Instruction Manual

FLOW-CONTROL series

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ATTENTION
Please read this Instruction Manual carefully before installing and operating the instrument.
Not following the guidelines could result in personal injury and/or damage to the equipment.

Bronkhorst®

Disclaimer

The information in this manual has been reviewed and is believed to be wholly reliable. No responsibility, however, is assumed for inaccuracies. The material in this manual is for information purposes only.

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Symbols

Important information. Disregarding this information could cause injuries to people or damage to the instrument or installation.

Helpful information. This information will facilitate the use of the instrument and/or contribute to its optimal performance.

Additional info available on the internet or from your local sales representative.

Receipt of equipment

Check the outside package box for damage incurred during shipment. If the box is damaged, then the local carrier must be notified at once regarding his liability, if so required. At the same time a report should be submitted to your local sales representative.

Carefully remove the equipment from the box. Verify that the equipment was not damaged during shipment. Should the equipment be damaged, then the local carrier must be notified at once regarding his liability, if so required. At the same time a report should be submitted to your local sales representative.

Check the packing list to ensure that you received all of the items within the scope of delivery.
Do not discard spare or replacement parts with the packaging material and inspect the contents for damage.

Refer to Removal and return instructions about return shipment procedures.

Equipment storage

The equipment should be stored in its original package in a cupboard warehouse or similar. Care should be taken not to subject the equipment to excessive temperatures or humidity.

Warranty

Bronkhorst® products are warranted against defects in material and workmanship for a period of three years from the date of shipment, provided they are used in accordance with the ordering specifications and not subject to abuse or physical damage. Products that do not operate properly during this period may be repaired or replaced at no charge. Repairs are normally warranted for one year or the balance of the original warranty, whichever is the longer.

For general warranty terms applying to Mass Flow ONLINE products, see the 'Guarantee' section of the Terms and conditions:
www.massflow-online.com/shop/en/conditions.html

The warranty includes all initial and latent defects, random failures, and indeterminable internal causes.

It excludes failures and damage caused by the customer, such as contamination, improper electrical hook-up, physical shock etc.

Re-conditioning of products primarily returned for warranty service that is partly or wholly judged non-warranty may be charged for.

Mass Flow ONLINE B.V. or affiliated company prepays outgoing freight charges when any part of the service is performed under warranty, unless otherwise agreed upon beforehand, however, if the product has been returned collect to our factory or service center, these costs are added to the repair invoice. Import and/or export charges, foreign shipping methods/carriers are paid by the customer.

General safety precautions

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Before operating, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables for cracks or breaks before each use.

The equipment and accessories must be used in accordance with their specifications and operating instructions, otherwise the safety of the equipment may be impaired.

If required, replace fuses with the same type and rating for continued protection against fire hazard.

Opening the equipment is not allowed. There are no repairable parts inside. In case of a defect please return the equipment to Mass Flow ONLINE B.V.

One or more warning signs may be present on different parts of the product. These signs have the following meaning:

Consult the instruction manual for handling instructions

Surface may get hot during operation

Shock hazard; electrical parts inside

To maintain protection from electric shock and fire, replacement components must be obtained from Mass Flow ONLINE. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be obtained from other suppliers, as long as they are equivalent to the original component. Selected parts should be obtained only through Mass Flow ONLINE, to maintain accuracy and functionality of the product. If you are unsure about the relevance of a replacement component, contact Mass Flow ONLINE for information.

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1 Introduction

1.1 Scope of this manual

This manual contains general product information, installation and operating instructions and troubleshooting tips for the FLOW-CONTROL series.

1.2 Intended use

The FLOW-CONTROL is designed to establish and control a constant gas or liquid flow rate in a system where the inlet pressure is unstable. The fluid in the pressurized system in which the instrument is mounted must be free of solid particles.

The wetted materials are compatible with the following fluids:

- Air
- N2 (Nitrogen)
- O_2 (Oxygen)
- CO (Carbon monoxide)
- Ar (Argon)
- CO_2 (Carbon dioxide)
- CH_4 (Methane)
- C_3H_8 (Propane)
- N_2O (Nitrous oxide)
- C_4H_{10} (Butane)
- H_2O (water)

For other media, always check compatibility with the wetted parts, before deploying the instrument (see Wetted materials).

*FLOW-CONTROL instruments are **not** suitable for use with He (Helium) and H (Hydrogen).*

The end user is considered to be familiar with the necessary safety precautions, and to comply with the appropriate protective measures as described in the Material Safety Data Sheets of the media to be used in the system (if applicable).

Responsibility for the use of the equipment with regard to suitability, intended use, cleaning and corrosion resistance of the used materials against the processed media lies solely with the end user.

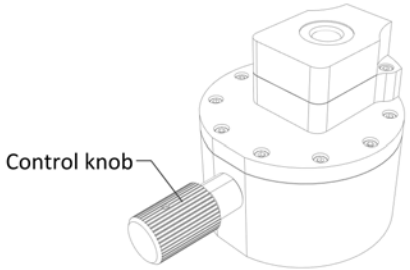
Bronkhorst High-Tech B.V. cannot be held liable for any damage resulting from improper use or use for other than the intended purpose.

1.3 Product description

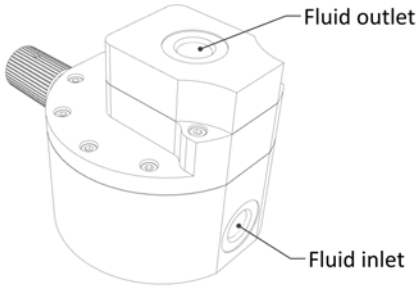
The FLOW-CONTROL is an enhanced needle valve, which contains a mechanism to eliminate pressure fluctuations, thereby creating a constant flow. It is operated just like a regular needle valve: to open, turn the control knob counterclockwise, to close, turn it clockwise.

The instrument has G¼" BSPP adapter chambers, and can be provided with different fittings.

Front

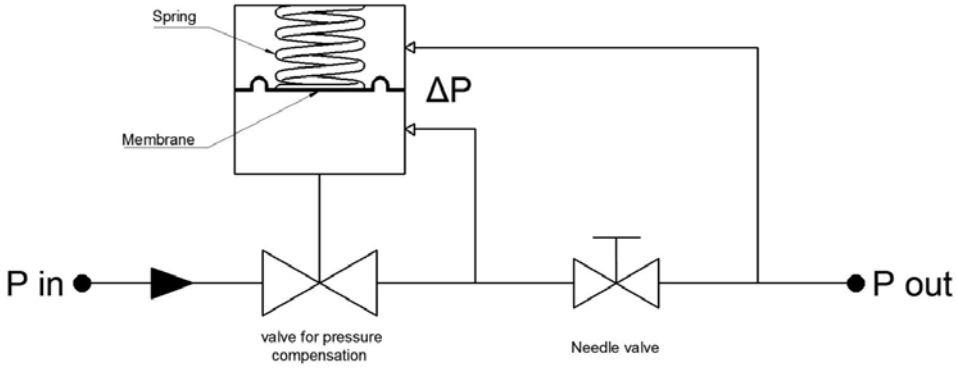


Rear



1.3.1 Process

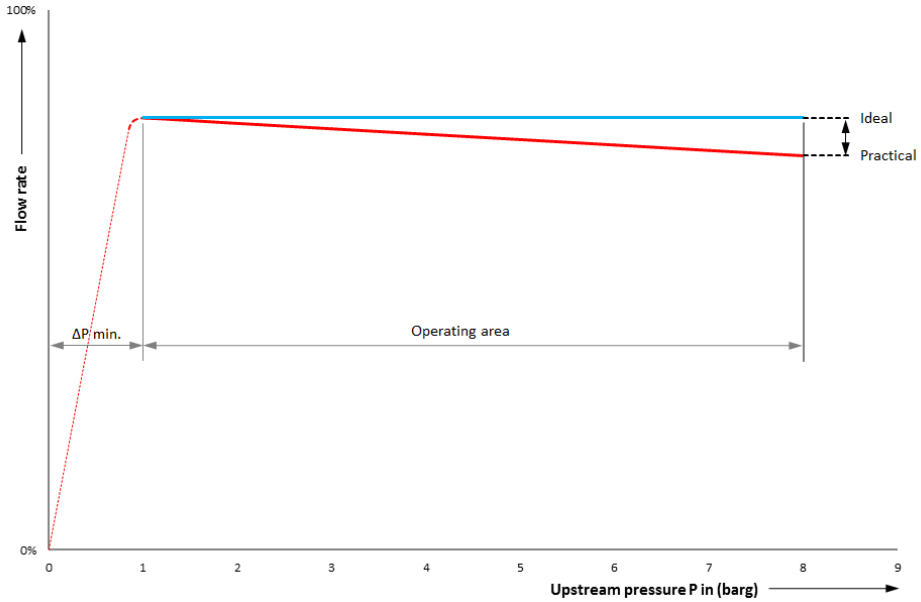
In a system where the inlet pressure is stable, flow control with a regular needle valve gives a constant flow rate. However, when pressure conditions are susceptible to change, the flow rate will become equally unstable. The FLOW-CONTROL eliminates this effect, by keeping the pressure drop across the needle valve (ΔP) constant, with the aid of a membrane operated (normally open) valve.



The membrane is actuated by a mechanical spring, which forces the valve to open. Pressurizing the inlet adds pressure to the volume under the membrane, until it is lifted, causing the pressure compensation valve to close. At the same time, the pressure after the needle valve is added to the spring force against the membrane, helping the spring keep the pressure compensation valve open.

The equilibrium between the spring force and the pressure on the membrane keeps the flow through the needle valve constant, even if the inlet pressure changes. Opening the needle valve decreases the pressure drop, forcing the pressure compensation valve to open further, thus creating a new equilibrium.

Increasing the inlet pressure has a small effect on the spring force, causing the required ΔP to open the membrane valve to be smaller, resulting in a somewhat lower flow (see graph). In practice, deviation of the ideal straight line is less than 0.5-1% per bar.



1.3.2 Wetted materials

The wetted parts of the instrument are made of the following materials:

Model	Materials
FC-001	Aluminum, Viton®, fiber-reinforced nitrile, SS316, PTFE
FC-002 FC-004 FC-005	Aluminum, Viton®, fiber-reinforced nitrile, Fluorosint®, Brass, Buna-N

1.3.3 Flow capacity

The table below lists the flow capacities for compatible media. Ranges are in l_n/min (SLM; measured at 0 °C and 1.013 bar(a)), except where otherwise stated.

Media	FC-001	FC-002	FC-004	FC-005
Air	0.02…0.6	0.02…7	0.02…25	0.02…50
N_2	0.02…0.6	0.02…7	0.02…25	0.02…50
O_2	0.02…0.55	0.02…6.5	0.02…23	0.02…47
CO	0.02…0.6	0.02…7	0.02…25	0.02…50
Ar	0.04…0.5	0.04…5.5	0.04…21	0.04…42
CO_2	0.02…0.45	0.02…5.5	0.02…20	0.02…40
CH_4	0.01…0.8	0.01…9	0.01…33	0.01…66
C_3H_8	0.01…0.45	0.01…5.5	0.01…20	0.01…40
N_2O	0.02…0.45	0.02…5.5	0.02…20	0.02…40
C_4H_{10}	0.01…0.4	0.01…4.5	0.01…17	0.01…34
H_2O	3…20 ml/min	4…400 ml/min	10…1000 ml/min	18…1800 ml/min

For other media, the maximum flow capacity can be calculated with the following formula:

$$\emptyset_{vnx} = \emptyset_{vnair} \cdot \sqrt{\frac{\rho_{nair}}{\rho_{nx}}}$$

- Øvn is the volume flow under normal conditions (0 °C, 1.013 bar)
- ñn is the density at normal conditions

1.4 Other documents

This document contains all necessary information for basic operation and maintenance. A material certificate will be provided on request.

*A dimensional drawing can be downloaded from **www.massflow-online.com/service_support/downloads/** (Dimensional drawing MASS-VIEW FC-00x - document no. 7.05.924).*

2 Installation

2.1 Check properties

Before installing the FLOW-CONTROL, check if the properties match your requirements:

- Model type
- Maximum operating pressure
- Ambient temperature range

The FLOW-CONTROL is fitted with specific sealing material(s), compatible with the media specified at ordering time. Be sure that the sealing materials are compatible with the media and conditions used in the system. Mass Flow ONLINE B.V. cannot be held responsible for any damage resulting from the use of other media and/or conditions than specified on the purchase order.

Bronkhorst® instruments are pressure tested; the tested pressure and the maximum process pressure are stated on the instrument label. If the instrument label is missing, or if the maximum process pressure and/or tested pressure are insufficient, the instrument must not be used and should be returned to the factory.

Before installation, make sure that the tested pressure is in accordance with the safety factor of your application. The tested pressure must always be higher than the maximum operating pressure.

Disassembling the instrument will invalidate the pressure test specification.

2.2 Mounting

The FLOW-CONTROL has no preferred mounting position or orientation.

2.3 Fluidic connections

When installing fittings, do not apply excessive force, as this may cause damage to the threads or other sensitive parts of the instrument. Tighten the nut finger tight, while holding the instrument, then tighten it further for 1 turn at most.

If oxygen (O_2) is to be used in the instrument, fittings must be degreased before mounting them to the body.

Install the FLOW-CONTROL in the process line, in accordance with the direction of the FLOW arrow on the serial number label. Tighten fittings according to the instructions of their supplier. The use of Swagelok RS-type stainless steel adapters is recommended.

For reliable performance, make sure the fluid stream is uncontaminated. If necessary, use filters to assure a particle free fluid stream. Select a suitable filter size, to avoid a too high pressure drop.

Do not install small diameter piping on high flow rates and avoid abrupt angles or other disturbances within a distance of 10 pipe diameters from the inlet or outlet of the device.
Do not install pressure regulators within a distance of 25 pipe diameters.

3 Operation

After correct installation and taking all necessary safety precautions, the FLOW-CONTROL is ready to be used.

3.1 First use

Before using the FLOW-CONTROL with corrosive, reactive or explosive media, purging for at least 30 minutes with a dry, inert gas (like Nitrogen or Argon) is strongly recommended. After use with these media, purging is also recommended, before exposing the instrument to air.

3.2 Points of attention

Check the system for leaks before applying pressure, especially if toxic, explosive or other dangerous fluids are used.

Be sure to apply the specified operating pressure(s). Avoid pressure shocks and bring the fluidic system gradually up to the level of operating conditions; open and close the fluid supply gently.

Do not pressurize the instrument beyond the maximum working pressure, stated on the instrument label.

When closing the valve, do not tighten the control knob with excessive force. This might damage the sealing surface of the needle valve, which seriously reduces performance. The needle might even get jammed in the valve seat, blocking the flow permanently.

4 Maintenance

No regular maintenance is required if the FLOW-CONTROL is operated properly, with clean media, compatible with the wetted materials, avoiding pressure and thermal shocks and vibrations. Units may be purged with a clean, dry and inert gas.

In case of severe contamination, cleaning the inside of the device may be required.

Inexpertly servicing instruments can lead to serious personal injury and/or damage to the instrument or the system it is used in. Therefore, servicing must be performed by trained and qualified personnel. Contact Mass Flow ONLINE for information about cleaning and calibration. Mass Flow ONLINE has a trained staff available.

The FLOW-CONTROL is sealed after final adjustment at the factory. Do not open the instrument or loosen the screws. Breaking the serial number seal will not only invalidate the test pressure, but will also void the warranty.

5 Troubleshooting and service

For a correct analysis of the proper operation of an instrument, it is recommended to disconnect the unit from the process line and check it without applying fluid supply pressure. In case the unit is dirty or clogged, this can be ascertained immediately by loosening the fittings and performing a visual inspection.

If you suspect leakage, do not disassemble the instrument for inspection, but contact Mass Flow ONLINE for service or repairs.

5.1 Common issues

Symptom	Possible cause	Action
Flow present while valve is closed	Valve leaking	Contact Mass Flow ONLINE
No flow, opening the needle valve has no effect	No fluid supply	Check upstream components for obstruction, e.g.: • fluidic lines • valves • filters
	Process outlet blocked	Check process outlet and downstream piping for obstruction
	Valve may have been tightened with too much force, jamming the needle into the valve seat. Turning the control knob only loosens it.	Contact Mass Flow ONLINE

5.2 Service

For information about repairable parts and service, please visit the 'Service and support' section of ***www.massflow-online.com****.*

6 Removal and return instructions

Before returning materials, go to the 'Service and support' section of ***www.massflow-online.com*** *and completely fill out a Return Material Authorisation (RMA) request form. In the RMA request, clearly describe the problem, and, if possible, the work to be done.*

Instrument handling:

1. Purge all fluidic lines
2. If toxic or dangerous fluids have been used, the instrument must be cleaned before shipping
3. Disconnect all external cabling and tubing and remove the instrument from the process line
4. If applicable, secure movable parts with appropriate transport safety materials, to prevent damage during transportation
5. The instrument must be at ambient temperature before packaging
6. Insert the instrument into a plastic bag and seal the bag
7. Place the bag in an appropriate shipping container; if possible, use the original packaging box

Add documentation:

- Reason of return
- Failure symptoms
- Contaminated condition
- Declaration on decontamination

It is absolutely required to notify the factory if toxic or dangerous fluids have been in contact with the device! *This is to enable the factory to take sufficient precautionary measures to safeguard the staff in their repair department.*

All instruments must be dispatched with a completely filled in 'Declaration on decontamination'. Instruments without this declaration will not be accepted.

The 'Declaration on decontamination' form is part of the RMA request.

Important:
Clearly note, on top of the package, the customs clearance number of Mass Flow ONLINE B.V., namely:

NL818553625B01

(only if applicable, otherwise contact your distributor for local arrangements.)