

Work drop prevention check valve FPV series



● Safety handling of workpiece with several pads

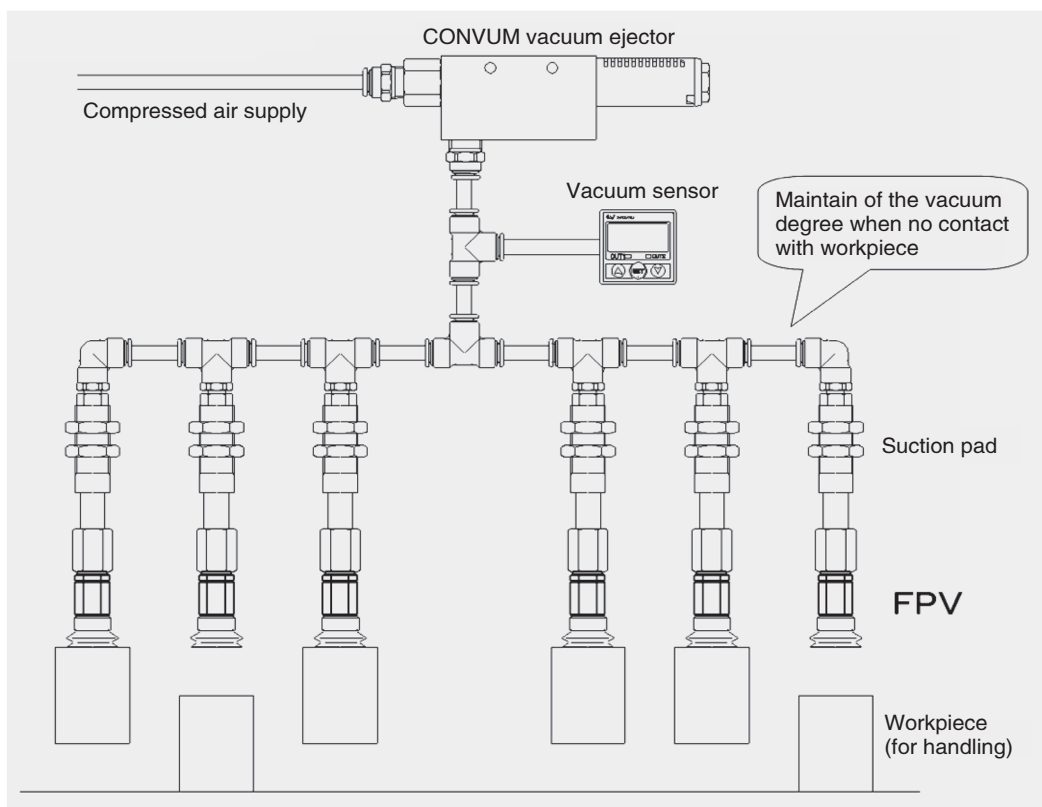
Enable using 1 CONVUM ejector and several pads, in applications where some of the suction pads may not be in contact with the workpiece.

● Maintain of suction even if no contact with workpiece

Suction is maintained even in no contact between workpiece and some of the suction pads.

● Integrated filter

Filter element integrated in check valve body.



Safety instructions



WARNING

- ① In the case of porous workpiece handling, it may not be possible to handle the workpiece if there is not enough vacuum (air) flow or if there is important leakage.
- ② The quantity of FPV that may not have contact with the workpiece changes depending on using conditions. Please select suitable quantity after checking CONVUM ejector, vacuum pump specifications (vacuum flow, vacuum pressure characteristics)

- ③ FPV check valve is not a vacuum maintaining product. Do not use it in this way.
- ④ Please test FPV valves in real condition on the equipment in the case that you need to check the suction with a signal by using a vacuum sensor set up between the FPV and the suction pad. As there is only few pressure variation, the vacuum degree may not be high enough to get the desired signal.
- ⑤ Please test FPV valves in real condition on the equipment in the case that you need to use 1 CONVUM ejector with several FPV valves.
- ⑥ Attachment of FPV: please attach male screw to CONVUM ejector side (vacuum source).

How to order

FPV – M5

Attachment screw (fitting side)

M5	M5 × 0.8
M6	M6 × 1.0
R1	R1/8
R2	R1/4
R3	R3/8
G1	G1/8
G2	G1/4
G3	G3/8
N1	1/8–27 NPT
N2	1/4–18 NPT
N3	3/8–18 NPT

Applicable pads and fittings

Reference	Applicable pad		
	Pad series		Setting screw
FPV-M5	PF10 ~ 20 PC15 ~ 20 PJ10 ~ 25 PB20	PD4 ~ 20 PA10 ~ 20A PA10 ~ 20B	TN-PF-15-M5 TN-PF-20-M5 TN-PC-10-M5 TN-PS-10-M5
	PF10 ~ 20 PC15 ~ 20 PJ10 ~ 25 PB20	PD4 ~ 20 PA10 ~ 20A PA10 ~ 20B	TN-PF-25-M6 TN-PF-50-M6 TN-PC-30-M6 TN-PA-30-M6
FPV-R1	PF15 ~ 50 PJ15 ~ 50		
FPV-R2			
FPV-R3			

Specifications

Description		Unit	FPV-M5	FPV-M6	FPV-R1 (FPV-G1) (FPV-N1)	FPV-R2 (FPV-G2) (FPV-N2)	FPV-R3 (FPV-G3) (FPV-N3)
Fluid			Non-lubricated air / non-corrosive gas				
Operating pressure range			-100kPa ~ 0.6MPa				
Min. operating vacuum (air) flow		ℓ /min(ANR)	10		15		
Ambient temperature		℃	0 ~ 60				
Filtration rate		μm	25				
Port size	Pad size		M5	M6	Rc1/8	Rc1/4	Rc3/8
	Fitting size		M5	M6	R1/8	R1/4	R3/8
Mass		g	6.5	7	12	16	24

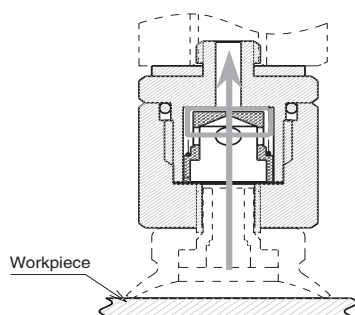
Note) Minimum operating vacuum (air) flow is the value required at CONVUM ejector side (vacuum source).

Note) Check screws details at drawing section.

Note) Specifications are same for G and N threaded FPV check valves.

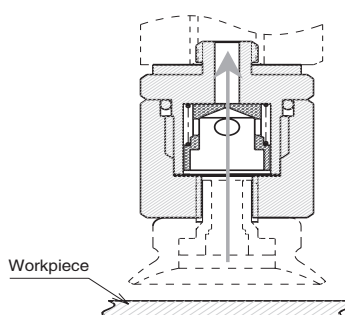
Operating principle

When contact with workpiece



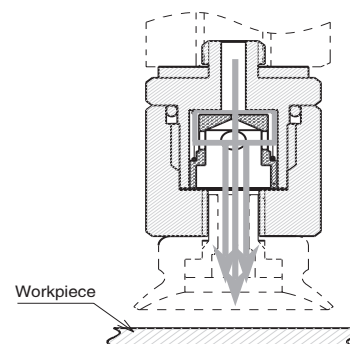
When suction pad grips the workpiece, the valve inside the circuit is pushed down by the spring and the air flow path is released between the valve and the body.

When no contact with workpiece



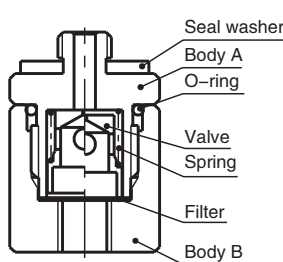
When there is no suction or when the work has been released from the pad, air flows from pad side and push up the valve. It closes the air flow path and prevent vacuum drop from ejector side. The central fine orifice let keep sucking air a little.

When releasing workpiece

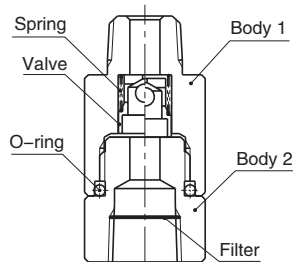


When releasing the working with a blow-off, compressed air flows from the ejector side through the check valve circuit and push down the valve releasing the air flow path. It decreases the vacuum level and the work can be released.

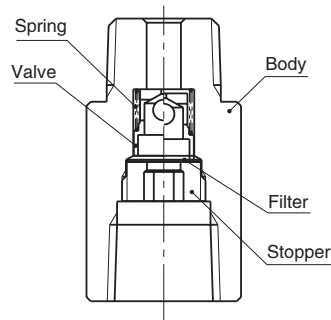
Construction



FPV-M5/M6



FPV-R/G/N1

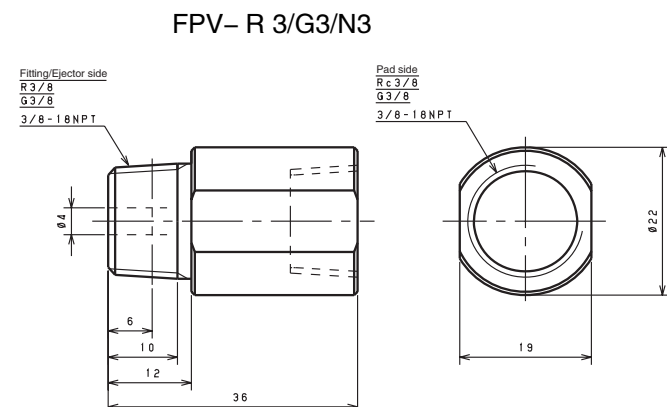
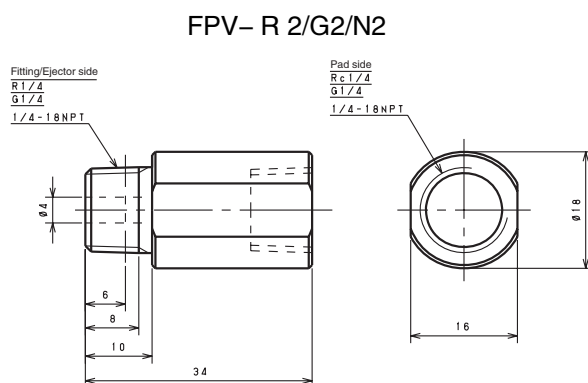
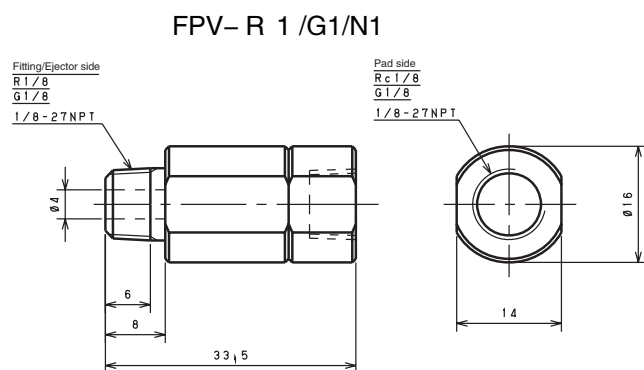
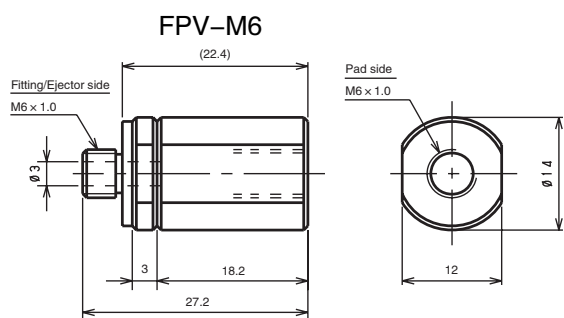
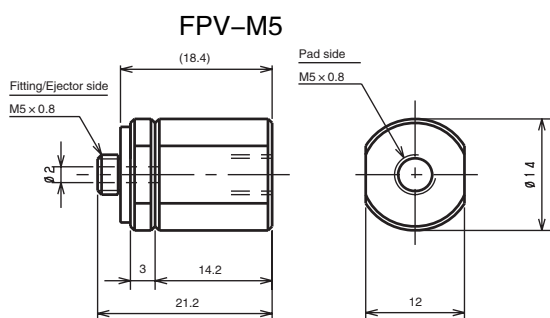


FPV-R/G/N2 · 3

Part name	Material
Body	Aluminium alloy
Valve	Aluminium alloy
Spring	SUS
Filter	SUS
O-ring	NBR
Seal washer	NBR

Dimensions

mm



Selection of FPV

Selection example 1 Vacuum source: CV CONVUM ejector

The below table shows the vacuum (air) flow and vacuum pressure characteristics needed in case of using 1 CONVUM ejector with several FPV check valves.

Table 1 FPV Performance table

FPV model	FPV				
	M5	M6	R1	R2	R3
Min. operating vacuum (air) flow [ℓ/min(ANR)]	10	10	15	15	15
Vacuum drop rate when no contact (-kPa)	3	3	8	8	14

Note 1) Above table is in case of using CV-15HS ejector. Values shown are per FPV valve.

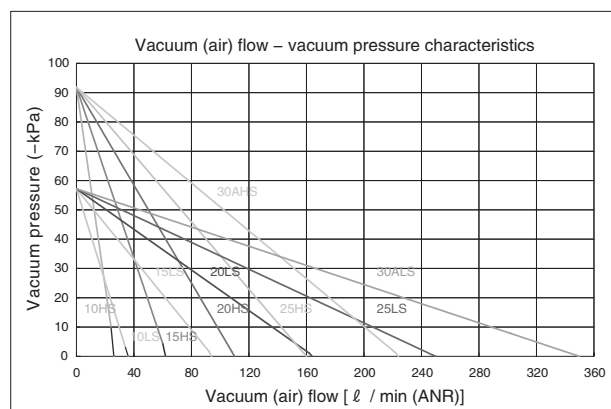
Note 2) Piping resistance and ejector characteristics have an effect on the vacuum degree decreasing values. Please use this data as reference.

Note 3) Please calculate the exact vacuum drop from CONVUM ejector or vacuum pump vacuum (air) flow and vacuum pressure performance graph.

Table 2 CV CONVUM ejector performance table

CONVUM series	CV									
	10		15		20		25		30A	
	HS	LS	HS	LS	HS	LS	HS	LS	HS	LS
Maximum vacuum pressure (-kPa)	-92	-57	-92	-57	-92	-57	-92	-57	-92	-57
Vacuum (air) flow [ℓ / min (ANR)]	27	36	63	95	110	165	160	250	225	350

Table 3



Selection example 2 Vacuum source: VTE vacuum pump

The below table shows the vacuum (air) flow and vacuum pressure characteristics needed in case of using 1 CONVUM ejector with several FPV check valves.

Table 5 FPV Performance table

FPV model	FPV				
	M5	M6	R1	R2	R3
Min. operating vacuum (air) flow [L/min(ANR)]	10	10	15	15	15
Vacuum drop rate when no contact (-kPa)	2	2	4	4	7

Note 1) Above table is in case of using VTE-6 vacuum pump. Values shown are per FPV valve.

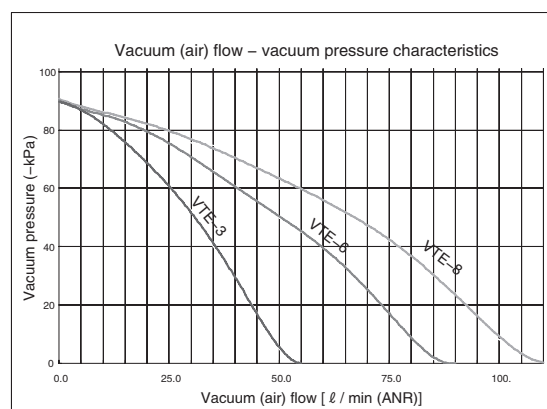
Note 2) Piping resistance and pump characteristics have an effect on the vacuum degree decreasing values. Please use this data as reference.

Note 3) Please calculate the exact vacuum drop from CONVUM ejector or vacuum pump vacuum (air) flow and vacuum pressure performance graph.

Table 6 VTE vacuum pump performance table

Vacuum pump series	VTE		
	3	6	8
	50Hz	50Hz	50Hz
Maximum vacuum pressure (-kPa)	-81.3	-81.3	-81.3
Vacuum (air) flow [ℓ / min (ANR)]	58.3	58.3	133

Table 7



Selection in case of using 1 CONVUM ejector

① We check the possible quantity of FPV without contact with workpiece

CONVUM ejector vacuum (air) flow ÷ FPV valve min. operating vacuum (air) flow = quantity of FPV valve

<Calculation>

CV-15HS vacuum (air) flow is 63 ℓ /min (ANR), FPV-M5 min. operating vacuum (air) flow is 10 ℓ /min (ANR).

$63 \text{ ℓ /min (ANR)} \div 10 \text{ ℓ /min (ANR)} = 6.3$

The possible quantity of FPV valve is 6 pieces for 1 CV-15HS ejector.

② We check the maximum vacuum pressure

We check the vacuum drop rate per FPV check valve from table 1. Vacuum drop rate when no contact x FPV quantity = total vacuum drop rate. We check the maximum vacuum pressure of CONVUM ejector from table 2.

Maximum vacuum pressure – Total vacuum drop rate = Maximum vacuum pressure when using FPV check valve.

<Calculation>

FPV-M5 vacuum drop rate is 3kPa per check valve.

In this case, total vacuum drop rate is 3kPa x 6 pcs = 18 kPa

CV-15HS Maximum vacuum pressure is -92 kPa

$(-92 + 18) = -74\text{kPa}$

When using 6 FPV-M5 with 1 CV-15HS, the maximum vacuum pressure is -74 kPa.

In the case of using 10 suction pads, all attached with FPV-M5, it means that if 6 of the 10 suction pads are not in contact with workpiece, suction force of remaining 4 suction pads is -74kPa: handling is possible.

Table 4 Estimation of suction pad without contact with workpiece when using CV-15HS

FPV model	FPV				
	M5	M6	R1	R2	R3
Quantity of FPV without contact ★	6	6	4	4	2
Vacuum pressure (kPa)	-74	-74	-60	-60	-64

★ Note) This means the number of the pad to which FPV valves are attached with when there is no contact between the suction pad and the workpiece.

Selection in case of using 1 VTE vacuum pump

① We check the possible quantity of FPV without contact with workpiece

Vacuum pump vacuum (air) flow ÷ FPV valve min. operating vacuum (air) flow = quantity of FPV valve

<Calculation>

VTE-8 vacuum (air) flow is 133 ℓ /min (ANR), FPV-R2 min. operating vacuum (air) flow is 15 ℓ /min (ANR).

$133 \text{ ℓ /min(ANR)} \div 15 \text{ ℓ /min(ANR)} = 8.8$

The possible quantity of FPV valve is 8 pieces for 1 VTE-8 vacuum pump.

② We check the maximum vacuum pressure

We check the vacuum drop rate per FPV check valve from table 5. vacuum drop rate when no contact x FPV quantity = total vacuum drop rate. We check the maximum vacuum pressure of VTE-8 vacuum pump from table 6.

Maximum vacuum pressure – Total vacuum drop rate = Maximum vacuum pressure when using FPV check valve.

<Calculation>

FPV-R2 vacuum drop rate is 4kPa per check valve.

In this case, total vacuum drop rate is 4kPa x 8 pcs = 32 kPa

VTE-8 maximum vacuum pressure is -81.3 kPa

$(-81.3 + 32) = -49.3\text{kPa}$

When using 8 FPV-R2 with 1 VTE-8, the maximum vacuum pressure is -49.3 kPa.

The conventional minimum vacuum pressure for handling is -60kPa. In this case the maximum vacuum pressure is not enough for handling and may cause workpiece drop. Let's review the selection as below for a safety handling.

③ We check the minimum vacuum pressure based on maximum quantity of FPV valve without contact

Minimum vacuum pressure for safety handling is -60kPa. We need to know the maximum vacuum drop rate acceptable from which we can calculate the maximum quantity of FPV valve that may not be in contact with the workpiece.

Vacuum pump maximum vacuum pressure – Minimum vacuum pressure for safety handling = Quantity of FPV valve that may not be in contact with the workpiece

<Calculation>

Acceptable vacuum drop rate is 81.3 kPa – 60 kPa = 21.3 kPa

Maximum quantity of check valve based on acceptable drop rate is $(21.3 \div 4) \text{ kPa} = 5.3$

Therefore, the maximum quantity of FPV-R2 check valve is 5 pieces.

In the case of using 10 suction pads, all attached with FPV-R2, it means that if 5 of the 10 suction pads are not in contact with workpiece, suction force of remaining 5 suction pads is -61.3kPa: handling is possible.

Table 8 Estimation of suction pad without contact with workpiece when using VTE-8

FPV model	FPV				
	M5	M6	R1	R2	R3
Quantity of FPV without contact ★	10	10	5	5	3
Vacuum pressure (kPa)	-61.3	-61.3	-61.3	-61.3	-60.3

★ Note) This means the number of the pad to which FPV valves are attached with when there is no contact between the suction pad and the workpiece.