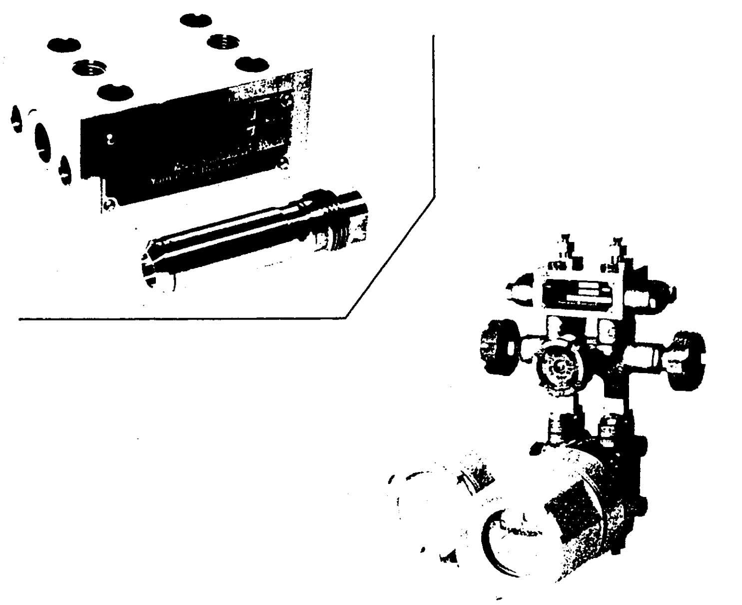
Integral Orifice Assembly For Very Small Flow Measurement Model KEE

Introduction

The Integral Orifice Assembly is a compact set of orifice mechanism which is used to measure a very small flow in a very small piping. The assembly can be directly mounted on the meter body of a ST or PREX Series Differential Pressure Transmitter or on that of a KFD Differential Pressure Field Mounted Controller. Six types of orifices are available to cover a wider flow range.



JTD210/215/220 Assembly

Standard Specifications

Applicable Transmitters :

ST3000 Series: JTD 210/215/220
PREX3000 Series: KDP 11/22/33/44
KFD Series: KFDB□□11/22/33/44

Operating Pressure and Temperature Ratings :

Depends on transmitter ratings. (Depends on flange ratings when flanges with short pipes are used.)

Mounting :

Direct mounting on top or bottom of transmitter meter body.

Materials :

Body and orifice: SUS316
Gaskets: Teflon rings

Piping Connections :

Rc1/2, 1/2NPT internal thread or flange connections. (In the case of thread connections, use 1/2-inch Sch 80 for piping.)

Orifice Diameters and Accuracies

Orifice No.	Orifice Aperture Diameter (mm)	Orifice Diameter Ratio $\beta = (\frac{d}{D})$	Orifice Factor $S = (\alpha \cdot \beta^2)$	Low Limit Reynolds Number R_D	Accuracy % FS
1	8.5	0.60729	0.32777	1600	±2
2	5.0	0.35734	0.10244	950	±2
3	2.8	0.20019	0.032492	550	±2
4	1.59	0.11382	0.010625	300	±2.5
5	0.9	0.064601	0.0034045	250	±3
6	0.5	0.036048	0.0011103	200	±4

Notes:
1) Select a Reynolds number higher than the low limit so that the orifice factor is maintained constant.
2) For gas measurement, the following conditions must be met:

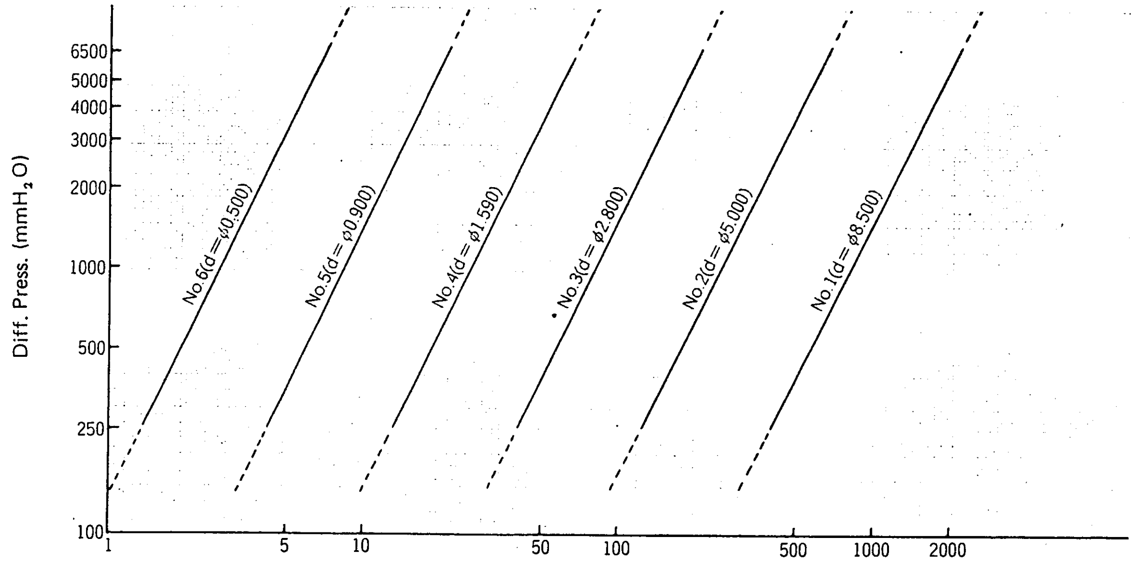
$$\frac{\Delta P\ (mmH_2O)}{1000 \times P\ (kgf/cm^2\ abs)} \leqq 1.5$$

3) Not applicable for measurement of fluid with suspension or adhesive substance.
4) The straight pipe section length requirements are identical with those of regular orifices.

Differential Pressures and Reynolds Numbers

See the following for flow rate/differential pressure charts and Reynolds number calculation equations.

[Liquid]



Vw: Reference Liquid Flow Rate ℓ/hr (at 15°C, 1atm)

● **Conversion equation to liquid flow**

$$Vw = V \times G_B \times \sqrt{\frac{1}{G_O}}$$

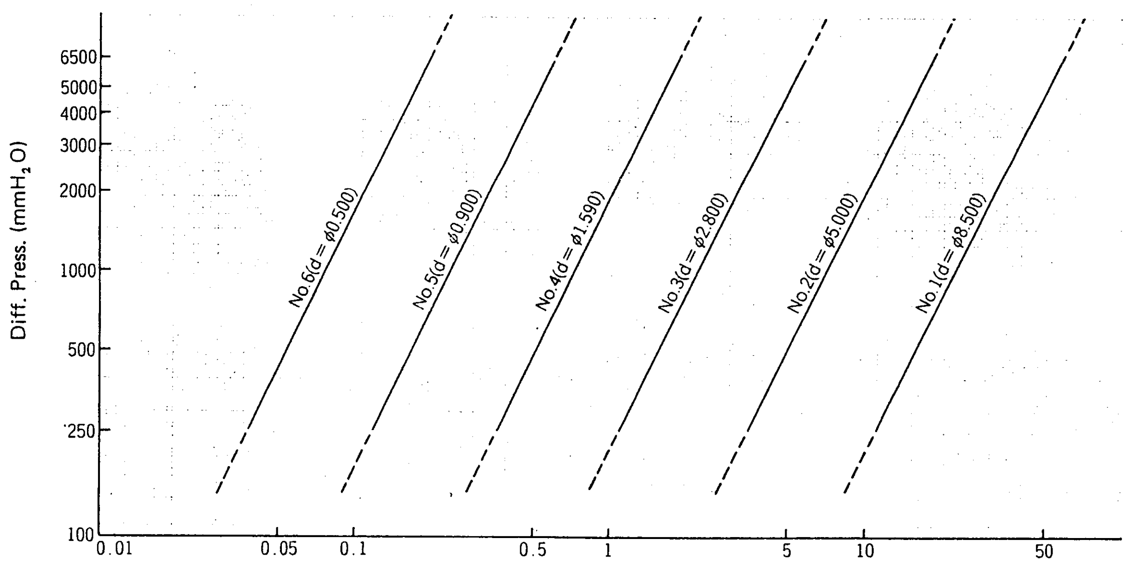
Vw: Reference liquid flow rate (ℓ/hr)
V: Flow of measured liquid (ℓ/hr)
G_B: Specific gravity of measured liquid at reference condition.
G_O: Specific gravity of measured liquid at operating condition.

● **Reynolds number calculating equation**

$$R_D = \frac{25.2 \times V \times G_B}{\mu}$$

R_D: Reynolds number
V: Flow of measured liquid (ℓ/hr)
G_B: Specific gravity of measured liquid at reference condition.
μ : Viscosity (CP)

[Gas]



QA: Reference Gas Flow Rate Nm³/h (at 0°C, 1 atm)

● **Conversion equation to gas flow**

$$Q_A{:}\ Q_n\sqrt{\frac{T}{273.2} \times \frac{1.033}{P}} \times G$$

Q_A: Reference gas flow rate (Nm^3/hr)
Q_n: Flow of measured gas (Nm^3/hr)
T: Absolute temperature of measured gas (°K)
P: Absolute pressure of measured gas (kgf/cm^2 abs.)
G: Specific gravity of measured gas, with air as a base. (G of air is 1)

● **Reynolds number calculating equation**

$$R_D = \frac{32.6 \times Q_n \times G}{\mu}$$

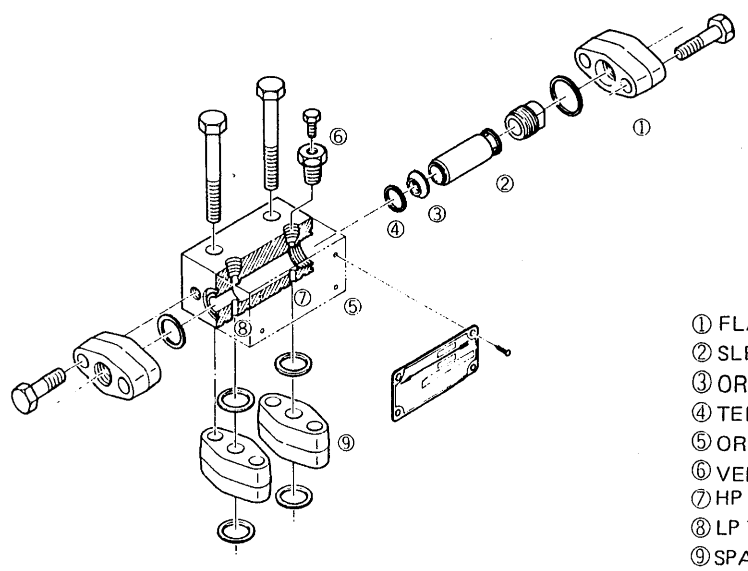
R_D: Reynolds number
Q_n: Flow of measured gas (Nm^3/hr)
G: Specific gravity of measured gas air as a base. (G of air is 1)
μ : Viscosity (CP)

Model Number Table

Basic Model No.	Selections I: Material of Plate	Material of Body	Vent/Drain Thread	Process Connections	Selections II: Flanges: Standard	Flanges: Class	Flanges: Diameter	Type of Connecting Plane	Gasket Plane Finish	Face to Face Dimension	Materials of Flange Pipes	Options	Description
KEE													Integral orifice assembly
	−2												SUS 316
		2											SUS F 316
			A										Rc ¼
			B										¼ NPT internal thread
				T									Rc ½
				N									½ NPT internal thread
				F									With short pipe flanges
					−J	1							JIS 10K
						2							JIS 20K
						3							JIS 30K
					−P	1							JPI 150
						2							JPI 300
						3							JPI 600
					−A	1							ANSI 150
						2							ANSI 300
						3							ANSI 600
							1						15mm (½")
								R					RF
									J				Standard
										4			400mm
										5			500mm
										6			600mm
										7			700mm
											2		SUS F 316 (Short pipe: SUS316TP Sch80)
												−N	No oil finish
												−S	Mounting bolts: SUS304
												−X	No options

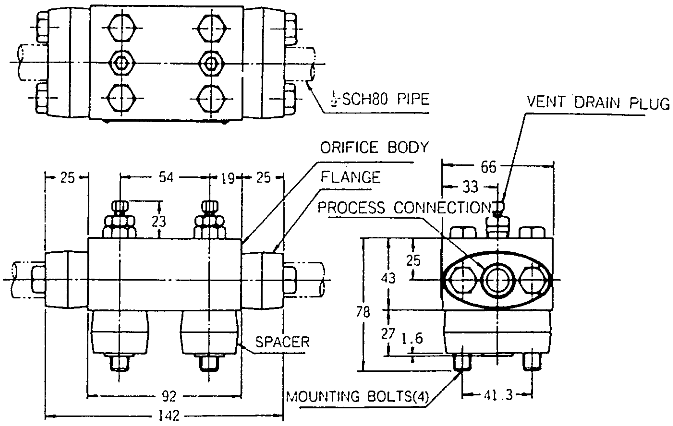
Note) When "T" or "N" is selected for process connections, Selection II is not required.
Example: KEE-22AT-X

Construction (**Exploded View**)

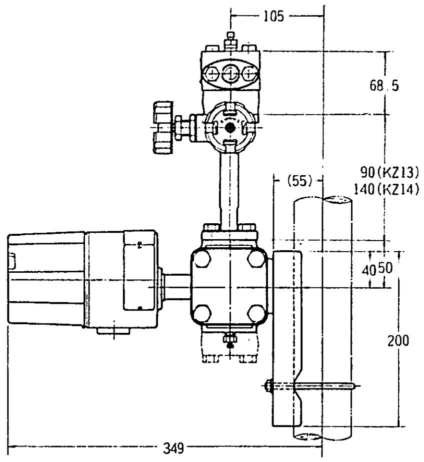


① FLANGE
② SLEEVE
③ ORIFICE PLATE
④ TEFLON RING
⑤ ORIFICE BODY
⑥ VENT/DRAIN PLUG
⑦ HP TAP
⑧ LP TAP
⑨ SPACER

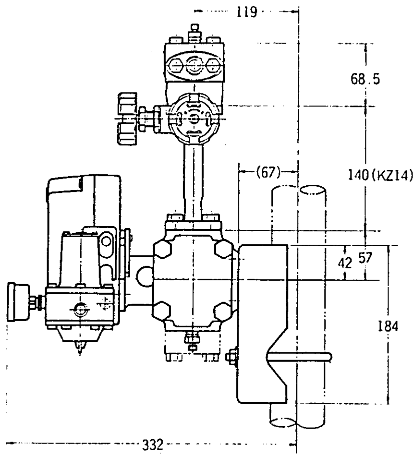
Dimensions



Integral Orifice Assembly

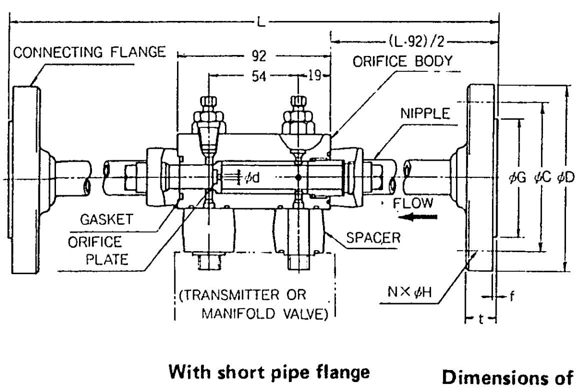


JTD210/215/220 Assembly



KDP 11/22 Assembly

Note) All assembly diagrams are with KZ14 manifold valves.



With short pipe flange

Dimensions of Connecting Flange

FLANGE RATING	ϕD	ϕG	t	f	ϕC PC	N×ϕH
15mm JIS10K RF	95	51	12	1	70	4×15
15mm JIS20K RF	95	51	14	1	70	4×15
15mm JIS30K RF	115	55	18	1	80	4×19
1/2" ANSI/JPI150RF	89	34.9	11.5	1.6	60.3	4×16
1/2" ANSI/JPI300RF	95	34.9	14.5	1.6	66.7	4×16
1/2" ANSI/JPI600RF	95	34.9	14.5	6.4	66.7	4×16

When ordering an integral orifice assembly please specify the following data for calculation

No.	Item			Calculation symbol	Unit
1	Plate material (Standard: SUS316)			—	—
2	Name of fluid			—	—
3*1	Maximum flow rate (instrument full scale)			W	kgf/hr
				Q	m^3/hr
					Nm^3/hr
4*2	Normal flow rate			WA	kgf/hr
				QA	m^3/hr
					Nm^3/hr
5*3	Scale reference (Specify for volumetric flow)	Liquid	at 15°C or at □°C	—	—
		Gas	at 0°C, 1 atm. Measuring base for wet gas [DRY BASE / WET BASE / TOTAL BASE] or at □°C, □kgf/cm² G	—	—
6	Normal temperature			T_1	°C
7	Normal pressure			P_1	kgf/cm² G
					mmH_2O
8*3	Specific weight	Liquid	at scale reference condition	RN	kgf/m³
			at operating condition	R_1	kgf/m³
		Gas	Mol weight or [DRY or WET]	MW	g/22.406ℓ
			Specific gravity quantity at 0°C, 1 atm. [DRY or WET]	RN	kgf/Nm³
9	Normal viscosity			U	cp
10*3	Compressibility factor	Gas only	at 0°C, 1 atm.	ZN*4	—
			at operating condition	Z_1	—
11*3	Relative humidity	Gas only	at operation or □°C, □kgf/cm² G	RH	%
12	Specific heat ratio	Gas only	at operating condition	IZ	—

Notes:

*1) For the maximum flow rate in No. 3 in the table, please specify the maximum value of the instrument scale.

*2) Unless specified otherwise by the customer, 80% of the maximum flow rate is assumed for the normal flow rate of No. 4.

*3) Refer to the followings for conversion from volumetric flow rate to weight flow rate of No. 5, specific weight of No. 8, compressibility factor of No. 10, and relative humidity of No. 11.

(1) LIQUID

$$W = Q_N \cdot R_N \quad \cdots\cdots (1)$$

$$W = Q_1 \cdot R_1 \quad \cdots\cdots (2)$$

(2) GAS

DRY BASE

$$W = \frac{Q_N(D) \cdot R_1}{\frac{(P_1 + 1.0332) - \phi \cdot P_V}{1.0332} \cdot \frac{273.15}{T_1 + 273.15} \cdot \frac{1}{Z_R}} \quad (3)$$

$$R_1 = R_N(D) \cdot \frac{P_1 + 1.0332}{1.0332} \cdot \frac{273.15}{T_1 + 273.15} \cdot \frac{1}{Z_R}\left[1 + \frac{\phi \cdot P_V}{P_1 + 1.0332}\left(\frac{0.6225}{G(D)} - 1\right)\right] \cdots (4)$$

WET BASE

$$W = Q_N(W) \cdot R_N(D) \quad \cdots\cdots (5)$$

R_1 = expression (4)

TOTAL BASE

$$W = Q_N(T) \cdot R_N(W) \quad \cdots\cdots (6)$$

$$R_1 = R_N(W) \cdot \frac{P_1 + 1.0332}{1.0332} \cdot \frac{273.15}{T_1 + 273.15} \cdot \frac{1}{Z_R} \quad (7)$$

$$G(D) = \frac{MW(D)}{28.97} \quad \cdots\cdots (8)$$

$$R_N(D) = \frac{1.2929 \cdot G(D)}{Z_N} \quad \cdots\cdots (9)$$

$$G(W) = \frac{MW(W)}{28.97} \quad \cdots\cdots (10)$$

$$R_N(W) = \frac{1.2929 \cdot G(W)}{Z_N} \quad \cdots\cdots (11)$$

$$Z_R = \frac{Z_1}{Z_N} \quad \cdots\cdots (12)$$

Where:

- W: Flow rate in weight unit [kgf/hr]
- Q_N: Flow rate in volumetric unit at reference condition [m³/hr or Nm³/hr]
- Q_1: Flow rate at operating condition [m³/hr]
- R_N: Specific weight at reference condition [kgf/m³ or kgf/Nm³]
- R_1: Specific weight at operating condition [kgf/m³]
- P_V: Staturated steam pressure [kgf/cm² abs]
- ϕ: Relative humidity $= \frac{RH}{100}$
- Z_R: Compressibility factor ratio.
- G: Specific gravity of gas based on air at 0°C, 1 atm.(G of air is 1)

D, W or T in ( ) denotes DRY, WET or TOTAL, respectively.

*4) Unless otherwise specified by the customer, 1.0 is assumed for compression factor Z_N of No. 10.

*5) When data items are omitted to be indicated by the customer but the physical property data of the mediums is well known to Yamatake-Honeywell, such data will be used for calculation.

*6) The adjusting range of differential pressure will be calculated referring to the above table.

Particular types of instruments as mentioned below also are available.
Please consult us.

1) Instruments for pressures are temperatures higher than those of standard specifications.
2) Instruments made of special materials (monel, tantalum, titanium or hastelloy C) other than those of standard specifications.
3) Special types of connections
4) Others