azbil

CM2-MGN200-2001

MagneW PLUS+
Electromagnetic Flowmeter
Open Channel Flowmeter Detector
User's Manual

Model: NNK140/941,NNK150/951

Azbil Corporation

NOTICE

While the information in this manual is presented in good faith and believed to be accurate, Azbil Corporation disclaims any implied warranty of merchantability or fitness for a particular purpose and makes no express warranties except as may be stated in its written agreement with and for its customer.

In no event shall Azbil Corporation be liable to anyone for any indirect, special or consequential damages. This information and specifications in this document are subject to change without notice.

Table of Contents

List of Figure

List of Table

1 : Introduction

This manual describes how to install and operate the MagneW^{TM}3000 FLEX/PLUS NNK open channel electromagnetic flowmeter detector. If you are using a MagneW^{TM}3000 FLEX/PLUS NNK in combination with a converter, refer to the operation manual of the converter.

Before installing a detector, make sure that its size is adequate by referring to the “Diameter Selection Graph” in the appendix of this manual.

2 : External view

Figure 1 Open channel type Electromagnetic flowmeter detector

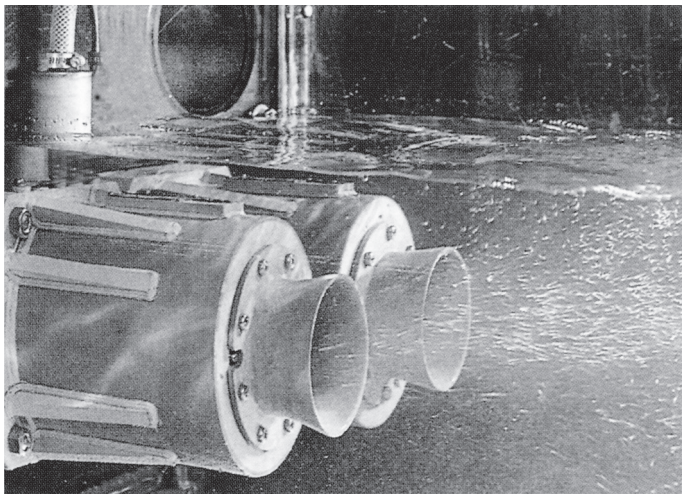


Figure 2 State during flow rate measurement

3 : Outline and standard specifications

This open channel type electromagnetic flowmeter is used for measuring flow rates in open channels or closed conduits such as drainage canals. It is used for a large variety of flow rate measurements, such as drainage under total pollutant load regulations, water and sewer service, and irrigation water. (This flowmeter is officially listed in the “General Specifications of Electric Work” of the Japan Sewage Works Agency.)

3-1 : Standard specifications

Overall specifications

Flow velocity range: 0 - 0.3 to 0 - 10 m/s. (Continuously adjustable)

Accuracy (Combined with the MGG10/14C):

	Within the recommended condition *	Outside of the recommended condition
When detector is used without dummy or dummies	+/- 1.0% F.S.	+/- 2.0% F.S.
When detector is used with dummy or dummies	+/- 2.0% F.S.	+/- 4.0% F.S.

~Note **Recommended condition of use*

Without dummy: *Straight channel section on the upstream side of detector is 3 times or more the nominal flowmeter diameter.*

With dummy: *Straight channel section on the upstream side of detector is twice or more the water channel width.*

Power supply: 90 to 250 V AC, 47 to 63 Hz

24V DC ± 10%, 110V DC ± 10%,

Power consumption: Approx. 10W (including detector and converter)

Detector

Material of body: Rigid vinyl chloride (parts in contact with fluid: SUS304)

(Resisting {internal, external} pressure = 0.05MPa)

Materials of electrodes: SUS316L, Titanium

Structure: Open channel type (equivalent to JIS C 0920 Submersible Type) IEC IP68 equivalent

Cables (10m for each cable): One 4 core shielded cable (outer diameter 11.4 mm; length 10 m) with cable protection vinyl tube (outer diameter 22 mm; length 10 m)

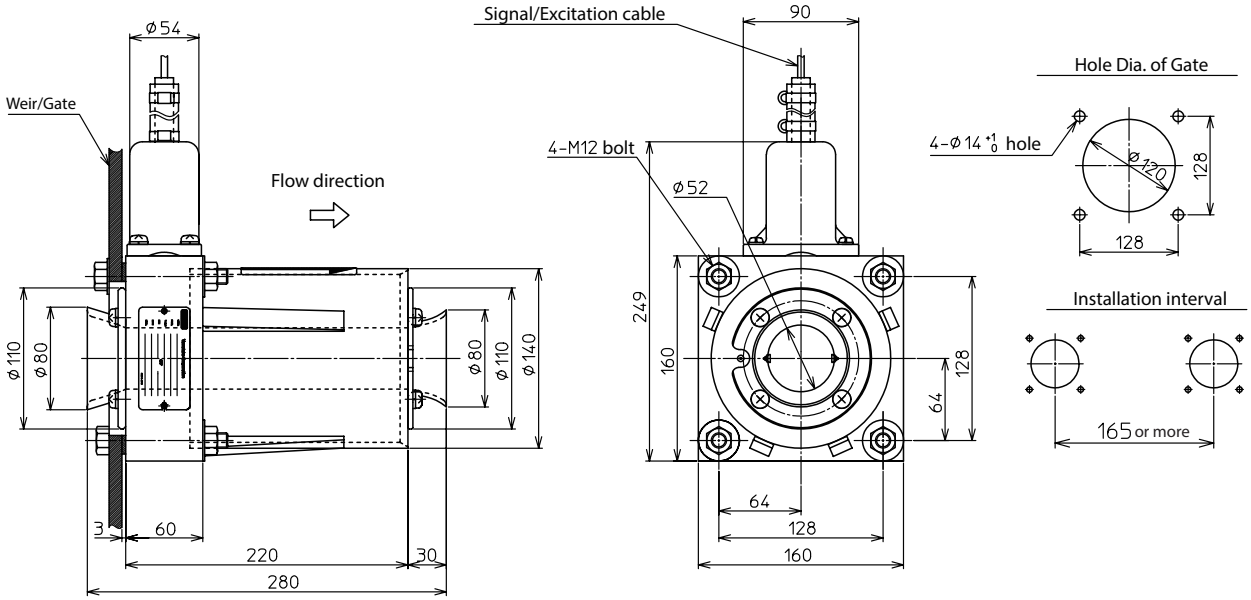
Electrical conductivity of the measured fluid: 5μS/cm

Ambient temperature: 0 to 40° C

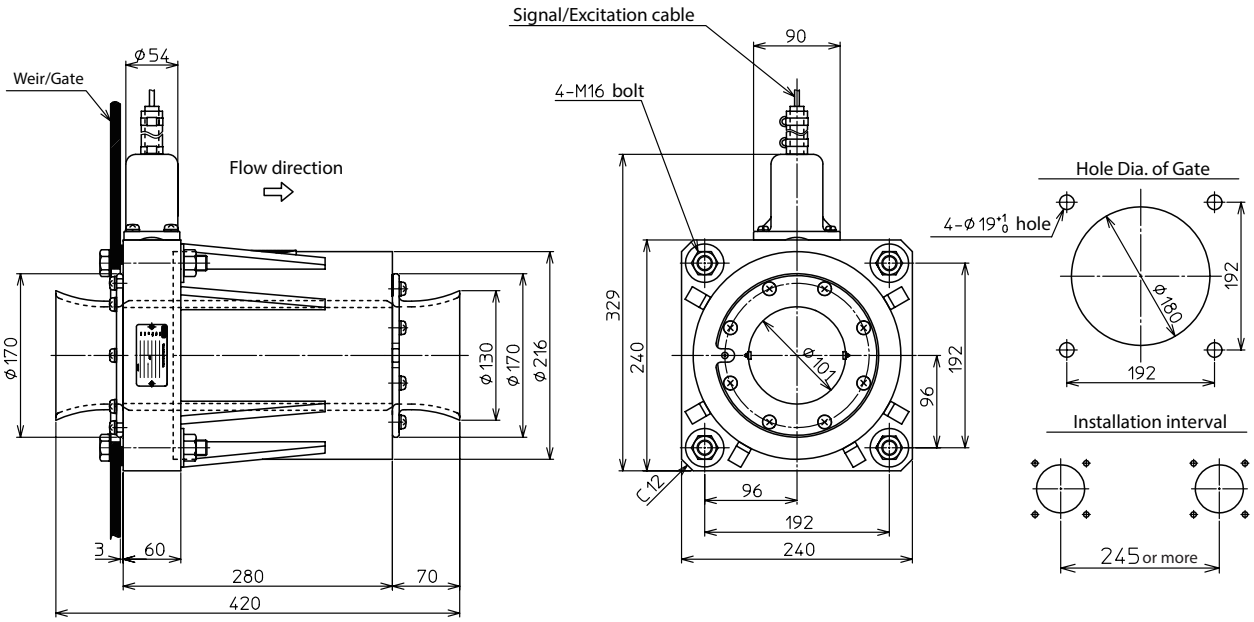
Mass: 50 mm (detector;10 kg. dummy; 1.4 kg)
400 mm (detector;130 kg, dummy; 33.4 kg)
100 mm (detector;23 kg. dummy; 3.4 kg)
600 mm (detector;220 kg, dummy; 59.4 kg)
200 mm (detector;45 kg. dummy; 10.4 kg)

3-2 : External dimensions

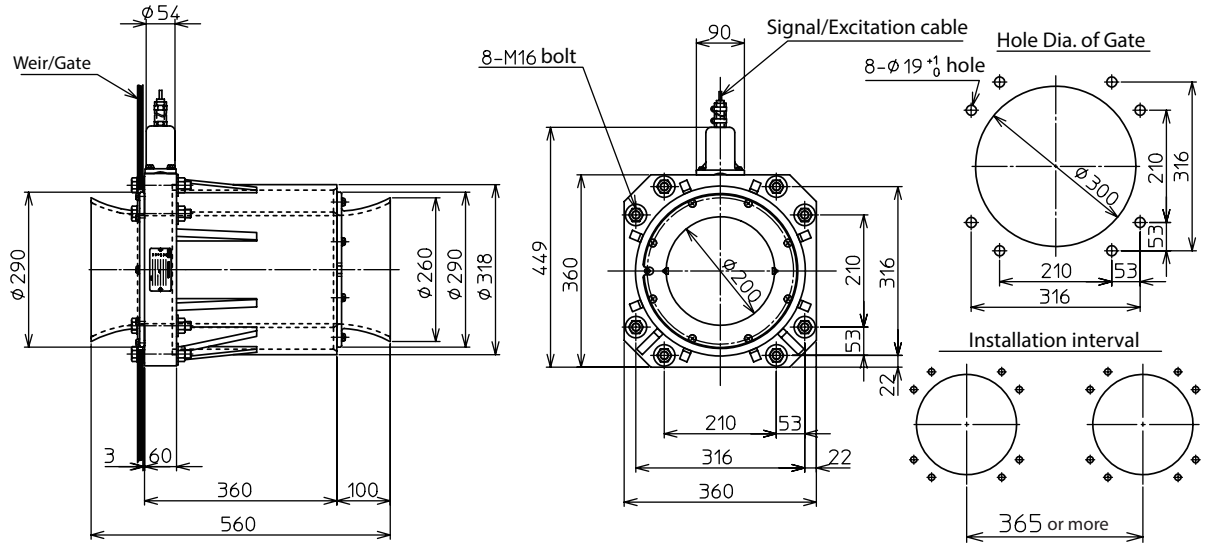
Bell mouth type detector



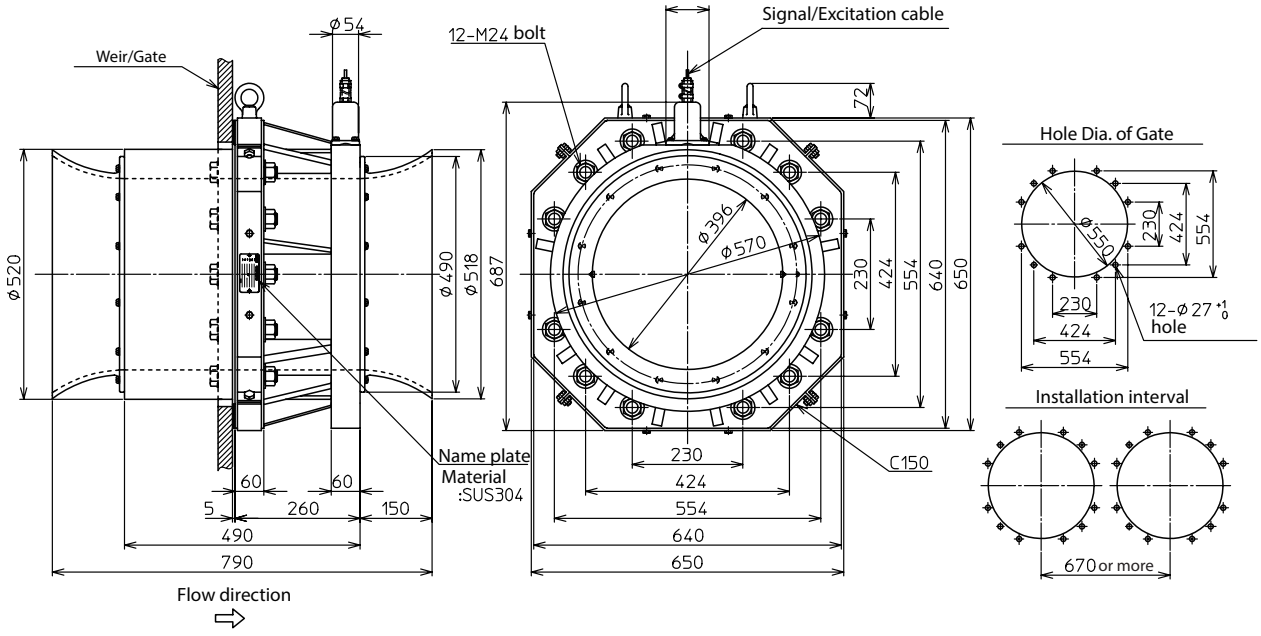
Size 50mm



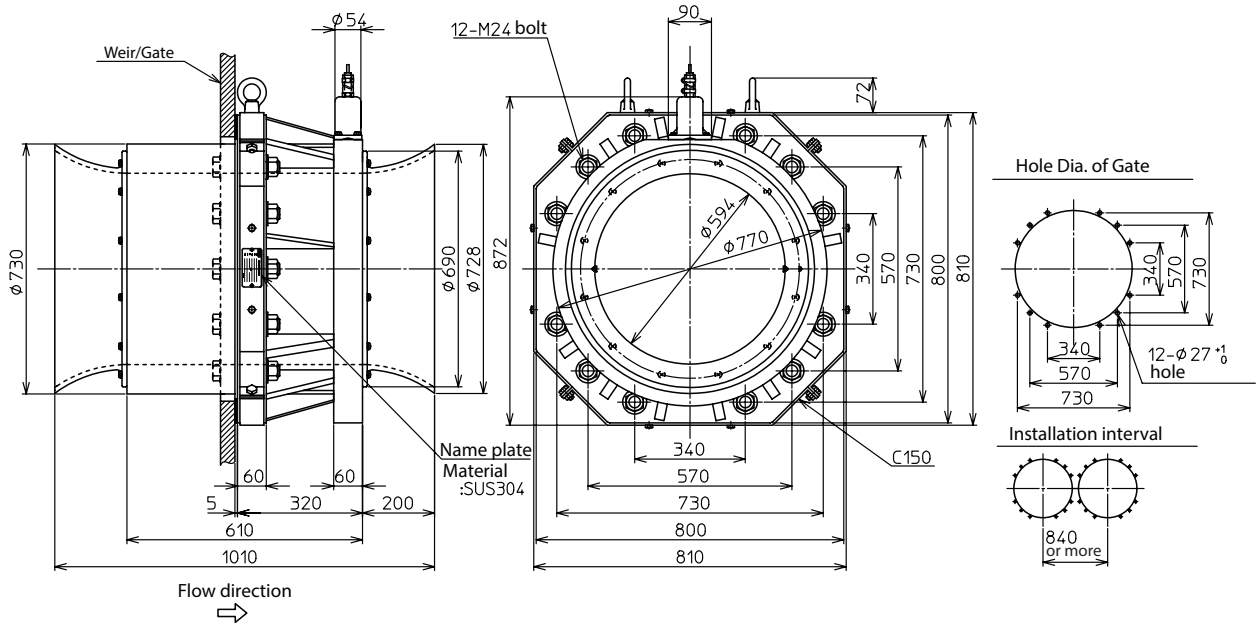
Size 100mm



Size 200mm



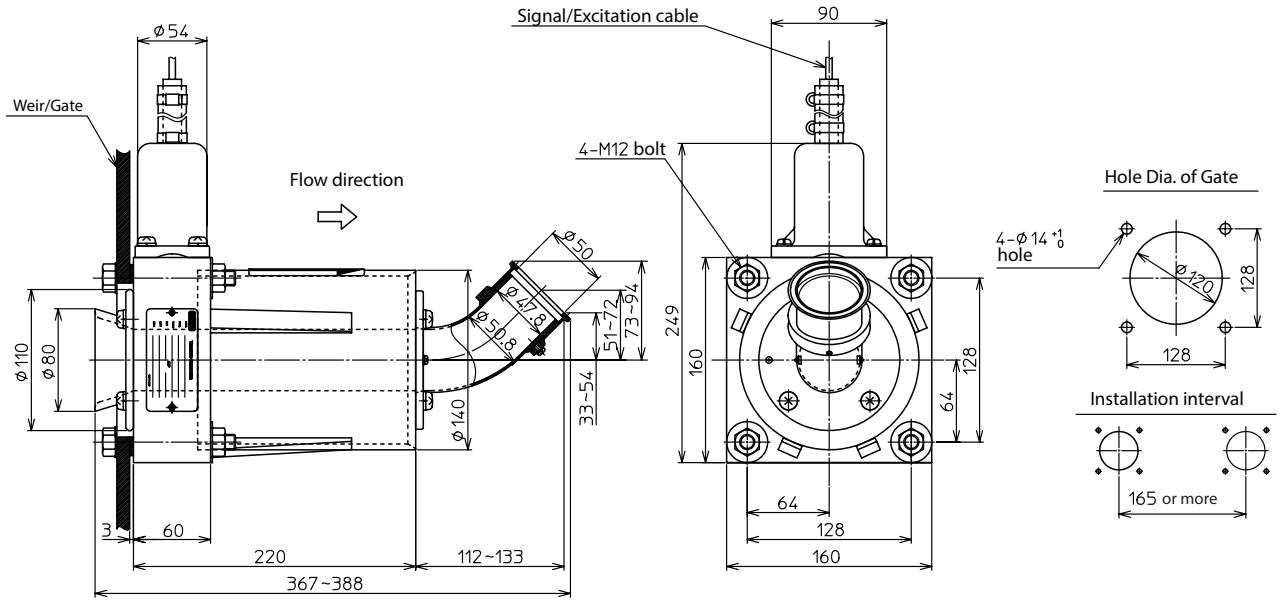
Size 400mm



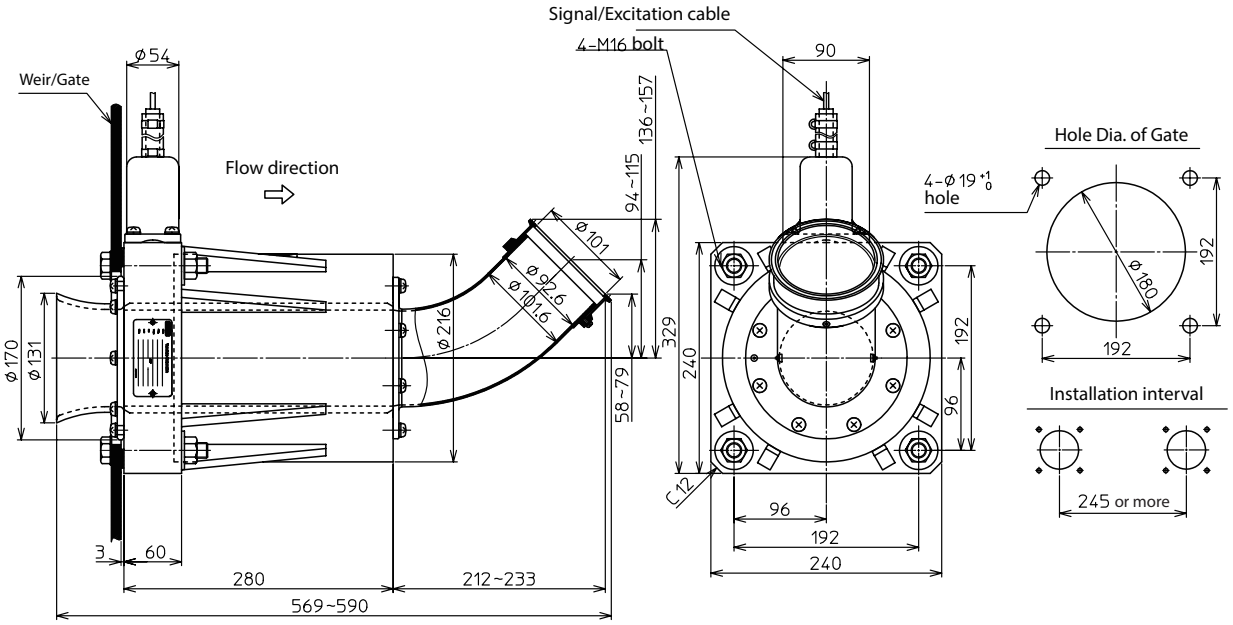
Size 600mm

Figure 3 Dimensional drawings of Bell mouth type detector

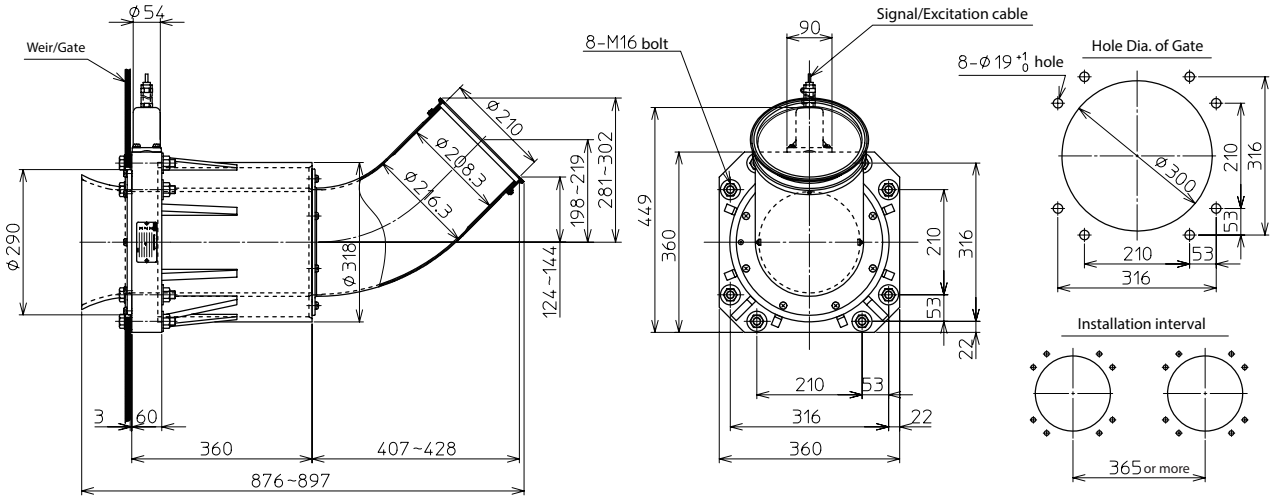
Detector with Elbow flange



Size 50mm



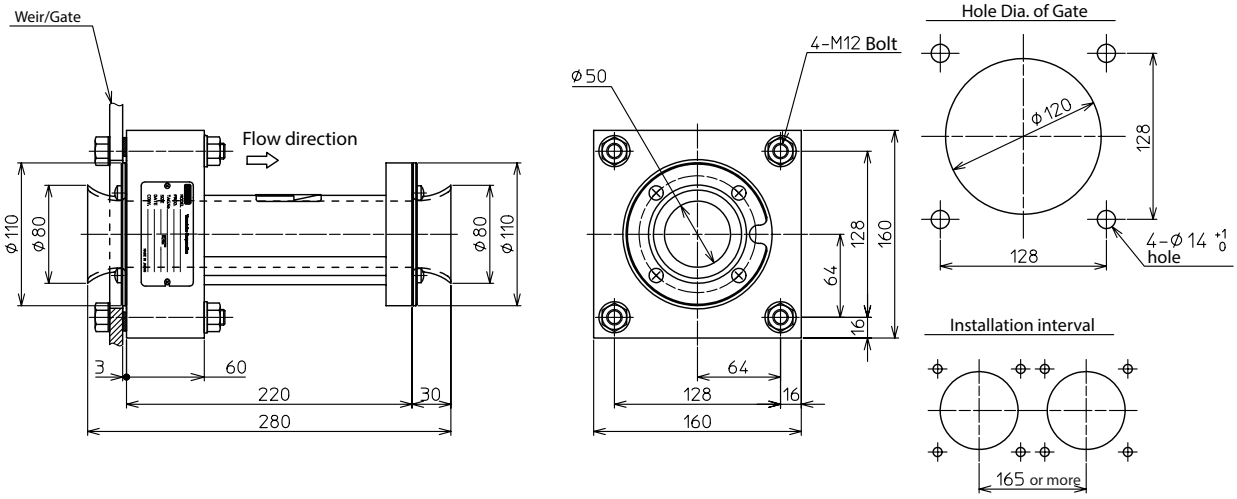
Size 100mm



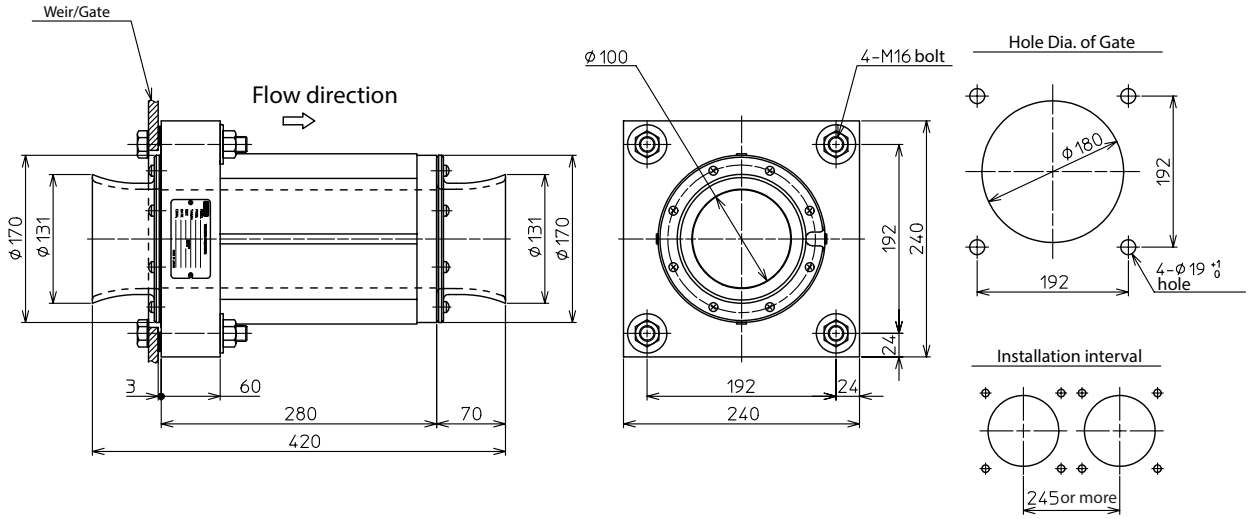
Size 200mm

Figure 4 Dimensional drawings of a detector with Elbow flange

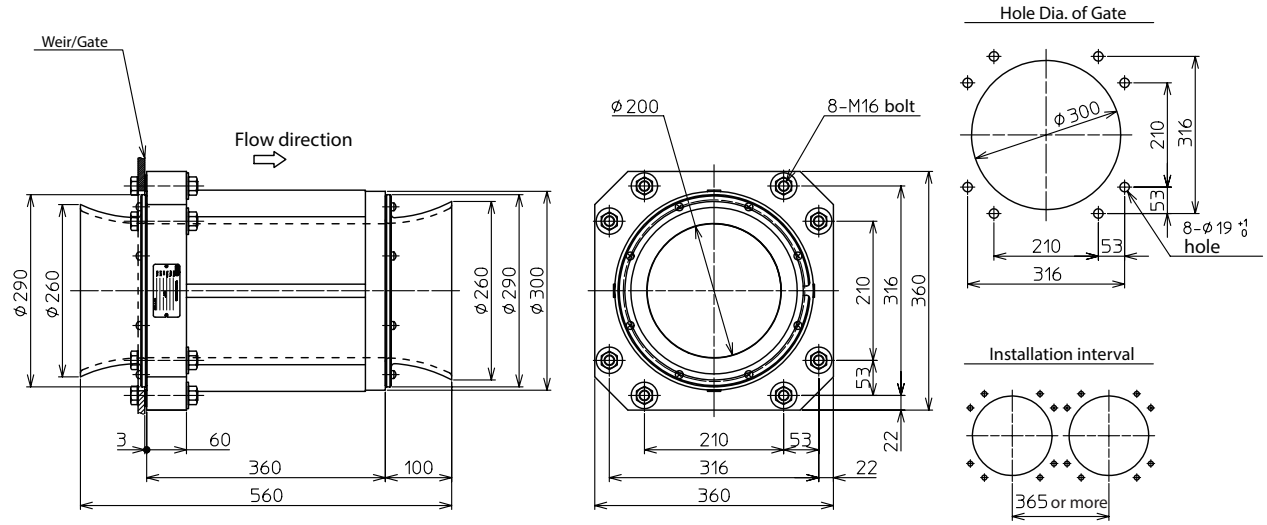
Dummy



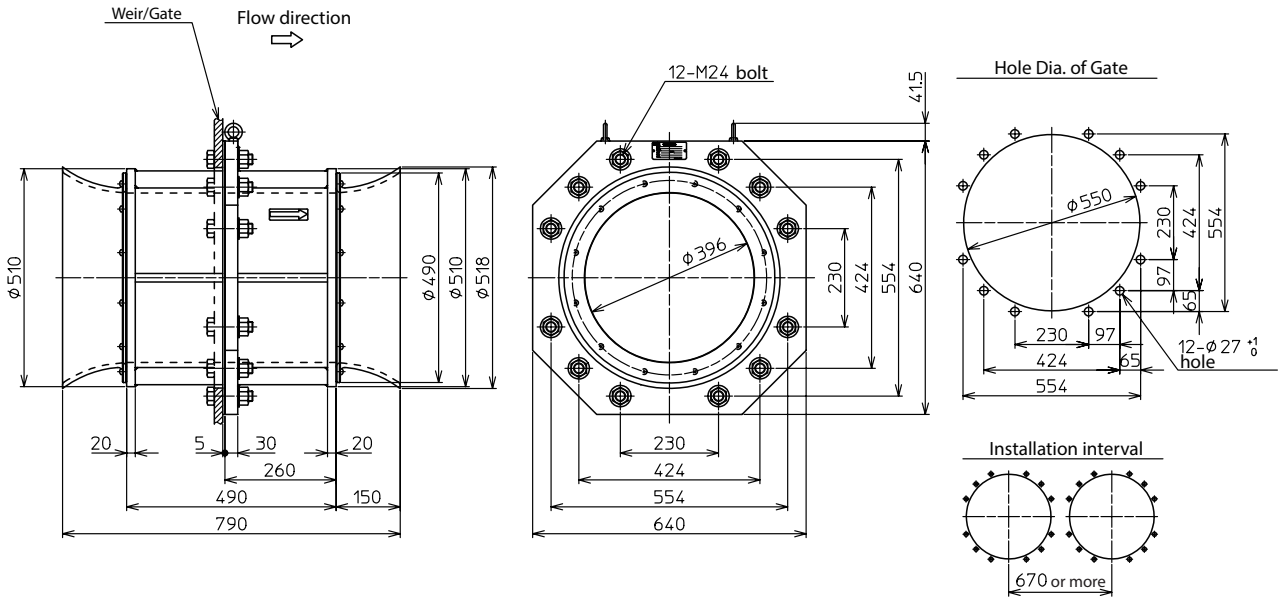
Size 50mm



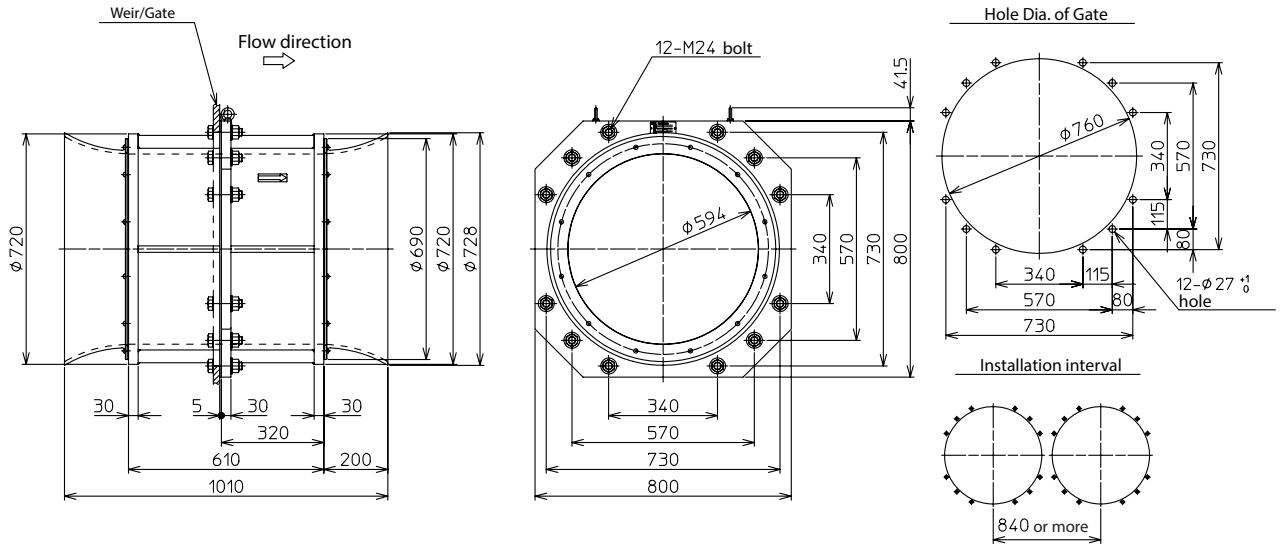
Size 100mm



Size 200mm



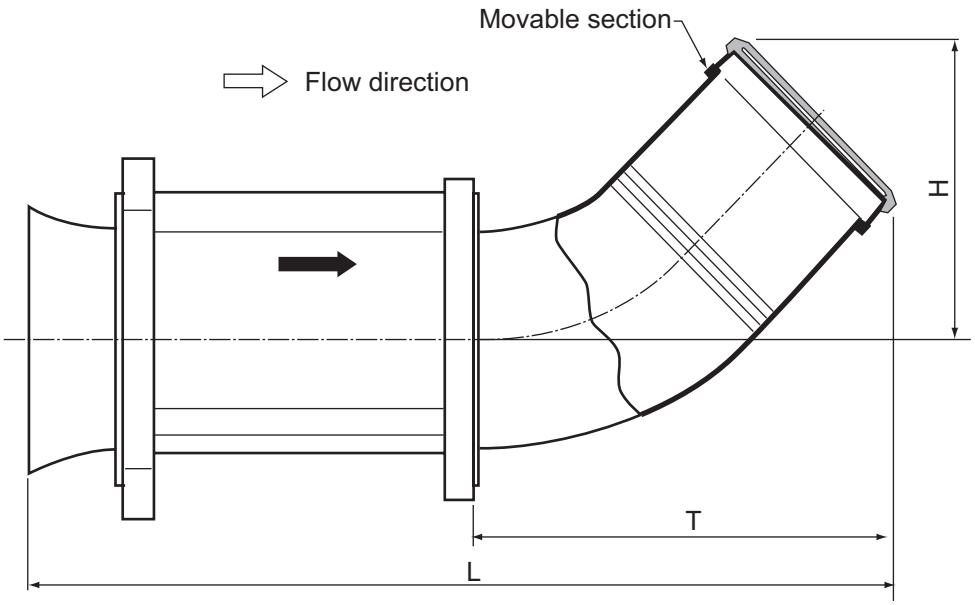
Size 400mm



Size 600mm

Figure 5 Dimensional drawings of a Dummy

Dummy with an Elbow flange



Size 50mm, 100mm, 200mm

Figure 6 Drawing of a Dummy with Elbow flange

Size	50mm	100mm	200mm
L	367 to 388	569 to 590	876 to 897
H	73 to 94	136 to 157	281 to 302
T	112 to 133	212 to 233	407 to 428

3-3 : How to use model with an Elbow Flange

When no weir plate can be installed on the downstream side of a detector, use a model with an Elbow flange.

(a) The water level (+ 7mm) can be adjusted since the elbow flange length can be changed. A water level error caused by the use of a dummy detector can be corrected by adjusting the arm.

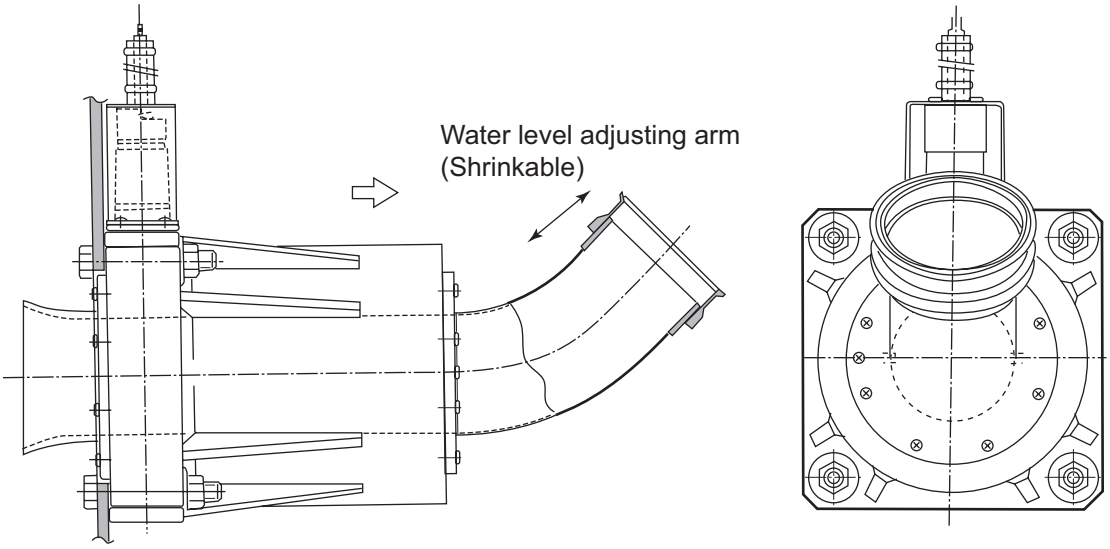


Figure 7 Detector with Elbow flange

(b) The measurement range can be increased in provision for a future flow rate increase by installing a model with an elbow flange (with cover).

The cover can be mounted and removed easily with a butterfly screw.

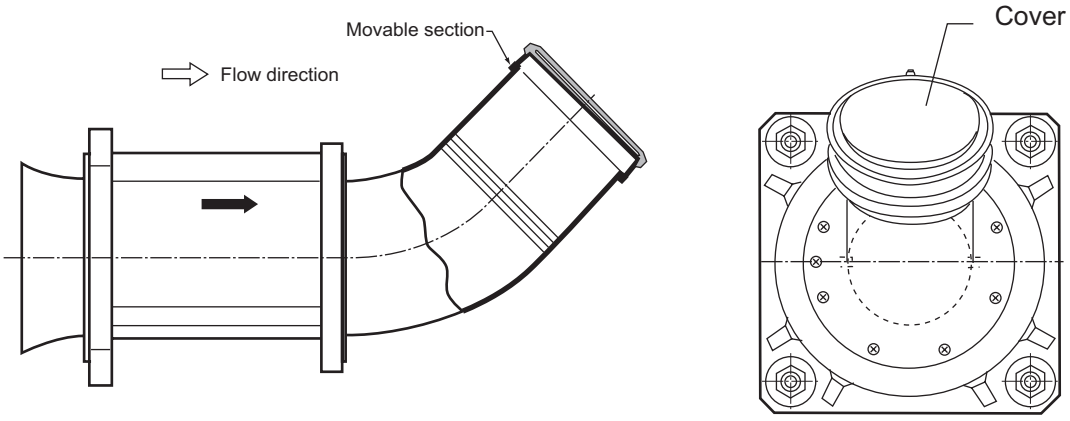


Figure 8 Dummy with Elbow flange

3-4 : How to use the Dummy detector

The measurable flow rate can be doubled, tripled, or quadrupled by installing 1,2,3 dummy detectors, respectively. A detector must be combined with dummy detectors of the similar shape. If the flow rate is to be increased in future, the measurable range can be expanded easily by installing a model with an elbow flange. (with a cover).

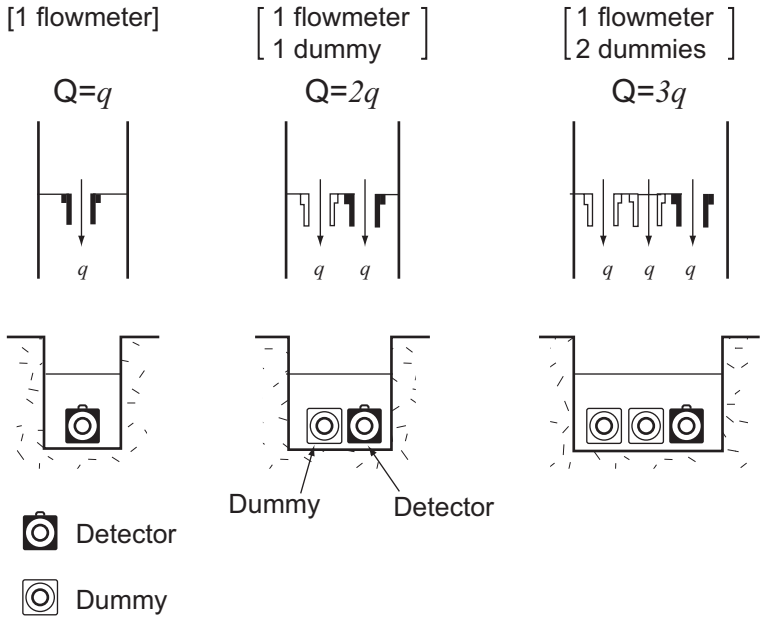
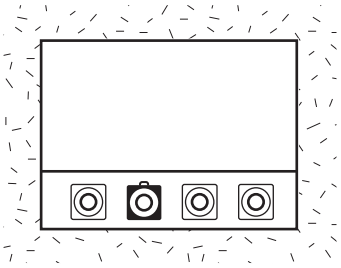
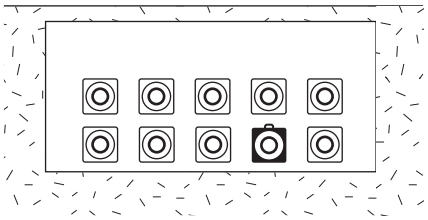


Figure 9 Measuring a large flow rate using dummy detectors



Flow rate measurement in trunk sewerage
(400mm: one detector and three dummies)



Flow rate measurement in sewage treatment plant
(600mm: one detector and nine dummies)

Figure 10 Examples of setting Dummy detector

4 : Installation

4-1 : Considerations on installation

Before the installation of a open channel type electromagnetic flowmeter, observe the following considerations.

- If you are asking a subcontractor to install a flowmeter, you are advised to check the procedure of installation work in writing in advance.
- Protect the ends of the dedicated cables attached to the body from water by wrapping them with tape.
- When locating a flowmeter on a gate, assign one worker to the upstream side of the gate and another to the downstream side. Suspend the flowmeter with a chain block and lock its body with bolts with the specified tightening torque. Make sure that the electrode is situated horizontally.
- Ground the flowmeter with the grounding terminal. (The placement of the grounding terminal is shown in Figure 11.)
- After mounting a detector, make sure that neither the body, nor the cables are damaged.
- The gate board on which the elbow flange–type detector and dummy detectors are installed must bear the weight of the detectors and of the water that flows through them. Therefore, use a board that is strong enough and that will not warp. If the gate board warps, leakage will occur between the board and the detectors, and measurement will be incorrect.
- When removing and reinstalling the submersible electromagnetic flowmeter from the gate board for replacement, recalibration, or other purposes, check that the board is not deformed and that there is no rust or foreign matter on the sealant between the board and the detector.

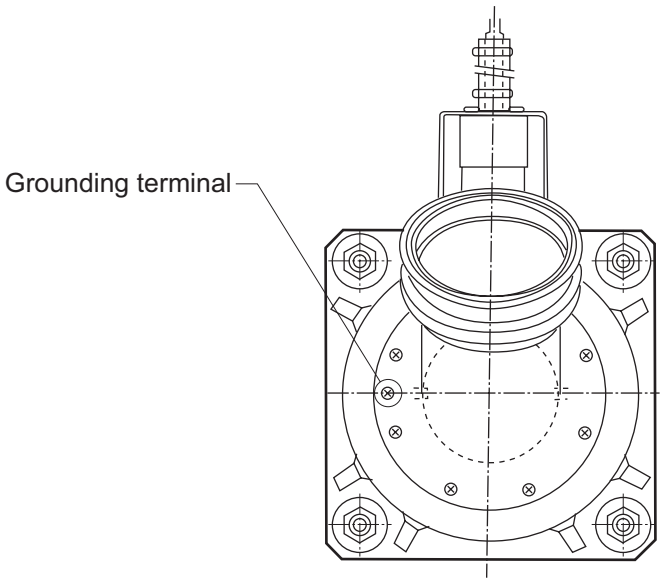


Figure 11 Grounding terminal

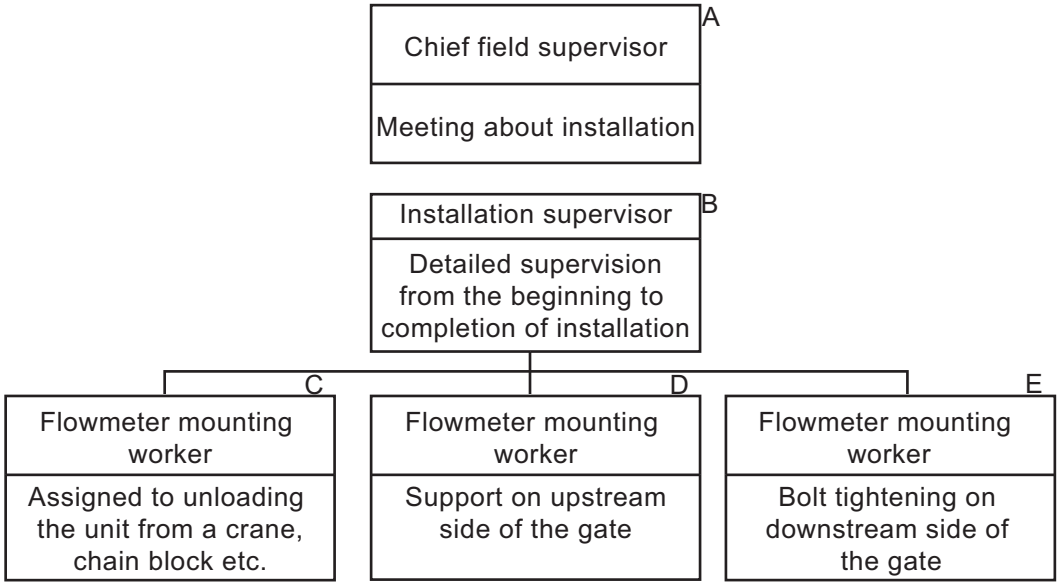
Table 1: Tightening torque of detector

Nominal size	Tightening torque	Nominal size	Tightening torque
50mm	10 to 20 $N \bullet m$	400mm	25 to 35 $N \bullet m$
100mm	11 to 21 $N \bullet m$	600mm	25 to 35 $N \bullet m$
200mm	25 to 35 $N \bullet m$		

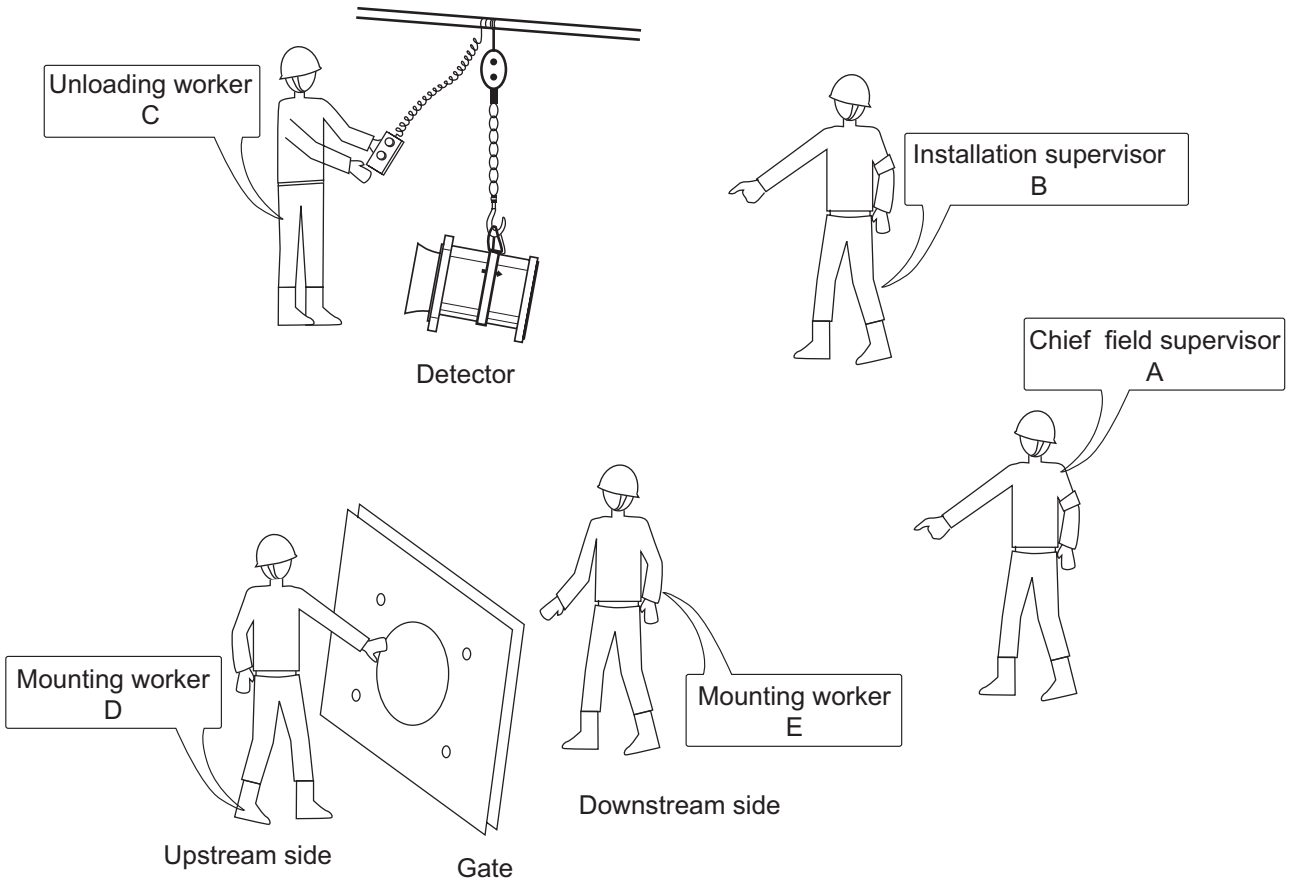
4-2 : Transportation of flowmeter to the installation site

- Weigh the flowmeter and post the weight in a place where one can see it.
- Check to see if a crane can be used.
- If rollers are to be used for moving a flowmeter, encase the flowmeter in a wooden frame.
- Provide a chain block scaffolding.
- Use a jack or a stepladder if necessary.

4-3 : Example of installation work

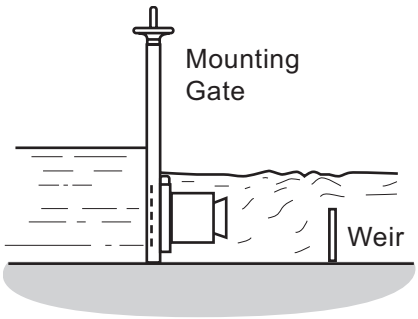


<Example of personnel assignment>

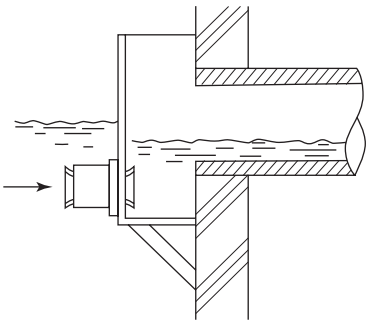


4-4 : Examples of installation

Schematic drawings



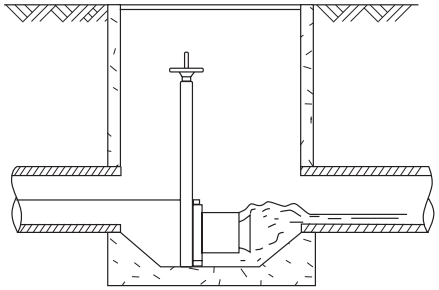
Flow measurement with a NNK detector installed in an open channel.



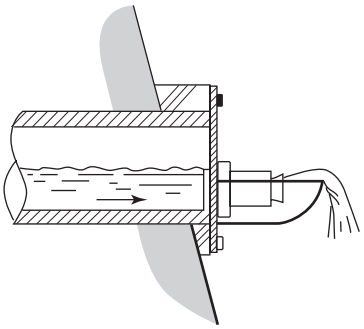
Flow measurement with a NNK detector installed on the intake end of channel.

1) It is recommended that a gate with a lifting device be used. If there is a possibility that the upstream water level will become lower than the inlet port of the detector, a downstream wirer plate or a adaptor must be installed to avoid exposing the measuring pipe in to air.

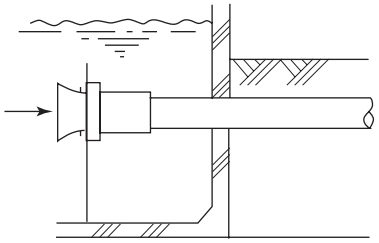
2) MagneW™3000 FLEX/ PLUS, the NNK detector, can be mounted in direct or reverse direction. However, wiring connections must be made accordingly.



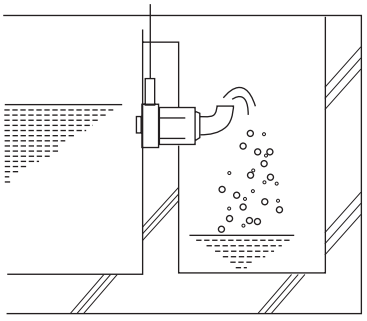
Flow measurement with submersible electromagnetic flormeter installed in a pit.



Flow measurement with a NNK detector installed in a discharge end channel.

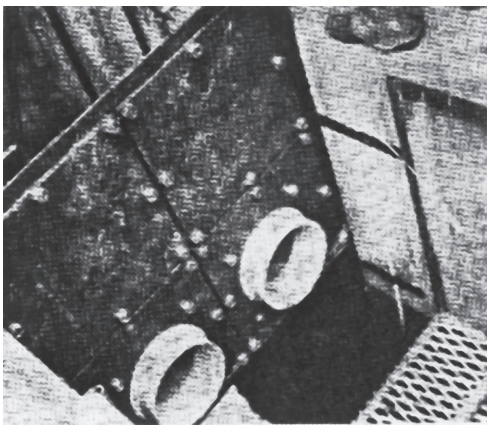


Flow measurement with a NNK detector installed in a discharge tube.

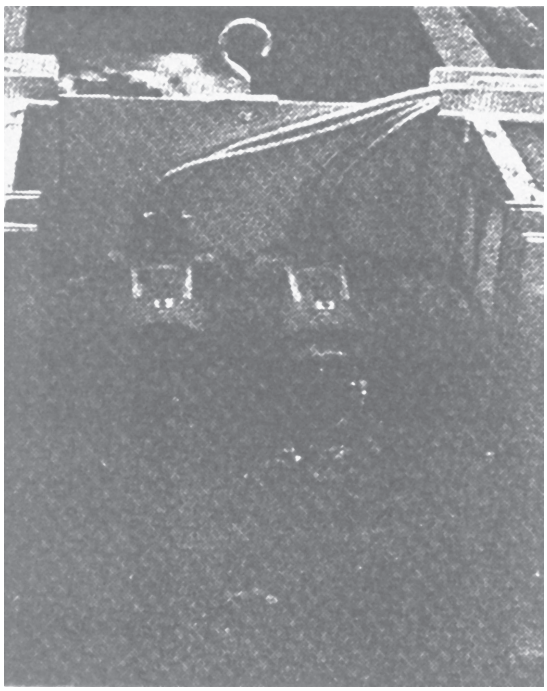


Discharge flow measurement with a NNK detector with an elbow flange installed in a profabrication sewage disposal plant.

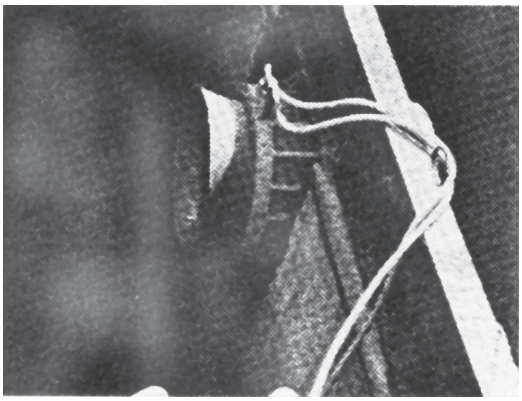
Pictures of flowmeter installation



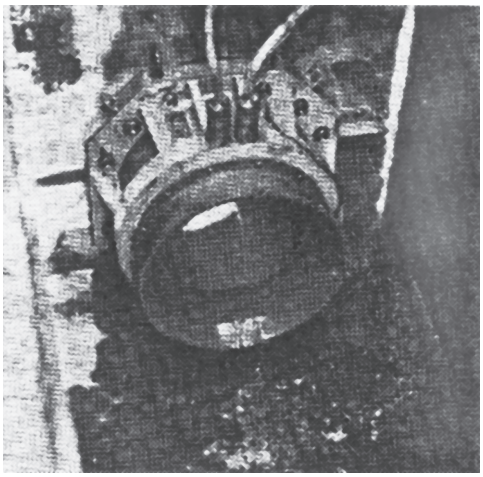
Measurement with one 200mm detector and one 200mm dummy



High accuracy measurement with two 200mm detectors



Installed on a water tank outlet (600mm)



Installed in a discharge pipe of the plant (400mm)

5 : Wiring

5-1 : Considerations on wiring

(a) Since the root of the 4-core cabtyre cable (including cores for signal and excitation) is a watertight structure, do not pull them.

(b) The standard length of each cable of the detector is 10m. If the cable length between a detector and a converter is over 10m, use a cable connection box (Model No. NNZ 102-X-X)*. (See Figure 9.) Since the fluid conductivity of the water and drain is over 100 mS/cm, the cable can be extended to a maximum of 100m. * Optional (Model SMC 11-HC)

(c) Make sure that the cable between the detector and the converter is laid at a place where it cannot be damaged.

(d) Screw the tightening gland into the wire connection port of the converter in order to ensure airtightness between the cabtyle cable and the wire connection port.

(e) Cable should be as far from a large current cable as possible, and they should not be laid in parallel.

5-2 : Wiring

(a) Install the converter in a place where it will not be exposed to direct sunshine.

(b) If to be used for a flow running reverse to the flow direction marked on the detector (See the arrows in Figure 7 and Figure 8.), reverse the white and black signal lines (White - B, Black - A)

(c) Ground the detector using the grounding terminal (Figure 11) (ground resistance needs to be less than 100 Ω).

(d) Never short-circuit the exciting terminals (X,Y) of the converter. Do not connect anything but a detector to the converter.

A detector is used in combination with a Open channel type detector (Type NNK) and a converter (Type MGG10C/14C). Its output signals are instantaneous flow rate signals (4 to 20mA DC), totalized output (pulse) and contact output (open collector).

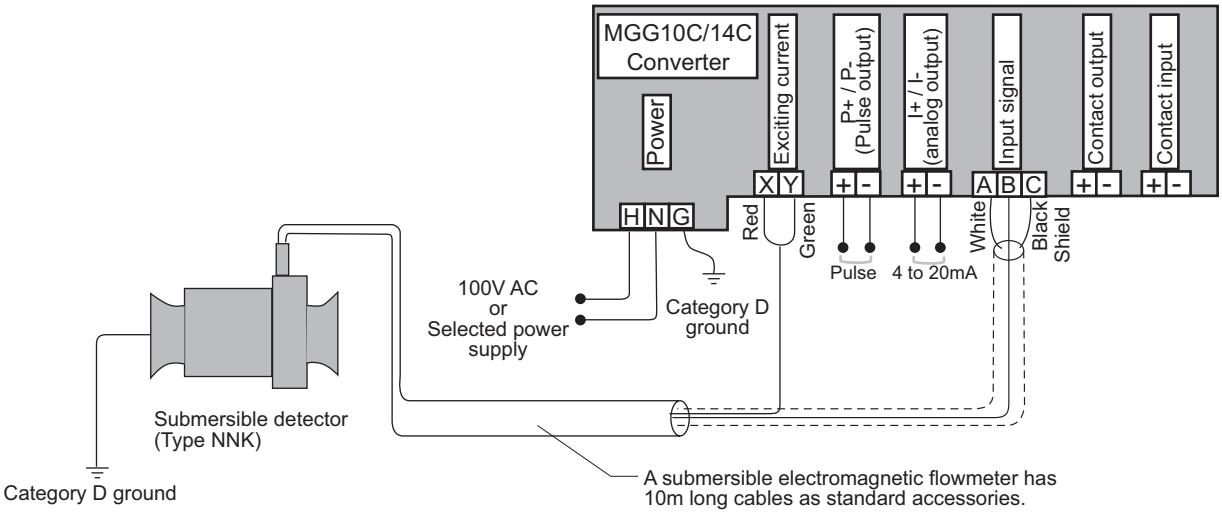


Figure 12 Connection of converter and detector

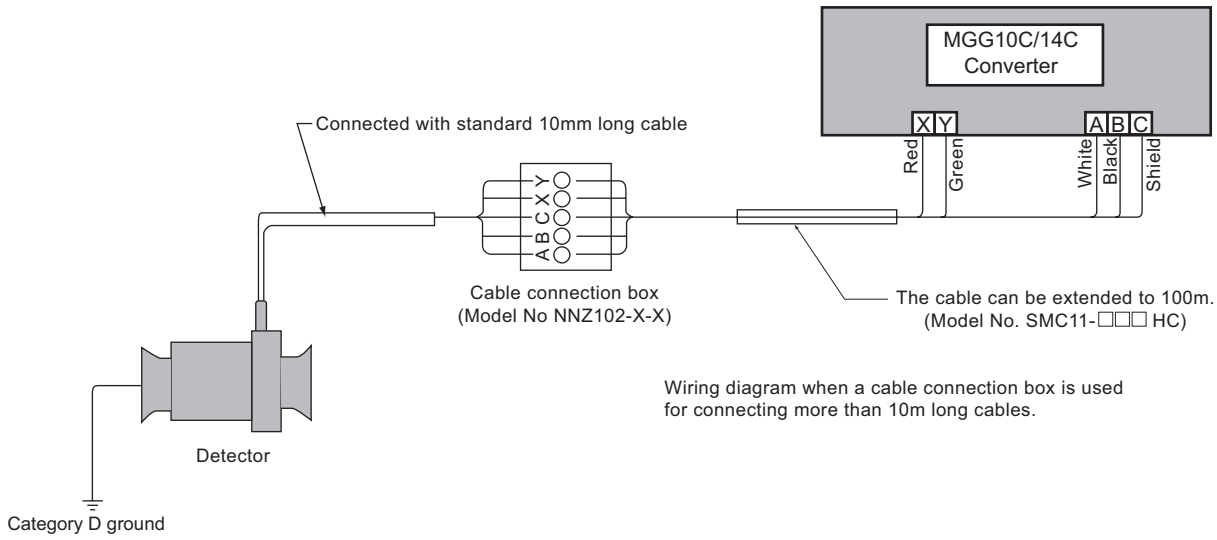


Figure 13 Wiring to connection box

6 : Inspection

Inspect the following parts.

6-1 : Flowmeter in general

(a) Check to see if the detector and the converter are mounted as specified.

…. See “Considerations on installation” on page 17. “Examples of installation” on page 20 and “Considerations on wiring” on page 22. “Wiring” on page 22 in this manual.

(b) Check to see if the detector and the converter are connected correctly.

…. See “Considerations on wiring” on page 22. in this manual.

6-2 : Detector

(a) Are all the bolts tightened?

…. Make sure that all the bolts are tightened.

(b) Is the detector grounded?

…. Refer to the instructions related to the ground terminal in “Grounding terminal” on page 17.

(c) Are the dummy detector and the detector installed at the same height?

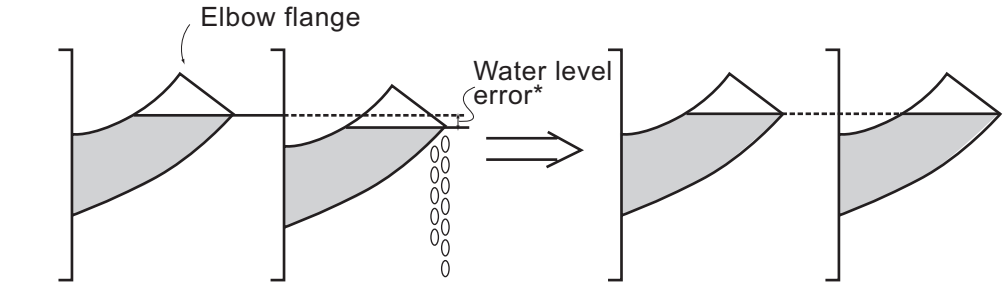
…. If detectors with elbow flanges are used, stop the flow and fill the elbow flanges with liquid and make sure that no fluid comes out from either of the detectors. If they are not installed at the same height, adjust it using the water level adjusting arm. (See “Figure 14 Water level adjustment”.)

(d) Is the detector or the dummy detector size large enough for the maximum flow rate?

… See “Detector size selection graph” on page 2 for checking this.

(e) Are oily suspended substances stuck to the inner wall?

…. Wipe with a cloth



When the two are not the same height. (Fluid overflows from one.)

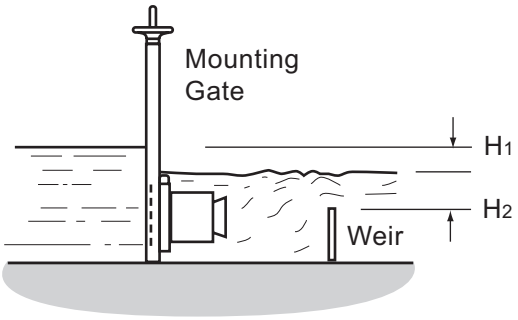
When the two are the same height.

* Correct the error using the water level adjusting arm by referring to 3-(4) “Instructions relating to the Elbow Flange”.

Figure 14 Water level adjustment

Appendix

Water level calculation (Bell mouth type)



Example:

Size and number of detector	: 200mm, 1unit
Size and number of dummy detector	: 200mm, 1unit
Width of weir plate (W)	: 2m
Maximum flow rate (Qt.)	: 500m³/h
Average flow velocity per detector (V)	: 2.21m/s

Conversion of water head differential (H_1) to water level

$$H_1 = K_1 \times V_2$$

in which K_1 : Water head differential conversion coefficient 0.053

(Example)

When the average flow velocity of the detector is 2.21[m/s]

$$H_1 = K_1 \times V_2 = 0.053 \times (2.21)^2 = 0.259[m]$$

Conversion of overflow water depth (H_2O) to water level

$$H_2 = \left(\frac{Q_1}{1.84 \times W \times 3600}\right)^{\frac{2}{3}}$$

(Example)

When the maximum flow rate is 500[m³/h] and the sheathing board width is 2[m]

$$H_2 = \left(\frac{Q_1}{1.84 \times W \times 3600}\right)^{\frac{2}{3}} = \left(\frac{500}{1.84 \times W \times 3600}\right)^{\frac{2}{3}} = 0.113m$$

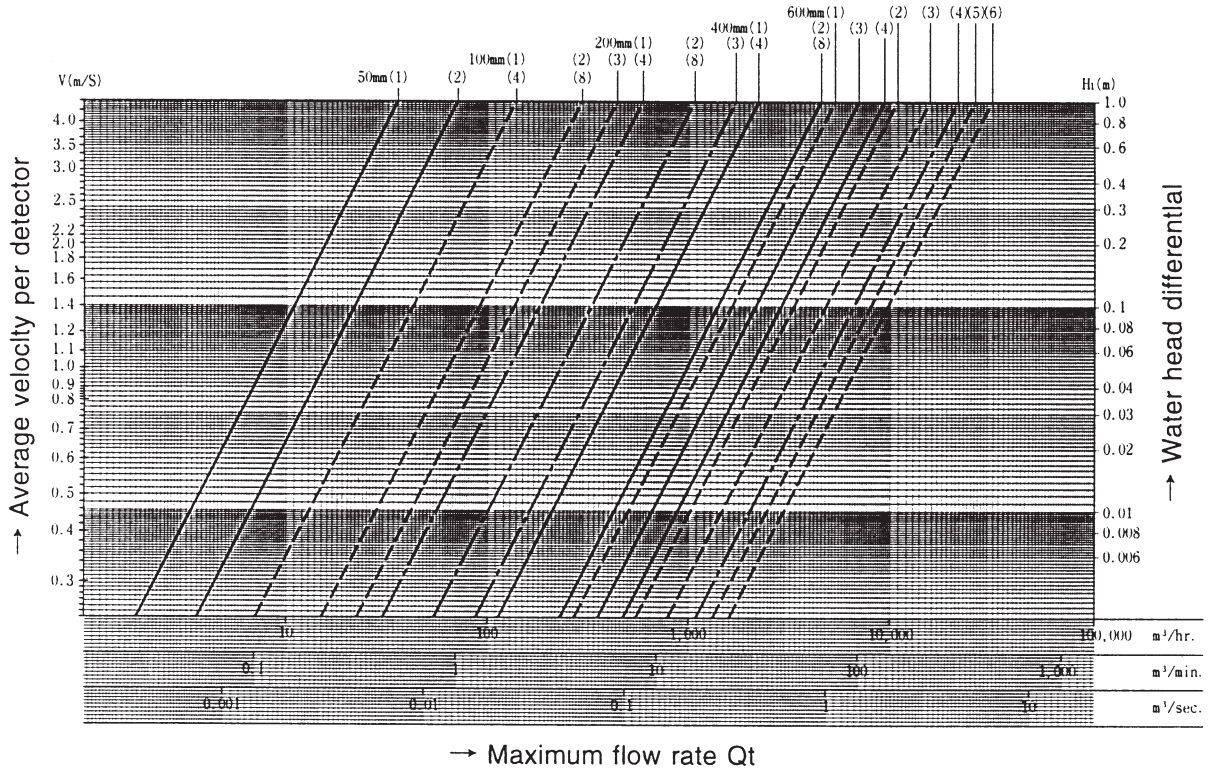


Figure A-1 Detector size selection graph

~Note *The expression "200mm(3)" refers to the structure consisting of one 200mm detector and two 200mm dummies. ("200mm" referts to the detector's size or aperture and "(3)"means that the total number of detectors including dummy detectors.)*

[How to use the graph]

The flow rate is graduated from left to right along the lower horizontal axis. If a line is drawn perpendicular to his axis, up wards to the top of this graph by drawing a lines directly left from the points of intersection.

[Example] Water head differential and flow velocity at flow rate of 500m³/hr

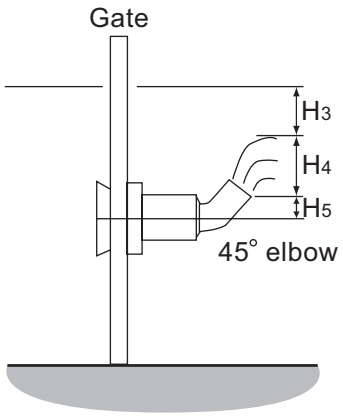
Draw a line upward from the point of 500mm³/hr, and it will intersect with the following diagonal lines:

400mm(4), 400mm(3), 600mm(2) {=200mm(8), 400mm(1) {=200mm(4)}, 200mm(3), 200mm(2) {=100mm(8)}, 200mm(1) {=100mm(4)}

When the line intersects with 200mm(2), the water head differential H1 is found to be about 0.26m and the flow velocity per detector V(m/s) is about 2.2m/s.

Example for a maximum flow rate of 500 (m³/h) and weir plate width of 2 (m):

Water level calculation (Elbow flange type)



Example
Size and number of detector: 200mm, 1 unit
Size and number of dummy detector: 200mm, 1 unit
Maximum flow rate (Qt.): 500m³/h
Average flow velocity per detector (V): 2.21m/s

Water level calculation of head difference (H_3)

$$H_3 = K_3 \times V_2$$

where K_3 : Water head conversion coefficient of the elbow flange: 0.055

Example: For a detector average flow velocity of 2.21 (m/s):

$$H_3 = K_3 \times V_2 = 0.055 \times (2.21)^2 = 0.269(m)$$

Elbow spouting height (H_4)

$$H_4 = K_4 \times V_2$$

Where K_4 : Conversion coefficient of elbow spouting height: 0.028

Example: For a detector average flow velocity of 2.21 (m/s):

$$H_4 = K_4 \times V_2 = 0.028 \times (2.21)^2 = 0.137(m)$$

Nominal size	50mm	100mm	200mm
Dimension of H_5	49mm	92mm	196mm

Consequently, THE head can be calculated as $H_3 + H_4 + H_5 = 0.685[m]$

Average flow velocity of detector (m/s)

Flow velocity conversion table

$V = K \times Q$ Where

V : Flow velocity (m/s), Q : Flow rate (m^3/h)

K : Flow velocity conversion coefficient $\frac{1}{3600} \times \frac{4}{\pi D^2}$

(Example)

Detector size: 200(mm)

Flow rate per detector: 250(m^3/h)

Nominal size (mm)	Flow velocity conversion coefficient K
50	0.1415
100	0.03537
200	0.00842
400	0.002210
600	0.0009824

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.

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

1. Warranty period and warranty scope

   1.1 Warranty period

   Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

   1.2 Warranty scope

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

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

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

2. Ascertainment of suitability

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

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

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

3. Precautions and restrictions on application

   3.1 Restrictions on application

   Please follow the table below for use in nuclear power or radiation-related equipment.

	Nuclear power quality*5 required	Nuclear power quality*5 not required
Within a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Cannot be used (except for limit switches for nuclear power*7)
Outside a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Can be used

   *5. Nuclear power quality: compliance with JEAG 4121 required
   *6. Radiation controlled area: an area governed by the requirements of article 3 of "Rules on the Prevention of Harm from Ionizing Radiation," article 2 2 4 of "Regulations on Installation and Operation of Nuclear Reactors for Practical Power Generation," article 4 of "Determining the Quantity, etc., of Radiation-Emitting Isotopes,"etc.
   *7. Limit switch for nuclear power: a limit switch designed, manufactured and sold according to IEEE 382 and JEAG 4121.

   Any Azbil Corporation's products shall not be used for/with medical equipment.

   The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.

   3.2 Precautions on application

   you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below. Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

(1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
(2) For use of specific purposes, such as:
    * Nuclear energy/radiation related facilities
      [When used outside a radiation controlled area and where nuclear power quality is not required]
      [When the limit switch for nuclear power is used]
    * Machinery or equipment for space/sea bottom
    * Transportation equipment
      [Railway, aircraft, vessels, vehicle equipment, etc.]
    * Antidisaster/crime-prevention equipment
    * Burning appliances
    * Electrothermal equipment
    * Amusement facilities
    * Facilities/applications associated directly with billing
(3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
(4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
(5) Machinery or equipment that may affect human lives, human bodies or properties
(6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

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

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.

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

6. Other precautions

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

7. Changes to specifications

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

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice. After manufacturing is discontinued, we may not be able to provide replacement products even within the warranty period.

For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts. For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

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

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

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

Document Number:	CM2-MGN200-2001
Document Name:	MagneW PLUS+ Electromagnetic Flowmeter Open Channel Flowmeter Detector User's Manual Model NNK140/941, NNK150/951
Date:	1st edition: Nov. 2008 3rd edition: Nov. 2019
Issued/Edited by:	Azbil Corporation

Azbil Corporation