

**MagneW™ 3000 FLEX/PLUS
Smart Electromagnetic Flowmeter
Open Channel type Detector
Model: NNK140/941, NNK150/951**

User's Manual



Azbil Corporation

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1 : Introduction

This manual describes how to install and operate the MagneW™3000 FLEX/PLUS NNK open channel electromagnetic flowmeter detector. If you are using a MagneW™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

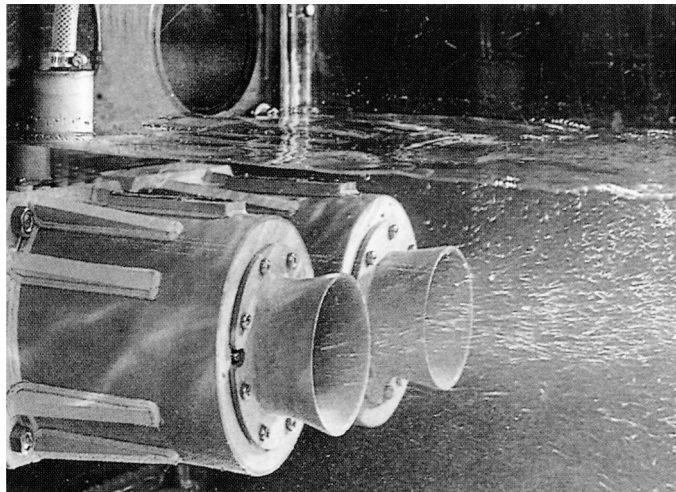


Figure 2 State during flow rate measurement

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 \pm 10%, 110V DC \pm 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)

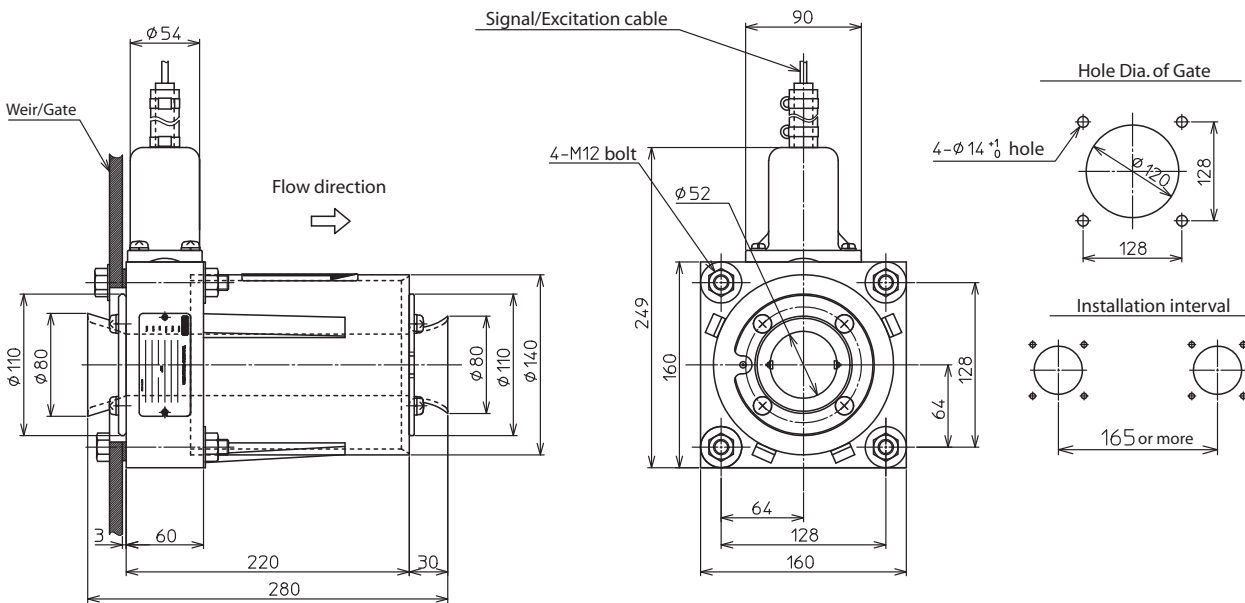
Electrical conductivity of the measured fluid: 5 μ S/cm

Ambient temperature: 0 to 40° C

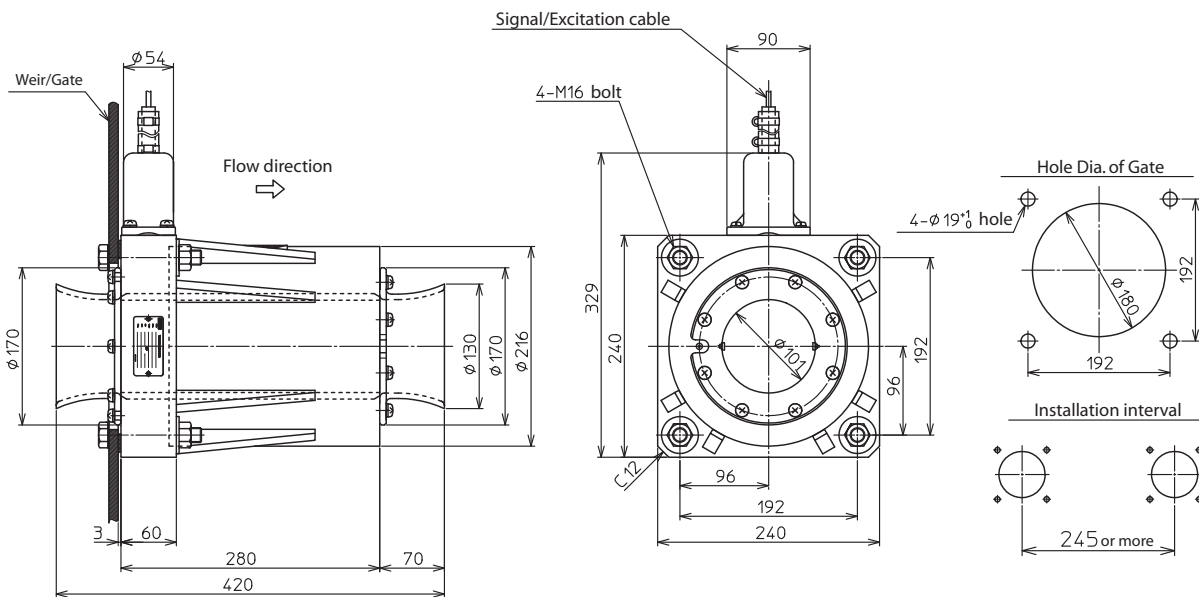
- Mass: 50 mm (detector;10 kg. dummy; 1.4 kg)
- 400 mm (detector;130 kg, dummy; 33.4 kg)
- 100 mm (detector;23 kg. dummy; 3.4 kg)
- 600 mm (detector;220 kg, dummy; 59.4 kg)
- 200 mm (detector;45 kg. dummy; 10.4 kg)

3-2 : External dimensions

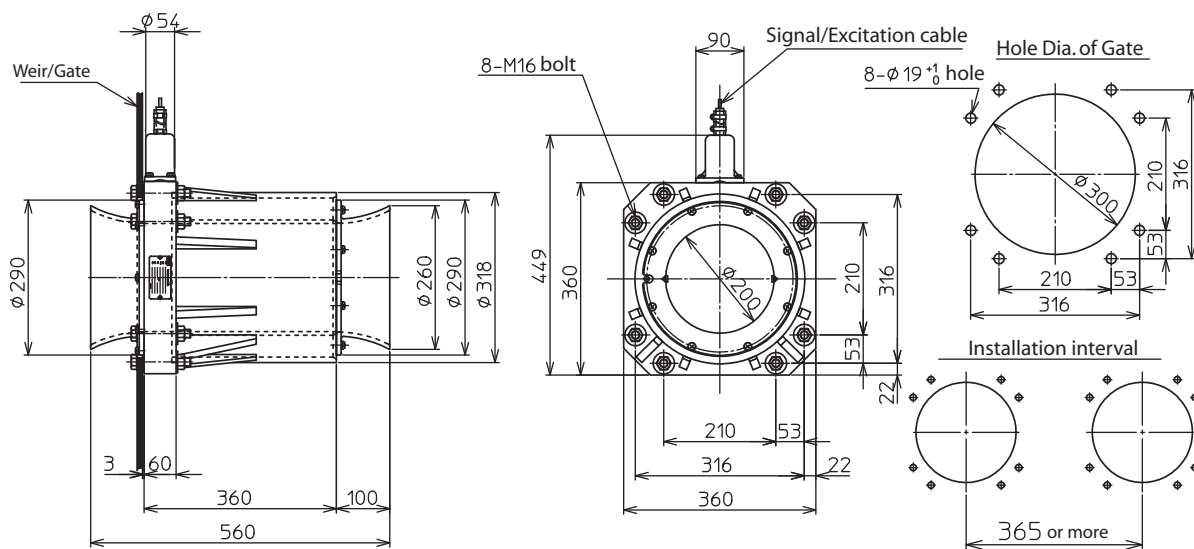
Bell mouth type detector



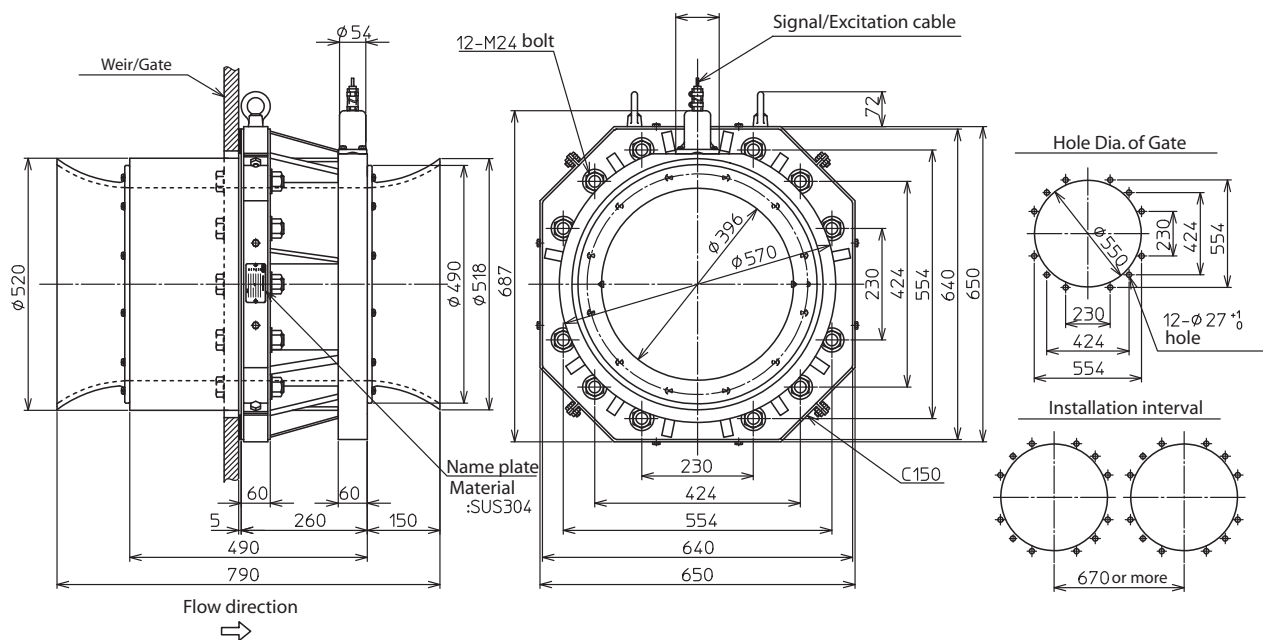
Size 50mm



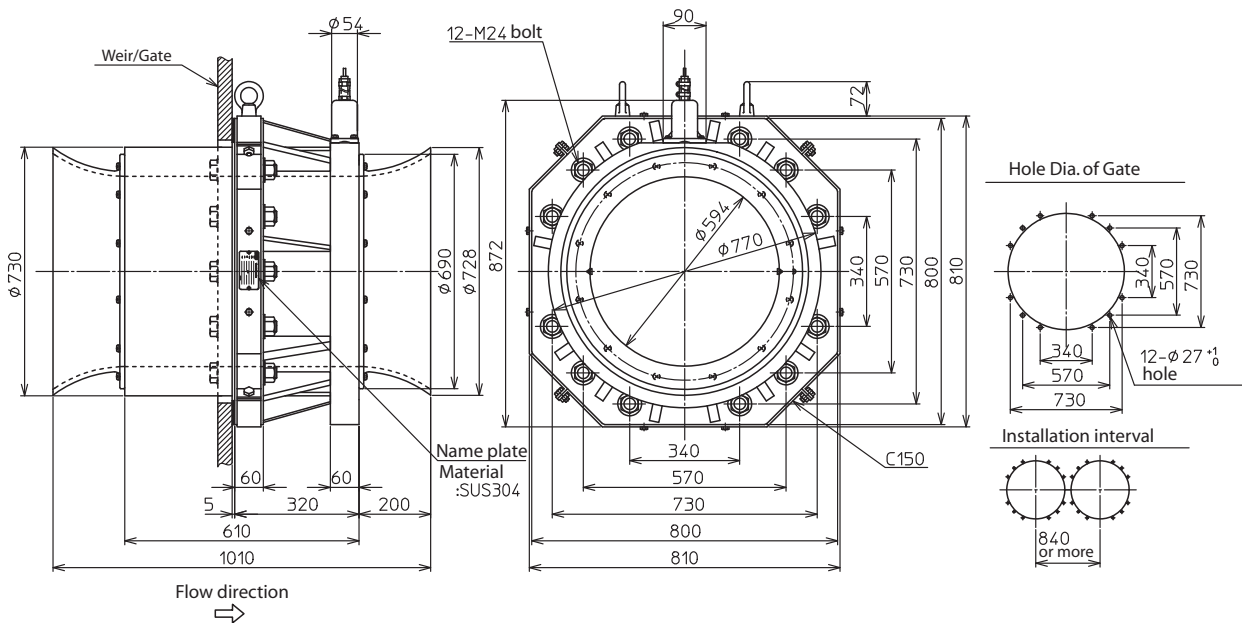
Size 100mm



Size 200mm



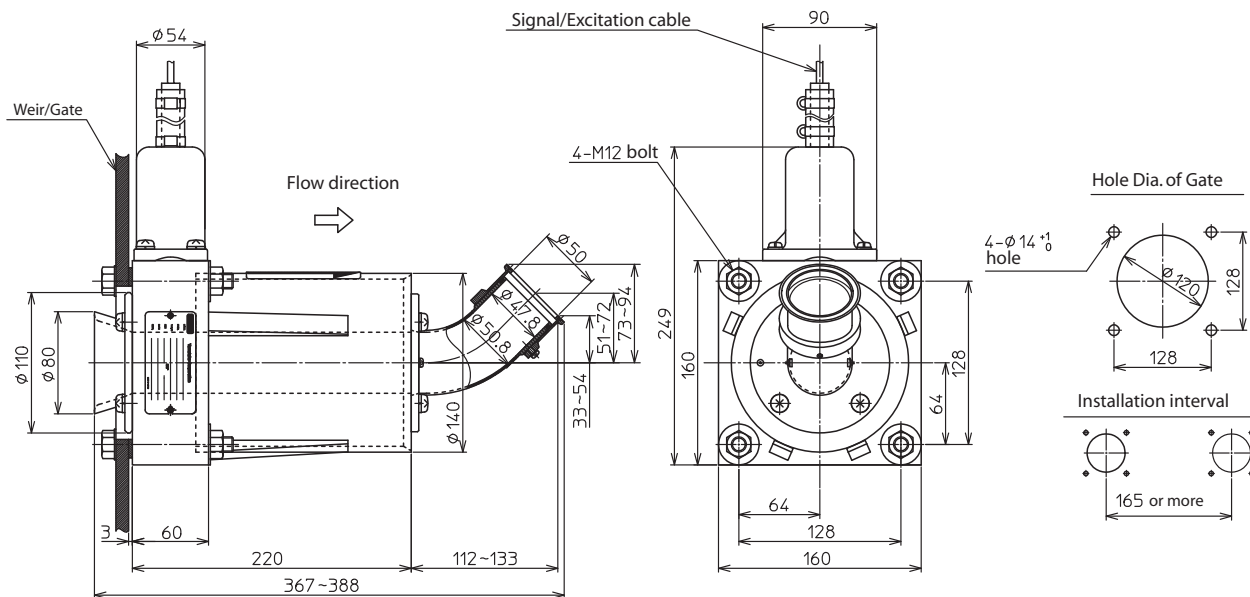
Size 400mm



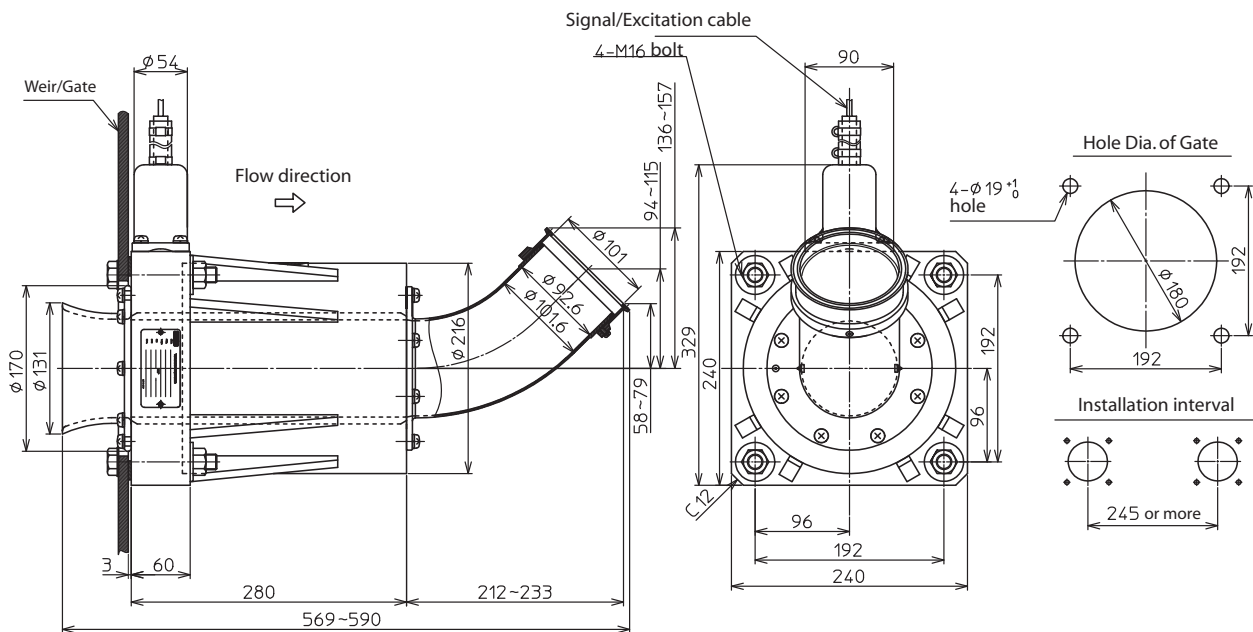
Size 600mm

Figure 3 Dimensional drawings of Bell mouth type detector

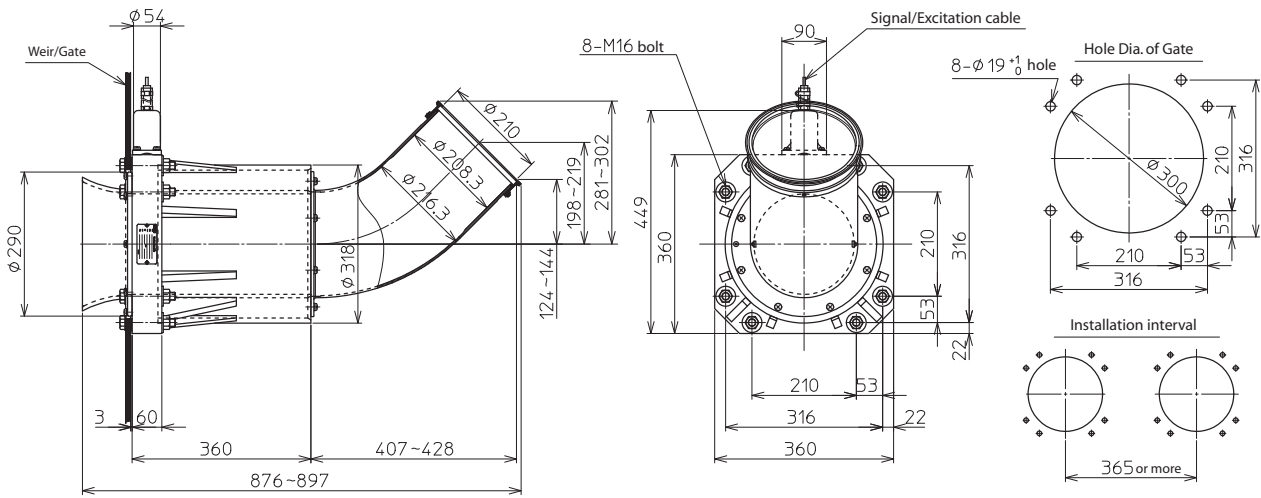
Detector with Elbow flange



Size 50mm



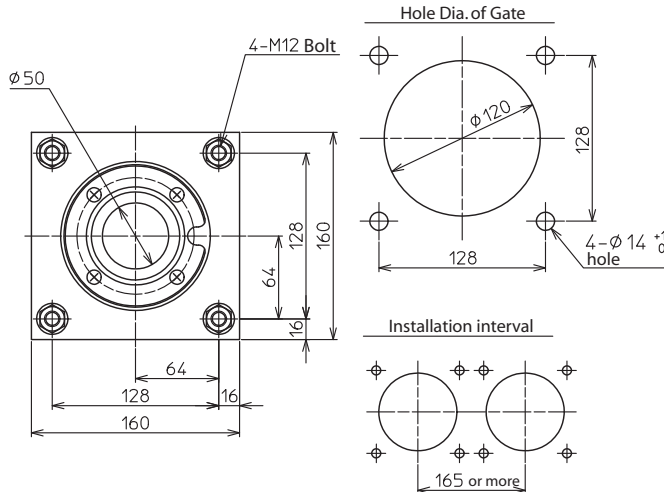
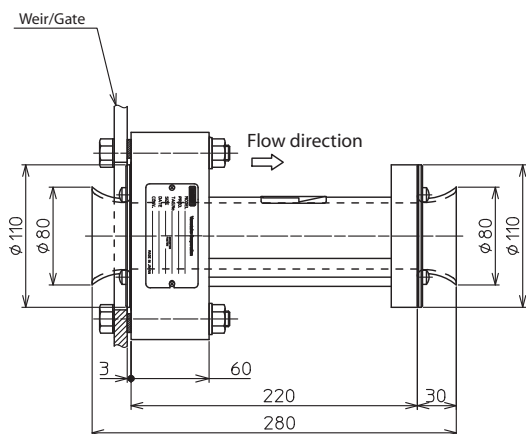
Size 100mm



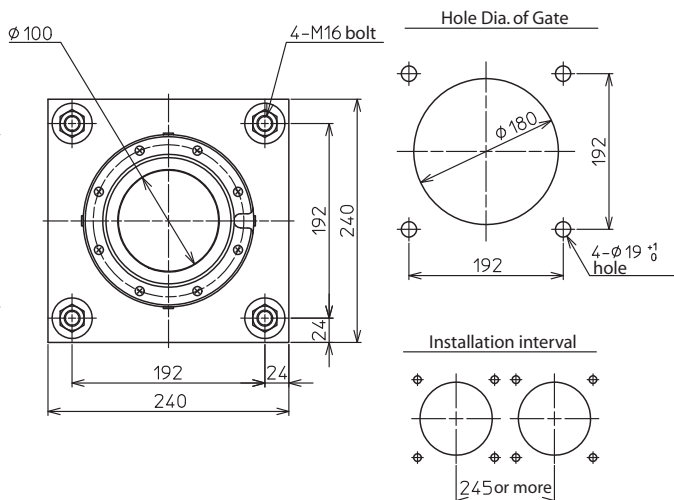
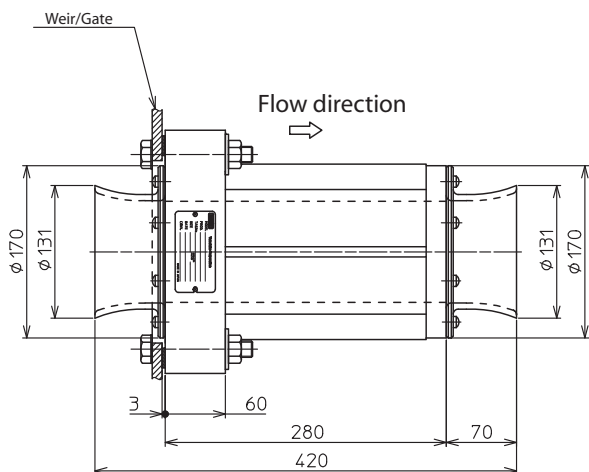
Size 200mm

Figure 4 Dimensional drawings of a detector with Elbow flange

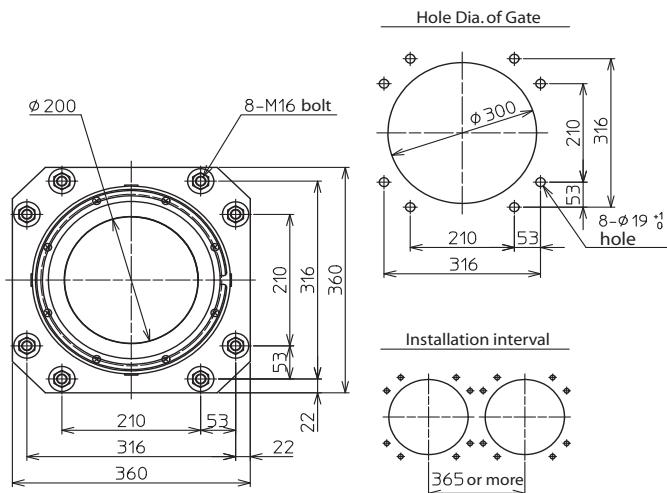
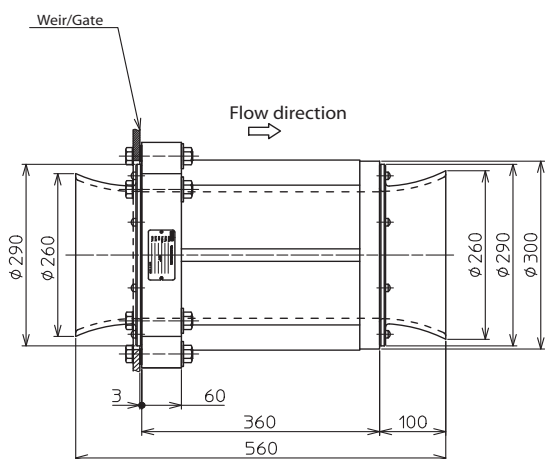
Dummy



Size 50mm



Size 100mm



Size 200mm

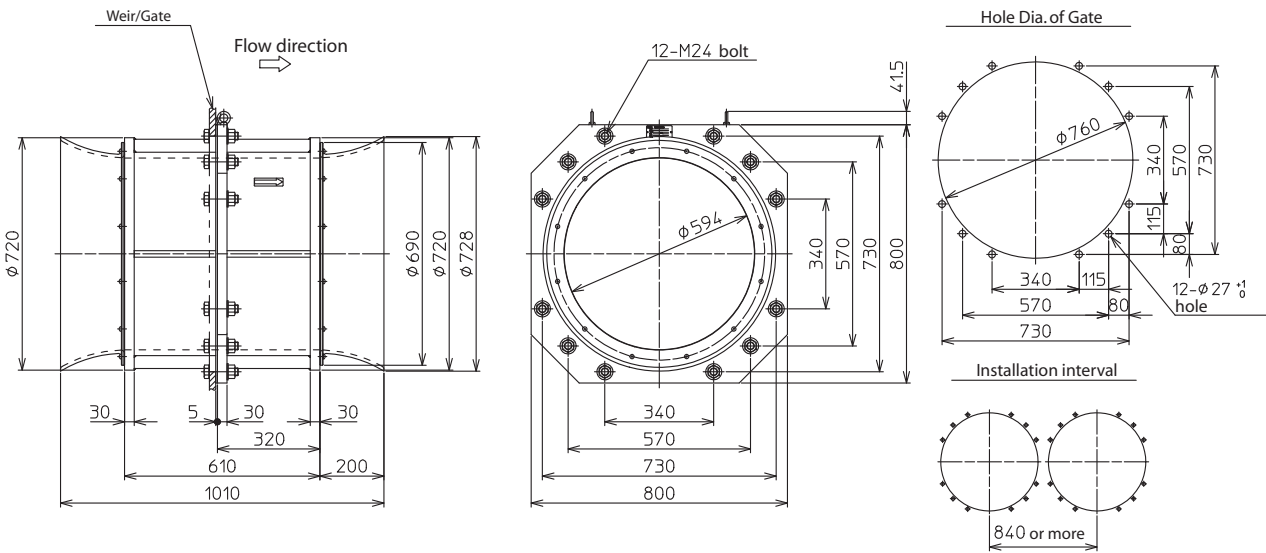
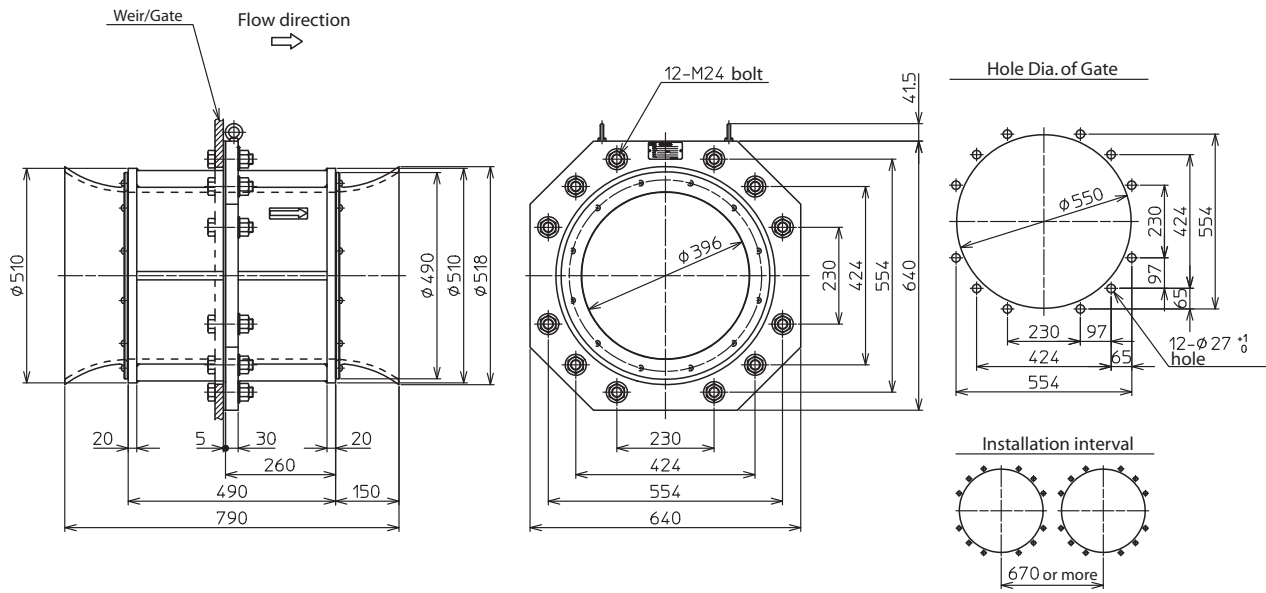
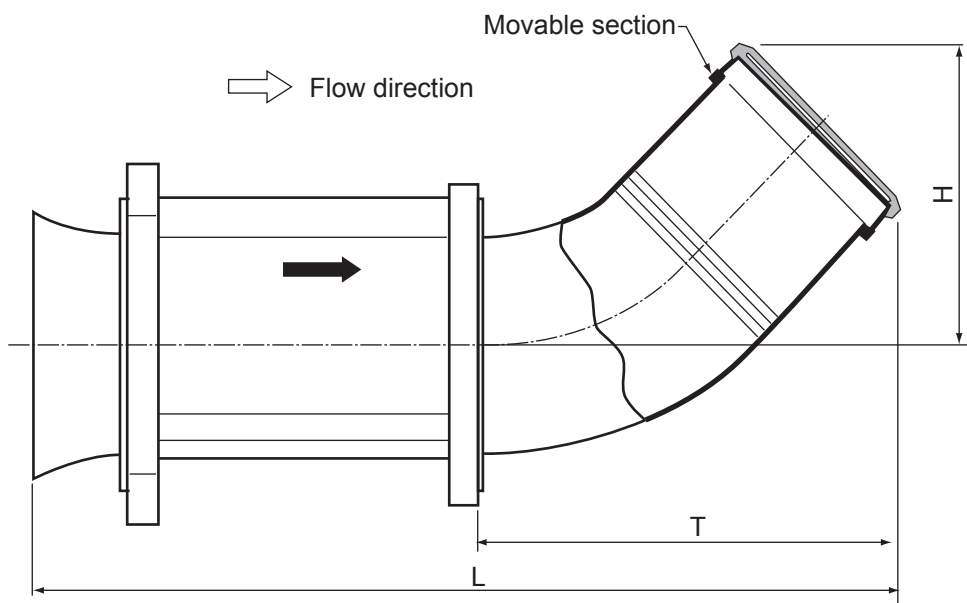


Figure 5 Dimensional drawings of a Dummy

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.

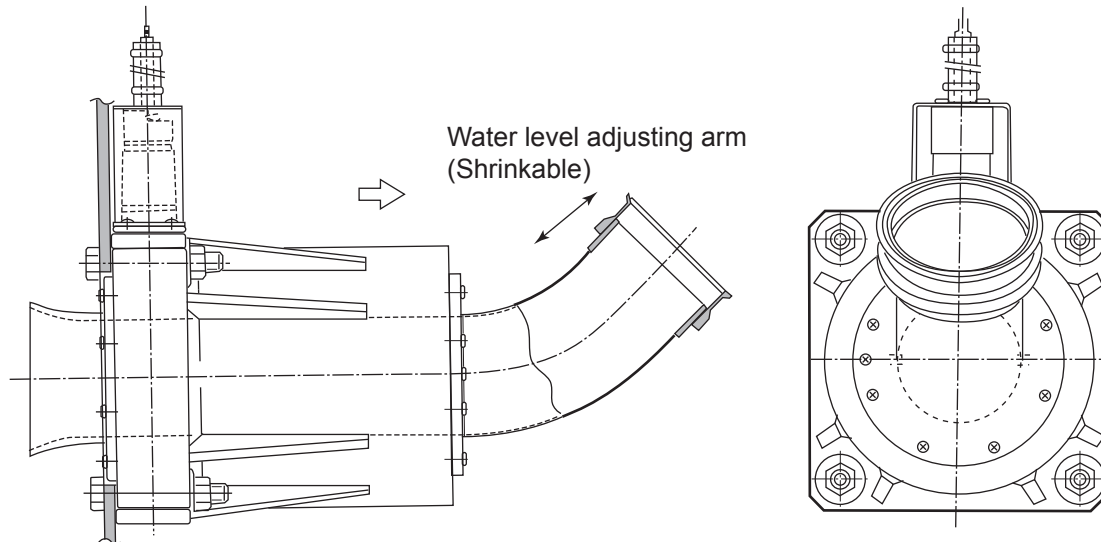


Figure 7 Detector with Elbow flange

(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.

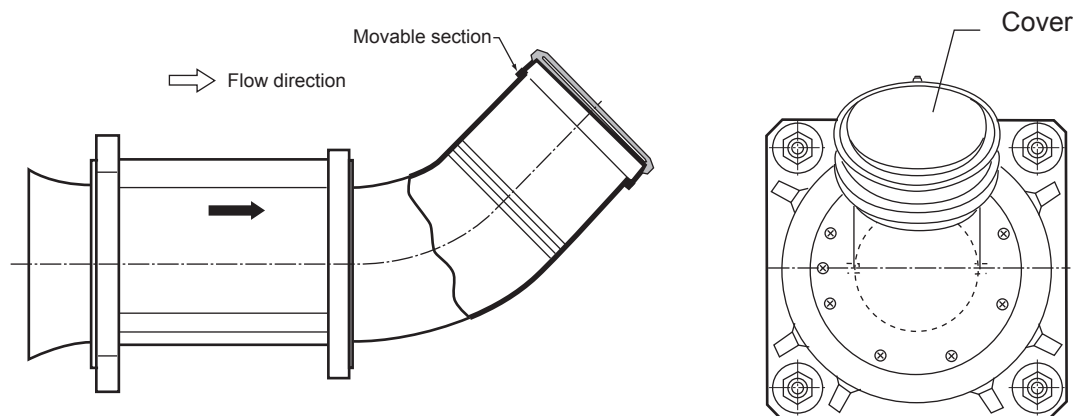


Figure 8 Dummy with Elbow flange

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).

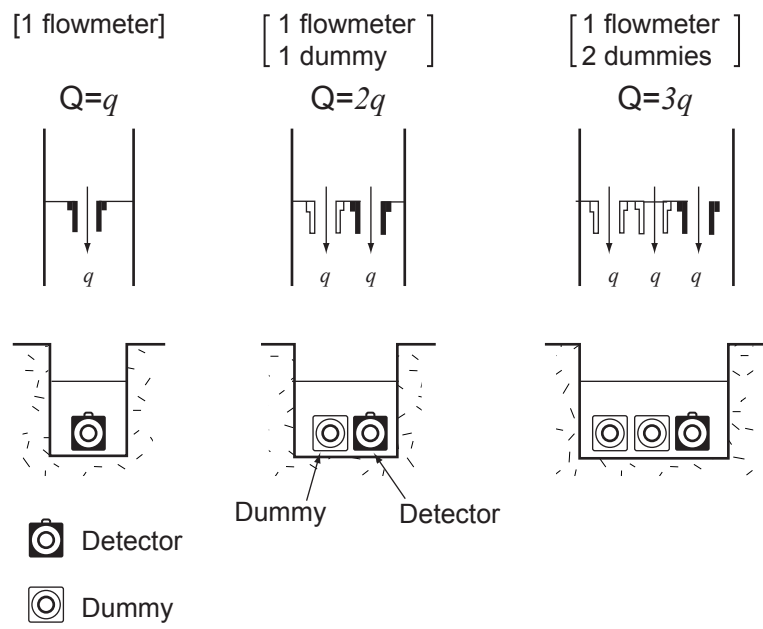
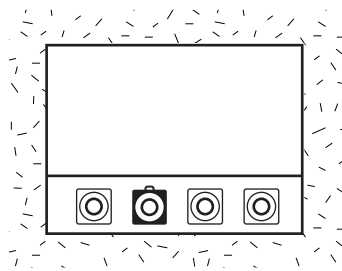
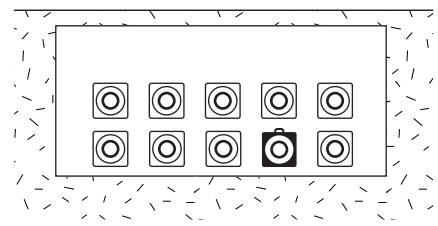


Figure 9 Measuring a large flow rate using dummy detectors



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.

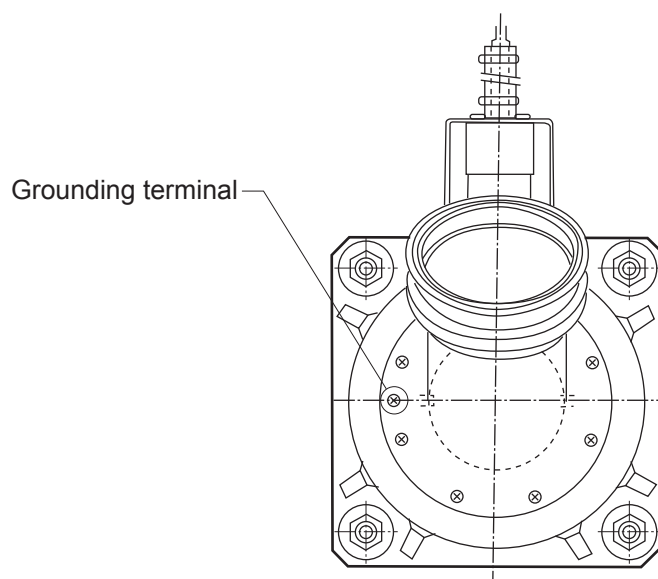


Figure 11 Grounding terminal

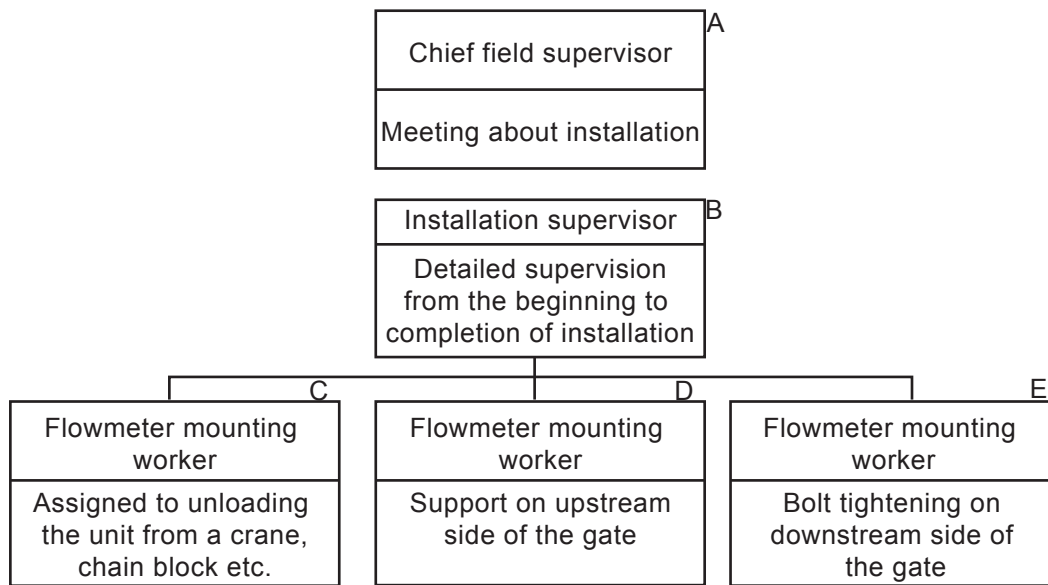
Table 1: Tightening torque of detector

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

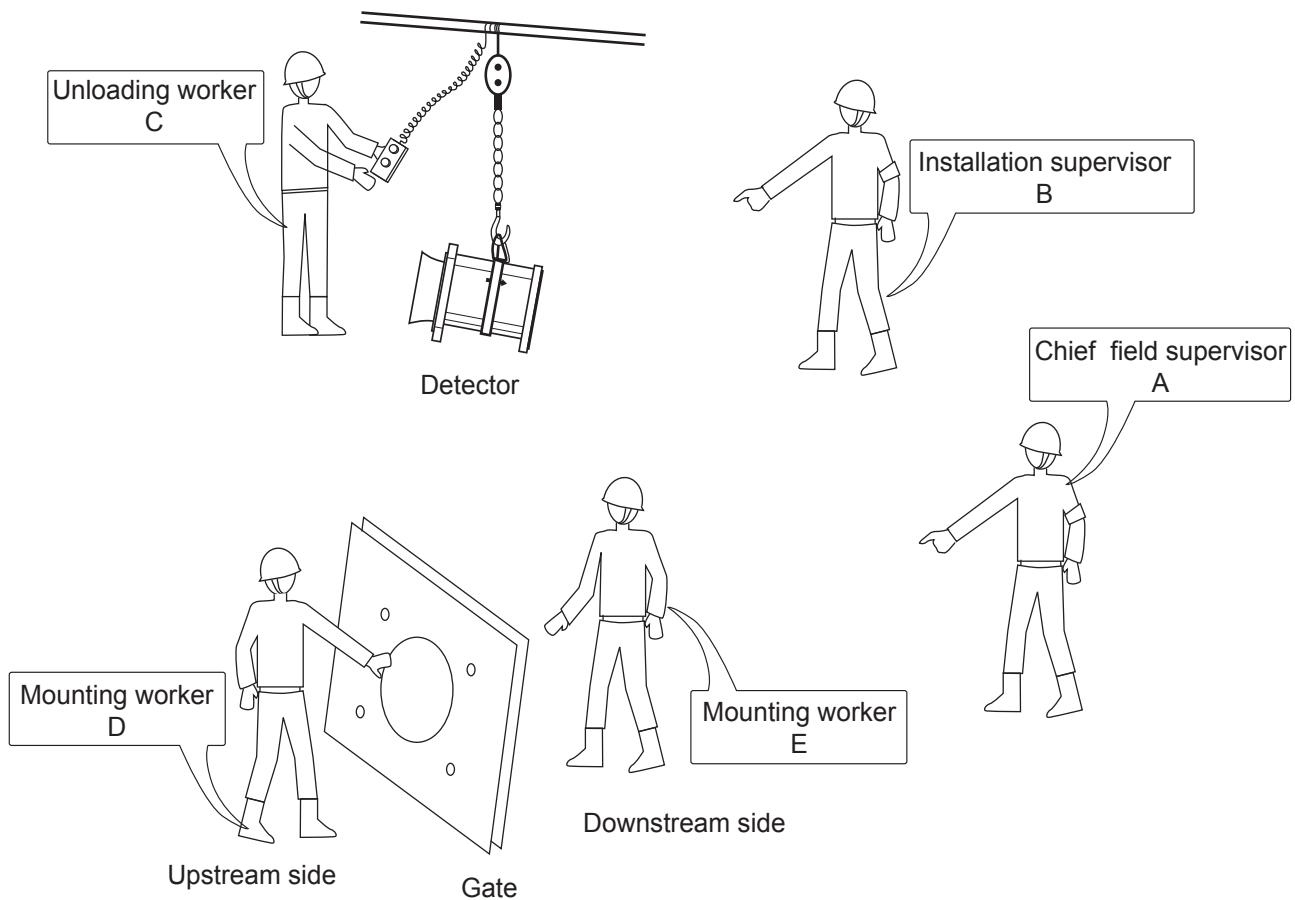
4-2 : Transportation of flowmeter to the installation site

- 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

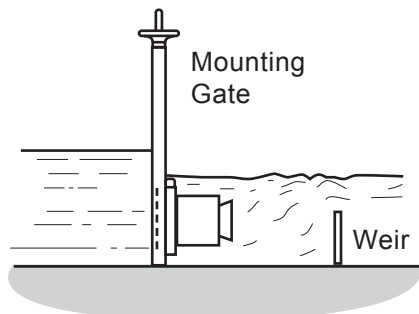


<Example of personnel assignment>

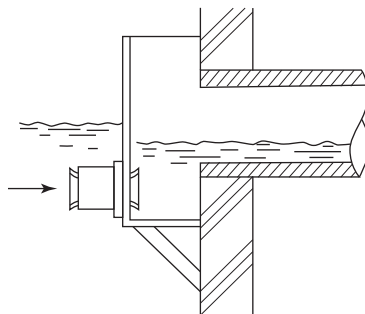


4-4 : Examples of installation

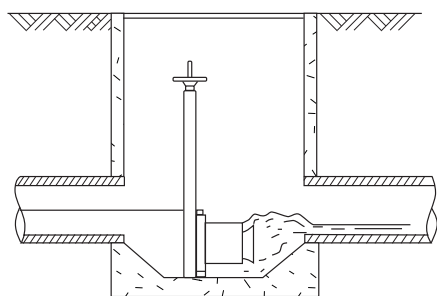
Schematic drawings



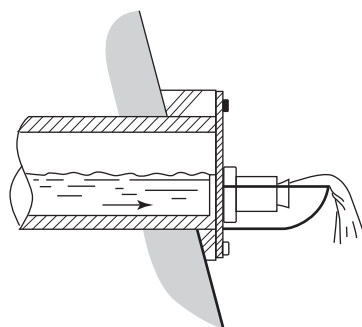
Flow measurement with a NNK detector installed in an open channel.



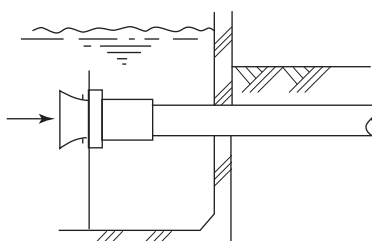
Flow measurement with a NNK detector installed on the intake end of channel.



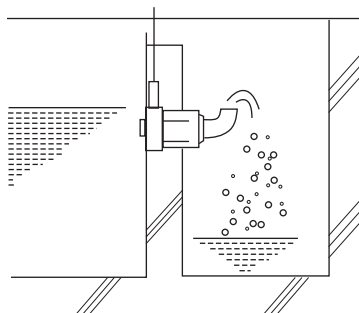
Flow measurement with submersible electromagnetic flowmeter installed in a pit.



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



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

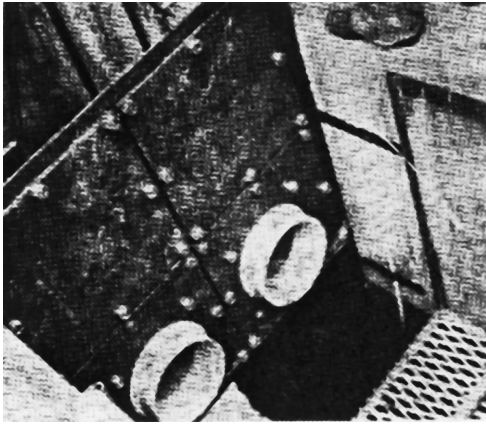


Discharge flow measurement with a NNK detector with an elbow flange installed in a prefabrication sewage disposal plant.

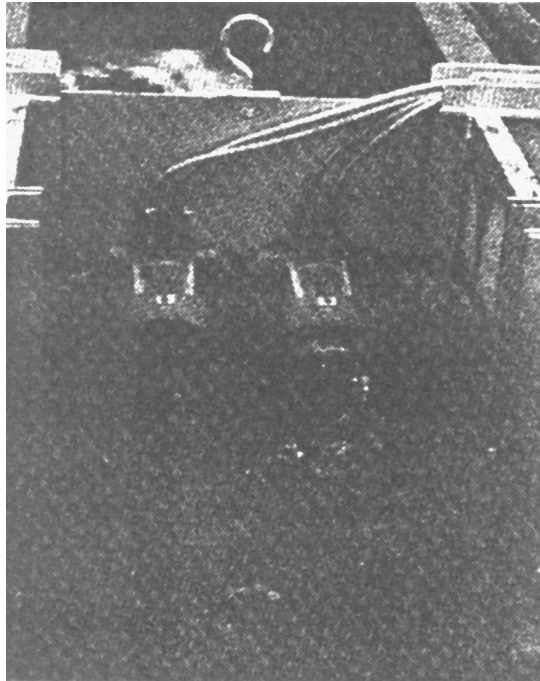
1) It is recommended that a gate with a lifting device be used. If there is a possibility that the upstream water level will become lower than the inlet port of the detector, a downstream weir plate or a adaptor must be installed to avoid exposing the measuring pipe in to air.

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

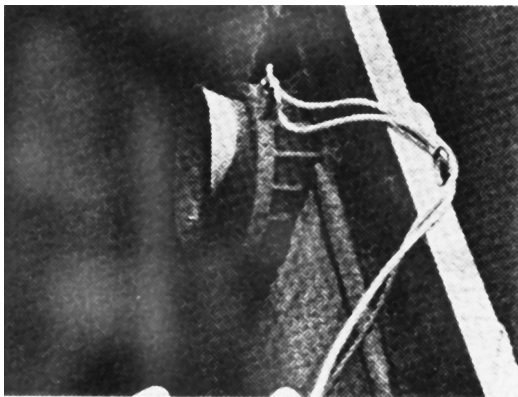
Pictures of flowmeter installation



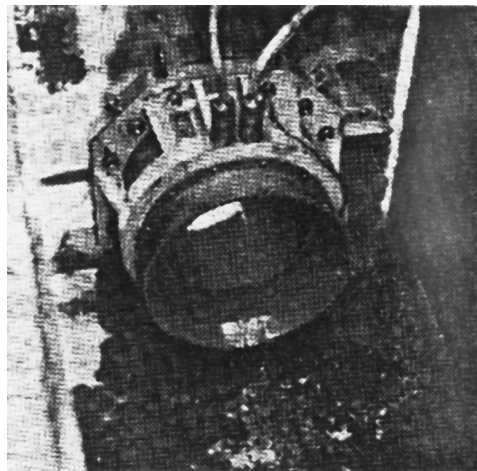
Measurement with one 200mm detector and one 200mm dummy



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 cabtyre 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 an 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).

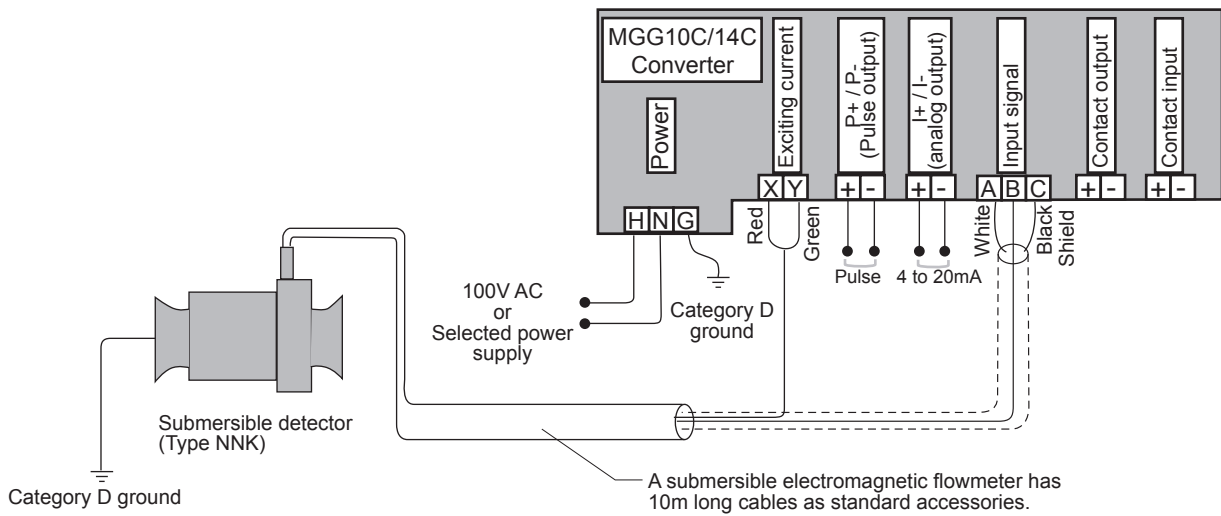


Figure 12 Connection of converter and detector

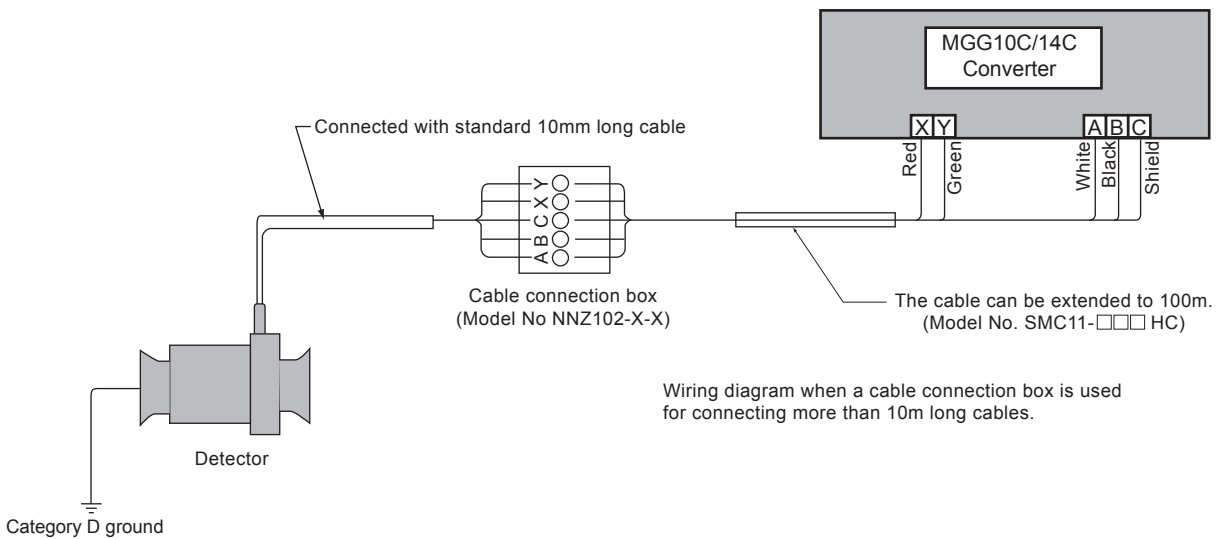


Figure 13 Wiring to connection box

6 : Inspection

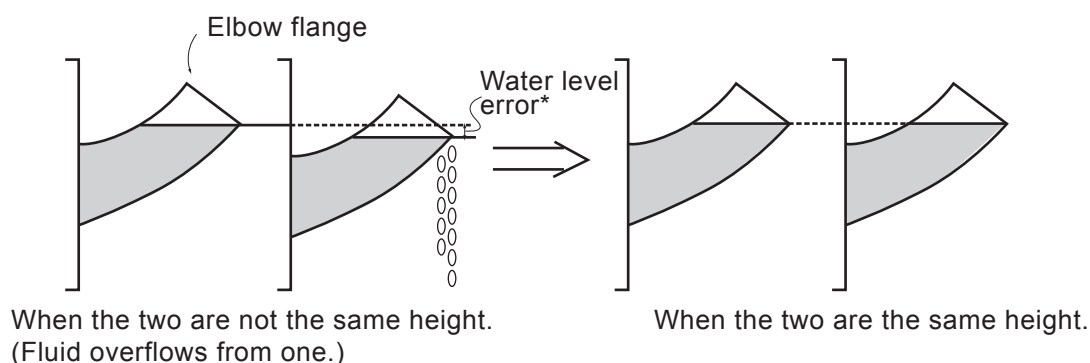
Inspect the following parts.

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 14. “Examples of installation” on page 17 and “Considerations on wiring” on page 19. “Wiring” on page 19 in this manual.
- (b) Check to see if the detector and the converter are connected correctly.
... See “Considerations on wiring” on page 19. 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 14.
- (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

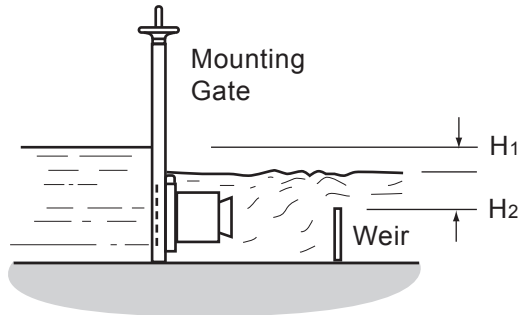


* Correct the error using the water level adjusting arm by referring to 3-(4) “Instructions relating to the Elbow Flange”.

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.)	: 500m ³ /h
Average flow velocity per detector (V)	: 2.21m/s

Conversion of water head differential (H₁) 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]

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

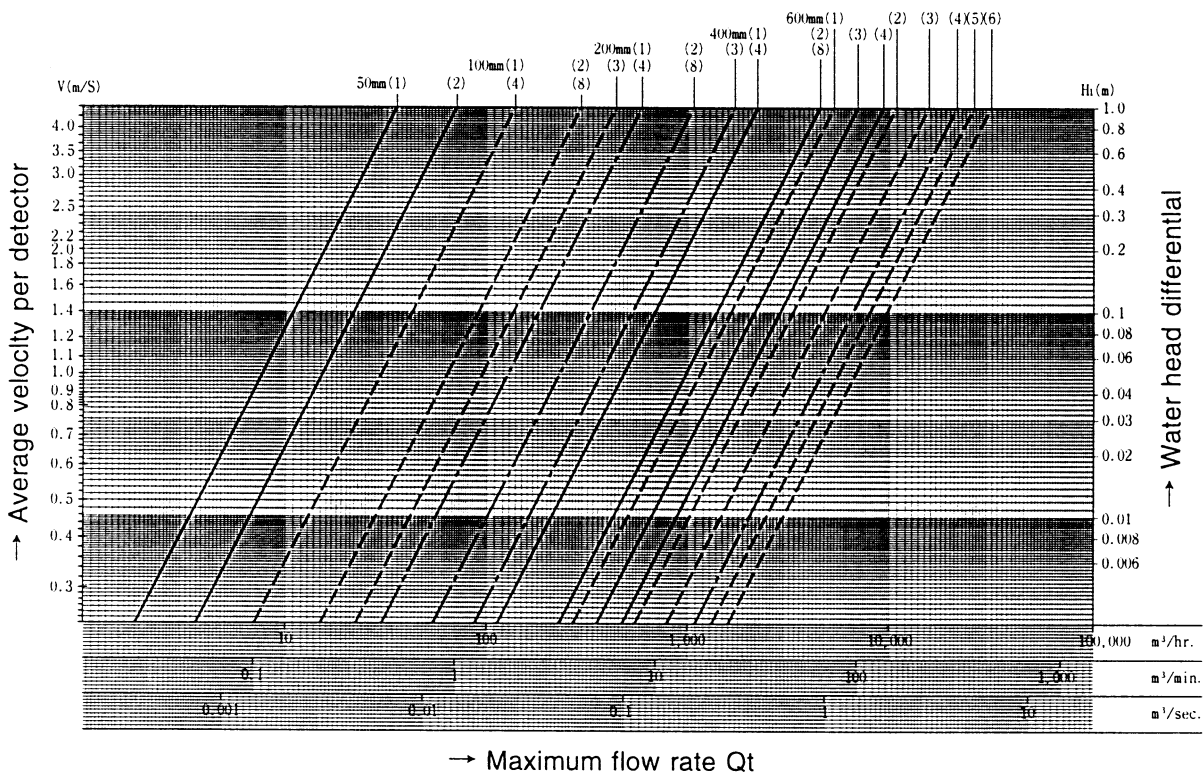


Figure A-1 Detector size selection graph

~Note The expression “200mm(3)” refers to the structure consisting of one 200mm detector and two 200mm dummies. (“200mm” refers 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 this 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

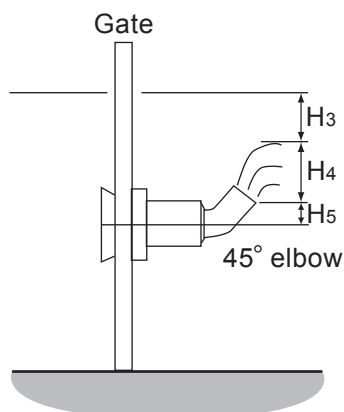
Draw a line upward from the point of 500m³/hr, and it will intersect with the following diagonal lines:

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

$$V = K \times Q \quad \text{Where}$$

V : Flow velocity (m/s), Q : Flow rate (m³/h)

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

(Example)

Detector size: 200(mm)

Flow rate per detector: 250(m³/h)

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

Document Number:	CM2-MGN200-2001
Document Name:	MagneW3000 FLEX/PLUS Smart Electromagnetic Flowmeter Submersible type Detector Model NNK140/941, NNK150/951
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