Tosilon Automation

Your Global Partner for Engineering

Density Solution

TDW Series

Tuning Fork Density Meter

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TDW Fork Density Meter could apply the on-line density testing. It could be applied in the product process controlling based on the basic parameters of density, or the mass controlling system as the solid percentage or the concentration for references.

Typical Industries include petroleum chemical industry, wine industry, food industry, pharmaceutical industry and mineral processing, (for example clay, Carbonate Carbon, Silicate, etc.). The Fork Density Meters are applied in the pipeline detection of the multiple medium of the industries listed above, density testing of the stirred mixture, the reaction kettle end monitoring, and the separator interface detection.

The communication protocol adopted by TDW Series is HART based

Working Principle

The working principle of the TDW Series Tuning Fork Density Meter is based on resonance. The vibrating element consists 2 tuning forks that is driven by piezoelectric crystal. The vibrating frequency, detected by another piezoelectric crystal, is processed by phase shift and amplifying circuit. The tuning fork will be stabilized based on natural frequency.

The vibration will be changed when there are liquids passing through, that change the resonant frequency. Processed by the electronic processing unit, the density is precisely calculated. The following is the relationship between vibration frequency and the density:

$\rho=K_0+K_1T+K_2T^2$

ρ	-	Fluids' Density
T	-	Vibration Period output by Sensor
K_0, K_1, K_2	-	Sensor Constant (calibrated during the production)

The density meter integrates a temperature sensor that enable auto-temp. compensation.

Typical Application Fields

Sugar Industry & Wine Making Industry

Juicing; Syrup; Grape Juice; Ethanol

Dairy Industry

Condensed Milk; Milk Sugar; Cheese; Yogurt

Construction Industry; Mining Industry

Size Mixing; Coal Washing; Potash; Brine; Phosphate; Limestone; Bauxite

Oil Refinery

Lubricating Oil; Aromatic; Fuel Oil; Vegetable Oil

Food Processing

Tomato Juice; Fruit Juice; Vegetable Oil; Starch Milk; Jam

Chemical Industry

Carbamide; Detergent; Polymer; Ethylene Glycol; Sodium Chloride; Caustic Soda

Petrochemical Industry

LPG; Kerosene; Lubricating Oil

Environmental Protection

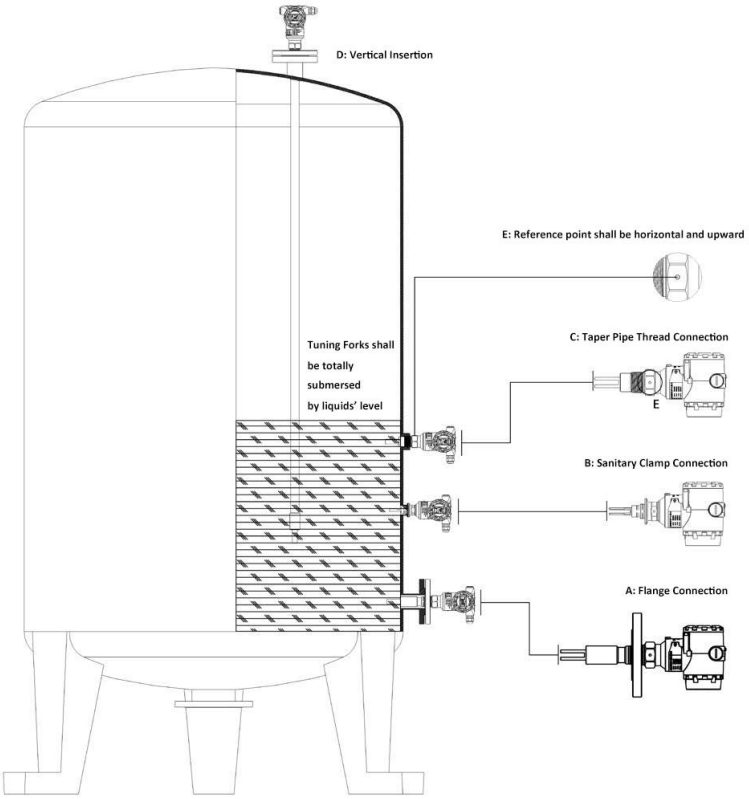
Desulfurization; Denitration

General Technical Index

Full Scale	-	0~3 g/cm³	**Impact from Pressure**	-	Negligible
Set Range	-	0~3 g/cm³	**Built-in Temperature Sensor**	-	PT100
Accuracy	-	±1 kg/m³	**Wetted Parts**	-	Stainless Steel 316L/ HC Hastelloy
Repeatability	-	±0.1 kg/m³	**Tine Finish**	-	Standard , PFA Coated, or Electro-Polished
Working Temp.	-	-20~150 Deg. C	**Power Supply**	-	24VDC,≥500 mA
Pressure Rating	-	10MPa ~ 20MPa	**Analog Output**	-	4 -20 mA, 0-100%, HART
Viscosity Range	-	0~20000cP	**Density Accuracy - (20 °C)**	-	± 0.1% or ± 0.05% FS of indicated figures
Temperature Effect	-	Less than 0.1 kg/m3/^{0}C (After Calibration)	**Repeatability - (-40 ~85 °C)**	-	± 0.05% F.S.
Process Connection	-	ANSI 150 ~ 1500 RF	**Electric Enclosure**	-	Aluminum Alloy
Protection Class	-	IP67	**Ex-Proof**	-	Exd IIC T6 Gb

Installation

Tank Mounting



Types of Mounting

A	-	Flange Connection
B	-	Sanitary Clamp Connection
C	-	Thread Connection
D	-	Vertical Insertion

Notes:

- **The tuning forks shall be totally submersed by the liquids**

Under the condition that the liquid is static

Level shall be better 200mm higher than the tuning forks

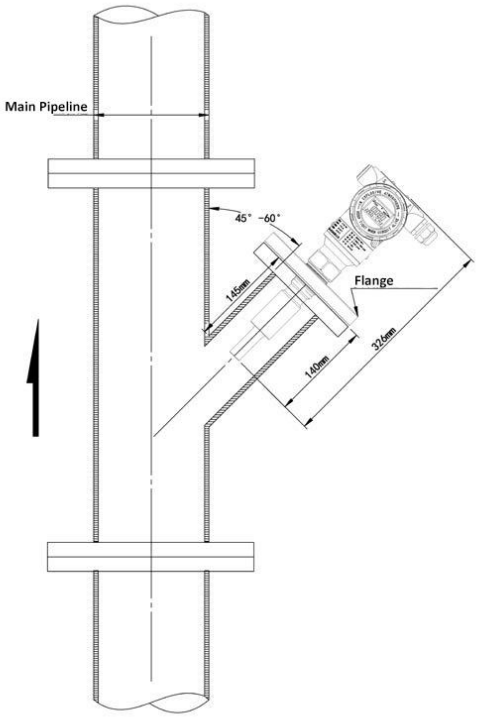
Under the condition that the liquid is stirred

Level shall be better 500mm higher than the tuning forks

The forks shall keep distance from the agitator

Reference point shall be horizontal, upward / downward

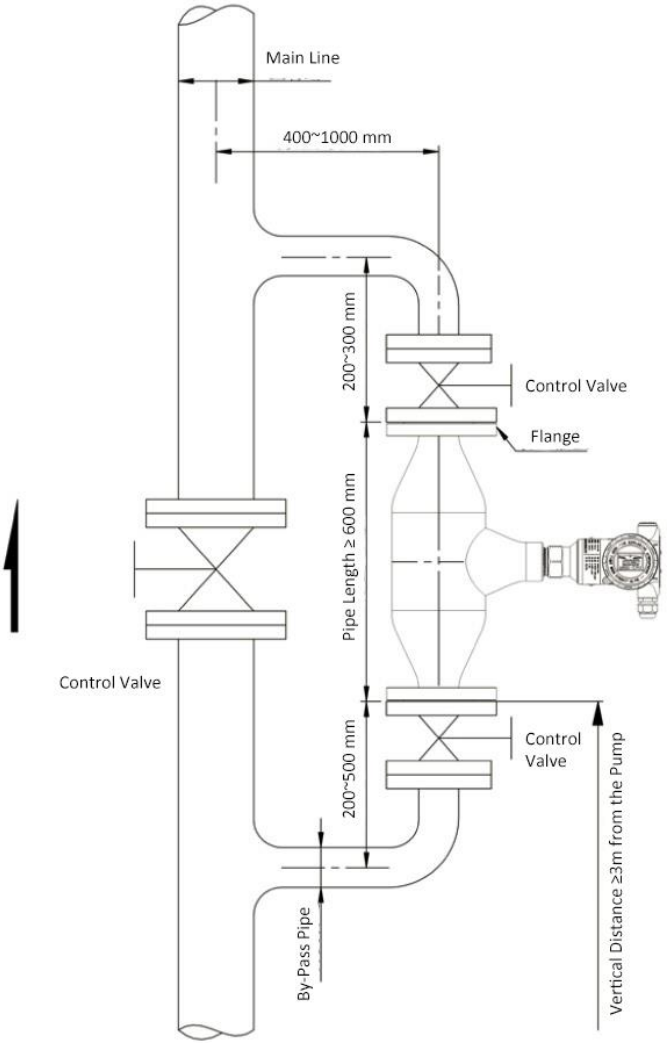
"Y" type Pipe Mounting



Applicable for Lower Velocity Fluids

- Velocity: ≤ 0.8 m/s
- Air Bubble will influence the measurement
- The flow shall be better stable during the application
- The flow direction in the main pipe shall be upwards
- The tuning fork shall not be extended to the main pipe

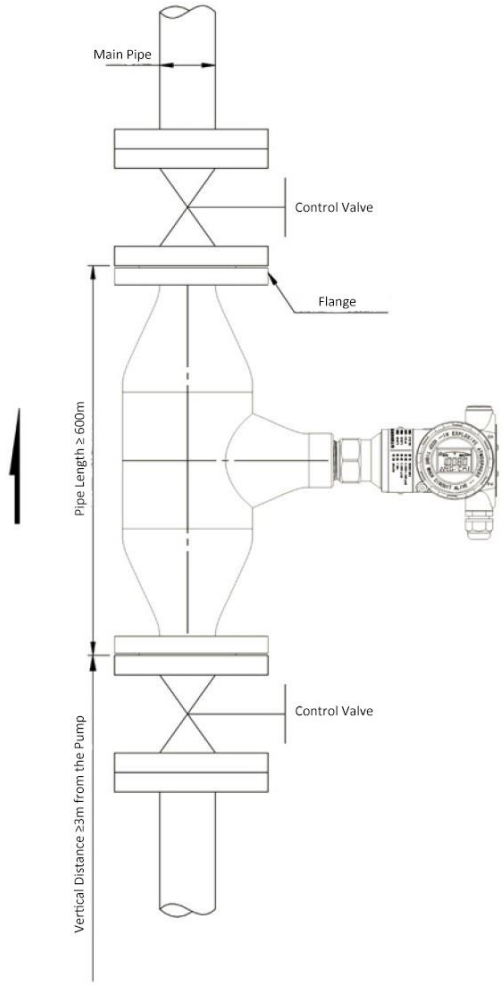
By-pass Vertical Pipe Mounting



Applicable for Main Pipe where the Velocity is over 3m/s

- Air bubble shall be avoided that influence the measurement
- The velocity in the by-pass pipe shall be lower than 1m/s controlled by the control valve
- The distance between the by-pass inlet and the pump shall be better over 2m vertically

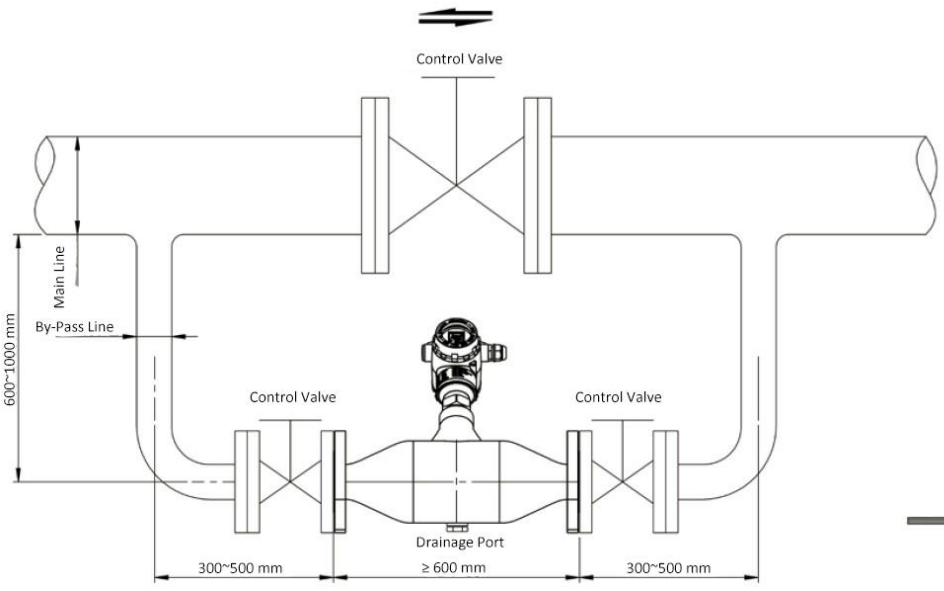
Vertical Pipe Mounting (Direct Insertion)

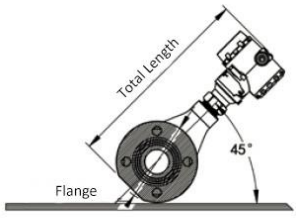


Applicable for Main Pipe where the Velocity is over 3m/s

1. Air bubble shall be avoided that influence the measurement
2. The velocity in the pipe shall be lower than 1m/s controlled by the control valve
3. The distance between the by-pass inlet and the pump shall be better over 3m vertically

By-pass Horizontal Pipe Mounting

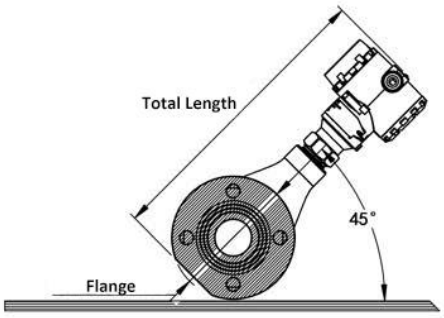


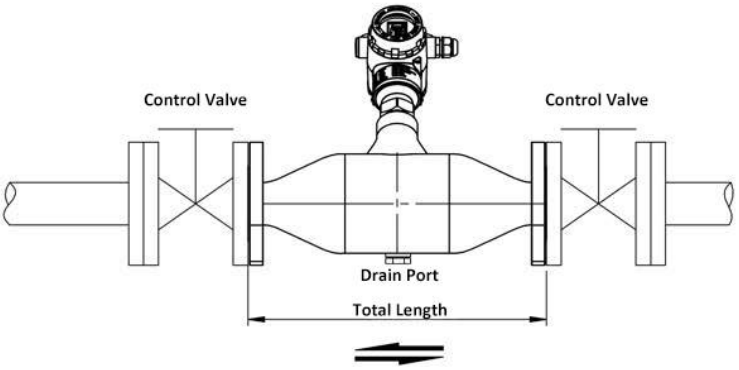


Applicable for Main Pipe where the Velocity is over 3m/s

- Air bubble shall be avoided that influence the measurement
- The velocity in the by-pass pipe shall be lower than 1m/s controlled by the control valve, that also reduce the air-bubble

Horizontal Pipe Mounting (Direct Insertion)

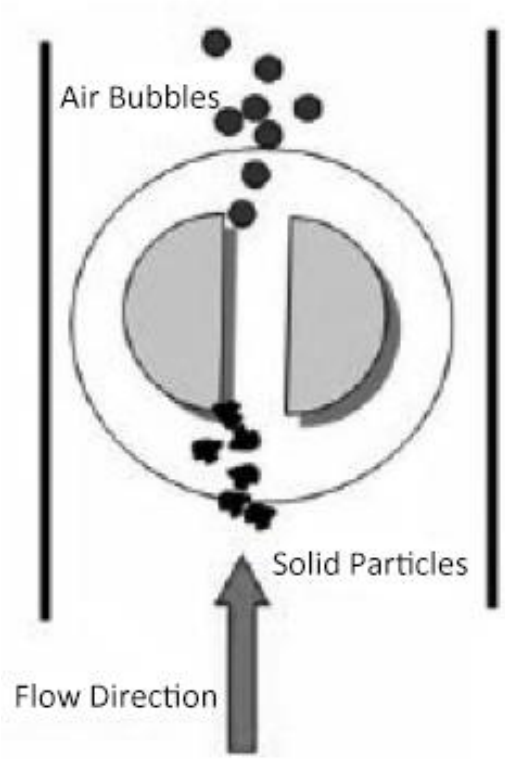


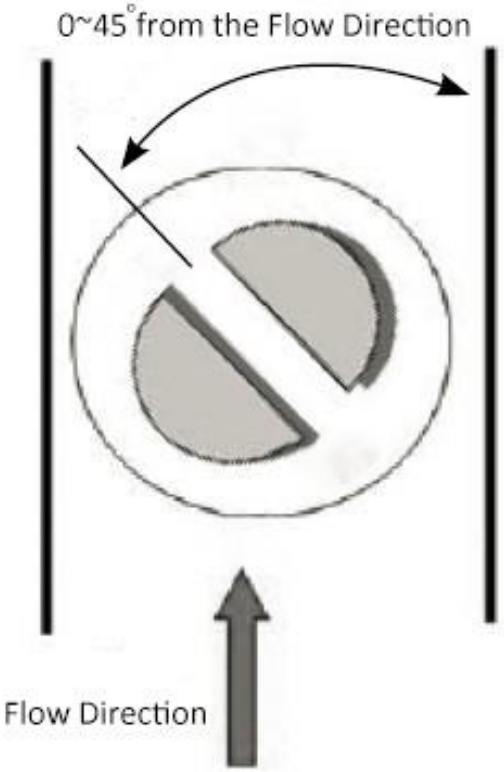


Applicable for Main Pipe where the Velocity is over 3m/s

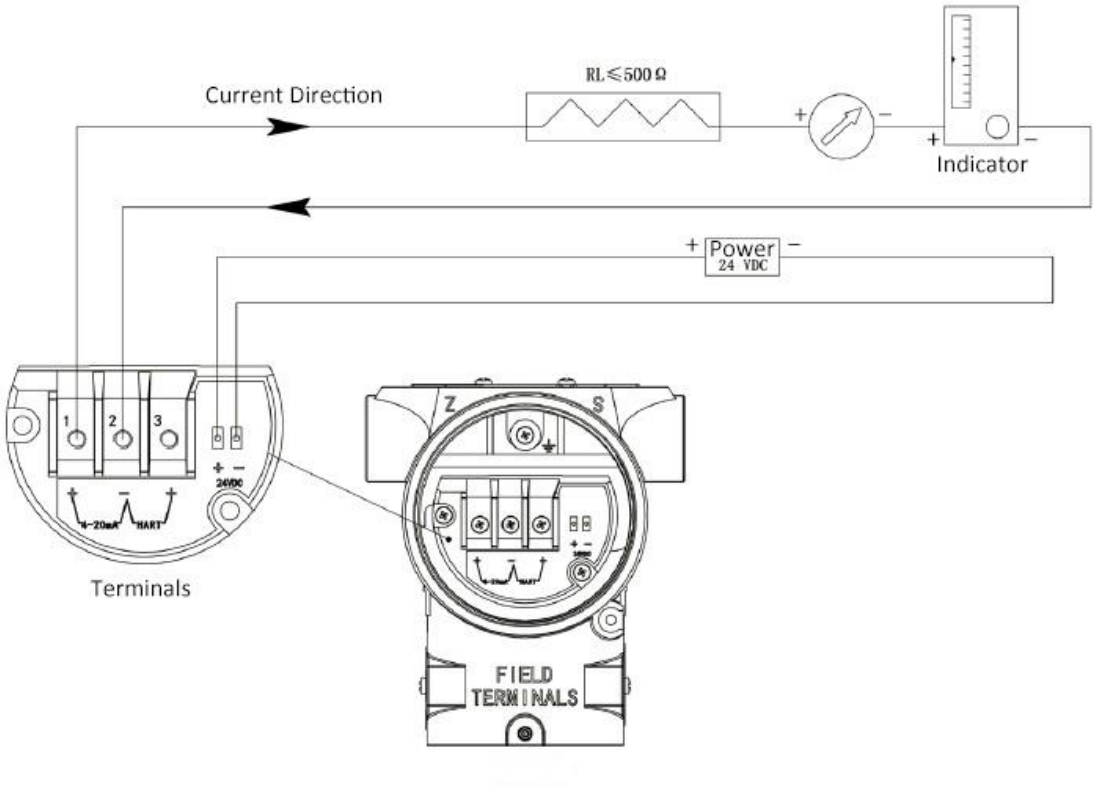
- Air bubble shall be avoided that influence the measurement
- The velocity in the by-pass pipe shall be lower than 1m/s controlled by the control valve, that also reduce the air-bubble

Tuning Fork Position





Electrical Connection



4-wire; 4-20mA, via HART

Remark:

1. When the connection load is not connected, the LCD light is out.

2. When the connection load is not connected during the testing, terminal 1&2 for 4~20mA could be wired as in short circuit.

3. When the load is over 500Ω, terminal 2&3 for HART could be connected in short circuit.

Operation Manual

Buttons

Button		Description
M	-	Function
Z	-	Shift Right
S	-	Value Adjust

Menu Instruction

Manual No.	Function	Interface	Description
3	Lower Range Set		Set based on site requirement
4	Upper Range Set		Set based on site requirement
5	Damping Time Set		Default Value: 0s
11	Master Variable Fine Tuning Set		Master Variable Fine Tuning Set for Site

Note:

The code need to be input, before make adjustment on the density meter.

The “Step 1 & 2” is the instruction on code input.

Lower Range Set

Step	Description	
1	Hold "M" for 3 seconds, then release "M", the interface will be	
2	Press “Z” to move the flashing position to the last bit, then press “S” change number into “2”, the interface will be Then Press “M” to confirm.	
3	Press "M" to paging, when the interface shown comes, Press "S" to inter this menu	
4	Pressing "Z" to shifting the flashing position, press "S" to adjust the value into 0.0000, Then press "M" to save and paging to next menu.	

Upper Range Set

Step	Description	
1	Hold "M" for 3 seconds, then release "M", the interface will be	
2	Press “Z” to move the flashing position to the last bit, then press “S” change number into “2”, the interface will be Then Press “M” to confirm.	
3	Press "M" to paging, when the interface shown comes, Press "S" to inter this menu	
4	Pressing "Z" to shifting the flashing position, press "S" to adjust the value as required Then press "M" to save and paging to next menu.	

Damping Time Set

Step	Description	
1	Hold "M" for 3 seconds, then release "M", the interface will be	
2	Press “Z” to move the flashing position to the last bit, then press “S” change number into “2”, the interface will be Then Press “M” to confirm.	
3	Press "M" to paging, when the interface shown comes, Press "S" to inter this menu	
4	Pressing "Z" to shifting the flashing position, press "S" to adjust the value as required Then press "M" to save and paging to next menu.	

Master Variable Fine Tuning Set

Step	Description	
1	**Hold "M" for 3 seconds, then release "M", the interface will be**	
2	**Press “Z” to move the flashing position to the last bit, then press “S” change number into “2”, the interface will be Then Press “M” to confirm.**	
3	**Press "M" to paging, when the interface shown comes, Press "S" to inter this menu**	
4	**Pressing "Z" to shifting the flashing position, press "S" to adjust the value as required (This value shall be the actual density value anticipated). Then press "M" to save and paging to next menu.**	

Remark

When completing the one menu setting, if there’s no need to change other values on menus, keep pressing “M”, then the interface will show

If there is no “button operation”, the interface will automatically return to normal monitoring interface.

Trouble Shooting

Alarming Error (corresponding to output current)

- Checking the diagnosis information if the density meter has error.
- Checking the “mV” value of the density meter’s output and signal input device. Make sure the measuring range of the density meter complies with the system setting.

Measuring Value is not stable (jumping frequently)

- Checking if the pipe is fully filled by the fluids, also make sure the fluids is free of bubble.
- Checking the fluids’ velocity, make sure the velocity is within the value required

Measuring Value is higher

- Checking the position of the tuning fork, make sure the sensor is free of wall effect.
- Checking the fluids’ character, including viscosity, corrosivity, solid particle size.
- Checking the pipe vibration condition. The intensive vibration will influence the measurement.

When there’s error happen, please contact Tosilon. (mason.ding@tosilon.com)

Remark

- **Before running the density meter, make sure the power supply is correct.**
- **The “Ground Protection” is recommended to be deployed.**
- **After wiring, check and make sure the cable glands and enclosure covers are tightly screwed.**
- **Clean the sensor (tuning fork) regularly that is positive to the service life**

Material & Liquids Compatibility List

A: Recommended		B: Applicable under specific concentration & Temp.				C: Normally not Adopted		
Liquids Character	**Liquids Name**	**Molecular Formula**	**Concentration (%)**	**Zirconium**	**Hastelloy B-3**	**Hastelloy C22**	**MONEL 400**	**SS**
Acid	Hydrochloric Acid	HCl	0~40	A	B	B	C	C
	Sulfuric Acid	H_2SO_4	0~50	B	A	B	B	B
		H_2SO_4	50~75	C	B	B	C	C
		H_2SO_4	75~98	C	B	B	C	B
	Nitric Acid	HNO_3	0~100	A	B	B	C	B
	Phosphoric Acid	H_3PO_4	0~98	B	A	A	C	B
Alkali	Sodium Hydroxide	NaOH	0~100	B	A	A	A	B
	Potassium Hydroxide	KOH	0~50	A	A	A	A	B
	Calcium Hydroxide	$Ca(OH)_2$	0~50	C	A	A	A	B
Others	Urea	$(NH_2)_2CO$	0~100	A	C	A	C	A
	Sodium Hypochlorite	NaOCl	0~16	B	C	B	C	C
	Hydrogen Peroxide	H_2O_2	0~90	B	B	A	B	A