



# CML Series High-Flow Mass Flow Meter User's Manual



Thank you for purchasing the CML Series.

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

This manual should be read by those who design and maintain devices that use the CML Series. Be sure to keep this manual nearby for handy reference.

Yamatake Corporation

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## RESTRICTIONS ON USE

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This product has been designed, developed and manufactured for general-purpose application in machinery and equipment.

Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

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### NOTICE

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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 Yamatake Corporation.

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

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# SAFETY PRECAUTIONS

## ■ About Icons

The safety precautions described in this manual are indicated by various icons. Please be sure you read and understand the icons and their meanings described below before reading the rest of the manual.

Safety precautions are intended to ensure the safe and correct use of this product, to prevent injury to the operator and others, and to prevent damage to property. Be sure to observe these safety precautions.



### **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 only physical damage to the product.

## ■ Examples

	Triangles warn the user of a possible danger that may be caused by wrongful operation or misuse of this product. These icons graphically represent the actual danger. (The example on the left warns the user of the danger of electric shock.)
	White circles with a diagonal bar notify the user that specific actions are prohibited to prevent possible danger. These icons graphically represent the actual prohibited action. (The example on the left notifies the user that disassembly is prohibited.)
	Filled-in black circles instruct the user to carry out a specific obligatory action to prevent possible danger. These icons graphically represent the actual action to be carried out. (The example on the left instructs the user to remove the plug from the outlet.)

# **WARNING**



If this device is used for measuring natural gas 13A or propane, mount it on the upstream side of the safety shutoff valve.

If somehow air gets into the pipes and an explosive mixture is produced, and if the sensor makes a spark due to lightning or some other reason, the gas mixture in the pipes could explode.



Do not stand on this device or its installed pipes. Doing so might damage the device or the pipes, or might cause physical injury.



The mass of this device is 14 to 45kg, depending upon the model. When moving or transporting this device, take the precaution of using appropriate equipment or handling with two or more persons. Careless lifting or dropping could cause injury or damage.

# **CAUTION**



Do not mount with the display facing down. Doing so might cause measurement error or equipment failure.



Do not flush out the pipes when this device is installed. If foreign matter enters this device it could cause equipment failure or errors in measurement.



To prevent leakage from the pipes, tighten bolts to the specified torque. Otherwise a leak could occur.



Be sure the load connected to the output terminals does not exceed the rated values given in the specifications. An excessive load could damage this device.



After wiring and before turning the power on, be sure to check that the wiring, the polarity of the power supply, etc., are correct. Wiring error could cause damage or malfunction.



Be sure that the gas temperature does not fall to  $-25^{\circ}\text{C}$ . At  $-25^{\circ}\text{C}$  and below, the O-ring could crack, causing a gas leak.



After the piping work is complete, remove the temporary support brackets. Otherwise someone might bump into them and be injured.

# Contents

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## SAFETY PRECAUTIONS Conventions Used in This Manual

### Chapter 1. INTRODUCTION

■ Introduction.....	1
■ Features .....	1
■ System.....	2
■ Model selection guide.....	2
■ Gas type and Flowrate range .....	3

### Chapter 2. NAMES AND FUNCTIONS OF PARTS

### Chapter 3. MOUNTING AND WIRING

■ Installation site.....	6
■ Pipes.....	7
■ Piping work.....	10
■ Wiring.....	13

### Chapter 4. METHOD OF OPERATION

■ flowrate display.....	16
■ Temperature and pressure display .....	16
■ Integrating display and integrated count resetting function .....	16
■ Function setup.....	17
■ Function setup item list.....	18
■ Parameter setup .....	19
■ Parameter setup item table .....	20

### Chapter 5. TROUBLESHOOTING





### Chapter 6. SPECIFICATIONS

■ Specifications .....	23
■ External dimensions.....	24
■ Pressure loss (flowrate - pressure loss characteristics).....	26

# Conventions Used in This Manual

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The following conventions are used in this manual:

-  **Handling Precautions** : Handling Precautions indicate items that the user should pay attention to when handling the CML.
-  **Note** : Notes indicate useful information that the user might benefit by knowing.
-  : This indicates the item or page that the user is requested to refer to.
- (1), (2), (3) : The numbers with the parenthesis indicate steps in a sequence or indicate corresponding parts in an explanation.
- 5-02 : This indicates 7-segment indication on the setup display.
-  : This indicates a key on the display.

# Chapter 1. INTRODUCTION

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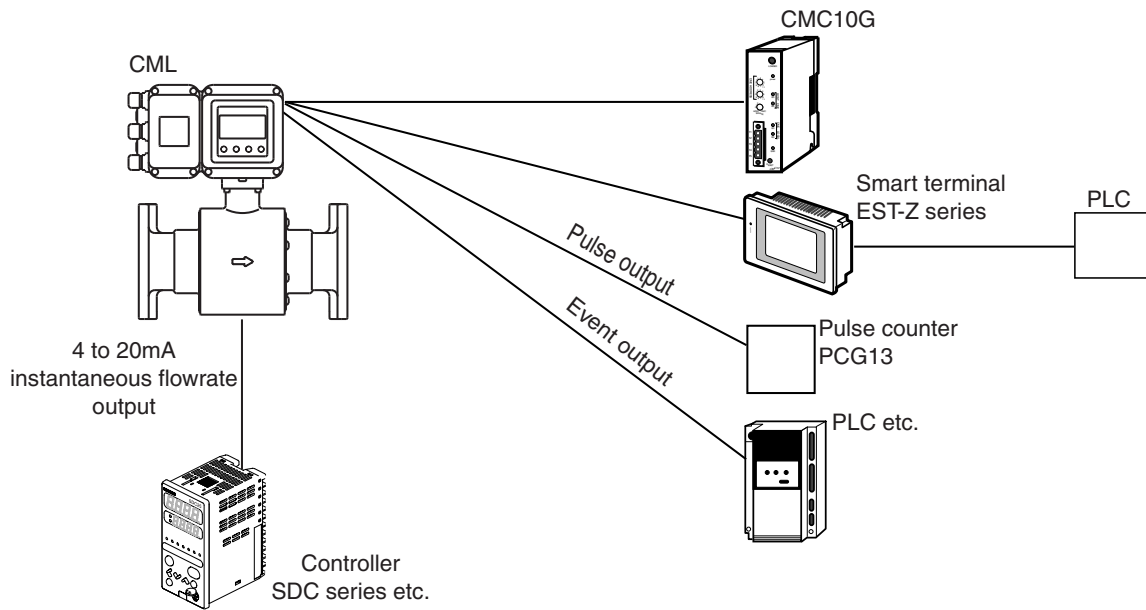
## ■ Introduction

The CML Series gas mass flow meter uses  $\mu$ F (Micro Flow) sensor (hereinafter referred to as a  $\mu$ F sensor) as the sensing section. The  $\mu$ F sensor is a thermal flow velocity sensor made using proprietary technology. This device is a mass flow meter having the features of high accuracy and high rangeability.

## ■ Features

- As the CML Series is a thermal mass flow meter, it is not influenced by temperature nor pressure. With no need for any expensive temperature and pressure compensation device, a cost reduction can be achieved.
- The CML Series incorporates a  $\mu$ F sensor made possible by silicon micro-machining technology and thin-film technology.  
One side of the  $\mu$ F sensor is a mere 1.7mm, and at a thickness of 0.5mm, this thermal flow velocity sensor features high sensitivity and response. Four sensors are installed in the CML Series.
- Two sets of sensors for high and low flowrate ranges are mounted on the flow passage walls at 90° intervals. By selecting alternately the sensors according to the measurement flowrate ranges, the CML Series can achieve high accuracy ( $\pm 2\%$ RD in the range of more than FS5% of measurement range) and high rangeability (all models 160:1) in flowrate measurement.
- All of CML Series is provided with wide range of functions to meet various applications: LCD display function, analog output (4 to 20mA), integrating calculation and display, integral pulse output (open collector) and instantaneous flowrate alarm output.  
Also, the communication function is provided as a standard function, a large amount of instrumentation cost reduction can be achieved when data is transferred to the upper system.
- Photoelectric touch sensors are used to allow easy setting change without opening the case.
- The straightener (honeycomb) is installed in the flow passage of the CML Series, the length in the straight pipe sections can be shortened.  
Even when this CML Series is mounted at the downstream side of an elbow type pipe, the length of 5D in the upstream side and 2D in the downstream side can be applied.

■ System



■ Model selection guide

Basic model No.	Pipe size	Model type	Material	Connecti-on method	Gas type	Output	Power supply	Commu-nication	Mounting direction	Option 1	Option 2	Append-ed	Description
CML													High-Flow Mass Flow Meter
	050												Pipe size 50A (2B)
	080												Pipe size 80A (3B)
	100												Pipe size 100A (4B)
	150												Pipe size 150A (6B)
		0											Applicable pressure range 0 to 1MPa
			S										Material of major parts SUS304/SCS13
				J									JIS10KRF Flange
					N								Air, Nitrogen (Setting can be changed to standard compatible gases *1)
					S								Oxygen *3
						0							4 to 20mA output + Integration pulse output
							F						Free power supply 85 to 264Vac *4
								1					RS-485 Communication
									0				Horizontal (Flow direction:left to right) *2
									1				Horizontal (Flow direction:right to left) *2
									2				Vertical (Flow direction:down to up) *2
									3				Vertical (Flow direction:up to down) *2
										0			Without optional function
										1			Gas-contacting parts treated to be oil-inhibited
											0		Without optional function
											D		Inspection Certificate provided
											Y		Inspection Certificate provided+Complying with the traceability certification
											K		Inspection Certificate provided+Complying with the traceability certification+Calibration certificate provided
												0	Product version

\*1. Standard compatible gases indicate air/nitrogen, natural gas 13A (LNG), argon, butane, propane and carbon dioxide. The setting of this device can be changed by key operation.  
 \*2. Specify at the order entry. Cannot be changed after delivery.  
 \*3. When gas type S is selected, specify the code 1 (oil-inhibition treatment) at Option 1.  
 \*4. The model of 24Vdc power supply can be supplied as a special model.

## ■ Gas type and Flowrate range

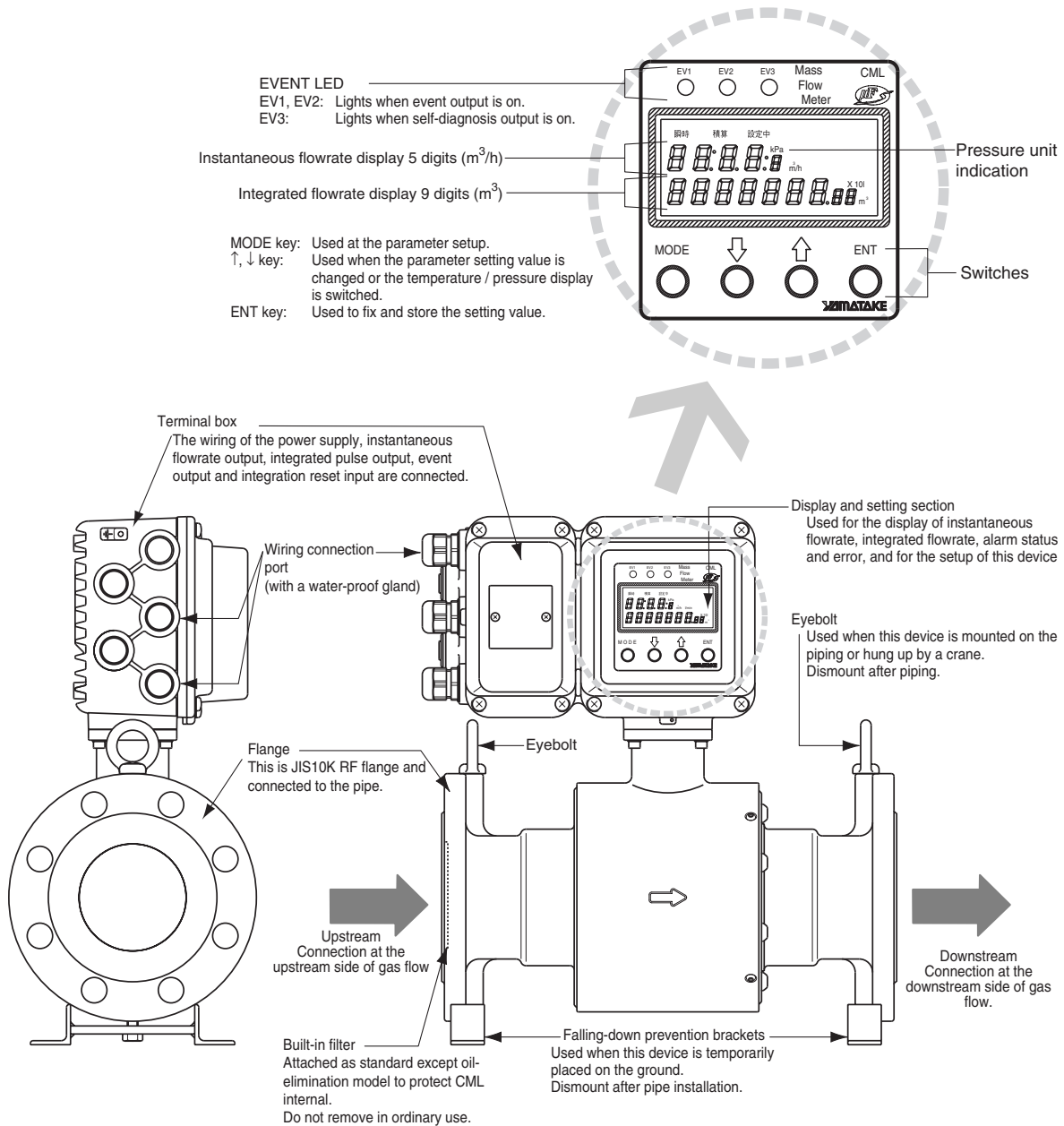
Gas type	Gas type setting 5-08	flow range [m <sup>3</sup> /h(normal)]			
		CML050	CML080	CML100	CML150
Air, Nitrogen	00	0 to 160	0 to 400	0 to 650	0 to 1600
Oxygen	01 *1	0 to 160	0 to 400	0 to 650	0 to 1600
Carbon dioxide(CO <sub>2</sub> )	02	0 to 120	0 to 300	0 to 480	0 to 1200
Argon	03	0 to 160	0 to 400	0 to 650	0 to 1600
Natural gas13A(46MJ) *2	04	0 to 160	0 to 400	0 to 650	0 to 1600
Butane *2	05	0 to 50	0 to 120	0 to 190	0 to 480
Propane *2	06	0 to 60	0 to 140	0 to 220	0 to 500
Natural gas13A(45MJ) *2	09	0 to 160	0 to 400	0 to 650	0 to 1600

\*1 01: Oxygen can be selected only for oxygen models.

\*2 Refer to;

 Chapter 6. Specification (on page 24).

# Chapter 2. NAMES AND FUNCTIONS OF PARTS



(Note) There are 3 wiring connection ports.

The water-proof gland is assembled at only one upper location when shipped from factory.

Other two water-proof glands are attached. The figure shows that the glands are assembled to all 3 locations.

# Chapter 3. MOUNTING AND WIRING

## WARNING



If this device is used for measuring natural gas 13A or propane, mount it on the upstream side of the safety shutoff valve.

If somehow air gets into the pipes and an explosive mixture is produced, and if the sensor makes a spark due to lightning or some other reason, the gas mixture in the pipes could explode.



Do not stand on this device or its installed pipes. Doing so might damage the device or the pipes, or might cause physical injury.



The mass of this device is 14 to 45kg, depending upon the model. When moving or transporting this device, take the precaution of using appropriate equipment or handling with two or more persons. Careless lifting or dropping could cause injury or damage.

## CAUTION



Do not mount with the display facing down.

Doing so might cause measurement error or equipment failure.



After the piping work is complete, remove the temporary support brackets. Otherwise someone might bump into them and be injured.

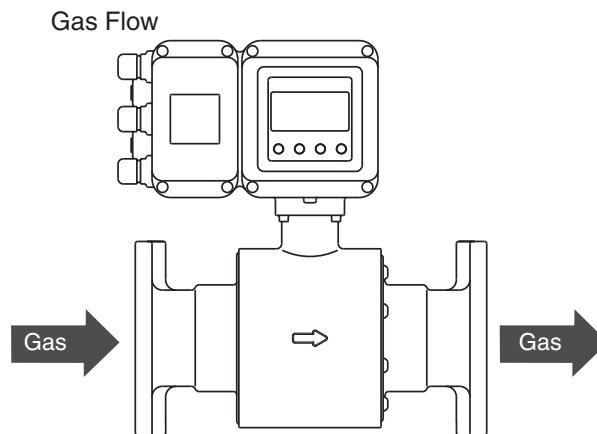
### Handling Precautions

- This device is a precision instrument. Do not drop it nor subject it to shock. Doing so might damage the device.
- When connecting to the pipe, be sure to check that there is no inclination of pipes nor any pipe center line misalignment, and then install the device. Doing so might cause leakage.
- When mounting the device, firmly fasten to prevent vibration.
- When used outdoors, protect from direct sunlight.
- If rust, oil mist or dust powder flows into the pipe, provide a strainer at the upstream side so that the foreign matter does not flow into this device. Any foreign matter might cause malfunction.
- When wiring, take care not to tug the display. The components inside might become damaged.
- Separate the wires of 4 to 20mA output, open collector output and communication from power lines, and do not lay in the same conduit. Doing so might cause faulty operation.
- Provide a main power supply shutdown switch of this device within the reach of the operator for this device.
- The common mode voltage between output and ground is less than 33V r.m.s., 46.7V peak and 70Vdc, excluding power supply and relay contact output.
- The eyebolt should be dismantled after completion of piping work.

### ■ Installation site

Avoid mounting this device in the following locations:

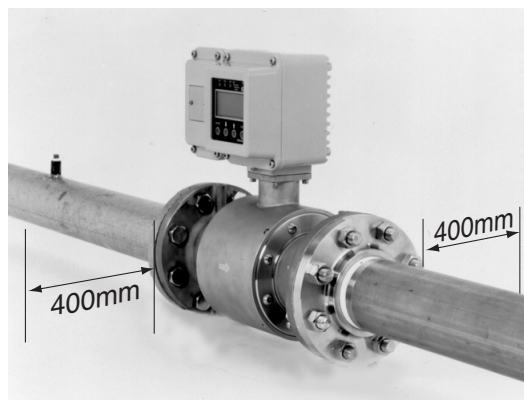
1. Locations whose ambient temperature falls below  $-25^{\circ}\text{C}$  and rises above  $+60^{\circ}\text{C}$
2. Locations whose ambient humidity exceeds 90%RH
3. Locations subject to sudden changes in temperature and condensation
4. Locations be filled with corrosive gases and flammable gases
5. Locations where there are lots of conductive substances (e.g. dust, salt or iron dust), or organic solvents
6. Locations subject to vibration or shock
7. Locations subject to direct sunlight
8. Locations subject to splashing by fluids (e.g. oil, chemicals.)
9. Locations where strong magnetic or electrical fields are generated



\* When feeding gas into this device, make it flow following the arrow on the side of the body. If gas is fed in the opposite direction, it cannot be measured accurately.

### ! Handling Precautions

- This device may be installed outdoors, but it is advisable to shield it from direct sunlight. In direct sunlight its temperature will rise, possibly causing malfunction or equipment failure.
- To facilitate maintenance, leave enough space to check the terminal box, as shown in the photograph below.

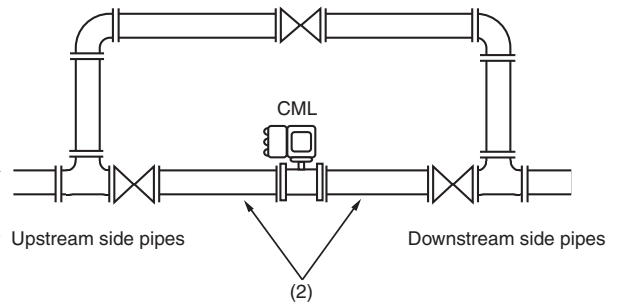


■ Pipes

● Precautions for piping installation

This device is a precision instrument. Intrusion of foreign matter such as dust, water or oil mist, even in small quantities, might cause faulty operation or measurement error. For piping installation, follow the guidelines below and install so that no foreign matter enters the device.

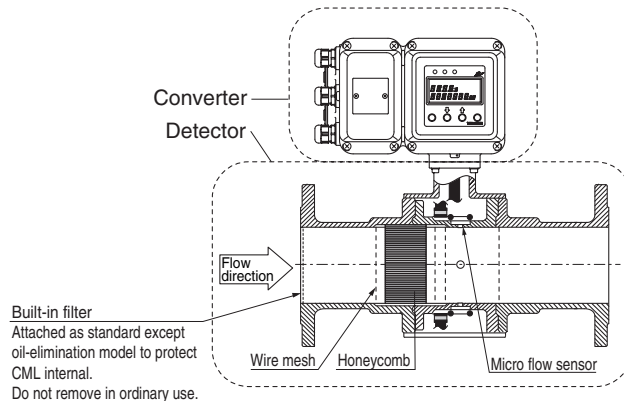
- (1) With the device dis-mounted, flush thoroughly to clean the inside of the upstream and downstream pipes to eliminate welding fumes or dust.



- (2) Wipe clean the inside of pipes to be connected to this device.
- (3) After completion of the above steps (1) and (2), check that there are no welding fumes or dust and then install the device.

! Handling Precautions

- If foreign matter cannot be fully eliminated by flushing or wiping, or if the regular presence of foreign matter can be expected, be sure to install a filter. If dust, oil or moisture adheres to the metallic mesh or to the  $\mu$ F sensor chip, measurement error or faulty operation may result.



● Filter

For applications with compressed air or propane, which regularly contain oil mist, or applications where rust etc. in the piping is expected, be sure to install a filter.

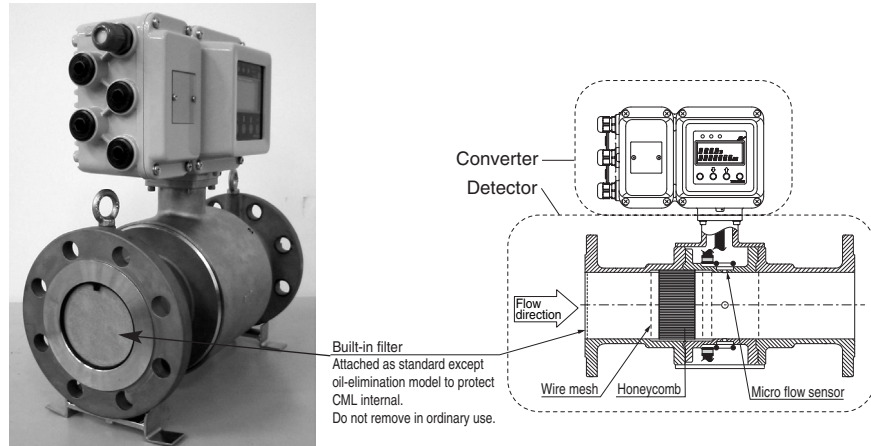
Model No.: MFF100 series

Specifications: For details, refer to;

➔ Yamatake's Specification sheet CP-SS-1824E.



● Built-in filter



Except for the oil-inhibited model, CML flowmeters have a built-in filter on the upstream side as a standard feature (models with the number CML \* \* \* \* SJN0F1 \* 0 \* \* \*).

Its purpose is to temporarily protect the CML from dust during piping work. If a large amount of dust enters the filter, pressure loss could become great enough to stop the gas flow. If there is a large amount of dust, or if there is a danger that dust will regularly enter the CML, be sure to install a permanent filter.

For permanent filters, refer to;

➡ Yamatake's Specification sheet CP-SS-1824E.

In addition, since the built-in filter cannot eliminate water or oil, be sure to use a permanent filter for that purpose also.

The built-in filter might cause pressure loss as shown on page 26. If no dust entered the filter at all, and if decreased pressure loss is desired, remove the built-in filter to obtain the pressure loss levels shown on page 27.

Removing the built-in filter

(1) Pull the protruding tab on the packing that holds the built-in filter in place to remove the packing.

(2) Remove the built-in filter.

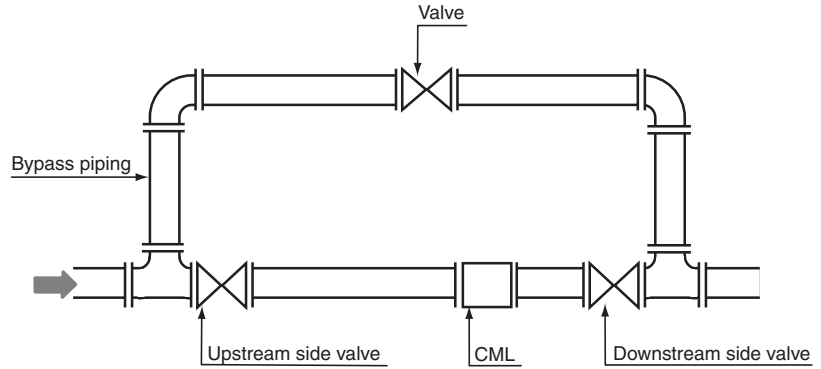
If the filter is difficult to remove, use adhesive tape to remove it as shown in the photograph at the lower right.



Tab on packing



- 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.  
Refer to the drawings below for the length of upstream pipe section. D indicates the connecting port size. Secure the length of more than 2D for the downstream pipe section.

Upstream side	
<p>90° elbow</p> <p>5D min.</p>	<p>Enlarging pipe with more than 15° circular cone angle (The pipe section with less than 15° circular cone angle is considered to be a straight pipe section.)</p> <p>5D min.</p>
<p>T-piping</p> <p>5D min.</p>	<p>Reducing pipe (Can be considered to be a straight pipe section.)</p> <p>5D min.</p>
<p>Gate valve</p> <p>5D min.</p>	<p>Various valves</p> <p>5D min.</p>

- 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.

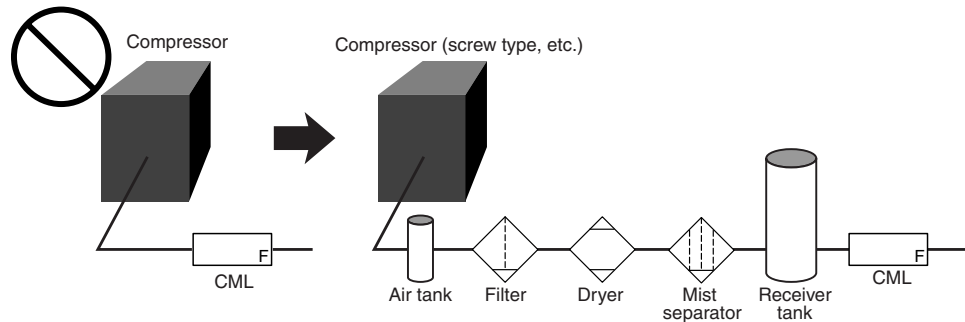
**! Handling Precautions**

- Remove the water using a dryer so that it does not cause dew condensation in the pipe.
- Use a dust-eliminating filter of less than 1µm mesh.
- Use an oil-eliminating mist separator with the eliminating capability of residual oil density less than 0.01mg / m<sup>3</sup>.  
Specifications of filter: For details, refer to;  
☞ Yamatake's Specification sheet CP-SS-1824E.

- Do not install at a location receiving the influence of pulsating flow.

**Note**

- 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 CML series.

- Take an effective measures in case of installation near the pump. When installed this device near the pump, there is a possibility to be received the influence of pulsating flow. Install a receiver tank between the pump and this device to suppress the influence of pulsating effect as much as possible.

**■ Piping work**

**⚠ WARNING**



The mass of this device is 14 to 45kg, depending upon the model. When moving or transporting this device, take the precaution of using appropriate equipment or handling with two or more persons. Careless lifting or dropping could cause injury or damage.

**⚠ CAUTION**



Do not flush out the pipes when this device is installed. If foreign matter enters this device it could cause equipment failure or errors in measurement.



To prevent leakage from the pipes, tighten bolts to the specified torque. Otherwise a leak could occur.



Purge and thoroughly clean the inside of piping that is upstream and downstream of this device to remove welding fumes and dust. Failure to do so might cause the flowmeter to break down due to entry of foreign matter.

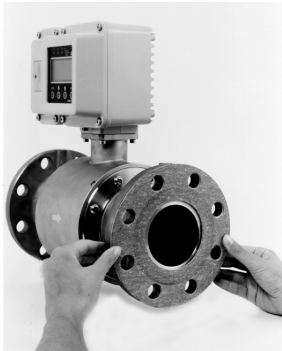
**! Handling Precautions**

- Be sure to flush the inside of the pipe before installation of this device to eliminate any foreign matter which might exist inside the pipe.

● **Mounting the gasket**

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

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

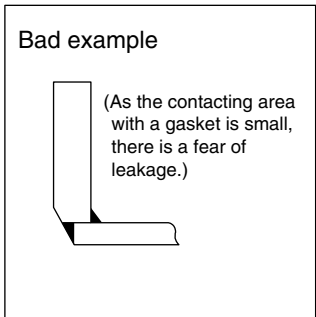
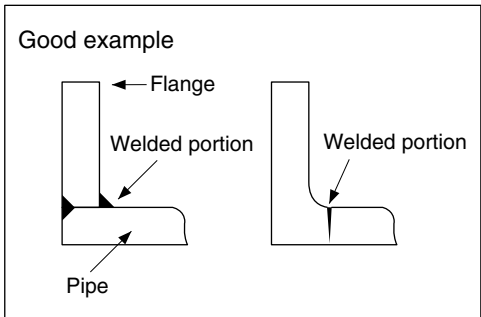


! **Handling Precautions**

- 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.

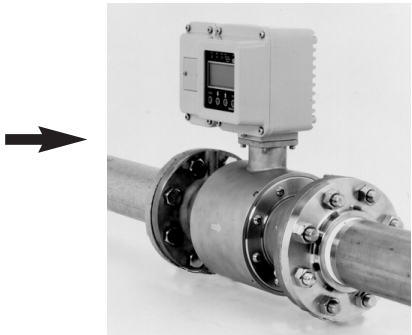
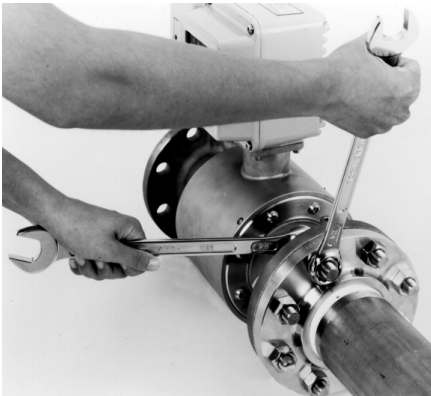
● **Flange shape**

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



● **Flange connection**

Tighten the flange with bolts.



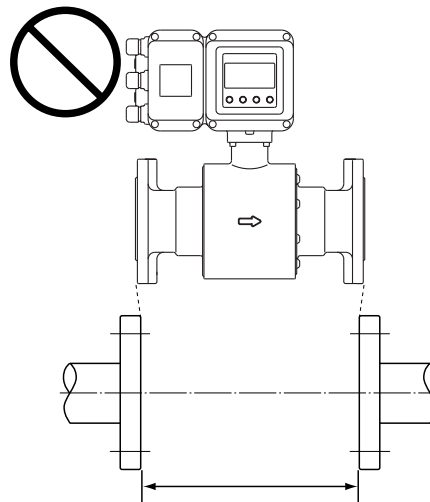
Tightening torque

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)

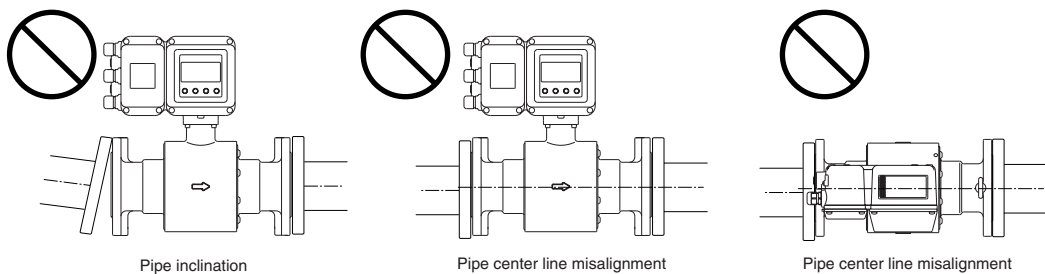
(The value in parenthesis indicates the reference value.)

**!** 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.



- Take care so that the pipe inclination or pipe center line misalignment does not occur.



■ Wiring

**⚠ CAUTION**



Be sure the load connected to the output terminals does not exceed the rated values given in the specifications. An excessive load could damage this device.



After wiring and before turning the power on, be sure to check that the wiring, the polarity of the power supply, etc., are correct. Wiring error could cause damage or malfunction.

● **Dismounting the terminal case**

Required item: Phillips-head screwdriver

(1) Loosen 4 screws on the terminal case using a philips-head screwdriver.



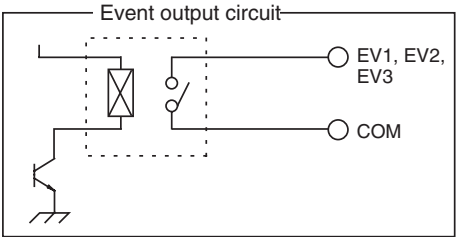
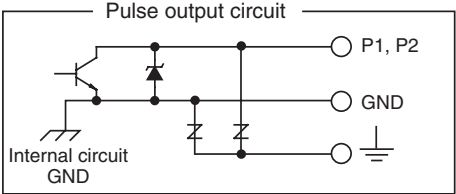
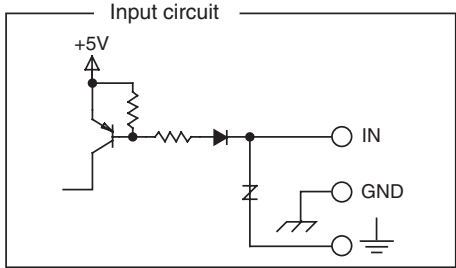
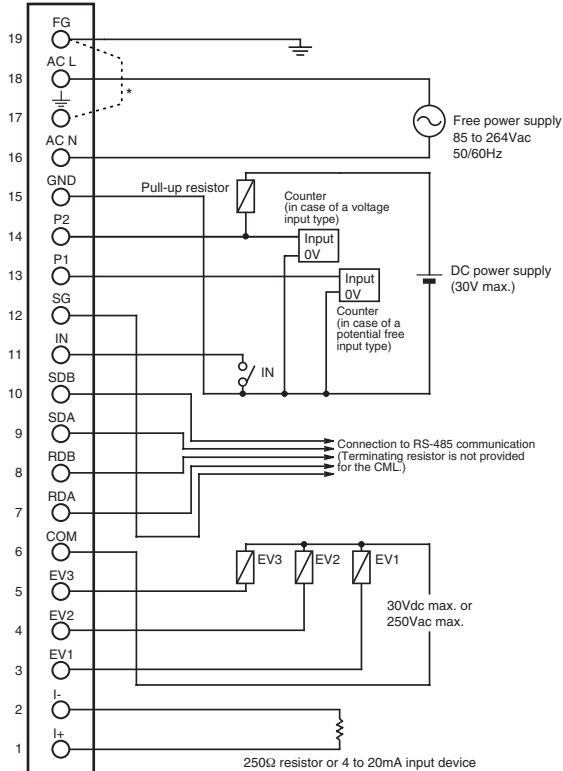
(2) Dismount the terminal case cover.



(3) Connect to each terminal.

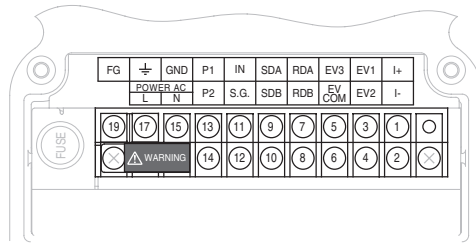


● **Wiring connection example**



\*: Terminals No.17 and No.19 are connected using a connecting plate of terminal block.

● Terminal layout



Terminal No.	Signal name	Description
1	I+	4 to 20mA Instantaneous flowrate output (+)
2	I-	4 to 20mA Instantaneous flowrate output (-)
3	EV1	Instantaneous flowrate upper limit event
4	EV2	Instantaneous flowrate lower limit event
5	EV3	Self-diagnosis output
6	COM	Event output common
7	RDA	RS-485 communication
8	RDB	RS-485 communication
9	SDA	RS-485 communication
10	SDB	RS-485 communication
11	IN	Integrated count reset input
12	SG	RS-485 communication
13	P1	Integrated pulse output 1
14	P2	Integrated pulse output 2
15	GND	Integrated output, reset input common
16	ACN	Power
17	⊥	Internal GND (wiring not required)
18	ACL	Power
19	FG	Earth (ground)

! Handling Precautions

- Connect each terminal securely using crimp type terminal lugs to ensure firm contact area.
- Use crimp type terminal lugs applicable to M3.5 screw.
- Be sure that the tightening torque of terminal screw is less than 0.8N•m.
- Use the JIS C 3401 cables for control (CVV etc.) of less than 2.2mm dia. for the wiring except RS-485 communications.
- Use the twisted-pair shielded cables for the wiring of RS-485 communications. Be sure to apply terminating resistors (150Ω 1/2W).
- The pulse output and input circuits are not insulated, and the GND terminal and the GND internal circuit are connected.
- The 4 to 20mA instantaneous flowrate output is insulated.
- The COM for the event output and self-diagnostic output is commonly used and is insulated from the internal circuit.
- Terminals No.17 and No.19 are connected using a connecting plate of terminal block.

● **Treatment on wiring connection port**

There are two methods in drawing out the wires.

Use a cable of 6 to 12mm outside diameter when using a water-proof gland.

For the connection of a flexible electric wiring tube, dismount the water-proof gland and then directly connect the wiring tube.

The connection of electric wiring tube is recommended for the outdoor use.

Three wiring connection ports are available.

When shipped from factory, the water-proof gland is assembled on only one top location.

When there are many wires, remove the plug, apply the attached water-proof gland, and then draw out the wires.

 **Handling Precautions**

- The wiring connection port size is G1 / 2 female thread.


# Chapter 4. METHOD OF OPERATION

## ■ flowrate display

The display content is different according to the function setup.  
In the default setting, the upper 5-digit LCD display indicates the instantaneous flowrate, and the lower 9-digit LCD display indicates the integrated flowrate.

## ■ Temperature and pressure display

When [5-02: Display mode] is set to 02 in the function setup, the pressure is indicated by pressing the  $\hat{\circ}$  key, and the temperature is indicated by pressing the  $\hat{\circ}$  key.  
For the display mode setup,

 refer to ■ Function setup item list (on page 18).

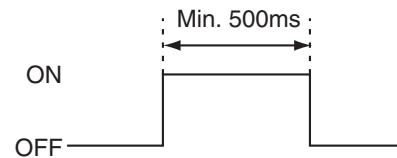
This device has two kinds of setups: the function setup and the parameter setup.

## ■ Integrating display and integrated count resetting function

When [5-02: Display mode] is set to 01 or 02 in the function setup, the lower display in the display and setting section indicates the integrated flowrate in the range of 0 to 9999999.99 (unit: m<sup>3</sup>).

To start the integrating count, input the integration count reset input signal (external contact, terminal No. 11 IN).

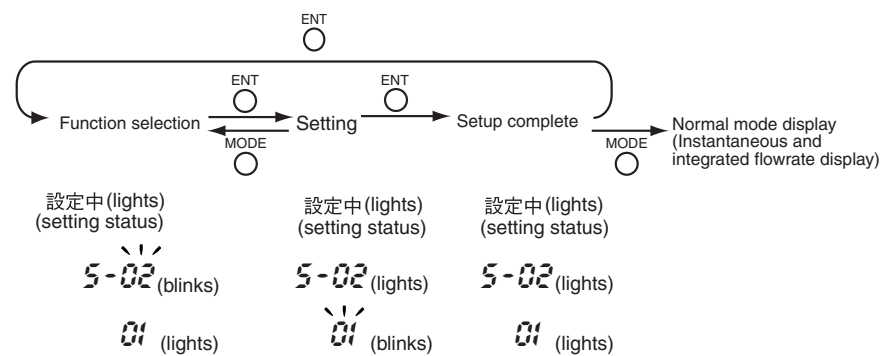
To reset the integration count, hold the integration count reset input signal ON for 500ms or longer as shown in the following figure:



## ■ Function setup

- (1) When the display section indicates the instantaneous flowrate value or integrated flowrate value, hold down the  $\text{MODE}$  and  $\hat{\text{O}}$  keys simultaneously for 3s or longer.
- (2) The [設定中] sign lights, and the function type is indicated in the instantaneous flowrate display section, and the setup content is indicated in the integrated flowrate display.  
At this moment, the lower 2 digits indicate the current setting value. Also, the function type (number) blinks.

### Display example



- (3) Pressing the  $\hat{\text{O}}$  key moves the setup to the next mode number. Pressing the  $\hat{\text{O}}$  key returns the setup to the previous mode number.  
Pressing the  $\hat{\text{O}}$  key again while  $5-32$  is displayed returns the display to  $5-01$ .  
Pressing the  $\hat{\text{O}}$  key while  $5-01$  is displayed moves the display to  $5-32$ .
- (4) When the setup value has become the target mode number, press the  $\text{ENT}$  key while the value is blinking.
- (5) This selects the mode number. The mode number lights, and the setup (number) blinks.
- (6) Press the  $\hat{\text{O}}$  or  $\hat{\text{O}}$  key to select the target setup value in the lower 2 digits of the integrated flowrate display section, and then press the  $\text{ENT}$  key.
- (7) The setup value is fixed and lights.
- (8) When continuing the setup, press the  $\text{ENT}$  key again and repeat the (3) to (7) operations.


## ! Handling Precautions

- Pressing the  $\text{MODE}$  key during (2) to (3), and (7) operations returns the display section to instantaneous flowrate indication.
- Pressing the  $\text{MODE}$  key during (5) to (6) operations returns the display section to (2) operation.

## ■ Function setup item list

Mode	Function	Setting value	Setup	Factory setting	Remarks
5-01	Key lock	00 01	Key lock disabled Key lock enabled	00	Other modes cannot be entered in a key lock state.
5-02	Display mode	00 01 02	Only instantaneous flowrate displayed Instantaneous flowrate and integrated flowrate displayed Instantaneous flowrate, integrated flowrate, pressure and temperature displayed	01	Pressing the $\bar{O}$ or $\bar{O}$ key indicates the temperature or pressure.
5-04	Event 2 setting (EV2)	00 01	Instantaneous flowrate lower limit event Pressure decrease event	00	When selecting the instantaneous flow rate lower limit event, set the desired flow rate limit in parameter setup P-02. When selecting the pressure decrease event, set the desired pressure limit in parameter setup P-12.
5-05	ON delay setting (EV1) *1	00 01	Not used Used	00	EV1 is the instantaneous flowrate upper limit output.
5-06	ON delay setting (EV2) *1	00 01	Not used Used	00	EV2 is the instantaneous flowrate lower limit output.
5-07	Event standby setting	00 01	Not used Used	00	Special for EV2
5-08	Gas type selection *2	00 01 02 03 04 05 06 09	Air / Nitrogen Oxygen Carbon dioxide Argon Natural gas 13A (46MJ) Butane Propane Natural gas 13A (45MJ)	00 (01)	The default setting is set to 01: Oxygen for the oxygen model. 01 is selectable only for the oxygen
5-12	Low flow cut setting	00 01 02 03	Not used Qmax X (1/1280) Qmax X (1/320) Qmax X (1/160)	01	Qmax means the maximum value in flowrate range.
5-14	Pulse weight	00 01 02	10L / pulse 100L / pulse 1000L / pulse	02	Used for setting the integrated pulse output 1 (P1). The pulse weight for the integrated pulse output 2 (P2) is fixed to 1L/pulse.
5-15	Burnout selection	00 01	Down scale Up scale	00	The output value at the measurement failure (E28 or E40 displayed) is set. At the downscale setting, the output is approx. 1.0mA. At the upscale setting, the output is the value set at P-15 in the parameter setup mode.
5-30	Communications address setting	00 01 to 7F	Communications function disabled Communications address (hexadecimal)	00	Communication function is disabled when set at [0]. Set an address different from other slave stations.
5-31	Transfer speed selection	00 01	9600 bps 4800 bps	01	Set the transfer speed with the connected devices.
5-32	Communications	00 01	8bits, even parity, 1 stop bit 8bits, no parity, 2 stop bits	01	Set the communication condition with the connected devices.

\*1: For details of ON delay, refer to;

 ■ Parameter setup item table (on page 20).

\*2: The gas type selection function enables the user to change the gas type to be used. When the gas type is changed, the measurement flowrate range is changed due to the thermal diffusion coefficient difference. For the measurement flowrate range, refer to;

 ■ Gas type and flowrate range (on page 3).

## Handling Precautions

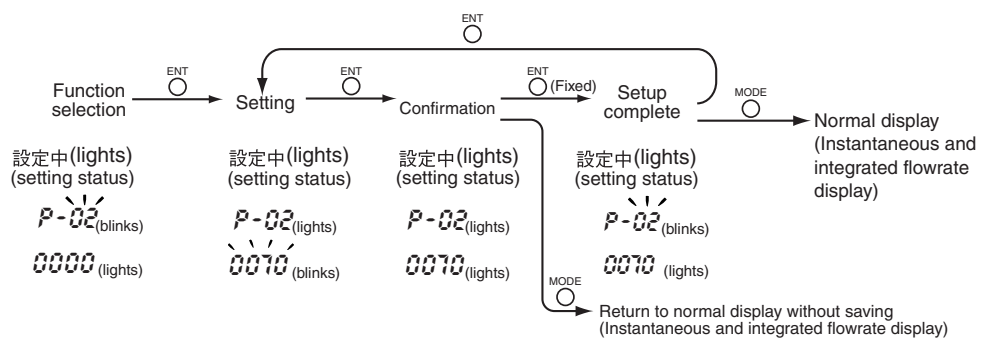
- When [5-01: Key lock] is set to [01: Key lock enabled], the display and setup of 5-02 to 5-32 are both disabled. Be sure that the display and setup of the parameters P-01 to P-16 are also disabled.
- When 5-01 is returned to [00: Key lock disabled], the display and setup of all setup items become to be enabled. Even if the operations of key lock enabled and disabled are repeated, the function and parameter setup data are kept.

## Parameter setup

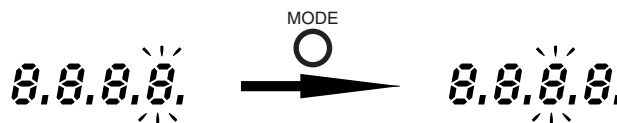
To setup the parameter, the function setup has to be set to the condition enabling the parameter setup.

- (1) Be sure that **S-01** is set to **[00: Key lock disabled]**.
- (2) To enter the parameter setup mode, hold down the **MODE** and **↓** keys simultaneously for 3s or longer.
- (3) In the parameter setup mode, **[P-□□]** is displayed. The parameter item is indicated in the instantaneous flowrate display section. The current setup value is indicated in the integrated flowrate display section. Also, the parameter item (number) blinks.

Display example



- (4) Pressing the **↓** key moves the setup to the next item. Pressing the **↑** key returns the setup to the previous item.
- (5) Pressing the **↓** key again while **P-01** is displayed returns the display to **P-15**. Pressing the **↑** key again while **P-15** is displayed returns the display to **P-01**.
- (6) Press the **ENT** key to set at the target item is indicated.
- (7) The parameter item lights, and the lowermost digit of the setup value blinks.
- (8) If you press the **MODE** key, the blinking cursor moves to the left.



- (9) Pressing the **↑** or **↓** key increments or decrements the blinking digit value. To change the setup value at each of these digits, use the **↑** or **↓** key.
- (10) After setting to the target setup value, press the **ENT** key.
- (11) All digits of the setup value light. In this state, the setup value has not yet been saved. Press the **ENT** key again.
- (12) The setup value is fixed, and the parameter item (number) blinks. If the setup value is different from the current value, the setup value has been saved.
- (13) To continue the setup, repeat the (3) to (12) operations.

## ! Handling Precautions

- Pressing the **MODE** key during (2) to (5), and (11) operations returns to the instantaneous flowrate indication in the display.

■ Parameter setup item table

Parameter	Item	Factory setting	Description	Remarks
P-01	Instantaneous flowrate upper limit value (EV1)	160(CML050) 400(CML080) 650(CML100) 1600(CML150)	0 to 9999m <sup>3</sup> /h	Instantaneous flowrate upper limit event is set.
P-02	Instantaneous flowrate lower limit value (EV2)	0	0 to 9999m <sup>3</sup> /h	Instantaneous flowrate lower limit event is set. Enabled when 5-04 (Event 2 setting) in the function setup is set to "00: Instantaneous flow rate lower limit event."
P-03	EV1 Hysteresis	0	0 to 100m <sup>3</sup> /h	-
P-04	EV2 Hysteresis	1	0 to 100m <sup>3</sup> /h	Applies to the event set in 5-04 (Event 2 setting) in the function setup.
P-05	EV1 On delay	0	0 to 60 (s)	-
P-06	EV2 On delay	0	0 to 60 (s)	-
P-08	User setup gas conversion factor	100.0	10.0 to 450.0	Multiply the measured amount of the gas that is selected in function setup 5-08 (Gas type selection) by the conversion factor.
P-11	Reference temperature	0	0 to 35°C	-
P-12	Pressure decrease event setting value(EV2)	0	0 to 1000kPa	Sets the desired pressure for the pressure decrease event. Enabled when 5-04 (Event 2 setting) in the function setup is set to "01: Pressure decrease event."
P-15	Burnout value setting	125	0 to 125%	"0%" corresponds to 4mA, and "100%" corresponds to 20mA.
P-16	4 to 20mA output span setting	0	0 to 9999m <sup>3</sup> /h	"0" means standard range.

**P-01:**

When the instantaneous flowrate exceeds the upper limit setting value, the event turns ON.

When the instantaneous flowrate downs below the upper limit value, the event turns OFF.

**P-02:**

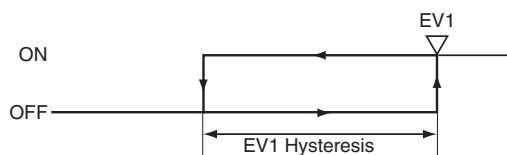
When the instantaneous flowrate downs below the lower limit setting value, the event turns ON.

When the instantaneous flowrate exceeds the lower limit value, the event turns OFF.

**P-03:**

The conditions to turn the event OFF after the instantaneous flowrate exceeds the upper limit value and then the event turns ON are set to the hysteresis.

[Event OFF conditions] = [Instantaneous flowrate upper limit value] - [EV1 hysteresis setting value]

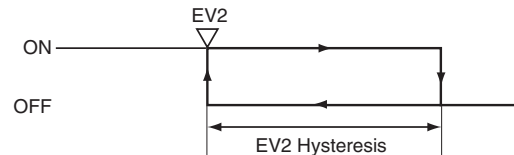


**P-04 :**

The conditions to turn the event OFF after the instantaneous flowrate falls below the lower limit value and then the event turns ON are set to the hysteresis.

[Event OFF conditions] = [EV2 setting value]+[EV2 hysteresis setting value]

The EV2 setting value is either the instantaneous flow rate lower limit or the pressure decrease event lower limit, depending on the selection in function setup **S-04**.

**P-05 :**

The event ON delay time after the instantaneous flowrate exceeds the upper limit value is set.

**P-06 :**

This determines the delay time before the event turns ON, after the instantaneous flow rate falls below the preset lower limit (or after the pressure decreases below the preset lower limit).

**P-08 :**

Gas conversion factor is set when the gas other than the standard compatible gases is used. When setting the conversion factor, contact Yamatake Corporation.

**P-11 :**

When this setting is changed, the maximum measurement range and the indication flowrate range are changed from the flowrate range of factory setting which refers to 0°C to the converted flowrate range at the setting temperature. The maximum value Q(t) can be calculated as follows where the maximum flowrate at 0°C conversion is Qmax and the setting temperature is t(°C):

$$Q(t)=Q_{\max} \times (273+t) / (273+0)$$

**P-12 :**

This setting is enabled when **S-04** (Event 2 setting) is set to "01: Pressure decrease event." When the pressure falls below the value set here, the event is turned ON. When it increases above the lower limit, the event is turned OFF.

**P-15 :**

This setting is enabled when **S-15** (burnout selection) is set to [0]: Up scale].

**P-16 :**

- When set to 0; the maximum measurement flowrate which is defined by the condition of **S-08** (gas type selection) and **P-11** (reference temperature setting) is automatically set as the 20mA flowrate.
- When set to 1 to 1/16 of maximum measurement value in air; the setting value is invalid. The output is the burnout output value.
- When set to 1/16 of maximum measurement value in air to 9999; the output is 20mA when the flowrate is equal to the setting value. The span is fixed even if the conversion temperature is changed.

## **!** Handling Precautions

- When **S-01** is set to [0] in the function setup, the display and setup of **P-01** to **P-16** are disabled. For the parameter setup, set **S-01** to [00].

# Chapter 5. TROUBLESHOOTING

Refer to the following table if trouble occurs:

Phenomena	Remedy
Nothing on display	<ul style="list-style-type: none"> <li>• Make sure that the correct power voltage being applied and the polarity are correct.</li> <li>• Make sure that the electric wires are connected.</li> </ul>
<i>E21</i>	Error 1 of the flow sensor for low flowrate range. *1 Contact Yamatake Corporation and ask for repair.
<i>E22</i>	Error 1 of the flow sensor for high flowrate range. *1 Contact Yamatake Corporation and ask for repair.
<i>E23</i>	Error 2 of the flow sensor for low flowrate range. *1 Contact Yamatake Corporation and ask for repair.
<i>E24</i>	Error 2 of the flow sensor for high flowrate range. *1 Contact Yamatake Corporation and ask for repair.
<i>E25H</i>	Pressure sensor error, or the pressure has exceeded the operating pressure range. If this error code is displayed within the allowable operating temperature range or operating pressure range, the cause is sensor error. Contact Yamatake Corporation and ask for repair.
<i>E25L</i>	Pressure sensor error, or the pressure has fallen below the operating pressure range. If this error code is displayed within the allowable operating temperature range or operating pressure range, the cause is sensor error. Contact Yamatake Corporation and ask for repair.
<i>E26H</i>	Temperature sensor error, or the gas temperature has exceeded 70°C. If this error code is displayed within the allowable operating temperature range or operating pressure range, the cause is sensor error. Contact Yamatake Corporation and ask for repair.
<i>E26L</i>	Temperature sensor error, or the gas temperature has fallen below -30°C. If this error code is displayed within the allowable operating temperature range or operating pressure range, the cause is sensor error. Contact Yamatake Corporation and ask for repair.
<i>E27</i>	Error 1 or 2 of the flow sensor for low flowrate range. *2
<i>E28</i>	Error 1 or 2 of the flow sensor for high flowrate range. *2
<i>E90</i>	Memory data error Contact Yamatake Corporation and ask for repair.
The display is other 0.0 even though the instantaneous flowrate should be zero	Check the pipe for any gas leaks.
Flowrate deviates	<ul style="list-style-type: none"> <li>• Check the piping for any gas leaks.</li> <li>• Check the piping and connection ports for dirt, oil or other foreign matter. If oil is adhering to these parts, contact Yamatake Corporation and ask for repair.</li> <li>• Check the wiring to make sure that it is correct.</li> <li>• Check the flowrate to see that it does not deviate considerably within several seconds, or that it does not greatly exceed the measurement range.</li> </ul>

\*1 : If either of *E21* or *E23*, or either of *E22* or *E24* has occurred, the measurement can be maintained by backup function. If *E21* or *E23* occurs while the flow is stopped, there may have been a temporary reverse flow. If so, the error is automatically fixed as soon as gas flows again in the correct direction. However, if *E21*, *E22*, *E23*, or *E24* is displayed for a long time, the cause may be sensor malfunction rather than reverse flow. Continued measurement may be possible, but the degree of measurement accuracy given in the specifications cannot be guaranteed in this situation. Contact Yamatake Corporation and ask for repair.

\*2 : If the instantaneous flowrate display shows minus value when *E27* or *E28* is displayed, there is a possibility that the flow is reverse against the correct flow direction. In this case, check the flow direction. If this is displayed when the flow direction is correct, the cause is sensor error. Contact Yamatake Corporation and ask for repair.

# Chapter 6. SPECIFICATIONS

## ■ Specifications

Item	Description					
	CML050	CML080	CML100	CML150		
Applicable gas	Air / Nitrogen, Natural gas 13A (LNG) *1, Propane *2, Carbon dioxide, Oxygen, Butane *3, Argon Note; The gas must be a dry gas not containing corrosive component (chlorine, sulfur, acid, etc.), and must also be a clean gas not containing dust or oil mist.					
Flowrate range (in air or nitrogen)	160m <sup>3</sup> / h (normal)	400m <sup>3</sup> / h (normal)	650m <sup>3</sup> / h (normal)	1600m <sup>3</sup> / h (normal)		
Measurement accuracy (Total accuracy including repeatability)	Differs by measurement flow Xm <sup>3</sup> /h(normal) range.					
	1.0 ≤ X < 8.0 ±3%RD 8.0 ≤ X ≤ 160.0 ±2%RD	2.5 ≤ X < 20.0 ±3%RD 20.0 ≤ X ≤ 400.0 ±2%RD	4.0 ≤ X < 32.5 ±3%RD 32.5 ≤ X ≤ 650.0 ±2%RD	10.0 ≤ X < 80.0 ±3%RD 80.0 ≤ X ≤ 1600.0 ±2%RD		
	Calibration reference at 20°C, 101.325kPa.					
Temperature characteristics	0.05%RD / °C (-25 to +60°C)					
Pressure characteristics	0.2%RD/0.1MPa (0.0 to 1.0MPa)					
Operating pressure range	0.0 to 1.0MPa					
Sampling cycle	160ms ±10%					
Instantaneous flowrate output	4 to 20mAdc (Allowable load resistance 600Ω max.) Burnout output : 1mA max., at down scale , 24.0mA max. at up scale.					
Event output (3 points)	SPST relay contact (3 points / common) Contact rated: 250Vac / 30Vdc, 3A max. (resistive load) Min. open / close specifications: 100μA, 100mV					
	Event No.	Functions (fixed)	Setting range	Hysterisis	On delay time	Stand by setting
	EV1	instantaneous flowrate upper limit	0 to 9999m <sup>3</sup> /h	0 to 100m <sup>3</sup> /h (Changeable)	0 to 60s (Changeable)	-
	EV2	instantaneous flowrate lower limit	0 to 9999m <sup>3</sup> /h	0 to 100m <sup>3</sup> /h	0 to 60s (Changeable)	valid
		Pressure decrease event	0 to 1000kPa	0 to 100kPa		
	EV3	self-diagnosis output	Output when error occurs (EXX indicated)			
Integrated pulse output (2 points)	Pulse output 1 (P1)	NPN open collector output rating: 30Vdc, 50mA max. Pulse rate: 10L/pulse, 100L/pulse, 1000L/pulse (changeable by key operation) Pulse Frequency: 0.0003 to 60Hz Pulse width: 8.3 to 1000ms (50% duty fixed)				
	Pulse output 2 (P2)	NPN open collector output rating: 30Vdc, 50mA max. Pulse rate: 1L/pulse (fixed) Pulse frequency: 0.0003 to 601Hz Pulse width: 0.83 to 1000ms (50% duty fixed)				
Integrated count reset input (1 point)	Input type : No-voltage contact or open collector OFF terminal voltage: 3.5±1V ON terminal current: approx. 2.5mA (flows from terminal) Allowable ON contact resistance: 500Ω max. Allowable OFF contact resistance: 5kΩ min. Allowable ON residual voltage: 0.8V max. (open collector input type) Allowable OFF leakage current: 0.8mA max. (open collector input type)					
RS-485 communication	Transmission line : 5-wire Communication distance : 300m max. Transmission speed: 9600/4800bps CML can communicate dedicated for Yamatake products (EST240Z, CMC10G, WEB100).					
Display	Flowrate display	instantaneous flowrate : LCD 5 digits integrated flowrate : LCD 9 digits				
	Instantaneous flowrate display range	0.0 to 216.6	0.0 to 541.5	0.0 to 880.0	0.0 to 2166.1	
	integrated flowrate	The indication flow range is the range that 1.2 times as large as the maximum flowrate range converted to standard temperature.				
	Status display	Display unit	0.01m <sup>3</sup>			
		Display range	0 to 9999999.99(7+2 digits)			
	Data storage	Integrated count data can be hold even though during power off.				
Switch	Four photoelectric touch sensors switch(for setting of setup and parameter)					
Power supply	Free power supply 85 to 264Vac (The model of 24Vdc is provided as a special model)					
Current consumption	10VA max.					
Operating temperature range	-25 to +60°C					
Storage temperature range	-30 to +70°C					
Operating humidity range	10 to 90%RH (condensation not allowed)					

Item	Description			
	CML050	CML080	CML100	CML150
Mounting direction	Horizontal / vertical mounting (depend on the model number)			
Required straight pipe length	Upstream ; 5D Downstream ; 2D (the specifications when an elbow is installed at upstream side. D means the pipe diameter.)			
Connection rated	JIS10K RF			
Pipe size	50A(2B)	80A(3B)	100A(4B)	150A(6B)
Body and gas contacting parts material	Body: SUS304 / SCS13A Case material: Aluminum alloy O ring material: Neoprene (Oil-inhibited model: Viton)			
Case coating specifications	Acrylic resin corrosion resistant coating Coating color: Light beige (Munsell 4Y7.2/1.3)			
Wiring connection port	G1/2 female thread with a water-proof gland			
Glass material	Tempered glass: Thickness 5mm			
Sealing	IP65 (JIS C 0920 and IEC 60529 Water-proof and dust-proof structure on the assumption of outdoor installation)			
Mass (kg)	14	24	29	45

\*1: If natural gas 13A is selected, calibration is based on gases with the compositions shown below.

5-28: Gas type setting	Gas type (as used by Yamatake)	Calorific value (MJ)	Methane (%)	Ethane (%)	Propane (%)	Butane (%)
04	City gas 13A(46MJ)	46.04655	88	5.8	4.5	1.7
09	City gas 13A(45MJ)	45.007	88.9	6.8	3.1	1.2

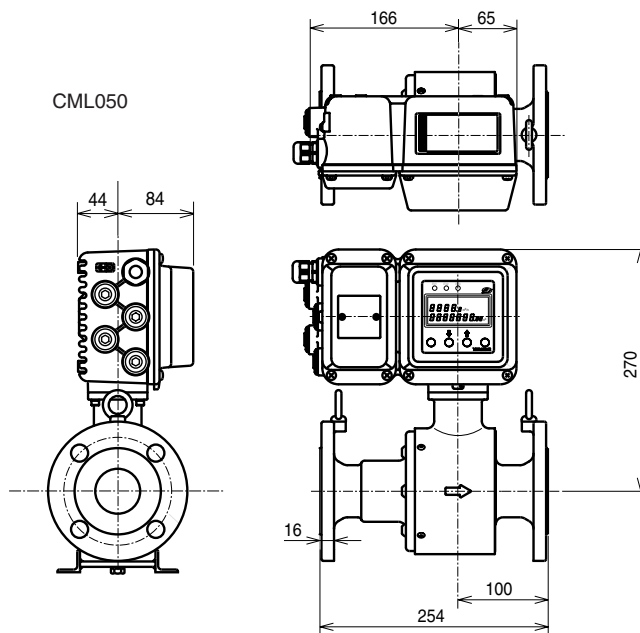
City gas that differs from the above may require a change in the factory setting or may not be measurable if it contains a large amount of hydrogen. For such gases, contact Yamatake Corporation.

\*2: If propane is selected, calibration is based on a reference gas of 98% propane and 2% isobutane. Propane with a different composition may require a change in the factory settings. Contact Yamatake Corporation.

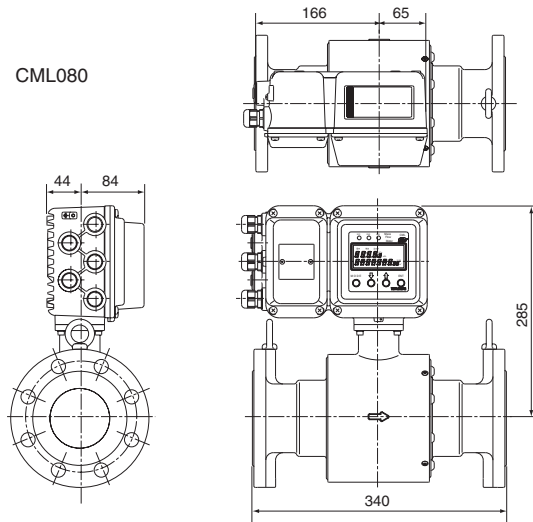
\*3: In the case of butane, calibration is based on a reference gas of 98% butane and 2% propane. Butane with a different composition may require a change in the factory settings. Contact Yamatake Corporation.

### External dimensions

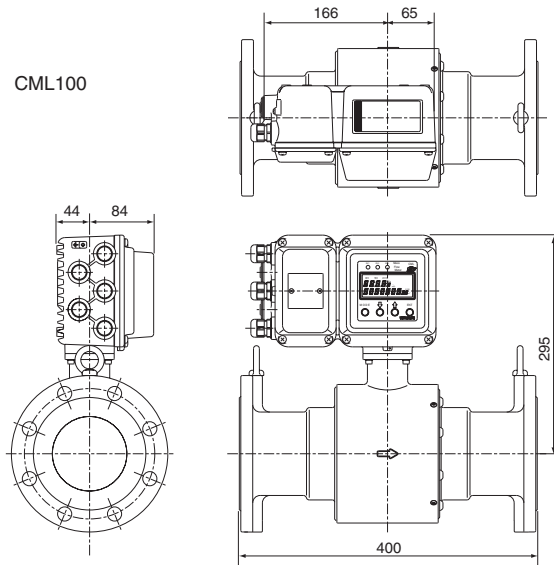
Unit : mm



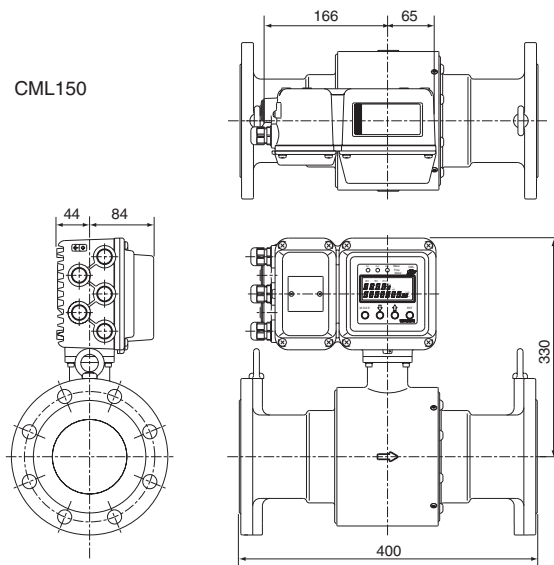
CML080



CML100



CML150



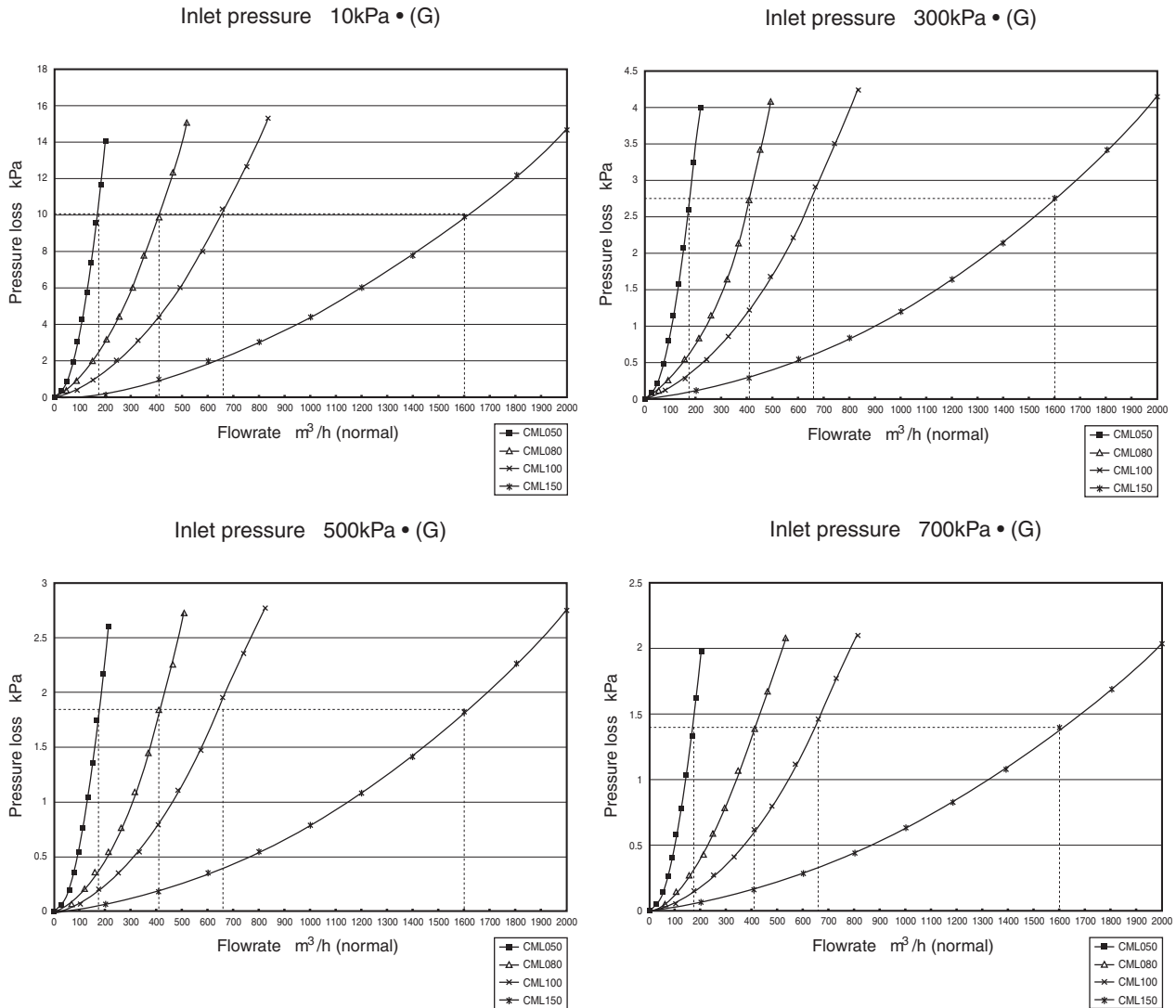
 **Note**

- The figure of CML080 / 100 / 150 shows that the glands are assembled to all 3 locations.

■ Pressure loss (flowrate - pressure loss characteristics)

● Excluding oil-elimination model (with built-in filter)

The graph below shows the data in air.



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

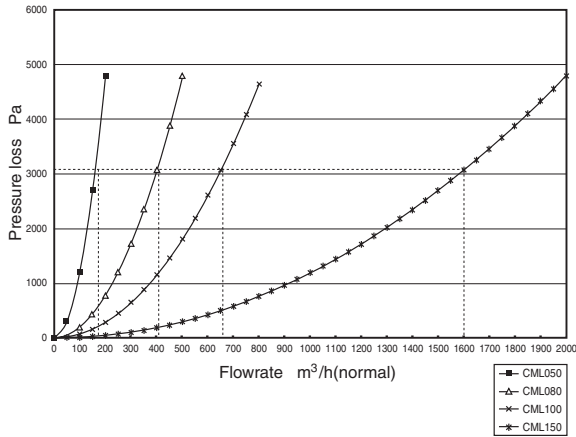
Specific gravity of each gas (when air is 1.0)	
Argon	1.38
Carbon dioxide	1.53
City gas 13A (Methane 88%)	0.64
Methane 100%	0.56
Propane 100%	1.56
Butane 100%	2.08

Example) When the inlet pressure of the CML150 is 700kPa, and the flow rate is 1000m³/h(normal), the pressure loss for city gas 13A is calculated as follows:  
 From the graph for 700kPa-(G) inlet pressure, the pressure loss is approx. 0.6kPa when the flow rate is 1000m³/h(normal).  
 Multiply this value by the specific gravity to get the result: 0.6kPa X 0.64 = 0.384kPa.

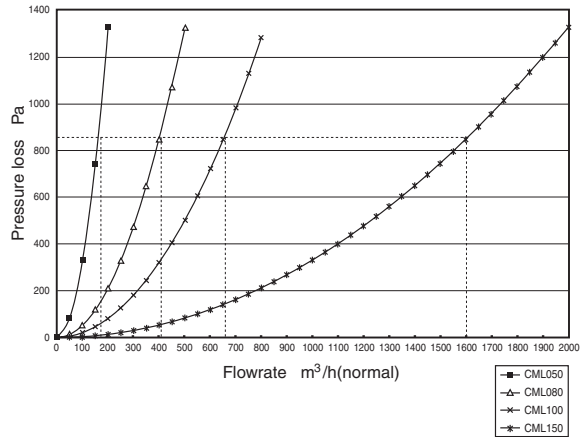
● Oil-elimination model (with built-in filter)

The graph below shows the data in air.

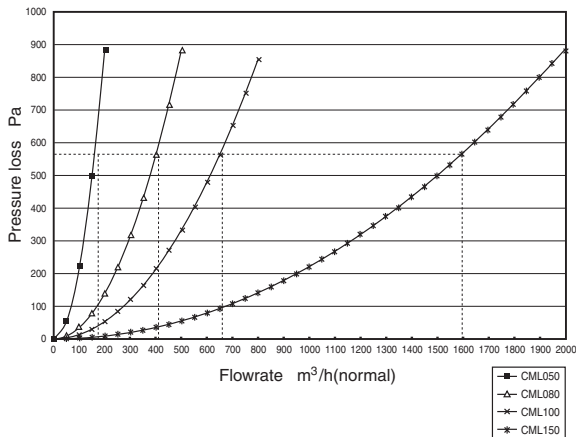
Inlet pressure 10kPa • (G)



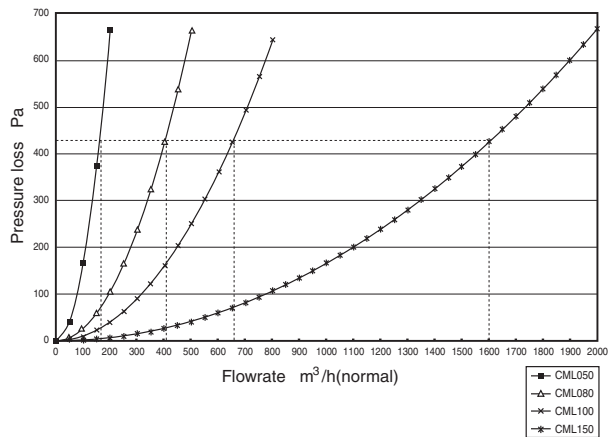
Inlet pressure 300kPa • (G)



Inlet pressure 500kPa • (G)



Inlet pressure 700kPa • (G)



When the CML 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
City gas 13A (Methane 88%)	0.64
Methane 100%	0.56
Propane 100%	1.56
Butane 100%	2.08

Example) When the inlet pressure of the CML150 is 700kPa, and flow rate is 1000m<sup>3</sup>/h(normal), the pressure loss for city gas 13A is calculated as follows:

From the graph for 700kPa•(G) inlet pressure, the pressure loss is approx. 0.17kPa when the flow rate is 1000m<sup>3</sup>/h(normal). Multiply this value by the specific gravity to get the result: 0.17kPa X 0.64 = 0.11kPa.





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