Installation and Instruction Manual

DAEHAN INSTRUMENT Co., Ltd.

WEDGE METER

Models: DHWM

Issued by:
Design and engineering department.
Issue Date: Apr/2020

Table of Contents

1) INTRODUCTION

1-1) GENERAL

DAEHAN INSTRUMENT's flow meters are differential pressure flow devices providing highly accurate and repeatable measurements of liquids, gases, and steam.

WEDGE meter flow elements utilize V-shaped restrictions to produce a square root relationship between differential pressure and volumetric flow. Elements are designed for either clean or dirty service and are offered in various materials, pipe sizes, and pressure ratings. The differential pressure is measured by a differential pressure transmitter. Various process connections on the WEDGE are provided for either pneumatic or electronic transmitters or other differential pressure sensing devices. Wedge meters can be flow calibrated and supplied with a factory calibration report, this includes calculations for the user's process when such data is supplied. The differential pressure measurement is used to calculate flow using a standard wedge flow equation.

The WEDGE elements are available with up to six different standard WEDGE ratios to provide the required differential pressures over a wide range of flow rates. The WEDGE ratio is defined as H/D where H is the WEDGE opening height and D is the nominal pipe diameter.

The WEDGE restriction is V-shaped at an optimum angle to give the best possible characteristics when measuring viscous fluids. The element will handle applications where the pipe Reynolds number is as low as 500 (well into the laminar flow zone) and as high as several million. This makes the element well suited to gas or steam flow measurement.

The area of unrestricted flow of the wedge meter is determined by different height/diameter ratios thus defining the differential range produced with respect to the fluid flow range. This height/diameter ratio equals the height of the opening under restriction divided by the internal pipe diameter.

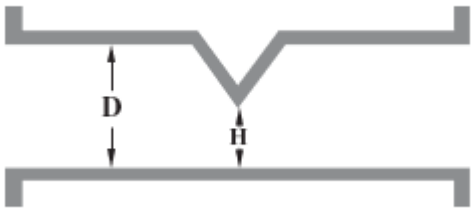

Fig. 1.1 WEDGE element cross-section view

1-2) Model WMP – Clean Service

The WMP WEDGE flow element is designed for in-line mounting and has a flanged-style body with various taps for the connection of transmitter impulse lines. This model is well suited for gas and steam applications as well as clean liquids. Refer to the datasheet for physical and performance specifications and ordering information.

Fig. 1.2 Model WMP Wedgemeter

1-3) Models DHWM-F and DHWM-T – dirty service

These WEDGE flow elements are offered in a flanged body style and are designed for use with remote seal pressure transmitters. Application of this model is recommended for use on difficult to measure slurries and fluids with high solid content that are prone to plugging or have high erosion factors. In addition, these models may also be used where it is necessary to contain hazardous materials within the process piping or where process temperatures exceed the limits of a conventional direct-connect transmitter. Remote seal connections are offered in both flanged and chemical tee type seal designs. Selection of the seal design is typically based on process conditions. The DHWM-F and DHWM-T are generally suited for fluids with a high solid content and abrasive properties since the seal is raised up and eliminates erosive effects of the process on the diaphragm surface. The chemical tee type is more suited for processes that tend to plug since the diaphragm face is flush with the pipe ID, and allows free passage of materials without buildup in the seal area. Refer to the datasheet for physical and performance specifications and ordering information.

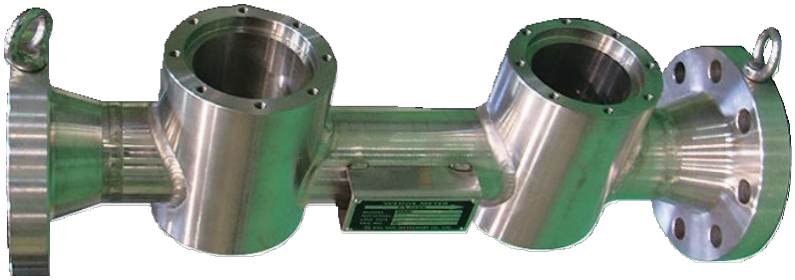

Fig. 1.3 Model DHWM-T chemical tee tapping Wedgemeter

Fig. 1.4 Model DHWM-F flanged tapping Wedgemeter

1-4) Accuracy

Pipe size (inches)	WEDGE ratio (H/D)	Accuracy in % of flow rate	
		Water calibrated in factory flow lab *	Uncalibrated
1/2	0.2, 0.3, 0.4, 0.5	+ 0.75%	+ 5%
1 and 1 1/2	0.2, 0.3, 0.4, 0.5	+ 0.5%	+ 5%
2 and 3	0.2, 0.3, 0.4, 0.5	+ 0.5%	+ 5%
4 to 24	0.3, 0.4, 0.5, 0.6, 0.7	+ 0.5%	+ 5%

*Refer to calibration report supplied with each calibrated instrument

Table 2.1 Models WMP, DHWM-F and DHWM-T

1-5) Maximum working pressure

Flanged element – maximum working pressure is that of flange rating per ANSI B16.5, except DHWM-T with chemical tee transmitter connections that may not exceed 300 psi or flange rating, whichever is the lower.

1-6) Maximum working temperature

all models

Dependent upon wetted material and gasket material.

2) INSTALLATION

2-1) Selecting a mounting location

A horizontal installation is recommended for all WEDGE elements rotated 45° to approximately 90° along the pipe center line as shown in Fig. 3.1. This method of mounting allows for free passage of solids and eliminates air entrapment at the transmitter connection. Other positions are acceptable provided proper venting of the transmitter is accomplished and differences in lead line elevations are considered. For clean liquid service, taps locations are suggested to be below the pipe centerline. For dirty liquid service, service taps should be positioned such that all are self draining, (ie: triple taps units will be at the 3, 9, and 12 o'clock position). Dirty liquid service can be any process where the fluid may settle, cake or set up within the tap chambers. Examples of dirty liquid service are waste streams, coke slurries, black liquor, fluids with high particulates and the like. Vertical installations as shown in Fig. 3.2 may introduce a slight hydrostatic head effect which must be considered when zeroing the transmitter – see Section 5, page 15.

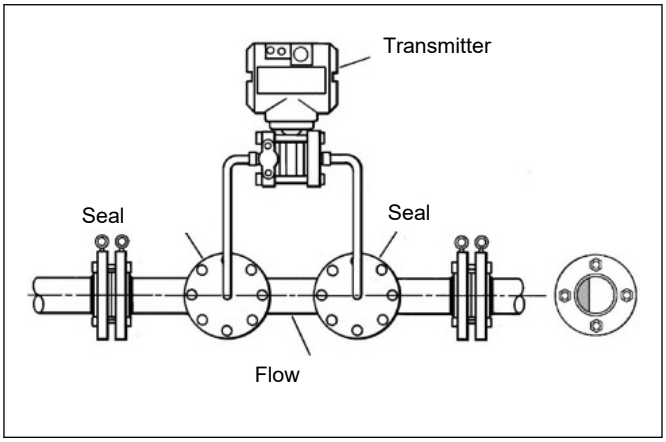

Fig. 2.1 Typical remote seal WEDGE horizontal installation

2-2) Straight pipe run requirements

As with most flow elements, proper operation and performance is dependent on the required lengths of unrestricted upstream and downstream piping. The recommended minimum length of the upstream side of the WEDGE flow element depends on the type of fitting at the end of the straight run, and the pipe configuration. Minimum upstream and downstream lengths are shown in Table 3.1. The minimum lengths will cause a slight Kd2 shift.

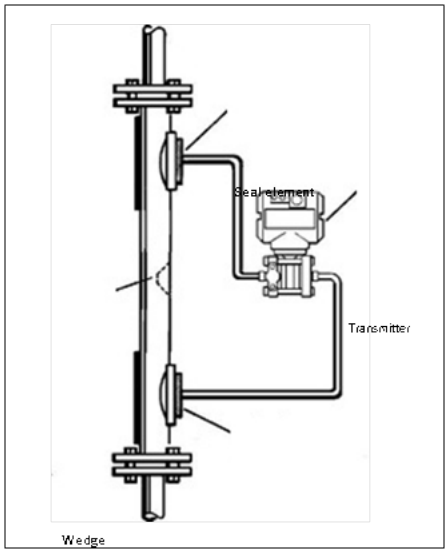

Fig. 2.2 Typical chemical tee vertical installation

Fittings	Recommended		Minimum	
	Upstream	Downstream	Upstream	Downstream
3 Elbows close coupled	15D	5D	15D	3D
2 Elbows close coupled out of plane	10D	5D	10D	3D
2 Elbows close coupled in plane	10D	5D	5D	3D
1 Elbow	10D	5D	5D	3D
Tee-bull plugged	10D	5D	5D	3D
Tee-run plugged	10D	5D	5D	3D
Tee-flow in bull and run	10D	5D	5D	3D
Y-Run plugged	10D	5D	5D	3D
Concentric reducer	10D	5D	5D	3D
Concentric expander	10D	5D	5D	3D
Partially open gate valve	10D	5D	10D	3D

* Based on testing conducted in the flow calibration laboratory.

Measured from apex of wedge element.

Table 3.1 Straight pipe length requirements from various flow obstructions *

2-3) Installation and differential pressure connections

Warning. Never exceed the maximum pressure or temperature recommended for the measured process. Exceeding proper pressure or temperature ratings can lead to personal injury or equipment damage. The process piping flanges for installation should be identical as called out in the serial number on the data plate. The process temperature and pressure should never exceed the ratings for the element stamped on the data plate.

2-3-1) General

Before installation of any WEDGE element inspect for damage; particularly at sealing surfaces. Any damage should be reported to as soon as possible. Also check the data plate to ensure that the stamped ratings match the process conditions of the pipeline in which it will be installed. Each flow element has a data plate attached with an arrow indicating the required direction of flow. Failure to properly orientate the WEDGE element according to the direction of flow may result in improper results when using data supplied for an element that has been calibrated.

2-3-2) Line installation

All WEDGE flow elements require a gasket between the process line connection and the mating flange. Select gaskets that are able to withstand the maximum process temperature and pressure and to resist corrosive attack from the process itself. End gaskets and gaskets for the DHWM-F flanged seal are not provided by DAEHAN as standard (they are available as an option).

To provide safe installation, it is important that the pipeline flanges be suitable for the temperature and pressure of the measured process. When completing the bolting process, be sure that the gaskets are properly centered so that protrusion into the pipe opening is minimized.

Misalignment may cause added flow turbulence, however performance affects are typically minimal depending upon the application. Bolt the element in line with suitable hardware using recommended bolt torques for the type and class rating of the flanges.

2-3-3) Differential pressure connections

The high-pressure connection is always on the upstream side of the flow direction arrow and the low-pressure connection on the downstream side. Fittings used must be able to withstand the process temperature and pressure conditions as well as provide proper corrosion resistance. Refer to the appropriate transmitter manual for connections to the transmitter high and low ports.

The DHWM-F flanged seals require a backup flange rated for the same type and class as that on the WEDGE element. Backup flanges with bolts and nuts are generally offered as an option to the transmitter and are not supplied with the WEDGE element. Again, observe recommended torque specifications for the type and class being used.

Model DHWM-T wedge meters with chemical tee type seals are supplied with the seal mounting hardware and gaskets. Do not substitute the type of cap screws or gaskets supplied as injury may result due to improper installation. Refer to Fig. 3.3 for the identification code of mounting screws. When installing chemical tee seals, tighten caps screws uniformly and avoid excessive tightening of one while others are

loose. Final torque values are dependent on selected temperature rating of the WEDGE as two different gaskets are employed.

Final torque values for Model DHWM-T chemical tee connections are:
204°C (400°F) maximum temperature Garlock Gylon® 3500 gasket 9.65-10.34 bar
(–140–150 inch/pounds)

340°C (645°F) maximum temperature
Graphite gasket 7.58-8.27 bar (– 110–120 inch/pounds) Torque all other models per ANSI flange ratings.

Warning. Do not exceed specified torque!

Fig. 2.3 Mounting bolt identification

2-3-4) Pipe connections

Tighten the flange bolts in a 'star' pattern as shown in Fig. 3.4 to avoid localized stresses on the gaskets.

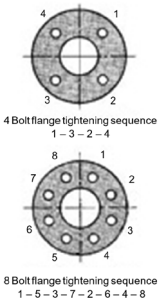

Fig. 2.4 Flange bolt tightening pattern

3) Mounting dimensions

3-1) Model DHWM-F with flanged tapping connection

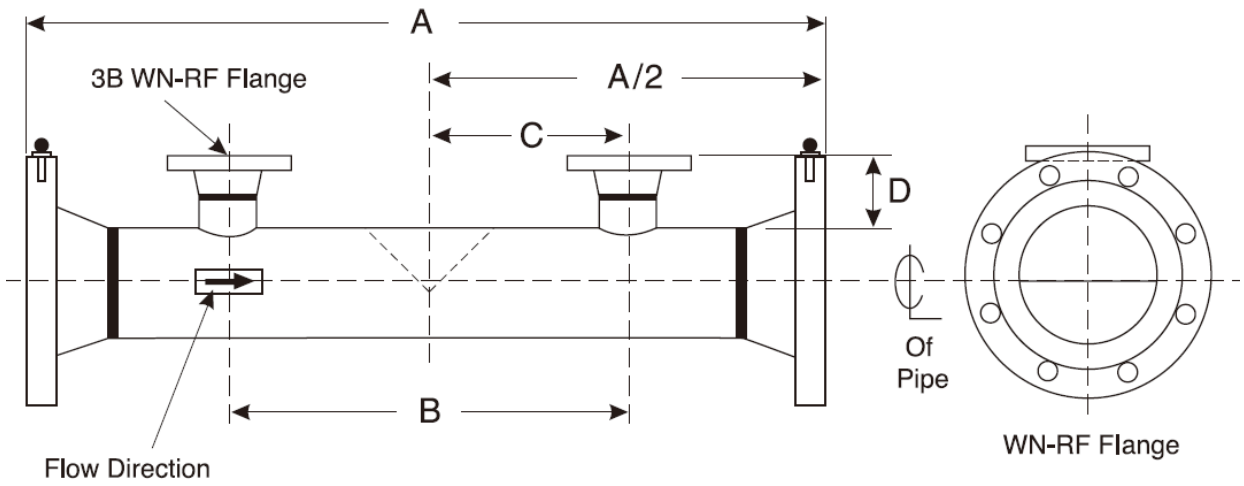

Fig. 3.1 Model DHWM-F with RFWN end flanges – sizes 40, 50, 80 mm (1 1/2, 2 and 3 in.)

Pipe size mm (in.)	A [±4.58] (±0.18)			B	C	D			Approximate weight kg (lbs)		
	Flange rating					Flange rating			Flange rating		
	150	300	600			150	300	600	150	300	600
40 (1.5)	530 (20.86)	543 (21.37)	559 (22)	292 (11.5)	146 (5.75)	207 (8.18)	214 (8.43)	212 (8.37)	25 (55)	28 (61)	32 (71)
50 (2)	546 (21.5)	559 (22)	577 (22.75)	292 (11.5)	146 (5.75)	216 (8.5)	222 (8.75)	231 (9.12)	28 (62)	32 (70)	38 (84)
80 (3)	645 (24.5)	641 (25.25)	660 (26)	311 (12.25)	155 (6.13)	155 (6.13)	166 (6.56)	175 (6.88)	35 (78)	42 (92)	46 (102)

Table 4.1 Model DHWM-F with RFWN end flanges – sizes 40, 50, 80 mm (11/2, 2 and 3 in.)

Note. Slip on, full face and RTJ flange connection are also available. Contact DAEHAN for length details.

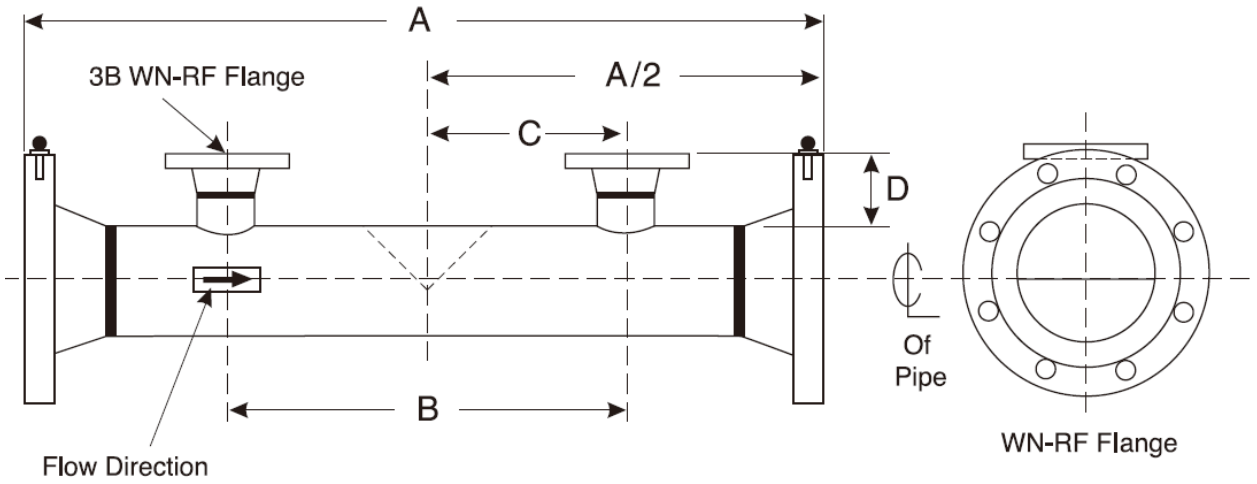

Fig. 4.2 Model DHWM-F with RFWN end flanges – sizes 100 to 600 mm (4 to 24 in.)

Pipe size mm (in.)	A [±6.35] (±0.25)			B	C	D Max (Ref)			Approximate weight kg (lbs)		
	Flange rating					Flange rating			Flange rating		
	150	300	600			150	300	600	150	300	600
100 (4)	901 (35.5)	920 (36.25)	990 (39)	381 (15)	190 (7.5)	70 (2.75)	79 (3.12)	89 (3.5)	3429 (135)	3810 (150)	4445 (175)
150 (6)	1028 (40.5)	1047 (41.25)	1098 (43.25)	457 (18)	228 (9)	70 (2.75)	79 (3.12)	89 (3.5)	4064 (160)	5334 (210)	6858 (270)
200 (8)	1092 (43)	1111 (43.75)	1168 (46)	521 (20.5)	260 (10.25)	70 (2.75)	79 (3.12)	89 (3.5)	5334 (210)	6731 (265)	9271 (365)
250 (10)	1143 (45)	1174 (46.25)	1257 (49.5)	597 (23.5)	298 (11.75)	70 (2.75)	79 (3.12)	89 (3.5)	6858 (270)	8763 (345)	13335 (525)
300 (12)	1321 (52)	1352 (53.25)	1416 (55.75)	673 (26.5)	336 (13.25)	70 (2.75)	79 (3.12)	89 (3.5)	8890 (350)	10160 (400)	
350 (14)	1397 (55)	1428 (56.25)	1485 (58.5)	736 (29)	356 (14)	70 (2.75)	79 (3.12)	89 (3.5)	10414 (410)	15494 (610)	
400 (16)	1473 (58)	1511 (59.5)	1587 (62.5)	775 (30.5)	387 (15.25)	70 (2.75)	79 (3.12)	89 (3.5)	12700 (500)	19177 (755)	
450 (18)	1574 (62)	1613 (63.5)	1676 (66 00)	851 (33.5)	413 (16.75)	70 (2.75)	79 (3.12)	89 (3.5)	12700 (500)	22098 (870)	
500 (20)	1686 (66.37)	1720 (67.75)	1790 (70.5)	940 (37)	470 (18.5)	70 (2.75)	79 (3.12)	89 (3.5)	17780 (700)	27940 (1100)	
600 (24)	1854 (73)	1886 (74.25)	1968 (77.5)	1066 (42)	533 (21)	70 (2.75)	79 (3.12)	89 (3.5)	24257 (955)	33274 (1310)	

Table 4.2 Model DHWM-F with RFWN end flanges – sizes 100 to 600 mm (4 to 24 in.)

Note. Slip on, full face and RTJ flange connection are also available. Contact DAEHAN for length details.

Start-Up

Operation

Before any true zero reading can be taken it is necessary to establish that the process pipe and flow element is completely purged and there is no flow. A shutoff valve or control valve downstream of the element will facilitate this condition. Opening the valve for a short period of time will remove any gases that are present in the system. In the case of the Model WMP pipe tap WEDGE, it is necessary to purge air from the transmitter body by opening the vent valves on the high and low side flanges. Any air present in the transmitter body will result in a false zero reading.

Zero check

With the flow element under full line pressure, at normal operating temperature, and at zero flow, the transmitter zero can be adjusted to an exact reading on the readout device. If possible, open the downstream valve for a few seconds and close it. The output should return to a zero reading. If it does not, readjust the zero screw on the transmitter. Repeat this procedure two or three times to establish a true zero.

Span check

In most cases, it will not be possible to check for the correct span as this would require a field calibration. The transmitter may be calibrated at the factory if ordered to agree with the calibration and/or calculation of the WEDGE flow element.

Note. A calibration report is supplied with each WEDGE flow element that is flow laboratory calibrated. Check that the calculated differential of the flow element agrees with the differential span of the transmitter. If it does not, it will be necessary to recalibrate the transmitter.

Accuracy

All WEDGE flow elements that are calibrated in the factory flow laboratory are calibrated to within 0.5% of the flow rate (1/2 inch size WEDGE meters are 0.75%). The accuracy of uncalibrated elements may be up to 5% of flow rate, depending upon the type of element, pipe size, and WEDGE ratio (see Section 2.4, page 5). Additional errors will be evident if the process fluid density defers from the designed value. Also, the same will be true if improper upstream pipe conditions exist. The percent errors given do not include the inherent errors of the transmitter which are normally very small until flow rates fall below 30% of maximum flow (9% of maximum differential pressure).

4) MAINTENANCE

4-1) Removing element from service

Warning. Process pressure and material retained in the flow element can cause injury and damage to equipment. Standard plant safety procedures must be followed when removing the element from service.

The WEDGEMETER has no moving parts that require servicing. Removal of the wedge element is generally not required other than for normal maintenance cleaning of process lines. Before removal, shut off all process flow and pressure, and drain lines if possible before loosening any bolts. Disconnect transmitter connections and remove impulse lines or remote seal elements. Loosen and disconnect element line connections and remove from process pipe line.

4-2) Inspection

General practices suggest that sealing surfaces be periodically checked for nicks and gouges before reinstallation. Elements under severe operating conditions should also be inspected for effects of corrosion and erosion to minimize unexpected shutdowns.

4-3) Reinstallation

Reinstallation should follow procedures outlined in Section 3. Model DHWM-T chemical tee seal screws should be applied with Molykote 505 or equivalent lubricant to prevent seizure of threads. Gaskets should be renewed upon reinstallation.