Differential Pressure Regulators & Vacuum Trim Valves

Instructions & Operation Manual

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I. SAFETY PRECAUTIONS

GENERAL: Be sure to follow all applicable and prudent safety precautions when working with chemical and electrical equipment.

CHECK FOR DAMAGE: Before removing the product from the shipping packaging, carefully check the equipment for damage. If any product is found damaged, do not put it into operation or install it. Contact Hydro Instruments to discuss repair or replacement of damaged equipment.

UNPACKING: After the equipment is unpacked, check all items against the packing list to be sure no parts are discarded with the packing material.

II. THEORY OF OPERATION

Hydro Instruments high-capacity floor cabinets and wall panel feeders are designed to control and indicate the rate of gas flow, to provide a simple means of manually or automatically setting the feed rate at any value within the range of the equipment, to mix the gas with water, and to deliver the resultant solution to the point of application.

All vacuum solution type gas feed systems require a stable and suitably sized ejector (or induction pump) to generate the required vacuum. The ejector produces a vacuum to draw gas from the source and pull it through the system. The gas flows under vacuum through a meter tube before passing through a feed rate control orifice. When the gas reaches the ejector it will be mixed with the water flowing through the ejector.

Proper operation of the ejector is dependent on sufficient supply water pressure and flow. The required supply water pressure and flow are determined by the ejector back pressure. Hydraulic operation charts have been developed to assist with this aspect of system design. These charts specify minimum supply water pressure and flow rates for the ejector based on the ejector back pressure and desired capacity.

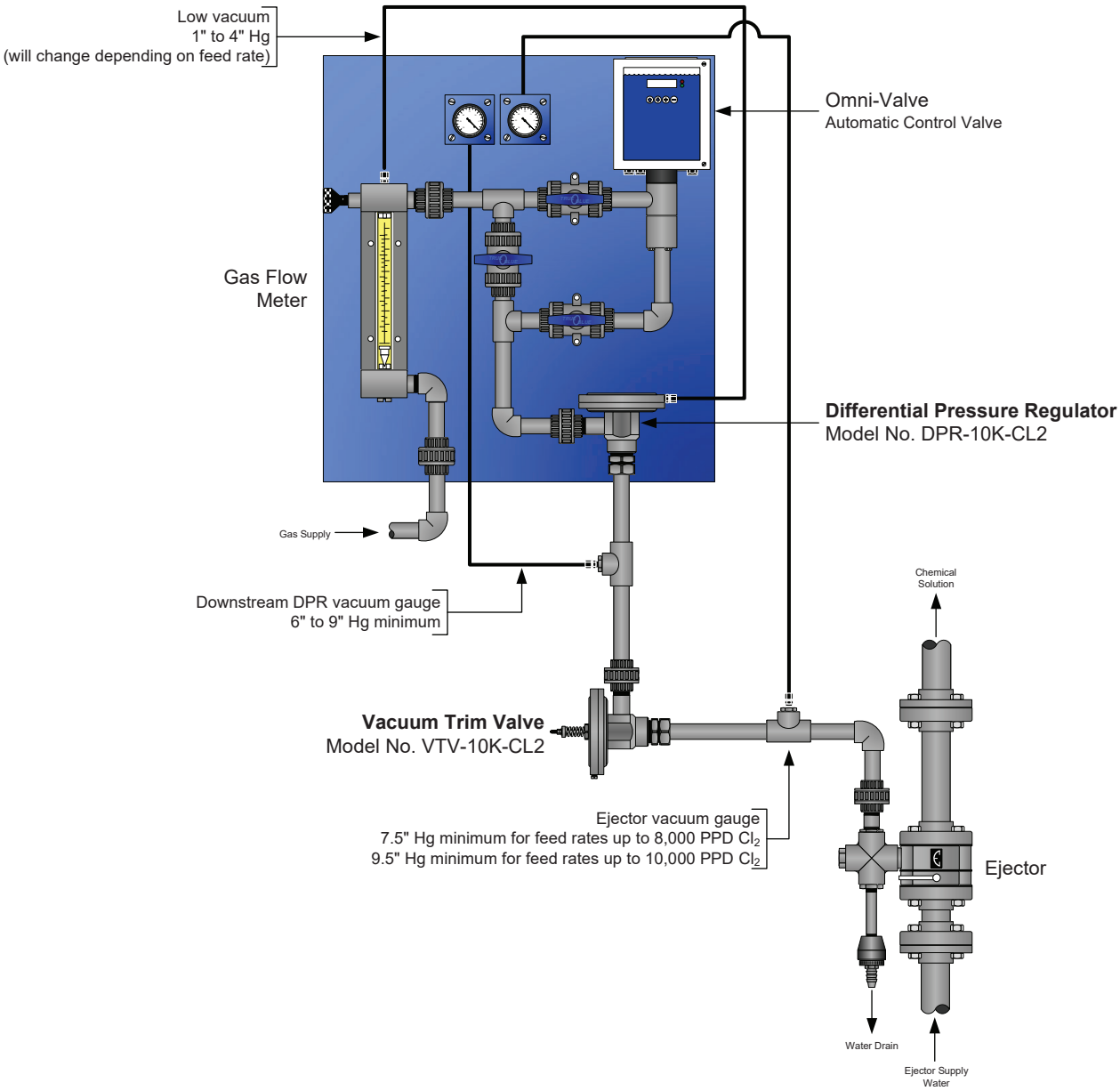
Most gas feed systems depend on sonic regulation which requires maintaining a high enough ejector vacuum (≥14” Hg) to accelerate the gas to MACH1, the speed of sound (i.e. sonically) through the control orifice so that a variation in vacuum will not cause a variation in feed rate. With larger capacity systems a differential pressure regulator may be required as the pressure differential across the control orifice will begin to equilibrate the more open it becomes; eventually reaching a point where the gas will no longer travel sonically. For these systems the gas flow becomes more susceptible to fluctuations in ejector performance and may result in undesirable variations in the gas feed rate. A differential pressure regulator controls the ejector vacuum to maintain a constant pressure drop across the variable control orifice. This ensures that the flow of gas through the control orifice is entirely the function of the size of the orifice as determined by its position; assuring that the gas feed rate will be maintained at its desired setting.

A vacuum trim valve is used to supplement the differential pressure regulator. It is installed between the ejector and the differential pressure regulator to reduce the ejector vacuum to a more controllable range for the differential pressure regulator to operate. A vacuum trim valve is recommended for systems feeding more than 4,000 PPD (80 Kg/h) or in high capacity systems using a differential pressure regulator where ejector vacuum levels may reach 14” Hg or more.

III. SPECIFICATIONS

Ejector Vacuum:	7.5" Hg min. for feed rates up to 8,000 PPD / 160 Kg/h Cl2 9.5" Hg min. for feed rates up to 10,000 PPD / 200 Kg/h Cl2
Downstream DPR Vacuum:	6" to 9" Hg
System Vacuum (i.e. Low Vacuum):	1" to 4" Hg (will change depending on feed rate)
Gas Inlet Connection:	1 ½" FPT union
Gas Outlet Connection:	1 ½" pipe compression fitting

FIGURE 1



IV. INSTALLATION

This document provides more information than what may apply to a specific installation; disregard details that do not apply.

A. Location of Components

The layout requirements for the differential pressure regulatot and vacuum trim valve can be seen in Figure 1.

NOTE: *When a vacuum trim valve is supplied with a Wall Panel Omni-Valve, it is supplied loose and will require installation in the piping between the differental pressure regulator and the ejector. Additionally, the ejector vacuum gauge will need to be connected between the ejector and vacuum trim valve. Refer to Figure 1.*

B. Piping

A line must be provided to carry the gas to the ejector. This piping must be sized appropriately to limit friction loss. Details on line sizing can be found in a separate document.

Inlet and outlet piping will be 1 ½" for both the differential pressure regulator and vacuum trim valve. See Section III for details on inlet and outlet connections.

The outlet piping for the differential pressure regulator and vacuum trim valve should be prepared in the following manner:

1. Cut the pipe with an ordinary hand or power saw. Make a square cut and remove burrs.
2. Clean and dry the end of the pipe.
3. Loosen the large hex nut at the outlet of the equipment. Insert the pipe until it stops. Tighten the large hex nut.

   NOTE: *When adjusting the differential pressure regulator and/or vacuum trim valve by changing the quantity of spacers on the outlet seat tube; it may be necessary to change the length of the outlet piping.*

V. DIFFERENTIAL PRESSURE REGULATOR

A differential pressure regulator maintains a constant pressure drop across the control orifice, providing a consistent gas flow rate regardless of variations in upstream or downstream pressure.

Vacuum upstream of the differential pressure regulator is typically not monitored, but will measure between 1" to 4" Hg depending on the gas feed rate.

A. Adjustment of the Differential Pressure Regulator

The differential pressure regulator rarely requires adjustment. However, some causes for adjustment are:

- Vibrating noise during operation. See Section VI Troubleshooting for additional information.
- Cannot achieve maximum feed rate.
- Inability to control at low feed rates.

1. Loosen the union capture nut at the differential pressure regulator outlet and remove this section of piping.
2. Unthread the outlet seat tube from the body assembly and pull it straight out. Be cautious not to lose any spacers.
3. Remove or add one spacer at a time. Most installations will use one to four spacers.

   NOTE: *Adding spacers will increase the maximum feed rate, but having too many spacers installed may inhibit adjustability at low feed rates. Removing ALL of the spacers may limit the maximum feed rate.*

VI. VACUUM TRIM VALVE

A vacuum trim valve is used to supplement the differential pressure regulator. It is installed between the ejector and the differential pressure regulator to reduce the ejector vacuum to a more controllable range for the differential pressure regulator to operate.

A. Adjustment of the Vacuum Trim Valve

The downstream differential pressure regulator vacuum gauge is connected between the differential pressure regulator and the vacuum trim valve. The reading on this gauge should be used when adjusting the vacuum trim valve. Refer to Figure 1.

IMPORTANT: Before making any adjustments to the vacuum trim valve, release the vacuum in the downstream piping (i.e. between the vacuum trim valve and the ejector). This is necessary to avoid galling of the adjustable hex nuts.

1. Unlock the top, outer hex nut (i.e. jam nut) on the guide pin assembly.
2. Using a suitable tool on the flats of the guide pin to prevent the pin from turning; rotate the inner hex nut as necessary to obtain the required vacuum. Downstream DPR vacuum should be set to 6" to 9" Hg.

   NOTE: *Loosening the inner nut will decrease the upstream vacuum, while tightening will increase the upstream vacuum.*
3. With the required vacuum set, lock the position of the inner hex nut by tightening the outer jam nut against it.

VII. MAINTENANCE

A. Preventative Maintenance

It is recommended that maintenance be performed annually (i.e. at one-year intervals). to each of the principal components of the gas feed system. They should be completely disassembled and a new parts & maintenance kit installed. Before starting the work, ensure that the appropriate preventive maintenance kits are on hand. PM kit numbers are listed in the equipment bill of materials.

B. Removal and Disassembly of the Differential Pressure Regulator

Reference Dwg. No. DPR-10K-CL2 in this document for parts details.

1. Loosen the union capture nut at the differential pressure regulator inlet and outlet.
2. Remove the four screws holding the differential pressure regulator to the angle bracket. Be cautious that the unit does not fall or that its weight is not fully applied to connecting piping. Once the unit is free it can be taken to a workbench for disassembly.
3. Unthread the outlet seat tube from the body assembly and lift straight out. Be cautious not to lose any spacers.
4. To gain access to internal parts, remove the 12 ¼-20 x 1 ¼" screws around the perimeter of the differential pressure regulator. Be cautious, the bodies are spring loaded.
5. After the bodies have been separated the diaphragm assembly and spring can be lifted out.
6. Unthread the valve plug head, valve plug base, diaphragm plates, hex plug and union capture hex nut.

C. Reassembly of the Differential Pressure Regulator

1. Refer to the general Preventative Maintenance & Cleaning of Gas Chlorination Components document.
2. Wipe a thin film of O-Ring grease onto all O-Rings before reassembling.

3. Reassemble in the reverse order of disassembly. Check for vacuum leaks. Make required corrections and resume normal service.

D. Removal and Disassembly of the Vacuum Trim Valve

Reference Dwg. No. VTV-10K-CL2 in this document for parts details.

1. Loosen the union capture nut at the vacuum trim valve inlet and outlet.
2. If the vacuum trim valve is installed into a floor cabinet; remove the four screws holding the differential pressure regulator to the angle bracket. Be cautious that the unit does not fall or that its weight is not fully applied to connecting piping. Once the unit is free it can be taken to a workbench for disassembly.

   NOTE: *When a vacuum trim valve is supplied with a Wall Panel Omni-Valve, it is supplied loose and will require installation in the piping between the differential pressure regulator and the ejector. Refer to Figure 1.*
3. Mark the position of the two 5⁄16"-18 nuts on the guide pin assembly that compress the spring before removing them. It will be necessary to return these to the same position. Remove the two nuts to decompress the spring. Lift away the spring, spring retainer and washer and set these parts aside.
4. Unthread the outlet seat tube from the body assembly and lift straight out. Be cautious not to lose any spacers.
5. To gain access to internal parts, remove the 12 ¼-20 x 1 ¼" screws around the perimeter of the vacuum trim valve.
6. After the bodies have been separated the diaphragm assembly can be lifted out.
7. Unthread the valve plug head, valve plug base, diaphragm plates, hex plug and union capture hex nut.

E. Reassembly of the Vacuum Trim Valve

1. Refer to the general Preventative Maintenance & Cleaning of Gas Chlorination Components document.
2. Wipe a thin film of O-Ring grease onto all O-Rings before reassembling.
3. Reassemble in the reverse order of disassembly. Make sure to restore the two 5⁄16"-18 nuts on the guide pin assembly to their original position. Check for vacuum leaks. Make required corrections and resume normal service.

VIII. TROUBLESHOOTING

A. Vibrating Noise During Operation

Two types of valve oscillation can cause an audible vibration:

1. High frequency vibration at low feed rates, usually below 2,000 PPD. This vibration, usually a humming noise, is generated at the differential regulating valve or trimmer valve.

   The high frequency hum is generated by vibrations at the valve plug head and outlet seat tube of the differential pressure regulator or vacuum trim valve. The cause may be air leaking into the system, an off-center diaphragm, or friction. To correct the issue, try the following:

   (1) Locate any air leaks by vacuum checking the assembly, especially at the rotameter. Eliminate all air leaks.

   (2) Check for an off-center diaphragm. If necessary, loosen all the screws around the perimeter of the bodies and shift the diaphragm to recenter it.

   (3) Noise at the differential pressure regulator or vacuum trim valve may be eliminated by changing the number of spacers used on the outlet seat tube. Remove or add one spacer at a time. Most installations will use one to four spacers.

NOTE: Removing ALL of the spacers may limit the maximum feed rate. Conversely, having too many of the spacers installed may inhibit adjustability at low feed rates.

2. Low frequency, high amplitude, “galloping” type of vibration, which usually causes an oscillation (swinging) of the vacuum gauge.

   The low frequency, “galloping” type of oscillation may be generated by air in the solution line causing the vacuum level to vary. If an ejector with water drain valve is being used, the drain line may be acting as a resonance chamber. To correct the issue, try the following:

   (1) If the ejector vacuum level is swinging, check for gas binding (i.e. air) in the solution line caused by traps. You can try to eliminate the traps by adjusting the water volume through the ejector and/or purging the solution line of gas pockets.

   (2) Remove or pinch off the drain hose from the ejectors drain valve. If this reduces the noise, change the size or length of the drain hose.

B. Cannot Feed Gas

The following assumptions have been made for this issue:

- The gas source is full and online and there are no blockages or issues with the vacuum regulator, gas flow meter or automatic control valve.
- The ejector is making adequate vacuum. See Section III. Specifications for details. If the ejector is not making a vacuum or insufficient vacuum refer to the relevant hydraulic information.

If any of these conditions is false, it must be addressed before continuing.

1. For systems using only a differential pressure regulator. During initial startup, it is possible that the differential pressure regulator has been suctioned closed by high ejector vacuum. To correct the issue:

   (1) Release the vacuum in the line.

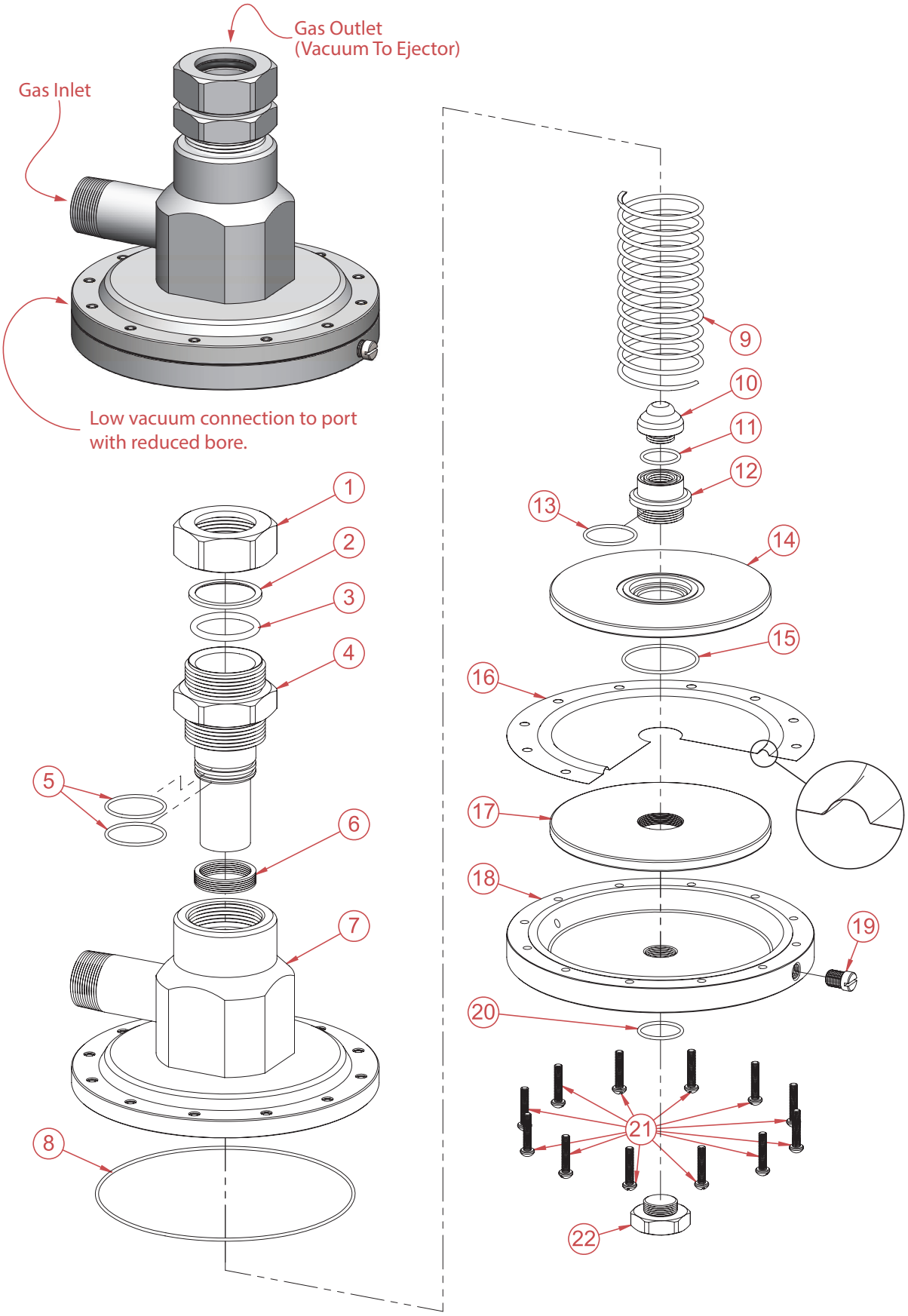
   (2) Change the number of spacers used on the differential pressure regulators outlet seat tube. See Section V. A. Adjustment of the Differential Pressure Regulator.

2. For systems using both a differential pressure regulator and vacuum trim valve. During initial startup, it is possible that the differential pressure regulator and/or vacuum trim valve have been suctioned closed by high ejector vacuum. To correct the issue:

   (1) Release the vacuum in the line.

   (2) Adjust the hex nuts on the vacuum trim valves guide pin assembly to compress the sping. See Section VI.A. Adjustment of the Vacuum Trim Valve.

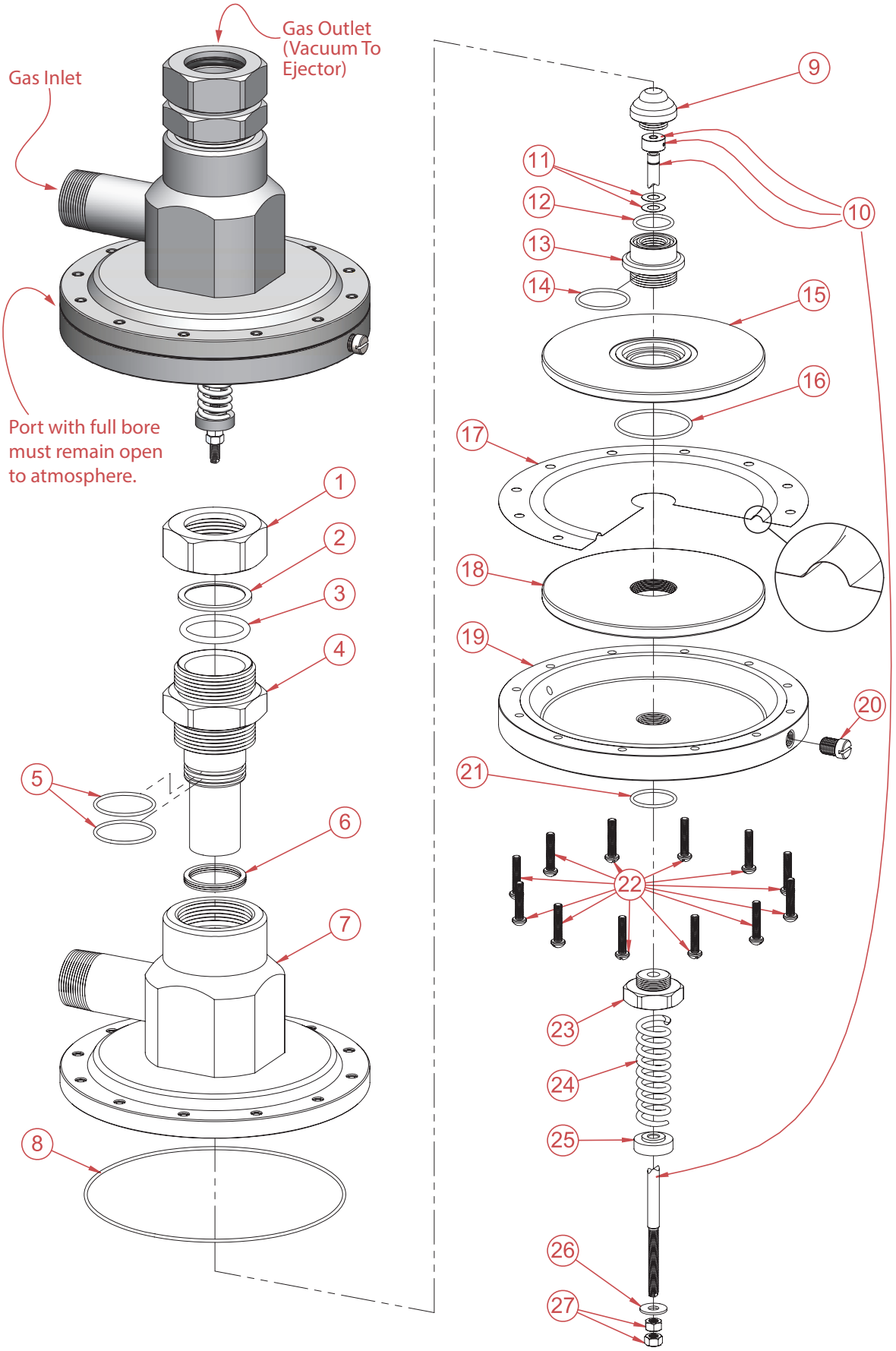
   (3) Change the number of spacers used on the differential pressure regulators outlet seat tube. See Section V. A. Adjustment of the Differential Pressure Regulator.



DIFFERENTIAL
PRESSURE REGULATOR

Date: 2025-01-07-v1
EXPLODED VIEW
Dwg. No. DPR-10K-CL2, EXP

Item No.		Description	Quantity	Part No.
1		Union Capture Nut, 1.5"	1	DPTR-UCN-150
2		Union Nut Washer, 1.5"	1	DPTR-UNW-150
3	PM	O-Ring	1	OH-VIT-328
4		Outlet Seat Tube	1	DPTR-OST
5	PM	O-Ring	2	OH-VIT-133
6		Spacing Washer (PVC) - As Req'd, 8 Max.	0-8	DPTR-SPACER
7		Inlet Outlet Body Assembly	1	ASM-DPTR-IOB
8	PM	O-Ring	1	OH-VIT-172
9		Spring	1	SPH-DPX
10		Valve Plug Head	1	VTV-VPLG-HEAD
11	PM	O-Ring	1	OH-VIT-122
12		Valve Plug Base	1	VTV-VPLG-BASE
13	PM	O-Ring	1	OH-VIT-128
14		Diaphragm Back Plate	1	VRH-764-001
15	PM	O-Ring	1	OH-VIT-141
16		Diaphragm (ECTFE), Set of 2	1	DIH-110-000
17		Diaphragm Front Plate	1	VRH-333-000
18		Front Body	1	DPTR-FB
19		¼" NPT Plug	1	PLH-108-250
20	PM	O-Ring	1	OH-VIT-125
21		¼-20 x 1¼" Bolt	12	BTH-STA-130
22		Hex Plug	1	DPX-PLUG
	PM	Part & Maintenance Kit		KTH-10K-DPW



VACUUM TRIM VALVE

Date: 2025-01-07-v1
EXPLODED VIEW
Dwg. No. VTV-10K-CL2, EXP

Item No.	Description	Quantity	Part No.
1	Union Capture Nut, 1.5"	1	DPTR-UCN-150
2	Union Nut Washer, 1.5"	1	DPTR-UNW-150
3	PM O-Ring	1	OH-VIT-328
4	Outlet Seat Tube	1	DPTR-OST
5	PM O-Ring	2	OH-VIT-133
6	Spacing Washer (PVC) - As Req'd, 8 Max.	0-8	DPTR-SPACER
7	Inlet Outlet Body Assembly	1	ASM-DPTR-IOB
8	PM O-Ring	1	OH-VIT-172
9	Valve Plug Head	1	VTV-VPLG-HEAD
10	Guide Pin Assembly	1	TRIM-GPA
11	PM Washer (PTFE)	2	TW-VTV
12	PM O-Ring	1	OH-VIT-122
13	Valve Plug Base	1	VTV-VPLG-BASE
14	PM O-Ring	1	OH-VIT-128
15	Diaphragm Back Plate	1	VRH-764-001
16	PM O-Ring	1	OH-VIT-141
17	Diaphragm (ECTFE), Set of 2	1	DIH-110-000
18	Diaphragm Front Plate	1	VRH-333-000
19	Front Body	1	DPTR-FB
20	¼" NPT Plug	1	PLH-108-250
21	PM O-Ring	1	OH-VIT-125
22	¼-20 x 1¼" Bolt (Monel)	12	BTH-STA-130
23	Pin Guide (GF PTFE)	1	TRIM-PG
24	Spring (316 SS)	1	SPH-TRIM
25	Spring Retainer	1	TRIM-SR
26	Washer, 5⁄16"	1	MW-VTV
27	Nut, 5⁄16"-18	2	NTH-STA-104H
PM	Part & Maintenance Kit		KTH-10K-VTV