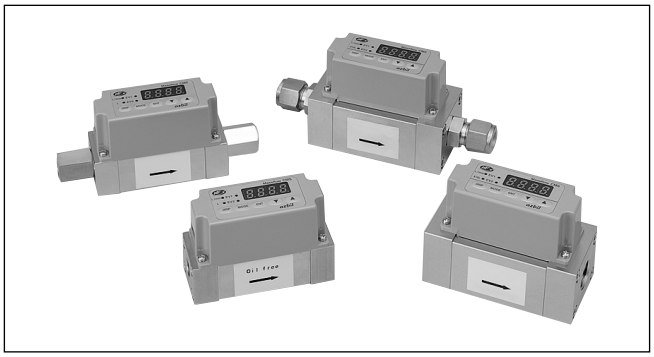
Gas Mass Flow Meter
SUS/SUS316

Overview

The CMS Gas Mass Flow Meter incorporates a thermal microflow sensor developed by Azbil Corporation utilizing silicon micromachining technology. By integrating this sensor with advanced channel design technology, it was possible to achieve new levels of accuracy and measurement range at a low price.
This is a next-generation flowmeter with improved usability and reliability.



Features

- The CMS incorporates a microflow sensor built with silicon micromachining and thin-film technologies. The thermal flow sensor is a mere 1.7 mm and 0.5 mm thick, but features high sensitivity and fast response.
- Because the CMS is a mass flow meter, its measurements are not affected by temperature or pressure.
- Provides high accuracy (±3 % rdg.) and high rangeability (100:1).
- Analog output signals can be switched among 0–5 V, 1–5 V, and 4–20 mA by the keys.
- The meter's functions include instantaneous flow rate indication, totalized or reverse-totalized flow display, event output, totalizer pulse output, totalized flow reset input, output scaling, gas type switching, etc., making it suitable for a wide variety of applications.

Specifications

Item		Description						
		CMS9500	**CMS0002**	**CMS0005**	**CMS0020**	**CMS0050**	**CMS0200**	**CMS0500**
Applicable gas type		Air, nitrogen, oxygen (oxygen models only), argon, carbon dioxide, natural gas 13A (LNG-based), 100 % methane, 100 % propane, 100 % butane, ammonia (semi-standard gas models only), and acetylene (semi-standard gas models only). The gas must be dry and not contain corrosive components (chlorine, sulfur, or acid). Also, it must be clean, without dust or oil mist. For ammonia, the dew point temperature must be –20 °C or below and it must be dry. Since ammonia becomes corrosive when exposed to moisture in the air, before introducing ammonia into the pipes or opening the piping to the atmosphere, purge the pipes with a gas like dry nitrogen.						
Air flow range *1		0 to 500 mL/min (standard)	0 to 2 L/min (standard)	0 to 5 L/min (standard)	0 to 20 L/min (standard)	0 to 50 L/min (standard)	0 to 200 L/min (standard)	0 to 500 L/min (standard)
		"Standard" refers to the volumetric flow rate normalized for 20 °C and 101.325 kPa (atmospheric pressure).						
Max. measurable flow rate at 20 °C, 101.325 kPa *2	**Air/nitrogen**	500 mL/min	2 L/min	5 L/min	20 L/min	50 L/min	200 L/min	500 L/min
	Argon	500 mL/min	2 L/min	5 L/min	20 L/min	50 L/min	200 L/min	500 L/min
	Carbon dioxide	250 mL/min	1 L/min	3.3 L/min	10 L/min	25 L/min	100 L/min	250 L/min
	Oxygen *3	500 mL/min	2 L/min	5 L/min	20 L/min	50 L/min	200 L/min	500 L/min
	Natural gas 13A (46MJ) *4	400 mL/min	1.5 L/min	4 L/min	15 L/min	40 L/min	150 L/min	400 L/min
	Methane	500 mL/min	2 L/min	5 L/min	20 L/min	50 L/min	200 L/min	500 L/min
	Propane	140 mL/min	0.5 L/min	1.7 L/min	5 L/min	14 L/min	50 L/min	140 L/min
	Butane	100 mL/min	0.4 L/min	1.25 L/min	5 L/min	12 L/min	50 L/min	120 L/min
	Natural gas 13A (45MJ) *4	400 mL/min	1.5 L/min	4 L/min	15 L/min	40 L/min	150 L/min	400 L/min
	Ammonia *5	380 mL/min	1.52 L/min	3.85 L/min	15.2 L/min	38 L/min	152 L/min	380 L/min
	Acetylene *5	280 mL/min	1.12 L/min	3.05 L/min	11.2 L/min	28 L/min	112 L/min	280 L/min
Measurement accuracy at 23 °C and 101.325 kPa, air ("x" represents measured flow rate)		5 ≤ x < 100 mL/min ±1 % FS ± 1 digit 100 ≤ x ≤ 500 mL/min ±3 % rdg. ± 1 digit	0.02 ≤ x < 0.4 L/min ±1 % FS ± 1 digit 0.4 ≤ x ≤ 2 L/min ±3 % rdg. ± 1 digit	0.05 ≤ x < 1 L/min ±1 % FS ± 1 digit 1 ≤ x ≤ 5 L/min ±3 % rdg. ± 1 digit	0.2 ≤ x < 2 L/min ±1 % FS ± 1 digit 2 ≤ x ≤ 20 L/min ±3 % rdg. ± 1 digit	0.5 ≤ x < 5 L/min ±1 % FS ± 1 digit 5 ≤ x ≤ 50 L/min ±3 % rdg. ± 1 digit	2 ≤ x < 20 L/min ±1 % FS ± 1 digit 20 ≤ x ≤ 200 L/min ±3 % rdg. ± 1 digit	5 ≤ x < 50 L/min ±1 % FS ± 1 digit 50 ≤ x ≤ 500 L/min ±3 % rdg. ± 1 digit
Repeatability		Within ±0.5 % FS						
Temperature characteristics (air)		At 0 to 75 % of flow rate range: ±0.10 % FS / °C ± 1 digit max. At 75 to100 % of flow rate range: ±0.15 % FS / °C ± 1 digit max.						

Item			Description						
			CMS9500	CMS0002	CMS0005	CMS0020	CMS0050	CMS0200	CMS0500
Pressure characteristics (air)	Operating pressure 0 to 1.0 MPa		±0.1 % FS / 0.1 MPa ± 1 digit max.		±0.25 % FS / 0.1 MPa ± 1 digit max.	±0.2 % FS / 0.1 MPa ± 1 digit max.	±0.1 % FS / 0.1 MPa ± 1 digit max.	±0.2 % FS / 0.1 MPa ± 1 digit max.	
	Operating pressure (negative) -0.07 to 0 MPa		±0.2 % FS / 0.01 MPa ± 1 digit max.						
Operating temperature			-10 to +60 °C						
Storage temperature			-20 to +70 °C						
Operating humidity			10 to 90 % RH (without condensation)						
Operating pressure			-0.07 to (but not including) 1.0 MPa						
Pressure resistance			1.5 MPa						
Pipe size, connection method			SUS model: Rc 1/4 SUS316 model: 9/16 - 18 UNF, Rc 1/4, 1/4 Swagelok, 1/4 VCR (selectable by model number)					SUS model: Rc 1/2 SUS316 model: 3/4 - 16 UNF, Rc 1/2, 1/2 Swagelok, 3/8 VCR equivalent products (selectable by model number)	
Main unit material			SUS model: SUS303 and SUS316; SUS316 model: SUS316						
O-ring material			Fluoroelastomer (for gas types N and S), EPDM (for gas type E)						
Case material			Polycarbonate						
Mounting orientation			Horizontal (but the display should not face downward), left to right flow For vertical piping, drift may occur when the flow rate is zero. For details, contact the azbil Group.						
External leakage			Helium leakage rate 1 × 10^{-6} Pa·m^3/s max.						
Rated voltage			12 to 24 V DC						
Supply voltage range			11.4 to 25.2 V DC						
Current consumption			100 mA max.						
Sampling cycle			100 ms ±10 ms						
Display unit	Flow rate indication		4-digit 7-segment LED (display of instantaneous flow rate and totalized flow can be switched)						
	Instantaneous flow rate	Min. displayed value	1 mL/min	0.01 L/min *7		0.1 L/min *8		1 L/min *9	
		Display resolution	1 mL/min	0.01 L/min *7		0.1 L/min *8		1 L/min *9	
	Total flow	Display unit	10 mL	1 L		1 L		10 L	
		Display range	0 to 99999999						
		Data storage	Data is written to the memory every 10 minutes. (The totalized value can be reset by the keys or external contact input.)						
		Status display	Instantaneous flow rate LED / totalized flow LED / event LED						
Output signal (instantaneous flow rate output)			DC 0–5 V / 1–5 V / 4–20 mA, changeable by the keys Allowable load resistance: 250 kΩ min. for voltage output, 300 Ω max. for current output						
Output scaling function*6			Select from 0–100, 0–200, 0–300, and 0–500 mL/min, or change within 10–250 % FS in increments of 1 % Factory default: 0–500 mL/min	Select from 0–0.2, 0–0.5, 0–1, and 0–2 L/min, or change within 10–250 % FS in increments of 1 % Factory default: 0–2 L/min	Select from 0–1, 0–2, 0–3, and 0–5 L/min, or change within 10–250 % FS in increments of 1 % Factory default: 0–5 L/min	Select from 0–2, 0–5, 0–10, and 0–20 L/min, or change within 10–250 % FS in increments of 1 % Factory default: 0–20 L/min	Select from 0–10, 0–20, 0–30, and 0–50 L/min, or change within 10–250 % FS in increments of 1 % Factory default: 0–50 L/min	Select from 0–20, 0–50, 0–100, and 0–200 L/min, or change within 10–250 % FS in increments of 1 % Factory default: 0–200 L/min	Select from 0–100, 0–200, 0–300, and 0–500 L/min, or change within 10–250 % FS in increments of 1 % Factory default: 0–500 L/min
Event output	Number of outputs		2						
	Output rating		Open collector (maximum rating: 30 V DC, 50 mA)						
	Event function		Instantaneous flow rate high/low limits, totalized flow count-up, reverse-totalized flow countdown, totalizer pulse output (Event 2 only), flow rate data serial output (Event 1 only), error output (Event 1 only) can be selected.						
External contact input	Number of inputs		1 (dedicated for totalized flow count reset input)						
	Input specifications		Circuit type of other device: Nonvoltage contacts or open collector Terminal voltage (contacts OFF): 4.5 ±1 V Terminal current (contacts ON): approx. 0.5 mA (current to contacts) Allowable ON contact resistance: 250 Ω Allowable OFF contact resistance: 100 kΩ min. Allowable ON residual voltage: 0.8 V max. (for open collector) Allowable OFF leakage current: 50 μA max. (for open collector)						
Serial data output			Open collector (maximum rating: 30 V DC, 50 mA)						
Communication protocol (available for SUS316 models as an optional function)			RS-485 interface, 3-wire system Max. wiring distance: 300 m. Communication speed: 9600/4800/2400 bps. Total flow, instantaneous flow rate, etc., can be read and settings can be changed.						

Item	Description						
	CMS9500	CMS0002	CMS0005	CMS0020	CMS0050	CMS0200	CMS0500
Gas type switching	Air/nitrogen, argon, carbon dioxide, oxygen, natural gas 13A-46 MJ, 100 % methane, 100 % propane, 100 % butane, and natural gas 13A-45 MJ (changeable by the device keys)						
Gas type conversion function	Specify a conversion factor from 0.100 to 8.000 by the keys in accordance with the gas type.						
Electrical connection	Harness with dedicated connectors (sold separately). Applicable connector: DF-11-10DS-2C, made by Hirose Electric Co.						
Applicable standards	CE-marked products EN 61326-2-3:2013, EN 61326-1:2013 (To be used in industrial electromagnetic environment) During EMC testing, the reading or output may fluctuate by the equivalent of ±10 % FS.						
Weight	Approx. 800 g					Approx. 1400 g	Approx. 2000 g

*1 Flow rate ranges are for air. Because this device has a gas-type switching function, the device keys can be used to switch from one gas type to another. In addition, instantaneous flow rate output scaling can be changed by the keys.

*2 Other types of gases can be measured by changing the conversion factor in accordance with the gas type. For details, contact the azbil Group.

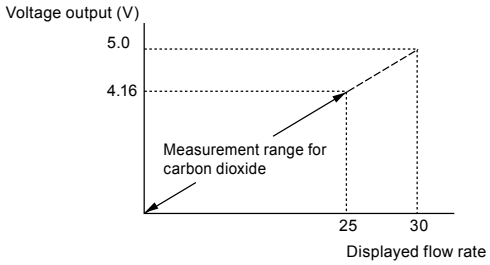
*3 Only for oxygen models: CMS_ _ _ _ _ _ _ S _ _ _ 1 _ _ (degreased models)

*4 In Japan, natural gas 13A is adjusted to either of the specifications shown below (the type can be changed by the keys). If the composition of the natural gas that you use does not match either of these types, please contact the azbil Group.

Function setup mode	Gas type (name used by Azbil)	Methane (%)	Ethane (%)	Propane (%)	Butane (%)
04	Natural gas 13A-46MJ	88	5.8	4.5	1.7
11	Natural gas 13A-45MJ	88.9	6.8	3.1	1.2

*5 If ammonia or acetylene gas is used, set function setting 08, “Gas type,” to “08: User-specified” and specify parameter P08, “Gas type conversion factor,” in accordance with the user’s manual.

*6 Voltage or current scaling can be changed by the keys.
If the gas type is changed, the flow rate measurement range changes accordingly, as shown in “Max. measurable flow rate” in the table above. However, with this function, analog output is scaled according to the analog output scaling setting even if the gas type is changed.
Ex.: Gas type is set to carbon dioxide for CMS0050
Flow rate measurement range is 0 to 25 L/min.
If “0 to 30L/min” is set for scaling, 0–5 V output is as shown in the figure on the right above.

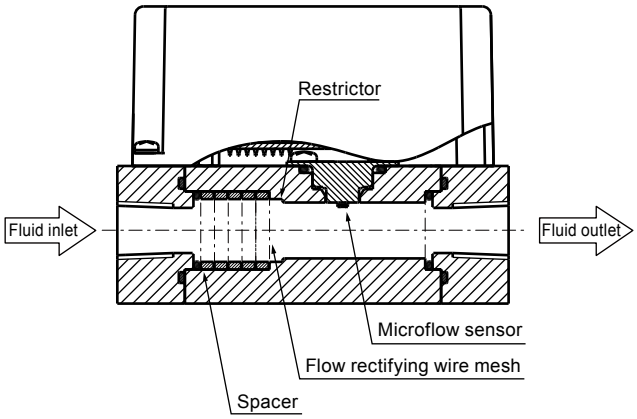


*7 If the gas type conversion factor is set to 0.10 to 0.49 for CMS0002, the flow rate is 0.005 L/min (standard).

*8 If the gas type conversion factor is set to 0.10 to 0.49 for CMS0020, the flow rate is 0.05 L/min (standard).

*9 If the gas type conversion factor is set to 0.10 to 0.49 for CMS0200, the flow rate is 0.5 L/min (standard).

CMS Structure



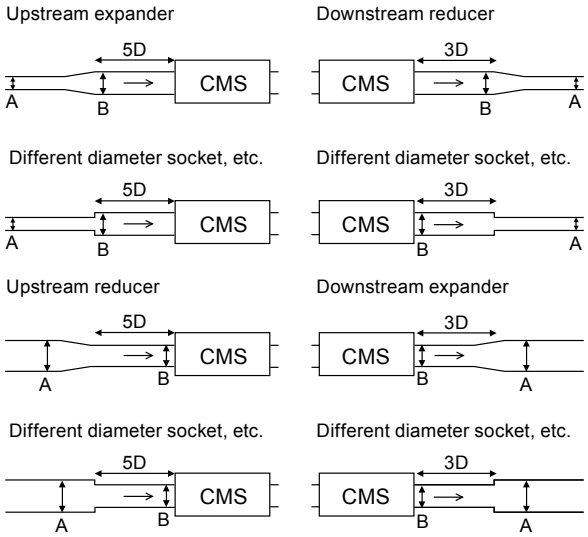
Filter Installation

If dust, oil mist, or water enters this device, it may cause measurement error or faulty operation.
If a gas that always contains oil mist such as compressed air or propane is used, or if it is expected that pipe rust will enter the device, make sure to install a filter.

Model number: MFF200 series

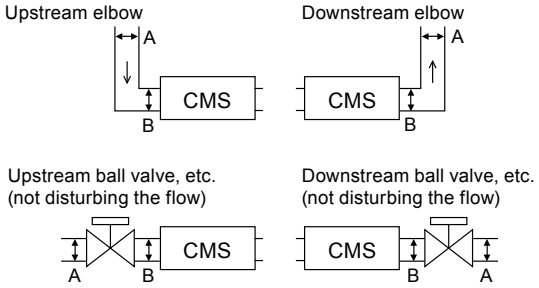
Straight Pipe Section

If the flowmeter and the pipe have different internal diameters (diameters A and B are different), a straight pipe section is required.



"D" is the connection port inner diameter.
CMS0200/0500 : 12mm
CMS9500/0002/0005/0020/0050 : 6mm

If the flowmeter and the pipe have the same internal diameter (diameters A and B are the same), a straight pipe section is not required.



! Handling Precautions

- If a valve that disturbs the flow (a butterfly valve, etc.) is used, add a straight pipe section whose length is five times the pipe diameter between the valve and the CMS.

Model Selection

● **Model SUS303** I II III IV V VI VII VIII IX X XI XII **Ex.: CMS9500BSRN200000**

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Description
Basic model No.	Flow rate range	Model	Mate-rial	Con-nec-tion	Gas type	Output	Option 1	Option 2	Option 3	Option 4	Suffix	
CMS												Gas mass flow meter
	9500											Airflow range: 0–500 mL/min (standard) *1 *3
	0002											Airflow range: 0–2 L/min (standard) *1 *3
	0005											Airflow range: 0–5 L/min (standard) *1 *3
	0020											Airflow range: 0–20 L/min (standard) *1 *3
	0050											Airflow range: 0–50 L/min (standard) *1 *3
	0200											Airflow range: 0–200 L/min (standard) *1 *3
	0500											Airflow range: 0–500 L/min (standard) *1 *3
		B										With display. Flow direction: left to right
		R										With display. Flow direction: right to left
			S									SUS303 stainless steel
				R								Rc connection (for a short face-to-face dimension), CMS0200/500: Rc 1/2, CMS9500/0002/0005/0020/0050: Rc 1/4
					N							Air/nitrogen (setting can be changed to another standard compatible gas *3)
					S							Oxygen *2
						2						Output: 4–20 mA / 0–5 V / 1–5V DC
							0					No optional function
								0				No optional function
									0			No optional function
									1			Degreasing for gas-contacting parts
										0		No optional function
										D		With inspection report
										Y		With traceability certificate
											0	Product version

● SUS316 model

I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII **Ex.: CMS9500BTTN200000**

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Description
Basic model No.	Flow rate range	Model	Material	Connection	Gas type	Output	Option 1	Option 2	Option 3	Option 4	Suffix	
CMS												Gas mass flow meter
	9500											Airflow range: 0–500 mL/min (standard) *1 *3
	0002											Airflow range: 0–2 L/min (standard) *1 *3
	0005											Airflow range: 0–5 L/min (standard) *1 *3
	0020											Airflow range: 0–20 L/min (standard) *1 *3
	0050											Airflow range: 0–50 L/min (standard) *1 *3
	0200											Airflow range: 0–200 L/min (standard) *1 *3
	0500											Airflow range: 0–500 L/min (standard) *1 *3
		B										With display. Flow direction: left to right
		R										With display. Flow direction: right to left
			T									SUS316
				U								UNF CMS0200/0500: 3/4 - 16 UNF CMS9500/0002/0005/0020/0050: 9/16–18 UNF
				T								Rc fitting CMS0200/0500: Rc 1/2 CMS9500/0002/0005/0020/0050: Rc 1/4
				S								Swagelok fitting CMS0200/0500: 1/2 Swagelok CMS9500/0002/0005/0020/0050: 1/4 Swagelok
				V								VCR fitting CMS0200/0500: 3/8 VCR CMS9500/0002/0005/0020/0050: 1/4 VCR
					N							Air/nitrogen (setting can be changed to another standard compatible gas *3)
					S							Oxygen *2
					E							Semi-standard gas (ammonia, acetylene) *2
						2						Output: 4–20 mA / 0–5 V / 1–5V DC
							0					No optional function
							1					With RS-485 communication
								0				No optional function
									0			No degreasing
									1			Degreasing for gas-contacting parts
										0		No optional function
										D		With inspection report
										Y		With traceability certificate
											0	Product version

*1 “Standard” refers to the flow rate normalized for 20 °C and 101.325 kPa (atmospheric pressure).
*2 If oxygen (gas type: S), semi-standard gas (gas type:E) is selected, be sure to specify “1” (degreasing for gas-contacting parts) for option 3.
*3 The factory default is air/nitrogen.
The default setting can be changed to any of the gas types shown below by the keys. If the gas type is changed, the flow rate range may change. When selecting a gas type, refer to “maximum measurable flow rate” in the specifications for the model.

● Parts sold separately

Name	Model No.	Description
Harness with dedicated connectors (For models without communication functions. One harness is necessary per CMS unit.)	**81446594-005**	For non-communication models, a 2 m harness without terminal lugs
	81446594-006	For non-communication models, a 5m harness without terminal lugs
Harness with dedicated connectors (For models with RS-485 communication *. One harness is necessary per CMS unit.)	**81446594-007**	For communication models, a 2 m harness with M3.5 spade terminals
	81446594-008	For communication models, a 5m harness with M3.5 spade terminals
AC adapter connection harness	**81446594-030**	For connecting the AC adapter
Mounting bracket (as needed)	**81446628-001**	For CMS9500/0002/0005/0020/0050
	81446721-001	For CMS0200
	81446856-001	For CMS0500
Fittings for maintenance (For the SUS316 model only. For replacement if fittings are damaged)	**81446834-001**	Two Rc 1/4 fittings
	81446834-002	Two Rc 1/2 fittings
	81446833-001	Two 1/4 Swagelok fittings
	81446833-002	Two 1/2 Swagelok fittings
	81446895-001	Two 1/4 VCR fittings
	81446895-002	Two 3/8 VCR fittings

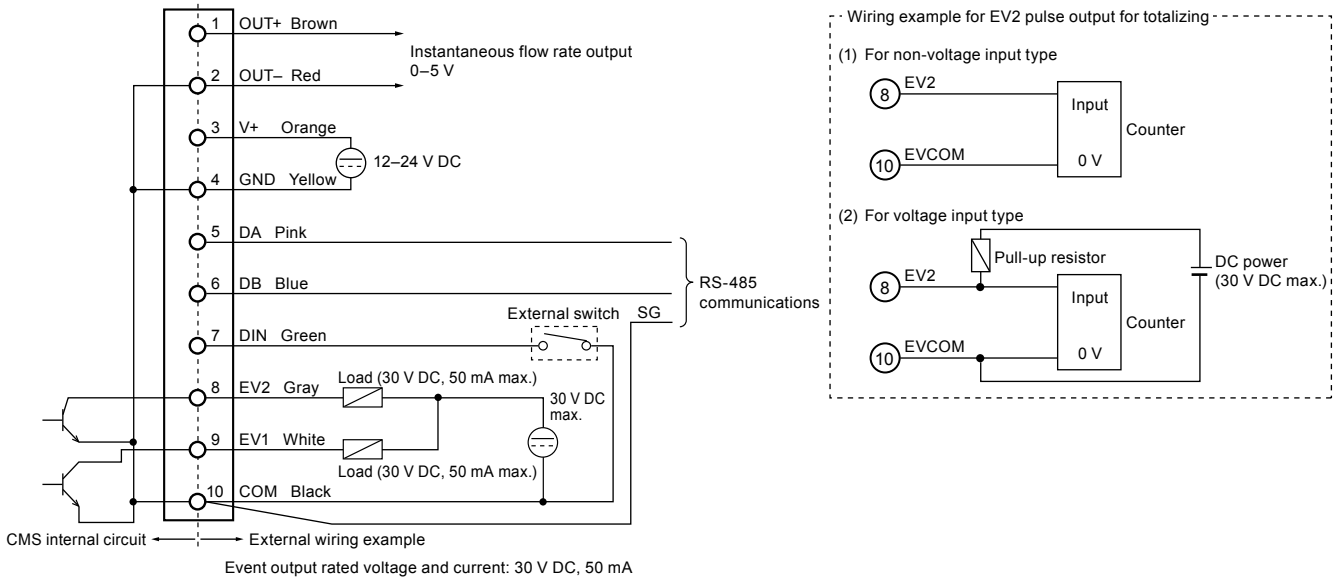
* This harness can be used for models without communication functions.

Connection

● Connector signal table

Pin No.	Signal name	Description	Notes
1	OUT+	Instantaneous flow rate output +	
2	OUT−	Instantaneous flow rate output −	
3	V+	Power+ (12–24 V DC)	
4	GND	Power GND	
5	DA	For RS-485 communications	Connect the pins only if a model with communication functions is used.
6	DB		
7	DIN	Totalized flow count reset input	
8	EV2	Event 2 output, totalizer pulse output	
9	EV1	Event 1 output, serial data output	
10	COM	Event output common	

● Wiring example

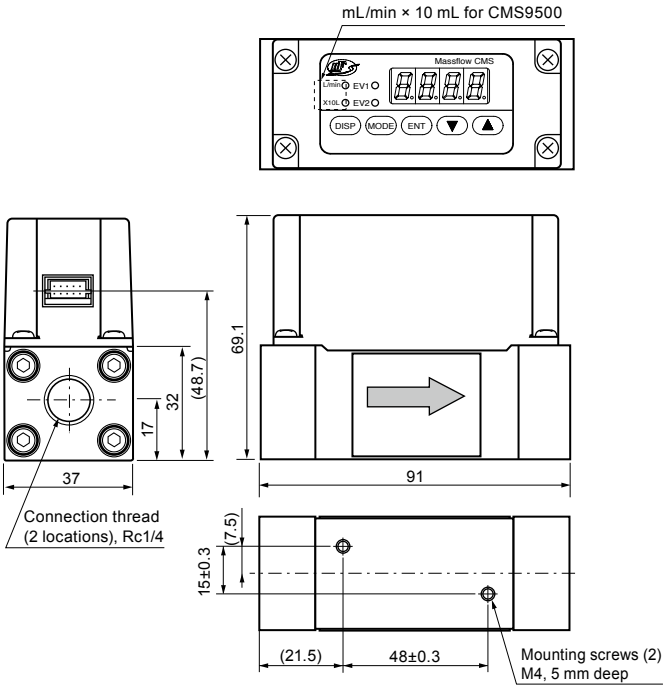


External Dimensions

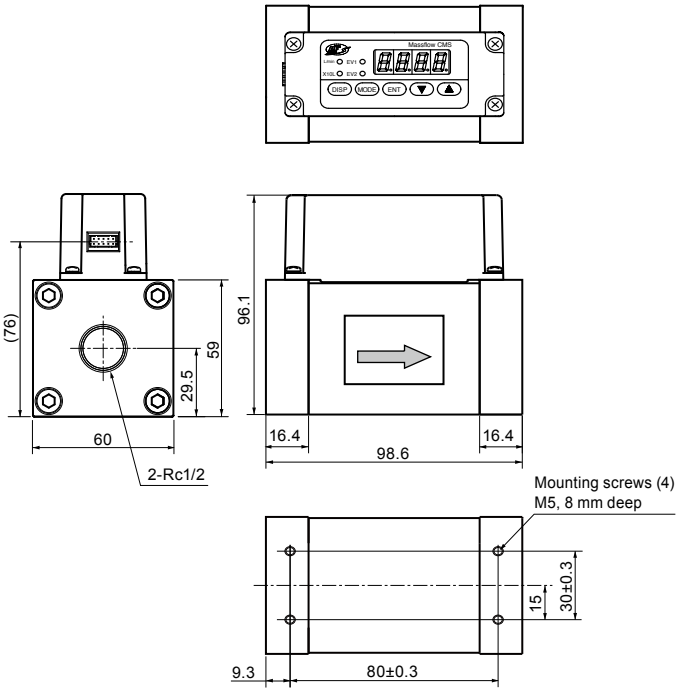
- **Model SUS**

(Unit: mm)

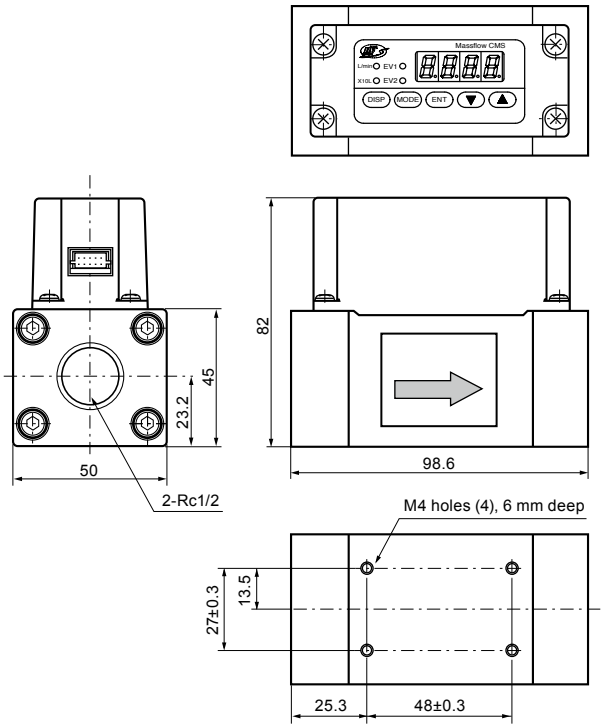
• CMS9500/0002/0005/0020/0050



• CMS0500



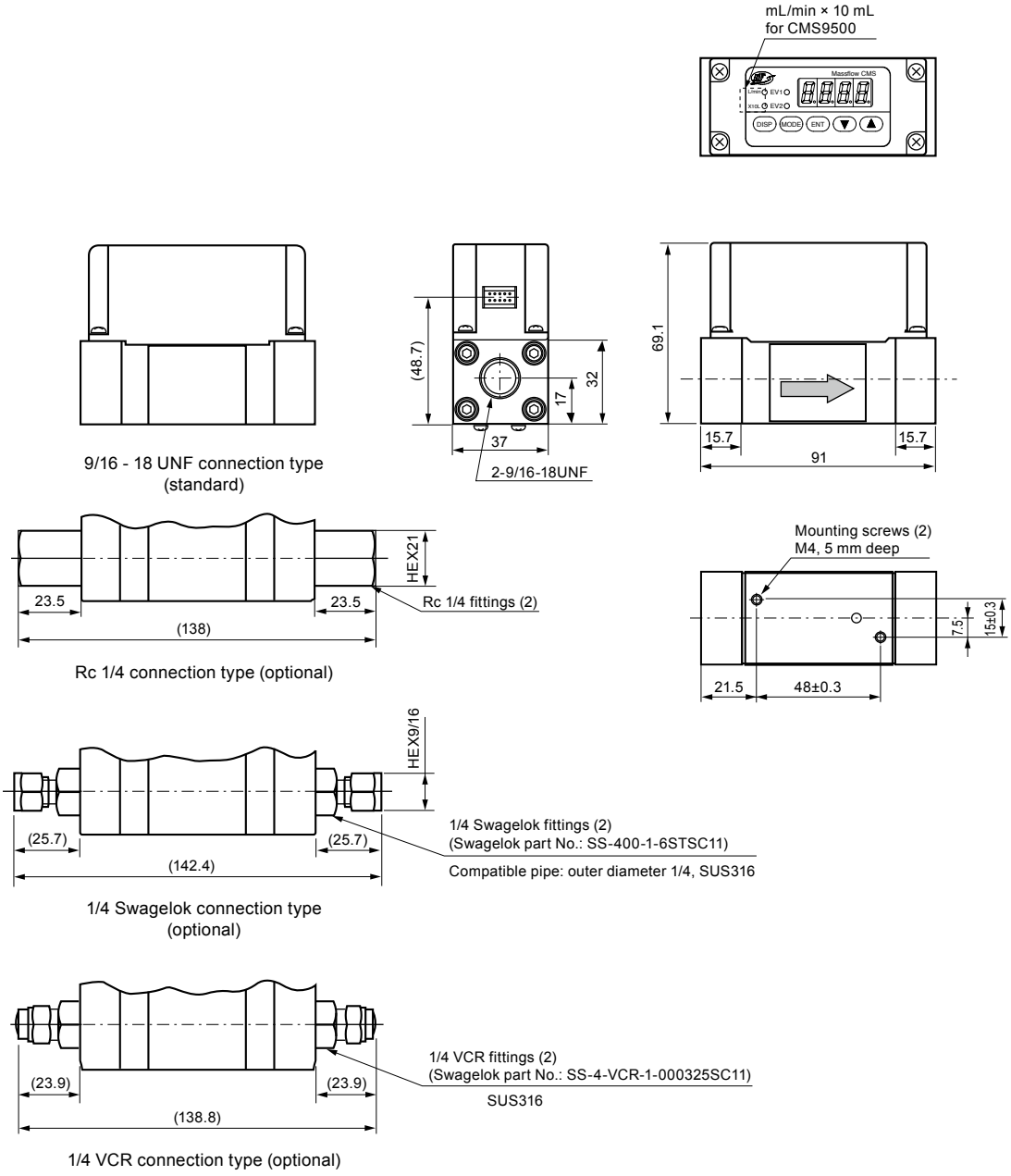
• CMS0200



The above figure shows the CMS_ _ _ _B with left-to-right flow direction.
The CMS_ _ _ _R with right-to-left flow direction has the same dimensions.

- **Model SUS316**
  - CMS9500/0002/0005/0020/0050

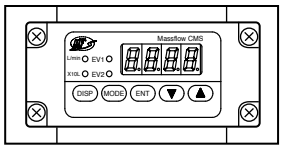
(Unit: mm)

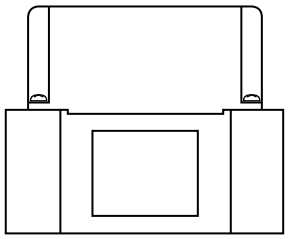


The above figure shows the CMS_ _ _ _B with left-to-right flow direction.
The CMS_ _ _ _R with right-to-left flow direction has the same dimensions.

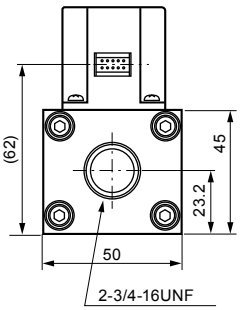
• CMS0200 (model SUS316)

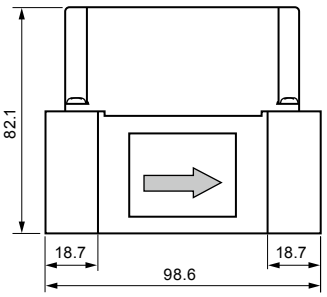
(Unit: mm)

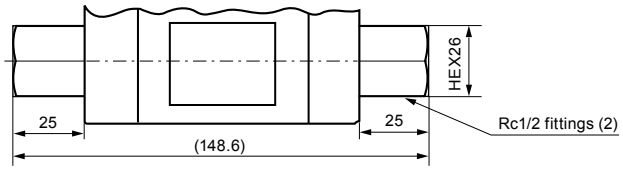




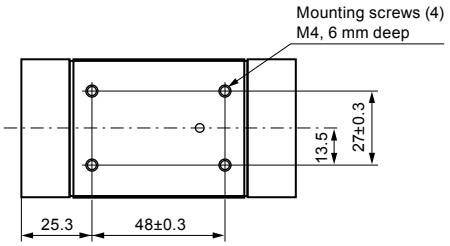
3/4 - 16 UNF connection type
(standard)

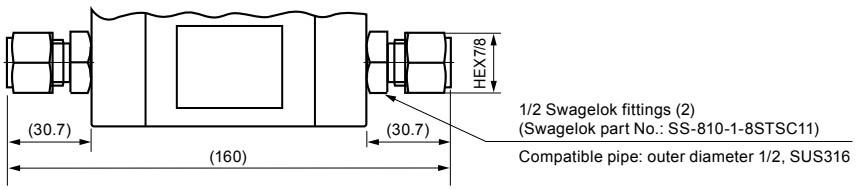




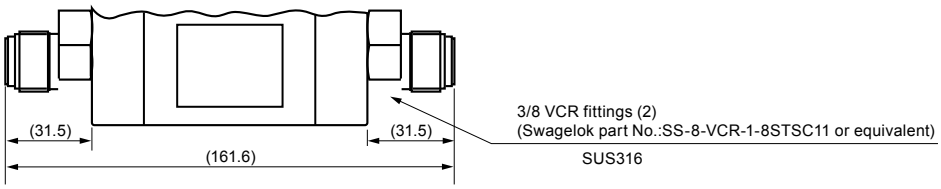


Rc 1/2 connection type (optional)





1/2 Swagelok connection type
(optional)

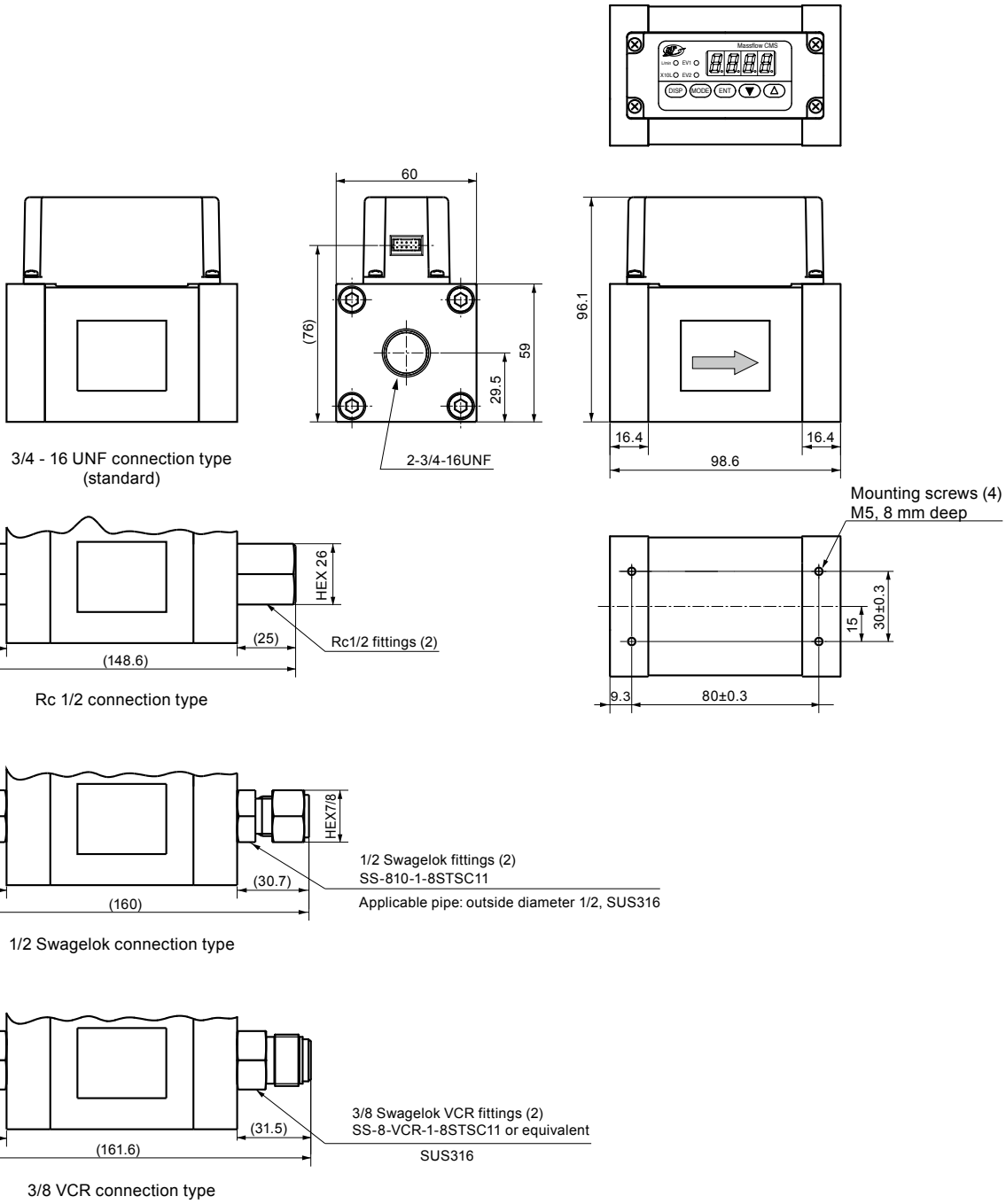


3/8 VCR connection type (optional)

The above figure shows the CMS_ _ _ _B with left-to-right flow direction.
The CMS_ _ _ _R with right-to-left flow direction has the same dimensions.

• CMS0500 (model SUS316)

(Unit: mm)

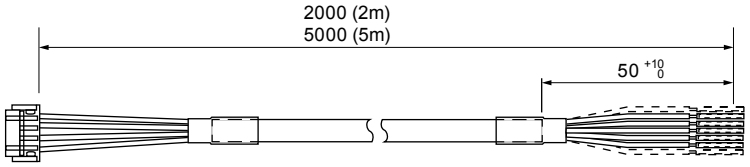


The above figure shows the CMS_ _ _ _B with left-to-right flow direction.
The CMS_ _ _ _R with right-to-left flow direction has the same dimensions.

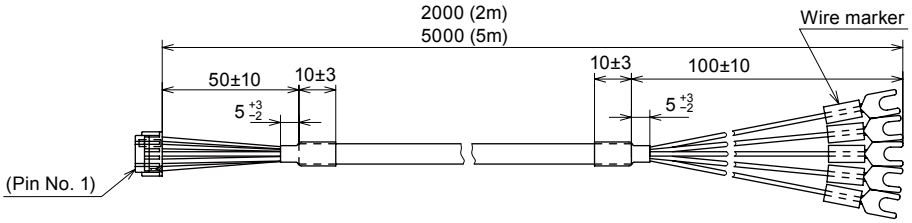
● Harness with dedicated connectors (connection cable)

(Unit: mm)

• For models without RS-485 communications
81446594-005 (2 m, 8 wires)
81446594-006 (5 m, 8 wires)

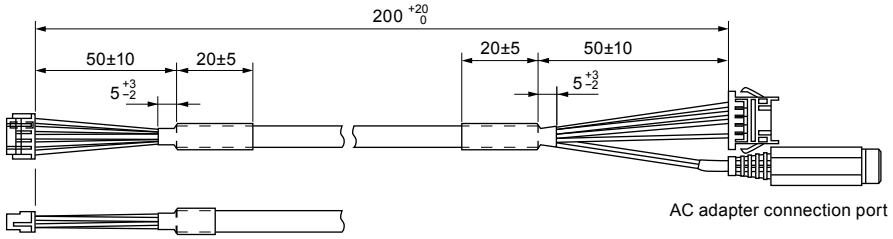


• For models with RS-485 communications (this harness can also be used for non-communication models)
81446594−007 (2 m, 10 wires, M3.5 spade terminals)
81446594−008 (5 m, 10 wires, M3.5 spade terminals)



● AC adapter connection harness

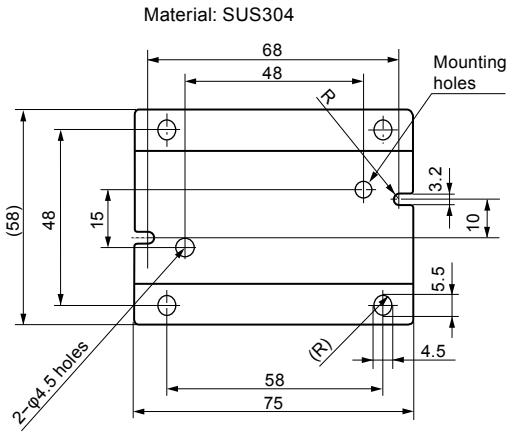
• 81446594-030



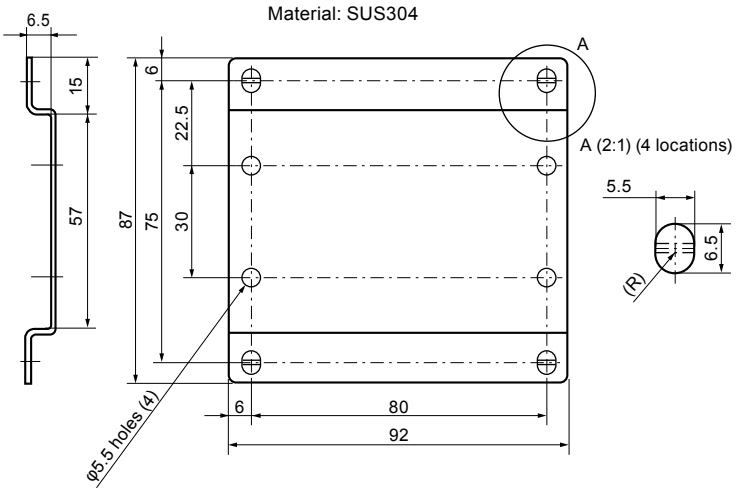
- **Mounting bracket**

(Unit: mm)

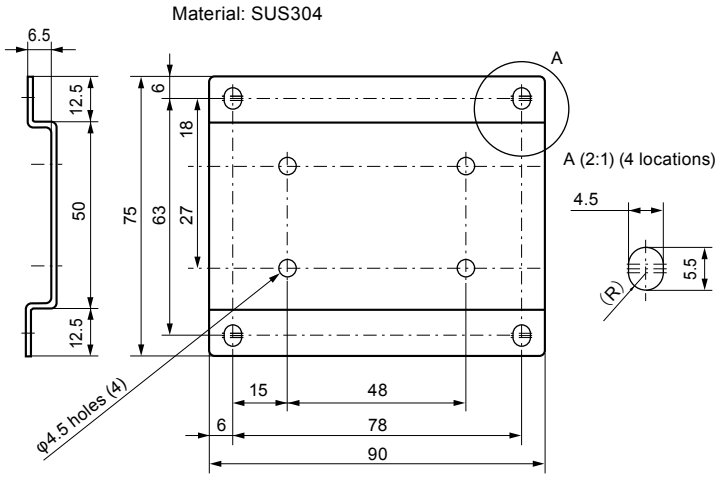
- 81446628-001
  (for CMS9500/0002/0005/0020/0050)



- 81446856-001 (for CMS0500)



- 81446721-001 (for CMS0200)



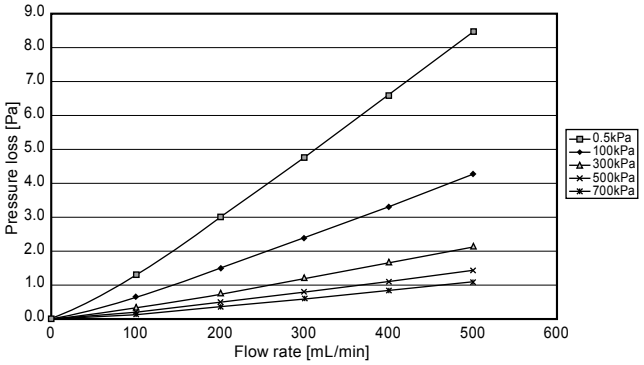
Pressure Loss

The graphs below show the data for air. If a gas other than air is used, multiply by the specific gravity in the table below.

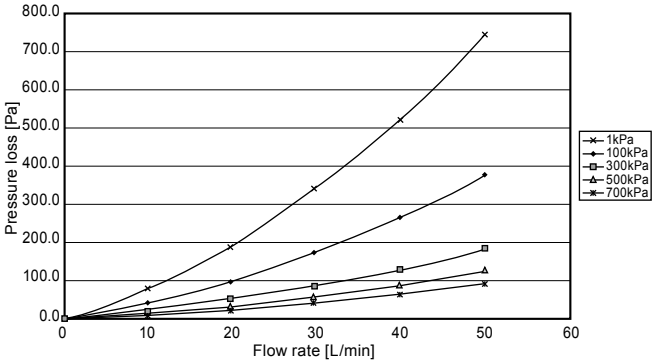
Example: For the CMS9500, if the primary pressure is 100 kPa and the flow rate is 500 mL/min, the pressure loss for argon is calculated as follows.
On the graph for CMS9500, the pressure loss is about 4.3 Pa when the primary pressure is 100 kPa and the flow rate is 500 mL/min. 4.3 × 1.38 (specific gravity of argon) = 5.934 Pa.

Specific gravity of gases (air = 1.0)	
Argon	1.38
Carbon dioxide	1.53
Oxygen	1.11
Natural gas 13A	0.64
100% methane	0.56
100% propane	1.56
100% butane	2.08

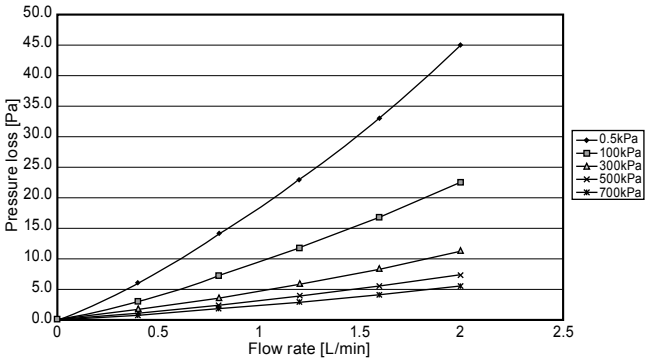
- **For CMS9500**



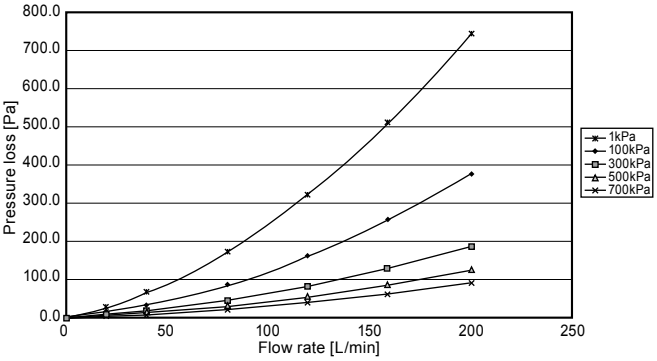
- **For CMS0050**



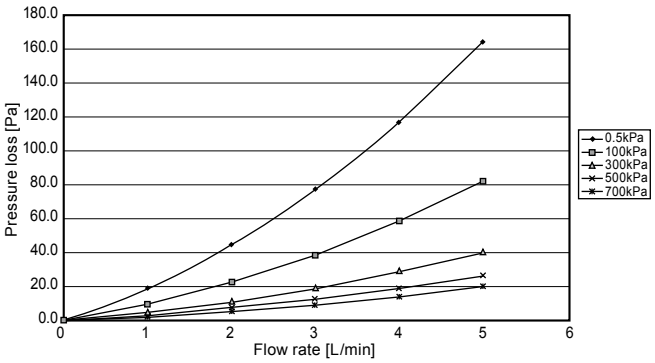
- **For CMS0002**



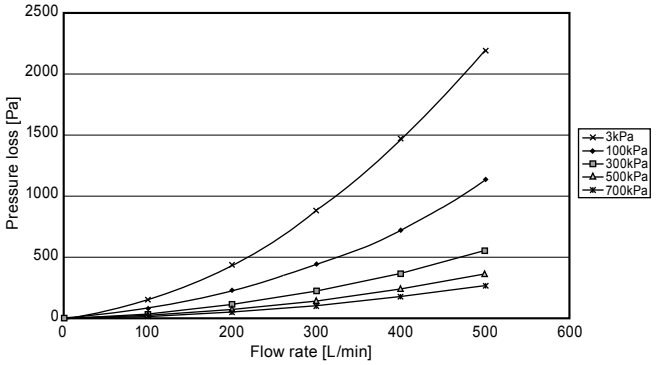
- **For CMS0200**



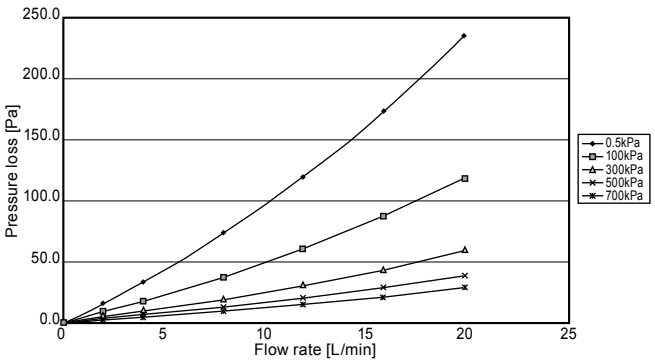
- **For CMS0005**



- **For CMS0500**



- **For CMS0020**



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1st edition: Nov. 2017
2nd edition: Jun. 2024