



McKenzie Valve & Machining LLC

Vacuum Relief Valve

Product Literature & Maintenance Guidelines

Current Issue Revision: September 2020

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1.0 Vacuum Relief (Safety) Valves (VRV)

- 1.1 Vacuum Relief Valves are used to protect the tank from negative pressures in such events as steam cleaning and product cooling. McKenzie Valve supplies threaded and flanged designs generally used for general purpose tank cars. The valve is available with settings between 3/4 psig vacuum and 4 psig vacuum (1.5 inHg – 8.1 inHg).
- 1.2 The valves mount on either a 2 1/2" NPT, 2" ANSI 150# Flange, or a Modified ANSI 1-1/2" ANSI 150# Flange. The valves are constructed of stainless steel with stainless trim.
- 1.3 The valves use a clover leaf shaped O-Ring, known as a quad seal or X-Seal.
- 1.4 The valves are available with several standard elastomeric material options. Alternate O-Ring materials are also available as a special order.

MODEL	SET PRESSURE (PSIG)	VALVE TYPE	BODY MATERIAL	MOUNTING	O-RING ELASTOMER MATERIAL
VRV	075 - 3/4	O - CYCLING (OBS)	CS - CARBON STEEL (OBS)	N1 - 1-1/2" MNPT	SEE ELASTOMER TABLE
	100 - 1	T - TRICAP	S4 - 304 STAINLESS STEEL	N2 - 2-1/2" MNPT	
	150 - 1.5	S - SECURECAP	S6 - 316 STAINLESS STEEL	F6 - 2" ANSI FLANGE, FABRICATED	
	200 - 2	C - COMPACT		F7 - 2" ANSI FLANGE, CAST, 5/8 HOLES	
	250 - 2.5			F10 - 1-1/2" ANSI FLANGE, NARROW GASKET	
	300 - 3				
	400 - 4				

Table 1 – Standard Vacuum Relief Valve offerings

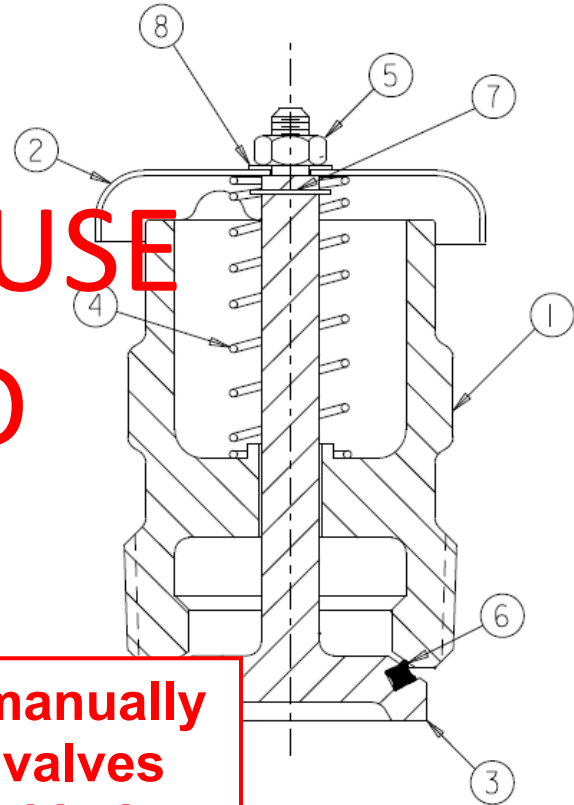
Compound No.	Material Description
VARIOUS COMPOUNDS	
BU	Butyl Compound, IIR
CHL	Chlorobutyl
NE	Neoprene
WNE	Neoprene, White, Food Grade
RFG	Rubber Food Grade
SI	Silicone Compound
ACRYLONITRILE BUTADIENE (NBR, Buna-N Nitrile)	
BN	Buna-N (NBR / Nitrile) Rubber Compound
BNFG	Food Grade Buna-N
BNWFG	White Food Grade Buna-N
ETHYLENE PROPLENE RUBBER (EPR / EPDM)	
EP	Peroxide Cured EPDM Compound
EPR	EPR Ethylene-Propylene Copolymer (use EPDM)
EPT	EPT Ethylene-Propylene-Diene Terpolymer (use EPDM)
EPFG	Food Grade EPDM
EP787	Carolina Seal Peroxide Cured / Nordel® based EPDM Compound
EB165	Parker Compound EB165-70 (3477), now Obsolete (use E195-70)
EB195	Parker Compound EB195-70, EPDM
FLUOROCARBON / (FLUOROELASTOMER (VITON, FPM, FKM)	
V	Viton® Generic, most commonly Viton® A
VA	Viton® A
VA-C	Viton® A - Certified Dupont
V747	Parker Compound 747
CS4273	Carolina Seal Viton® Compound – ExxonMobil-specific Compound
CS4273A	Carolina Seal Viton® A Family Compound
CS4273B	Carolina Seal Viton® "B+" Family Compound
VB	Viton® B
VB-C	Viton® B - Certified Dupont
VETP	Viton® Extreme ETP
VF	Viton® F
VG	Viton® GF (replaced by GFS)
VGFS	Viton® GFS
VGFLT	Viton® GFLT
9703	PAI Compound 9703 - Similar to GFLT
CS5350	Carolina Seal Viton® GF-S Family Compound
CS5355	Carolina Seal t Viton® GF-LT Family Compound
VTFE	Teflon® Encapsulated Viton®
PERFLUOROELASTOMER (FFKM/FPFM)	
CZ505	Chemraz® 505 Perfluoroelastomer Compound
KZ1050	DuPont Kalrez® 1050LF Perfluoroelastomer Compound
KZ2035	DuPont Kalrez® 2035 Perfluoroelastomer Compound
KZ4079	DuPont Kalrez® 4079 Perfluoroelastomer Compound
KZ6375	DuPont Kalrez® 6375 Perfluoroelastomer Compound

Table 2 – Standard Elastomeric Materials



**3/4 psig vacuum
Cycling
2 1/2" NPT
Vacuum Relief Valve
0.75 psi - 98751**

**DO NOT REUSE
OR REBUILD**



Effective July 1, 2013, manually actuated vacuum relief valves must not be replaced in kind. – C-III, M-1002, App A 4.10.4

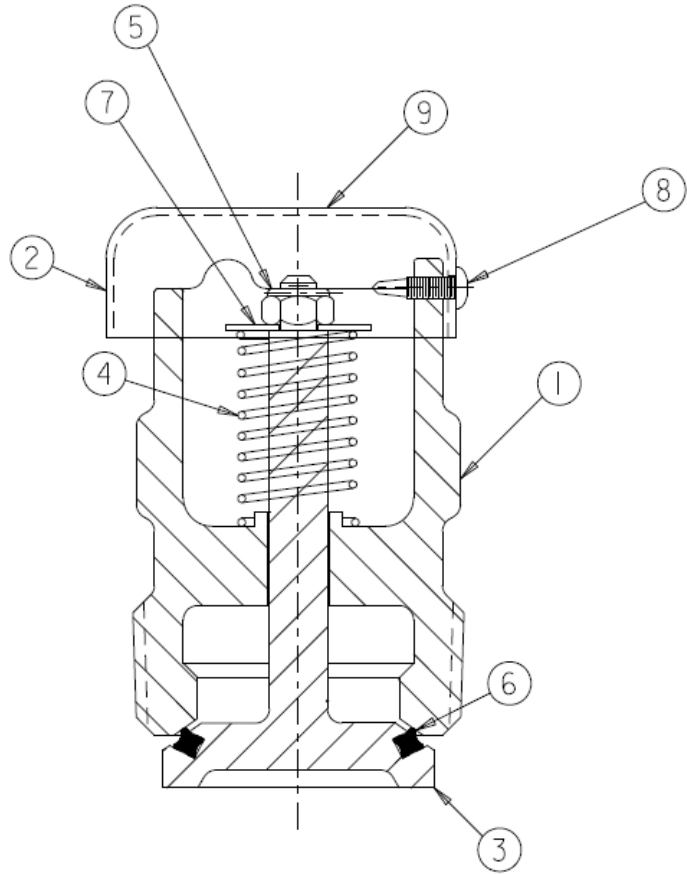
	PART NO	QTY	DESCRIPTION	MATERIAL
1	104937-01	1	BODY	304 SST
2	104932-01	1	CAP	304 SST
3	104938-01	1	STEM-BASE	304 SST
4	104939-01	1	SPRING	302 SST
5	304-8602	1	NUT, LOCK HEX 5/16 "-24	AISI 303
6	TABLED	1	QUAD-SEAL	TABLED
7	308-7522	1	RING. RETAINING INDUST #3100-50-SS2	SST
8	305-8660	1	5/16 PLAIN WASHER	304 SST

Table 3 – Cycling Cap VRV (commonly known as a foot valve)



**3/4 - 4 psig vacuum
Non-Cycling (No-Step)
2 1/2" NPT
Vacuum Relief Valve**

- 0.75 psi - 506981
- 1.5 psi - 508564
- 2 psi - 508565
- 3 psi - 508556



	PART NO	QTY	DESCRIPTION	MATERIAL
1	104937-01	1	BODY	304 SST
2	109294-01	1	CAP	304 SST
3	109293-01	1	STEM-BASE	304 SST
4	TABLED	1	SPRING	302 SST
5	304-8602	1	NUT, LOCK HEX 5/16 "-24	AISI 303
6	TABLED	1	QUAD-SEAL	TABLED
7	305-8766	1	FLAT WASHER	SST
8	304-8997	3	#10 PAN HEAD SCREW	304 SST
9	TABLED	1	NAMEPLATE	FOIL

Table 4 – Non-Cycling Cap VRV, 2-1/2" NPT



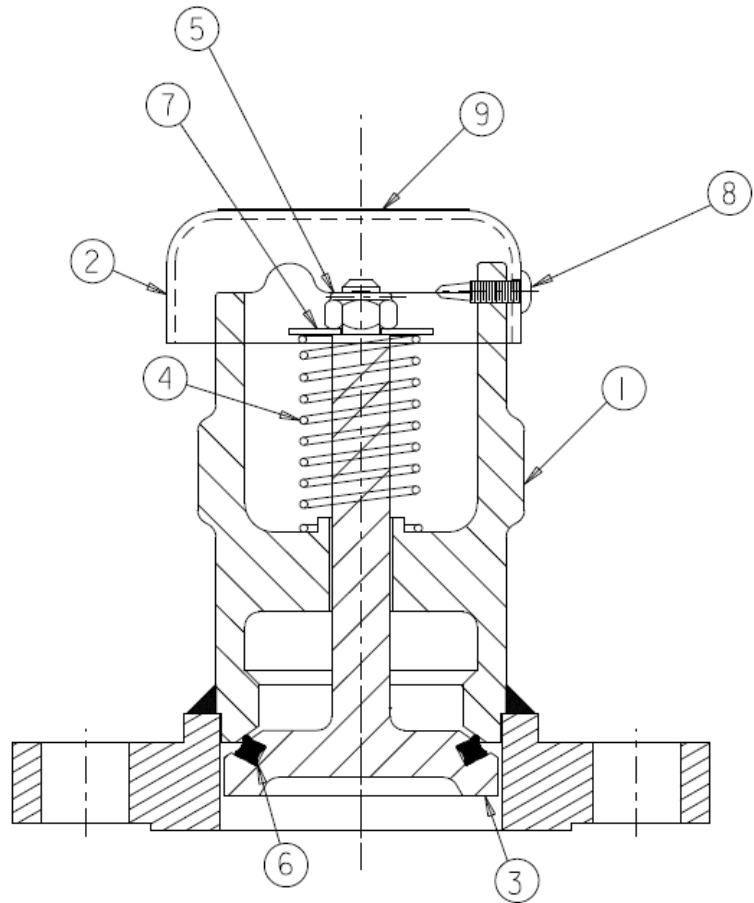
**3/4 - 4 psig vacuum
Non-Cycling (No-Step)
ANSI 2" 150# Flange,
Fabricated Body
(4) 3/4 on a 4.75 BC
Vacuum Relief Valve**

0.75 psi - 508424

1.5 psi - 508825

2 psi - 508826

3 psi - 508827

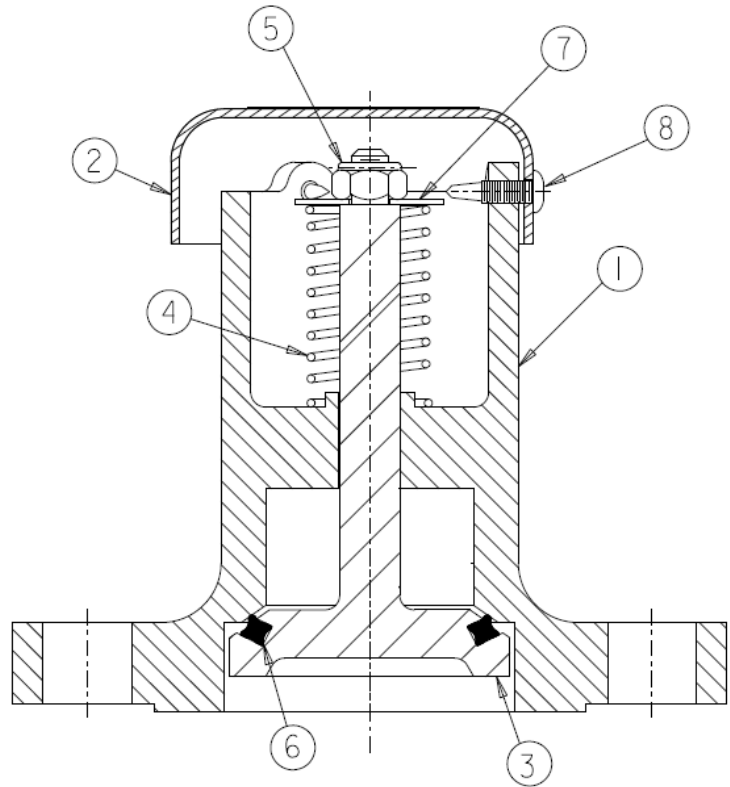


	PART NO	QTY	DESCRIPTION	MATERIAL
1	110295-01	1	BODY	304 SST
2	109294-01	1	CAP	304 SST
3	109925-01	1	STEM-BASE	304 SST
4	TABLED	1	SPRING	302 SST
5	304-8602	1	NUT, LOCK HEX 5/16 "-24	AISI 303
6	TABLED	1	QUAD-SEAL	TABLED
7	305-8766	1	FLAT WASHER	SST
8	304-8997	3	#10 PAN HEAD SCREW	304 SST
9	TABLED	1	NAMEPLATE	FOIL

Table 5 – Non-Cycling Cap VRV, Fabricated Flanged



**3/4 - 4 psig vacuum
Non-Cycling (No-Step)
ANSI 2" 150# Flange,
Cast Body
(4) 3/4 on a 4.75 BC
Vacuum Relief Valve**
0.75 psi - 509727
1.5 psi - 509728
2 psi - 509729
3 psi - 509730



	PART NO	QTY	DESCRIPTION	MATERIAL
1	110306-01	1	BODY	304 SST
2	109294-01	1	CAP	304 SST
3	109925-01	1	STEM-BASE	304 SST
4	TABLED	1	SPRING	302 SST
5	304-8602	1	NUT, LOCK HEX 5/16 "-24	AISI 303
6	TABLED	1	QUAD-SEAL	TABLED
7	305-8766	1	FLAT WASHER	SST
8	304-8997	3	#10 PAN HEAD SCREW	304 SST
9	TABLED	1	NAMEPLATE	FOIL

Table 6 – Non-Cycling Cap VRV, Cast Flanged



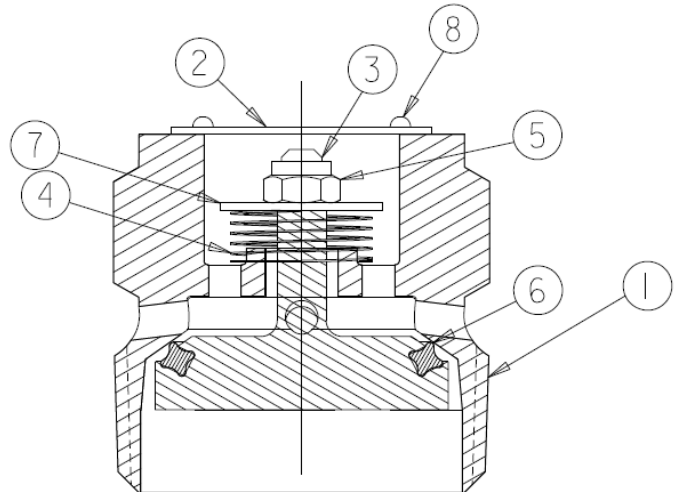
**3/4 - 4 psig vacuum
Non-Cycling (No-Step)
2 1/2" NPT
Compact
Vacuum Relief Valve**

304 SST

- 0.75 psi - 507951
- 1.5 psi - 509981
- 2 psi - 509982
- 3 psi - 509983
- 4 psi - 507952

316 SST

- 0.75 psi - 509988
- 1.5 psi - 509989
- 2 psi - 509990
- 3 psi - 509991
- 4 psi - 509992



	304	316	QTY	DESCRIPTION	MATERIAL
1	109616-01	109616-02	1	BODY	
2	109615-01		1	COVER	304 SST
3	109613-01	109613-02	1	STEM-BASE	
4	TABLED		1	SPRING	302 SST
5	304-8602		1	NUT, LOCK HEX 5/16 "-24	AISI 303
6	TABLED		1	QUAD-SEAL	TABLED
7	305-8774		1	FLAT WASHER	SST
8	304-8745		3	#2 DRIVE SCREWS	304 SST

Table 7 – Non-Cycling Compact VRV, 2 1/2" NPT



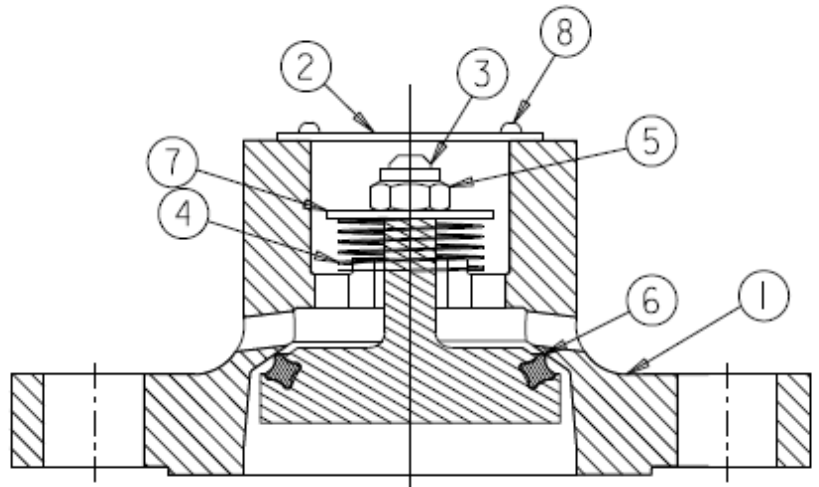
**3/4 - 4 psig vacuum
Non-Cycling (No-Step)
2" Flange
(4) 5/8 on a 4.75 BC
Compact
Vacuum Relief Valve**

304 SST

- 0.75 psi - 507941
- 1.5 psi - 509978
- 2 psi - 509979
- 2.5 psi - 510861
- 3 psi - 509980
- 4 psi - 507948

316 SST

- 0.75 psi - 509975
- 1.5 psi - 509984
- 2 psi - 509985
- 2.5 psi -
- 3 psi - 509986
- 4 psi - 509987



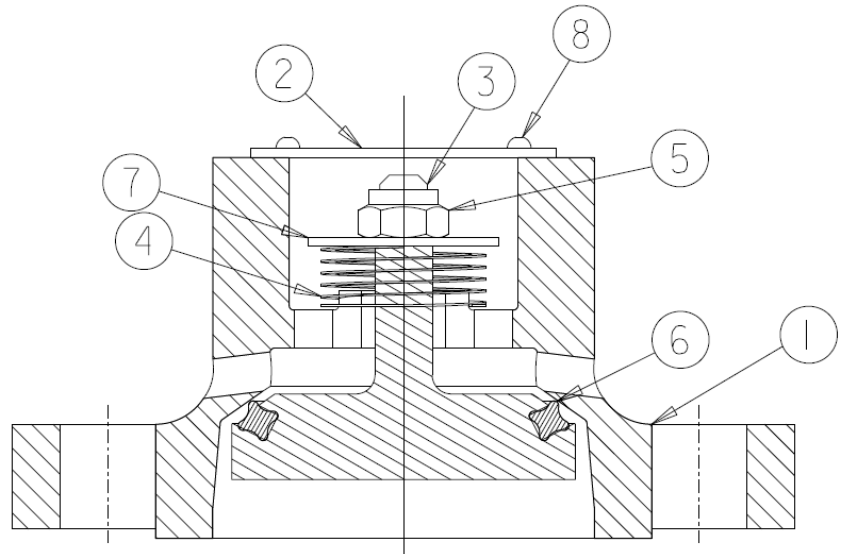
	304	316	QTY	DESCRIPTION	MATERIAL
1	109611-01	109611-02	1	BODY	
2	109615-01		1	COVER	304 SST
3	109613-01	109613-02	1	STEM-BASE	
4	TABLED		1	SPRING	302 SST
5	304-8602		1	NUT, LOCK HEX 5/16 "-24	AISI 303
6	TABLED		1	QUAD-SEAL	TABLED
7	305-8774		1	FLAT WASHER	SST
8	304-8745		3	#2 DRIVE SCREWS	304 SST

Table 8 – Non-Cycling Compact VRV, 2" ANSI 150# FLANGE



**3/4 - 4 psig vacuum
Non-Cycling (No-Step)
1 1/2" ANSI FLANGE SPCL
Req's 3 1/4 x 2 1/2 Gskt
Compact
Vacuum Relief Valve**

- 316 SST**
0.75 psi -
1.5 psi - 510668
2 psi -
3 psi - 510862
4 psi -



	PART NO	QTY	DESCRIPTION	MATERIAL
1	111530-02	1	BODY	316 SST
2	109615-01	1	COVER	304 SST
3	109613-02	1	STEM-BASE	316 SST
4	TABLED	1	SPRING	302 SST
5	304-8602	1	NUT, LOCK HEX 5/16 "-24	AISI 303
6	TABLED	1	QUAD-SEAL	TABLED
7	305-8774	1	FLAT WASHER	SST
8	304-8745	3	#2 DRIVE SCREWS	304 SST

Table 9 – Non-Cycling Compact VRV, 2 1/2" NPT



2.0 General Warnings and Disclosures:

- 2.1 The following guidelines describe McKenzie Valve and Machining LLC's standard disassembly and reassembly instructions. These are not meant to conflict, override, supersede or be used in place of a company's safety, production, and engineering standards or government rules and regulations. All DOT, AAR, CTC, national, federal, local, and other regulations that apply must be followed.
- 2.2 Only trained, qualified personnel should perform any procedures described within this brochure.
- 2.3 Read and understand the entire procedure before attempting any service or inspection.
- 2.4 These valves are used in numerous services and complete information about the commodity should be obtained, verified, and reviewed before any inspection or maintenance is performed.
- 2.5 To avoid exposure to toxic or hazardous conditions and materials, ensure that the direct area and all components are free of hazardous materials before performing any maintenance.

During maintenance, use appropriate personal protection equipment based on the service in which the valve was used. Residual materials may still be in the valve, so appropriate precautions need to be taken.

During installation, take care to ensure the valve is in purchased condition; clean, free of debris, and free of scratches that can lead to leakage. Use appropriate gaskets, fasteners, torque, tools, and methods to install the valve.

- 2.6 To avoid physical harm, use appropriate equipment to handle the valves. The design of Vacuum Relief Valves (VRV) utilizes a compressed spring. These springs store potential energy that could be harmful if uncontrollably released.

When transporting, removing, disassembling, assembling, or installing the valves, do not place any part of your body directly in front of the spring.

Handle the valves with care to avoid damage to the valve and any of its components which might lead to a discharge of this energy.



3.0 VRV Installation:

- 3.1 Vacuum relief valves are designed using three standard mounting styles.
 - 2-1/2" NPT
 - 2" 150# ANSI Flange (using 5/8" Clearance Hole)
 - 1-1/2" 150# ANSI Flange (Using custom gasket size)
- 3.2 All new valves are set and tested at the McKenzie facility to ensure the quality of the valve. Prior to installation, the valve should be handled appropriately and inspected to ensure that the gasket sealing surfaces are clean and undamaged. If damage is found, the valve will require maintenance.
- 3.3 As each manufacturer may impose different requirements based on service and design, install the valve using the tank car manufacturer's, or other end user's, specified materials and procedures.
- 3.4 The valve is designed to be installed with the cap outside the tank. Inspect the sealing surfaces and position the appropriate gasket between the valve and its mounting surface. Carefully lower the valve into position taking care to align the gasket, valve, threads and/or mounting surface.
- 3.5 If using a flanged VRV, check to ensure that the fastener threads are clean. As the fasteners are installed, they should be equally tightened in increments to ensure proper alignment and even gasket compression. See Figure 1. As a general rule, the increments should be hand tight, then one third of required torque, then two-thirds, then the complete torque. The fasteners should not be tightened in a circular, or rotational, pattern as this may distort the gasket and result in uneven sealing. A criss-cross, or star, pattern should be used. Once the fasteners are fully tightened, a circular pattern can be used to check the torques.

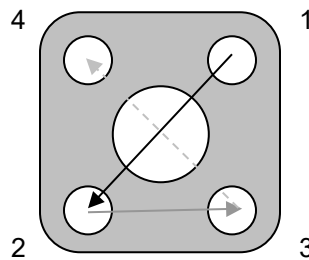


Figure 1

- 3.6 After the valve is installed, check for leakage around the newly installed gasket or threads. If any leaks are detected, the valve should be removed, the valve and mounting surfaces should be inspected, and a new gasket, O-Ring or thread tape must be installed.

4.0 VRV Operation:

- 4.1 The VRV is not meant to be manually operated. This valve is designed for significantly low forces and the spring is inherently weak. Do not attempt to manually actuate the valve, as side loading may occur which in turn may damage the spring inside valve.



5.0 VRV Disassembly: (refer to Table 3-10 accompanying figures)

- 5.1 Read and understand the entire procedure before attempting any service or inspection. Follow all safety procedures applicable.
- 5.2 Before disassembling the valve, measure the assembled height of the spring in the valve. This measurement will be used when assembling the valve.

For Cycling Cap Design (Table 3 and accompanying figure)

- 5.3 Hold Stem Base (3), remove Nut (5) and Washer (8).
- 5.4 Remove Cap (2), Spring (4), and Retaining Ring (7)
- 5.5 Lower Stem (3) through Body (1)
- 5.6 Remove Quad-Seal (6)

For Non-Cycling Cap Design (Table 4-7 and accompanying figures)

- 5.7 Remove three Pan Head Screws (8).
- 5.8 Remove Cap (9)
- 5.9 Hold Stem Base (3), remove Nut (5) and Washer (7).
- 5.10 Remove Spring (4)
- 5.11 Lower Stem (3) through Body (1)
- 5.12 Remove Quad-Seal (6)

For Compact VRV Design (Table 8-10 and accompanying figures)

- 5.13 Carefully remove three Drive Screws (8) by inserting a fine edged screwdriver or similar under the Cover (2) and slowly prying upward by rotating the screwdriver blade.
- 5.14 If applicable, remove the two tack welds securing the Cover (2) to the Body (1).
- 5.15 Remove Cover (2)
- 5.16 Hold Stem Base (3) from underneath using a standard ratchet and extension, remove Nut (5) and Washer (7).
- 5.17 Remove Spring (4)
- 5.18 Lower Stem (3) through Body (1)
- 5.19 Remove Quad-Seal (6)



6.0 VRV Component Inspection:

- 6.1 When a VRV is removed from an existing application, it must be cleaned and inspected.
- 6.2 All elastomeric and gasket materials must be removed and discarded. While removing them, do not use any tools that may cause scratches or grooves. Ensure that all existing elastomeric and gasket material is removed.
- 6.3 Inspect the sealing surfaces. For a flat face flange, inspect for scratches that can be detected by sliding a fingernail across. For O-ring and quad-seal sealing surfaces, inspect for any scratches on the smooth sealing surface. Any pitting or irregularities, which can be seen or felt, may be cause for rejecting the part.
- 6.4 Replace the Cap, Body, and Stem/Plug as necessary. Do not attempt to remachine any sealing surfaces.
- 6.5 Clean all threads where oil was applied during disassembly. These may include top fasteners, the lock nut threads on the stem, and pipe threads on a flanged body.
- 6.6 Clean and inspect the body of the valve.
- 6.7 Inspect Stem
 1. Wire brush the entire length of stem, if required, to remove scale, solidified product and any foreign matter.
 2. Visually inspect stem for defects and overall condition including threads and stem for cracks, nicks, and/or pits caused by corrosion, etc., before continuing. Repair work is limited to cleaning and polishing.
 3. If the threads are slightly galled, run the correct size thread die over the affected area. Stems with severely galled area of thread shall be replaced.
- 6.8 Inspect Spring
 1. Wire brush the entire length of non-coated springs, as needed, to remove scale, solidified product and any other foreign matter.
 2. Visually inspect the spring for damage or cracks. A crack in the spring is cause for rejection.

7.0 VRV Assembly:

- 7.1 Inspect all components and ensure they are clean, free of nicks and scratches and are in proper condition for assembly.
- 7.2 Select the o-ring, quad-seal, and/or gasket material per customer's requirements. Clean and inspect the quad-seal and then apply a very thin film of food grade silicone sealant compound to the quad-seal. Dow Corning (Molycote) 111 is an acceptable compound, unless otherwise specified by the customer.
- 7.3 Insert the quad seal into the stem. See Figure 2.

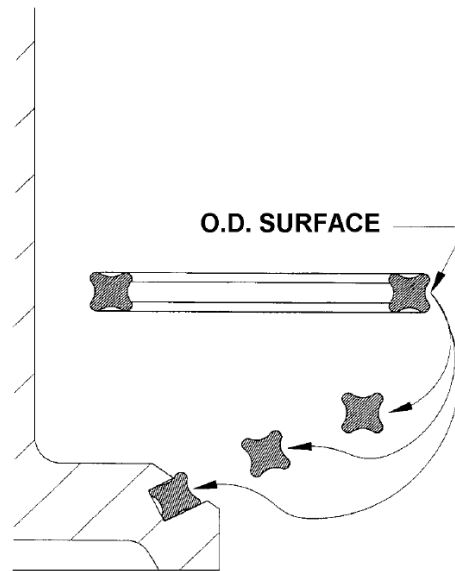


Figure 2

- 7.4 Seat the quad-seal into the stem by applying pressure to the OD surface of the quad seal and rotating the stem at least 360 degrees.
- 7.5 Install the stem into the body.

For Cycling Cap Design (Table 3 and accompanying figure)

- 7.6 Hold Stem Base (3), apply Retaining Ring (7), center Spring (4) in Body (1)
- 7.7 Apply Cap (2), apply Nut (5) and Washer (8).
- 7.8 Tighten Nut (5) against the Cap (2) until there is no more thread travel.

For Non-Cycling Cap Design (Table 4-6 and accompanying figures)

- 7.9 Hold Stem Base (3), center Spring (4) in Body (1)
- 7.10 Apply Nut (5) and Washer (7).
- 7.11 Tighten Nut (5) against the Washer (7) until there is no more thread travel.
- 7.12 Apply Cap (9)
- 7.13 Apply three Pan Head Screws (8).
- 7.14 Tighten Screws (8) evenly until they are all tight against the cover.



For Compact VRV Design (Table 8-10 and accompanying figures)

- 7.15 Hold Stem Base (3), center Spring (4) in Body (1)
- 7.16 Apply Nut (5) and Washer (7).
- 7.17 Tighten Nut (5) against the Washer (7) until there is no more thread travel.
- 7.18 Apply Cap (2)
- 7.19 Apply three Drive Screws (8).
- 7.20 The Cover (2) must be tack welded to the Body (1) in two places using a 309L electrode or filler metal.

8.0 VRV Testing:

- 8.1 Testing methods will vary highly depending on test fixture available. The following is a guideline and should be tailored to the exact fixture used.
- 8.2 For Flanged VRVs, bolt or clamp the valve to the fixture
- 8.3 For threaded VRVs, Thread the valve into the fixture. TFE tape does not need to be used as the fixture should be designed to seal against an O-ring against the bottom taper.

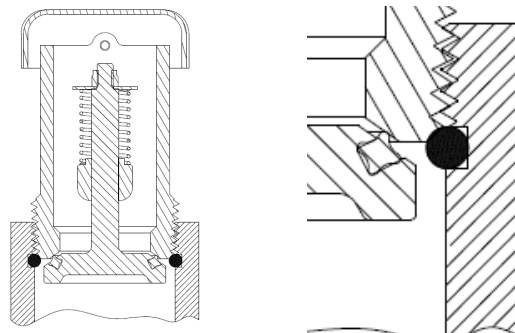


Figure 3

- 8.4 Apply a vacuum to the valve and determine a Set Pressure. This is accomplished by drawing a vacuum until the valve releases or by drawing a maximum vacuum and measuring how much is being pulled through the valve. Either method is acceptable.
- 8.5 Tolerance is as follows:

Range for Start-to-Open (psig)	Tolerance (psig)	Example
Negative ¾ and up to negative 1	- ¾ and + 0 psig	-¾ (-¾ to -1.5)
Negative 1 and up to negative 5	+/- ½ psig	-2 (-1.5 to -2.5)
Greater vacuum than -5 psig	+/- 1 psig	-6 (-5 to -7)

Table 10



- 8.6 If the valve is not within tolerance, the valve must be disassembled and the spring must be adjusted by stretching or compression. Alternatively, the washer may be cupped to achieve minor adjustments.
- 8.7 After testing for set pressure, the valve should be tested for low positive pressure sealing.
- 8.8 Apply 2-3 psig positive air or nitrogen pressure to the valve.
- 8.9 Apply leak detection fluid around the mounting connection to ensure that the valve is not leaking at that connection.
- 8.10 Isolate the pressurized valve from the air supply.
- 8.11 Wait 2-5 seconds for the pressure to equalize. Watch the gauge for one minute. Pressure loss in excess of 0.2 psig is considered failure and the valve will have to be rebuilt.
- 8.12 If the valve passes the 2-3 psig pressure degradation test, apply 80-100 psig positive air or nitrogen pressure to the valve.
- 8.13 Isolate the pressurized valve from the air supply.
- 8.14 Wait 2-5 seconds for the pressure to equalize. Watch the gauge for one minute. Pressure loss in excess of 5 psig is considered failure and the valve will have to be rebuilt.
- 8.15 Remove the valve from the test fixture and apply to tank car or package to keep it clean from dust and debris.

9.0 VRV Testing on car:

- 9.1 The Compact VRV can easily be tested on the car.
- 9.2 The valve has (4) holes around its perimeter. Block these holes with a ring of tape, earplugs, or other method. They do not have to be completely sealed, only blocked to a minimal flow which can be detected with leak detection fluid.
- 9.3 Apply an approved leak detection fluid, Winton Sherlock Type CG is recommended, around the top cover and the four holes. Any pressure leaking through the valve will attempt to escape around the hole blockage or the cap and can easily be seen.
- 9.4 Leakage is grounds for rejection.



10.0 Revisions

Date	Section	Revision
9/2018	5.14	Added "If applicable, remove the two tack welds securing the Cover (2) to the Body (1)".
9/2018	7.20	Added "Alternatively, the Cover (2) may be tack welded to the Body (1) using a matching electrode".
9/2020	3.5, 7.3 & 8.3	Added Figure 1, 2 & 3 below figures.
9/2020	1	Revised Table 8 to 7, 9 to 8 & 10 to 9.
9/2020	7.20	Added requirement that the cover (2) must be tack welded using a 309L electrode or filler metal.
	8.5	Added "Table 10" to table

Always check for the current guidelines for McKenzie Valve and Machining LLC's products at:

www.McKValve.com

For other correspondence, mail or call at:

McKenzie Valve and Machining LLC

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