
VRG CONTROLS



ASV Anti-Surge Valves

RCVC Red Circle Valve Controller

Model:	RCVC-2000 Red Circle Valve Controller
Installation:	Valve Mount or Remote Installation
Diagnostics:	Onboard Graphical Performance Evaluation
Display:	High Resolution, Programable, Multi-Color Display
Command Signal:	4 – 20 mA Analog OR 24 VDC Discrete Pulse
Feedback Signal:	4 – 20 mA (Internal or External Loop Power) Remote/Local Trigger Counter Digital Feedback
Deadband:	Adjustable 0.1% to 2.0% Travel, Typically Set 0.5% Standard
Hysteresis:	0.5% Full Scale (with standard Rotary Position Feedback Module
Linearity:	0.5% Full Scale (with standard Rotary Position Feedback Module
Failure Mode:	OPEN, CLOSE, or LOCK on Loss Command Signal
Consumption:	ZERO STEADY-STATE Bleed to Pressure System Capable
Rating:	EXPLOSION PROOF, Class 1, Div. 1
Connections:	½ FNPT Pneumatic Connections Port ¾ FNPT Electrical Connections
Temperature:	-20°F to +120°F (-29°C to +49°C)
Compatibility:	Dimensions, Ports, Connections 100% Compatible with Existing GE/Becker DNGP Replacement
Communication:	HART Protocol Compliant, USB Computer Interface
Manual Override:	Local Manual Valve Positioning Onboard
Adjustment:	Non-Intrusive Local Thumbwheel Adjustment
Area Classification:	Class 1, Div. 1 EXPLOSION PROOF



RED CIRCLE VALVE CONTROLER

REQUIRES PAIRED SOLENOID VALVE(S) ASSEMBLY
PAIRED VALVE POSITION TRANSMITTER

ASV Anti-Surge Valves

VRG CONTROLS

RCVC Red Circle Valve Controller

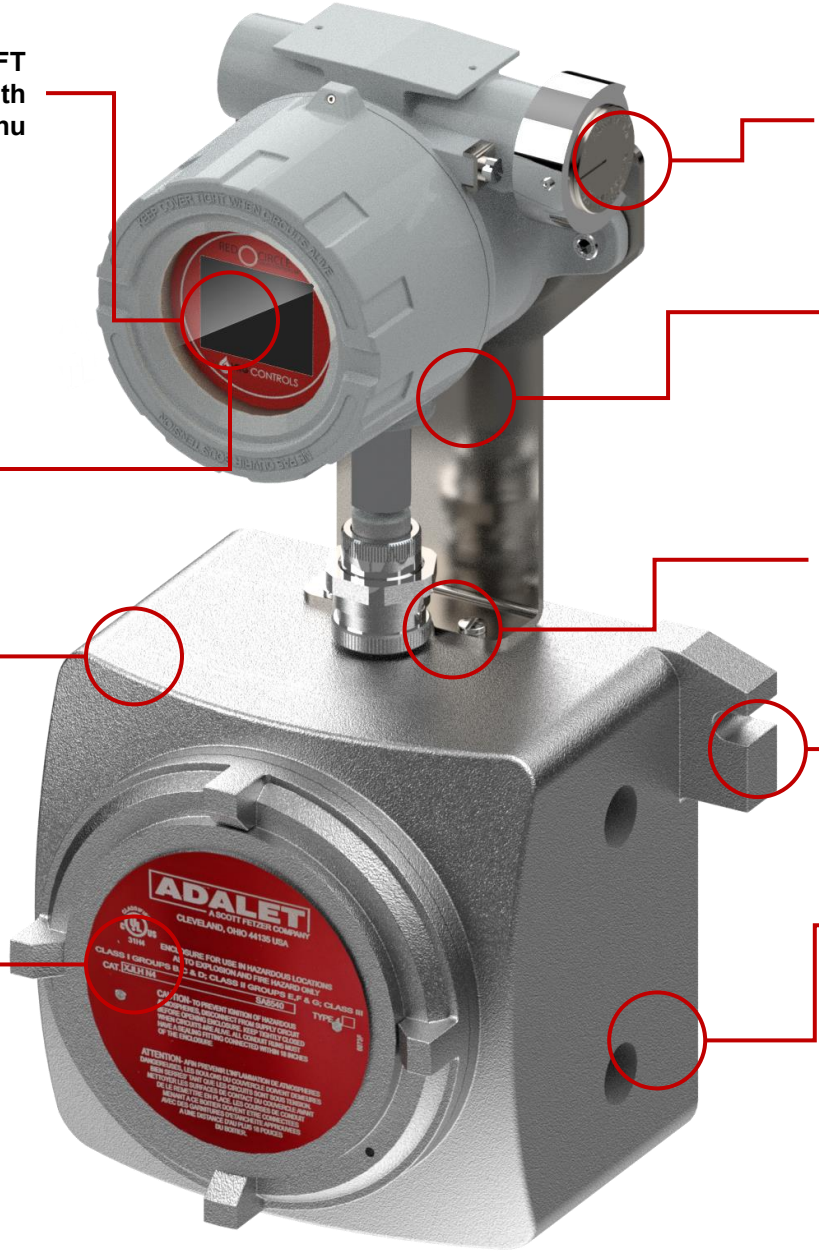
Hi Resolution Color TFT Programmable Display with Intuitive and Easy Read Menu

PLUG & PLAY REPLACEMENT FOR BECKER/GE DNGP POSITIONER

HART Protocol Communication Standard. Wireless Bluetooth Capable for Easy Configuration and Evaluation. Bluetooth May Be Disabled as Desired.

Class 1, Div. 1 Ex Proof Terminal Strip Housing Provides Generous Room for Easy Wire Termination

RCVC May be Installed Directly on Control Valve or Remotely in Control Cabinet or RTU Building



Rotary Control Switch Provides Non-Invasive Menu Navigation and Setup

4-20 mA Analog Command Signal Input OR ±24 VDC Discrete Pulse Positioning

ZERO Steady State Emissions with Ability to Discharge to Pressure System for Complete Atmospheric Emissions.

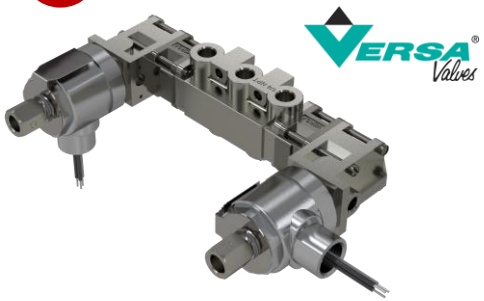
RCVC Electrical Ports and Mounting Brackets Provide Flexible Configuration. 100% Compatible with Existing Becker/GE DNGP & EFP Enclosures for Easy Retrofit

RED CIRCLE VALVE CONTROLER

ASV Anti-Surge Valves

VRG CONTROLS

Primary Components – Solenoid Valves

	RCVC ASV Solenoid Pack Standard Response	Double Acting Standard Pressure Solenoid Pack	Angle Body Valve
	3  	4  	5 
Model	ASCO EV8327G052 (QTY 2)	Versa VXX-4323-316-H2-ME-S-XXL-44-D024	ASCO Angle Body Valve - 8290A398. 1" NPT
Voltage	24 VDC	24 VDC	N/A
Supply	**41 - 150 psig**	**20 – 150 psig**	**0 – 240 psig**
Type	2-Position, 3-Way One Port Plugged 2/2	4-Way, 3-Position, Blocked Center Double Solenoid-Pilot Spring Center	2 Way, Direct Acting, Normally Open
Other Specs	Cv 0.50, 24 VDC, 2-Position, 3-Way (One Port Plugged), Low Temp. (-40F), Stainless Steel Body, Universal, UL CSA CE Approved, Ex Proof Cl. 1 Div. 1., Buna N Elastomers, 0.250 NPT Ports, Tapped Exhaust. One (1) for CLOSE and One (1) for OPEN.	Cv 1.8, 24 VDC, 4-Way, 3-Position, Blocked Center Double Solenoid-Pilot Spring Center, Internal Pilot, Mod. Temperature (-20F), 316SS Construction, Cl I, Grps C,D - Cl II, Grps E,F,G - Cl I, Div 2, Grps A,B,C,D - Cl II, Div 2, Grps E,F,G, Buna N Elastomers, 0.250 FNPT Primary Ports, Tapped Exhaust	Cv=15, 316 SS

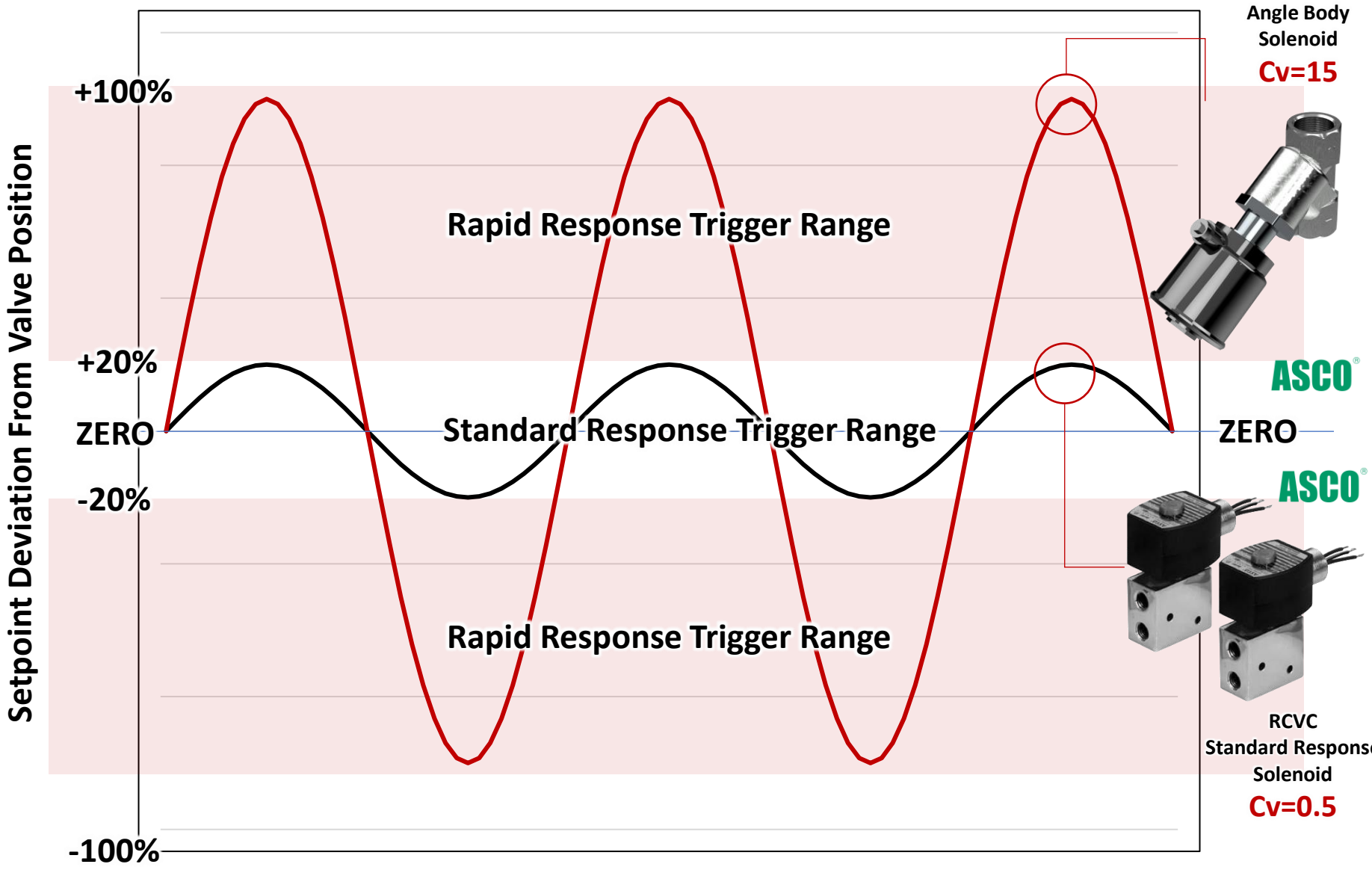
Primary Components – Exhaust Booster & Manual Override

	Series 289RC Exhaust Booster	VMO Valve Manual Override
	6  FISHER	7  VRG CONTROLS
Model	289RC (QTY 1)	VMO-150
Supply Pressure	100 psig Max	150 psig Max**
Operating Temperature	-20 – 180° F	-50 – 200° F
Type	Exhaust Booster	Pneumatic Manual Override
Other Specs	Cv 22, Inlet/Outlet 1.00 IN FNPT, Signal Port 0.250 FNPT, Body, Cover: Aluminum Die Cast, Valve, O-Rings & Gaskets: NBR	Cv 0.40, 0.250 FNPT Ports Body: Carbon Steel Bolting: 316 SS, Internals: 304 SS O-Rings: Buna-N

Primary Components – Valve Status Monitor and Position Sensor

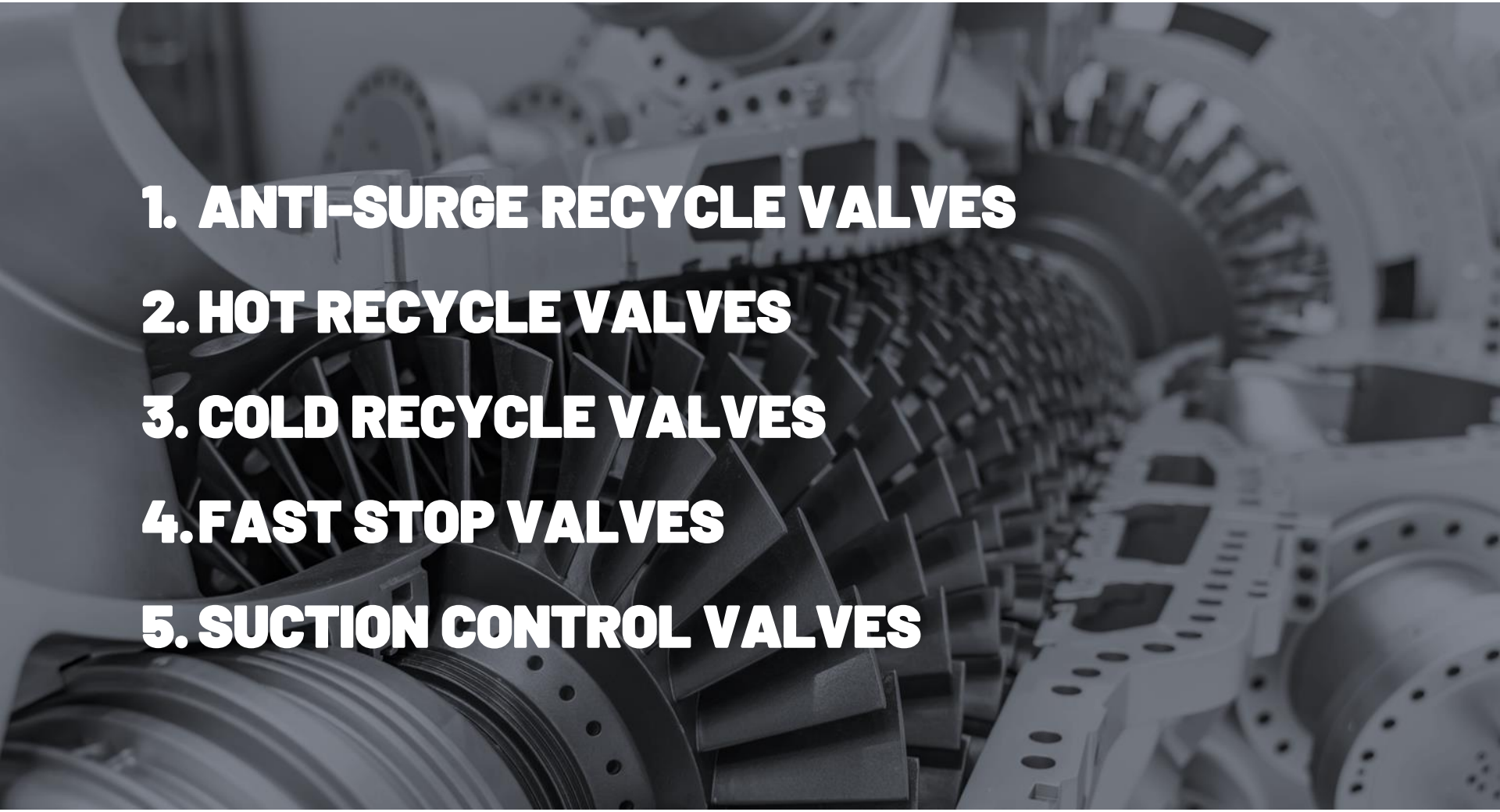
	Westlock 2007X Valve Status Monitor	Balluff BTL Linear Position Sensor
	8 	9 
Model	Rover – Rotary Valve Status Monitor	Balluff BTL7-E501-M0153-J-DEXC-TA12
Type	Rotary Limit Switch Assembly	Micropulse Linear Position Sensor
Limit Switches	Mechanical Close (1) & Open (1) – Adjustable	Not Available
Visual Indicator	Beacon High Visibility Position Indicator	Linear Travel Scale (10% Increments)
Other Specs	VRG ROVER EXd Rotary Feedback w Limit Switches / AA ID: A-HR-FSH2M3NVUS-522 / 4-20 mA + Mechanical Limit Switches (2) / HART / CSA + IECEx / Visual Indicator	4-20 mA Micropulse Transducer, 0.250 FNPT Elec. Connections, UL CSA CE Approved, Ex Proof Cl. 1 Div 1, Stroke Lengths Available: 4, 6, 8, 12 and "SHORT LENGTH" 2.0 IN or less adjustable, Linear Feedback Mounting Kits Available

Rapid Response Solenoid Triggers on Large Setpoint Deviaton

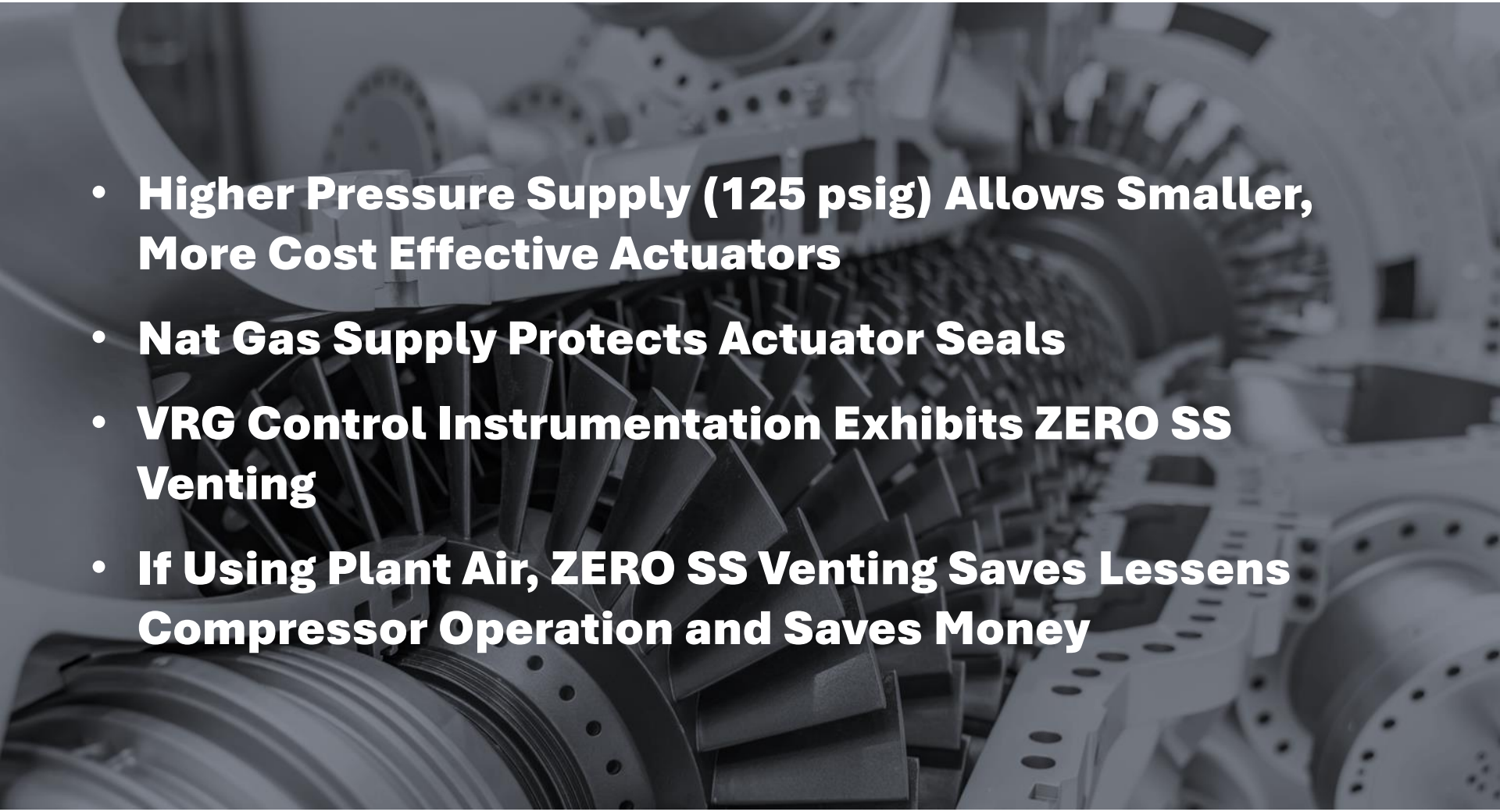


VRG CONTROLS

Full Suite of Gas Compressor Control Valves



Pneumatic Actuation – Natural Gas versus Plant Air

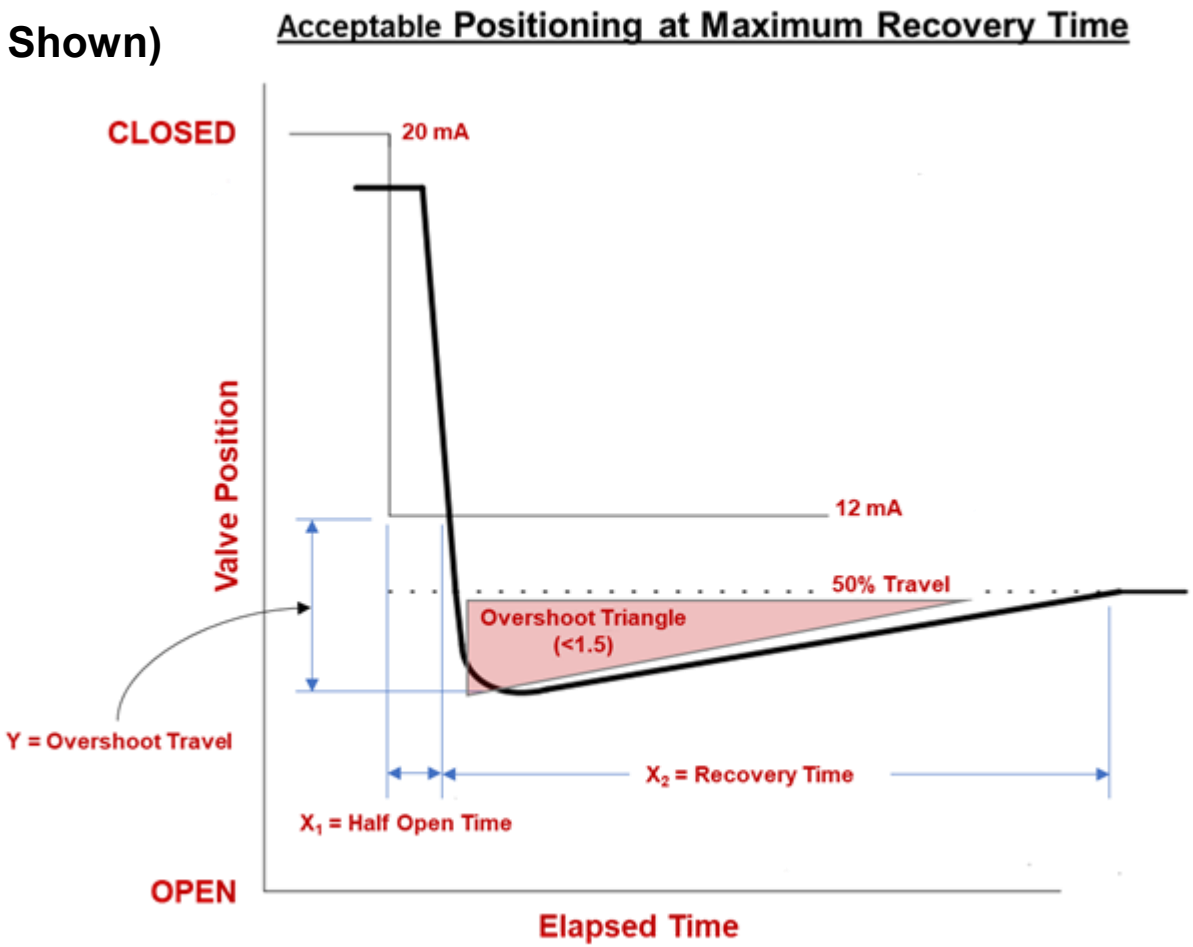


- **Higher Pressure Supply (125 psig) Allows Smaller, More Cost Effective Actuators**
- **Nat Gas Supply Protects Actuator Seals**
- **VRG Control Instrumentation Exhibits ZERO SS Venting**
- **If Using Plant Air, ZERO SS Venting Saves Lessens Compressor Operation and Saves Money**

ASV Valve Performance Specifications – Typical Specifications

Four (4) Key Performance Criteria: The ASV must operate very rapidly with minimal error in position accuracy, and maximum stability

- **Rapid Response Time (Not Shown)**
- **Half Open Stroke Time (X_1)**
- **Overshoot (Y)**
- **Overshoot Triangle**



VRG CONTROLS

ASV Valve Performance Specifications – Typical Specifications

Rapid Response Time

The valve shall meet or exceed the opening speed/time requirements from fully closed position. Opening time requirement as a result of the solenoid being de-energized as follows:

Anti-Surge Valve: The valve must reach 63.2% open:

$$T_{Rapid\ Response} = 100 + 100\sqrt{D_{Valve}}$$

$T_{Rapid\ Response}$ = Rapid Response Time (msec)

D_{Valve} = Bore ASV Valve (in)

ASV Size (Bore)	T_{Stroke}
4.0 in	300 msec
6.0 in	345 msec
8.0 in	383 msec
10.0 in	416 msec
12.0 in	446 msec

ASV Valve Performance Specifications – Typical Specifications

Half Open Time

The valve shall meet or exceed the opening speed/time requirements from fully closed position. With positioner command step change from 20 to 12 mA:

<u>Anti-Surge Valve: The valve must reach 50% open:</u>

$$T_{Half\ Open} = 300 + 100\sqrt{D_{Valve}}$$

$T_{Max\ Half}$ = Half Open Stroke Time (msec)

D_{Valve} = Bore ASV Valve (in)

ASV Size (Bore)	T_{Stroke}
4.0 in	500 msec
6.0 in	545 msec
8.0 in	583 msec
10.0 in	616 msec
12.0 in	646 msec

ASV Valve Performance Specifications – Typical Specifications

Overshoot

The valve shall not overshoot by more than 60% and have a maximum excursion not to exceed 80% open.

$$H = 100 \times \frac{(Max\ Excursion - Final\ Position)}{(Final\ Position - Starting\ Position)}$$

H = Overshoot

Max Excursion = Maximum Valve Travel Half Stroke Test

Final Position = 50% for Half Stoke Test

Starting Position = 0% (Full Closed) for Half Stroke Test

Example: Valve goes from FULL CLOSED to 80% Travel and Return to 50% Travel

Starting Position = 0%, Max Excursion=80%, Final Position= 50%

$$H = Overshoot = 100 \times \frac{(80 - 50)}{(50 - 0)} = 60\%$$

ASV Valve Performance Specifications – Typical Specifications

Overshoot Triangle

After the Overshoot the valve shall return to its Final Position (50% Open) in less than 10 times its Half Open Time.

<u>The area beyond the ultimate destination (overshoot triangle) shall be less than 1.5:</u>

$$Area_{Overshoot} = \left(\frac{Recovery\ Time}{Half\ Open\ Time}\right) \times \left(\frac{H}{2}\right)$$

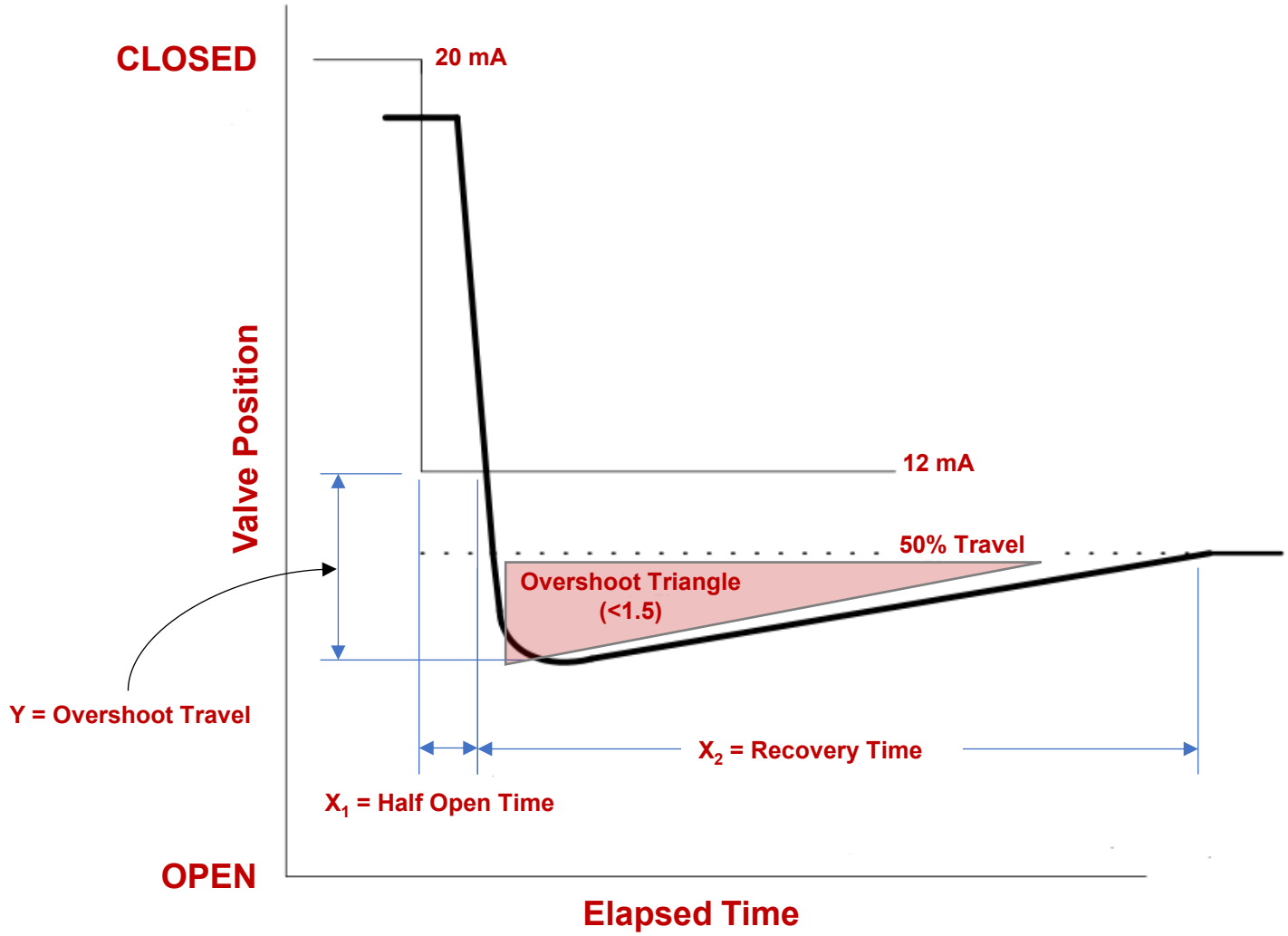
Recovery Time = X_2

H = Overshoot Half Stoke Test

Example: A 4" valve, 4.375 port, at maximum overshoot, must return to its ultimate destination in 5.09 seconds, and at maximum recovery time, must have no more than 30% overshoot.

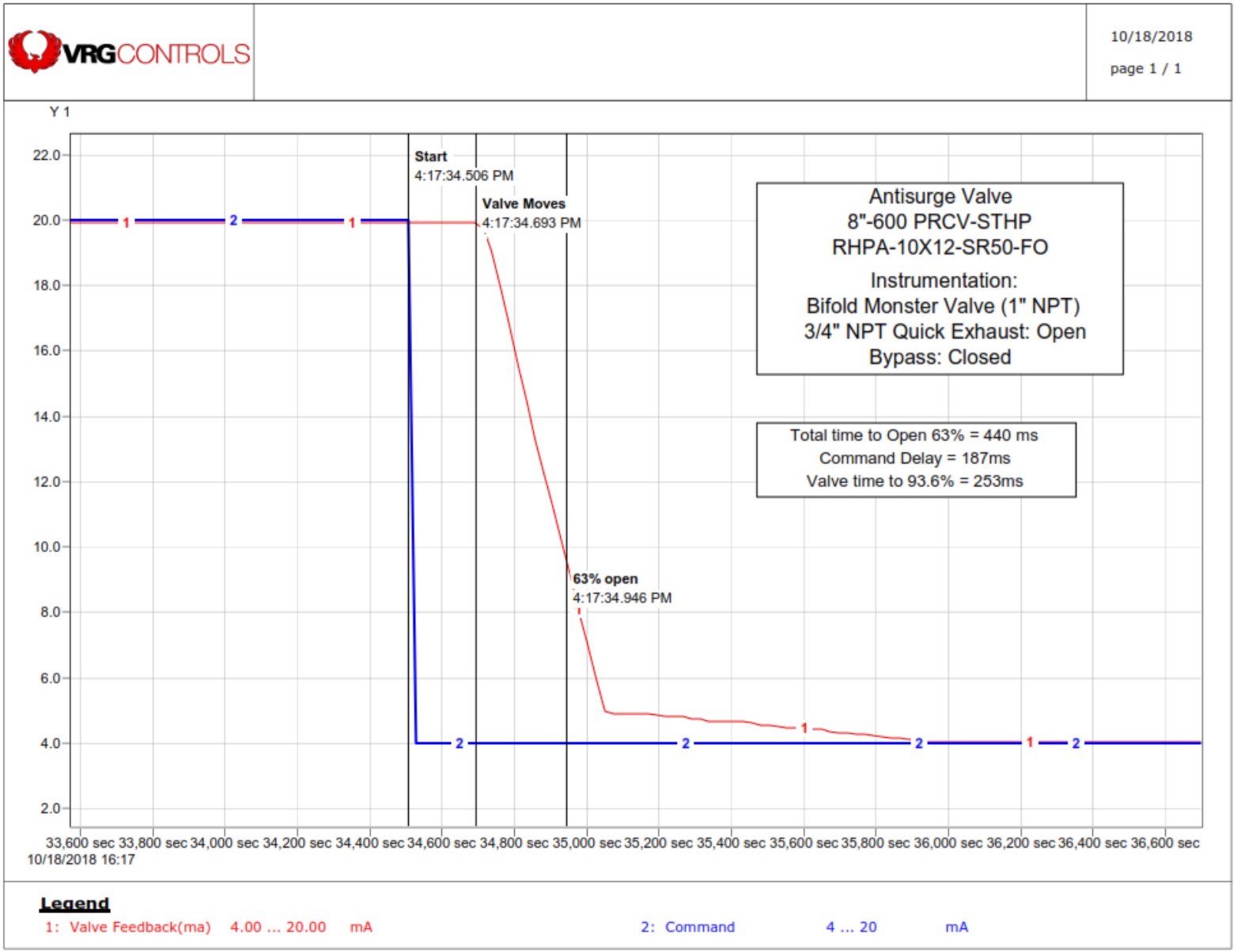
ASV Valve Performance Specifications – Typical Specifications

Acceptable Positioning at Maximum Recovery Time



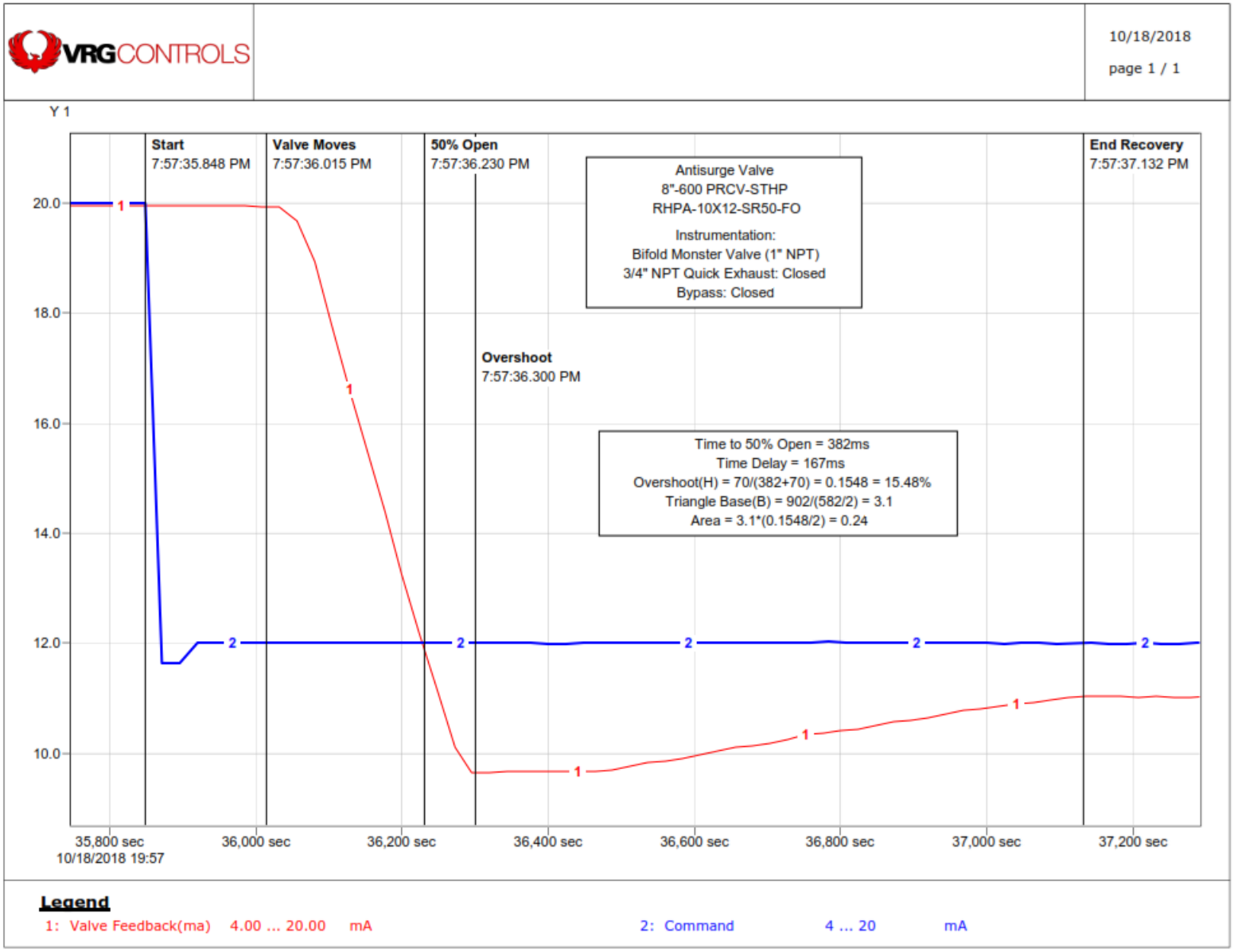
VRG CONTROLS

Rapid Response Test Results – 8.0 in ASV



VRG CONTROLS

Overshoot & Overshoot Triangle Test Results – 8.0 in ASV



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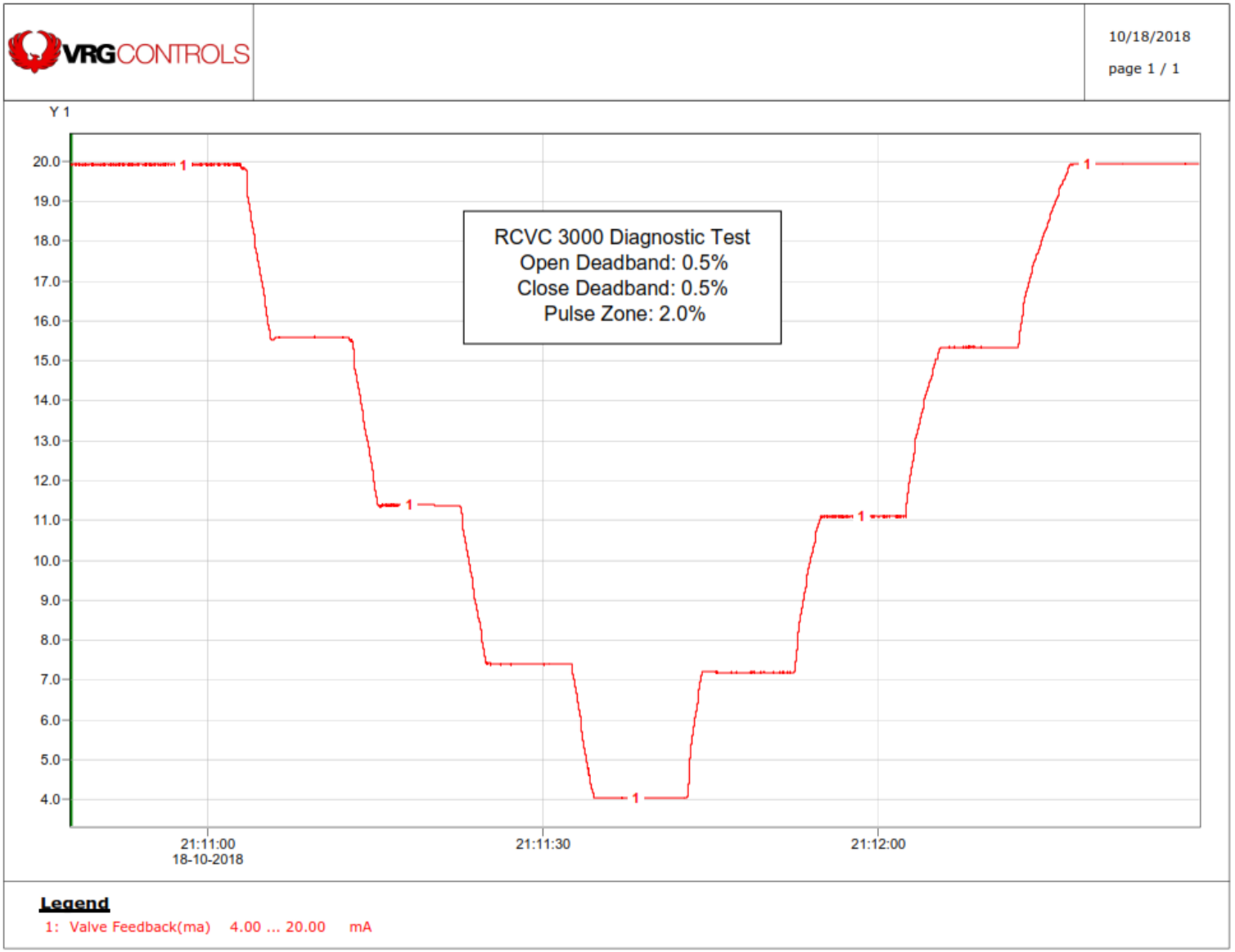
RCVC Diagnostic Test Results – 8.0 in ASV



Our Customers

ASV Anti-Surge Valves

VRG CONTROLS

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