NAGMAN FLOW-LEVEL SYSTEMS AND SOLUTIONS LLP

TURBINE FLOWMETERS

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I. General

1.1 Introduction

QTLD turbine flow meter consists of turbine flow sensor and display instrument and it is made by us using foreign state-of-the-art technologies, which is an ideal gauge for measuring of liquid flow.

The flow meter is characterized by simple structure, high precision and easy installation and repair. The product may be used in a wide range of industries, including oil industry, chemical industry, metallurgy, water supply, paper-making, environment protection and food industry.

It is applicable for use in closed pipes to measure flow of liquid which will not erode stainless steel (1Cr18Ni9Ti), 2Cr13, Al2O3 and hard alloy and is free of impurities such as fiber and granules. If this product is used in association with display instruments with special functions, it can be used for purpose of automatic definite quantity control and alarming in case of excessive amount.

1.2 Product Features

1. The sensor is of hard alloy bearing thrust type, which may guarantee the precision and improve the wear resistance performance as well.
2. Simple and firm structure, easy for installation and dismantling.
3. Wide range of measuring with very low lower flow velocity limit.
4. Small loss of pressure, fine repeat ability and high precision.
5. High resistance to electromagnetic interference and vibration.

1.3 Working Principle

When liquid flows through the casing of sensor, the impulse of fluid will provide the blade with a rotation moment as there is an angle between the blade of impeller and
the flow direction. The blade will rotate as the friction moment and the fluid resistance are overcome and it will reach a stable speed when the moments are at balance. Under certain conditions, the rotation speed of blade will be in direct proportion to the flow velocity. Due to the magnetic conductivity of blade, when located in the magnetic field generated by signal detector (made of permanent magnet steel and coils), the rotating blade will cut the magnetic lines and periodically change the flux through the coil, thereby inducing electrical impulse signals at both ends of the coil. The induced signals, after amplified and rectified by amplifier, will form a continuous rectangular impulse wave with certain amplitude which may be remotely transmitted to display instrument indicating the instant flow and the cumulative flow of fluid. Within a certain range of flow, the impulse frequency \( f \) is in direct proportion to the instant flow of fluid flowing through the sensor, which is shown in the equation below:

\[
Q = 3600 \times \frac{f}{k}
\]

Wherein:

- \( f \)- Impulse frequency [Hz];
- \( k \)- Instrument factor of sensor [1/m3], which is given by checklist. If [1/L] is used as the unit, the equation will be:

\[
Q = 3.6 \times \frac{f}{k}
\]

- \( Q \)- Instant flow of liquid (in operation) [m3/h];
- 3600- Conversion factor.

Instrument factor of each sensor will be filled out in verification certificate by the manufacturer. The instant flow and cumulative flow will be displayed when the value of \( k \) is loaded into associated display instrument.

**1.4 Major Technical Performance**

1. Nominal drift diameter: (4〜200) mm, refer to Table 1 for the basic parameters;
2. Medium temperature: (-20〜80) °C; Split type (-20〜120) °C;
3. Ambient temperature: (-20~70) °C;
4. Precision: ±0.5%, ±1%;
5. Detector signal transmission wiring system: three-wire voltage impulse (three-core shield wire);
6. Power supply:
   1) TB3WE Three Wire
      External Power: 12~24VDC/30mA(-20%~+15%), if no output can be as low as 6V
      Battery: Lithium battery 3.6V(2/13Ah)/0.4mA
   2) TB2WE Two Wire
      12~24VDC/4-20mA(-20%~+15%)
7. Transmission distance: the distance between the sensor and the display instrument may be as far as 1000m;
8. Local display power supply: 3.6V (Lithium battery, may be used continuously for more than 3 years);
9. Display mode: local LCD displays instant flow and cumulative flow;
10. Output Signal
    a) TB3WE Three Wire
       1) Pulse Output: High level voltage amplitude ≥ 5V, low level ≤ 0.5V
       2) Three wire 4-20mA linearity correction current output (need ground wire) (load resistance ≤ 800 Ω at 24V)
       3) RS485 communication: flowmeter with RS485 interface, communication distance ≤ 1200mm.
    b) TB2WE Two Wire
       1) Two wire 4~20mA linearity correction current output (need ground wire) (load resistance ≤ 600 Ω at 24V)
       2) Origin Pulse output: High level ≥ 5V (power supply voltage - 1V), Low level < 0.5V
Table 1: Model Selection Guidance for Liquid Turbine Flowmeter

<table>
<thead>
<tr>
<th>Model Suffix Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QTLD -</td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Three Digital; for example: 010: 10 mm; 015: 15 mm; 080: 80 mm; 100: 100 mm</td>
</tr>
<tr>
<td>A</td>
<td>No display; 24V DC; Pulse Output</td>
</tr>
<tr>
<td>B</td>
<td>No display; 24V DC; 4 ~ 20mA Output</td>
</tr>
<tr>
<td>C</td>
<td>Local display; Lithium Battery Power; No output output</td>
</tr>
<tr>
<td>C1</td>
<td>Local display; 24V DC Power; 4 ~ 20mA Output; Optional backup power: Lithium Battery</td>
</tr>
<tr>
<td>C2</td>
<td>Local display; 24V DC Power; 4 ~ 20mA Output; Modbus RS485 Communication Optional backup power: Lithium Battery</td>
</tr>
<tr>
<td>Accuracy 10</td>
<td>Local display; 24V DC Power; 4 ~ 20mA Output; HART Communication Optional backup power: Lithium Battery</td>
</tr>
<tr>
<td>Accuracy 05</td>
<td>1.0% of Rate</td>
</tr>
<tr>
<td>Flow Range S</td>
<td>0.5% of Rate</td>
</tr>
<tr>
<td>Flow Range W</td>
<td>Standard Range: refer to flow range table</td>
</tr>
<tr>
<td>Body Material S</td>
<td>Wide Range: refer to flow range table</td>
</tr>
<tr>
<td>Body Material L</td>
<td>SS304</td>
</tr>
<tr>
<td>Body Material S</td>
<td>SS316</td>
</tr>
<tr>
<td>Body Material L</td>
<td>Safety Field without Explosion</td>
</tr>
<tr>
<td>Explosion Rating N</td>
<td>ExdIIIBT6</td>
</tr>
<tr>
<td>Explosion Rating E</td>
<td>Per Standard</td>
</tr>
<tr>
<td>Pressuring Rating N</td>
<td>Customized Pressure Rating</td>
</tr>
<tr>
<td>Pressuring Rating H(x)</td>
<td>DXX: D06, D10, D16, D25, D40 D06: DIN PN6; D10: DIN PN10 D16: DIN PN16; D25: DIN PN25 D40: DIN PN40</td>
</tr>
<tr>
<td>Pressuring Rating H(x)</td>
<td>JX: J1, J2, J4 J1: JIS 10K; J2: JIS 20K; J4: JIS 40K</td>
</tr>
<tr>
<td>Pressuring Rating H(x)</td>
<td>-TH: Thread; DN4...DN50</td>
</tr>
<tr>
<td>Pressuring Rating H(x)</td>
<td>-Tr: Tri-clamp, sanitary structure</td>
</tr>
<tr>
<td>Connection -DXX</td>
<td>Fluid Temperature</td>
</tr>
<tr>
<td>Connection -AX</td>
<td>-T1  - 20...+80°C</td>
</tr>
<tr>
<td>Connection -JX</td>
<td>-T2  - 20...+120°C</td>
</tr>
<tr>
<td>Connection -TH</td>
<td>-T3  - 20...+150°C</td>
</tr>
<tr>
<td>Connection -Tr</td>
<td></td>
</tr>
</tbody>
</table>

Model Code: QTLD - 050C10SSNN - A1 - T1
Explanation - Diameter: 50mm; Converter: 24V DC Power Supply, 4 ~ 20mA Output, Local Display
Accuracy: 1.0%; Flow range: 4 ~ 40 m3/h; Body Material: SS304; No Explosion;
Connection: ANSI 150# Flange; Fluid Temperature: -20...+80°C
1.5 Overall Dimension

The installation types of sensors vary according to specifications, which may be connected either by thread or flange. The installation types are shown in Fig. 1, Fig. 2, Fig.3, Fig. 4 and Fig. 5. The installation dimensions are shown in Table 2.

Fig. 1 Structure of DN4~DN10 sensor and installation dimension diagram


Fig. 2 Filter structure diagram

Clamp ring 2. Bolts 4×14 3. Washer 4. Sealing washer 5. Steel wire 1Cr18Ni9Ti-0.8×2.5 6. Filter screen 7. Base
Fig. 3 Structure of DN15～DN40 sensor and installation dimension diagram


Fig. 4 Structure of QTLD—50～200 sensor and installation dimension diagram


Fig. 5 Wiring diagram for connection between sensor and display instrument
II. Installation Requirements

Flow meter may be installed horizontally or vertically. In the latter case the fluid shall be flowing from downward and fulfill the pipe to avoid bubbles; the flowing direction of liquid shall be consistent with the direction indicated by the arrow on casing of the sensor; as far as front and rear straight pipe sections are concerned (see Fig. 6), at upstream there shall be front straight pipe section at least 10 times of nominal drift diameter in length and at downstream no less than 5 times of nominal drift diameter in length. The internal wall of pipe sections shall be smooth and clean, free of defects such as indent, fouling and peeling. The pipe axis of the sensor shall be aligned with that of the neighboring pipe and the washers used for connection and sealing may not be embedded into depth of the pipe cavity; the sensors shall be kept away from foreign electric field and magnetic field, effective shielding measures shall be taken in case of necessity to avoid external interference.

In order that the normal transfer of liquid will not be affected by maintenance, it is recommended that bypass pipes be installed at position of sensor.

In case of open air installation, water proof measures shall be taken for purpose of amplifier and plug of the sensor. The wiring between sensor and display instrument is shown in Fig. 5.

When fluid contains impurities, filter shall be additionally installed. The number of filter screen meshes is determined in accordance with the flow and impurity, normally 20 to 60 meshes. When fluid is mixed with free gases, gas eliminator shall be additionally installed. The complete pipe system shall be well sealed. The user shall fully understand the erosion nature of the measured medium to protect the sensor from being eroded.

Fig. 6 Requirements on straight pipe section for installation of flow meter
III. Operation

◆ When sensor is used, the liquid to be measured shall be clean and free of impurities such as fiber and granules.
◆ When sensor is used, it shall be at first slowly filled with liquid, then open the outlet valve (which should be installed behind the flow meter). It is prohibited to render the sensor under impact of high-velocity fluid when it is not filled with liquid.
◆ The maintenance interval for sensor is in general half a year. In case of maintenance and cleaning, attention shall be paid not to damage the parts in the measuring cavity, particularly the impeller. During assembly, watch carefully the positional relation between guide part and impeller.
◆ When the sensor will be out of service for a long time, the internal liquid shall be cleaned. After dried, the sensor shall be provided with protection sleeves at both ends to protect against dust and it shall be placed in dry conditions for storage.
◆ The associated filter shall be cleaned on regular basis and the internal liquid shall
be cleaned when it is out of service for a long time. Similar to sensor, the filter shall also be provided with dust protection and stored in dry conditions.

- The transmission wire of sensor may be overhead or buried (iron bushing shall be provided in the latter case).
- Prior to installation of sensor, the connection thereof with display instrument or oscilloscope shall be finished. Then switch on the power, blow the impeller with mouth or move the impeller with hand to make it rotate quickly, see if there is any reading. Install the sensor if there is reading. In case of no reading, the related sections shall be inspected to eliminate any fault.

### 3.1 Wiring

**Warning:**
*Before wiring, cut off the external power. Wiring with electric is strongly prohibit.*

#### 3.1.1TB3WE Three-Wire System Electric Wiring

1. **Main power supply and output signal terminals**
   (3-digit under-hang spinning terminals in the left).

<table>
<thead>
<tr>
<th>Fout</th>
<th>-</th>
<th>+</th>
</tr>
</thead>
</table>

   Fout: Pulse Signal Output Terminal
   “-” is the power supply “-” or current flow terminal
   “+” is external 12-24VDC power “+”
   When “+” “-” connect (or battery type power on), pulse output from “Fout”.

2. **Auxiliary Wire (small terminal)**
   The three-wire between main terminal and auxiliary terminal are pulse output switch.
   If insert into the outside F0, there will be pulse output.
   If insert into the inside NC, then no pulse output.
   For two wire current type, only insert outside F0 while testing.
   If use current, must insert inside NC to disconnect pulse output. Or else, the current will not be accuracy.
3. Battery Powered Type

<table>
<thead>
<tr>
<th>+3V6</th>
<th>3V6-</th>
<th>B-</th>
<th>A+</th>
</tr>
</thead>
</table>

1). Battery Wiring (the right side 1 and 2 in small terminal)
- +3V6: Connect 3.6V battery “+”
- 3V6-: Connect 3.6V battery “-”

2) Communication Wiring
(the left side 3 and 4 in small terminal, if without RS485, no terminal here)
- B-: Connect RS485 “B-”
- A+: Connect RS485”A+”

3.1.2 TB2WE Two-Wire System Electric Wiring

1. Main power supply and output signal terminals

<table>
<thead>
<tr>
<th>Fout</th>
<th>-</th>
<th>+</th>
</tr>
</thead>
</table>

“-“: 4-20mA output terminal
“+”: 15-24V power “+” terminal

“+” Connect with +24V external power, current output from “-” to computer/sample resistance of the display. After flow through some load resistance like sample resistance, then back to power “-”.

2. Auxiliary Wire (3-digit small terminal)
4-20mA current output type with no auxiliary small terminals.
Fout: Pulse output terminal
When “+” “-” connect with external power then work, pulse output from “Fout”.
The three-wire near main terminal are pulse output switch.
If connect to the outside F0, there will be pulse output.
If connect to the inside, then no pulse output.
For two wire current type, only insert outside while testing.
If use current, must insert inside NC to disconnect pulse output. Or else, the current will not be accuracy.
This pulse is origin pulse without any modify, usually use while doing calibration; Output signal is the open-collector output include 2K7 pull-up resistor.

System wiring please refer to the appendix “TB3WE three wire” and “TB2WE Two Wire”.

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3.2 Local LCD Operation Instruction

3.2.1 User Menu Operation

(1) Working Menu

After power-on, meter will be self-checking first, after then it will enter into LCD (figure 1) working display status.

<table>
<thead>
<tr>
<th>XX</th>
<th>XXXX</th>
<th>XXXX.XXm3</th>
</tr>
</thead>
<tbody>
<tr>
<td>XX</td>
<td>XXXX.XXm3/h</td>
<td></td>
</tr>
</tbody>
</table>

Chart 1 TB2/3WE working screen (Figure One)

The first line: High level of Accumulative flow; 5 fixed integer part number. If no, it’ll display as “0”.

The second line: Low level of Accumulative flow; 3 decimals part number after the 5 fixed integer number. The unit is the same with instant flow non-time part.

The third line: Instantaneous Flow; 5 or 6 integers and automatic keep 2 or 1 decimals. The unit can be set.

Press “<” or “>” to change the screen from Working Screen 1 and 2

| T=xx.xx °C |
| P=xx.xxkPa |
| F=xx.xxHz |
| Enter pass word:xxxx |

Chart 2 TB3WE Three-wire System working screen (Figure Two, Sub Screen)
From Up to Down:
The first line: Temperature value setting for temperature compensation calculation, shows "T=999.9°C", reserving 1 decimal.
The second line: Pressure value setting for pressure compensation calculation, shows "P=99999.99kPa", reserving 2 decimals.
The third line: For TB3WE is frequency value.
   For TB2WE is frequency value(left side) and current output(right side)

The four line: password entering set state.
Press the enter key of “<” (about 1.2 seconds) to enter password initial input state.
Press the key of “+”(about 1.2 seconds) to cancel entering state and return to figure two Subsidiary LCD.

Press “+” key in the input state to change the value of cursor circularly.
Press the shift key “<” to change the position of input cursor.
Press “<” key (about 1.2 seconds) at the input state to submit the password.
If right, enter to menu, if incorrect, return to initial input state.

Password: User menu password 2010

3.2.2 User’s Data Setting

1. Input operation
In the input state:
Pree “+”key in a long time to exit the input state.
Pree “<”key to confirm and save the input.
Press “+”key in the input state to change the value or symbol of cursor circularly.
Press “<”key to move the current cursor one position towards the right.
Max. 8 digits inputting is allowed.(including the symbol, decimal).

2. Menu Operation
In the menu browse:
Press “+” key for page down;
Press “<” key for page up;
Long Press “<” key for entering into the sub-menu;
Long press “+” key for returning to the working screen figure 2;

In the sub-menu, long press “+” key to quit out; long press “<”key to enter into modified state: In the modified state, press “+” key for downward selecting; press “<” for upward selecting; long press “<”key for confirmation and saving.

Attention: When the parameter setting, it should long press “<”key for saving the displaying. Otherwise, the setting is invalid.

### User Parameter Setting Menu

<table>
<thead>
<tr>
<th>Sub-menu Series#</th>
<th>Display of menu</th>
<th>Definition</th>
<th>Alternative options or range of value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flow Unit select</td>
<td>Flow Unit select (default 0)</td>
<td>0: m³/h 1: m³/m 2: l/h 3: l/m 4: t/h 5: t/m 6: kg/h 7: kg/m</td>
</tr>
<tr>
<td>2</td>
<td>Algorithm Selection</td>
<td>Algorithm Selection (default 0)</td>
<td>00: Conventional Volume flow 01: Conventional mass flow 02: Volume flow of conventional gases 03: Mass flow of conventional gases</td>
</tr>
<tr>
<td>3</td>
<td>Flow Coefficient</td>
<td>Flow Coefficient (default 3600)</td>
<td>Set the meter coefficient with the unit of P/m³</td>
</tr>
<tr>
<td>4</td>
<td>Maximum Output Flow</td>
<td>Max. Flow (default 1000)</td>
<td>When the meter outputs 4~20mA analog signal, must set the value and the value cannot be zero, the unit should be accordance with the flow unit.</td>
</tr>
<tr>
<td>5</td>
<td>Density setting</td>
<td>Density setting (default 1.0)</td>
<td>When Algorithm Selection is setting to mass flow(01,03), it must set this item, the unit is kg/m³</td>
</tr>
<tr>
<td>6</td>
<td>Temperature Setting</td>
<td>Temperature Setting (default 0.0)</td>
<td>Setting the temperature calculated value, when choose 02,03,04,06 algorithm, it must set this item, the unit is Celsius degree.</td>
</tr>
<tr>
<td>7</td>
<td>Absolute pressure setting</td>
<td>Gas Absolute pressure set (default)</td>
<td>Setting the absolute pressure of gas, when choose 02,03 algorithm, it must set this item, the unit is Kpa. (when vacuum is 0.0, it will cause the flow is 0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Low flow cut off</td>
<td>Set percentage of resection pulse input (Default 1%)</td>
<td>The value is between 0~100</td>
</tr>
<tr>
<td>9</td>
<td>485 Address</td>
<td>Set RS485 communication No. (Default 1)</td>
<td>For three-wire system TB3WE only. The meter uses RS485 communication should set this item, and should not equal to other equipment in the same system, the range is 0~255.</td>
</tr>
<tr>
<td>10</td>
<td>Damping time</td>
<td>Set current output damping time (Default 4s)</td>
<td>Setting current and displaying damping time, it is for avoiding the current’s fluctuation too big along with the flow rate. The range is 2~32.</td>
</tr>
<tr>
<td>11</td>
<td>Reset Cumulant</td>
<td>Reset cumulant</td>
<td>If need to Reset cumulant, choose YES and press “E” key.</td>
</tr>
</tbody>
</table>