BELL
Flow Systems

BF1001
Coriolis Mass Flow Meter

BF1001 User Manual

This manual includes the structure, principle, specifications, usage, applicable scope and precautions of the Mass Flow Meter sensor and transmitter developed and manufactured by our company. Be sure to read the manual before installation and operation. For more details about the product, please contact our company or the local agents.

The transmitter has obtained the explosion-proof approval. No one is allowed to replace parts and components without authorisation in case its performance is affected.

For maintenance, the primary power supply should be disconnected first. When opening the explosion-proof enclosure, user must take care to protect the explosion-proof surface. During installation, make sure that the explosion-proof surface has no damage; cable connection is good; no metal washer, sealing rubber gasket and tightening nut is lost so that the electric explosion-proof performance is maintained.

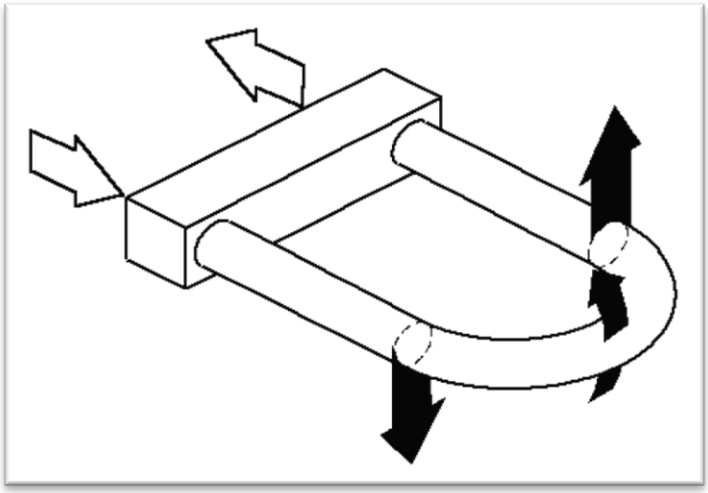
1. GENERAL

1.1 Introduction

BF1001 Coriolis Mass Flow Meter(hereafter BF1001 Coriolis Meter) is designed according to the Coriolis Force Principle. It is widely used for the process detecting and custody transfer/fiscal unit in many industries such as petroleum, petro-chemical, chemical industry, pharmacy, paper making, food, energy, and so on. As an advanced flow and density measurement instrument, it is widely used in the measurement of liquids, gases and slurries.

1.2 Principle

BF1001 Coriolis Meter is designed according to the principle of Coriolis force. Under the alternating current effect, the electromagnetic coils mounted on the measuring tube will make two parallel measuring tubes vibrating at a certain fixed frequency. Whenever mass (either liquid or gas) flows through the measuring tubes, Coriolis force is generated, causing a “bending” or “deflection” in the top of the tubes. This deflection is sensed as a phase shift between two electronic pick-ups mounted on the tubes. The degree of phase shift is directly proportional to the mass flow within the tubes. The mass flow rate can be calculated by detecting the phase shift of the tubes.



The vibration frequency of measuring tube is determined by the total mass of measuring tube and inner mass flow. The vibration frequency of measuring tube changes over the changes of mass flow density. Thus, the flow density can be calculated.
Working together with the measuring circuit, the temperature sensor mounted on the measuring tubes can obtain the real-time temperature value.

1.3 Feature

Compared with traditional flow measurement methods, BF1001 Coriolis Meter has following obvious advantages:
1.3.1 Able to measure the direct mass flow rate of mass flow in the measuring tubes without any parameters conversion, which avoids the intermediate measurement error. The mass flow measuring can realise high accuracy and good repeatability as well as wide turndown ratio.
1.3.2 The applicable mass flows are more extensive, such as the steady uniform flows of

common viscosity fluid, the high viscosity fluid, non-Newtonian fluid, slurry flow containing solid components and liquid containing a little gas.

1.3.3 With little vibration, the measuring tube can be regarded as no-moving parts, which will reduce the meter maintenance, and ensure the stability and long lifetime.

1.3.4 Besides the mass flow measurement, the density and temperature and even consistency can also be realised.

2. TECHNICAL SPECIFICATIONS

2.1 Main Technical Specifications

Table1: Main Technical Specifications

DN(mm)	10 ~ 200
Medium	Liquid, gas, slurry
Type / Medium Temp.	Integrate type: (-50 ~ 125) ℃ Remote type: (-50 ~ 200) ℃ Remote type with high temp.: (-50 ~ 300) ℃ Remote type with low temp.: (-150 ~ 125) ℃
Sensor	Triangle type, U-type, Micro-bend type
Transmitter	DSP
Certification	Ex-proof
Power Supply	DC24V、AC220V
Output Port	RS485
Pressure (MPa)	1.6、2.5、4.0、6.3; Customised for high pressure: 10.0, 16.0, 26.0
Output Signal	4~20mA, pulse
Accuracy	0.1%, 0.15%, 0.2%, 0.5%
Hygienic Type	Customized
Process Connection	Customized

2.1.1 Flow Range

Table 2: Flow Range of U-type sensor with *DSP transmitter* (for Liquid)

DN(mm)	Allowable Flow Range (kg/h)	Normal Flow Range for Accuracy 0.1% (kg/h)	Normal Flow Range for Accuracy 0.2% & 0.5% (kg/h)	Stability of Zero Point(kg/h)
10	10～1000	70～1000	50～1000	0.04
15	30～3000	150～3000	100～3000	0.12
25	80～8000	400～8000	300～8000	0.32
40	320～32000	2000～32000	1500～32000	1.2
50	500～50000	3500～50000	2500～50000	2
80	1400～140000	6000～140000	6000～120000	6
100	2000～200000	15000～200000	10000～200000	8
150	5000～500000	35000～500000	25000～500000	20
200	10000～1000000	70000～1000000	500000～1000000	40

Table 3: Flow Range of Micro-bend type sensor with *DSP transmitter* (for Liquid)

DN(mm)	Allowable Flow Range (kg/h)	Normal Flow Range for Accuracy 0.1% (kg/h)	Normal Flow Range for Accuracy 0.2% & 0.5% (kg/h)	Stability of Zero Point(kg/h)
10	10～1000	100～1000	70～1000	0.1

15	20～3000	200～3000	150～3000	0.3
25	80～8000	600～8000	400～8000	0.8
40	240～24000	2400～24000	1200～24000	3
50	500～50000	5000～50000	2500～50000	5
80	800～120000	8000～120000	5500～120000	12
100	1500～200000	15000～200000	10000～200000	20
150	5000～500000	50000～500000	25000～500000	50
200	10000～1000000	100000～1000000	500000～1000000	100

Table 4: Flow Range for GAS with *DSP transmitter*

DN (mm)	Measurable Flow Range (kg/h)	Flow Range with Accuracy 0.5% (kg/h)	Stability of Zero Point (kg/h)
15	15 ~ 3000	75 ~ 3000	0.12
25	40 ~ 8000	200 ~ 8000	0.32
40	160 ~ 32000	800 ~ 32000	1.2
50	250 ~ 50000	1250 ~ 50000	2
80	700 ~ 140000	3500 ~ 140000	6
100	1000 ~ 200000	5000 ~ 200000	8
150	2500 ~ 500000	12500 ~ 500000	20

Table 5: Flow range of volume for air under standard temperature and pressure condition (hereafter we call “standard condition”)

DN (mm)	Start Flow (Nm^3/h)	Flow Range with Accuracy 0.5% (Nm^3/h)
15	12.50	62.5 ~ 2500.0
25	33.33	166.7 ~ 6666.7
40	133.33	666.7 ~ 26666.7
50	208.33	1041.7 ~ 41666.7
80	583.33	2916.7 ~ 116666.7
100	833.33	4166.7 ~ 166666.7
150	2083.33	10416.7 ~ 416666.7

The flow value of other gas medium =

$$\frac{\text{The value in the below table * Air density under standard condition}}{\text{Medium density under standard condition}}.$$

The volume under working condition can be calculated by the following formula:

Volume flow under working condition =

$$\text{Standard volume flow} \times \frac{0.1}{\text{Working Pressure} + 0.1} \times \frac{\text{Working Temperature} + 273}{273}$$

(Note: 1. The unit of working pressure is MPa, the unit of the working temperature is ℃.

2. Other gas medium data can be calculated based on above table data * air density under standard condition /medium density under standard condition)

Table 6: Flow rate factor

In many cases, the flow rate of the medium while using DSP type BF1001 Coriolis Meter is required for gas measurement. The flow rate factor changes with the chosen connection size, thus the flow rate of BF1001 Coriolis Meter (with DSP transmitter) needs to be calculated according to the formula below:

$$\text{Medium Flow Rate} = \frac{\text{Volume Flowrate under working condition}}{\text{Flow Rate Factor}}$$

DN (mm)	15	25	40	50	80	100	150
Flow Rate Factor	0362	1.046	3.535	5.436	15.89	26.15	58.84

Note:

1. The gas flow rate is usually much higher than liquid when measured by a flow meter, so there will be noise caused by gas medium and the tube walls of flow meter under high speed gas flow and if the noise becomes too great, the signal of flow meter will be influenced, so **please use . F1001 Coriolis Meter for gas medium measurement at speed less than 1/3 of sound velocity.**

2. Please use BF1001 Coriolis Meter for gas with pressure drop not more than 0.2Mpa.

2.1.2 Mass Flow Measuring

2.1.2.1 Flow Range: Table 2~4

2.1.2.2 Accuracy, Basic error and Repeatability

Table 7

Accuracy	0.1%	0.15%	0.2%	0.5%
Basic Error	±0.10%	±0.15%	±0.20%	±0.50%
Repeatability	±0.05%	±0.075%	±0.10%	±0.25%
Accuracy=|basic error| $\pm(\frac{Stability of Zero Point}{Instantaneous Flow})\times 100\%$				
Accuracy is calculated based on the water measurement under the condition of +20℃~25℃ and 0.1MPa~0.2MPa.				

2.1.3 Density Measuring

Table 8

Density Range	(0.2~3.0)g/cm^3
Basic Error	±0.002g/cm^3
Repeatability	±0.001g/cm^3

2.1.4 Temperature Measuring

Table 9

Temperature	(-50~+125)℃	Integrated Type

Range	(-50~+200)℃	Separate Type
	(-50~+300)℃	High Temperature Separate Type
	(-125~+125)℃	Low Temperature Separate Type
Basic Error	≤±1.0℃	

2.2 Specification of Function

2.2.1 Current Output

4-20mA Passive Current Output can be configured to indicate the mass flow, volume flow, density or water ratio.

Table 10

Output Range	(4～20)mA
Resolving Power	0.000244mA
Basic Error	0.2%F.S
Temperature Influence	±0.005%F.S/℃
External resistor should be 250～600Ω	

2.2.2 Pulse Output

Active Pulse Output can be configured to indicate the mass flow, volume flow, density or water ratio.

Table 11

Output Range	(0～10)kHz
Resolving Power	0.152Hz
Basic Error	±0.075%
Temperature Influence	±0.001%F.S/℃
Capability of Outrange is 12kHz	

2.2.3 Low Flow Cut-off

When the mass flow value is lower than the value of Low Flow Cutoff, the BF1001 Coriolis Meter will output a flow rate of zero, and the totalizer will stop to accumulate. The value of Low Flow Cutoff is usually set to be 1% of the maximum flow rate.

2.2.4 RS485 Output

RS485 output is compatible to the RTU mode of MODBUS protocol. For details, please contact Bell Flow Systems.

2.3 Environment Limitation

2.3.1 Environment vibration

Table 12

Frequency Range	(10~2000)Hz
Acceleration amplitude value	2g
Circulation time	50 times

2.3.2 Environment temperature

Table 13

Working Temperature	(-40~+55)℃
Storage Temperature	(-40~+70)℃

2.3.3 Environment humidity

Table 14

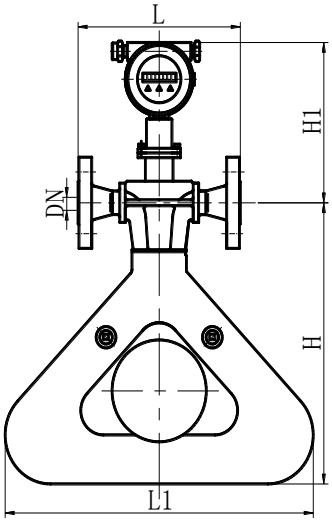
Working Humidity	＜90%	+25℃
Storage Humidity	＜95%	No condensation

2.3.4 Enclosure Grade: IP65

2.3.5 Power Consumption

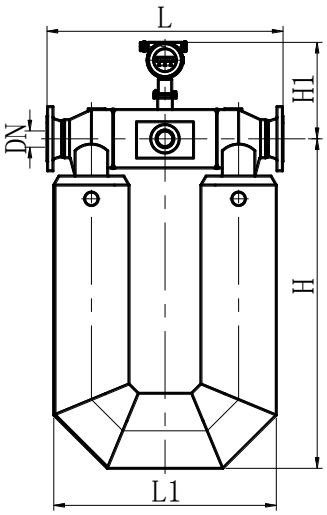
The normal power consumption for flow meter is 10W, and the max. power consumption is 15W.

2.4. Outlines and Dimensions



DN (10~25)

Drawing 1: Integrate Type (Triangle)



DN (40~200)

Drawing 2: Integrate Type (U- type)

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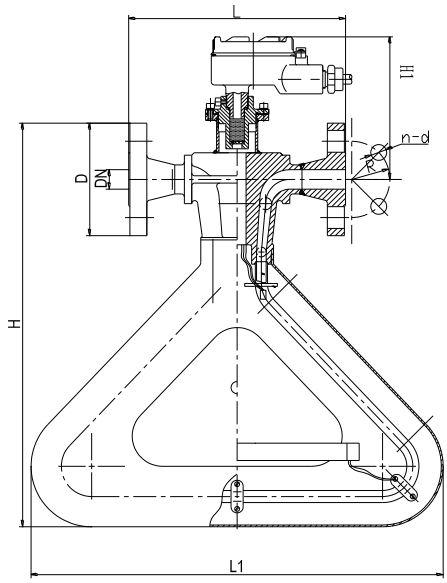
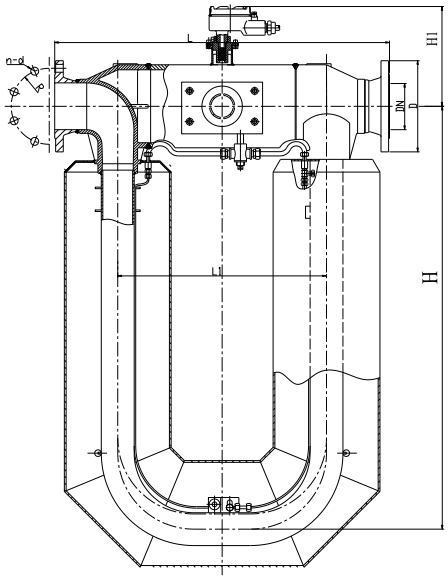
Table15: Dimensions of Integrate Type (Triangle, U- type) Unit: mm

BF1001-	DN	L		L1	H	H1	
		≤ 4.0MPa	≥6.3MPa			Integrate	Remote
010	10	150	170	350	290	260	190
015	15	180	194	350	300	260	190
025	25	200	248	450	420	280	210
040	40	520	547	470	660	280	210
050	50	558	588	550	710	290	220
080	80	780	808	710	1040	320	250
100	100	920	948	860	1140	350	280
150	150	1100	1140	1050	1520	380	310
200	200	1364	1410	1160	1655	420	350

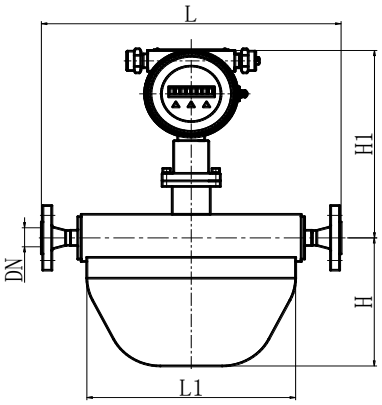


Drawing 3: Remote Type (Triangle)



Drawing 4: Remote Type (U-type)

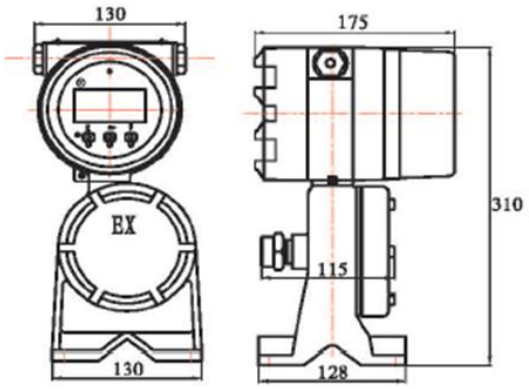
Note: the above dimensions are for U-type sensor



Drawing 5: Micro-bend Type

Table16: Dimensions of Micro-bend type Unit: mm

BF1001-	DN	L		L1	H	H1	
		≤ 4.0MPa	≥6.3MPa			Integrate	Remote
010	10	270	290	160	130	280	210
015	15	400	414	280	184	290	220
025	25	500	536	360	250	300	230
040	40	600	634	460	300	310	240
050	50	800	828	640	410	320	250
080	80	900	928	700	490	350	280
100	100	1130	1156	860	660	370	290
150	150	1410	1450	1200	900	400	330
200	200	1800	1844	1450	1170	420	350



Drawing 6: Dimensions for remote type transmitter (unit: mm)

2.5 Weights

Table 17: net weights Unit: kg

DN (mm)	10	15	25	40	50	80	100	150	200
Triangle and U type	10	13	17	30	40	100	190	325	536
Micro-bend type	8	12	15	25	38	78	135	265	430

Note: transmitter for remote type is 5kg.

3. BF1001-CNG/LNG/LPG

3.1 BF1001 – CNG

3.1.1 CNG

In order to reduce the urban air pollution caused by vehicle exhaust, the CNG is widely used as the vehicle fuel. And in order to meet the challenges of CNG measurement, GPE designs the BF1001-CNG measurement with industrial standards and requirements.

3.1.2 Features

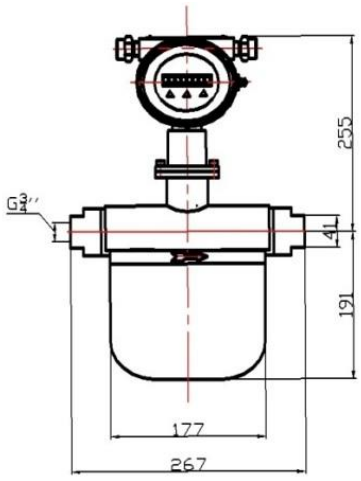
BF1001-CNG is designed with more smart size and direct process connection, which is more adaptable to the CNG applications. BF1001-CNG has wider turndown ratio, and high accuracy (0.5%) within flow range of 75~3000kg/h. So BF1001-CNG can be widely used in the gas stations for motor vehicles.

3.1.3 Technical Data

Table 18

ITEM	DATA
DN (mm)	15
Medium	Natural gas
Transmitter	DSP
Flow Range	1.2~50 kg/min
Accuracy	0.5%
Zero Point Stability	0.38 kg/h
Pressure	25 MPa
Material	Housing: SS304; Measuring tubes: SS316L
Ambient Temp.	-20~50℃
Working Temp.	-50~125℃
Signal Output	Pulse, 4-20mA, RS485, HART
Connection	G3/4” Female type
Ex-proof	Exdib II CT4~CT6
Power Consumption	10W~25W
Net Weight	13kg

3.1.4 Drawing 7: Outlines and Dimensions (mm)



3.2 BF1001 – LNG

3.2.1 LNG

LNG (Liquefied Natural Gas), is mostly consisted of methane, and is liquefied at -162℃ condition. LNG can save a lot of shipment storage space and can achieve high performance. BF1001-LNG is specially designed for extreme low temperature medium measurement like LNG, and can maintain stable measurement at -162℃ condition with high accuracy of 0.1%.

3.2.2 Technical Data

Table 19

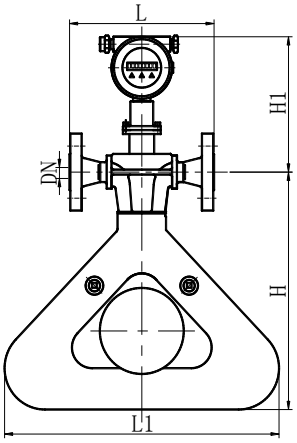
ITEM	**DATA**
DN (mm)	15, 25
Medium	LNG
Transmitter	DSP
Accuracy	0.1%, 0.2%
Pressure	6.4 MPa
Material	Housing: SS304; Measuring tubes: SS316L
Working Temp.	-196~50℃
Signal Output	Pulse, 4-20mA, RS485, HART
Connection	Customized
Ex-proof	Exdib II CT3~CT6
Power Consumption	10W~25W

3.2.3 Flow Range

Table 20

DN (mm)	0.1% (kg/h)	0.2% (kg/h)	Zero Point Stability (kg/h)
15	150～3000	100～3000	0.38
25	400～8000	300～8000	1.00

3.2.4 Outlines and Dimensions



Drawing 8: LNG: Outlines

Table 21: Dimensions Unit: mm

DN (mm)	15	25
L1	350	450
L（PN＜4MPa）	180	200
L（PN＞6.3MPa）	194	248
H	300	420
H1	190	210

3.3 BF1001 – LPG

For any technical information of parameter and specification, please contact us directly.

4. INSTALLATION

4.1 Brief

4.1.1 Pre-installation

This section offers instructions for installation, wiring, operation, and trouble-shooting. The user must read this manual carefully before installation and operation, because improper installation may cause incorrect measurement and even damage the flow meter.

4.1.2 Safety

4.1.2.1 When the flow meter is going to be installed in the dangerous region, please confirm if the flow meter explosion-proof class is consistent with the environment requirement in order to avoid the potential danger.

4.1.2.2 Please make sure that the power is shut off to avoid the accident of electric shock when installing the transmitter.

4.1.2.3 Please obey the installation and operation instruction to ensure the safety operation.

4.1.3 Components

BF1001 Coriolis Meter is made up of sensor (measuring tubes) and transmitter, which can be installed integrally or separately. When BF1001 Coriolis Meter is installed separately, the sensor and transmitter should be connected by special Nine-Core Cable.

4.2 Installation

4.2.1 Installation Process

Step 1: Location: Determine the sensor installation location, which should take the installation area, pipeline, transmitter location and valve into account.

Step 2: Direction: Determine the sensor installation direction in the pipeline.

Step 3: Installation: Install the sensor and transmitter in the pipeline.

Step 4: Connection: When BF1001 Coriolis Meter is installed separately; the sensor and transmitter should be connected by special Nine-Core Cable.

Step 5: Start-up.

4.2.2 Position selection

- The sensor should be placed away from interference source (such as the pump) which may cause pipe mechanical vibration. If sensors are used in series along the same line, care must be taken to avoid the mutual influence due to resonance. The distance between sensors should be no less than three times its width.
- When installing the sensor, pay attention to the expansion and contraction of the process pipeline due to temperature change. It is strongly recommended that the sensor should not be installed near the expansion joint of the process pipeline. Otherwise, the pipe expansion and contraction of the pipeline will bring about transverse stress which will affect the sensor‘s zero, as a result of which the measurement accuracy will be affected.
- The sensor should be placed away from industrial electromagnetic interference sources such as large power motors and transformers. Otherwise, the measuring tube’s auto-oscillation within the sensor will be interfered, and the weak signal detected by the speed sensor may be affected by the electromagnetic noise. Therefore, the sensor should be placed away from such sources such as motors and transformers, at least five

meters distance.

- The sensor should be placed in the position where its measuring tube is always filled with fluids and a certain pressure at the outlet is maintained, thus it should be placed in the lower position of the pipeline.
- Basic requirement: Install the BF1001 Coriolis Meter in the lower position of the pipeline so that the fluid can fill with the sensor during the process of zero point calibration and operation. The transmitter should be installed in the environment with temperature from -40~+55 ℃ and humidity <90%.
- Dangerous area: Please confirm the explosion-proof class indicated in the nameplate of BF1001 Coriolis Meter matches the application environment regulation before installation.
- Straight pipe: The BF1001 Coriolis Meter does not require the special straight pipe upstream or downstream. However, if more than one mass flow transmitters are installed in the same pipe, please ensure the length of pipe between any two sets is more than 2 meters.

4.2.3 Maximum length of cable: shown in Table 22

Cable Model	Cable Specification	Max. Length
Special Nine-Core Cable	Special	300m
Current Power Line	18AWG(0.8mm2)	300m
RS485 Communication Line	22AWG(0.35mm2)	300m

4.2.4 Working temperature of sensor: shown in Table 23

Integral Type	(-50~+125)℃
Separate Type	(-50~+200)℃
High temperature Separate Type	(-50~+300)℃

4.2.5 Valve: It is necessary to conduct the zero point calibration once the installation is completed. The downstream stop valve has to be closed before zero point calibration, and then close the upstream stop valve.

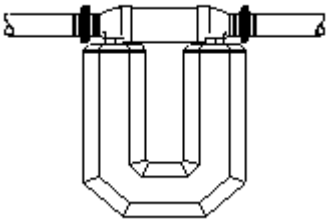
4.3 Direction

4.3.1 Basic requirement:

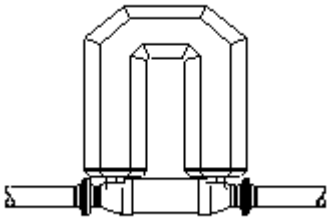
The BF1001 Coriolis Meter works well only when the measuring tube is filled with mass flow. In principle, as long as the measuring tube is full of mass flow, the BF1001 Coriolis Meter will work properly in any orientation installation. Generally speaking, the BF1001 Coriolis Meter should be installed in the orientation that can ensure the measuring tube is filled with mass flow.

For the horizontal installation, the measuring tube should be installed underside the pipeline when the process medium is liquid or slurry (shown on Drawing 9) and topside the pipeline when the process medium is gas (shown on Drawing 10). For the vertical installation, the measuring tube should be installed besides the pipeline when the process

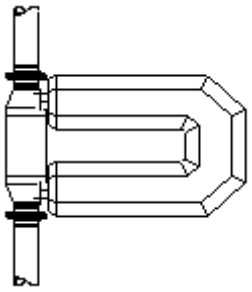
medium is liquid or slurry or gas (shown on Drawing 11)



Drawing 9



Drawing 10



Drawing 11

4.3.2 Flow direction:

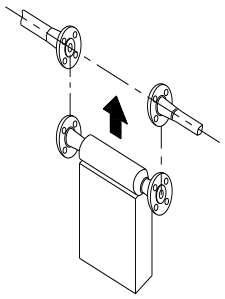
There is flow direction arrow that indicates the proper flow direction on the front of the sensor, so please install the BF1001 Coriolis Meter accordingly. Otherwise, the transmitter may not display the mass flow normally.

For vertical installation, if the process medium is liquid or slurry, the flow direction should be from down-to-up; if the process medium is gas, the flow direction can be either down-to-up or up-to-down. The transmitter can be mounted with 90° revolution according to the requirement of installation.

4.4 Sensor Installation

4.4.1 Basic requirements:

The installation of the BF1001 Coriolis Meter should decrease the tortuosity of the process connection. Meanwhile, do not support the pipeline by the sensor of the BF1001 Coriolis Meter. (As shown in Drawing 12)



Drawing 12

4.4.2 Installation of the BF1001 Coriolis Meter -150 Sensor:

It is better to support the sensor of BF1001 Coriolis Meter using rubber connector as the buffer.

4.5 Wiring

4.5.1 Basic requirements:

If the sensor of BF1001 Coriolis Meter is installed integrally with the transmitter, it will be OK that the power of transmitter is connected. If the sensor of BF1001 Coriolis Meter is installed separately with the transmitter, it will be required that the transmitter is connected with the sensor through special nine-core cable. If the BF1001 Coriolis Meter -150 (DN150mm) is installed, it is required that the drive-amplifier of sensor is supplied with power connection.

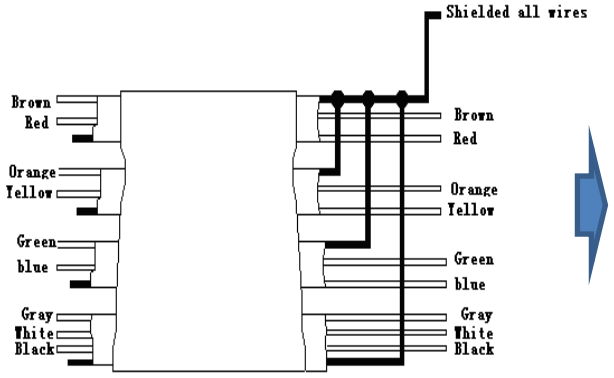
4.5.2 Junction box

If the sensor and the transmitter are installed separately, the sensor and transmitter have been respectively matched with junction box for connecting the special nine-core cable.

4.5.3 Cable connection

If the sensor and the transmitter are installed separately, signal lines are 9-core cables between transmitters and mass flow sensors.

Table 24: cables and functions



Line NO.	Line Color	Function
1	brown	The left coil+
2	red	The left coil-
3	orange	The left coil+
4	yellow	The left coil-
5	green	Driving coil+
6	blue	Driving coil-
7	Gray	Temperature+
8	white	Temperature-
9	black	Temperature Compensation

Caution

Cut off power before connecting cables. The power voltage must match that indicated in the junction box of the transmitter and the ground wire must be well grounding to ensure its intrinsic safety performance.

4.5.4 Grounding

Both of the sensor and the transmitter have to be grounded correctly, otherwise the measurement error will occur and even the BF1001 Coriolis Meter may not work. If the pipeline is grounded, the transmitter can be grounded through the pipeline; if the pipeline is not grounded, the transmitter should be grounded independently.

4.5.5 Power line wiring

The transmitter can be supplied with AC220V or DC24V. The power line more than 0.8mm^2 is recommended and the maximum length of power line should be 300m. For transmitter of BF1001 Coriolis Meter -150, a single Driver amplifier is required to be supplied with AC220V power.

4.6 Start-up

4.6.1 Zero-point calibration

Zero-point calibration supplies the base point for the flow meter. After the first installation or reinstallation, Zero-point calibration is required for the BF1001 Coriolis Meter. Before zero-point calibration, close the downstream valve of the flow sensor to make sure that no fluid is flowing through the pipe. The sensor should be filled with process fluid whose temperature change should not exceed ±10℃. If the flow meter is zeroed when fluids are flowing through, its measurement will be extremely smaller. At that time, stop using the meter or re-zero it before use.

4.6.2 Instrument coefficient

Each BF1001 Coriolis Meter has its own instrument coefficients, which have been set before delivery and shown on the calibration report. So the user does not need to set instrument coefficient except either the sensor or the transmitter is replaced. All the coefficients that can be found on the calibration report are also printed on the name plate. Generally, the sensor and the transmitter are in couples, and the coefficient has been input into the transmitter. The meter can be used without additional change.

5. POWER SUPPLY AND SIGNAL OUTPUT WIRING

5.1 Power Wiring

5.1.1 The basic requirement:

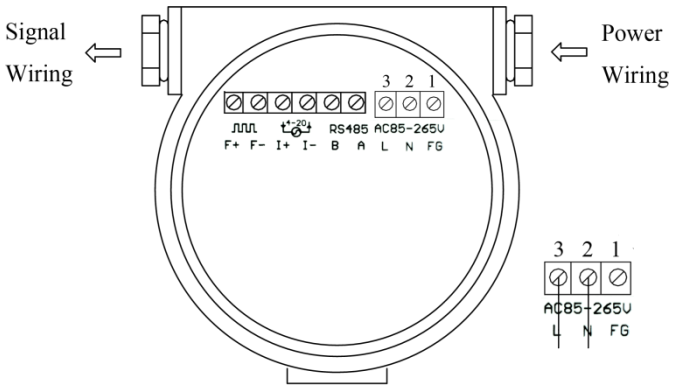
The transmitter can be connected to the AC220V or the DC24V power.

Table 25

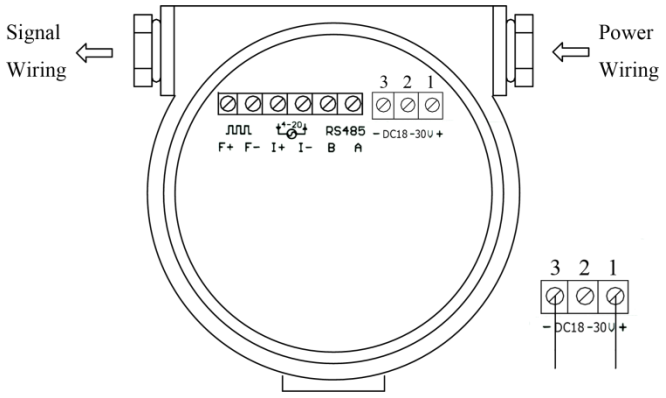
AC (85 to 265) V	Power Consume: Normal 10 W, MAX 15W
DC (18 to 30) V	Power Consume: Normal 10 W, MAX 15W

5.1.2 Power Cable

The power cable should choose 2-core cable and the area of each core >0.8 square millimeter. The maximum length of the power cable is 300m.



Drawing 13: AC Power Wiring



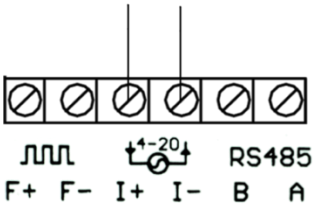
Drawing 14: DC Power Wiring

5.2 Current Output Wiring

5.2.1 4~20mA output can be configured to mass flow, volume flow, density or water ratio.

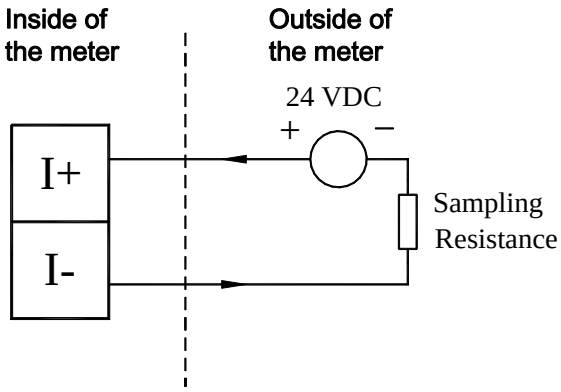
5.2.2 The cable should be 2-core cable and the area of each core > 0.5 square millimeter.

5.2.3 The factory default current output is passive current output, while you can also change the output type to active output. (Please contact local agent for instructions)



Drawing 15

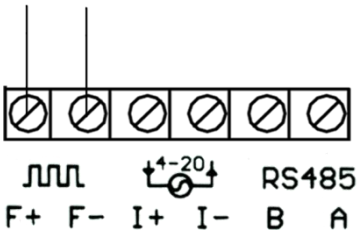
The outer wiring of passive current output is as the figure shows below:



Drawing 16

5.3 Pulse Output Wiring

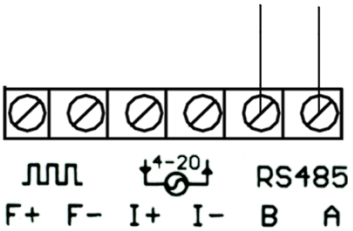
5.3.1 Active pulse output can be configured to mass flow, volume flow, density or water ratio.
5.3.2 The cable should choose 2-core cable and the area of each core > 0.5 square millimeter. The maximum length of output line is 150m.



Drawing 17

5.4 RS485 Output Wiring

RS485 output is compatible to RTU mode of MODBUS protocol. The maximum length of output line is ≤300m.



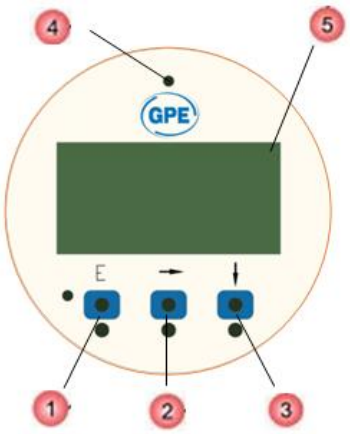
Drawing 18

6. CONFIGURATION

6.1 General

Please use the operation panel of transmitter to set the configuration, such as basic configuration parameters, zero calibration, cutoff value of low flow and output range of current frequency, etc.

The face plate of the transmitter is shown in Drawing 19.



No.	Notes
1	E key: enter
2	→ key: move curse or return
3	↓ key : page down
4	OLED light for working status
5	Two line LCD

Drawing 19

6.2 Configuration Parameter (*Note: Default Password: "000000"*)

Please review or set the configuration parameters according to the following indications (press ↓ to turn a page and press → to move the position of cursor or return):

6.2.1 Low Flow Cutoff

Configuration → E → Flow configuration → E → Zero-Calibration → ↓ → Low Flow Cutoff → → → (change the number among 0~9) → E → → → Yes → E → confirm the modification of low flow cutoff is successful.

6.2.2 Reset Totalizer

Configuration → E → Flow configuration → E → Zero-Calibration → ↓ → Low Flow Cutoff → → → Reset Totalizer → E → Input password to reset to zero.

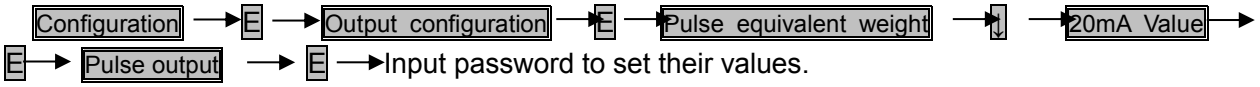
6.2.3 Measurement Unit

Configuration → E → Unit configuration → E → Mass Unit or Mass Flow Unit or Volume Unit or Volume Flow Unit or Density Unit → E → set their values.

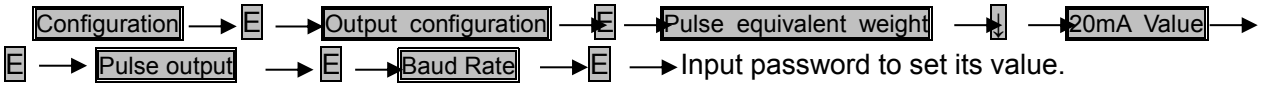
6.2.4 Current Output

Configuration → E → Output configuration → E → Pulse equivalent weight → ↓ → 20mA Value → E → Input password to set their values.

6.2.5 Pulse Output



6.2.6 RS485Output



6.3 Calibration

Generally speaking, the BF1001 Coriolis Meter does not need the field calibration because it has been calibrated before delivery.

Each BF1001 Coriolis Meter has its own instrumental coefficient, including one flow coefficient and four density coefficients (high density D1, high period K1, low density D2 and low period K2), which will be shown in Nameplate of Sensor or Calibration certificate.

The sensor and transmitter are usually delivered as a pair and instrumental coefficient has been set in transmitter so the user does not need to change any longer.

6.3.1 Zero Calibration

Zero calibration provides the datum mark of flow meter for flow measurement. It is necessary to conduct the zero calibration when the BF1001 Coriolis Meter installation is completed for the first or a second time.

After installation correcting, ***the BF1001 Coriolis Meter should be powered at least 30 minutes for warm-up and then make the liquid pass through the flow meter until the temperature of BF1001 Coriolis Meter is same as working temperature of liquid.*** Afterward, close the downstream valve, make the liquid pass through the flow meter under normal temperature, density and pressure and then close the upstream valve to assure the sensor is full of liquid during the process of zero calibration.

Finally, press ↓ → Configuration → Zero-Cal → Flow configuration → Zero Correction → E Input password to start zero calibration.

6.3.2 Flow Calibration

The mass measured by the BF1001 Coriolis Meter is resulted from the multiplication of detected signals' time difference between two circuits and flow calibration factor. When the accuracy is not up to grade after long-term service, please modify the flow calibration factor according to the following formula:

$$K1=K0\times[1+(M-Mt)\ /\ Mt]=K0\times M/Mt$$

Note:

K1	New flow calibration factor,
K0	Old flow calibration factor,
M	Total mass flow of Master Meter,
Mt	Total mass flow of Tested Meter.

7. Pressure Loss

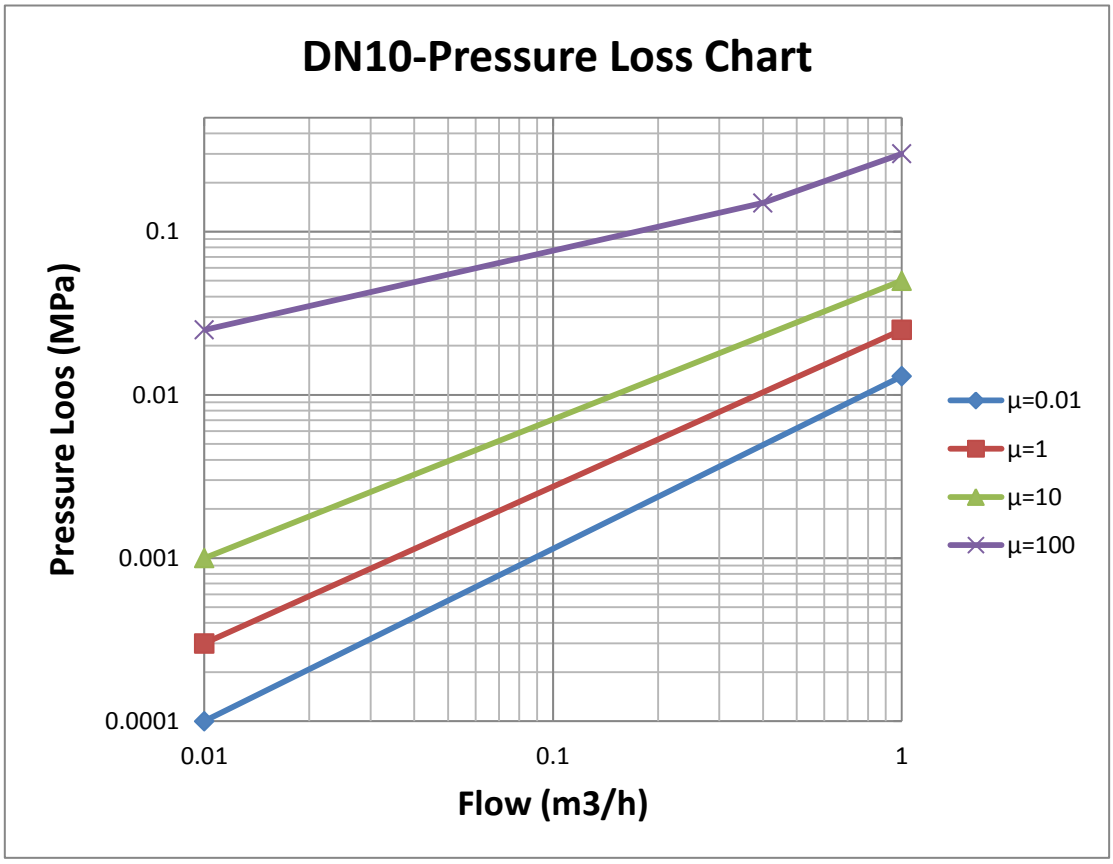
The pressure loss of BF1001 Coriolis Meter can be checked from following Pressure Loss Chart (including pressure loss, flow, and viscosity parameters).

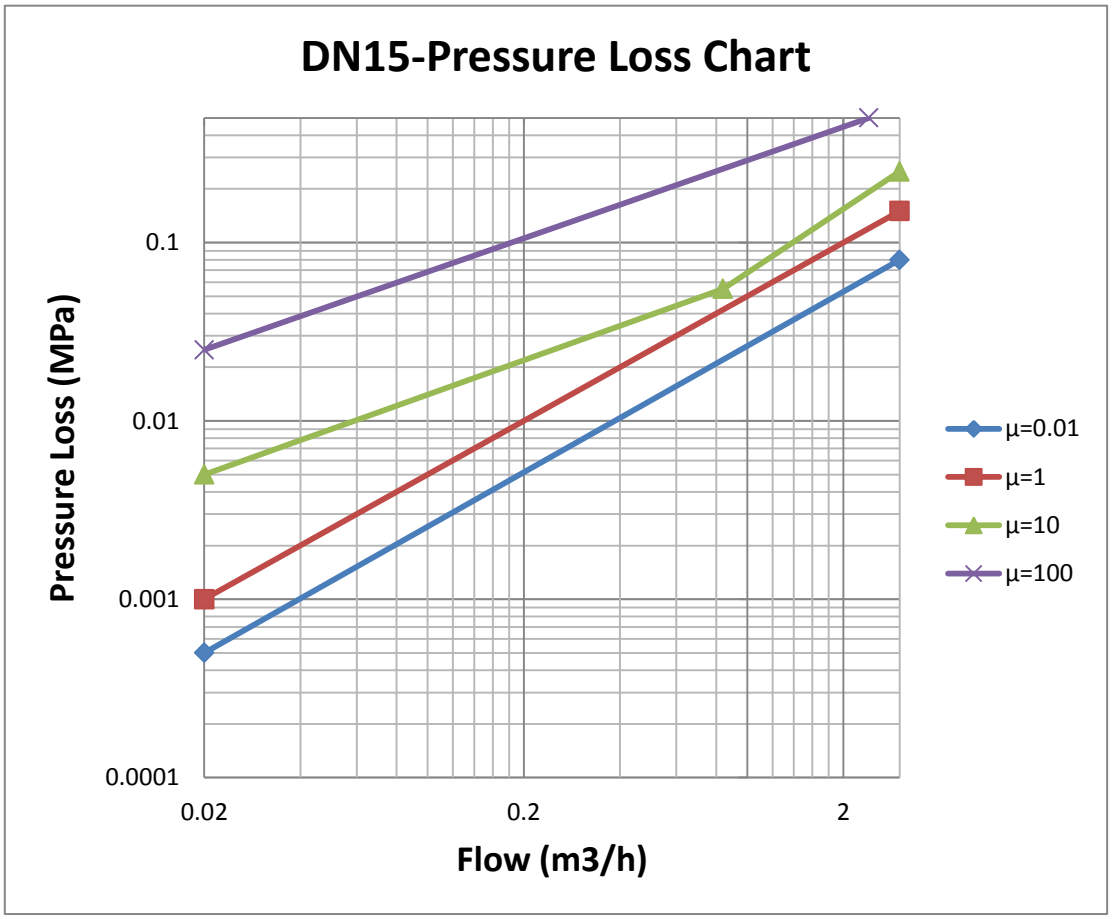
When the viscosity is between two adjacent pressure loss lines, the pressure loss can be calculated with following formula:

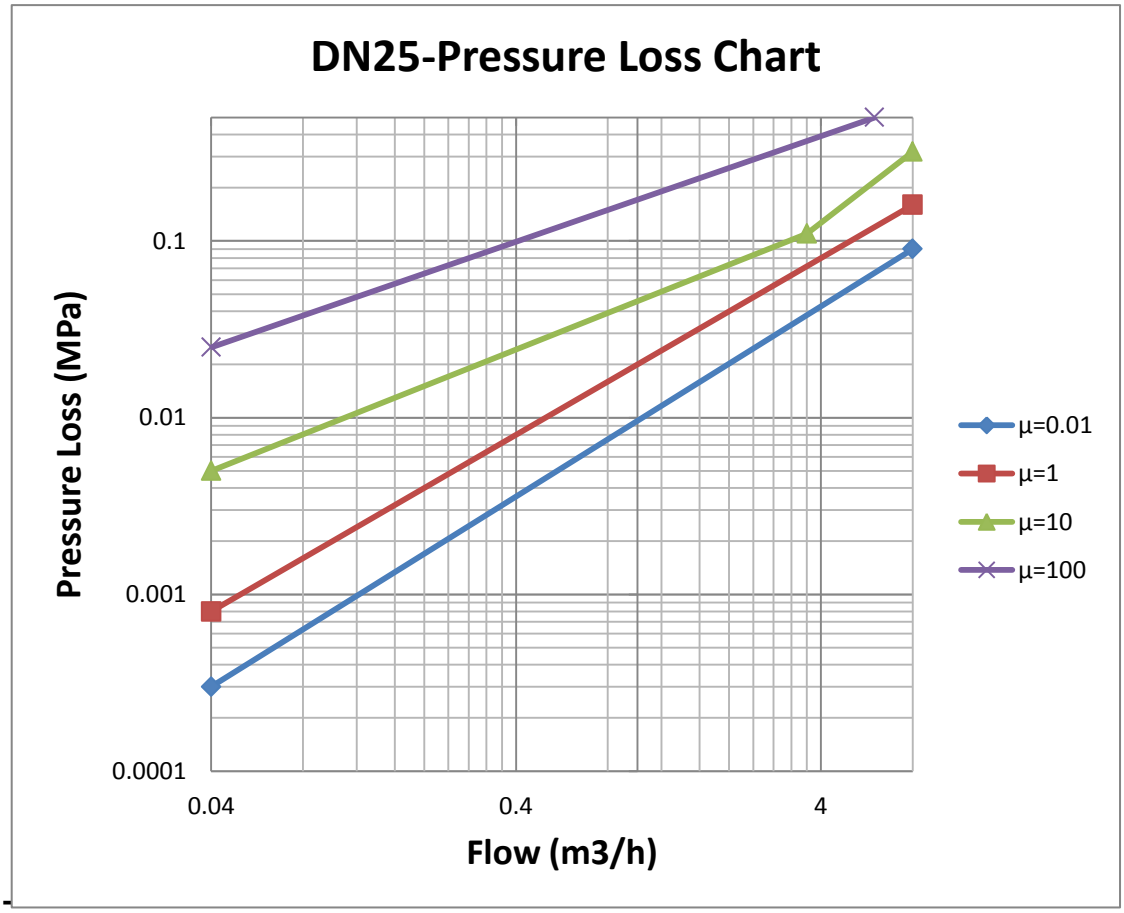
$$\Delta P = \Delta P_1 + \frac{\Delta P_2 - \Delta P_1}{\mu_2 - \mu_1} \times (\mu - \mu_1)$$

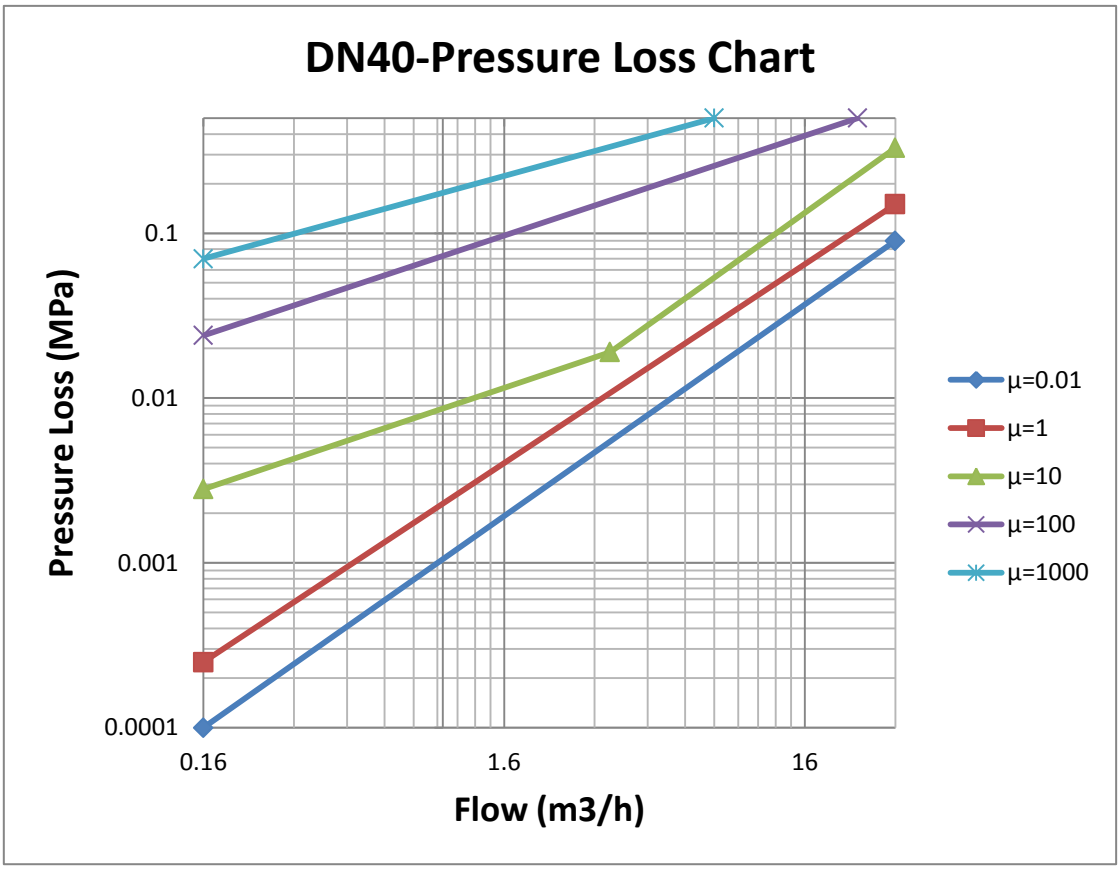
Note: the mass flow value should be converted to the volume flow value.

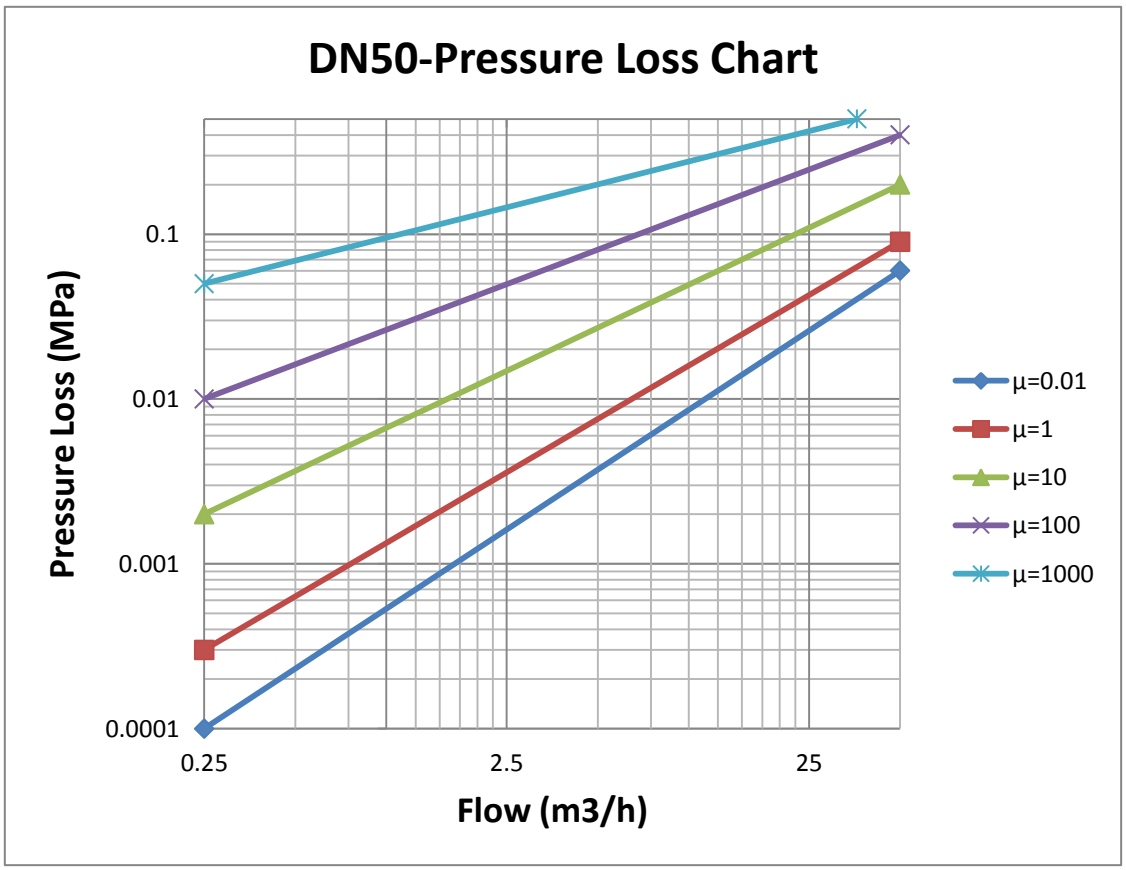
Follow is the pressure loss for different size flow meter (for triangle and U-type)

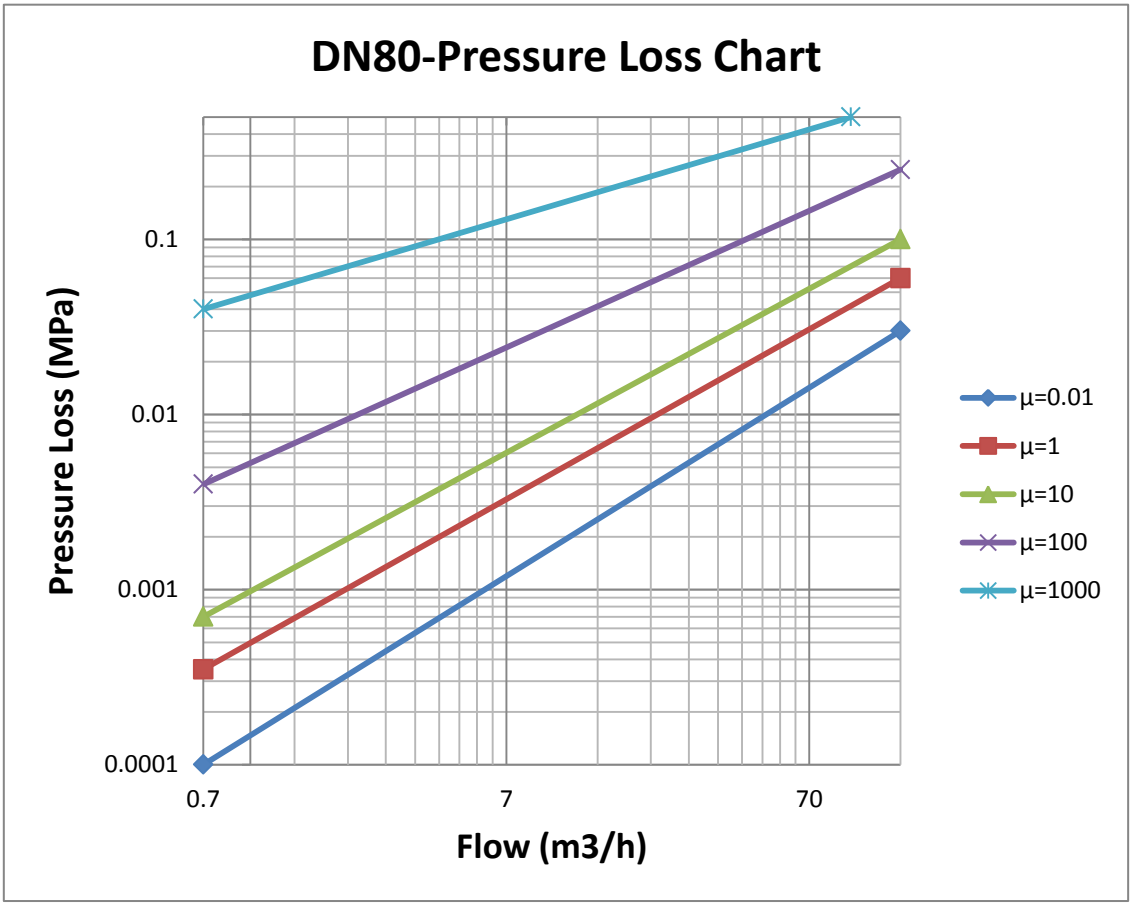


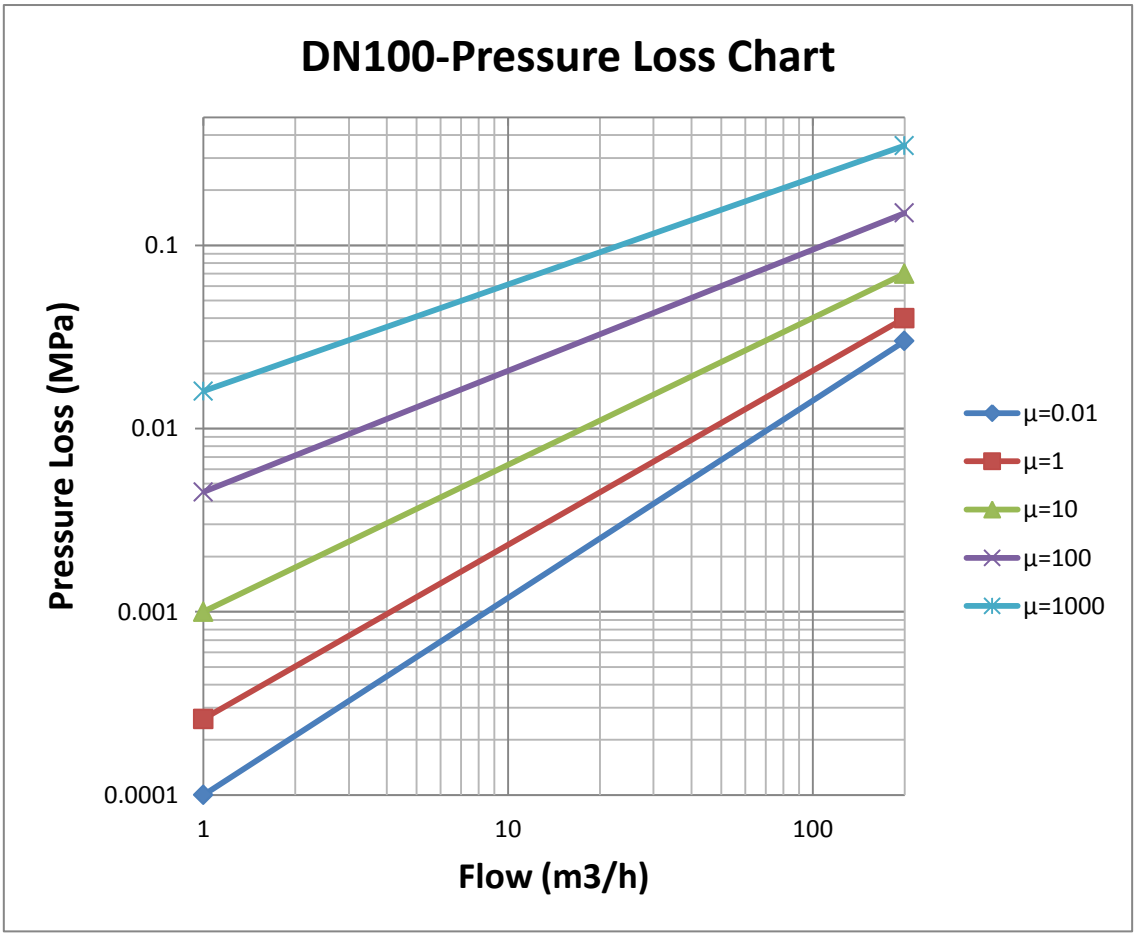

DN15-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
0.02
0.2
2
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100

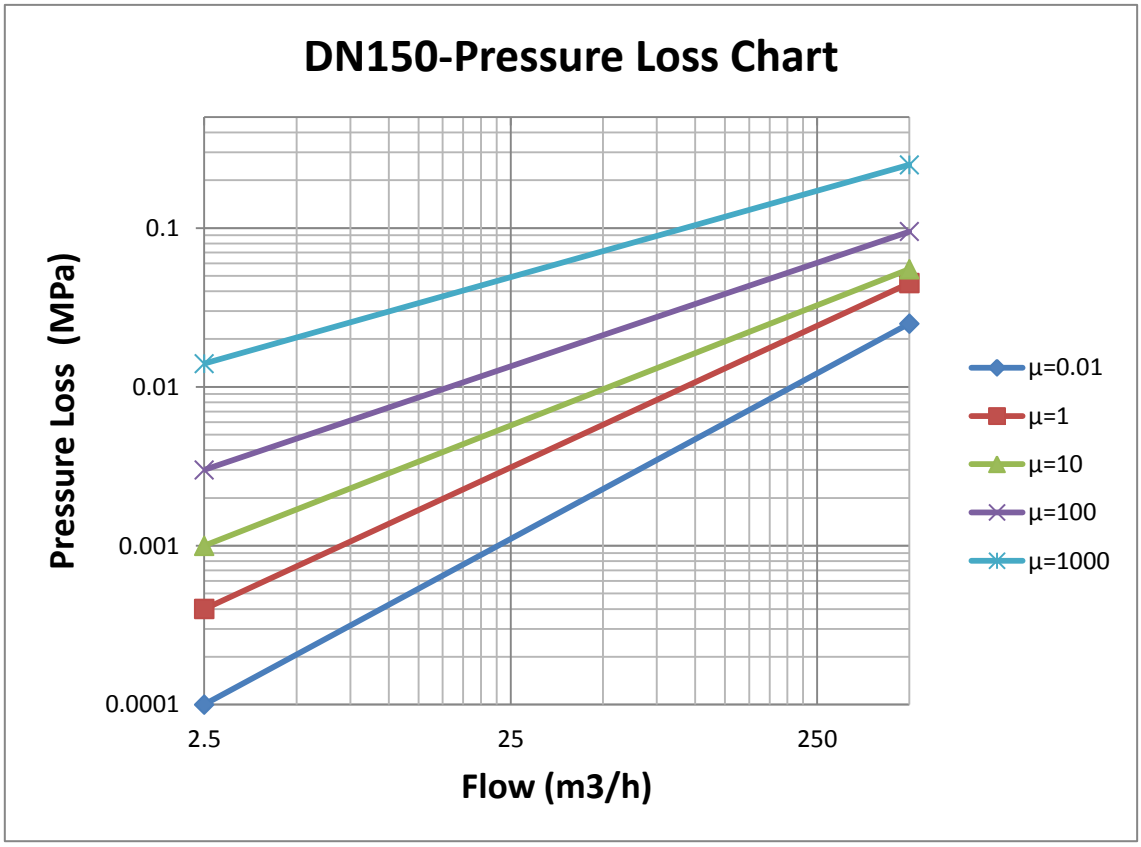

DN25-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
0.04
0.4
4
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100

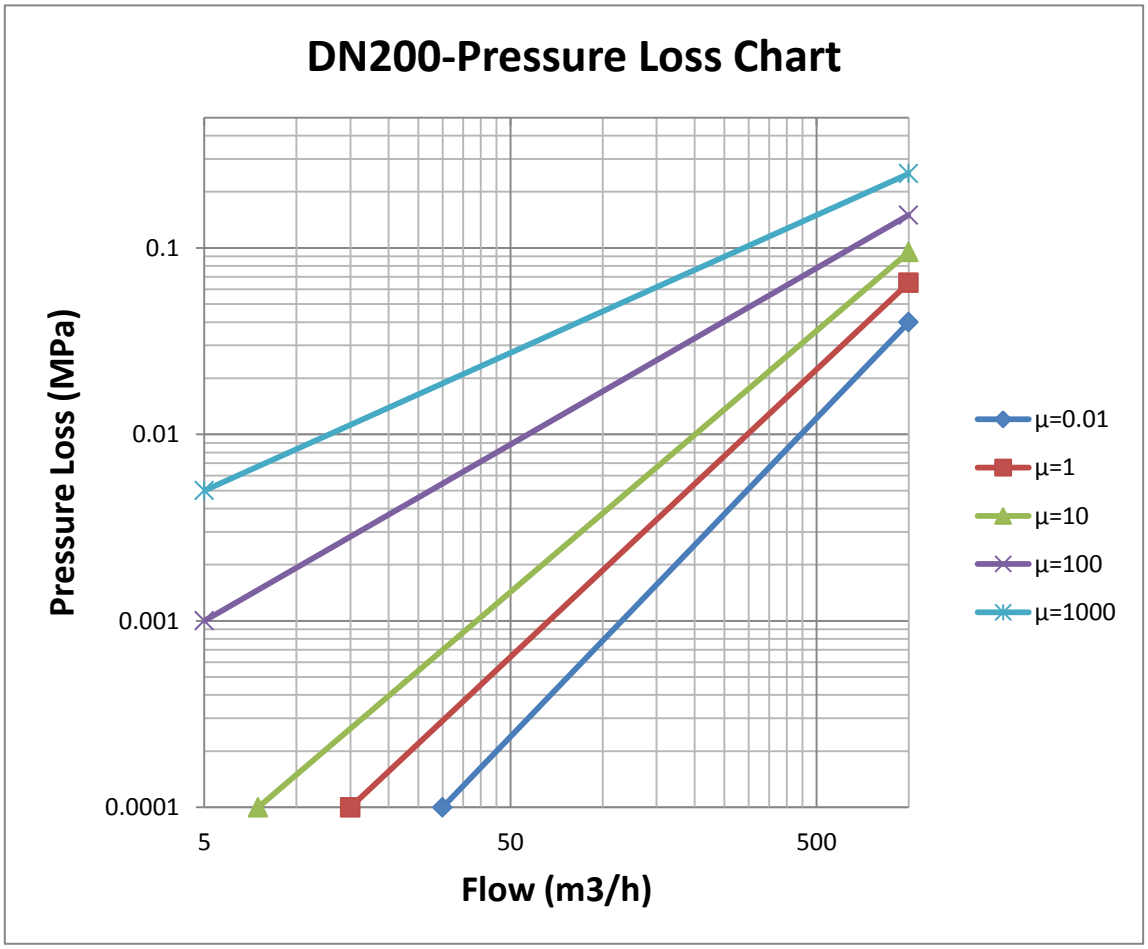

DN40-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
0.16
1.6
16
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN50-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
0.25
2.5
25
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN80-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
0.7
7
70
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN100-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
1
10
100
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN150-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
2.5
25
250
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN200-Pressure Loss Chart
Pressure Loss (MPa)
0.1
0.01
0.001
0.0001
5
50
500
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000

8. TROUBLE SHOOTING

8.1 Overview

For the first installation and operation, if there is something abnormal working phenomenon, the user should determine the causes.

Generally speaking, the causes may come from two kinds: flow meter or application causes. Application problem is usually complex, which involves the fluctuation measurement error caused by the process or medium status changes, which should be analyzed according to the actual application. While this chapter mainly focuses on the causes and trouble shooting of flow meter system malfunctions.

8.2 Diagnostic Tool

For the flow meter fault diagnosis, the user can determine by the OLED indicator and LCD displays, OLED lights of different colors and brightness contrast on the panel, which represent the working condition of flow meter. Meanwhile, LCD displays can show the self-diagnostic alarming information of the transmitter, which is favorable for user's judgment and defining the malfunctions.

In addition, it is necessary to use handheld digital multi-meter when testing the static resistance values and cables of the sensor.

8.3 Sensor

When testing the malfunction of the flow meter, first of all, detect the coils resistance of sensor according to Table 24 and check if their values are fallen within the normal range.

Table 26

Loop	Line color	Sensor port	Normal resistance range
Left coil	Brown, red	1, 2	(60~75)Ω
Right coil	Orange, yellow	3, 4	(60~75)Ω
Drive coil	Blue, green	5, 6	(6~30)Ω
Temperature	Gray, white	7, 8	(75~175)Ω
Temperature	Gray, black	7, 9	(75~175)Ω

8.4 Power and connection

The first installation of electricity, power should be checked to ensure that effective the following elements:

Choose the correct voltage for power supply, connect the power cable correctly, open insulating layer of two ends of the cable and pinch them firmly;

Power cable should be not connected with same output port of BF1001 Coriolis Meter Transmitter with signal cables of input/output;

Transmitter should be earthed firmly and the earth resistance should be less than 1 Ω, (use the copper wire with area more than 2.5 mm2).

8.5 OLED-Indicator

The proportion of light and dark shown by OLED indicator represents the working condition of the flow meter.

Table 27

OLED condition	Working condition
Always light at beginning	Impassable self-test
Always light afterward	Wrong zero-calibration
Light for 1/4second，dark for 3/4 second	Malfunction alarm
Light for 3/4second，dark for 1/4 second	Slug flow excesses