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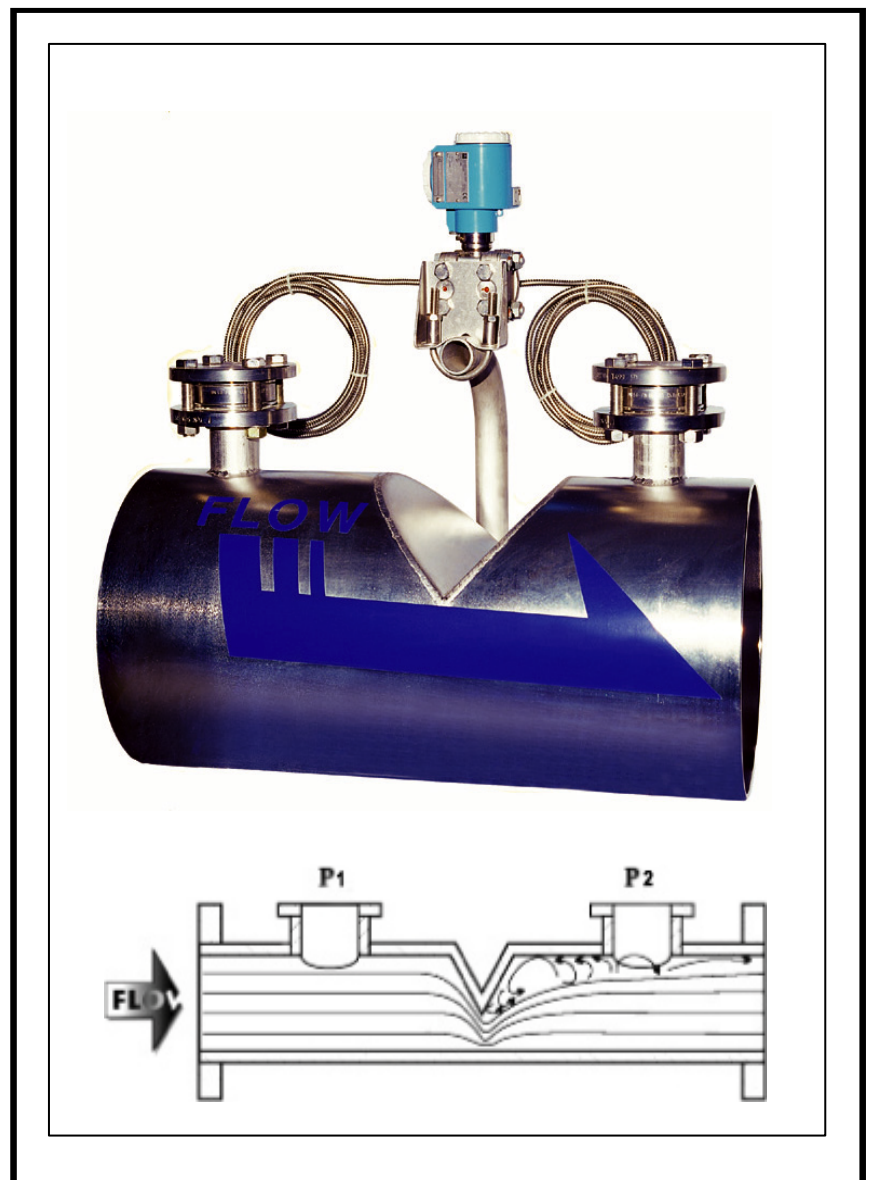
General Information

HITROL

## General Information

# HWFM-Series

## Wedge Type DP Flowmeter



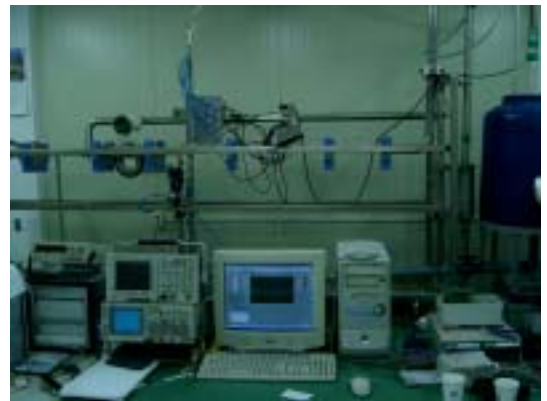
HITROL CO., LTD.

## A flow metering solution for highly viscosity, slurry type, or contained solids particle in liquids fluid.

In line sizes from 0.5" through 24", the wedge type flow meter is a differential pressure design available in the public domain which, when utilized, is generally applied in air entrained liquid, particulate entrained, high viscosity or slurry type, most frequently described as difficult to-meter line fluids. abrasive or fibrous slurry are examples of possible applications, relatively low pipe Reynolds numbers can be addressed with some accuracy and the discharge coefficient is stable through the application range.

Though accuracy, reliability and head loss characteristics are inferior to that obtained with venturi meter product lines, if highly viscous, particulate laden flows along with low acquisition cost is of highest priority to the exclusion of the other factors, HITROL wedge type flow meter can be a metering option worth consideration.

When your application requirements dictate the use of HITROL wedge type flow meters, Hitrol co. Ltd., can provide expert technical assistance estimating bore size, differentials and flow rates coupled with high quality.



### DESIGN AND OPERATION INFORMATION

The basic system consists of a cylindrical pressure vessel into which a constriction "WEDGE" is fabricated thereby leaving an open segment of a known height.

Pressure taps which receive the (extended or chemical tee, depending on design) sealed sensors on either side of the "WEDGE" provide the differential signal to the flow transmitter which is then related, by formula, to the rate of flow occurring through the open segment.

All HITROL Wedge type flow meters are wet calibrated as using the flow standard system for liquids in order to provide +/- 0.50% of coefficient accuracy for the calibrated range.



## MATERIALS OF HWFM-SERIES

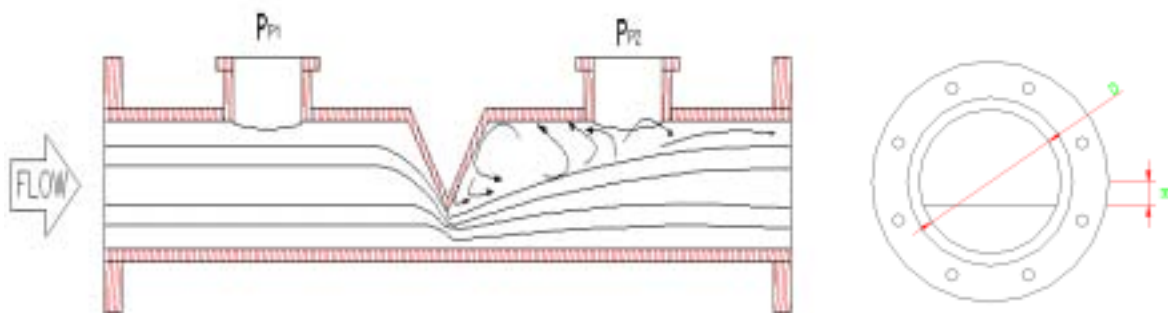
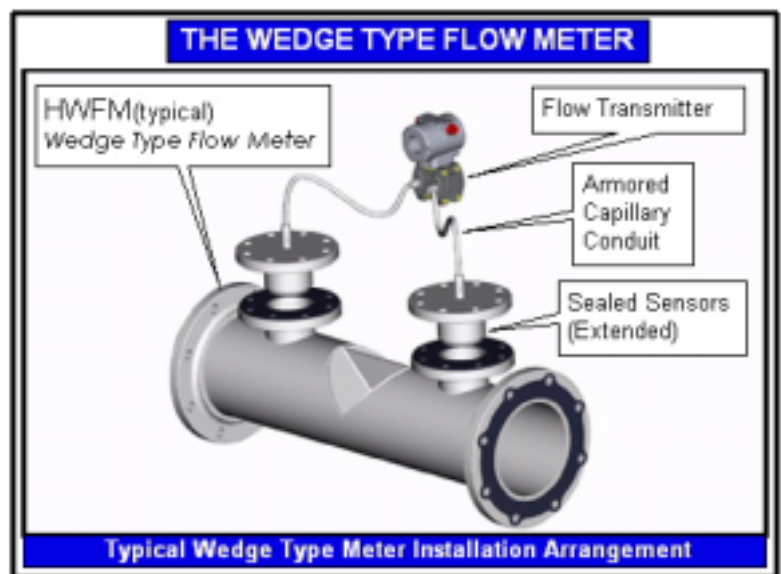
The HITROL-wedge type **HWFM-series** design can be produced using a wide variety of materials depending upon the particular demands of the application. typical materials selection, however, may include carbon steel, 304 and 316 Stainless Steel, Monel, Hastelloy, or PVC for Chlorine and similar Chemical applications.

The sealed sensor assemblies are of 316 Stainless Steel with armored capillary conduits containing various fill fluids depending on the intended service.

## MEASURING PRINCIPLE

The line fluid is forced downward similar to a segmental orifice plate, but is guided along a slopping "wedge" shape rather than a sharp edge. The pressure taps are located upstream and downstream of the wedge and in all cases are equipped with sealed sensors.

The differential produced by the device is a function of the ratio between the wedge segment opening, H, and the diameter of the body, D.



The equivalent beta ratio therefore is :

$$\text{wedge} = \frac{D}{D} = \left( \frac{1}{\pi} \left\{ \arccos \left[ 1 - \frac{2H}{D} \right] - 2 \left[ 1 - \frac{2H}{D} \right] \left( \frac{H}{D} - \left[ \frac{H}{D} \right]^2 \right)^{1/2} \right\} \right)^{1/2}$$

Discharge coefficients are as follows for line sizes indicated :

line size 0.5": $C=0.7883+0.107(1 - \text{ }^2_{\text{wedge}})$	line size 1" through 1.5": $C=0.6143+0.718(1 - \text{ }^2_{\text{wedge}})$	line size 1.5" through 24": $C=0.5433+0.2453(1 - \text{ }^2_{\text{wedge}})$
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And the mass flow rate equation for incompressible flow is:

$$Q_M = N_{MG} \frac{Cd^2}{\sqrt{1 - (d/D)^4}} \sqrt{F_p G_F} \sqrt{H_W}$$

$N_{MG}$  = dimensional constant     $H_W$  = differential inches of water

$G_F$  = specific gravity     $F_p$  = thermal expansion factor

The calculations for compressible flow are similar but must account for temperature and adiabatic expansion and compressibility factors.

The operating principal of the HITROL wedge flow meter is analogous to that of other differential producing flow meters such as orifice plates or venturi meters in the respect that the pressure difference measured across a flow constriction in this case a sloping "wedge" is related to the velocity of the flow passing through the narrowest cross section of the flow element.

Pressure taps are located up stream and downstream from a "v"(Called "Wedge") shaped constriction placed in a length of pipe. The constriction creates a pressure drop between the upstream tap and downstream tap which is related to the velocity in the pipe line, and thus, inferentially, to the volumetric flow rate through the narrowest cross section of the flow element thereby created.

The opening height of the wedge can be changed in design according to the amount of differential required for a particular application flow range modified by the tolerance for permanent pressure loss.

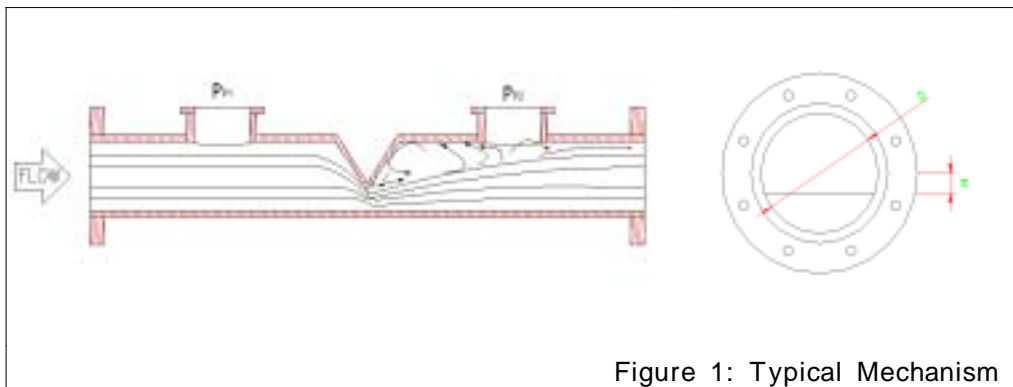


Figure 1: Typical Mechanism



**Technical information (cont.)** .....

Typically available line size range from 1/2 inch through 24 inch.,

The features and advantages of the HITROL wedge type flow meter include:

- No interior machining requirement, thereby yielding an intrinsically less expensive shape to manufacture;
- Resistance to erosion of the internal shape due to the inclined nature of the V-shaped constriction;
- A hydraulic shape that is substantially not susceptible to clogging or the buildup of any secondary phase and acts in a "self-scouring" manner with respect, particularly, to the narrowest cross section of the flow element;
- To measure flow having a much lower pipe reynolds number than venturi orifice type meters
- To measure high viscosity in line fluids.
- Can be multiply the resistance to abrasion caused by harsh and/or abrasive line fluids, like tar sands.
- Design variations can permit extremely high line pressure.
- Long service life and no maintenance requirements.
- No internal moving parts

Application assistance is available from the Hitrol as using the Flow Standard System for liquids.

**Table 1. Standard models and physical features**

Model Number	Application	Transmitter Connection	Line Size
HWFM-SERIES	Liquid,Gas,Steam,Slurry, Harsh	Internal Threaded (1/2") & Flange(2")	0.5" to 24"

**Table 2. Gernal Specifications**

Transmitter Connections ;  
 Internal Threaded (1/2"PT) & Flange (2")  
 Process Connections ;  
 ANSI Class 150, 300, and 600LBS  
 JIS 10K, 20K and 30K  
 Other available on request  
 Materials ; Stainless Steel 304, 316, Carbon  
 Steel, Hastelloy C or Monel  
 Other available on request

Accuracy ; +/- 0.5% of R.D.  
 Max. Pressure & Temperature ;  
 Per ANSI B 16.5 & dependent on  
 wetted material and gasket  
 material  
 Installation ; Proper operation of Hitrol Wedge  
 Type Flow Meter is dependent  
 upon orientation and upstream  
 and downstream piping.



**Installation information .....**

The proper operation of the HWFM wedge flow element is relatively forgiving of the specific installation arrangement imposed. Nevertheless, to achieve the best results, the recommended installation parameters enumerated below should be observed and incorporated. The adverse results arising from failure to properly install the flow element can include plugging of impulse lines and/or tap holes, air(gas or unwanted secondary phase) entrapment in the taps and/or impulse lines, introduction of a minor hydrostatic head effect(in a vertically orientated installation) or Kd2 shift (i.e. accuracy impairment.

Meter orientation A horizontal orientation is preferred and typical for most installations.

The element should be rotated between 45 to 90 degrees resulting the tap locations that substantially allow any undissolved solids to easily pass beneath the wedge without build-up and also minimizes air(or gas) entrapment at tap locations.(see figure 1.)

Vertical installations may result in a hydrostatic head effect Due to the elevation difference of the individual impulse lines. this can(and must) be corrected by adjusting (calibrating) the transmitter.

Other orientations and installations are permissible, providing Adequate consideration and accommodation is made by virtue of proper venting and compensation for relative differences in impulse/tap elevations.

**Straight pipe requirement**

The HWFM wedge type flow element will produce the performance envelope profiled elsewhere here under subject to the nature of the process piping and disturbers located therein.

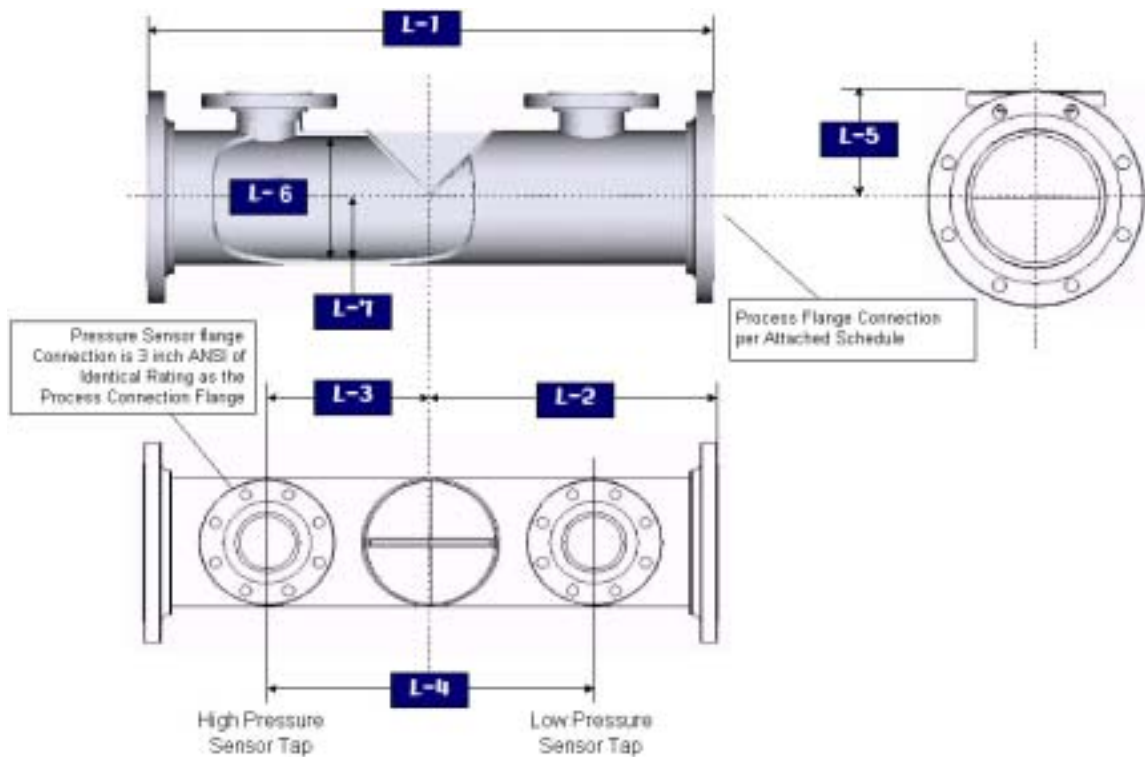
As with most flow meters, straight(unrestricted)piping upstream and downstream of the flow element is preferred and will produce better results and accuracy. Providing adequate straight piping upstream and downstream however, can significantly normalize the performance accuracy, despite the presence of disturbers. General guidance is offered in table 9 below with all dimensions provided being considered from the apex of the wedge element.





Table 4.

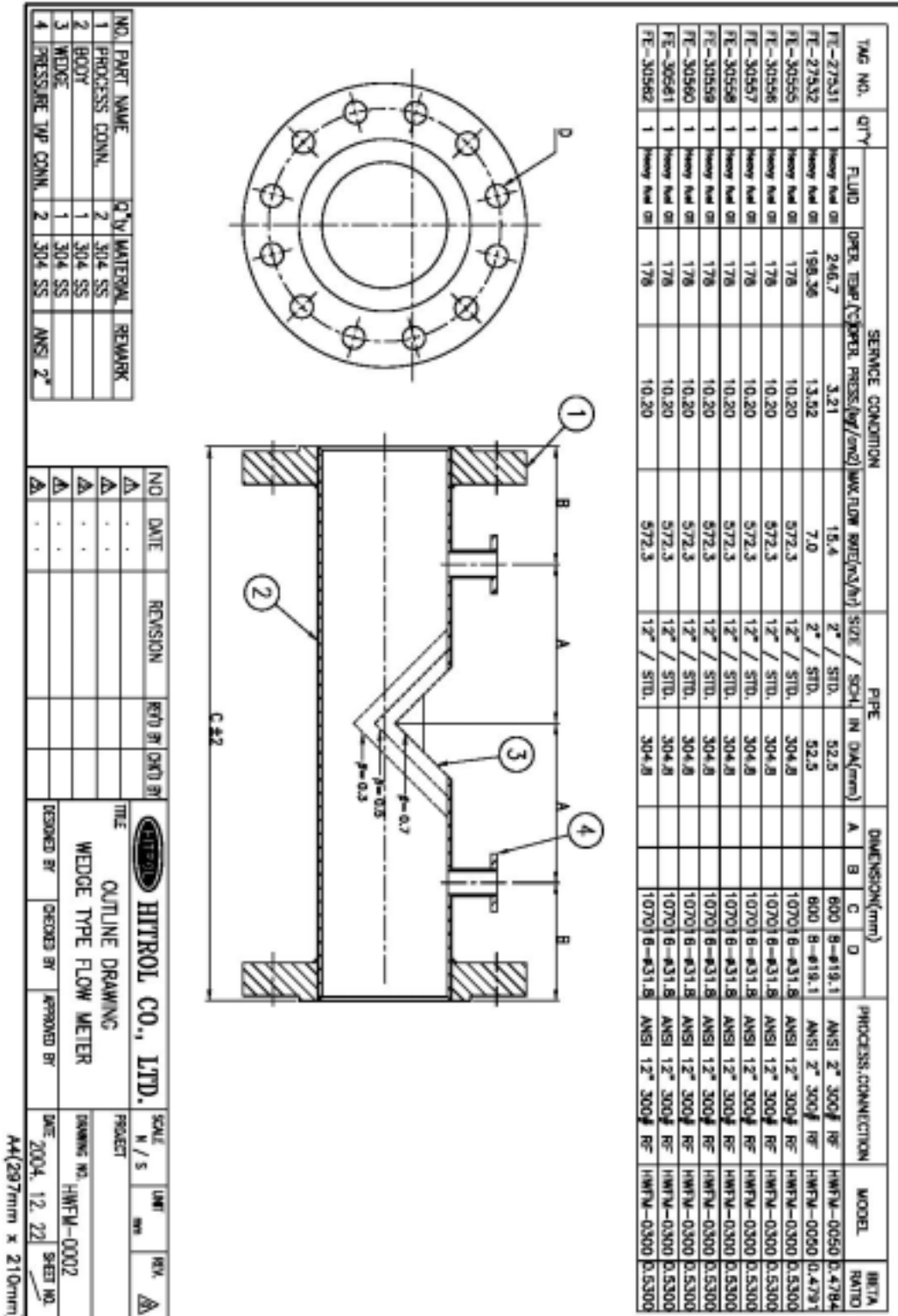
STANDARD DIMENSIONAL SCHEDULE FOR 2.0" THRU 24" LINE SIZE HWFM WEDGE TYPE™ Flow Meter							
Normal Line Size	L-1	L-2	L-3	L-4	L-5	L-6	L-7
2.00	28.00	14.00	4.63	9.26	7.19	2.00	tbd
3.00	34.00	17.00	7.56	15.12	7.75	3.00	tbd
4.00	36.00	18.00	7.50	15.00	8.25	4.00	tbd
6.00	40.00	20.00	9.00	18.00	9.31	6.00	tbd
8.00	42.00	21.00	10.25	20.50	10.31	8.00	tbd
10.00	45.00	22.50	11.75	23.50	11.38	10.00	tbd
12.00	47.00	23.50	13.25	26.50	12.38	12.00	tbd
14.00	49.00	24.50	14.00	28.00	13.00	14.00	tbd
16.00	49.00	24.50	15.25	30.50	14.00	16.00	tbd
18.00	52.00	26.00	16.75	33.50	15.00	18.00	tbd
20.00	56.00	28.00	18.50	37.00	16.00	20.00	tbd
24.00	62.00	31.00	21.00	42.00	18.00	24.00	tbd





# The HI-WEDGE™ FLOWMETER

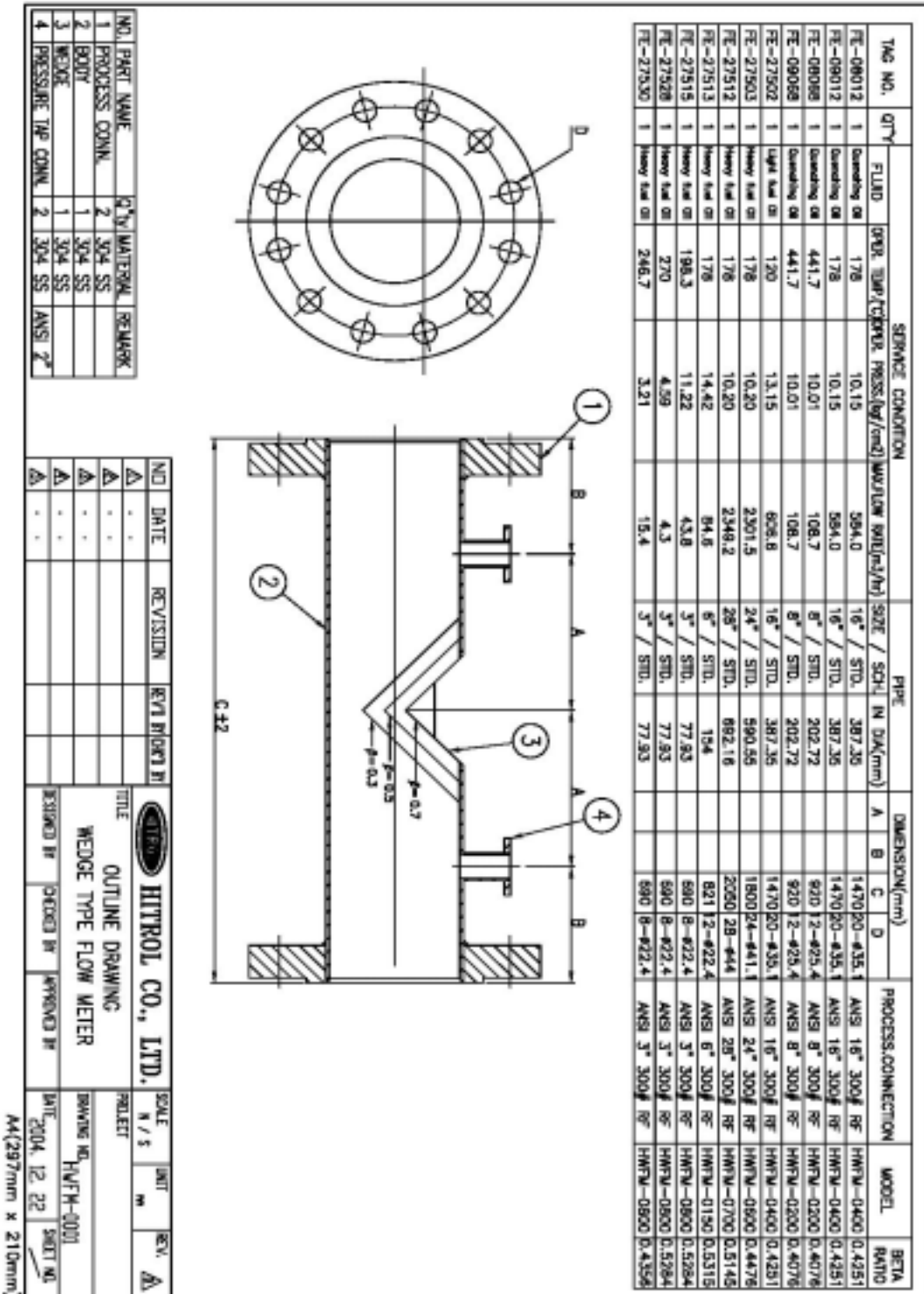
HWFM sample drawing.1





# The HI-WEDGE™ FLOWMETER

HWFM sample drawing 2.



**Table 5.****FLOW METERING PERFORMANCE SUMMARY**

Wedge Series Element Calculation by HITROL R&D INSTITUTE

Customer Name : JILIN DONGFANG  
 Project Name :  
 Model : HWFM Series.  
 Tagging Number : FE30555~FE30562  
 Serial Number :

**\*\*\* Calculation Condition \*\*\***

Fluid Name :	Heavy fuel oil
Flowrate Maximum :	572.3 m <sup>3</sup> /h
Normal :	476.1 m <sup>3</sup> /h
Minimum :	286.1 m <sup>3</sup> /h
Pipe Inner Diameter :	304.8 mm
Density :	1039.6 kg/m <sup>3</sup>
Viscosity :	0.2 cP
Operating Pressure :	10.20 kgf/cm <sup>2</sup>
Operating Temperature :	178
Differential Pressure Maximum :	1500.0 mmH2O
Normal :	1038.2 mmH2O
Minimum :	374.8 mmH2O

**\*\*\* Results \*\*\***

Beta-Ratio :	0.5300
Element Diameter :	205.98 mm
Pressure Loss :	290.3 mmH2O
Reynolds Number at Max. Flow :	4253535
at Nor. Flow :	3538655
at Min. Flow :	2126196
Velocity at Max. Flow :	2.2 m/s
at Nor. Flow :	1.8 m/s
at Min. Flow :	1.1 m/s