

SPECIAL FLOW METER

Averaging Pitot Tube

Average Pitot Tube

MODEL : 301 TYPE / 302 TYPE / 303 TYPE / 304 TYPE



301 TYPE

302 TYPE

303 TYPE

304 TYPE

Daehan Instruments developed a new pitot tube that resolves several problems of conventional pitot tubes — low differential pressure, the need for precise installation position, and the difficulty of measuring the average velocity in the pipe.

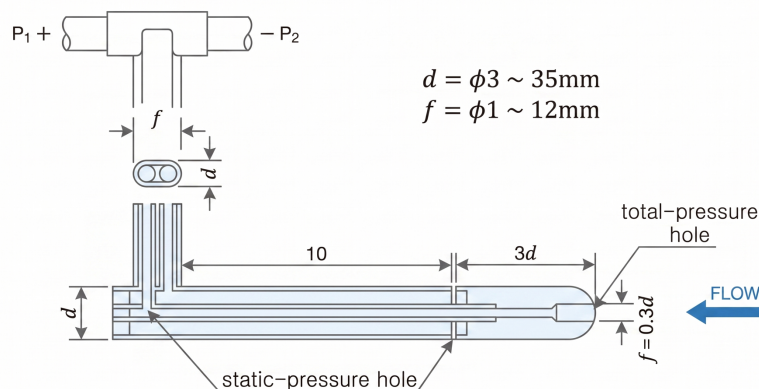
With six months of technical support from the Korea Institute of Industrial Technology starting in 1994, the new pitot tube was successfully developed.

A conventional pitot tube has the advantages of a simple structure and the ability to measure velocity over a relatively small area regardless of pipe size, but it also has the disadvantages of low differential pressure, demanding precision in installation position and orientation, and difficulty in measuring the average velocity in the pipe.

The Daehan pitot tube detects a differential pressure about 2 ~ 3 times greater than a conventional pitot tube, and obtains the average velocity by sensing pressure at 4 ~ 8 points inside the pipe. It saves 5 ~ 8% energy compared with an orifice meter, and its simple construction reduces installation and maintenance costs.

3B ~ 16B / 10B ~ 120B Accuracy $\pm 1.5\%$ STS316 · Inconel · Monel · Hastelloy
Screw & Flange

Measurement principle



Pitot tube structure — total pressure holes and static pressure holes ($d = \phi 3 \sim 35\text{mm}$, $f = \phi 1 \sim 12\text{mm}$)

The velocity of an incompressible fluid is obtained from the Bernoulli equation. $Q = A \cdot V = A \cdot \sqrt{(2g(P_1 - P_2)/r)}$... Eq. (1). P_1 : total pressure, P_2 : static pressure, V : velocity, A : pipe cross-sectional area, r : specific gravity.

In practice, the velocity/pressure coefficient C obtained from experimental data is applied, and the flow is calculated as $Q = A \cdot V = A \cdot C \cdot \sqrt{(2g(P_1 - P_2)/r)}$... Eq. (2).

Taking the velocity profile in the pipe (Figure 2) into account, the sensing holes are placed at the equal-area division positions r_i/R .
 $n = 2$: 0.5, 0.866 / $n = 3$: 0.408, 0.707, 0.912 / $n = 4$: 0.354, 0.612, 0.790, 0.936.

Types · model configuration

**301 TYPE**

Single support type — for low pressure (10K or less) and ducts, two needle valves, 3B ~ 16B

**302 TYPE**

Double support type — for high pressure (10 ~ 20K), large diameter (10 ~ 120B) and high velocity, two ball valves

**303 TYPE**

Isolation valve type — prevents fluid escaping from the pipe during maintenance

**304 TYPE**

Isolation valve · rod type — insertion/retraction structure preventing leakage under high pressure

Photographic images by type. Connection sizes, materials and other details follow the ordering code.

Item	301 TYPE Single support type (Single support)	302 TYPE Double support type (Double support)	303 TYPE Isolation valve type	304 TYPE Isolation valve & Rod type
Features	Easy to install	Suitable for large caliber (suitable for large pipe sizes)	Shut-off fluid after remove element on maintenance (fluid is shut off after removing the element for maintenance)	Installation & maintenance can be done in operation (installation and maintenance possible during operation)
Type	Single support type — suitable for low pressure (10K or less) and ducts, simple construction, applicable sizes 3B ~ 16B	Double support type — suitable for high pressure (10 ~ 20K) and large pipe sizes (10 ~ 120B), handles high velocities	Isolation Valve type — fitted with an isolation valve to prevent liquid overflow from the tube during maintenance and repair	Isolation valve & Rod type — overflow prevention system for maintenance and repair under high-pressure conditions (insertion rod · packing gland · cage nipple)
Applicable piping	3B ~ 16B Pipe & Duct	10B ~ 120B Pipe & Duct	3B ~ 16B Pipe & Duct	3B ~ 16B Pipe & Duct
Materials	STS316, Inconel, Monel, Hastelloy	STS316, Inconel, Monel, Hastelloy	STS316, Inconel, Monel, Hastelloy	STS316, Inconel, Monel, Hastelloy
Connection	Screw & Flange	Screw & Flange	Screw & Flange	Screw & Flange
Measured fluid	Liquid & Gas not included sludge (not for high-viscosity fluids)	Liquid & Gas not included sludge (not for high-viscosity fluids)	Liquid & Gas not included sludge (not for high-viscosity fluids)	Liquid & Gas not included sludge (not for high-viscosity fluids)
Accuracy	±1.5%	±1.5%	±1.5%	±1.5%

Technical Specifications

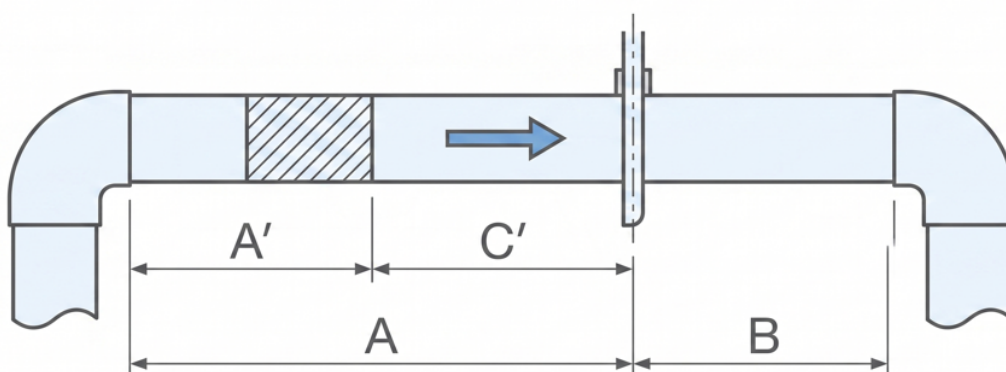
Item	Value
Accuracy	±1.5%
Measured fluid	Liquids and gases not containing sludge (not for high-viscosity fluids)

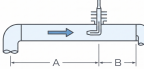
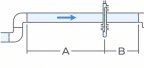
Item	Value
Applicable pipe sizes	301 / 303 / 304 TYPE: 3B ~ 16B · 302 TYPE: 10B ~ 120B (Pipe & Duct)
Pressure classes	Single support type (301): low pressure (10K or less) and ducts · double support type (302): high pressure (10 ~ 20K), high velocity
Sensor material	STS316, Inconel, Monel, Hastelloy
Mounting connection	Screw & Flange ※ Ordering codes: PT1", PT1-1/2, PT2" · JIS 10K / 20K 40A · 50A · 80A · ANSI 150# / 300# 1-1/2B · 2B · 3B
DP (D/P) connection	PT 1/2 · PT 3/8 · PT 1/4
Differential-pressure characteristics	About 2 ~ 3 times the differential pressure of a conventional pitot tube · pressure sensed at 4 ~ 8 points inside the pipe
Energy	5 ~ 8% better than an orifice meter
Isolation valve material (Body / Ball)	SCPH2/316 · SCPH13/316 · 304/316 · 316/316 · Option (303, 304 TYPE)
Packing · cage nipple · insertion rod material	Packing: Rubber, Teflon, Graphite / Cage Nipple: Carbon steel, Stainless steel / Insertion Rods: Carbon steel, Stainless steel (304 TYPE)
Installation angle tolerance	Tilt within the pipe cross-section $\pm 3^\circ$ · tilt along the pipe axis $\pm 5^\circ$ · sensing hole orientation $\pm 3^\circ$

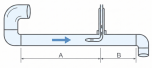
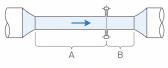
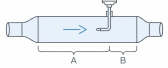
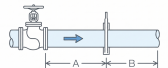
Dimensions · drawings

Unit: mm. Actual manufacturing dimensions are based on the approved drawing.

Required straight run (Table 4, multiples of D)



Upstream piping condition	Without conditioner			With conditioner		Downstream
Piping condition	A (same plane)	A (different planes)	A'	A	C'	B
 Single 90° elbow	7	9	6	3	3	3
 Two 90° elbows (same plane)	9	14	8	4	4	3

Upstream piping condition	Without conditioner			With conditioner		Downstream
Piping condition	A (same plane)	A (different planes)	A'	A	C'	B
 Two 90° elbows (different planes)	19	24	9	4	5	4
 Reducer	8	8	8	4	4	3
 Expander	8	8	8	4	4	3
 Valve	24	24	9	4	5	4

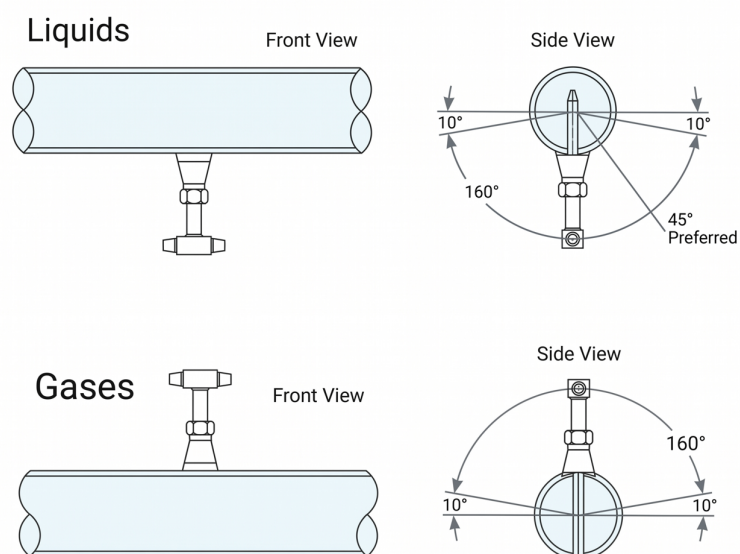
A: upstream straight run, B: downstream straight run, A' / C': with a flow conditioner, upstream of the conditioner / conditioner to pitot tube. Figures: A = upstream straight run, B = downstream straight run, A' = elbow to flow conditioner, C' = conditioner to pitot tube (unit: multiples of pipe inner diameter D).

Equal-area division positions r_i/R (Figure 2 velocity profile)

n	r_1	r_2	r_3	r_4	r_5
2	0.5	0.866	–	–	–
3	0.408	0.707	0.912	–	–
4	0.354	0.612	0.790	0.936	–

n: number of radial divisions, r_i/R : ratio of the sensing point position to the pipe radius.

Installation orientation in horizontal piping (Figures 6, 7)



Fluid	Installation position	Allowable range (side view)
Liquids	Inserted from the bottom of the pipe	Within 10° either side of vertical (excluding the 160° range), 45° preferred (Preferred)
Gases	Inserted from the top of the pipe	Within 10° either side of vertical (excluding the 160° range)

The diagrams in Pitot Tube catalog p.5 Figure 6 (Liquids) and Figure 7 (Gases), arranged as a table.

Installation requirements

- In vertical piping, the pitot tube is installed at a position in the horizontal plane (Figure 5).
- In horizontal piping, the installation method is chosen according to the type of fluid. For liquids it is installed at the bottom of the pipe (Figure 6), for gases at the top (Figure 7).
- The required straight run follows Table 4 according to the upstream piping condition and whether a flow conditioner is installed.
- The installation angle tolerances are $\pm 3^\circ$ within the pipe cross-section, $\pm 5^\circ$ along the pipe axis and $\pm 3^\circ$ in sensing hole orientation (Figure 8).
- Precautions: avoid locations with heavy dust (if the sensing holes become blocked by dust, this can be cleared by blowing high-pressure air). Not suitable for turbulent flow. Do not use for high-pressure steam or in locations subject to vibration.

Ordering information (How to Order)

1 Series	
301	Single support type
302	Double support type
303	Isolation Valve type
304	Isolation valve & Rod type (Isolation valve & Rod type)

2 Code 1 · D/P Connection	
2	PT 1/2
8	PT 3/8
4	PT 1/4

3 Code 2 · Mounting connection	
1	PT 1"
2	PT 1-1/2
3	PT 2"
4	10K 40A
5	10K 50A
6	10K 80A
7	20K 40A
8	20K 50A
9	20K 80A
10	150# 1-1/2B
11	150# 2B
12	150# 3B
13	300# 1-1/2B
14	300# 2B
15	300# 3B
0	Option

4 Code 3 · Insulation T	
☐ ☐ ☐	Insulation thickness (T) + 50mm (301, 302 series)

5 Code 4 · Line size & SCH	
☐ ☐ ☐	Pipe size & SCH or pipe inside diameter (original: Line size & SCH or Line India)

6 Code 5 · Sensor material	
5	STS304 (standard)
6	STS316
7	STS316L
8	Inconel
9	Hastelloy
0	Option

7 Code 6 · Isolation Valve mat'l Body / Ball (303, 304)	
1	SCPH2 / 316
2	SCPH13 / 316
3	304 / 316
4	316 / 316
5	Option

8 Code 7 · Packing Gland & Cage Nipple mat'l (304)	
R	Packing: Rubber
T	Packing: Teflon
G	Packing: Graphite
O	Packing: Option
C	Cage Nipple: Carbon steel
S	Cage Nipple: Stainless steel
O	Cage Nipple: Option

9 Code 8 · Insertion Rods mat'l (304)	
C	Carbon steel
S	Stainless steel

10 Option	
★	e.g. Handle (304 TYPE)

Ordering example: 301 - PT1/4 - PT1 - 150 - STPG38 8B SCH40 (or 203.5) - STS304

301 series, D/P connection PT1/4, mounting PT1, insulation thickness + 50mm = 150, pipe STPG38 8B SCH40 (I.D. 203.5), sensor STS304 · other examples from the catalog: 302 - PT1/2 - PT1-1/2 - 150 - STPT 20B SCH40 (or 508.0) - STS304 / 303 - PT1/2 - 10K50A RF or PT1-1/2 - 100 - 10B SCH40 - STS316 - SCPH2/STS316 / 304 - PT1/2 - PT1-1/2 or 10K50A RF - 50 - 6B SCH80 - STS316 - SCS13/SUS316 - Graphite/SUS304 - STS - Handle