



FLOW METER CONVERTER USC-741 INSTRUCTION MANUAL



This instruction manual is for the USC-741 type electronics for the M-2000 series high purity ultrasonic flowmeters. Read thoroughly before installation and operation..

- Specification is subject to change without notice.

Contents

■ Notation	3	6. PARAMETER SETTING UP-EXAMPLE	15
■ Operational Notes	3	6.1 full scale flowrate setting	15
1. INSTALLATION	4	6.2 Alarm output function - selection and setting	16
1.1 Installation of Flow Detector	4	6.3 Totalization function setting.....	18
1.1.1 Selecting location	4	6.3.1 Totalization function output - calculation of setting value	18
1.1.2 Mounting of Flow Detector	4	6.3.2 Totalization output change setting.....	18
1.2 Installation of Converter	4	6.3.3 totalization output preset function selection and setting	20
1.2.1 Selecting location	4	6.4 Manual linearizer setting.....	22
1.2.2 Mounting of Converter	4	6.4.1 How to use the linearizer	22
1.3 Wiring	5	6.4.2 Linearizer data input procedure.....	22
1.3.1 Connection to Detector	5	7. MAINTENANCE NOTE	24
1.3.2 Wiring of terminals	5	7.1 Connection of Flow Detector	24
2. COMPONENT NAMES OF FRONT PANEL	7	7.2 Connecting pipe	24
2.1 Name and its function	7	7.3 Cable connectors	24
3. OPERATION	8	7.4 Sediments or bubbles in the Flow Detector...	24
3.1 Inspection before start up	8	8. TROUBLE SHOOTING	24
3.1.1 Confirm the following before switching power on.....	8	9. FITTING TOOLS COMBINATION	32
3.1.2 Introduction of fluid into detector.....	8	10. SERVICE NETWORK	33
3.2 Operation	8	11. WARRANTY	33
3.2.1 Switching on power	8	12. Appendix	34
3.2.2 Zero adjustment	8	12.1 Sound Velocity of Water (m/s)	34
3.2.3 Operation	9	12.2 Kinematic Viscosity of Water (mm ² /s).....	34
4. PARAMETER CONFIGURATION	10	12.3 Recommended Full Scale Flowrate and Flow unit	34
4.1 Mode switch function and setting keys... ..	10		
4.2 Parameter setting	12		
4.2.1 Setting procedure.....	12		
4.2.2 Parameter contents.....	12		
5. ERROR MESSAGES	13		
5.1 Error message list	13		

• Notations

Safety symbols

This manual classifies safety notes using the following symbols:

WARNING

If this indication is disregarded and the instrument is operated incorrectly, serious injury or fatal accident may result.

CAUTION

If this indication is disregarded and the instrument is operated incorrectly, injury or property damage may result.

NOTES

Indicates procedures or information required to operate this product.

Operation notes

WARNING

This product is delivered after manufacturing and adjustments. All testing and Inspections have been conducted based on optimum quality control methods for industrial instruments. DO NOT ATTEMPT to modify or change settings as this instrument may fail to perform as intended or incompatibility and accidents may result. DO NOT MODIFY settings, If necessary to modify or change, contact malema sensors.

WARNING

Be sure to operate the instrument within the ranges of the specifications for fluid pressure and temperature listed in the Approval drawing. If the instrument is operated out of these ranges, it may become defective or be damaged.

CAUTION

During transportation and storage, ensure to prevent moisture, dirt or sand from entering the instrument, this will cause damage or render the instrument defective.

CAUTION

Use this product only as an industrial instrument.

CAUTION

The material of this product is described in the approval drawing. Although we make every effort to select the optimal material for the customer's specifications, it may not be perfect due to the presence of contaminations. user is responsible for checking for corrosivity and compatibility.

WARNING

When removing this product from your process for maintenance or inspection, make sure there is no material to be measured remaining in the instrument. If the material is corrosive or toxic, the operator may be adversely affected.

WARNING

Although the product is delivered after manufacturing, adjustments and inspections based on the optimum quality control methods applicable to industrial instruments, an unanticipated defect may occur. If this product is used in process control all necessary safety precautions should be followed to avoid any critical safety problems.

1. INSTALLATION

1.1 Installation of Flow Detector

1.1.1 Selecting location



NOTES

The following must be considered when selecting installation location of the Flow Detector:

- 1) Ambient temperature: 10 to 60°C (50 to 140°F) protected from direct sunshine.
- 2) Free from electromagnetic interference. Keep away from such heavy inductive devices as motors, pumps, power-relays and solenoid valves.
- 3) The location must be protected from water splashes or corrosive gases.
- 4) The location should be of easy access for maintenance.

1.1.2 Mounting of Flow Detector



NOTES

Consider the following when selecting and installing Flow Detector for accurate measurement.

- 1) Flow Detector can be installed at any angle - vertical, horizontal or inclined. However, if possible, trapping of bubbles in the measuring tube should be avoided. If deposits or sediments of particles are expected, Flow Detector must be mounted for ease of flushing and cleaning.
- 2) To install on pipe that has an open end, mounting should be in lower position of pipeline.
- 3) The arrow on side plate of Flow Detector shows flow direction. Make sure the arrow matches the direction of flow.
- 4) Flow Detector should be mounted where pressure in the pipe is above atmospheric.
- 5) A flow control valve is recommended downstream of Flow Detector to prevent formation of bubbles in the liquid. an upstream valve may form bubbles: thus reducing the intensity of the ultrasound and interfering with measurement.
- 6) A bypass pipe (including bypass valve and shutoff valve) is recommended for easy zero adjustment and maintenance.
- 7) Use two threaded holes for the mounting of Flow Detector on the bottom. Take great care to avoid mechanical stress on the inlet and outlet pipes.
- 8) Please refer to Maker's Instruction Manual for the connection of the inlet and outlet pipes. (Refer to Chapter 9. FITTING TOOLS COMBINATION").

1.2 Installation of Converter

1.2.1 Selecting location



NOTES

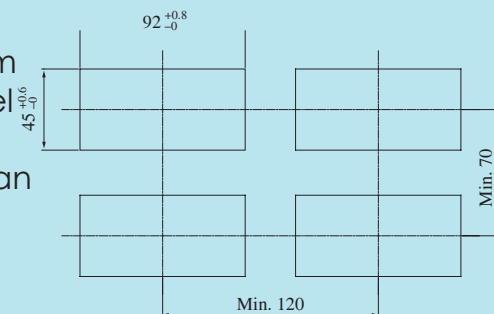
Consider the followings when selecting installation for Signal Converter:

- 1) Ambient temperature: 0 to 50°C (32 to 122°F) protected from direct sunshine.
- 2) Ambient humidity: 30 to 80%R.H. and free from condensation.
- 3) Free from electromagnetic interference. Keep away from heavy inductive devices.
- 4) Free from rain and water drops / splashes.

1.2.2 Mounting of Converter

The converter is of panel mounting type.

- 1) Cut out the panel 92 (up to +0.8) mm x 45 (up to +0.6) mm at intended location. The thickness of an intended panel should be 0.8 to 5mm. When you install the multiple converters, center-to-center pitch of cut outs is more than 120mm vertically and 70 mm horizontally.
- 2) Remove bracket from converter.
- 3) Fit in the converter from the front of the panel.
- 4) Align the bracket with the fixing guide on the side of the converter.
- 5) From the back of the converter, tighten the setscrews of the bracket with a Philips screw driver. Tightening both setscrews alternately fix the converter so that the converter's face flange is mounted tightly on the panel.



1.3 Wiring

1.3.1 Connection of the Flow Detector

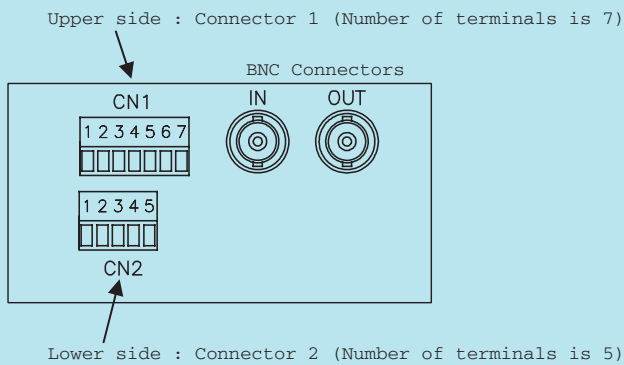
A pair of coaxial cables with BNC type connectors is used for connection between detector and converter. Standard cable length is 5m. The cables are attached to the Flow Detector.

1.3.2 Wiring of terminals

1) Specifications of cable

Use cable with core size of AWG22-14. Strip the sheath approximately 7mm from cable end. Insert core into terminal end and tighten the screw. Confirm cable is securely fixed by pulling it by hand. It is preferable to use the sleeve for secure fixing.

2) Terminals and connectors



BNC Connectors

Terminals	Polarity	Description
IN	Inlet side	Sensor signal input
OUT	Outlet side	

Connector 1

1	+	Power supply (24 V DC)
2	-	
3	FG	Grounding
4	+	Analog output
5	-	
6	+	Totalization reset input
7	-	

Connector 1

1	+	Pulse output
2	-	
3	+	Flow rate high alarm (Hi) or Totalization preset output (HH)
4	-	Alarm common
5	+	Flow rate low alarm (Lo) or Totalization preset output (H)



NOTES

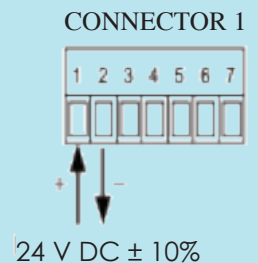
3) Connection of input and output signal cables The exclusive cables are connected with attached BNC connectors. Check the seals marked as upstream (IN) and downstream (OUT) first. Connect and lock firmly with BNC connectors.

4) Connection of power supply

- (1) Confirm that the supply voltage shown on the tag plate and the supply voltage, which is going to connect are the same.
- (2) The power supply for instrumentation etc, should be used, The power supply for general power operation should be avoided.
- (3) Confirm supplied voltage is within tolerance of converter.
- (4) At the start of the converter operation, electric current 400mA is consumed. Reserve the current for each converter.



CAUTION



5) Connection of analog output

Analog output is source type, 4 to 20mA or 0 to 10V. Connect to terminals 4 (+) and 5 (-). Maximum load resistance is 500 Ohms for I.OUT, while source resistance is 500 Ohms for V.OUT.

Remark:

#5 is internally connected to #2

Output type depends on the Converter model number, as follows.

USC-741-X-0 4-20mA

USC-741-X-1 0-10V

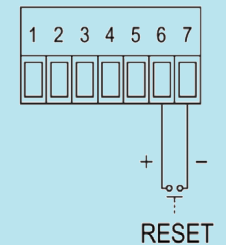
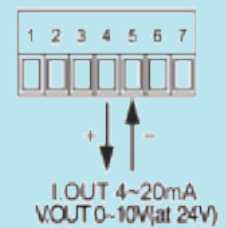
6) Connection of reset pulse for totalizer

Connect reset pulse for totalizer to terminals 6 (+) and 7 (-).

Pulse width : 0.2 sec min

Remark :

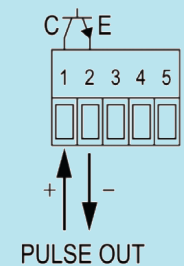
#7 is internally connected to #2



CONNECTOR 2

7) Connection of pulse totalizer

Connect external counter or totalizer to terminals 1 (+) and 2 (-) [PULSE OUTPUT]. The contact rating is max. 30VDC, 50mA.



! CAUTION

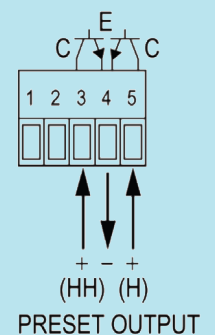
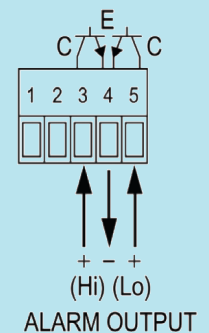
Open-collector output configuration needs a load resistor in addition to power supply. **DO NOT CONNECT** power supply directly, otherwise certain component failures may result.

8) Connection of flow alarm and preset alarm

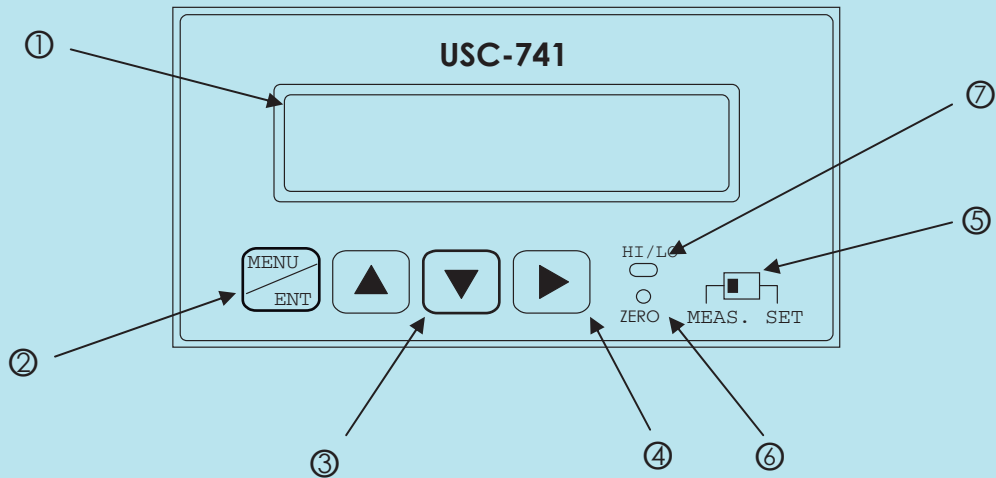
Connect annunciator or other alarm devices to the terminals 3 (+) and 4 (-) and/or terminals 4 (-) and 5 (+). Terminals 3 and 4 are for high flow rate alarm (Hi) or high preset alarm (HH) for totalizer. Terminals 4 and 5 are low flow rate alarm (Lo) or high preset alarm (H). The contact rating is max 30VDC, 50mA.

- (1) Connection of flow rate alarm
(No.7 of parameter menu, Chapter 4, page 10)
- (2) Connection of totalizer preset output
(No.9 of parameter menu, Chapter 4, page 10)

9) The grounding of frame (connector 1 #3) is required to comply with CE requirement more than grade D.



2. COMPONENT NAMES OF FRONT PANEL



2.1 Components and its function

No.	Name	Function
①	Display window	Indication of flow rate, total flow or parameters.
②	Menu / ENTER key	Selection and Fixing of menu for parameter setting
③	UP and DOWN keys	Setting of numerical values in parameter setting
④	SHIFT key	Shift of decimal position of parameter
⑤	Mode selection switch	Selection switch for measurement or parameter setting.
⑥	Zero point adjustment switch	Adjusts the zero point (hole button switch)
⑦	Alarm indication lamp	Indication of alarm condition

3. OPERATION

This product is delivered after manufacturing and adjustment. Operate this product according to the procedure of this manual after installation and wiring are completed, flow rate signal by the current, voltage or pulse will be acquired.

If any discrepancy happens at the time of operation start, check the setting parameter with reference to Chapter 4.

The unit function is set up with the standard values. Change the setting parameter if needed.

3.1 Inspection before start up



CAUTION

3.1.1 Confirm the following before switching power on.

1) Wiring

- The power supply and the output terminal have been properly wired.
- Cable has been properly connected to the terminals.
- Check grounding and ensure it.
- Detector and converter are connected in the right combination.
- Supply voltage matches the specification.

2) Installation of detector

- The lock nuts of the connecting threads have been firmly fastened.
- The flow direction is in accordance with the flow indication.

3.1.2 Introduction of fluid into detector



NOTES

Fill the detector with measuring liquid and stop the flow by closing valves. Confirm that the fluid is returned perfectly and no leakage is found at valve. Also confirm that no bubbles are produced and no bubble exists in flow lines.

3.2 Operation

3.2.1 Switching on electricity

- 1) Switch on the power supply to converter.
 - 2) After switching on the power supply, allow about 15 minutes for warm up.
- To change a parameter, refer to the Chapter 4.

3.2.2 Zero adjustment



NOTES

Perform zero adjustment of USC-741 before measuring for the first time, following procedureS. Confirm 3.1 Inspection before start up.

- Ultrasonic flow sensor is properly installed.
- Ultrasonic flow sensor is filled fully with liquid.
- Flow of the liquid in the piping system is completely stopped.
- The converter is in the measuring mode; i.e. the mode changeover switch is in the left hand position.

Press zero adjustment switch (hole button) located on the front panel with a slim pointer for about 1 second, when zero adjustment starts.

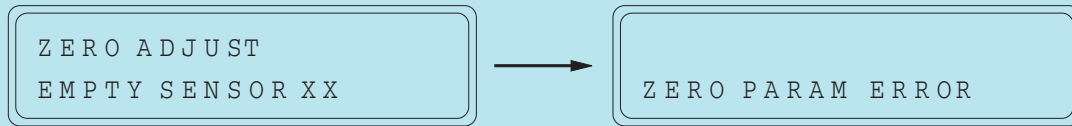
LED searches for an ultrasonic signal. XX is a number indicating receiving sensitivity of the signal; note that this indication is instantaneous if the ultrasonic signal has been detected already.

ZERO ADJUST
WINDOW SEARCH XX

Once the ultrasonic signal is captured, the bottom line display will be replaced by the numbers. It starts zero adjustment, which will take 10 to 30 seconds.

```
Z E R O  A D J U S T
X X . X X X   X . X X X
```

If the ultrasonic signal cannot be captured or the installation of sensor is improper, "EMPTY SENSOR XX"(XX is the magnitude of receiving sensitivity) will be indicated, followed by "ZERO PARAM ERROR". When an error message appears at the time of zero adjustment, see "B : Zero adjustment is not available" in "8 TROUBLE SHOOTING".



3.2.3 Operation

- 1) Introduce the measuring liquid and start operation.
- 2) When the indicator is indicating the flow rate, if "—" is indicated in the flow, the actual flow is in the reverse direction. Check the following points.
 - a) Reconfirm that the actual flow is in accordance with the flow direction marking on the detector.
 - b) Reconfirm that IN and OUT connections of the sensor connectors are in accordance with the marking on the converter.

4. PARAMETER Configuration

In making change of the scale range, pulse rate and the contents of a display, refer to the following procedure. This converter has the MODE switch and four setting keys.

The MODE switch changes mode of operation to measurement mode and setting mode. When changing parameters, **set the MODE switch at the SET position** and change the setting values using 4 keys. In a parameter menu, when a setting value is not right, an error message is displayed. Re-check the contents of a setting and re-do the setup.

4.1 Mode switch function and setting keys

Key Name	Operation Status
MODE switch	Selection of MODE, Measure or Parameter setting
MENU/ENT Key	1) Validation of parameter or numerical value 2) Shift to next Menu
UP Key	1) Shift to next Menu 2) Increase parameter figure
DOWN Key	1) Shift to next Menu 2) Decrease parameter figure
SHIFT Key	Shift parameter decimal position

4.2 Parameter setting

4.2.1 Setting procedure

Mode switch is flipped into the SET side, parameter setting menu is presented. The MENU/ENTER key is pressed, Menu No. will change to 1-12.

When changing the parameter, shift or determine by the SHIFT key after selecting the parameter using UP and DOWN key or change the numerical value.

(Ex. Menu No.1)

```

1 . S E N S O R   S I Z E
4 m m

```

Parameter menu		Contents chosen by the UP / DOWN / SHIFT key : Lower line of LCD	
No	[Indication] : Upper line of LCD		
1	[SENSOR SIZE]	3mm, 4mm, 6mm, 10mm, 15mm, 20mm	
2	[FULL SCALE]	0~9999 #.###, ##.##, ###.#, #### (There is restriction for setting.)	mL/s, mL/min, L/min, L/h, m3/h
3	[KINEM VISCOSIT]	0.30~40.00mm ² /s	
4	[K FACTOR]	0.800~1.200	
5	DAMPING TIME] (63%)	0.0, 0.2, 0.5, 1, 2, 3, 5, 8, 10 s *	
6	[LOW CUT OFF]	None, 00%~30% (1%step)	
7	[FLOWRATE ALARM]	None, Yes	
	a [ALARM POINT Hi]	000.0~150.0%	
	b [ALARM POINT Lo]	10~99%	
	c [HYSTERESIS]	00.0~20.0%	
	e [CONTACT TYPE Hi]	NO,NC	
	e [CONTACT TYPE Lo]	NO,NC	
8	[TOTALIZATION]	None, Yes	
	a [COUNTER RESET]	None, Yes	
	b [TOTAL VOL UNIT]	mL, L, m ³	
	c [MULTIPLIC FACTOR]	0.1, 1, 10, 100	
	d [PULSE WIDTH]	0.5ms (Max 1kpps), 50ms (Max 10pps), 100ms (Max 5pps)	
9	[TOTAL PRESET]	None, Yes	
	a [TOTAL PRESET H]	000000~999999 (H<HH)	
	b [TOTAL PRESET HH]	000000~999999 (H<HH)	
	c [CONTACT TYPE H]	NO,NC	
	d [CONTACT TYPE HH]	NO,NC	
10	[MANUAL LIN'RIZER]	None, Yes	
	a [FOLD POINT NO]	1~15	
	b [DECIMAL POINT]	#.###, ##.##, ###.#, #### (mL/min)	
	c [DATA **/**]	Out #### (Actual flow rate)	In #### (Indication flow rate of M-2001)
11	[DISPLAY]	Flow Rate, Flow Rate + Total	
12	[FLOW MODE]	Steady, Pulsating	
	a [FILTER SELECTION]	Cutoff Frq. 3, 2, 1, 0.5, 0.2, 0.1 Hz	

* The meaning of 0.0 is no damping operation. There is output delay of the followings, size 03 to 06 : 0.05s, 10 to 20 : 0.1s.

* "9.The values of TOTAL PRESET" and "11.DISPLAY"are indicated only when "8. TOTALIZATION" is set as "Yes".

4.2.2 Contents of each parameter

No.1 DETECTOR SIZE

Selection of Flow detector type (size)



NOTES

Converter combined

M-2001-04	4 mm	} USC-741-1
M-2001-06	6 mm	

M-2001-10	10 mm	} USC-741-2
M-2001-15	15 mm	
M-2001-20	20 mm	

No. 2 FULL SCALE

Setting of full scale and selection of flow rate unit. Refer to 12.3 of REFERENCE for recommended flow range.

No. 3 KINEM VISCOSITY

The converter is equipped with flow rate vs current output linearizing function. Enter the kinematic viscosity of the fluid to measure at the operating temperature (viscosity is generally temperature dependant). The kinematic viscosity is also called as dynamic viscosity. Its SI unit, mm^2/s , is equivalent to cSt (centi-Stokes) and also equal to absolute viscosity (μ) divided by density (ρ) in the units as shown below.

$$\text{mm}^2/\text{s} = \text{cSt} = \mu \text{ (cP} \times 1000) / \rho \text{ (kg/m}^3\text{)}$$

No.4 K FACTOR

K factor is a parameter which indicates calibration characteristics of the sensor. This factor is already set at the factory before shipping. However if the combination of the sensor and converter is to be changed, new K factor, which is affixed to the sensor body, must be registered in order to adjust for the difference of calibration characteristics.

No.5 TIME CONSTANT (63%)

Setting of response of indication and output to the changing flow rate. 0.0 to 10.0s are available. (0.0 has the response delay without damping time operation. [0.05s for USC-741-1, 0.1s for USC-741-2 respectively])

No.6 LOW CUT OFF

Setting of low flow cut off.

Below the set value (%: percentage of flow rate) is considered mandatorily that current output and flowrate display are zero.

No.7 ALARM OUTPUT

Selection of alarm output, None, Flow rate or Total preset.

Either alarm output or totalization preset is available. If both are set, alarm output has a priority. Hysteresis of 0 to 20% can be set for high and low alarm.

No.8 TOTALIZATION

Setting of totalization function.

If set up with Yes, totalization function is used.

If set up with None, neither the sub menu of this item nor the selection menu of No.9 will be displayed.

No.9 PRESET

Setting of integrating preset function.

When alarm output function (No.7) is set up with None, the selection menu of integrating preset is displayed.

No.10 MANUAL LINEARIZER

Setting of linearizer by manual control. Refer to 6.4 of PARAMETER SET Linearizer procedure for details.

No.11 DISPLAY MODE

Selection of display in LCD



NOTES

When selection of totalization function (No.8) is set up with None, totalization count is not displayed.

Flow Rate Flow rate (%) is displayed on the upper line, and flow rate in engineering unit. is displayed on the lower line.

Flow Rate + TotalFlow rate is displayed on the upper line, and totalization count is displayed on the lower line.

No.12 FLOW RATE MODE



NOTES

When the measuring fluid has severe pulsation, set Pulsating. However the digital filters used have relatively large equivalent dead-time. Therefore do not use this function alone in flow control loop, otherwise there is tendency of loop oscillation. Combination with certain amount of DAMPING, will be effective.

5. ERROR MESSAGES

5.1 Error message list

- Error messages appeared during setting

Error messages	Possible causes	Solutions
SETTING ERROR SENSOR VS F.S.	Wrong sensor setting against full scale.	Change the full scale according to the sensor.
SETTING ERROR F.S.VS PULSE	Relation of full-scale and totalization pulse width is unsuitable.	Change the pulse width according to the full scale.
SETTING ERROR In DATA OVER FS	M-2001 flow indication exceeds full scale at Manual Linearizer.	Check the setting M-2001 flow indication.
ERROR MESSAGE TOTAL VOL ERROR	The totalized value is out of 0 to 999999.	Push any one of setting keys. The totalized value reverts to 0.
ERROR MESSAGE SETTING ERR XXX	"XXX" means error codes. Setting values are out of the allowable range.	Change the setting values according to the error code list.

- Error messages appeared during zero adjustment

Error messages	Possible causes	Solutions	
ZERO ADJUST EMPTY SENSORXX *1	00 to 10	Either the liquid does not fill the piping or contains bubbles. Either sensor installation distance is not proper, its connection comes off, or sensor itself is out of order.	Check sensor is properly installed and piping is filled with liquid. If they are correct, perform zero adjustment.
	99	Received ultrasonic wave exceeds the predetermined wave.	Check sensor is properly installed. Perform zero adjustment.
	11 to 98	The window which receives and determines ultrasonic wave, deviates from the predetermined location. The ultrasonic wave is not found because of attenuation due to bubbles or any sedimentations. The numerical varies with changes of gain codes just before error message or changes in measuring liquid nature.	Check any causes to attenuate receiving ultrasonic wave such as bubbles or any sedimentation in the piping. The frequent error messages might be caused by the change of liquid
ZERO ADJUST FLOW?	The measuring fluid may be flowing during zero adjustment.	Check measuring condition. If you cannot stop flow, perform tentative zero adjustment.	
ZERO ADJUST U/D LEVEL RETIO	The level difference of receiving signal at the upstream and downstream is large at zero adjustment.	Check the sensor is properly installed. ZERO PARAM ERROR	
ZERO PARAM ERROR	Zero adjustment failed.	Check sensor is properly installed and piping is filled with liquid. If they are correct, perform zero adjustment.	

• Error messages appeared during operation

Error messages		Possible causes	Solutions
ZERO ADJUST EMPTY SENSORXX *1	00 to 10	Either the liquid does not fill the piping or contains bubbles. Either sensor connection is not proper, or connection comes off, or sensor itself is out of order.	Check sensor is properly installed and piping is filled with liquid. If they are correct, perform zero adjustment.
	99	Received ultrasonic wave exceeds the predetermined wave.	Perform zero adjustment. Adjust amplification coefficient.
	11 to 98	The window which receives and determines ultrasonic wave, deviates from the predetermined location. The ultrasonic wave is not found because of attenuation due to bubbles or sedimentation. The numerical varies with changes of gain codes just before error message or changes in measuring liquid nature.	Check any causes to attenuate receiving ultrasonic wave such as bubbles or sediments in the piping. The frequent error messages might be caused by the change of liquid concentration or sensor malfunctioning. Check these and perform zero adjustment.
WAVE DIFFERS *1	11 to 98	The ultrasonic wave patterns differ significantly from the ones when zero adjusted.	
U/D LEVEL RETIO		The level difference of receiving signal at the upstream and downstream is large at zero adjustment.	Check the sensor is properly installed.
PARAMETER ERROR XXX		"XXX" means error codes. Setting values are out of the allowable range	Change the setting values according to the error code list.

***1 Two (2) digit figures** following error message **shows gain codes** which are **different from error codes**. These figures represent the amplification coefficient of which the smaller figures mean larger gain, i.e. the intensity of receiving wave signal becomes smaller. The gain codes of USC-741 vary automatically to keep the signal constant level. For instance, the figure becomes gradually small to increase gain when receiving signal is not found at the measuring end.

• Error code list

Error codes	User parameters
201	Sensor setting does not meet Full Scale value.
202	Input error of kinematic viscosity [3. KINEM VISCOSITY]
203	Input error of sensor constants [4. K_FACTOR]
205	Input error of low cut off [6. LOW CUTOFF]
211	Input error of high alarm set point [ALARM POINT Hi]
212	Input error of low alarm set point [ALARM POINT Lo]
241	Input error of breaking point numbers for approximation [FOLD POINT NO]
242	Input error of M-2001 flow rate indication [In DATA] in the articles of Manual Linearizer data setting [DATA**/**]
243	Flow rate of M-2001 flow rate indication [In DATA] is not in the ascending order in the articles of Manual Linearizer data setting [DATA**/**]

6. PARAMETER SETUP EXAMPLE

6.1 Setting of full scale flowrate

The following describes the procedure used when switching the full scale flowrate range from 20.00 L/min to 1000mL/min.

- 1) Shift the MODE switch to the SET side.

The setup mode is turned on and Parameter menu No.1 SENSOR SIZE appears.

```
1 . S E N S O R   S I Z E
4 m m
```

- 2) Press the MENU / ENTER key.

Parameter menu No.2 FULL SCALE and unit appear. The column of 2 flashes.

```
2 . F U L L S C A L E
2 0 . 0 0           L / m i n
```

- 3) Press the DOWN key.

"2" is replaced by "1".

```
2 . F U L L S C A L E
1 0 . 0 0           L / m i n
```

- 4) Press the SHIFT key four times.

Left end letter of unit flashes.

```
2 . F U L L S C A L E
1 0 . 0 0           L / m i n
```

- 5) Press the DOWN key.

"L/min" is replaced by "mL/min".

```
2 . F U L L S C A L E
1 0 . 0 0           m L / m i n
```

- 6) Press the SHIFT key.

Decimal place flashes.

```
2 . F U L L S C A L E
1 0 . 0 0           m L / m i n
```

- 7) Press UP key twice.

Decimal point is shifted.

```
2 . F U L L S C A L E
1 0 0 0           m L / m i n
```

- 8) Press MENU / ENTER key.

Following menu appears and specified value has been validated.

```
3 . K I N E M   V I S C O S I T
0 1 . 0 0 m m 2 / s
```

- 9) Shift the MODE switch to the MEAS. side.

The measurement mode will be restored.



NOTES

6.2 Selecting and setting up the alarm output function

The following describes how to select and set up the High / Low alarm function.

Note 1) Note that the High / Low alarm function and the Totalization preset output function cannot be turned on at the same time, (higher priority for Hi/Lo alarm).

Note 2) The Hi and Lo settings and corresponding contacts are independent, and alarm lamp works on OR logic basis. However, alarm display uses the same upper line, and when both alarms work, display priority is placed on Hi alarm. To avoid confusion, it is recommended to set Hi setting to be higher than Lo setting.

Refer to 6.3.3 about totalization preset output function.

The following describes the procedure of the below example;

Flow rate high alarm : 80%, flow rate low alarm :+20%, hysteresis : 0%,

high alarm set point : "b" contact (Normal close) low alarm set point : "a" contact (Normal open)

- 1) Shift the MODE switch to the SET side.

The setup mode is turned on and Parameter menu No.1 SENSOR SIZE appears.

```
1 . S E N S O R   S I Z E
4 m m
```

- 2) Press the MENU / ENTER 6 times.

Parameter menu No.7 FLOWRATE ALARM appears.

```
7 . F L O W R A T E   A L A R M
N o n e
```

- 3) Select the menu.

Press the UP or DOWN key and select Yes.
Note) None is to be selected when not using Alarm output function or using totalization preset output function.

```
7 . F L O W R A T E   A L A R M
Y e s
```

- 4) Press MENU / ENTER key.

No.7-a ALARM POINT Hi appears, and left end letter of figure flashes.

```
A L A R M   P O I N T   H i
1 5 0 . 0 %
```

- 5) Press the UP / DOWN key and SHIFT key.

Set at 80.0%.

```
A L A R M   P O I N T   H i
0 8 0 . 0 %
```

- 6) Press MENU / ENTER key.

No.7-b ALARM POINT Lo appears, and left end letter of figure flashes.

```
A L A R M   P O I N T   L o
+ 1 0 %
```

- 7) Press the UP / DOWN key and SHIFT key.

Set at +20%.

```
A L A R M   P O I N T   L o
+ 2 0 %
```

- 8) Press MENU/ENTER key one time.

No.7-c HYSTERESIS appears.

```
H Y S T E R E S I S
0 1 . 0 %
```

9) Press UP/DOWN key and SHIFT key.

Set at 00.0%.

```
HYSTERESIS
00.0%
```

10) Press MENU/ENTER key one time.

No.7-d CONTACT TYPE Hi appears.

```
CONTACT TYPE Hi
NO
```

11) Press UP/DOWN key and SHIFT key.

Select NC (Normal Close).

```
CONTACT TYPE Hi
NC
```

12) Press MENU/ENTER key one time.

No.7-e CONTACT TYPE Lo appears.

```
CONTACT TYPE LO
NC
```

13) Press UP/DOWN key.

Select NO (Normal Open).

```
CONTACT TYPE LO
NO
```

14) Press MENU / ENTER key.

Following menu appears and specified value has been validated.

```
8. TOTALIZATION
None
```

15) Shift the MODE switch to the MEAS. side.

The measurement mode will be restored.

6.3 Setting of totalization function

6.3.1 The calculation of setting value for totalization output function

The proper pulse width which is required for the setting of totalizing output is determined from the combination of full scale flow rate, pulse number per second and allowable input pulse width of the receiving instrument. Obtain a suitable pulse to set from the following table.

Pulse width	Outgoing pulse number per second pps (PULSE/s)	
0.5ms	Max. 1kpps	Select an appropriate pulse width after converting outgoing pulse number at full-scale flowrate into pps. (Pay attention to specification for transmitter.)
50ms	Max. 10pps	
100ms	Max. 5pps	

Totalization volume unit \ Flow rate unit	mL	L	m ³
mL/s	1	10 ³	10 ⁶
mL/min	60	60 x 10 ³	60 x 10 ⁶
L/min	60 x 10 ⁻³	60	60 x 10 ³
L/h	3600 x 10 ⁻³	3600	3600 x 10 ³
m ³ /h	3600 x 10 ⁻⁶	3600 x 10 ⁻³	3600

Let's take an example;

Full scale flow rate: 20.00L/min, Unit volume of totalized flow: mL, Totalized multiplier factor: x 1 (means 1 mL per one pulse).

Confirm if this assumption is feasible or not by the following calculation.

The calculation of required pulse number

$$\frac{\text{The volume per second at full scale flow rate}}{\text{The volume per one pulse}} = \frac{20 \text{ [L/min]}}{1 \text{ [mL/PULSE]}} = \frac{\frac{20}{60 \times 10^{-3}} \text{ [L/min]}}{1 \text{ [mL/PULSE]}} = 333.33 \text{ [pps]}$$

From above calculation, interim number of between 333 and 334 pulses per second is obtained.

In this case, pulse width must be 0.5ms. You can select this value in the following procedures. If the obtained input pulse width does not meet the specification of the receiving instrument, recalculate the pulse width by changing unit volume of totalized flow and totalized multiplier factor.

6.3.2 Setting Change of Totalization Output

6.3.1 let's take an example; Unit volume of totalized flow : mL, Totalized multiplier factor: x 1 (means 1mL per 1pulse), and Totalized pulse width: 0.5ms.

1) Shift the MODE switch to the SET side.

The setup mode is turned on and Parameter menu No.1 SENSOR SIZE appears.

1 . S E N S O R S I Z E
4 m m

2) Press the MENU / ENTER key 7 times.

(In case of using an alarm output function, press it 9 times.)

Parameter menu No.8 TOTALIZATION appears.

8 . T O T A L I Z A T I O N
N o n e

- 3) Select the menu.

Press the UP or DOWN key and select Yes.

```
8 . T O T A L I Z A T I O N
Y e s
```

- 4) Press MENU/ENTER key 2 times.

Parameter menu No.8-b TOTAL VOL UNIT appears.

```
T O T A L V O L U N I T
L
```

- 5) Press UP/DOWN key several times.

Change Unit volume of totalized flow to mL.

```
T O T A L V O L U N I T
m L
```

- 6) Press MENU/ENTER key one time.

Parameter menu No.8-c MULTIPLIC FACTOR appears.

```
M U L T I P L I C F A C T O R
x 1 0 0
```

- 7) Press UP/DOWN key several times.

Change Totalized multiplier factor to x1.

```
M U L T I P L I C F A C T O R
x 1
```

- 8) Press MENU/ENTER key 1 time.

Parameter menu No.8-d PULSE WIDTH appears.

```
P U L S E W I D T H
5 0 m s ( M a x 1 0 p p s)
```

- 9) Press UP or DOWN key several times.

Select 0.5ms.

```
P U L S E W I D T H
0 . 5 m s ( M a x 1 k p p s)
```

- 10) Press MENU / ENTER key.

Following menu appears and specified value has been validated.

```
9 . T O T A L P R E S E T
N o n e
```

- 11) Shift the MODE switch to the MEAS. side.

The measurement mode will be restored.

6.3.3 Selecting and setting up the totalization preset output function

The totalized multiplier factor of the totalization preset output must be same as the one set at No.8 "8. TOTALIZATION". If you can not select the proper totalization preset output, recalculate setting values using 6.3.1 The calculation of setting value for totalizing output function.

- 1) Shift the MODE switch to the SET side.

The setup mode is turned on and parameter menu No.1 SENSOR SIZE appears.

1 . S E N S O R S I Z E
4 m m

- 2) Press the MENU / ENTER key 6 times.

Parameter menu No.7 FLOWRATE ALARM appears.

7 . F L O W R A T E A L A R M
Y e s

- 3) Select the menu.

Press the UP / DOWN key and select None.
Note) Totalization preset output function cannot be used if Yes is selected.

7 . F L O W R A T E A L A R M
N o n e

- 4) Press the MENU / ENTER key.

Parameter menu No.8 TOTALIZATION appears.

8 . T O T A L I Z A T I O N
N o n e

- 5) Select the menu.

Press the UP / DOWN key and select Yes.
Note) Totalization preset output function cannot be used if None is selected.

8 . T O T A L I Z A T I O N
Y e s

- 6) Press the MENU / ENTER key twice.

No.8-b TOTAL VOL UNIT appears.

T O T A L V O L U N I T
m L

- 7) Press the UP or DOWN key and select "L".

T O T A L V O L U N I T
L

- 8) Press the MENU / ENTER key 3 times.

No.9 TOTAL PRESET appears.

9 . T O T A L P R E S E T
N o n e

- 9) Select the menu.

Press the UP/DOWN key and select Yes.

9 . T O T A L P R E S E T
Y e s

10) Press MENU/ENTER key one time.

No.9-a TOTAL PRESET H appears.

```
TOTAL  PRESET  H
999999  X1L
```

11) Press UP, DOWN, SHIFT key several times.

Set at 000050.

```
TOTAL  PRESET  H
000050  X1L
```

12) Press MENU/ENTER key one time.

No.9-b TOTAL PRESET HH appears.

```
TOTAL  PRESET  HH
999999  X1L
```

13) Press UP,DOWN,SHIFT key several times.

Set at 000100.

```
TOTAL  PRESET  HH
000100  X1L
```

14) Press MENU/ENTER key one time.

No.9-c TOTAL PRESET H appears.

```
TOTAL  PRESET  H
NO
```

15) Press UP/DOWN key.

Select NC (Normal Close).

```
TOTAL  PRESET  H
NC
```

16) Press MENU/ENTER key one time.

No.9-c TOTAL PRESET HH appears.

```
TOTAL  PRESET  HH
NO
```

17) Press UP/DOWN key.

Select NO (Normal Open).

```
TOTAL  PRESET  HH
NO
```

18) Press MENU/ENTER key.

Next menu appears and specified value has been validated.

```
10.MAN  LIN'RIZER
None
```

19) Shift the MODE switch to the MEAS. Side.

The measurement mode will be restored.

6.4 Setting of manual linearizer

As mentioned already, this converter has automatic linearizer which ensures linearity of output with regard to flow rate by entering the kinematic viscosity of the fluid. However, this function is effective for a Newtonian fluid, and certain nonlinear error may exist in Non-Newtonian fluid flow measurements. The Manual Linearizer offers an effective means to correct this error by customers themselves for individual problems.

6.4.1 How to use the linearizer



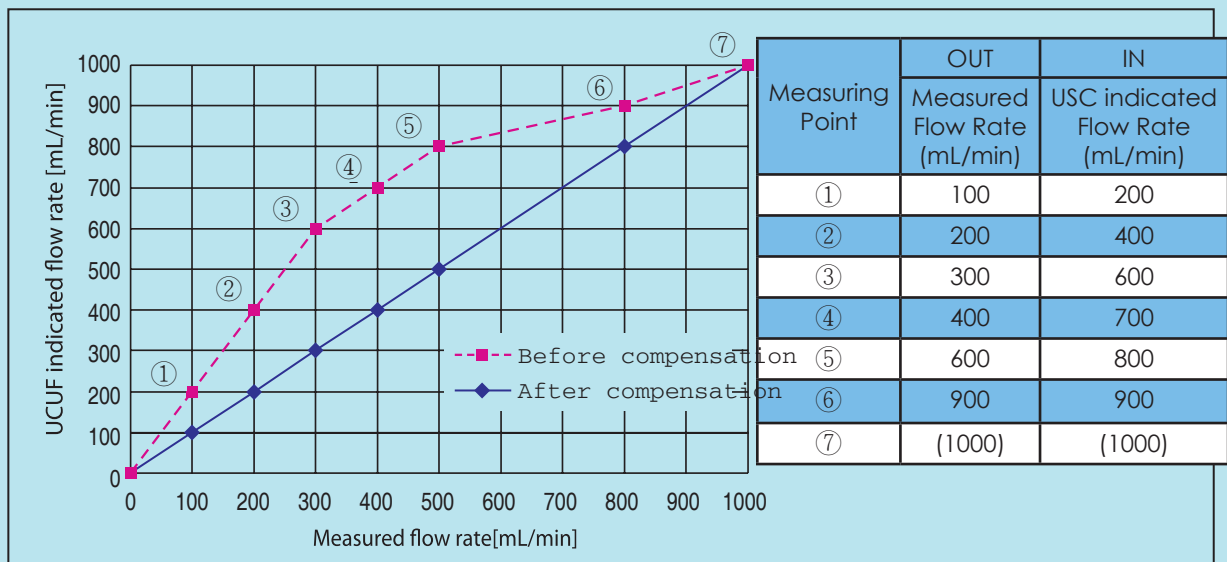
NOTES

The flow rate can be compensated by the broken line approximation. The maximum compensation points are 15. Input the corrected M-2001 indication flow rate (In ####) vs. the corresponding actual flow rate (OUT ####). Input flow rate in the same unit as full scale flow rate and in the ascending sequence, i.e. from small to large figures for the manual linearize function.

Do not input the data exceeding the full scale. Change full scale when the data exceeds the full scale beforehand. The portion under the smallest input value to zero point is approximated as a linear. The largest input value must be the same as full scale. Please note the accuracy around the smallest input value and around full scale, may not be realistic.

6.4.2 Linearizer data input procedure

The following shows how to compensate the deviations at 7 points within the full scale flow rate 1000 mL/min.



1) Shift the MODE switch to the SET side.

The setup mode is turned on and parameter menu No.1 SENSOR SIZE appears.

```
1 . SENSOR SIZE
4 m m
```

2) Press the MENU / ENTER key 8 to 15 times.

It changes in the use situation of alarm or totalization function.

```
10 . MANLIN'RIZER
None
```

Set the No.10 MANUAL LIN'RIZER.

3) Press the UP key or DOWN key.

Select "Yes".

```
10.MAN LIN'RIZER
Yes
```

4) Press the MENU / ENTER key.

No.10-a FOLD POINT NO appears.

```
FOLD POINT NO
15
```

5) Input points are selected by the UP / DOWN key and SHIFT key. (Max.15 points)

Set the numeral at 06.

```
FOLD POINT NO
06
```

6) Press the MENU / ENTER.

No.10-b DECIMAL POINT appears.

```
DECIMAL POINT
X.XXX mL/min
```

7) Press the UP / DOWN key several times.

XXXX mL/min appears.

```
DECIMAL POINT
XXXX mL/min
```

8) Press the MENU / ENTER.

No.10-c DATA **/** appears and the 1st data setting menu appears.

```
DATA 01 / 07 mL/min
Out 1000 In 1000
```

9) Enter the 1st point data using UP / DOWN key and SHIFT key. (01/07)

Enter the measured flow rate and M-2001 indicated flow rate, in this order.

```
DATA 01 / 07 mL/min
Out 0100 In 0200
```

Note) Enter the data from the low flow rate.

10) Press MENU/ENTER key one time.

2nd linearizer input menu appears. (02/07)

```
DATA 02 / 07 mL/min
Out 2000 In 2000
```

11) Setting the data of 2 to 7 points.

Repeat 8) 9) 10) up to last linearizing point.

Note) the largest input data must be the same as full scale flow rate.

```
DATA 07 / 07 mL/min
Out 1000 In 1000
```

12) Press the Menu/Enter key and shift the MODE switch to the MEAS. side.

The measurement mode will be restored.



NOTES

7. MAINTENANCE NOTE

Ultrasonic flow meter requires no daily maintenance since it has no moving parts that can be subject to wear and tear. However, we recommend the following checks to ensure smooth and reliable operation.

7.1 Connection of Flow Detector

- Check for leakage around pipe connections or liquid penetration into Flow Detector tube.
- Check for any slack nut.
- Tighten the connection port periodically.

7.2 Connecting pipe

- Check for mechanical stress to Flow Detector caused by possible warping of connecting pipes or loose connections caused by heavy pipe vibration.

7.3 Cable connector

- Check cable connector of Flow Detector and tighten them if loose.

7.4 Sediments or bubbles in the Flow Detector

- Observe the Flow Detector visually from outside and note that there are no sediments or bubbles or foreign materials in the measuring tube.

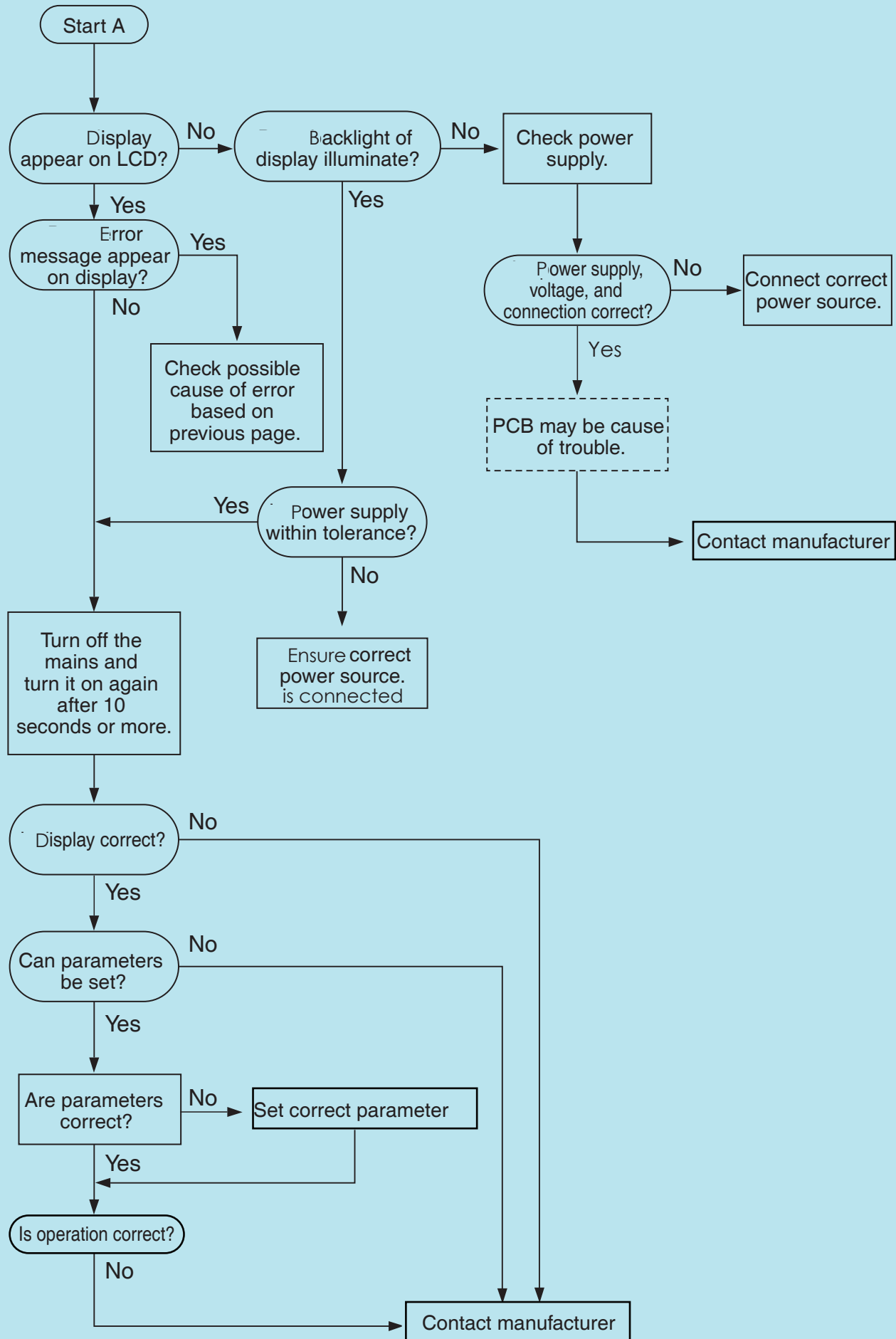
8. TROUBLE SHOOTING

Possible troubles fall into several categories. Trouble shooting charts on the following pages identify possible causes for each category.

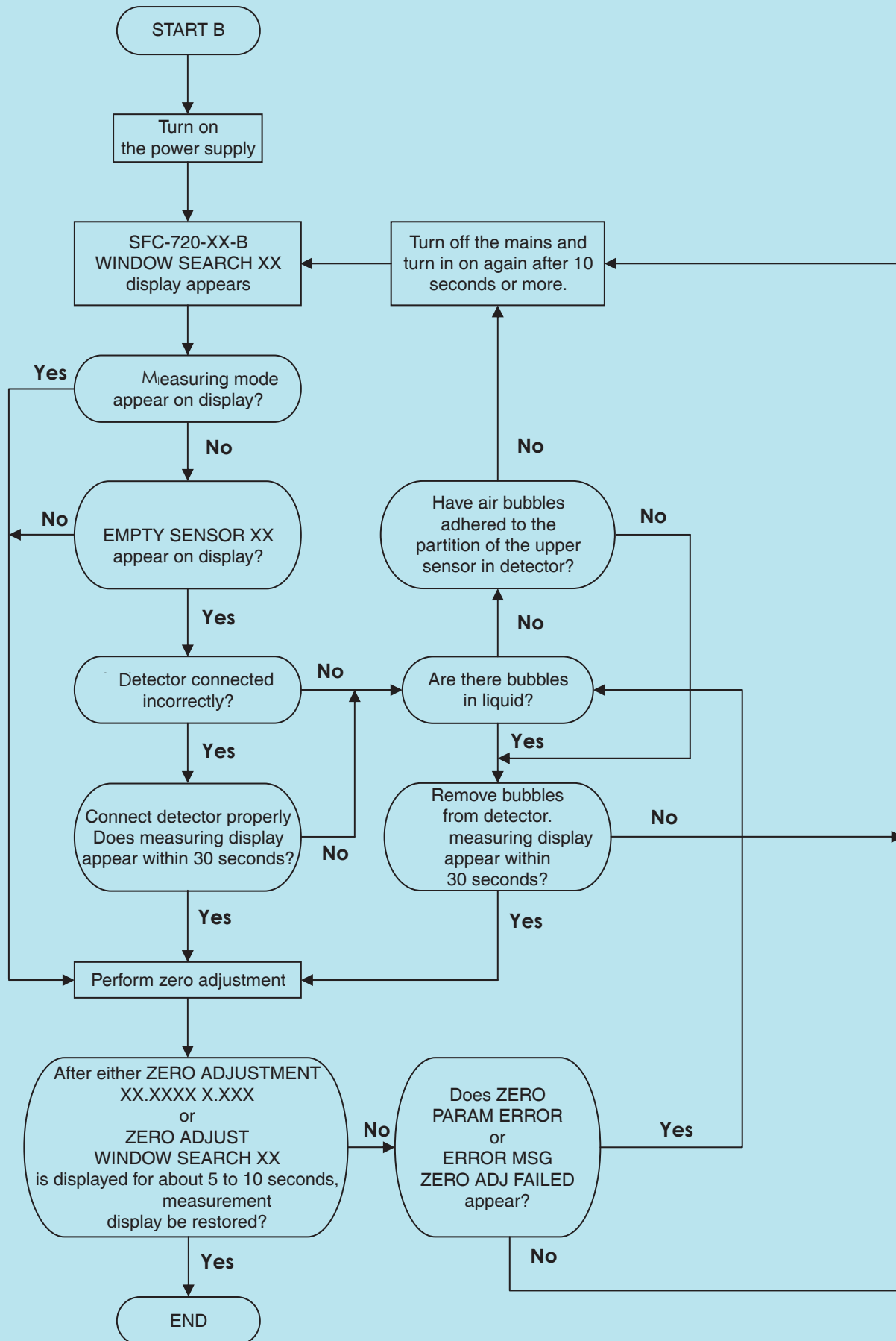
Please refer to the Index Table below for trouble category.

Phenomenon		Trouble shooting chart by category
1	Display does not show anything.	A : No display or abnormal display
2	Display shows abnormal character(s).	
3	Display is frozen.	
4	Error message appears on the display.	
5	Keys are not operable. Parameters cannot be set.	
6	Error message appears at zero point adjustment.	B : Not available for zero point adjustment
7	Display shows zero in liquid flow condition.	C : No indication with flow
8	Display shows flow rate but output is not available.	
9	Zero point is not stable (Zero point drift).	D : Unstable zero point
10	Display shows flow rate or above Full scale when the flow stops.	
11	Display is unstable in liquid flow condition.	E : Unstable flow rate
12	Displayed flow rate differs from actual flow rate.	F : Inaccurate measurement
13	Output does not match actual flow rate.	
14	Displayed value is over Full scale.	

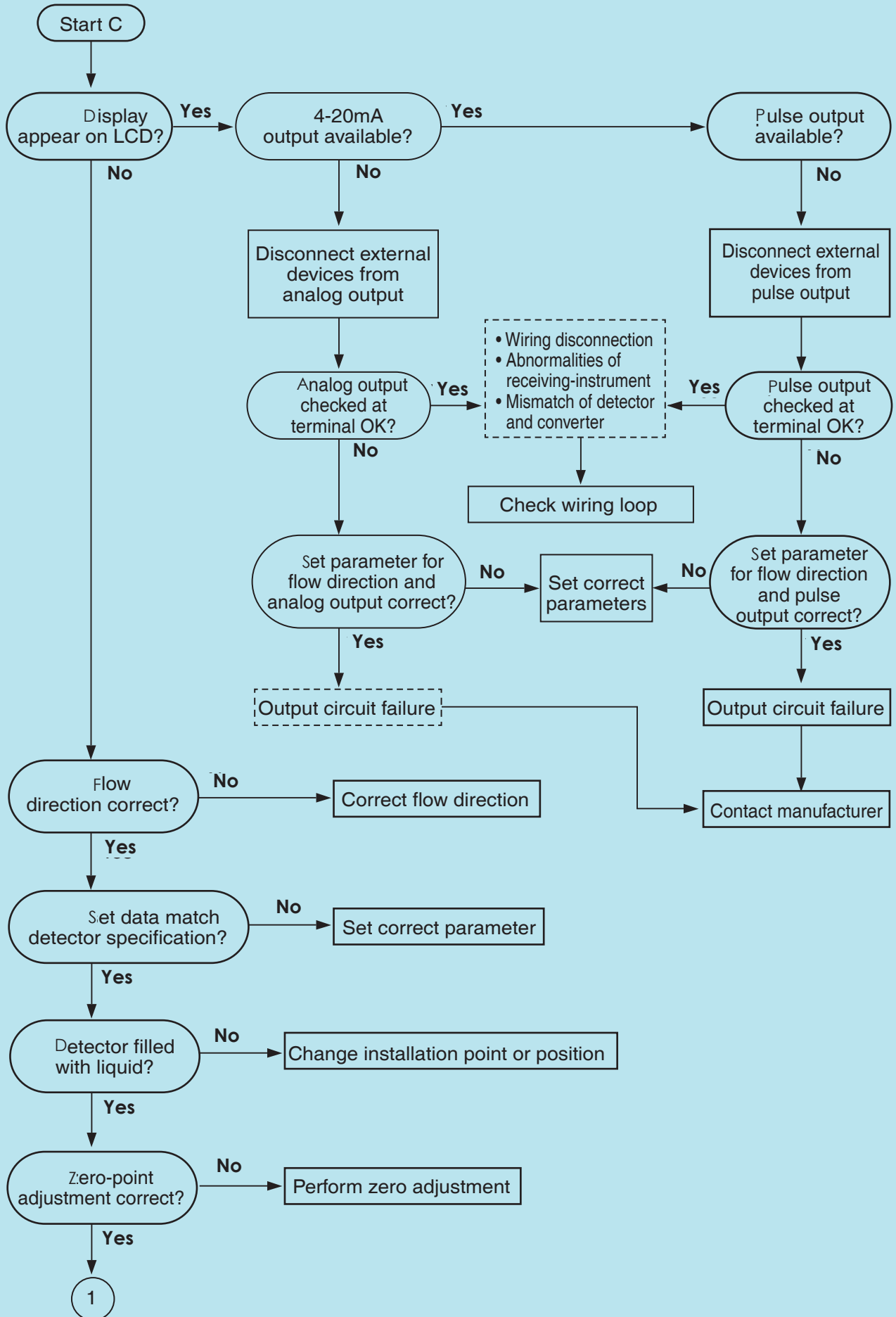
A. No display or abnormal display

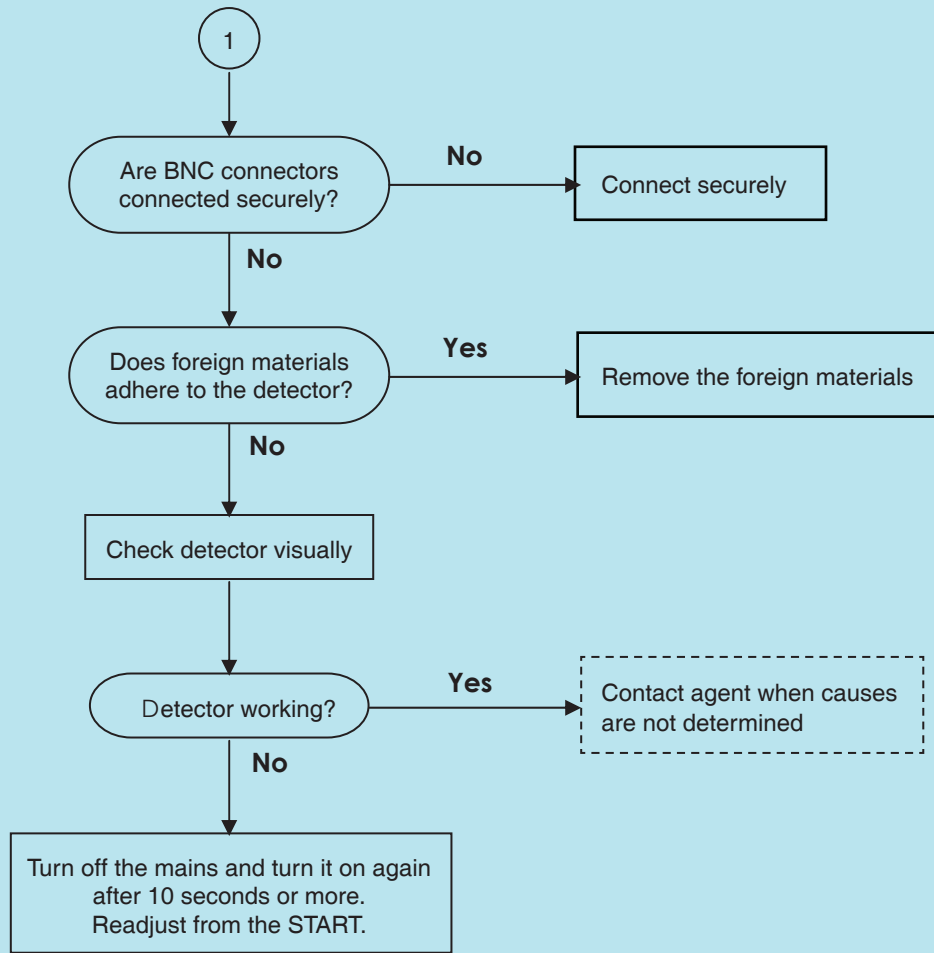


B. Zero point adjustment is not available.

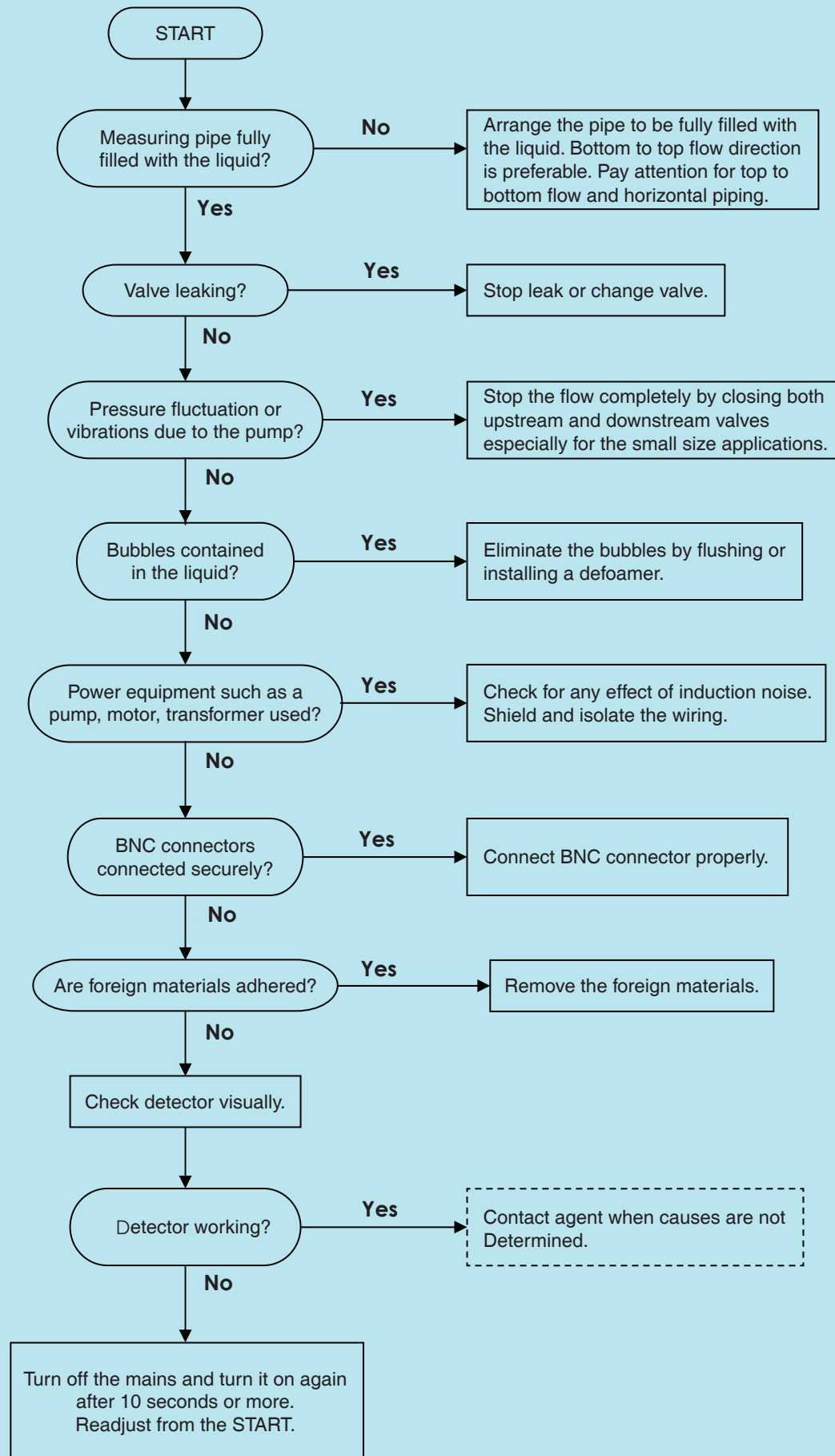


C. No indication of flow

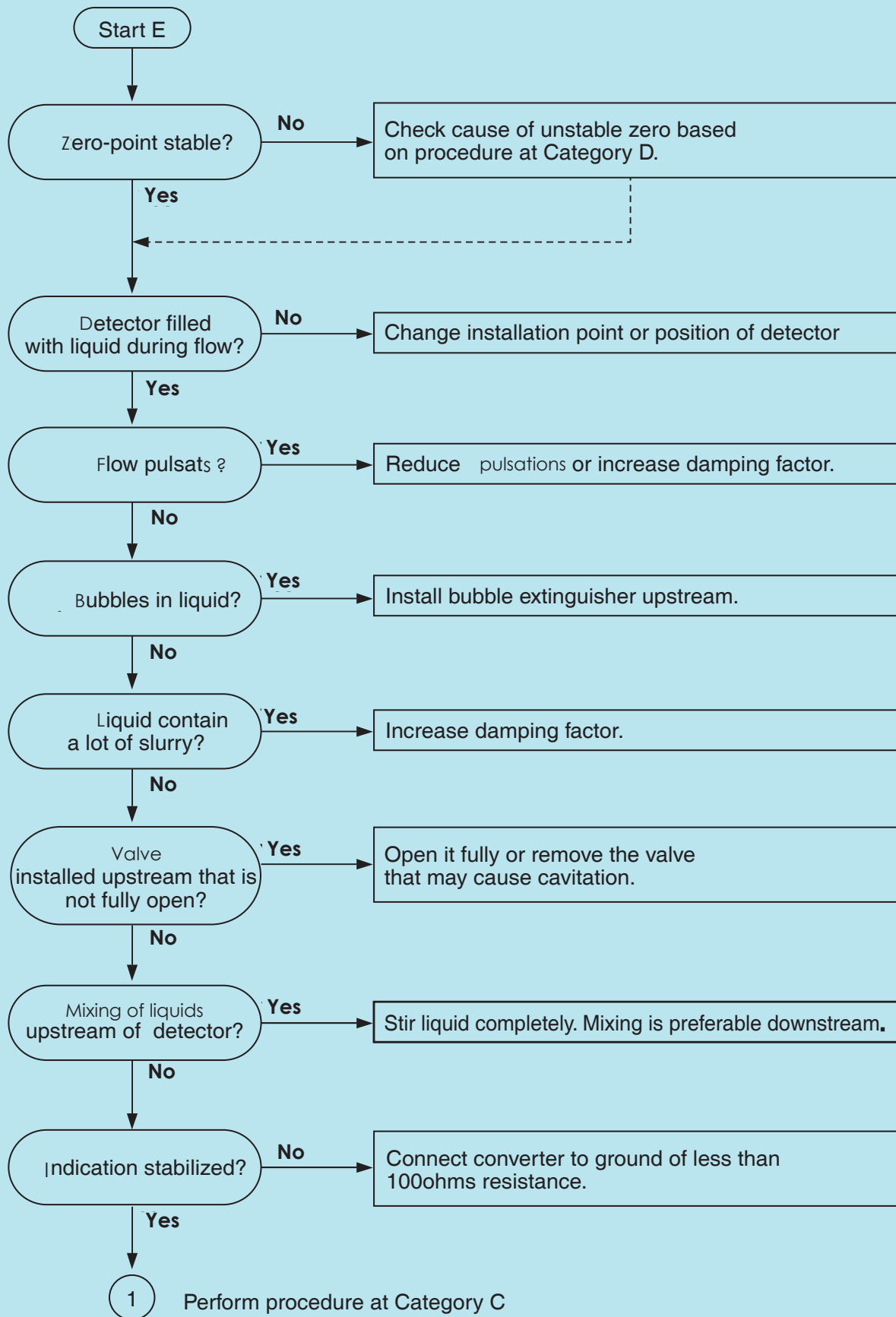




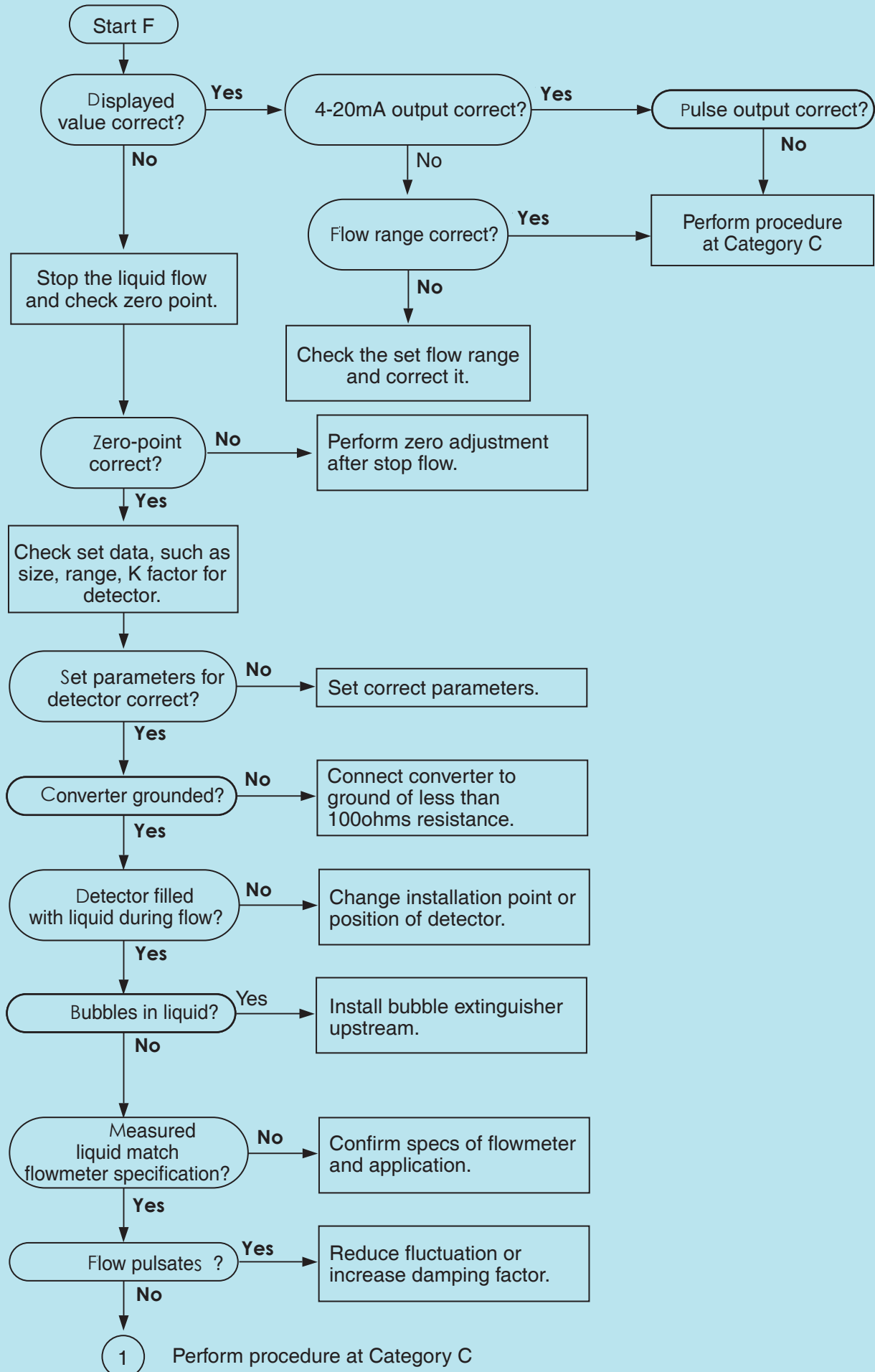
D. When the zero point is unstable



E. Unstable indication



F. Inaccurate measurement



9. FITTING TOOLS COMBINATION

Converter Model	NIPPON PILLAR (Super Type)	FLOWELL (20 Series)	KURABO (Final Lock)	FLUORO WARE (Flare Tech)
M-2001-04 M-2001-06	For heating: SH-HW3, FH-W3 or For normal temperature: ST-A2, SH-AW3 (Tube holder is used for adjusting installation position only)	Ring insertion tool handy type 20-0-KB, 20-3/8x6.3RS	Handy type tool for short pipe X-FJK6T-ST	213-59 (T6-F)
M-2001-10	For heating: SH-HW4, FH-W4 or For normal temperature: ST-A2, SH-AW4 (Tube holder is used for adjusting installation position only)	Ring insertion tool handy type 20-0-KB, 20-1/2x9.5RS	Consult malema sensor for details.	213-60 (T8-F)
M-2001-15	For heating: SH-H19, FH-19 or For normal temperature: ST-A2, SH-A19 (Tube holder is used for adjusting installation position only)	Ring insertion tool handy type 20-0-KB, 20-19x16RS	Consult malema sensor for details.	213-81 (T12-F)
M-2001-20	For heating: SH-H25, FH-25 or For normal temperature: ST-A2, SH-A25 (Tube holder is used for adjusting installation position only)	Ring insertion tool handy type 20-0-KB, 20-25x22RS	Handy type tool for short pipe X-FJK16-ST	213-82 (T16-F)

10. SERVICE NETWORK

Contact the following for service and spare parts supply etc.

malema sensors

1060 S, Rogers Circle

Boca Raton, FL 33487

TEL: +1-561-995-0595

FAX: +1-561-995-0622

Home page address : www.malema.com

Or

malema agent in your locality

11. WARRANTY

Unless otherwise stipulated, the quality warranty for this product shall be as follows: -

Duration :

18 months after delivery or 12 months after start-up of operation. Whichever is shorter.

Range of warranty :

Any damages arising from our mistakes in design, manufacture testing and/or selection of materials.

Enforcement of warranty :

Our warranty work shall be fulfilled when parts have been replaced or repairs have been done, and tested.

We shall not be responsible for any secondary damages arising from the defects of this product, due to faulty use or installation.

12. REFERENCE

12.1 Velocity of Sound in Water (m/s)

Temp [°C]	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	1402.39	1407.37	1412.23	1416.99	1421.63	1426.16	1430.59	1434.91	1439.13	1443.25
10	1447.27	1451.19	1455.02	1458.75	1462.38	1465.93	1469.39	1472.76	1476.04	1479.23
20	1482.34	1485.37	1488.32	1491.19	1493.98	1496.69	1499.32	1501.88	1504.37	1506.78
30	1509.13	1511.40	1513.60	1515.74	1517.81	1519.81	1521.75	1523.62	1525.43	1527.18
40	1528.86	1530.49	1532.06	1533.56	1535.02	1536.41	1537.75	1539.03	1540.26	1541.43
50	1542.55	1543.62	1544.64	1545.60	1546.52	1547.38	1548.20	1548.97	1549.69	1550.36
60	1550.99	1551.57	1552.10	1552.59	1553.04	1553.44	1553.79	1554.11	1554.38	1554.61
70	1554.80	1554.95	1555.05	1555.12	1555.15	1555.13	1555.08	1554.99	1554.86	1554.70
80	1554.49	1554.25	1553.97	1553.66	1553.31	1552.92	1552.50	1552.05	1551.56	1551.03
90	1550.48	1549.88	1549.26	1548.60	1547.91	1547.19	1546.44	1545.65	1544.83	1543.99

V. A. Del Grosso and C. W. Mader, J. Acoust. Soc. Am., 52, 1442 (1972)

12.2 Kinematic Viscosity of Water (mm²/s)

Temp [°C]	Kinematic Viscosity [mm ² /s]	Temp [°C]	Kinematic Viscosity [mm ² /s]
0	1.792	55	0.5117
5	1.519	60	0.4750
10	1.307	65	0.4425
15	1.139	70	0.4138
20	1.004	75	0.3883
25	0.8928	80	0.3654
30	0.8008	85	0.3449
35	0.7234	90	0.3263
40	0.6578	95	0.3096
45	0.6020	100	0.2944
50	0.5537		

JIS Z-8803

12.3 Recommended Full Scale Flowrate and Flow unit

Size \ Unit	4mm		6mm		10mm	
	min.	max.	min.	max.	min.	max.
mL/min	20	4000	200	9000	500	9000
L/min	1	4	1	10	1	30
L/h	2	200	12	600	30	1800

Size \ Unit	15mm		20mm	
	min.	max.	min.	max.
mL/min	2	60	2	100
L/min	79	4000	100	7000
L/h	1	4	1	7