Mixing Vaporizer
MV-2000

Instruction Manual

CODE: I031170900

Preface

This manual describes the operation of the Product name, MV-2000 series.
Be sure to read this manual before using the product to ensure proper and safe operation of the instrument. Also safely store the manual so it is readily available whenever necessary.

Product specifications and appearance, as well as the contents of this manual are subject to change without notice.

■ Warranty and Responsibility

HORIBA STEC warrants that the Product shall be free from defects in material and workmanship and agrees to repair or replace free of charge, at HORIBA STEC's option, any malfunctioned or damaged Product attributable to HORIBA STEC's responsibility for a period of one (1) year from the delivery unless otherwise agreed with a written agreement. In any one of the following cases, none of the warranties set forth herein shall be extended;

- Any malfunction or damage attributable to improper operation
- Any malfunction attributable to repair or modification by any person not authorized by HORIBA STEC
- Any malfunction or damage attributable to the use in an environment not specified in this manual
- Any malfunction or damage attributable to violation of the instructions in this manual or operations in the manner not specified in this manual
- Any malfunction or damage attributable to any cause or causes beyond the reasonable control of HORIBA STEC such as natural disasters
- Any deterioration in appearance attributable to corrosion, rust, and so on.
- Replacement of consumables

HORIBA STEC SHALL NOT BE LIABLE FOR ANY DAMAGES RESULTING FROM ANY MALFUNCTIONS OF THE PRODUCT, ANY ERASURE OF DATA, OR ANY OTHER USES OF THE PRODUCT.

■ Trademarks

Generally, company names and brand names are either registered trademarks or trademarks of the respective companies.

Safety instructions

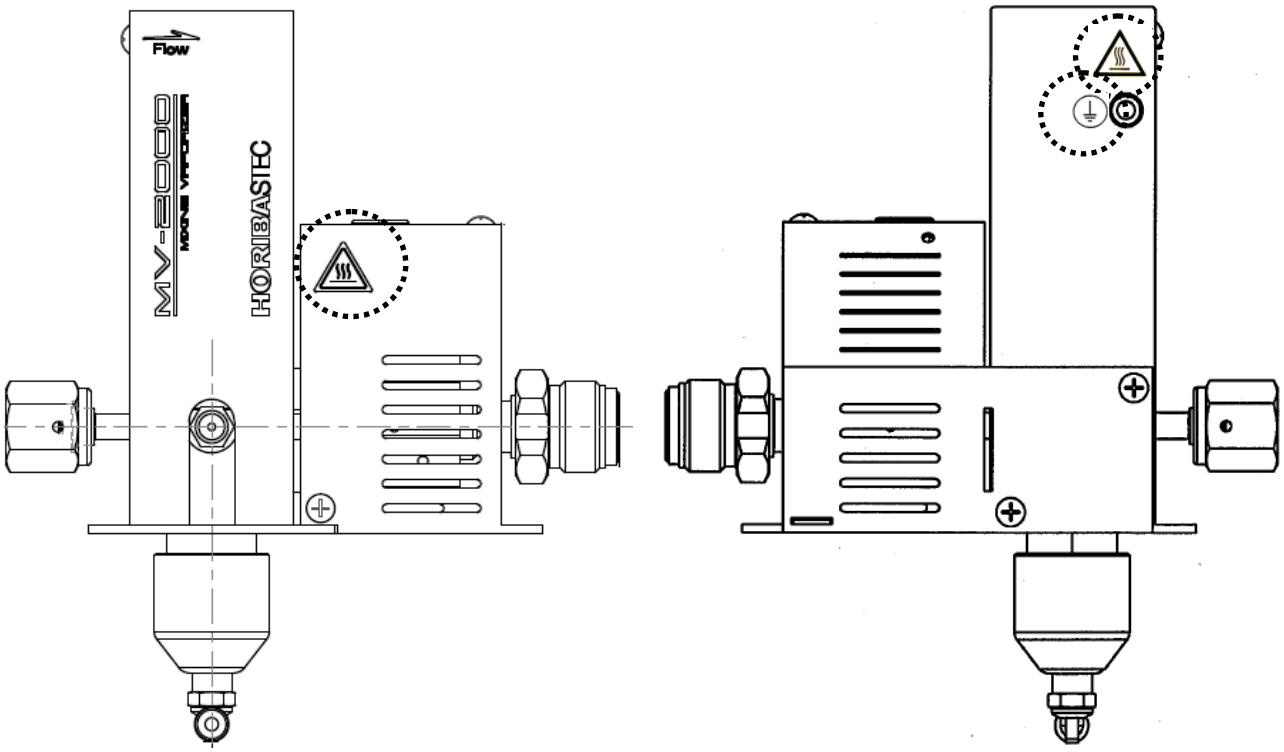
Be sure to read this “Safety instructions” section before using this equipment.
Read and understand these messages thoroughly before operating the equipment.

⚠ WARNING	Failure to abide by the information in a **WARNING** may result in serious injury and can be life threatening.

⚠ WARNING

	CAUTION ! HOT SURFACE After heating up, do not touch the main unit. Doing so can burn your hands.
	CONNECTION WITH PROTECTIVE CONDUCTOR TERMINAL An earth wire is surely connected. When it does not connect, the protection performance of the equipment is spoiled.

WARNING LABEL AND ITS LOCATION



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1. Outline

MV Series vaporizers have flow rate adjusting valves and vaporizer functions. When one of them is combined with an appropriate model of LF or XF Series micro liquid mass flow meters for feedback control of the liquid flow rate, the equipment ensures stable generation of material. Since the vaporizer unit [vaporizer]and the flow rate control unit[mixing valve] of each model of MV series are separated, it is possible to make independent temperature control. It is possible to set temerature of the vaporizer unit[vaporizer] higher than control unit[mixing valve], restraining the temperature rise in the flow control unit. It preuents heat decomposition in the flow rate control unit and enables stable supply.

2. Specifications

Model	MV-2□□□-□□□
Applicable material[*1]	TEOS etc.
Heater specifications[*2]	MV-21□□-□□□: Mixing valve AC 120 V, 50/60 Hz, 200 VA, Vaporizer AC 120 V, 50/60 Hz, 200 VA MV-22□□-□□□: Mixing valve AC 208 V, 50/60 Hz, 200 VA, Vaporizer AC 208 V, 50/60 Hz, 200 VA MV-23□□-□□□: Mixing valve AC 240 V, 50/60 Hz, 200 VA, Vaporizer AC 240 V, 50/60 Hz, 200 VA
Orifice	MV-2□4□-□□□ :ϕ0.4 mm MV-2□7□-□□□ :ϕ0.7 mm MV-2□0□-□□□ :ϕ1.0 mm
Applicable flow rate[*3]	MV-2□□1-□□□ :Less than 1 ccm(or g/min) MV-2□□2-□□□ :1 to less than 5 ccm(or g/min) MV-2□□3-□□□ :5 to less than 10 ccm(or g/min) MV-2□□4-□□□ :10 ccm(or g/min) or more
Wetted material[*4]	MV-2□□□-M□□ :SUS316L MV-2□□□-P□□ :SUS316L, PFA: Standard
Pneumatic valve	MV-2□□□-□V□: With pneumatic valve *7 MV-2□□□-□N□: Without pneumatic valve
Filter	MV-2□□□-□□F: With Filter MV-2□□□-□□N: Without Filter
Temperature setting[*5]	Depend on vaporization condition
Temperature sensor	K type thermocouple (Mixing valve unit and vaporizer unit)
Temperature switches [*6]	Mixing valve: For prevention of temperature rise: UCHIYA EP42P 140°C NC type Vaporizer: For prevention of temperature rise: UCHIYA EP42P 140°C NC type
External leak standard	1×10^{-8} Pa·m^3/s (He) or less
Valve seat leak standard	Mixing valve: 1×10^{-6} Pa·m^3/s (He) or less [at working temperature] Pneumatic valve: 1×10^{-9} Pa·m^3/s (He) or less [at working temperature]
Standard joint	Liquid inlet : 1/8 inch VCR type Male Carrier gas inlet: 1/4 inch VCR type Female Gas outlet : 1/2 inch VCR type Male
Ambient temp. in main unit installation location	15°C - 50°C (altitude: up to 2000m)
Pressure resistance	1.0 MPa (G)
Weight	1,290 +/- 10 g (with pneumatic valve) 1,150 +/- 10g (without pneumatic valve)

Supplied cables

Name	Model	Specifications
Valve cable	SC-MIV-1MF	Cable length: 100 +/- 2 cm Connector (MV side): FGJ.00.302.CYMD35 (LEMO) (LF or XF side) :FGG.00.302.CYC.D35 (LEMO)
MAIN T.C. Cable	SC-MIT-2MA	Cable length: 200 +/- 10 cm Connector (MV side):SMP-KM (OMEGA) (Temp. controller side):Bare wire
VAPO T.C. Cable	SC-MVT-2MA	
MAIN Heater Cable	SC-MIH-2MF	Cable length: 200+/- 10 cm Connector (MV side): FGJ.1B.302.CYMD52 (LEMO) Connector (Temp. controller side): Bare wire [18AWG]
VAPO Heater Cable	SC-MVH-2MF	Cable length: 200+/- 10 cm Connector (MV side): FGK.1B.302.CYMD52 (LEMO) Connector (Temp. controller side): Bare wire [18AWG]

*1 : As for other materials, consult us. Use a material having a high purity of 99.9999% or more.

*2 : Each of the Mixing valve and the vaporizer unit uses two 100 VA heaters at the working voltage, and the heater capacity is 200 VA. Do not supply heater power at a voltage higher than this voltage. Doing so can damage the heaters. When the 120 V AC (200 VA) heaters are used on 100 VAC , the heater capacity is 140 VA. If the amount of heat about 1.2 times the vaporization latent heat and radiated heat at the full-scale flow rate of generated material can be supplied at a capacity of 140 VA, the heaters can be used without any problem.

*3 : The valve travel has been adjusted according to the flow rate applicable to each model. The valve travel has been adjusted at the working temperature. Use the vaporizer within the main unit temperature setting recommended by us ±10°C.(Even 140 °C is a maximum in the case of 140 °C specification.) The maximum flow rate during actual operation will be determined depending on the Liquid flow meter to be used in combination.

*4 : As for the wetted materials, the models differ in the material of the seat of the flow rate control valve. The P (PFA) type valves are standard because seat leakage owing to particles and product hardly occurs. For some materials having high permeability, it is necessary to use the M type (SUS316L) valves.

*5 : The maximum operating temperatures of the mixing valve and the vaporizer are 140°C and 200°C. However, the temperature settings vary depending on the liquid material to be used and vaporization conditions. When actually vaporizing, use the units at the temperatures specified by us. The valve travel has been adjusted at the temperatures specified by us.

*6 : The temperature switch is connected also with the control part and the vaporizer part at a heater and series. When the temperature switch operates by a rise in heat, the electric supply to a heater is disconnected and carries out a temperature fall. A temperature switch is a self-hold type. In order to make it return, it is necessary to suspend the electric supply to a temperature switch. (If electric supply occurs to a temperature switch, it is a mechanism in which a temperature switch's own temperature does not fall, by PTC with a built-in temperature switch.) Where the current supply source to a temperature switch is suspended, When a temperature switch becomes about 80 °C or less, a power supply comes to be again supplied to a heater. The temperature switch on each of the mixing valve and the vaporizer is connected in parallel with the heaters. The contact of temperature switch will be ”open”, when temperature is abnormal compared with the preset temperature.

*7 : MV-2□□□-□V□ models have integrated pneumatic valves (NC) for shutting off the liquid. For the pneumatic valves, nickel alloy, SUS316L and polyimide parts are used as wetted material.

Conformable Directive

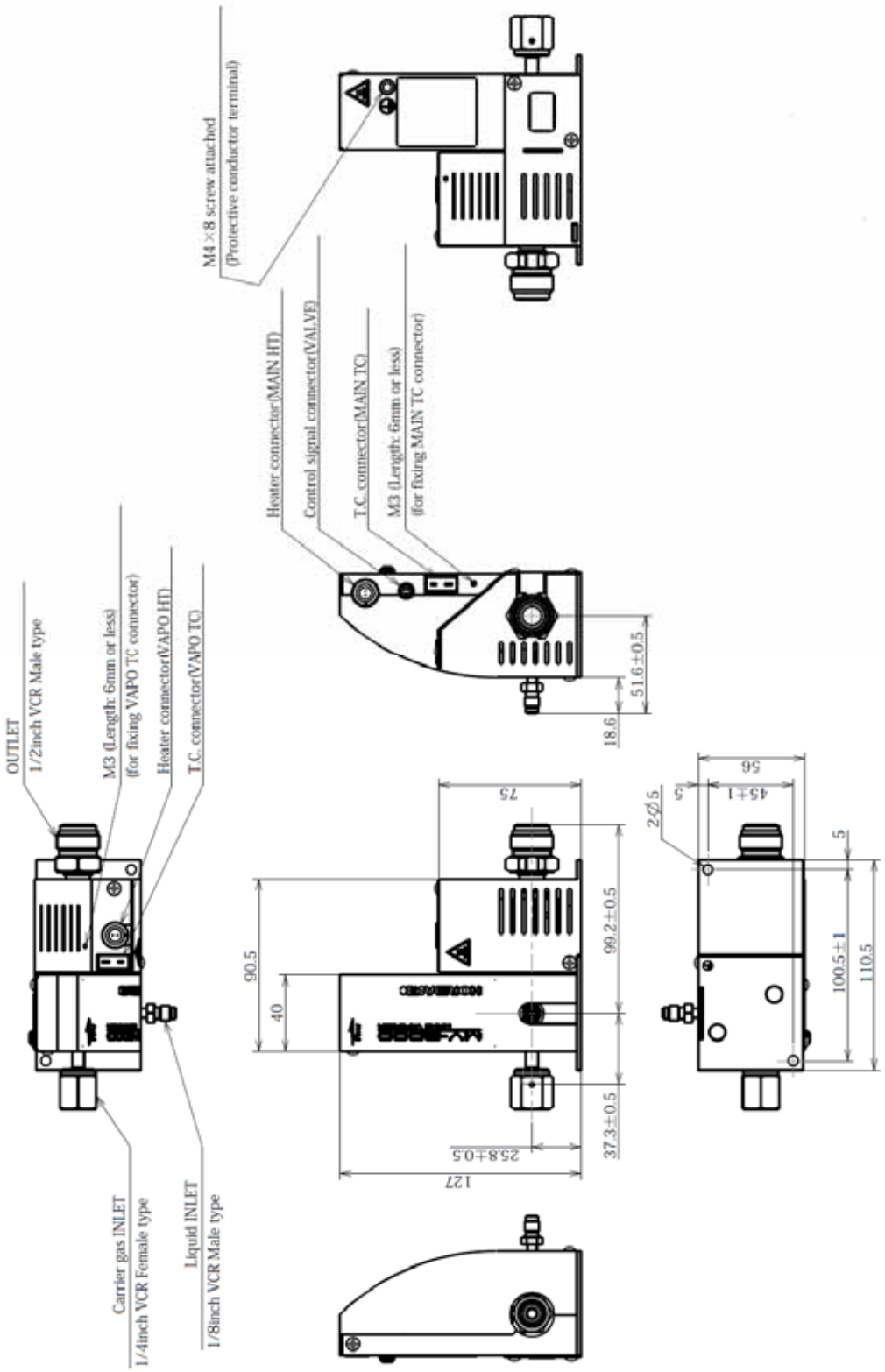
This equipment conforms to the following standards;

- [the Low Voltage Directive] EN61010-1: 2010(Ed3.0)

CE

3. External Dimensions

3.1 without pnuematic valve



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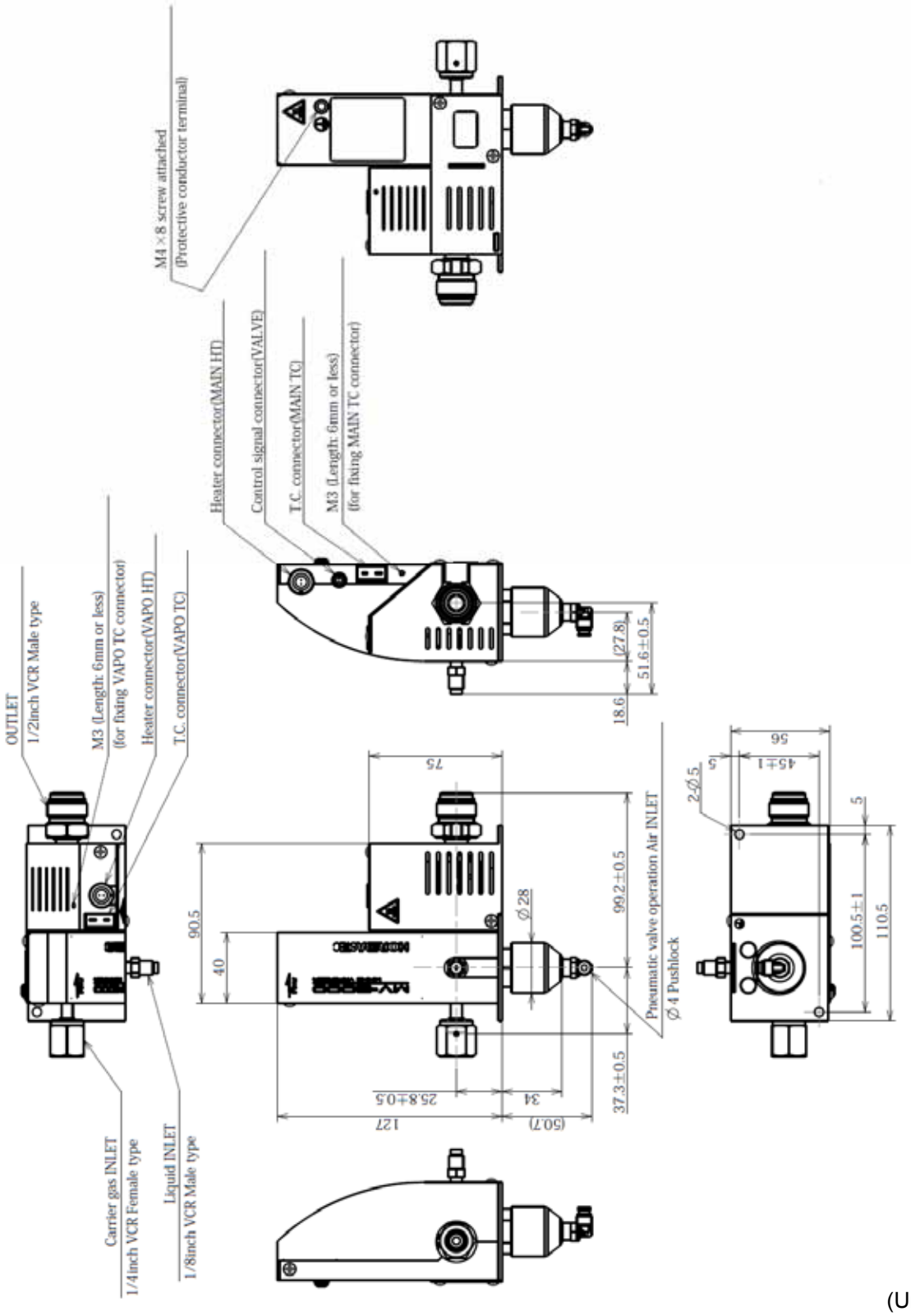
3.2 with pnuematic valve



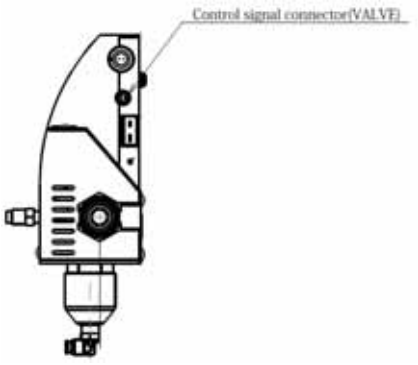
(Unit:mm)

4. Operating Procedures

Connect and start up the equipment in accordance with the following procedures.

4.1 Piping and electric wiring

1) Connect the pipes setting the flow direction in the direction of the arrow on the main body so that the Liquid flow meter(LF or XF) is on the upstream side of the liquid supply line of MV. The MV liquid supply port is a 1/8inch VCR Male type.
   Fit the MFC for carrier gas on the upstream side of the MV carrier gas inlet.
   If stainless steel pipes are used, set the Liquid flow meter(LF or XF) at a distance of 10 cm or more from MV to prevent transmission of heat of MV to the Liquid flow meter. Set MV and the MFC at a distance of 10 cm or more from each other so that the MFC is not affected by heat.
   * Length of the valve cable for connecting the Liquid flow meter(LF or XF) and MV is 1m. Install the Liquid flow meter(LF or XF) within the reach of the valve cable from MV.
   * To prevent increase in the secondary pressure during vaporization, determine the piping diameter in consideration of piping pressure loss.
   * When the liquid material contains particles, fit a filter (0.01 μm or so) in the middle of the line. Please select the filter in consideration of pressure loss.
   * MV is a normal open type. It is recommended to provide a normal closed type pneumatic valve between Liquid flow meter(LF or XF) and MV to prevent damage in case of urgent stop owing to power interruption.
   * For introduction of purging liquid or purging gas, it is recommended to use an angle integrated valve.
   * Clean the installed piping line with ethanol or IPA before connecting MV.
2) Perform leak test of the joints with a helium leak detector or the like.
3) Fit a jacket heater and a temperature measuring sensor, such as a thermocouple, onto the piping on the secondary side of MV, and wind a tape heater and an insulating material over them to heat the piping. (See Section 10 “Example of preparation of secondary heating piping.”)
4) Please connect "MV side" of the valve cable of attachment in a valve connector, and the connector of a side with a statement to MV, and already connect the connector of an end to the round connector in a liquid flow meter (LF or XF).



5) Fit the supplied thermocouple (MAIN TC) cable for mixing valve to the thermocouple (MAIN TC) connector on the mixing valve, and connect the thermocouple (VAPO TC) cable for vaporizer to the thermocouple (VAPO TC) connector on the vaporizer. Connect the heater cable (MAIN HT) for mixing valve to the heater connector (MAIN HT) on the mixing valve, and connect the heater (VAPO HT) connector for vaporizer to the heater (VAPO HT) connector on the vaporizer.

Table 1 Connector Names

	Thermocouple	Heater
Mixing valve	MAIN TC	MAIN HT
Vaporizer	VAPO TC	VAPO HT
Valve control	VALVE	

6) Seeing the instruction manual for LF Series or XF Series, connect the power and signal cables.

7) Connect the thermocouple cables and heater cables for the Mixing valve and vaporizers of MV to their respective temperature regulators. For MV, use temperature regulators provided with a control constant auto tuning function.
Select temperature regulators and SSRs (solid-state relays) appropriate to the specifications (type of temperature sensor and heater capacity) for the temperature sensors and heaters on the heating piping on the secondary side of MV, and connect them. (See Section 11 “Examples of temperature regulator wiring.”) To prevent disconnection of the thermocouple connector, secure the thermocouple cable connector fitting and the case with a screw M3 (10 mm or less in length).
   * For MV, K type (CA) thermocouples and 200W heaters are used. Use temperature regulators and SSRs appropriate to these specifications.
   * For MV, use temperature regulators having a control period (proportional period) of 1 second or less for stable vaporization.
   * Use temperature regulators with a heater burnout warning function as needed to check the temperature switch operations and give the alarm upon occurrence of heater burnout.
   * Use temperature regulators with a temperature range alarm function to monitor the temperature with the temperature alarm.

4.2 Startup and warm-up

(1) Turn on power to the temperature regulators, and set the temperatures of MV and heating piping according to the specified temperatures shown on the individual setting sheets. (Heat-up)
   * The temperature setting for MV varies depending on the type of liquid and flow rate.
   * The specified temperatures are shown on the label at the back of the product.
   * **After heating up, do not touch the main unit. Doing so can burn your hands.**

(2) After the temperature increases, warm up the equipment for more than 30 minutes.
After the temperature stabilizes, perform auto tuning of the control constant of each temperature regulator.

(3) After warming up, supply the material in accordance with the following procedures.
   1) Evacuate the piping.
      * If the liquid material reacts with the atmosphere, cycle purging is recommended. For the cycle purging, feed purging gas, such as inert gas, into the piping after evacuating, and evacuate the piping again.
      * If the line to be connected is not a vacuum line, sufficiently purge the line with gas.

2) After turning on power to the Liquid flow meter(LF or XF), input the forced closing signal to close the control valve. (See Instruction Manual for Liquid flow meter.)
3) Set the primary pressure (material supply pressure).
   * The material supply pressure varies depending on the material to be produced and product flow rate. Set the supply pressure, referring to the specification sheet.
   * Set the pressure for supplying to the tank under pressure in consideration of the difference in level between MV and tank, so that the supply pressure to MV is identical with the pressure indicated on the individual setting sheet.
4) Please control a predetermined carrier gas flow by MFC for carrier gas.
5) Supply MV with the liquid material.
   * If the forced closing signal has not been input, the material is supplied at the beginning in such a large quantity that all material cannot be vaporized, and the material may be left in the liquid state on the secondary side. Before supplying the material, check that the signal has been input.
   * When the liquid material is introduced, the output signal of the Liqud flow meter (LF or XF) temporarily increases. This is not an error. The signal will become zero when the line to MV is filled with the liquid. (Check the Liquid flow meter(LF or XF) output signal.)

4.3 Vaporization

(1) Feed the necessary carrier gas to the MFC.
(2) After the carrier gas flow rate stabilizes, input the setting signal to cancel the forced closing signal, and vaporization will be started.
   * After vaporization is started, check the Liquid flow meter output signal to ensure that the flow rate is controlled normally.
   * Immediately after the equipment is started up, gas may be left in the piping, and vaporization may be unstable. Feed the gas into the exhaust line.

5. Peripheral Equipment

We supply mixing valves and cables designed for this equipment. The use of these special equipments eliminates the necessity of wiring and ensures reliable operations.

Control unit for Mixing valve : PE-D20, etc.
Cable : SC-ELV (for LF), SC-EDH (for XF)

- Temperature control unit

For MV :HC-100VE
For heating piping :HC-100VE

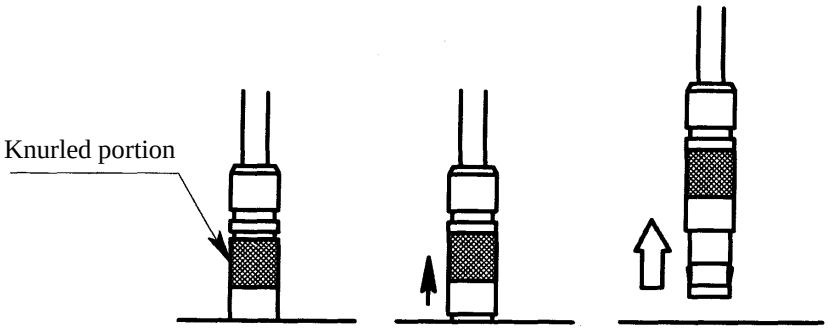
Other various peripheral equipments are available. See our catalogs.

6. Procedures for Disconnecting Valve Cable and Heater Cable Connectors

When the valve and heater cable connectors are fitted, they are secured inside by the claws at the end of the connectors. Therefore, once they are connected, they cannot be disconnected by pulling.
Disconnect the connectors in accordance with the following procedures.

1) Make sure that power is not on the Liquid flow meter(LF or XF) and heaters.
2) Slide up the knurled portion of each connector in the drawing direction straightly.
3) Disconnect the connector with the knurled portion up.

*** While MV is at the set temperature, also the connectors are hot. Before disconnecting the connectors, turn off the temperature regulators of MV. Disconnect them after the main unit cools off.**



7. Troubleshooting

When any trouble occurs with MV flow control or temperature condition, check the following points.

- The temperature of MV does not stabilize.

Cause	Countermeasure
The PID constants of the temperature regulators are improper.	Perform the auto tuning of the temperature regulators under the working conditions (supply voltage, temperature, etc.).
The heater power supply shorted out.	Once turn off power, and check the heater power line.
Thermocouple contact failure	Check the connection of the thermocouples to the temperature regulators and MV.
The control cycle of the temperature regulators is long.	Use temperature regulators having a control period of 1 second or less. If the control cycle can be set, change the setting to 1 second or less.

- The temperature of MV does not increase.

Cause	Countermeasure
Power is not supplied to the heaters.	Check the wiring to the heaters, and supply power to the heaters.
Signals from the temperature regulators are not input to the SSRs or the power regulators.	Correctly wire the devices.
The temperature switch in MV functioned.	The self-hold type temperature switch is used. The return method of a temperature switch needs to lower the stoppage of deliveries of the heater power supply to MV, and a temperature switch to below return temperature. After the heater power supply to MV has carried out stoppage of deliveries, please wait for about 1 hour. Please contact us, when you still shut off after a temperature fall and a heater power supply when temperature does not rise, and you check heater resistance and there is no electrical connection of a heater.
The heater power supply shorted out.	Turn off power, and check the heater power line.
Setting data has not been input to the temperature regulators.	Input the specified setting data to the temperature regulators.

- The temperature of MV does not stabilize. The temperature is not restored. (During vaporization)

Cause	Countermeasure
The material was fed in a quantity exceeding the vaporization limit.	Forcibly close the valve of MV before starting vaporization. (See page 6.)
The flow rate is not stable.	See the countermeasure stated in the following item “The flow rate indication does not stabilize.”
The liquid is not vaporized inside. The vapor is condensed.	Check the secondary pressure, temperature and warm-up time.

- The flow rate of carrier MFC, Liquid flow meter indication does not stabilize. The liquid does not flow in full scale.

Cause	Countermeasure
The primary pressure (supply pressure) is low (high).	Set the primary pressure as specified.
The secondary pressure is high, and the vapor is condensed.	Set the secondary pressure as specified.
MV is not at the set temperature.	Check the temperature setting and the temperatures displayed on the temperature regulators.
Air bubbles in the liquid material	It is necessary to investigate the cause of generation of air bubbles and take measures. See 9.1 “Entry of air bubbles into liquid supply line.”
The flow meter is disordered.	Stop the supply of the material, and check that the flow meter indicates the zero point and stabilizes. (Please confirm the instruction manual of the flow meter currently used.)
Seat leakage from MV	Input the forced closing signal to the liquid flow meter(LF or XF), and check for seat leakage. (See the remedies stated in the following item “Seat leakage.”)
The valve cable has not been connected to MV or Liquid flow meter (LF or XF).	Connect the cable.
Nozzle clogging	The purge gas after vacuuming is introduced and the cycle purge which carries out vacuuming again is carried out. Please exchange MV, when you do not improve.

- Seat leakage (When the valve is forcibly closed, the Liquid flow meter(LF or XF) output fluctuates.)

Cause	Countermeasure
The primary pressure (supply pressure) is too high.	Reduce the primary pressure to the specified pressure.
The forced closing signal is not input. The setting signal is not a minus value.	Check the wiring and signal.
The temperature of MV is too high.	Reduce the temperature of MV to the specified temperature.
The valve cable has not been connected to MV or LIQUID FLOW METER(LF or XF).	Connect the cable.
Leak of piping	A leak part is pinpointed and it changes into a state without leak.

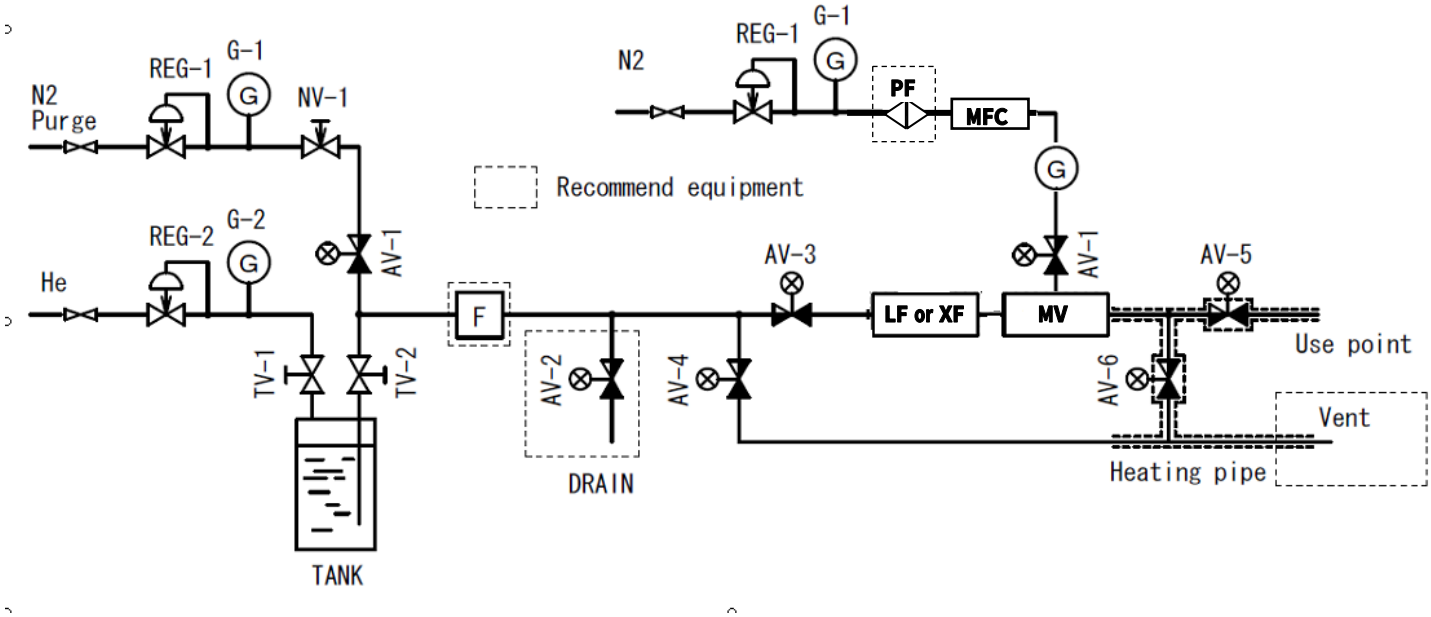
If the trouble is not removed by performing the remedies stated above, contact us.

8. Instructions for Handling

1) Check that the piping does not leak, and sufficiently purge the inside of the piping.
2) To keep the control valve travel correct, use filters to remove particles in the liquid material, or clean the piping. (When filters are used, 0.01-μm-mesh metal filters or 0.05-μm-mesh membrane filters are recommended.)
3) The maximum operating temperature of the mixing valve is 140°C, and that of the vaporizer is 200°C. Avoid baking or using these units at temperatures exceeding the maximum working temperatures.
4) **High voltage (approx. 120 V) is used to drive the control valve. To prevent electric shock, never remove the main unit case while power is on the unit.**
5) When selecting temperature regulators for MV and heating piping, check the sensor type and heater capacity.
6) Since MV is normal open, it is recommended to provide a normal closed type pneumatic valve on the liquid phase line and on the gas phase line (before the chamber) against power interruption and emergency stop.
7) Before starting vaporization, sufficiently warm up MV (for more than 30 minutes after the temperature stabilizes).
8) Since MV and its heating piping are insulated, they become hot. Do not install them near objects that may be affected or disordered by heat.
9) Since MV and its heating piping become hot, never put combustible materials or ignitable objects near them.
10) **Never touch MV or its heating piping directly with hand after they are heated. Doing so can burn your hands. When it is necessary to touch them with hand for maintenance, turn off the temperature regulators of MV, and wait until the units cool off.**
11) **The temperature of each of the Mixing valve and the vaporizer of MV is controlled by the temperature regulator. Therefore, thermocouple and heater wires are necessary for each regulator. Wire the regulator correctly, checking the marking on the cables. If the regulator is wired improperly, the temperature may be out of control, and the equipment may not operate correctly.**
12) Do not install MV where it is exposed directly to wind from a fan.
13) Supply the liquid material to MV while the carrier gas is flowing in MV.
14) The control valve travel changes with the set temperature of the main unit. To prevent malfunction due to change in valve travel, keep the MV set temperature within the specified temperature ±10°C. The maximum operating temperatures of the mixing valve and the vaporizer are 140°C and 200°C. The specified temperature is shown on the label at the back of the product.
15) **Before dismantling the equipment for repair or overhaul, purge the equipment to discharge the liquid from the main unit. If it is purged incompletely, vapor gas may leak when it is dismantled. Dismantle it while ventilating the area.**
16) Before returning the equipment to us for repair or overhaul, purge it sufficiently in the same manner as stated in (15) to discharge the liquid from the main unit. If the liquid is left in the unit, it may leak or react during transportation. In this case, it is difficult to investigate the causes of trouble. If the liquid is left in the unit when the equipment is returned, there is a possibility that it cannot be repaired or overhauled.
17) The response speed from the liquid flow meter(LF or XF) to be combined with the vaporizer has been adjusted on the Liquid flow meter(LF or XF) in the single state. The response speed has not been adjusted for MV to be actually used. Therefore, after installing the Liquid flow meter(LF or XF), it is necessary to adjust the speed of response of liquid flow rate.

9. Other Instructions for Use

This section gives instructions for use and installation.
Follow these instructions to fit the pipes correctly and use the equipment safely.An example of piping is shown below. Lay the lines appropriately to the conditions of use.



9.1 Entry of air bubbles into liquid supply line

If air bubbles enter the MV and the LF or XF for detecting the flow rate, the air bubbles can cause fluctuation of output and variation of vaporization flow rate. Therefore, check the liquid supply line taking the following points into consideration.

(1) The liquid supply tank (pressure tank for supply) and MV are different in installation level. If the supply tank is installed at a lower level, the gas (pressure gas) dissolved in the liquid in the supply tank is supplied to MV while the gas is in the saturated state. The gas dissolved in the liquid in the saturated state reduces in pressure by gravity with rise of the liquid level, and the gas dissolved in the saturated state is supersaturated and turned into air bubbles in the liquid. The amount of gas dissolved in the liquid material changes depending on the applied pressure, kind of pressure gas, kind of liquid material and temperature. In this case, it is necessary to install an air bubble removing device in the supply unit or install an air bubble separating device just before the LF or XF. When an air bubble separating device is installed just before the LF or XF, reduce the difference of level between the LF or XF and MV and the pressure loss of the piping to prevent occurrence of air bubbles after the LF or XF.

(2) If the liquid is supplied at a dash into the piping under vacuum from the tank under pressure to fill the piping at the beginning of liquid feeding, part of vapor and dissolved gas in the liquid released into the vacuum piping becomes air bubbles. In this case, gradually increase the tank supply pressure from the state close to vacuum after supplying the liquid into the vacuum piping, or, if an air bubble separating device is installed on the MV side, first feed the liquid to up to the air bubble separating device, and supply the liquid to MV, so that air bubbles are not generated in the piping.

9.2 Clogging by vaporization

Since MV vaporizes a liquid material and supplies the vapor material, the particles in the material and product generated by thermal decomposition of the material may cause clogging in MV. If clogging develops to completely block the passage, the inside of MV cannot be purged. We recommend you to consider taking the following measures to monitor the clogging state and conduct periodic inspection and overhaul.

(1) Provide a pressure sensor between the MV carrier gas supply port and the MFC for carrier gas to monitor the pressure while the carrier gas is being supplied. Then, you can check for internal clogging based on changes in pressure loss of the carrier gas in MV. However, when the operating conditions, such as the carrier gas flow rate, liquid material flow rate, secondary pressure and MV temperature, change, also the pressure being monitored changes. It is necessary to compare the pressure under uniform conditions.

(2) The valve travel can be monitored by checking the supply voltage to the control valve (valve voltage monitor output). Since MV is normal open, when it is fully closed, the control valve voltage increases up to approx. 120 V. However, when the flow rate is controlled, the voltage reduces so that the liquid flows at the specified flow rate. By comparing the voltage while the flow rate is controlled, clogging of the valve can be checked. Like the carrier gas pressure, the voltage is affected by the carrier gas flow rate, vaporization flow rate, secondary pressure, MV temperature and liquid supply pressure. Therefore, it is necessary to compare the voltage under uniform conditions. When the voltage is 0 V, the valve is fully opened to the limit travel. Therefore, as the voltage becomes closer to 0 V, the valve travel has less allowance. If the voltage keeps lowering under the normal working conditions while the flow rate is being controlled, purge the valve before it is completely blocked, and replace it with a new one.

9.3 Pressure loss of internal nozzles

There are two nozzles in MV. Carrier gas is supplied to the secondary side through these two nozzles. Therefore, the carrier gas flow rate is restricted by the nozzles. The nozzles having a diameter of 0.4 mm reduce the flow rate to 1.4 LM at an N_2 supply pressure of 0.1 MPa (G), 2.2 LM at 0.2 MPa (G) and 3 LM at 0.3 MPa (G). To increase the diluted gas flow rate higher than these values, it is necessary to dilute the gas in the piping on the secondary side of MV or replace the MV nozzles with those having a larger diameter (0.7 or 1mm).

9.4 Valve travel for set temperature

The travel of the control valve used in MV changes under the influence of the set temperature of MV. Before shipment, we adjusted the valve travel and check for seat leakage at the MV temperature at which the designated liquid material can be vaporized under the specified conditions. Therefore, when using the equipment, keep the temperature within the temperature specified by us ±10°C. If the set temperature is lower than the specified temperature, the valve travel will become larger to cause seat leakage. On the contrary, if the set temperature is higher, the valve travel will decrease, the response speed may lower, and the flow rate of the liquid material may be decreased.

9.5 Purging procedures

When the piping is evacuated to purge the liquid material, if the piping is evacuated from the secondary side through MV, it is evacuated through the control valve. Since the valve is a throttle part and there are nozzles in the piping, the material may not be purged completely. Therefore, for a material having an excessively low vapor pressure, it is recommended to provide a branch line for evacuation on the piping for supplying the liquid material to MV and evacuate the liquid supply piping together with the MV secondary side when purging the material.

9.6 Temperature control

When MV starts vaporization, the heat in MV is removed by the vaporization latent heat of the liquid material. Fluctuation of MV temperature during vaporization affects the stability of vaporization flow rate. Therefore, stable temperature control is required not only to maintain the temperature when vaporization is not performed, but also to stabilize the temperature during vaporization. Except when the temperature lowers at the beginning of vaporization, the temperature fluctuation during vaporization must be within ±1°C, and the fluctuation period must be 30 seconds or more. Select temperature regulators in consideration of the following points.

- Control cycle : When using temperature regulators of voltage or contact output type, select regulators having an output cycle of 1 second or less. For stable control, current control type (power control type) temperature regulators are recommended.
- PID control : Use temperature regulators that are capable of PID control of heater output. Use temperature regulators whose PID constants can be automatically tuned.

9.7 Setting of pressure of liquid supply tank

When the liquid supply tank and MV differ in installation level, if the tank is installed at a lower level, the supply pressure to MV is reduced owing to the weight of the liquid material. When they are different in level, determine the drop of supply pressure caused by the

difference in level from the specific gravity of the liquid to be used, and set the tank pressure higher.

9.8 Moisture contents (dew points) of carrier gas and purging gas

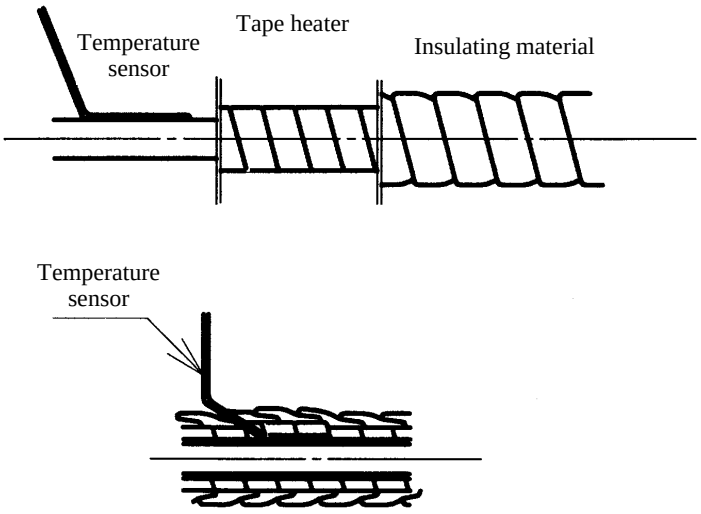
When a material that reacts strongly with water and the dew point of the carrier gas is high, the material reacts in the mixing unit (mixing valve) of MV, and the reaction product is generated in the carrier gas passage, thereby clogging the passage. Therefore, when a material that reacts strongly with water is used, use carrier gas and purging gas whose dew points are –80°C or less.

9.9 Carrier gas and liquid supply pressure

If the secondary shutoff valve malfunctions or a nozzle in the main unit is clogged, the supplied carrier gas and liquid are not fed to the secondary side and flow from a side where the supply pressure is higher to a side where the supply pressure is lower. Therefore, monitor the clogging state on the secondary side referring to Item (1) of 9.2 “Clogging by vaporization,” and stop the vaporization before the secondary side is completely blocked.
If the passage is clogged to stop the flow, the values output from the mass flow controller for gas and the mass flow meter for liquid decrease, and you can find the abnormality. However, if the liquid material enters the mass flow controller for gas, the controller may be damaged so heavily that it cannot be restored. In addition, the piping may be contaminated to cause particles. Set the carrier gas supply pressure higher than the liquid supply pressure. When the carrier gas supply pressure is set higher, the carrier gas may flow back into the liquid supply line. In this case, the line can be restored by removing the clog and supplying the liquid.

10. Example of Preparation of Secondary Heating Piping

Insulate the secondary piping and pneumatic valve with temperature sensors, tape heaters and insulating materials. To heat them as uniformly as possible, examine the sensor positions, tape heater density and insulating material overlap.

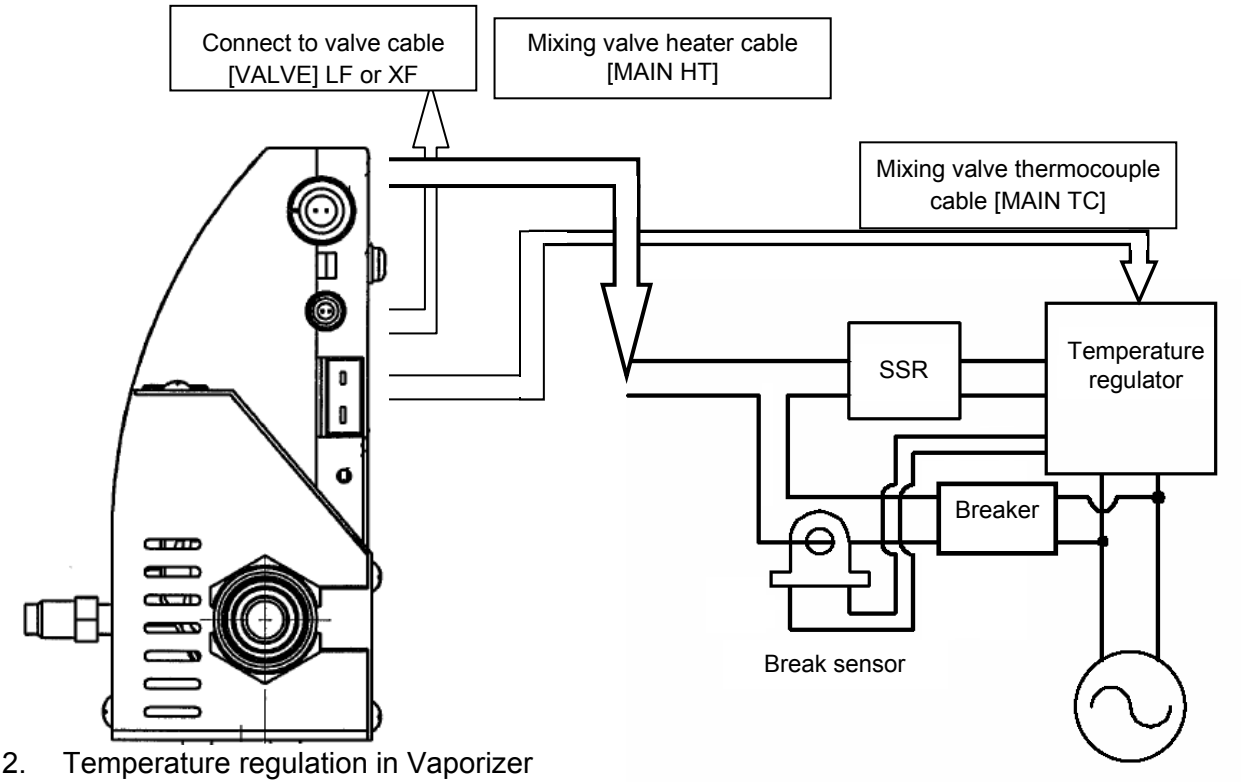


11. Examples of Temperature Regulator Wiring

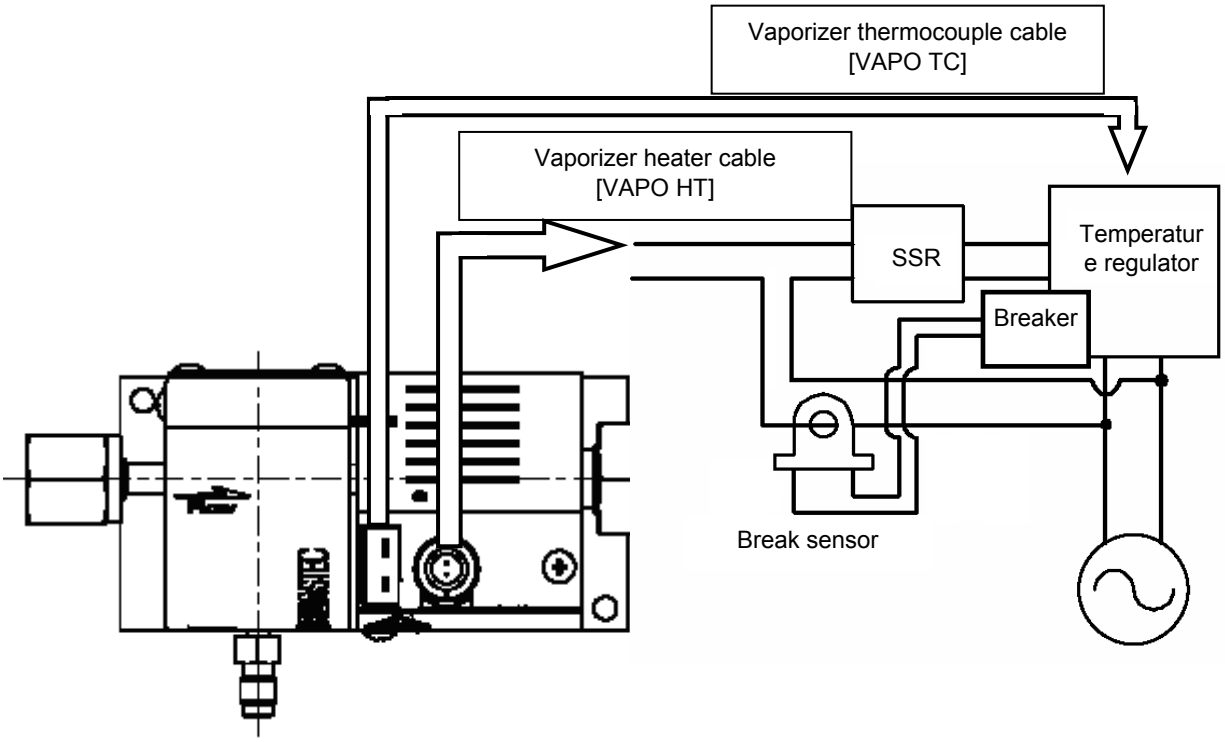
When the temperature of MV is controlled with temperature regulators and SSRs, wire them referring to the following diagrams.

When the heaters or connectors fail, overcurrent may be the reason. For safety, it is required to install 5 Amp specification of overcurrent protection, such as circuit breaker or fuse, in the heater power line.

1.Temperature regulation in mixing valve



2. Temperature regulation in Vaporizer



12. CHEMICAL CONTENT INFORMATION(The Six China RoHS Restricted Materials)Example of Preparation of Secondary Heating Piping

环境保护使用期限标记的意义

Meaning of Environmental Protection Use Period Marking

環境保護使用期限マークの意味

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产品中有毒有害物质或元素的名称及含量

Name and amount of toxic/hazardous substance or element used in a product

部件名称 Unit name		有毒有害物质或元素 Toxic/hazardous substance or element					
		铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent chromium (Cr (VI))	多溴联苯 Polybromo-biphenyl (PBB)	多溴二苯醚 Polybromo-diphenyl ether (PBDE)
线材	Wire rod	×	○	○	○	○	○
箱	Case	○	○	○	○	○	○
机械零件部	Machine parts	×	○	○	○	○	○

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。
Denotes that the amount of the toxic or hazardous substance contained in all of the homogeneous materials used in the component is below the limit on the acceptable amount stipulated in the SJ/T11363-2006 standard.

×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T SJ/T11363-2006 标准规定的限量要求。
Denotes that the amount of the toxic or hazardous substance contained in any of the homogeneous materials used in the component is above the limit on the acceptable amount stipulated in the SJ/T11363-2006 standard.