azbil

No. CP-SP-1190E

TM

MVF050/080/100/150 Micro Flow Vortex Gas Flowmeter

User's Manual

Thank you for purchasing an Azbil Corporation product.

This manual contains information for ensuring the correct use of this product. It also provides necessary information for installation, maintenance, and troubleshooting.

This manual should be read by those who design and maintain equipment that uses this product. Be sure to keep this manual nearby for handy reference.

Azbil Corporation

NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact the azbil Group.

In no event is Azbil Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

Conventions Used in This Manual

■ The safety precautions explained in the following section aim to prevent injury to the operator and others, and to prevent property damage.

⚠WARNING	Warnings are indicated when mishandling this product might result in death or serious injury.
⚠CAUTION	Cautions are indicated when mishandling this product might result in minor injury to the user, or physical damage to the product.

■ In describing the product, this manual uses the icons and conventions listed below.

Use caution when handling the product.

The indicated action is prohibited.

Always follow the indicated instructions.

Handling precautions:

Handling Precautions indicate items that the user should pay attention to when handling the this device.

Note: Notes indicate information that might benefit the user.

(1), (2), (3): Numbers within parentheses indicate steps in a sequence or parts of an explanation.

☞ This indicates the item or page that the user is requested to refer to.

RL02
100000

This indicates 7-segment indication on the display.

Safety Precautions

⚠WARNING

If this device is used with flammable gases such as natural gas, propane or butane, mount it on the upstream side of the safety shutoff valve. When air gets in the pipe and an explosive mixture is produced, and if a sensor should make a spark due to lightning or other reasons, the mixture may explode inside the pipe.
The mass of this device is 7 to 23 kg according to the model number. Ensure to take complete precautions and care while handling for transportation or installation. For safe handling, two or more persons are required while handling this device. Accidental dropping of the device on the foot might cause injury.
Do not hold the device by the converter alone. Doing so might damage the device, or the pipe connector section may drop off.
Do not use this device or its installed pipes as a scaffolding. Doing so might damage the device or the pipe, or might cause physical injury.
Do not disassemble this device. If it is disassembled when pressure remains in the pipes, the device could be damaged or someone could be injured by flying parts.

⚠CAUTION

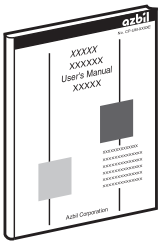
Be sure to use this device for a flow not exceeding 36 m/s, the maximum measurable velocity. To prevent excessive flow, use a suitable means to control the supply pressure or use a throttle valve or the like to control the flowrate. If the velocity exceeds the maximum measurable velocity, both the flowrate display and the output voltage/current may indicate considerably lower values than the actual flowrate. Refer to; ☞■ Behavior when the flowrate greatly exceeds the upper limit of flowrate (page 7).
If damage could result from the abnormal functioning of this device include appropriate redundancy in the system design.
Be sure that the operating gas temperature does not fall below −15°C. Using the gas below −15°C, the O-ring might crack and cause gas leakage.
Prevent foreign matter from entering the device. If the rust, water droplet, oil mist or dust in the piping flows into the device, measurement error might occur and result in damaging the device. If there is a possibility that any foreign matter flows into the device, provide a filter, strainer or mist trap capable of eliminating more than 1 µm foreign matter at the upstream, and periodically inspect and replace the filter.
If this device is used for monitoring flowrate of the burner, consider the piping instrumentation lest the backfire damage this device.
When connecting the load to the output terminals, do not exceed the rated value shown in the specifications. Doing so might cause the damage of this device.
This device is a precision instrument. Do not drop it or subject it to shock. Doing so might damage the device.

⚠CAUTION

❗	When connecting flanges, tighten with the specified torque. Otherwise gas could leak from the pipe, causing injury.
❗	When mounting the device, firmly fasten to prevent vibration.
🚫	Do not peel off the pipe connector port seals until immediately before you connect the piping. Doing so might allow foreign objects to enter the connector port and cause defective operation.
🚫	Do not flush when the device is mounted in the pipe. Doing so might cause damage due to entry of foreign matter and cause faulty operation or errors in measurement.
❗	Before wiring, be sure to turn the power OFF.
❗	Before supplying power, be sure to check that there is no wiring error. A wiring error might damage the device or cause a dangerous condition.
🚫	Do not use this device outside of the operating pressure range. Also, do not subject this device to a pressure above the pressure resistance. Doing so might damage this device.

The Role of This Manual

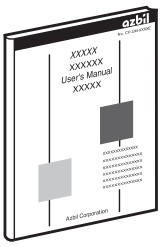
A total of 2 different manuals are available for the MVF Series. Read them as necessary for your specific requirements. If a manual you require is not available, contact the azbil Group or its dealer.



MVF Series Micro Flow Vortex Gas Flowmeter

Manual No. CP-SP-1190E

This manual.
First-time users of the MVF Series, and those in charge of maintenance or hardware design for incorporating a MVF Series flowmeter in instrumentation should read this manual.
This manual outlines the product, tells how to install, wire, and incorporate the product into instrumentation, and describes its operation, inspection and maintenance, troubleshooting, and hardware specifications.



MVF Series Micro Flow Vortex Gas Flowmeter : Communications

Manual No. CP-SP-1183E

Those using the communications functions of the MVF Series should read this manual.
This manual describes an outline of communications, wiring, communications procedures, MVF Series communications data, troubleshooting, and communications specifications.

Organization of the Manual

This manual is organized as follows.

Chapter 1. INTRODUCTION

This chapter describes features on this device.

Chapter 2. NAMES AND FUNCTIONS OF PARTS

This chapter describes the NAMES AND FUNCTIONS OF PARTS on this device.

Chapter 3. INSTALLATION, MOUNTING, WIRING

This chapter describes installation, mounting and wiring on this device.

Chapter 4. TROUBLESHOOTING

This chapter describes how to investigate and remedy trouble that may occur during operation of this device.

Chapter 5. SPECIFICATIONS

This chapter describes the specifications and external dimensions of this device.

Contents

Chapter 1. INTRODUCTION

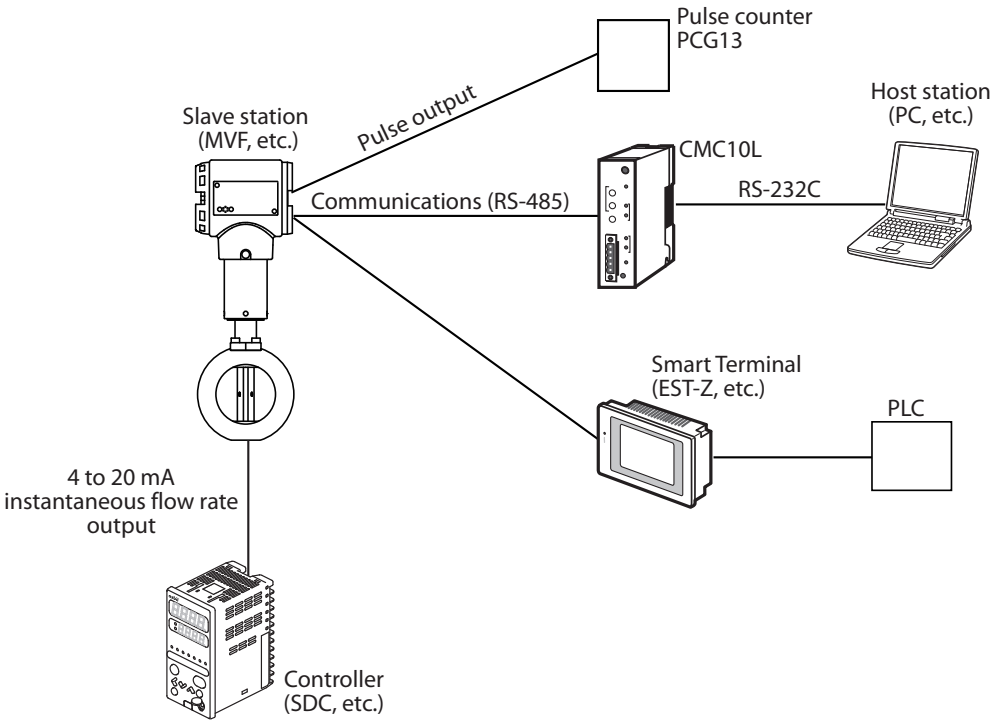
■ Introduction

The MVF Series Micro Flow Vortex Gas Flowmeter (hereafter called the MVF) is a thermal vortex gas flowmeter featuring a wide measurement range. It uses the Azbil Corporation-designed Micro Flow sensor (or "μF sensor") as a vortex generator.

■ Features

- 35 % more of the MVF's component materials are available for re-use or recycling, as compared with the conventional CMK model.
- Temperature and pressure compensation functions are integrated into the MVF. Since expensive temperature and pressure compensation devices are not required, a large cost reduction can be expected.
- This device incorporates a μF (Micro Flow) sensor a mere 1.7 mm square and 0.5 mm thick, made possible by silicon micro-machining and thin-film technologies. By using this high-sensitivity, high-speed sensor to detect vortex frequency, measurement rangeability of 100:1 has been achieved.
- The entire MVF is provided with wide range of functions to meet various applications needs: LCD display function, analog output (4 to 20 mA), integrating calculation, display and integral pulse output (open collector).
  Also, an RS-485 communications function is provided as a standard feature, so a large amount of instrumentation cost reduction can be achieved when data is uploaded.

■ System



■ Model selection table

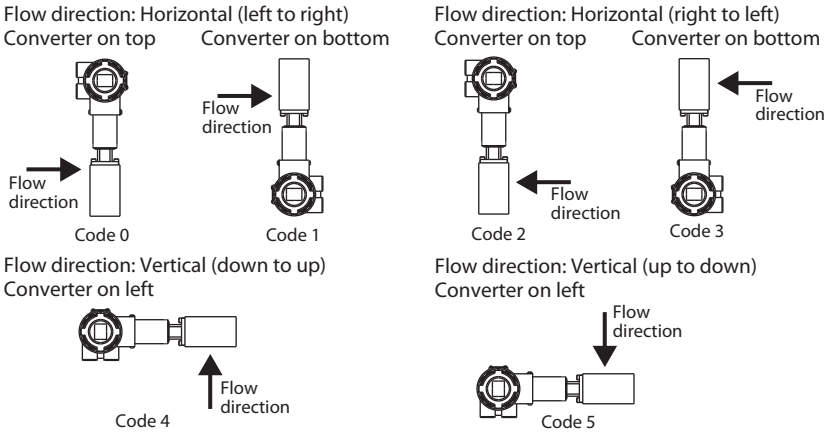
The following shows the model Nos. for this flowmeter:

● SUS304

Basic model No.	Pipe size	Model type	Material	Connection method	Gas type	Output	Power	Commu-nication	Flow and mounting direction	Option 1	Option 2	Appended	Descripton
MVF													Micro Flow Vortex Flowmeter
	050												Pipe size 50A (2B)
	080												Pipe size 80A (3B)
	100												Pipe size 100A (4B)
	150												Pipe size 150A (6B)
		0											With temperature and pressure compensation, standard operating pressure range 0–1.0 MPa
		L											With temperature compensation but no pressure compensation
		1											With temperature and pressure compensation, low operating pressure range 0–0.1 MPa
		3											With temperature and pressure compensation, medium operating pressure range 0–0.3 MPa
			S										Body material SUS304
				U									Wafer connection (with JIS flange compatible spacers)
					N								Air, Nitrogen, Algon
					S								Oxygen (be sure to specify degreasing)*1
					C								Carbondioxide
					G								Natural gas (LNG base), Methane
					P								Propane
					B								Butane
						0							4 to 20 mAdc output + Integration pulse output
							1						Power 24 Vdc
								1					RS-485 communications
									0				Horizontal (Flow direction:left to right) Converter on top*2
									1				Horizodntal (Flow direction:left to right) Converter on bottom*2
									2				Horizontal (Flow direction:right to left) Converter on top*2
									3				Horizontal (Flow direction:right to left) Converter on bottom*2
									4				Vertical (Flow direction:down to up) Converter on left *2
									5				Vertical (Flow direction:up to down) Converter on left*2
										0			No optional functions
										1			Degreased gas-contacting parts (necessary if the gas type is oxygen*1)
											0		No optional functions
												0	Product version

*1. If the gas type is oxygen, be sure to specify degreasing.

*2. Flow and mounting directions

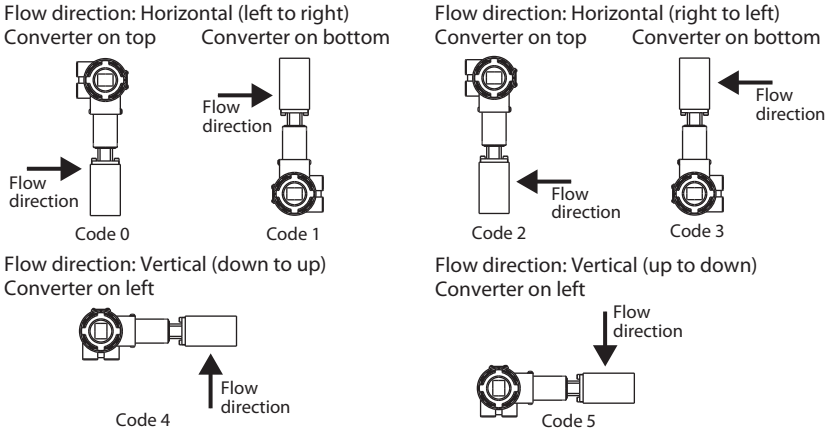


● SCS13A

Basic model No.	Pipe size	Model type	Material	Connection method	Gas type	Output	Power	Commu-nication	Flow and mounting direction	Option 1	Option 2	Appended	Descripton
MVF													Micro Flow Vortex Flowmeter
	050												Pipe size 50A (2B)
	080												Pipe size 80A (3B)
	100												Pipe size 100A (4B)
	150												Pipe size 150A (6B)
		0											With temperature and pressure compensation, standard operating pressure range 0–1.0 MPa
		L											With temperature compensation but no pressure compensation
		1											With temperature and pressure compensation, low operating pressure range 0–0.1 MPa
		3											With temperature and pressure compensation, medium operating pressure range 0–0.3 MPa
			C										Body material SCS13A
				U									Wafer connection (with JIS 10K flange compatible spacers)
				D									Wafer connection (with DIN PN10 flange compatible spacers)
				A									Wafer connection (with ANSI 150 flange compatible spacers)
					N								Air, Nitrogen, Algon
					S								Oxygen (be sure to specify degreasing)*1
					C								Carbondioxide
					G								Natural gas (LNG base), Methane
					P								Propane
					B								Butane
						0							4 to 20 mAdc output + Integration pulse output
							1						Power 24 Vdc
								1					RS-485 communications
									0				Horizontal (Flow direction:left to right) Converter on top*2
									1				Horizodntal (Flow direction:left to right) Converter on bottom*2
									2				Horizontal (Flow direction:right to left) Converter on top*2
									3				Horizontal (Flow direction:right to left) Converter on bottom*2
									4				Vertical (Flow direction:down to up) Converter on left*2
									5				Vertical (Flow direction:up to down) Converter on left*2
										0			No optional functions
										1			Degreased gas-contacting parts (necessary if the gas type is oxygen*1)
											0		No optional functions
											C		Mill test report for the body and vortex generator materials
												0	Product version

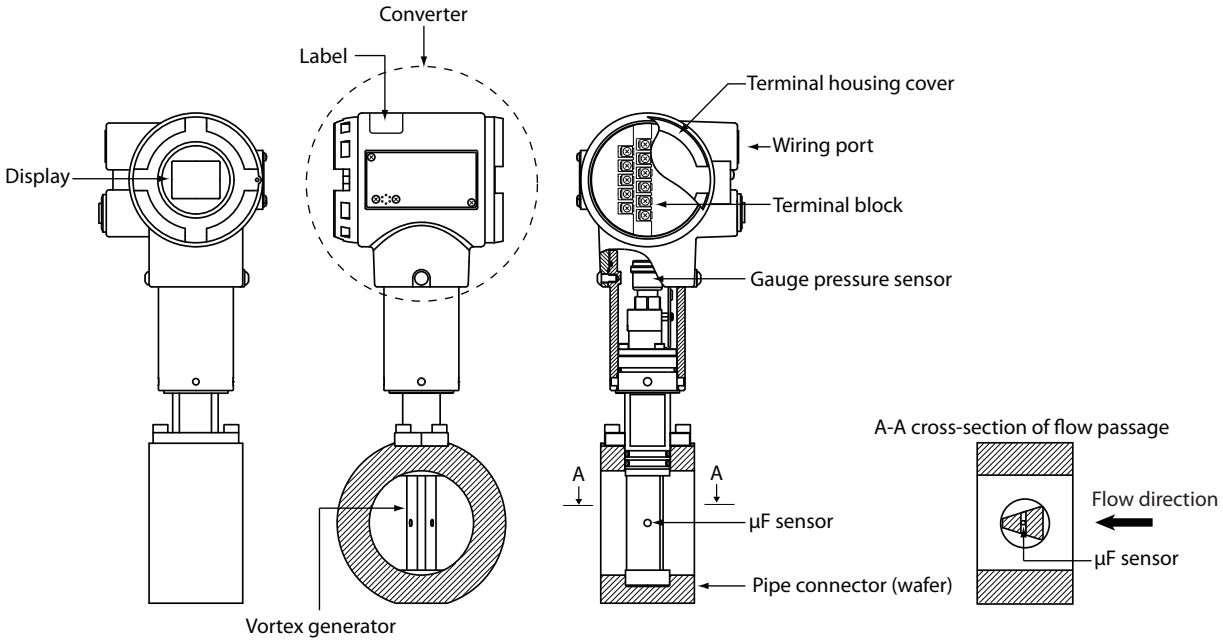
*1. If the gas type is oxygen, be sure to specify degreasing.

*2. Flow and mounting directions



Chapter 2. NAMES AND FUNCTIONS OF PARTS

■ Body



Display

Used for the display of instantaneous flow rate, integrated flow rate, and alarm status and error of this device. For details of the display, refer to; ☞ ■ Display (page 5).

Label

Indicates model number, range, and pulse rate. Check that they are the same as the specifications ordered.

Converter

Calculates temperature and pressure correction etc.

Wiring port

There are 2 wiring ports. Used for connecting an electric wiring conduit or mounting the included waterproof gland.

Terminal block

Used for wiring a power supply to the device, for 4-20mAdc output, integrated pulse output and communications.

Gauge pressure sensor

Detects pressure.

μF sensor

Detects vortex frequency and temperature.

Pipe connector

Wafer connection. Pipes are connected by sandwiching the pipe connector between flanges.

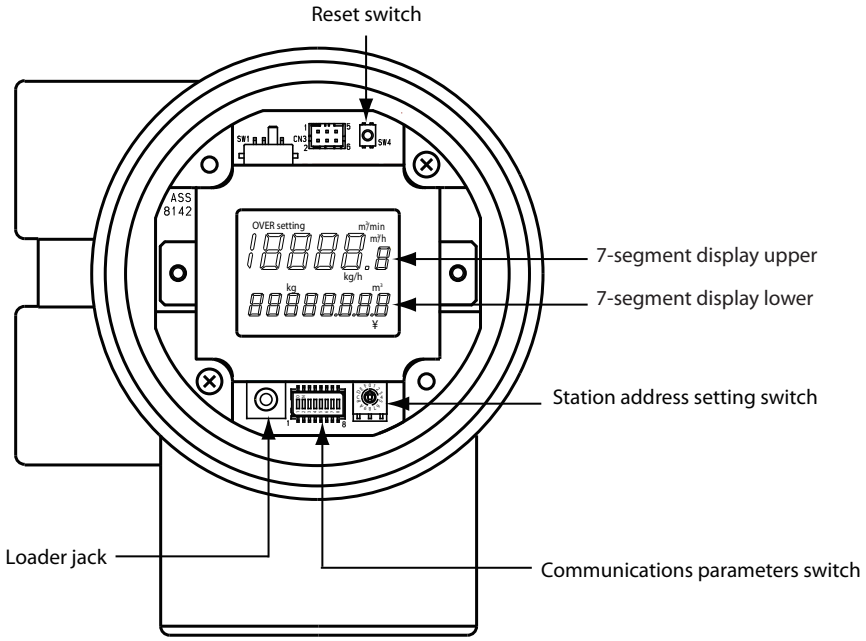
Vortex generator

Generates vortex.

■ Display

⚠ CAUTION

Before pressing the reset switch, touch a metal surface such as the housing of the device to discharge static electricity.



Reset switch

Resets the integrated (cumulative) value. To reset the integrated value, press the switch for 3 seconds or more.

Upper 7-segment display

Displays instantaneous flow rate.
(Example: 10000.0 m^3/h)

Lower 7-segment display

Displays integrated flow rate.
(Example: MVF050 1000000.0 m^3
MVF080/100/150 10000000 m^3)

Station address setting switch

Sets the station address for the device.
For setup details, refer to;
☞ MVF050/080/100/150 Micro Flow Vortex Gas Flowmeter User's Manual for Communications (CP-SP-1183E).

Communications parameters switch

Sets the communications parameters for the device.
For setup details, refer to;
☞ MVF050/080/100/150 Micro Flow Vortex Gas Flowmeter User's Manual for Communications (CP-SP-1183E).

Loader jack

For maintenance only. Do not connect.

Chapter 3. INSTALLATION, MOUNTING, WIRING

⚠ WARNING

- If this device is used with flammable gases such as natural gas, propane or butane, mount it on the upstream side of the safety shutoff valve. When air gets in the pipe and an explosive mixture is produced, and if a sensor should make a spark due to lightning or other reasons, the mixture may explode inside the pipe.
- The mass of this device is 7 to 23 kg according to the model number.
  Ensure to take complete precautions and care while handling for transportation or installation.
  For safe handling, two or more persons are required while handling this device.
  Accidental dropping of the device on the foot might cause injury.
- Do not hold the device by the converter alone.
  Doing so might damage the device, or the pipe connector section may drop off.
- Do not use this device or its installed pipes as a scaffolding.
  Doing so might damage the device or the pipe, or might cause physical injury.
- Do not disassemble this device.
  If it is disassembled when pressure remains in the pipes, the device could be damaged or someone could be injured by flying parts.

⚠ CAUTION

- Be sure to use this device for a flow not exceeding 36m/s, the maximum measurable velocity. To prevent excessive flow, use a suitable means to control the supply pressure or use a throttle valve or the like to control the flowrate. If the velocity exceeds the maximum measurable velocity, both the flowrate display and the output voltage/current may indicate considerably lower values than the actual flowrate. Refer to;
  ☞■ Behavior when the flowrate greatly exceeds the upper limit of flowrate (page 7).
- If damage could result from the abnormal functioning of this device include appropriate redundancy in the system design.
- Prevent foreign matter from entering the device.
  If the rust, water droplet, oil mist or dust in the piping flows into the device, measurement error might occur and result in damaging the device.
  If there is a possibility that any foreign matter flows into the device, provide a filter, strainer or mist trap capable of eliminating more than 1µm foreign matter at the upstream, and periodically inspect and replace the filter.
- This device is a precision instrument.
  Do not drop it nor subject it to shock. Doing so might damage the device.
- When mounting the device, firmly fasten to prevent vibration.

■ Installation

Avoid mounting this device in the following locations:

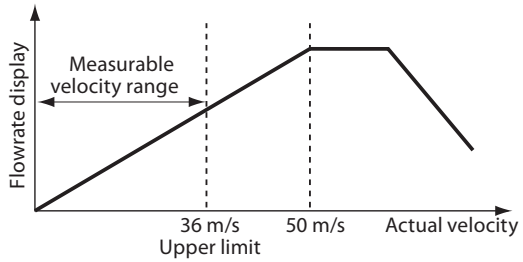
- Locations whose ambient temperature falls below −15˚C and rises above +60˚C
- Locations whose ambient humidity exceeds 90 %RH
- Locations subject to sudden changes in temperature and condensation
- Locations be filled with corrosive gases and flammable gases
- Locations where there are lots of conductive substances (e.g. dust, salt or iron dust), or organic solvents
- Locations subject to vibration or shock
- Locations subject to splashing by fluids (e.g. oil, chemicals.)
- Locations where strong magnetic or electrical fields are generated

[!] Handling precautions

- Although this device can be installed outdoors, if it is installed at the locations subject to direct sunlight, be sure to provide a sunshade.
  Doing so might cause faulty operation.

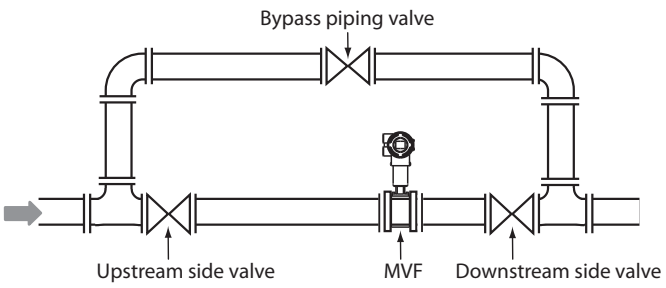
■ Behavior when the flowrate greatly exceeds the upper limit of flowrate

If the actual velocity exceeds the maximum measurable velocity of 36 m/s, the flowrate display will stop increasing in proportion to the flowrate. Be sure to use this device within the maximum measurable velocity.
If the velocity exceeds 50 m/s, the flowrate display will begin to decrease, giving the appearance that the flowrate is within the flowrate range limits.
Also, if there is a sudden greatly excessive velocity (50 m/s or more) for a very short period, the flowrate display will continue to indicate flow within the flowrate range, without indicating the spike.
Especially when this device is used for flow control, make sure to take appropriate measures, such as controlling the supply pressure or using a throttle valve, so that even at maximum control output, the flowrate does not exceed 36 m/s.

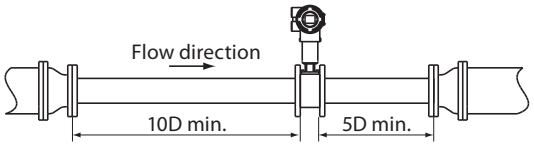
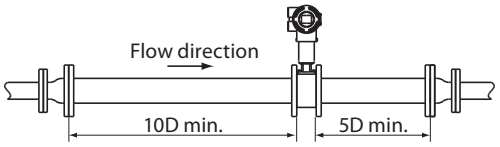
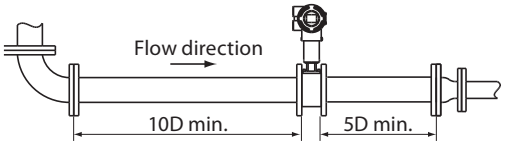
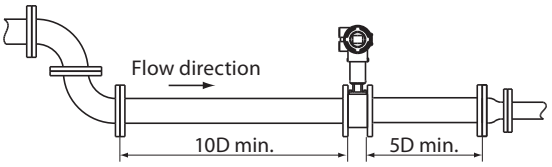
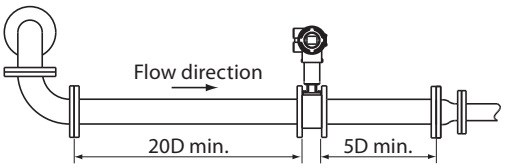


■ Precautions for piping installation

- When this device is installed, be sure to provide the bypass piping as shown below. Also, for the valves before and after this device, use a ball valve like as having the structure which does not disturb the gas flow.



- Provide a straight pipe section in upstream side and downstream side of the installation location.
  Use Sch 20 pipe for 50A, and Sch 40 pipe for 80A/100A/150A.
  D indicates the connecting port size. Secure the length of more than 5D for the downstream pipe section.

Type of Installation	
Reducing pipe	
Enlarging pipe	
Pipe with 90° bend	
Pipe with single-plane double 90° bend	
Pipe with threedimensional double 90° bend	

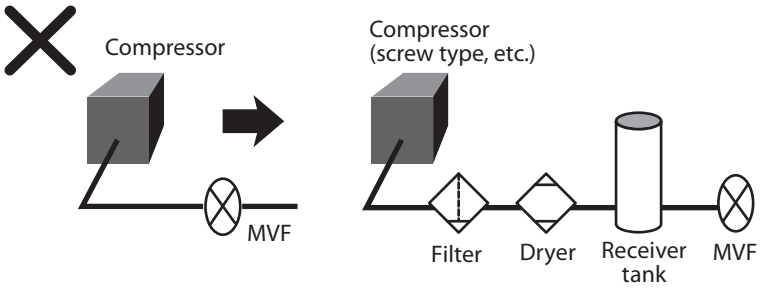
- If the oil, water or dust is contained in a fluid, install a device to remove them.
  If the oil, water or dust is contained in a fluid, they might cause measurement error or faulty operation.

Note

- Remove the water using a dryer so that it does not cause dew condensation in the pipe.
- Use an oil-eliminating mist separator with the eliminating capability of residual oil density less than 0.01mg/m^3.
- Do not install at a location receiving the influence of pulsating flow.

[!] Handling precautions

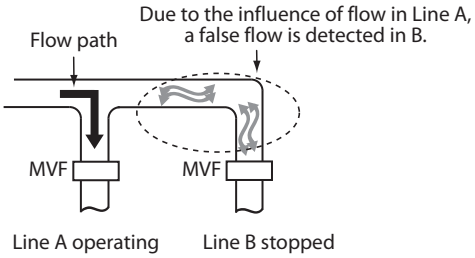
- Do not install this device at the location near the exit of compressor. At the location near the exit of compressor the strong pulsating flow is caused and there might be a dispersing of iron powder depending on the compressor type, there is a possibility of causing faulty operation.



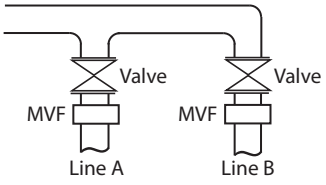
  As shown in the above figure, provide the devices eliminating the foreign matters such as oil, water and iron powder, and install a receiver tank as the measures against pulsating flow ; at the upstream of MVF series.

- Take effective countermeasures in case of installation near a pump or roots blower. If this device is installed near a pump or roots blower, it may be affected by a pulsating flow. Install a volume tank or pulsation-damping device (muffler) between the pump or roots blower and this device to suppress the influence of pulsation as much as possible.

- If the device is installed downstream of branched piping, it may detect reverse flow rate. Be sure to take countermeasures as illustrated below.
  Example: In this application, Line A is operating but B is stopped. Although the flow rate of B is essentially zero as detected by the MVF in B, the MVF might count and integrate a false flow rate caused by the influence of the flow in Line A.



  Countermeasure 1
  Install a valve on the upstream side of the MVFs if there is an unused line, to eliminate the influence of flow in the other line.



  Countermeasure 2
  Design the system so that other devices do not receive the output (4 to 20 mA or pulse) from the MVF on the unused line.

■ Piping work

⚠ WARNING

The mass of this device is 7 to 23 kg according to the model number.
Ensure to take complete precautions and care while handling for transportation or installation.
For safe handling, two or more persons are required while handling this device.
Accidental dropping of the device on the foot might cause injury.

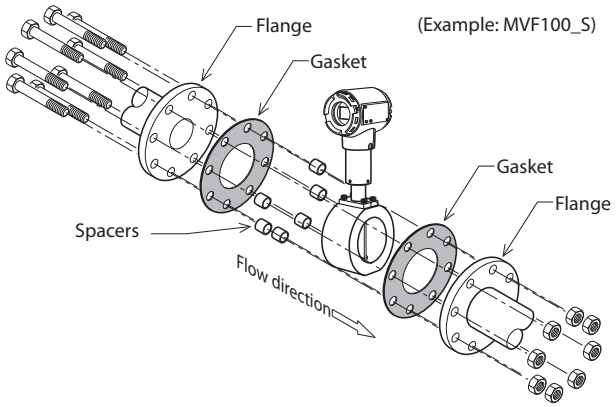
⚠ CAUTION

Do not flush when the device is mounted in the pipe. Doing so might cause damage due to entry of foreign matter and cause faulty operation or errors in measurement.

When connecting flanges, tighten with the specified torque.
Otherwise gas could leak from the pipe, causing injury.

[!] Handling precautions

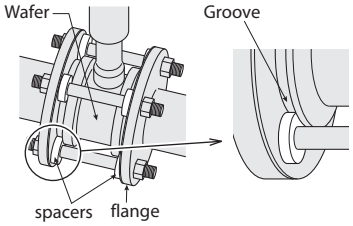
- When connecting to piping, be sure to check before installation that there is no inclination or displacement of the pipes. Failure to do so might cause leakage or measurement error.
- Be sure to flush (cleaning the inside of pipe) before installation this device to eliminate any foreign matter which might exist inside the pipe.
- When installing, pay special attention to the flow direction.



To mount this device, sandwich it between two pipe flanges (wafer mounting). Note that spacers should be used to prevent displacement during mounting. The use of spacers enables proper alignment of the piping and this device. Be sure to use the spacers.

Notes for mounting MVF _ _ _ _ C

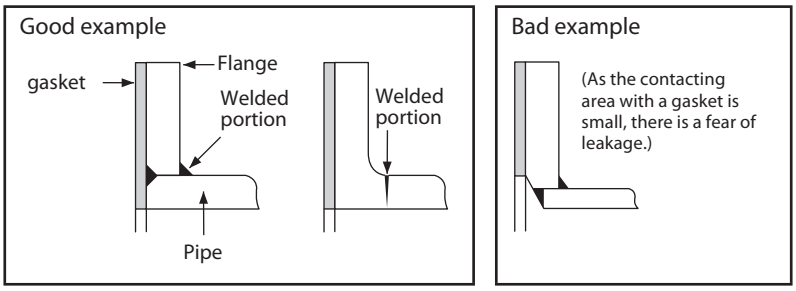
- Attach the spacers to the inside of both flanges.
- Be sure to place the spacers into both grooves between the wafer and the flange so that the wafer and the pipes are correctly aligned.



The number of spacers varies depending on the model.
MVF050_S: 4
MVF050_C: 8
MVF080_S/MVF100_S/MVF150_S: 6
MVF080_C/MVF100_C/MVF150_C: 12

● Flange shape

Use a flange which can secure a large contacting area with a gasket.



● Flange connection

Tighten the flange with bolts.
Tightening torque differs by pipe size. Tighten at a torque that is within the range specified in the table below.

Pipe size	Torque [Unit : N·m (kgf·cm)]
50A	37 to 47 (378 to 480)
80A	26 to 36 (265 to 367)
100A	32 to 42 (327 to 429)
150A	64 to 74 (653 to 755)

(The value in parentheses indicates the reference value.)

[!] Handling precautions

- Tighten bolts so that they are uniformly tightened. If leakage does not stop after tightening bolts, gradually tighten the bolts more a little at a time.
- Tighten bolts within the specified tightening torque.
  Otherwise, the bolts may be damaged.
- Do not forcibly insert into the narrow space between the flange faces.
  Doing so might cause leakage or damage.
- Six of the 8 bolts on MVF080/100/150 models require the use of a spacer to ensure that the are correctly aligned around the pipe connection unit (wafer) and that they match up properly with the holes in the pipe flanges.

● Diameter of gasket

A gasket is required for flange connection.
Refer to the table below for the inside diameter of gasket.

Pipe size	Inside diameter of gasket (Reference value)
50A	61 mm
80A	90 mm
100A	115 mm
150A	167 mm

[!] Handling precautions

- If the inside diameter of the gasket is too small, it might disturb the flow straightening condition inside of this device and cause inaccuracies.
- If the inside diameter is too large, it might cause leakage.

■ Wiring

⚠ CAUTION

When connecting the load to the output terminals, do not exceed the rated value shown in the specifications.
Doing to do so might cause the damage of this device.

Before wiring, be sure to turn the power OFF.

Before supplying power, be sure to check that there is no wiring error.
A wiring error might damage the device or cause a dangerous condition.

[!] Handling precautions

- Be sure to separate the communications wires from power lines, which should not be laid in the same electrical conduit.

There are two wiring methods, direct cable lead-out and use of an electrical wiring conduit.
When installing the device outdoors, be sure to use a conduit.

● Tools required

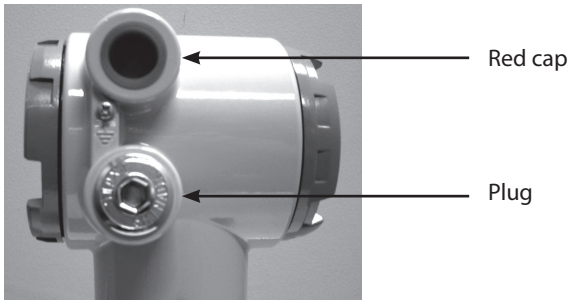
Phillips-head screwdriver, adjustable wrench (spanner)

● Procedure for direct cable lead-out

(1) Specify the wiring port.

[!] Handling precautions

- There are 2 wiring ports. One has a red cap and the other has a plug. Decide whether to use 1 port or 2 ports depending on the number of cables or desired separation of signal wires.

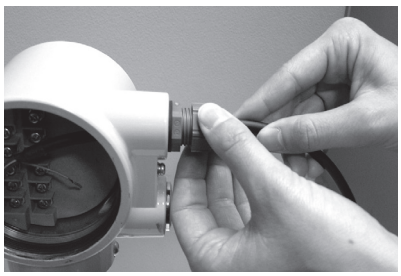


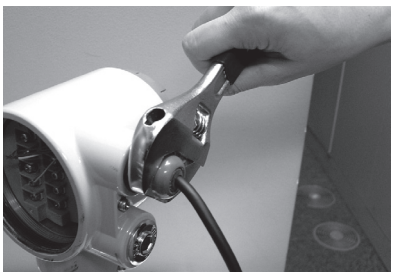
(2) Remove the red cap from the wiring port. When leading out the wiring from two ports, remove the plug also.

(3) Remove the terminal cover.

(4) Put the packing on the supplied waterproof gland.

(5) Pass the cable through the waterproof gland, and mount the waterproof gland in the wiring port.





[!] Handling precautions

- Never remove the packing from the waterproof gland.
- Use a cable that is 6 to 12 mm in diameter.

(6) Connect the wiring to the terminal block.

(7) Put the terminal cover back in place.

● **Procedure for using an electrical wiring conduit**

The wiring port thread is G1/2.

(1) Specify the wiring port.

[!] Handling precautions

- There are 2 wiring ports. One has a red cap and the other has a plug. Decide whether to use 1 port or 2 ports depending on the number of cables or desired separation of signal wires.

(2) Remove the red cap from the wiring port.

(3) When leading out the wiring from two ports, remove the plug also.

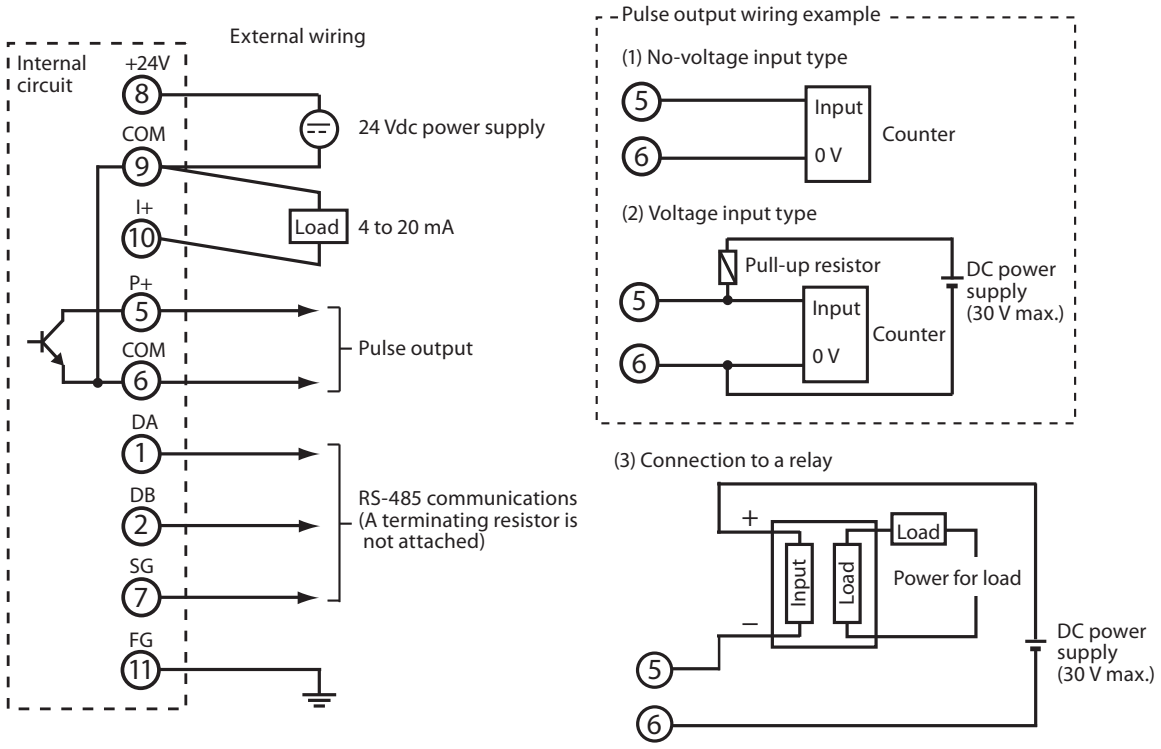
(4) Remove the terminal cover.

(5) Connect an electrical wiring conduit.

(6) Pass the wiring through the electrical wiring conduit and then connect the wiring to the terminal block.

(7) Put the terminal cover back in place.

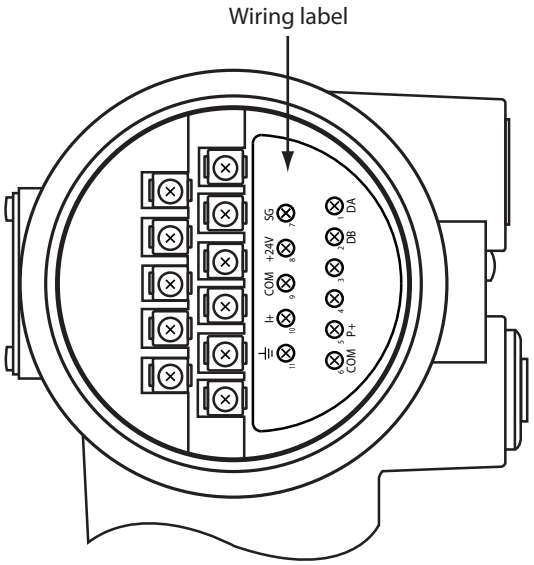
● **Wiring example**



! Handling precautions

- Connect COM of 4-20 mA output directly from the terminal block.
- Do not use the COM of power supply terminal (4-20 mA) and the COM of pulse output terminal as a common power supply terminal for external devices.
- Be sure that the pulse output never exceeds the output rating of this device. When driving a relay, use a relay with a built-in diode for coil surge absorption. Failure to do so may cause faulty operation.
- This device becomes a warm-up mode for about 13 seconds after power on. During the warm-up period, calculation and outputs are as follow:
  - Display: does not display a flowrate. (Demonstration only)
  - Accumulative operation: no operation
  - Analog output: outputs current over 20 mA during 200-300 ms period. Then an instantaneous flowrate will be output.
  - Pulse output: no outputs
  - Communication: no operation

● **Terminal layout**



Terminal No.	Signal name	Description
1	DA	RS-485 communication DA
2	DB	RS-485 communication DB
3	Unused	Do not use
4	Unused	Do not use
5	P+	Pulse output (NPN open collector)
6	COM	Common
7	SG	RS-485 communication common
8	+24V	24 V power
9	COM	Common
10	I+	4 to 20 mA output
11	⏚	Ground terminal

[!] Handling precautions

- Connect each terminal securely using crimp type terminal lugs to ensure firm contact area.
- Use crimp type terminal lugs applicable to M4 screw.
- Be sure that the tightening torque of terminal screw is less than 0.8 N·m.
- Use the JIS C 3401 cables for control (CVV etc.) of less than 2.2 mm dia. for the wiring except RS-485 communications.
  However, if there is a risk of power surge due to lightning on a signal line, use a shielded cable.
- Use the twisted-pair shielded cables for the wiring of RS-485 communications.
  Be sure to apply terminating resistors (150 Ω 1/2 W).
  For communications of wiring details, refer to;
  ☞ MVF050/080/100/150 Micro Flow Vortex Gas Flowmeter User's Manual for Communications (CP-SP-1183E).

Chapter 4. TROUBLESHOOTING

If there is a problem with this device, refer to the table below.

■ Nothing on display

Make sure that the correct power voltage being applied and the polarity are correct.
Make sure that the electric wires are connected.

■ Error message (faulty operation)

When an error message is displayed, contact the azbil Group. Repair at Azbil Corporation is required.

Error message	Failure location	Cause
Er01	Flow sensor	Flow sensor error
Er02	Temperature sensor	The cause may be an error or burnout of the sensor for temperature detection. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er03	Flow sensor Temperature sensor	There may be an error or burnout of the flow sensor or temperature sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er04	Pressure sensor	The cause may be an error or burnout of the pressure compensating sensor.
Er05	Flow sensor Pressure sensor	The cause may be an error or burnout of the flow sensor or pressure sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er06	Temperature sensor Pressure sensor	The cause may be an error or burnout of the temperature sensor or pressure sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er07	Flow sensor Temperature sensor Pressure sensor	The cause may be an error or burnout of the flow sensor, temperature sensor, or pressure sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er08	EEPROM	The cause may be an error in the nonvolatile memory used by the internal microcomputer.

Note. While an error is displayed, the analog output (4–20 mA) is the output that is set for burnout. The default setting for burnout is downscale output (3 mA max.).

■ Alarm display

If conditions exceed the device's specified range, an alarm message and the instantaneous flowrate are displayed alternately. In order to use this device within an allowable range, change the conditions of the fluid.

Alarm display	Cause
AL01	Flowrate upper limit alarm
AL02	Temperature lower limit alarm
AL03	Flowrate upper limit alarm + Temperature lower limit alarm
AL04	Temperature upper limit alarm
AL05	Flowrate upper limit alarm + Temperature upper limit alarm
AL08	Pressure upper limit alarm
AL09	Flowrate upper limit alarm + Pressure lower limit alarm
AL10	Temperature lower limit alarm + Pressure lower limit alarm
AL11	Flowrate upper limit alarm + Temperature lower limit alarm + Pressure lower limit alarm
AL12	Temperature upper limit alarm + Pressure lower limit alarm
AL13	Flowrate upper limit alarm + Temperature upper limit alarm + Pressure lower limit alarm
AL16	Pressure upper limit alarm
AL17	Flowrate upper limit alarm + Pressure upper limit alarm
AL18	Temperature lower limit alarm + Pressure upper limit alarm
AL19	Flowrate upper limit alarm + Temperature lower limit alarm + Pressure upper limit alarm
AL20	Temperature upper limit alarm + Pressure upper limit alarm
AL21	Flowrate upper limit alarm + Temperature upper limit alarm + Pressure upper limit alarm

Flowrate upper limit alarm: Velocity 45 m/s or more.
Temperature lower limit alarm: −15 ˚C or lower.
Temperature upper limit alarm: +60 ˚C or more.
Pressure lower limit alarm: −50 kPa or lower.
Pressure upper limit alarm: 0.1 MPa or more (model with operating pressure range 0-0.1 MPa).
0.3 MPa or more (model with operating pressure range 0-0.3 MPa).
1.0 MPa or more (model with operating pressure range 0-1.0 MPa).

Chapter 5. SPECIFICATIONS

■ Specifications

Item		Specifications			
		MVF050	MVF080	MVF100	MVF150
Pipe size		50A (2B)	80A (3B)	100A (4B)	150A (6B)
Flowrate measurement range (for air)*2 [m³/h (normal)]*3	at a pressure of 0.05 MPa	7.4 to 322	11.0 to 711	13.7 to 1095	23.6 to 2356
	at a pressure of 0.15 MPa	7.4 to 535	11.8 to 1181	18.2 to 1819	39.1 to 3913
	at a pressure of 0.5 MPa	12.8 to 1280	28.3 to 2825	43.5 to 4351	93.6 to 9364
Applicable gas		Air, Nitrogen, Argon, Oxygen*1, Carbon dioxide, natural gas (LNG base), Methane, Propane, Butane, and other inert gases and mixed gases outside the explosion limit range.			
Volumetric flowrate accuracy (for air)*4*5		±2 %RD at 73 m³/h (actual) or more	±2 %RD at 109 m³/h (actual) or more	±2 %RD at 154 m³/h (actual) or more	±2 %RD at 282 m³/h (actual) or more
Accuracy after temperature and pressure correction (at a pressure of 0.5 MPa)*6		±3.3 %RD at 74 m³/h (normal) or more	±3.3 %RD at 110 m³/h (normal) or more	±3.3 %RD at 156 m³/h (normal) or more	±3.5 %RD at 286 m³/h (normal) or more
Operating pressure range (Accuracy of pressure sensor)		0.0 to 0.1 MPa (±2 %FS at 23 °C) for MVF_ _ _1			
		0.0 to 0.3 MPa (±2 %FS at 23 °C) for MVF_ _ _3			
		0.0 to 1.0 MPa (±1 %FS at 23 °C) for MVF_ _ _0			
Pressure resistance		0.15 MPa for MVF_ _ _1			
		0.45 MPa for MVF_ _ _3			
		1.5 MPa for MVF_ _ _0			
Operating temperature range (Accuracy of temperature sensor)		−15 to +60 °C (±2 %RD (absolute temperature base))			
Operating humidity range		10 to 90 %RH (No condensation allowed)			
Flow rate calculation/output updating cycle		100 ms			
Rated power supply		24 Vdc			
Current consumption		100 mA max.			
Output signal (1 point)		Instantaneous flowrate output: 4 to 20 mAdc (Allowable load resistance 600 Ω max.) Maximum Current value: 23.2 mA			
Integrated pulse output (1 point)		Open collector output Absolute maximum rating: 30 Vdc, 20 mA max. Pulse weight MVF050: 0.01, 0.1, 1, 10 (The unit depends on the instantaneous flow rate display unit.) MVF080/100/150: 0.1, 1, 10, 100 (The unit depends on the instantaneous flow rate display unit.) Pulse width Output intervals of 1s or more: 0.5 s Output intervals of less than 1s: duty ratio 50 %			
Communication function 1		RS-485 interface, Transmission line: 3-wire system Communication distance: 300 m max. Compatible with Azbil Corporation's products (CMC15G, etc.) Transmission speed: 2400, 4800, 9600, 19200 bps Integrated value, instantaneous, value/warning, and settings can be recorded.			
Communication function 2		Mini-plug jack for PC Smart Loader connection, used in servicing by the manufacturer.			
Display	Flowrate display	6-digit LCD for instantaneous flow rate, 8-digit LCD for totalized flow rate			
	Instantaneous flow rate	_ _ _ _ _._ m³/h ("1" is the max. value for the first digit)			_ _ _ _ _ m³/h (no decimal point) ("1" is the max. value for the first digit)
	Totalized flow rate*7	_ _ _ _ _ _ _._ m³ (up to 1 digit after the decimal point)	_ _ _ _ _ _ _ _ m³ (no decimal point)		
	Status display	OVER: Flowrate range over, setting: For maintenance			
Gas contacting parts material		Flow passage: SUS304 (SCS13A) µF sensor: Silicon, Gold etc., O-ring: Type 4D (Viton)			
Convertor material		Aluminum alloy (ADC12)			
Convertor coating		Acrylic resin corrosion resistant coating Coating color: Light beige			
Display glass parts material		Tempered glass: Thickness 10 mm			
Mounting direction		(flow direction) Horizontal/Vertical mounting			
Connection type		MVF_ _ _ _ _U: JIS 10K wafer connection MVF_ _ _ _CD: DIN PN10 wafer connection MVF_ _ _ _CA: ANSI 150 wafer connection			

Item	Specifications			
	MVF050	MVF080	MVF100	MVF150
Wiring port	Connection port: 2 locations, Connection standard: G1/2 female thread Accessories: 2 water-proof glands attached			
Sealing	IP67 (JIS C 0920 and IEC 529 Water-proof and dust-proof structure on the assumption of outdoor installation)			
Applicable standard	EN61326-2-3: 2006, EN61326-1: 2006			
Mass (kg)*8	7 (6.3)	8 (6.6)	10 (9)	23 (17)

*1. Oxygen can be used only for models with degreased gas-contacting parts.
*2. Flow rate measurement range at a fluid temperature of 23 °C.
*3. The "normal" shows a volumetric flowrate (m^3/h) after correcting with 0 °C, 101.325 kPa.
For other conditions, see "Tables for accuracy after temperature and pressure correction (in air)" (page 24).
*4. The volumetric flowrate accuracy differs with an operating pressure and a flowrate range.
For details, the "Tables for specifying volumetric flow rate accuracy (in air)" (page 23).
*5. Volumetric flow rate accuracy at a fluid temperature of 23 °C and fluid pressure of 0.01 MPa
*6. The data is an example of the MVF_ _ _0 with the pressure sensor of 0-1.0 MPa.
For other models, see "Tables for accuracy after temperature and pressure correction (in air)" (page 24).
And, using a gauge pressure sensor, atmospheric pressure fluctuation is not included.
*7. The integrated flowrate display becomes "00000000" after counting up to "99999999."
For details about setup, refer to "MVF050/080/100/150 Micro Flow Vortex Gas Flowmeter User's Manual for Communications," manual No. (CP-SP-1183E).
*8. The number in parentheses is the mass if the body material is SCS13A.

■ Specifying accuracy

Velocity of measurable specifying accuracy:
From the large one which the velocity at Re 3500 or 0.3 m/s, to the velocity of 30 m/s
Minimum measurable velocity:
The large one which the velocity at Re 3500 or 0.3 m/s
Maximum measurable velocity:
36 m/s

See the tables for specifying accuracy on pages 23 and following. The accuracy tables show the ranges when the gas is air. To convert to other application conditions, calculate as shown below.

The Reynolds number (Re) used below is calculated using the formula

$Re = (V \times D)/\nu$.
V: velocity (m/s)
D: typical length (internal diameter of the MVF body (m))
MVF050: 52.5 mm, MVF080: 78 mm, MVF100: 96.8 mm, MVF150: 142 mm
ν: Kinetic viscosity of the fluid (m^2/s), $\nu = \mu/\rho$
For instance, in the case of air (dry air) at 0 °C and 101.3 kPa,
Viscosity $\mu = 17.24 \times 10^{-6}$ Pa·s
Density $\rho = 1.293$ kg/m^3
From these conditions, the kinetic viscosity $\nu = 13.35 \times 10^{-6}$ m^2/s.
Also, in the case of air (dry air) at 23 °C and 700 kPa,
$\nu = 1.883 \times 10^{-6}$ m^2/s.

As a calculation example, we will use the following conditions:
Installed flowmeter: MVF0800 (operating pressure range 0-1.0 MPa)
Fluid: air (dry air)
Operating pressure: 700 kPa
Fluid temperature: 23 °C
Atmospheric pressure: 101.3 kPa

We will calculate the following items:

1. Minimum measurable flow rate
2. Maximum measurable flow rate
3. Accuracy after temperature and pressure correction (examples: for 100 and 150 m^3/h (normal))

1. Minimum measurable flow rate (volumetric flow rate (m^3/h) and mass flow rate (m^3/h (normal))

First, the minimum measurable velocity is determined as the larger of 0.3 m/s or the velocity at Re 3500. The velocity at Re 3500 is calculated from the formula for calculating Re:

$V = Re \times \nu/D.$

Here, if Re = 3500, $\nu = 1.883 \times 10^{-6}\ m^2/s$, and $D = 78 \times 10^{-3}$ m,

$V = 3500 \times 1.883 \times 10^{-6}/(78 \times 10^{-3}) = 0.08$ m/s.

Since a velocity of 0.08 m/s at Re 3500 is less than 0.3 m/s, the minimum measurable velocity is 0.3 m/s.

Now, the minimum measurable volumetric flow rate can be calculated as

Qactual (m^3/h) = S × V × 3600 = 5.2.

S: flow path cross-section of MVF080 (m^2) = $(78 \times 10^{-3})^2 \times \pi/4$
V: velocity (m/s) = 0.3

Therefore, volumetric flow rate can be measured down to 5.2 m^3/h.

Next, we can calculate the minimum mass flow rate Qnormal (m^3/h (normal)) at 0 °C and pressure of 101.3 kPa, with temperature and pressure correction.

$$\text{Qnormal } (m^3/h(\text{normal})) = 5.2 \times \underbrace{((273+0)/(273+23))}_{\text{Amount of temperature correction}} \times \underbrace{((101.3+700)/101.3)}_{\text{Amount of pressure correction}} = 38$$

Therefore, mass flow rate can be measured starting from a minimum of 38 m^3/h (normal).

2. Maximum measurable flow rate (volumetric flow rate (m^3/h) and mass flow rate (m^3/h (normal))

MVF flowmeters can measure velocity up to 30 m/s.

The volumetric flow rate Qactual (m^3/h) at velocity 30 m/s is determined by
Qactual (m^3/h) = S × V × 3600 = 516.
S: flow path cross-section of MVF080 (m^2) = $(78 \times 10^{-3})^2 \times \pi/4$
V: velocity (m/s) = 30

The volumetric flow rate can be measured up to 516 m^3/h.

Next, we can calculate the mass flow rate at 0 °C and pressure of 101.3 kPa, with temperature and pressure correction, by

$$\text{Qnormal } (m^3/h(\text{normal})) = 516 \times \underbrace{((273+0)/(273+23))}_{\text{Amount of temperature correction}} \times \underbrace{((101.3+700)/101.3)}_{\text{Amount of pressure correction}} = 3765$$

Mass flow rate can be measured up to 3765 m^3/h (normal).

3. Accuracy after temperature and pressure correction

As an example, we will calculate the accuracy after temperature and pressure correction at 100 m^3/h and 150 m^3/h (normal), using the following formula:

$$\text{Accuracy after correction}\ (\%RD) = \sqrt{(\text{volumetric flow rate accuracy}\ (\%RD)^2 + \text{temperature accuracy}\ (\%RD)^2 + \text{pressure accuracy}\ (\%RD)^2)}$$

Temperature and pressure sensor accuracy is as follows:

Temperature measurement accuracy: ±2 % RD (absolute temperature base)
Pressure accuracy (%RD) = (upper limit of operating pressure range (MPa) × pressure measurement accuracy (%FS)/100)/(fluid pressure (MPa) + 0.1013 (MPa))

In this case, the pressure measurement accuracy is 1 %FS in the 0-1.0 MPa range of the MVF0800 (operating pressure range 0-1.0 MPa).

In order to calculate the volumetric flow rate accuracy, the Reynolds number is first calculated from the mass flow rate (m^3/h, normal).

The steps of the calculation are: mass flow rate → volumetric flow rate → velocity → the Reynolds number.

Mass flow rate → volumetric flow rate calculation
Qactual (m^3/h) = 100 × ((273+23)/(273+0) × (101.3/(101.3 + 700)) = 13.7

Volumetric flow rate → Velocity calculation
Velocity V(m/s) = Qactual(m^3/h)/S/3600 = 13.7/((78 × 10^{-3})^2 × π/4)/3600 = 0.8
S: flow path cross-section of MVF080 (m^2) = (78 × 10^{-3})^2 × π /4

Velocity → Re calculation
Re = (V × D)/ ν = 0.8 × 78 × 10^{-3} / 1.883 × 10^{-6} = 33139
V: velocity (m/s) = 0.8
D: internal diameter of the MVF body (m); for MVF080, D = 78 mm
ν: kinetic viscosity of fluid (m^2/s)
For dry air, 23 °C and 700 kPa, ν = 1.883 × 10^{-6} m^2/s

Volumetric flow rate accuracy is checked by the Reynolds number.
With Re = 33139 (flow rate = 0.8 m/s), since the velocity is 0.5 m/s or more and the Reynolds number is in the 10000-35000 range, the volumetric flow rate accuracy is ±4 % RD.
☞ ● Specifying volumetric flow rate accuracy (page 22)

Volumetric flow rate accuracy = 4 % RD
Temperature accuracy = 2 % RD
Pressure accuracy = 1 (MPa) × 1 (%FS)/100/(fluid pressure (MPa) + 0.1013 (MPa))
= 0.01/(0.7+0.1013) = 1.2 % RD
In this case, the pressure measurement accuracy is 1 %FS in the 0-1.0 MPa range of the MVF0800 (operating pressure range 0-1.0 MPa).

Based on these conditions,

The accuracy after temperature correction = $\sqrt{(4\ \%)^2 + (2\ \%)^2 + (1.2\ \%)^2}$ = 4.6 %RD

At 100 m^3/h (normal), the accuracy is 4.6 % RD.

The calculation for the flow rate of 150 m^3/h (normal) is performed similarly.

Re = 49517 (velocity = 1.2 m/s).

Since the Reynolds number is more than 35000, the volumetric flow rate accuracy is ±2 % RD.
☞ ● Specifying volumetric flow rate accuracy (page 22)

Volumetric flow rate accuracy = 2 % RD
Temperature accuracy = 2 % RD
Pressure accuracy = 1 (MPa) × 1 (%FS)/100/(fluid pressure (MPa) + 0.1013 (MPa))
= 0.01/(0.7+0.1013) = 1.2 % RD

Based on these conditions,

The accuracy after temperature correction = $\sqrt{(2\ \%)^2 + (2\ \%)^2 + (1.2\ \%)^2}$ = 3.1 %RD

At 150 m^3/h (normal), the accuracy is 3.1 % RD.

● Specifying volumetric flow rate accuracy

The volumetric flow rate accuracy is specified as follows:

- MVF50 (pipe size 50A)
  - ±Qmin (minimum measurable flow rate) when velocity is 0.5 m/s or less, or the Reynolds number is 15000 or less.
    4 % RD when velocity is 0.5 m/s or more, and the Reynolds number is from 15000 to 35000.
    2 % RD when the Reynolds number is 35000 or more.
- MVF80 (pipe size 80A)
  - ±Qmin (minimum measurable flow rate) when velocity is 0.5 m/s or less, or the Reynolds number is 10000 or less.
    4% RD when velocity is 0.5 m/s or more, and the Reynolds number is from 10000 to 35000.
    2% RD when the Reynolds number is 35000 or more.
- MVF100 (pipe size 100A)
  - ±Qmin (minimum measurable flow rate) when velocity is 0.5 m/s or less, or the Reynolds number is 10000 or less.
    4 % RD when velocity is 0.5 m/s or more, and the Reynolds number is from 10000 to 40000.
    2 % RD when the Reynolds number is 40000 or more.
- MVF150 (pipe size 150A)
  - ±Qmin (minimum measurable flow rate) when velocity is 0.5 m/s or less, or the Reynolds number is 10000 or less.
    4 % RD when velocity is 0.5 m/s or more, and the Reynolds number is from 10000 to 50000.
    2 % RD when the Reynolds number is 50000 or more.

■ Tables for specifying volumetric flow rate accuracy (in air)

Flow rate unit of measurement: m^3/h (normal)
Accuracy is measured at a fluid temperature of 23 °C.
Accuracy differs according to operating pressure and flow rate ranges.

● MVF050 (Pipe size 50A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
		±Q min	±4 %RD	±2 %RD
0.01	7.3	7.3≤Q≤31	31<Q<73	73≤Q≤234
0.02	6.7	6.7≤Q≤29	29<Q<67	67≤Q≤234
0.03	6.2	6.2≤Q≤27	27<Q<62	62≤Q≤234
0.04	5.8	5.8≤Q≤25	25<Q<58	58≤Q≤234
0.05	5.4	5.4≤Q≤23	23<Q<54	54≤Q≤234
0.06	5.0	5.0≤Q≤22	22<Q<50	50≤Q≤234
0.07	4.7	4.7≤Q≤20	20<Q<47	47≤Q≤234
0.08	4.5	4.5≤Q≤19	19<Q<45	45≤Q≤234
0.09	4.3	4.3≤Q≤18	18<Q<43	43≤Q≤234
0.10	4.0	4.0≤Q≤17	17<Q<40	40≤Q≤234
0.20	2.7	2.7≤Q≤12	12<Q<27	27≤Q≤234
0.30	2.3	2.3≤Q≤ 9	9<Q<20	20≤Q≤234
0.40	2.3	2.3≤Q≤ 7	7<Q<16	16≤Q≤234
0.50	2.3	2.3≤Q≤ 6	6<Q<14	14≤Q≤234
0.60	2.3	2.3≤Q≤ 5	5<Q<12	12≤Q≤234
0.70	2.3	2.3≤Q≤ 4	4<Q<10	10≤Q≤234
0.80	2.3	2.3≤Q≤ 4	4<Q< 9	9≤Q≤234
0.90	2.3	2.3≤Q≤ 4	4<Q< 8	8≤Q≤234
0.98	2.3	2.3≤Q≤ 4	4<Q< 8	8≤Q≤234

● MVF080 (Pipe size 80A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
		±Q min	±4 %RD	±2 %RD
0.01	10.9	10.9≤Q≤31	31<Q<109	109≤Q≤516
0.02	10.0	10.0≤Q≤28	28<Q<100	100≤Q≤516
0.03	9.2	9.2≤Q≤26	26<Q< 92	92≤Q≤516
0.04	8.6	8.6≤Q≤24	24<Q< 86	86≤Q≤516
0.05	8.0	8.0≤Q≤23	23<Q< 80	80≤Q≤516
0.06	7.5	7.5≤Q≤21	21<Q< 75	75≤Q≤516
0.07	7.1	7.1≤Q≤20	20<Q< 71	71≤Q≤516
0.08	6.7	6.7≤Q≤19	19<Q< 67	67≤Q≤516
0.09	6.3	6.3≤Q≤18	18<Q< 63	63≤Q≤516
0.10	6.0	6.0≤Q≤17	17<Q< 60	60≤Q≤516
0.20	5.2	5.2≤Q≤11	11<Q< 40	40≤Q≤516
0.30	5.2	5.2≤Q≤ 9	9<Q< 30	30≤Q≤516
0.40	5.2	5.2≤Q≤ 9	9<Q< 24	24≤Q≤516
0.50	5.2	5.2≤Q≤ 9	9<Q< 20	20≤Q≤516
0.60	5.2	5.2≤Q≤ 9	9<Q< 17	17≤Q≤516
0.70	5.2	5.2≤Q≤ 9	9<Q< 15	15≤Q≤516
0.80	5.2	5.2≤Q≤ 9	9<Q< 13	13≤Q≤516
0.90	5.2	5.2≤Q≤ 9	9<Q< 12	12≤Q≤516
0.98	5.2	5.2≤Q≤ 9	9<Q< 11	11≤Q≤516

● MVF100 (Pipe size 100A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
		±Qmin	±4%RD	±2%RD
0.01	13.5	13.5≤Q≤39	39<Q<154	154≤Q≤795
0.02	12.4	12.4≤Q≤35	35<Q<141	141≤Q≤795
0.03	11.4	11.4≤Q≤33	33<Q<131	131≤Q≤795
0.04	10.6	10.6≤Q≤30	30<Q<121	121≤Q≤795
0.05	9.9	9.9≤Q≤28	28<Q<113	113≤Q≤795
0.06	9.3	9.3≤Q≤27	27<Q<106	106≤Q≤795
0.07	8.8	8.8≤Q≤25	25<Q<100	100≤Q≤795
0.08	8.3	8.3≤Q≤24	24<Q< 95	95≤Q≤795
0.09	7.9	7.9≤Q≤22	22<Q< 90	90≤Q≤795
0.10	7.9	7.9≤Q≤21	21<Q< 85	85≤Q≤795
0.20	7.9	7.9≤Q≤14	14<Q< 57	57≤Q≤795
0.30	7.9	7.9≤Q≤13	13<Q< 43	43≤Q≤795
0.40	7.9	7.9≤Q≤13	13<Q< 34	34≤Q≤795
0.50	7.9	7.9≤Q≤13	13<Q< 29	29≤Q≤795
0.60	7.9	7.9≤Q≤13	13<Q< 24	24≤Q≤795
0.70	7.9	7.9≤Q≤13	13<Q< 21	21≤Q≤795
0.80	7.9	7.9≤Q≤13	13<Q< 19	19≤Q≤795
0.90	7.9	7.9≤Q≤13	13<Q< 17	17≤Q≤795
0.98	7.9	7.9≤Q≤13	13<Q< 16	16≤Q≤795

● MVF150 (Pipe size 150A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
		±Qmin	±4%RD	±2%RD
0.01	19.8	19.8≤Q≤56	56<Q<282	282≤Q≤1710
0.02	18.1	18.1≤Q≤52	52<Q<259	259≤Q≤1710
0.03	17.1	17.1≤Q≤48	48<Q<239	239≤Q≤1710
0.04	17.1	17.1≤Q≤44	44<Q<222	222≤Q≤1710
0.05	17.1	17.1≤Q≤42	42<Q<208	208≤Q≤1710
0.06	17.1	17.1≤Q≤39	39<Q<195	195≤Q≤1710
0.07	17.1	17.1≤Q≤37	37<Q<184	184≤Q≤1710
0.08	17.1	17.1≤Q≤35	35<Q<173	173≤Q≤1710
0.09	17.1	17.1≤Q≤33	33<Q<164	164≤Q≤1710
0.10	17.1	17.1≤Q≤31	31<Q<156	156≤Q≤1710
0.20	17.1	17.1≤Q≤29	29<Q<104	104≤Q≤1710
0.30	17.1	17.1≤Q≤29	29<Q< 78	78≤Q≤1710
0.40	17.1	17.1≤Q≤29	29<Q< 63	63≤Q≤1710
0.50	17.1	17.1≤Q≤29	29<Q< 52	52≤Q≤1710
0.60	17.1	17.1≤Q≤29	29<Q< 45	45≤Q≤1710
0.70	17.1	17.1≤Q≤29	29<Q< 39	39≤Q≤1710
0.80	17.1	17.1≤Q≤29	29<Q< 35	35≤Q≤1710
0.90	17.1	17.1≤Q≤29	29<Q< 31	31≤Q≤1710
0.98	17.1	17.1≤Q≤29	—	29<Q≤1710

■ Tables for accuracy after temperature and pressure correction (in air)

Flow rate unit of measurement: m^3/h (normal)
Accuracy is measured at a fluid temperature of 23 °C.
Accuracy differs according to operating pressure and flow rate ranges.

(1) Operating pressure range 0-0.1 MPa: MVF_ _ _1

● **MVF0501**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.01	7.4	±Q min	±4.8 %RD	±3.4 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤237
0.02	7.4	±Q min	±4.8 %RD	±3.3 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤258
0.03	7.4	±Q min	±4.7 %RD	±3.2 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤279
0.05	7.4	±Q min	±4.7 %RD	±3.1 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤322
0.1	7.4	±Q min	±4.6 %RD	±3.0 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤428

● **MVF0801**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.01	11.0	±Q min	±4.8 %RD	±3.4 %RD
		11.0≤Q≤31	31<Q<110	110≤Q≤523
0.02	11.0	±Q min	±4.8 %RD	±3.3 %RD
		11.0≤Q≤31	31<Q<110	110≤Q≤570
0.03	11.0	±Q min	±4.7 %RD	±3.2 %RD
		11.0≤Q≤31	31<Q<110	110≤Q≤617
0.05	11.0	±Q min	±4.7 %RD	±3.1 %RD
		11.0≤Q≤31	31<Q<110	110≤Q≤711
0.1	11.0	±Q min	±4.6 %RD	±3.0 %RD
		11.0≤Q≤31	31<Q<110	110≤Q≤946

● **MVF1001**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.01	13.7	±Q min	±4.8 %RD	±3.4 %RD
		13.7≤Q≤39	39<Q<156	156≤Q≤805
0.02	13.7	±Q min	±4.8 %RD	±3.3 %RD
		13.7≤Q≤39	39<Q<156	156≤Q≤878
0.03	13.7	±Q min	±4.7 %RD	±3.2 %RD
		13.7≤Q≤39	39<Q<156	156≤Q≤905
0.05	13.7	±Q min	±4.7 %RD	±3.1 %RD
		13.7≤Q≤39	39<Q<156	156≤Q≤1095
0.1	14.6	±Q min	±4.6 %RD	±3.0 %RD
		14.6≤Q≤39	39<Q<156	156≤Q≤1457

● **MVF1501**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.01	20.0	±Q min	±4.8 %RD	±3.4 %RD
		20≤Q≤57	57<Q<286	286≤Q≤1733
0.02	20.0	±Q min	±4.8 %RD	±3.3 %RD
		20≤Q≤57	57<Q<286	286≤Q≤1889
0.03	20.4	±Q min	±4.7 %RD	±3.2 %RD
		20.4≤Q≤57	57<Q<286	286≤Q≤2045
0.05	23.6	±Q min	±4.7 %RD	±3.1 %RD
		23.6≤Q≤57	57<Q<286	286≤Q≤2356
0.1	31.3	±Q min	±4.6 %RD	±3.0 %RD
		31.3≤Q≤57	57<Q<286	286≤Q≤3135

(2) Operating pressure range 0-0.3 MPa: MVF_ _ _3

● **MVF0503**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.1	7.4	±Q min	±5.4 %RD	±4.1 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤428
0.15	7.4	±Q min	±5.1 %RD	±3.7 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤535
0.2	7.4	±Q min	±4.9 %RD	±3.5 %RD
		7.4≤Q≤32	32<Q<74	74≤Q≤641
0.3	8.5	±Q min	±4.7 %RD	±3.2 %RD
		8.5≤Q≤32	32<Q<74	74≤Q≤854

● **MVF0803**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.1	11.0	±Q min	±5.4 %RD	±4.1 %RD
		11.0≤Q≤31	31<Q<110	110≤Q≤ 946
0.15	11.8	±Q min	±5.1 %RD	±3.7 %RD
		11.8≤Q≤31	31<Q<110	110≤Q≤1181
0.2	14.2	±Q min	±4.9 %RD	±3.5 %RD
		14.2≤Q≤31	31<Q<110	110≤Q≤1461
0.3	18.9	±Q min	±4.7 %RD	±3.2 %RD
		18.9≤Q≤31	31<Q<110	110≤Q≤1886

● **MVF1003**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.1	14.6	±Q min	±5.4 %RD	±4.1 %RD
		14.6≤Q≤39	39<Q<156	156≤Q≤1457
0.15	18.2	±Q min	±5.1 %RD	±3.7 %RD
		18.2≤Q≤39	39<Q<156	156≤Q≤1819
0.2	21.8	±Q min	±4.9 %RD	±3.5 %RD
		21.8≤Q≤39	39<Q<156	156≤Q≤2180
0.3	29.0	±Q min	±4.7 %RD	±3.2 %RD
		29.0≤Q≤48	48<Q<156	156≤Q≤2904

● **MVF1503**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.1	31.3	±Q min	±5.4 %RD	±4.1 %RD
		31.3≤Q≤ 57	57<Q<286	286≤Q≤3135
0.15	39.1	±Q min	±5.1 %RD	±3.7 %RD
		39.1≤Q≤ 65	65<Q<286	286≤Q≤3913
0.2	46.9	±Q min	±4.9 %RD	±3.5 %RD
		46.9≤Q≤ 78	78<Q<286	286≤Q≤4692
0.3	62.5	±Q min	±4.7 %RD	±3.2 %RD
		62.5≤Q≤104	104< Q<286	286≤Q≤6249

(3) Operating pressure range 0-1.0 MPa: MVF_ _ _0

● **MVF0500**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.3	8.5	±Q min	±5.1 %RD	±3.8 %RD
		8.5≤Q≤32	32<Q<74	74≤Q≤ 854
0.4	10.7	±Q min	±4.9 %RD	±3.5 %RD
		10.7≤Q≤32	32<Q<74	74≤Q≤1067
0.5	12.8	±Q min	±4.8 %RD	±3.3 %RD
		12.8≤Q≤32	32<Q<74	74≤Q≤1280
0.6	14.9	±Q min	±4.7 %RD	±3.2 %RD
		14.9≤Q≤32	32<Q<74	74≤Q≤1493
0.7	17.1	±Q min	±4.6 %RD	±3.1 %RD
		17.1≤Q≤32	32<Q<74	74≤Q≤1706
0.8	19.2	±Q min	±4.6 %RD	±3.0 %RD
		19.2≤Q≤32	32<Q<74	74≤Q≤1919
0.9	21.3	±Q min	±4.6 %RD	±3.0 %RD
		21.3≤Q≤36	36<Q<74	74≤Q≤2131
0.98	23.0	±Q min	±4.6 %RD	±3.0 %RD
		23.0≤Q≤38	38<Q<74	74≤Q≤2302

● **MVF0800**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.3	18.9	±Q min	±5.1 %RD	±3.8 %RD
		18.9≤Q≤31	31<Q<110	110≤Q≤1886
0.4	23.6	±Q min	±4.9 %RD	±3.5 %RD
		23.6≤Q≤39	39<Q<110	110≤Q≤2355
0.5	28.3	±Q min	±4.8 %RD	±3.3 %RD
		28.3≤Q≤47	47<Q<110	110≤Q≤2825
0.6	33.0	±Q min	±4.7 %RD	±3.2 %RD
		33.0≤Q≤55	55<Q<110	110≤Q≤3295
0.7	37.6	±Q min	±4.6 %RD	±3.1 %RD
		37.6≤Q≤63	63<Q<110	110≤Q≤3765
0.8	43.0	±Q min	±4.6 %RD	±3.1 %RD
		43.0≤Q≤71	71<Q<110	110≤Q≤4235
0.9	48.0	±Q min	±4.6 %RD	±3.0 %RD
		48.0≤Q≤78	78<Q<110	110≤Q≤4705
0.98	51.0	±Q min	±4.6 %RD	±3.0 %RD
		51.0≤Q≤85	85<Q<110	110≤Q≤5081

● **MVF1000**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.3	29	±Q min	±5.1 %RD	±3.8 %RD
		29.0≤Q≤ 48	48<Q<156	156≤Q≤2904
0.4	36.3	±Q min	±4.9 %RD	±3.5 %RD
		36.3≤Q≤ 60	60<Q<156	156≤Q≤3628
0.5	43.5	±Q min	±4.8 %RD	±3.3 %RD
		43.5≤Q≤ 73	73<Q<156	156≤Q≤4351
0.6	50.7	±Q min	±4.7 %RD	±3.2 %RD
		50.7≤Q≤ 85	85<Q<156	156≤Q≤5705
0.7	58.0	±Q min	±4.6 %RD	±3.1 %RD
		58.0≤Q≤ 97	97<Q<156	156≤Q≤5799
0.8	65.2	±Q min	±4.6 %RD	±3.1 %RD
		65.2≤Q≤109	109<Q<156	156≤Q≤6522
0.9	72.5	±Q min	±4.6 %RD	±3.0 %RD
		72.5≤Q≤121	121< Q<156	156≤Q≤7246
0.98	78.2	±Q min	±4.6 %RD	±3.0 %RD
		78.2≤Q≤130	130< Q<156	156≤Q≤7825

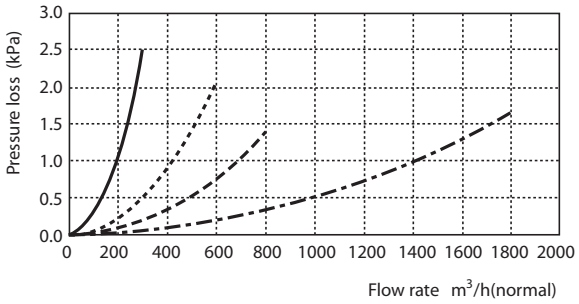
● **MVF1500**

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.3	62.5	±Q min	±5.6 %RD	±4.4 %RD
		62.5≤Q≤104	104<Q<286	286≤Q≤6249
0.4	78.1	±Q min	±5.1 %RD	±3.8 %RD
		78.1≤Q≤130	130<Q<286	286≤Q≤7806
0.5	93.6	±Q min	±4.9 %RD	±3.5 %RD
		93.6≤Q≤156	156<Q<286	286≤Q≤9364
0.6	109.2	±Q min	±4.8 %RD	±3.3 %RD
		109.2≤Q≤182	182<Q<286	286≤Q≤10921
0.7	124.8	±Q min	±4.7 %RD	±3.2 %RD
		124.8≤Q≤208	208<Q<286	286≤Q≤12478
0.8	140.4	±Q min	±4.6 %RD	±3.1 %RD
		140.4≤Q≤234	234<Q<286	286≤Q≤14035
0.9	155.9	±Q min	±4.6 %RD	±3.0 %RD
		155.9≤Q≤260	260<Q<286	286≤Q≤15593
0.98	168.4	±Q min	±4.6 %RD	±3.0 %RD
		168.4≤Q≤281	281< Q<286	286≤Q≤16838

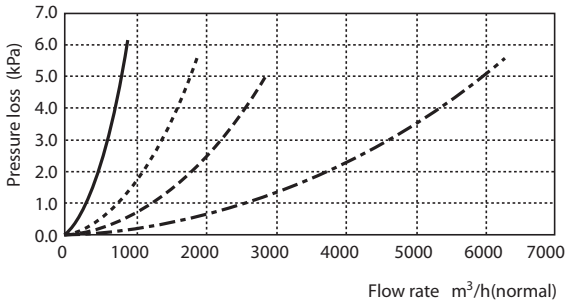
■ Pressure loss

MVF050 (Pipe size 50A)
MVF080 (Pipe size 80A)
MVF100 (Pipe size 100A)
MVF150 (Pipe size 150A)

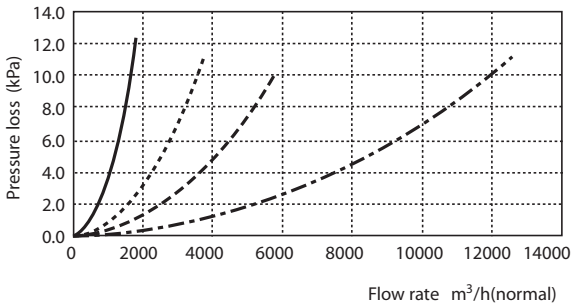
● Primary pressure 0.01 MPa



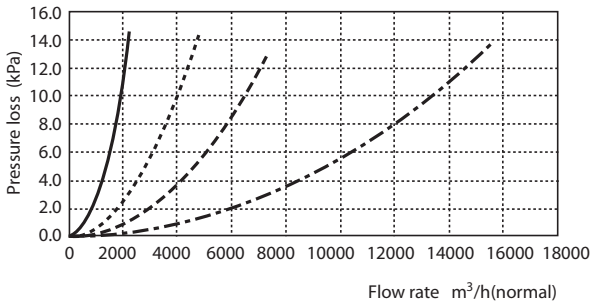
● Primary pressure 0.3 MPa



● Primary pressure 0.7 MPa



● Primary pressure 0.9 MPa



When the MVF is used for a gas other than air, multiply by the appropriate specific gravity below.

Specific gravity of each gas (when air is 1.0)	
Argon	1.38
Carbon dioxide	1.53
Oxygen	1.11
Natural gas (LNG base)	0.64
Methane 100 %	0.56
Propane 100 %	1.56
Butane 100 %	2.08

Example: For the MVF150, with a primary pressure of 0.9 MPa and a flow rate of 6000 m³/h (normal), the pressure loss of natural gas can be calculated as follows:

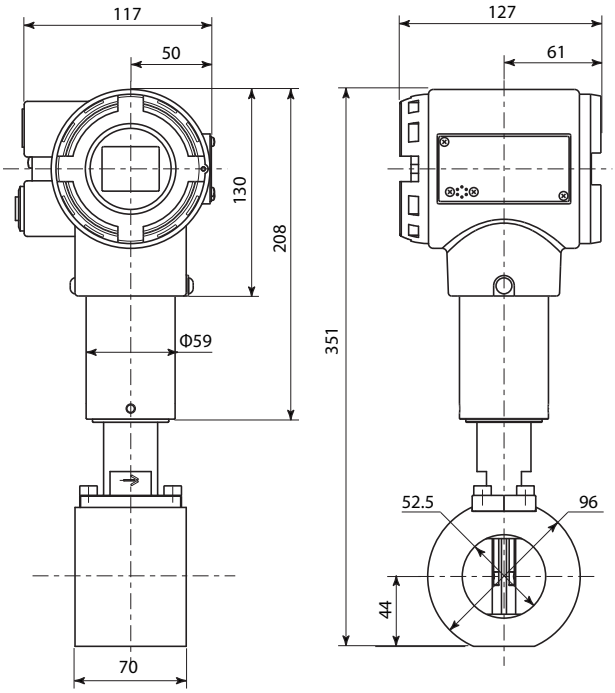
Using the graph for 0.9 MPa primary pressure, the pressure loss is 2 kPa at a flow rate of 6000 m³/h (normal). Multiplying the pressure loss of air by the specific gravity of natural gas of 0.64, the pressure loss is obtained:

2 kPa × 0.64 = 1.28 kPa

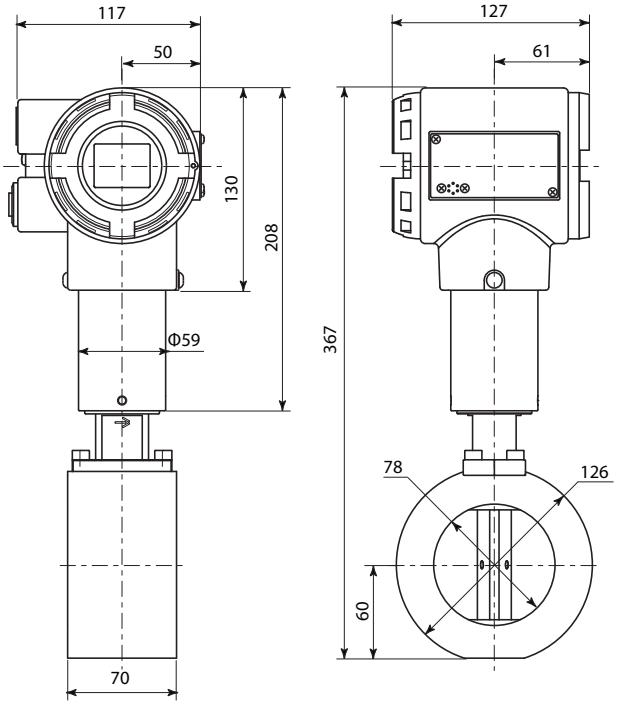
■ External dimensions

● MVF050_S (Pipe size 50A)

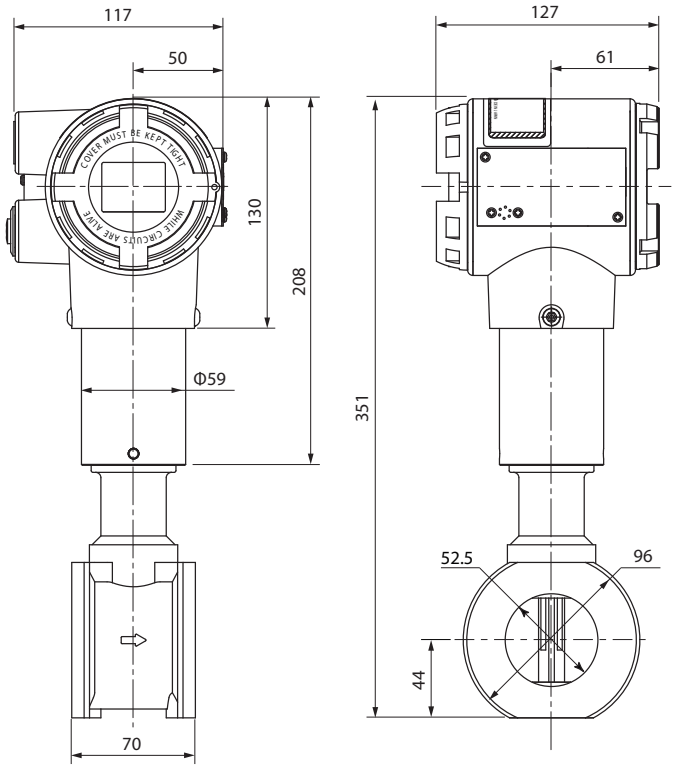
Unit : mm



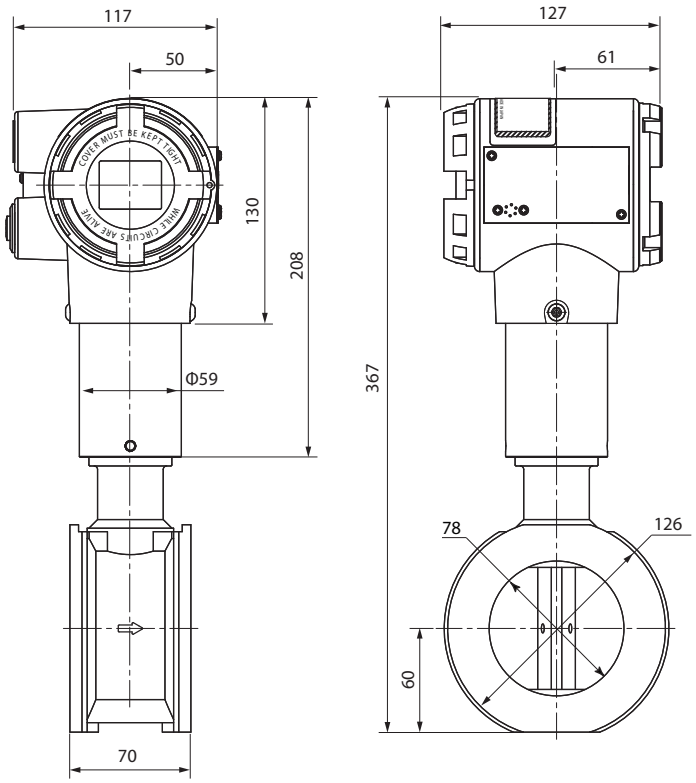
● MVF080_S (Pipe size 80A)



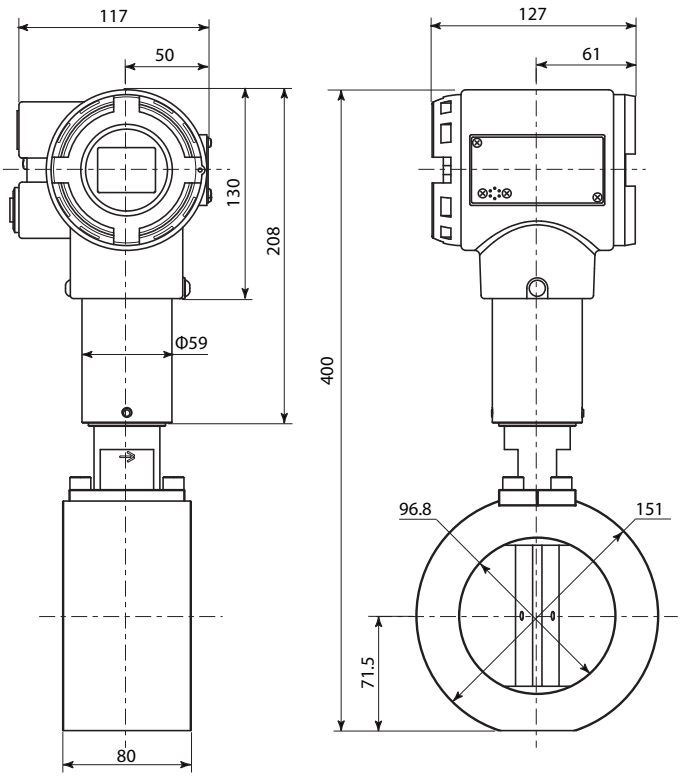
● **MVF050_C (Pipe size 50A)**



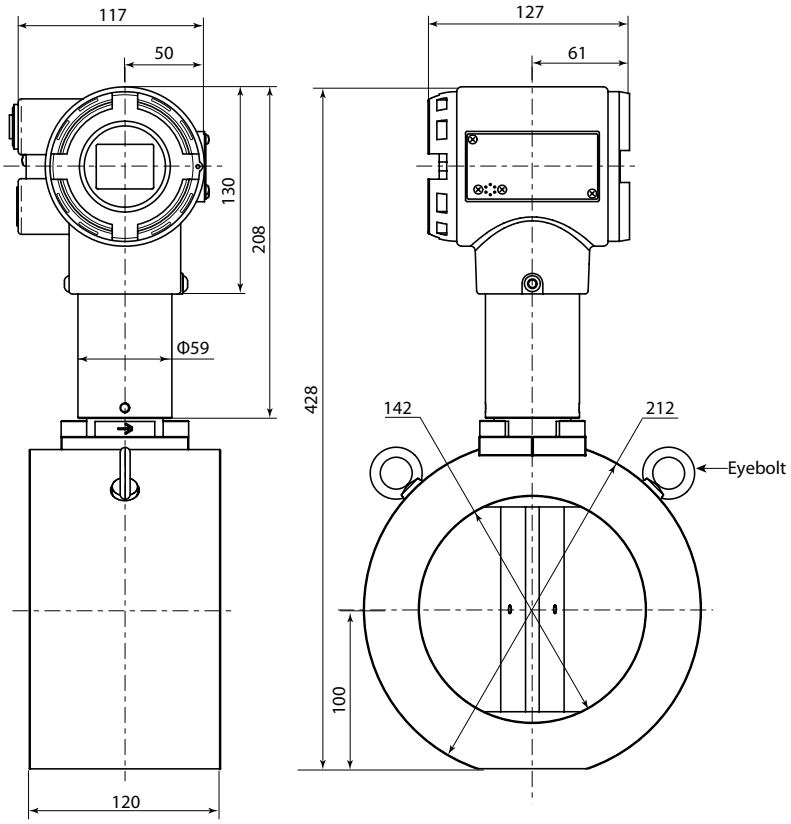
● **MVF080_C (Pipe size 80A)**



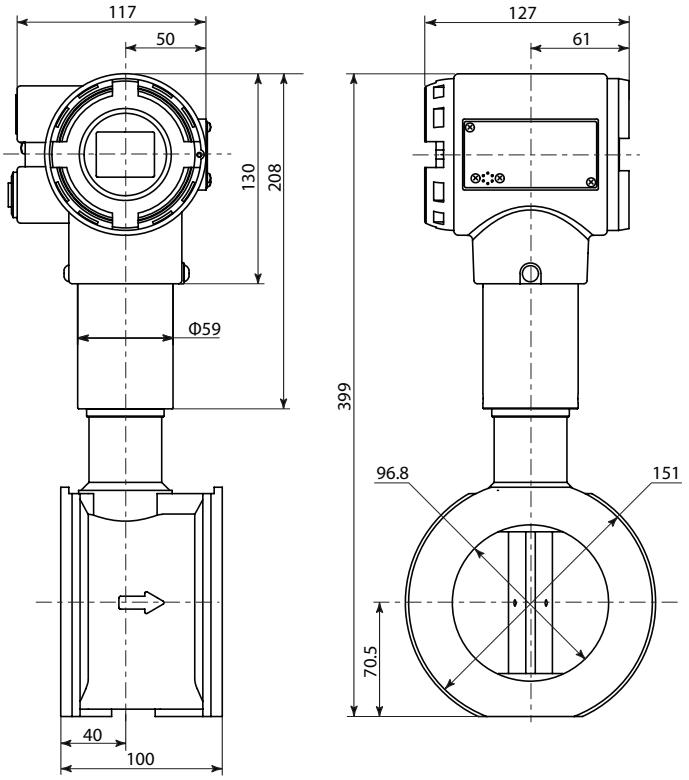
● **MVF100_S (Pipe size 100A)**



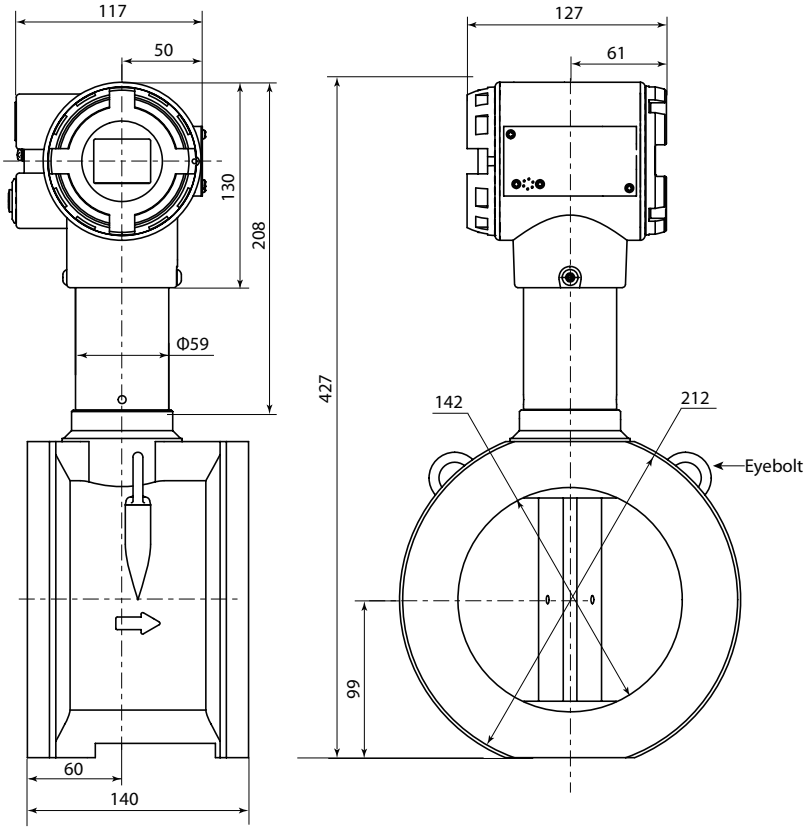
● **MVF150_S (Pipe size 150A)**



● **MVF100_C (Pipe size 100A)**



● **MVF150_C (Pipe size 150A)**



Revision History (CP-SP-1190E)

Printed	Edn.	Revised pages	Description
Sep. 2005	**1**		
Feb. 2006	**2**	ii, iii 1 4 5 9 10 11 to 14 15, 16 17 18 19 to 26	Warning about disassembling added to WARNING section. Order of CAUTION items changed. System section: “Integrated pulse output” changed to “Pulse output.” “Rotary switch” changed to “Station address setting switch.”. “DIP switch” changed to “Communications parameters switch.” Warning about disassembling added to WARNING section. Caution about vibration added to CAUTION section. Description of “Note” removed. Description of mounting method added. “Flange shape” item moved from page 10. “Mounting the gasket” moved from page 9. Subject changed to “Dimensions of gasket.” Description of “Wiring” section completely changed. Old pages are 11 to 13. Old pages are 14 and 15. “Contact rating” changed to “Absolute maximum rating.” Pulse width added to pulse output. Old page is 16. “One atmospheric pressure” changed to “101.3kPa.” Old page is 17. Old pages are 18 to 25.
June 2007	**3**	13 17 19 21 22	● Wiring connection example changed. ■ Specifications “Flowrate measurement range, “Volumetric flow rate-accuracy” added to (@23°C for air)”. “Volumetric flow rate accuracy”, “Accuracy after temperature and pressure compensation” changed. “Pressure accuracy (% RD)” added to “ + 0.1013(MPa)”. ■ Tables for specifying volumetric flow rate accuracy (in air) changed. ■ Tables for accuracy after temperature and pressure compensation (in air) changed.
Apr. 2008	**4**		Two models with different operating pressure range added. Overall revised. 4th ed = 5th JP ed.
Apr. 2012	**5**		Company name changed.
Dec. 2013	**6**	End of the manual	Overall revision. 6th ed = 13th Jp ed. Terms and Conditions were changed (to version No. AA511A-014-03).

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.
You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.
In the case of products that Azbil Corporation has repaired for a fee, the repaired part only shall be warranted for three (3) months from the time of delivery to the location designated by the customer.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place.
Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

(1) Failure caused by your improper use of azbil product
(noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
(2) Failure caused for other reasons than Azbil Corporation's product;
(3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
(4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
(5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
(6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

(1) Regulations and standards or laws that your Equipment is to comply with.
(2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
(3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use
Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down.
You are required to provide your Equipment with safety design such as fool-proof design, *1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance, *3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.
*2. A design that is safe even if the device fails.
*3. Avoidance of device failure by using highly reliable components, etc.
*4. The use of redundancy.

3. Precautions and restrictions on application

Azbil Corporation's products other than those explicitly specified as applicable (e.g. azbil Limit Switch For Nuclear Energy) shall not be used in a nuclear energy controlled area (radiation controlled area).
Any Azbil Corporation's products shall not be used for/with medical equipment.
The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.
In addition,
you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below.
Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

(1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
(2) For use of specific purposes, such as:
* Nuclear energy/radiation related facilities
[For use outside nuclear energy controlled areas] [For use of Azbil Corporation's Limit Switch For Nuclear Energy]
* Machinery or equipment for space/sea bottom

* Transportation equipment
  [Railway, aircraft, vessels, vehicle equipment, etc.]
* Antidisaster/crime-prevention equipment
* Burning appliances
* Electrothermal equipment
* Amusement facilities
* Facilities/applications associated directly with billing

(3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
(4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
(5) Machinery or equipment that may affect human lives, human bodies or properties
(6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification.
Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.
In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used.
Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals.
System products, field instru ments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts.
For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason.
For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice.
For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts.
For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service.
Accordingly, a separate fee will be charged in any of the following cases:

(1) Installation, adjustment, guidance, and attendance at a test run
(2) Maintenance, inspection, adjustment, and repair
(3) Technical guidance and technical education
(4)Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

azbil

Azbil Corporation
Advanced Automation Company

1-12-2 Kawana, Fujisawa
Kanagawa 251-8522 Japan

URL: http://www.azbil.com

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