SPINK CONTROLS®

CE-2424

JAS-ANZ

An ISO 9001:2008
Certified Company

OPERATING MANUAL

MODEL: ELECTROMAG

SPINK CONTROLS®

CE-2424

JAS-ANZ

An ISO 9001:2008
Certified Company

Cautions!

IMPORTANT STORAGE AND HANDLING INSTRUCTIONS

1) Do not lift the Flowmeter by the Transmitter or Junction box.
2) When the Flowmeter is in unused condition, the cable gland holes must be adequately closed to avoid Ingress of moisture which could lead to problems in Electronic circuitry
3) Do not roll or drag the unit on the lining on the flange which will damage the lining.
4) For Flowmeters above size DN 125, do not lift it by its case. Use eye bolts provided.
5) Rest your Flowmeter only in its upright position on the pedestals provided and not on the casing.
6) When Flowmeter is not in use for extended period, empty the Flowmeter by draining the liquid.
7) While storing cover the flanges by earthing rings and wooden covers to protect lining from any damage.

INDEX

1. INTRODUCTION

Principle of Operation (Ref. Fig. 1)

The Electromagnetic Flowmeters are based on Faraday's law of Electromagnetic induction. In Electromagnetic Flowmeter, magnetic field is generated by a pair of coils. As the conductive liquid passes through the Electromagnetic field an Electric voltage is induced in the liquid, which is directly proportional to its velocity. This induced voltage is perpendicular to both the liquid Flow direction and the Electromagnetic field direction. The voltage sensed by the Electrodes is further processed by the Transmitter to a give standardized output signal.The flux density of Electromagnetic field in a given Flowmeter and the distance between the Electrodes are constant. Therefore the induced voltage is only a function of liquid velocity.

$E = K. B. v. D.$ where E = Induced Voltage
B = Magnetic Field Strength
K = Flow Tube Constant (Meter Constant)
v = Mean Flow Velocity
D = Electrode Spacing

Volume Flow is calculated by equation,

$$qv = (\pi \times D^2 / 4) \times v$$

Therefore,

$$qv = (\pi \times E \times D) / 4 K B$$

The induced voltage is not affected by the physical properties of the liquid like temperature, viscosity, pressure, density and conductivity, as long as conductivity of the measured liquid is above a minimum threshold level.

For reliable measurements the pipe must be completely full of liquid. The Electromagnetic field coils are excited by pulsed DC technique, which eliminates the interfering noise and provides automatic zero correction.

2. APPLICATIONS

- Chemical and Process Industries
- Fertilizer Industries
- Pharmaceutical Industries
- Sugar and Beverage Industries
- Paper and Pulp Industries
- Aluminum and Steel Industries
- Mining and Dredging Industries
- Polymer Industries
- Water and Waste Water Management

3. INSTALLATION

Inspection

Before installing the Flowmeter, check for mechanical damage due to possible mishandling during shipping. All claims for damage are to be made promptly prior to installation.

Primary Requirement

The Flowmeter and the signal cables should not be installed in close proximity to strong Electromagnetic fields. The Flowmeter must be installed in such a way that the meter tube is always completely filled with fluid and cannot drain. A slight upward slope of approx. 3% is desirable to prevent gas build up within the Flowmeter. (Ref. Fig. 2 for various installation locations) Up and Downstream of the Flowmeter primary straight pipe sections are to be installed with the same inside diameter as the inlet opening of the Flowmeter. Upstream of the Flowmeter the length must be at least 5 times the diameter of the Flowmeter and the downstream length must be at least 3 times the diameter of the Flowmeter.(Ref. Fig. 4) .

3.1 Mechanical Installation

Flow Tube Installation

The Electromagnetic Flowmeter can be installed at any arbitrary location in the pipeline as long as the installation requirements are satisfied. Installation dimensions may be found in the appropriate Specification Sheet. At the same time, care should be exercised when selecting the installation site to assure that moisture cannot enter into the connection area. Exercise cares to assure that the housing cover gaskets are correctly seated when installing the covers after the installation and start-up have been completed.

Torque Specifications for Flanges

The mounting bolts are to be tightened equally in the usual manner without excessive onesided tightening. We recommend that the bolts be greased prior to tightening and that they be tightened using a wrench with a normal length, in a crisscross pattern. Tighten the bolts during the first pass to approx. 50%, during the second pass to approx. 80% and only during the third pass to 100% of the max. torque value. The max torque values should not be exceeded, see the following tables.

Tightening Torque in Newton-Meters (NM)

Flowmeter Size DN	Bolt Qty. X Size	Torque NM Teflon Lining	Torque NM Hard Rubber Lining
10	4 x M12	3.5	3.5
15	4 x M12	3.5	3.5
20	4 x M12	5.0	5.0
25	4 x M12	7.0	5.0
32	4 x M12	10.0	8.0
40	4 x M12	13.0	10.0
50	4 x M16	25.0	20.0
65	4 x M16	25.0	21.0
80	4 x M16	45.0	40.0
100	8 x M16	35.0	30.0
125	8 x M20	55.0	45.0
150	8 x M20	60.0	50.0
200	8 x M20	84.0	70.0
250	12 x M22	100.0	80.0
300	12 x M22	120.0	105.0
350	12 x M22	130.0	90.0
400	16 x M25	130.0	90.0
450	16 x M28	200.0	140.0

After installation of the Flow Tube, gradually fill the pipeline with the liquid preferably water instead of process liquid to ensure leak free installation. If it is still leaking, cleanliness of gasket material and rating of gasket material should be checked. After removing the leakages, process fluid may be passed through the pipeline.

Flow Tube Local Earthing / Grounding

For proper working of the Flowmeter grounding as mentioned in Fig. 10 is very important. For accurate measurement, with Electromagnetic Flow measuring technique, an efficient grounding of primary head is necessary. This ground is the reference ground for the measurement and should not add any interference to the signal to be measured. Use 2.5 sq.mm or higher cable for earthing. To ensure interference free operation, no other Electrical appliance should be connected to this ground. This ground performs the function of safety ground also.

Mechanical Installation of Transmitter

If Transmitter is of integral type as per your order, it comes mounted on the Flow Tube and gets installed with Flow Tube in the above procedure. If Transmitter is remote type, the Terminal/ Junction box is fitted on the Flow Tube. The Transmitter along with the mounting bracket comes separate. The mounting bracket is suitable for 2" NB pipe mounting on vertical, horizontal or wall mounting. Figure 6 shows different methods of mounting the Transmitter ona pipe or wall. The Transmitter can be turned around on the mounting bracket in suitable viewing direction around the vertical axis. Provide a canopy to Flow Transmitter Housing to avoid direct exposure
to Sunlight and Rain.

3.2 Electrical Installation

Integral Transmitter (Ref. Fig. 7)

1) The integral Transmitter is mounted on the Flow Tube with coil and Electrode connections done.
2) Open the cover of Terminal compartment of the Transmitter.
3) Connect proper power supply as indicated on tag plate to proper Terminals marked L, N and E in the Terminal box. The cable gland of ½" NPT size double compression type should be used to insert the cable inside the Terminal box. This will ensure environmental protection of Transmitter housing.
4) Connect output cable to the output Terminals marked 4 – 20 mA DC with polarity marking and take the cable through gland for above reasons. Signal and Mains cable should be run in separate conduit. Refit the Transmitter Terminal box cover.

Remote Transmitter (Ref. Fig. 7)

1) In case of remote Transmitter, the Terminal/Junction box is fitted on the Flow Tube.
2) Open the Terminal compartment cover of the Transmitter and Terminal box on the Flow Tube. The Terminals in both the compartments are marked for proper wiring.
3) Connect proper power supply to the supply Terminals as indicated by L, N and E in the Terminal compartment of the Transmitter. Connect output cable to output Terminals marked I + and I - .(Ensure proper polarity for other end of the cable to any indicator or in any control loop connect the cable)
4) Connect the cable supplied for Electrode cabling between E1, E2 and G of Transmitter Terminal Compartment to E1, E2 and G respectively in the Terminal box on the Flow Tube.

5) The maximum permissible cable length of Electrode cable is 10 meters. Also connect coil Terminals marked C1 and C2 in the Transmitter Terminal compartment to Terminals marked C1 and C2 respectively in the Terminal box on the Flow Tube.
6) Use separate cable gland for Main Supply Cable, Output Cable, Electrode Cable and Coil Cable. Also bring out Electrode and coil cables through the separate cable glands in the Terminal box. Refit the Transmitter cover and the Terminal box cover.
7) Under no circumstances should the signal cable run in close proximity to any other power cable.
8) The cable length should be as short as possible. The total load capacity of the Transmitter inducing cable load and other instrumental loads is 1000 Ohms. **The output is isolated**.

3.3 Installation Check Points

1.Is the liquid to be measured compatible with the lining and Electrode materials?
a) If the liquid to be measured is a mixture of the liquids, the compatibility of all liquids with Electrode and lining should be confirmed. Many process liquids are designated by generic names. But it may contain the contaminations in traces. These traces may also be harmful to the Flowmeter.
b) Beside the corrosion of materials depends upon the temperature and the concentration of the liquid.
c) The corrosion due to service liquid will reduce the life of the Flowmeter.
2. Is the Flowmeter rated for the supply voltage and frequency available?
3. Is the Flowmeter suitable for the Flow rate being measured? I.e. the velocity in normal conditions should be above 1 m/sec. and should not exceed 10 m/sec.
4. Is the Flowmeter completely filled with liquid? (No gas bubbles are flowing with the liquid)
5. Is the installation wired properly as per the diagrams in this manual?
6. Is the grounding done as specified?

4. OPERATION

After completion of installation as stated above, the Flowmeter is ready for use.

Switch ON the power supply. The Flowmeter will give output signal proportional to the Flow rate of the liquid in the pipe line as per set velocity of the Flowmeter. Tag plate fitted on the Transmitter indicates the maximum Flow rate for which the Flowmeter has been calibrated.

If Flow more than the set velocity is passed through the Flowmeter, the output signal will be more than 20 mA DC.The current saturates at about less than 30 mA DC. The current more than 20 mA may not represent the actual Flow rate accurately.

The Flow beyond the maximum Flow rate may damage the Flowmeter lining.

The Ten Turn potentiometer with dial indicator is provided on PCB PC 9502 (Ref. Fig. 8) for full scale velocity setting. The output will be 20 mA DC for the Flow velocity set by the potentiometer. The velocity can be set from 0 to 10 m/sec. The set velocity dial resolution is 0.02 rotations (50 divisions per rotation of setting knob).Thus, the velocity can be set with resolution of 0.02 m/sec. The integral portion of the velocity setting is visible in the window on the dial indicator and the frictional portion is on the circular dial.

Flow rate at 20 mA DC output will be:

Velocity setting of Potentiometer X Flow rate of Flowmeter at 1 m/sec.

Note:

The Product Technical Datasheet gives Flow rates of Flowmeters at 1 m/sec, depending on the DN Size.

The facility of full scale velocity potentiometer is very useful for getting better accuracy results for the actual Flow rate. To clarify the use of velocity potentiometer, let us use an example DN 50 Flowmeter.

Suppose actual Flow is 175.2 LPM through the Flowmeter.

At 1 m/sec velocity the Flow rate in Flowmeter DN 50 size will be 117.81 LPM

Thus, the Flow velocity will be 175.2 / 117.81 = 1.4871 m/sec.

$$\text{Output Current} = \left(\frac{\text{Actual Flow Rate}}{\text{Set Velocity x Flow Rate at 1 m/sec}} \times 16 \right) + 4$$

Set Velocity x Flow Rate at 1 m/sec If velocity potentiometer is set at 10 m/sec, the output current at 175.2 LPM will be 6.38 mA Flow velocity being less than 20 % of full scale velocity the accuracy will not be better than 1%

To get better accuracy, if velocity potentiometer is set to 2 m/sec (235.62 LPM), the output current will increase to 15.90 mA for 175.2 LPM. Also Flow velocity will be higher than 20 % of full scale velocity, thus, the output will be accurate within 1% of actual Flow.

By this way effectively we get wide range of Flow rate with accuracy of better than 1% of actual Flow rate from 0.1 m/sec. velocity range.

5. DISPLAY

A 16 X 2 LCD is provided for indication of Flow Rate and Totaliser.
The Flow Rate and Totaliser can be viewed in engineering units according to your choice.

3 Tactile Keys are provided below Display for Configuration purpose.
(Ref. Fig. 12)

(Left) Increment Key

(Middle) Shift Key

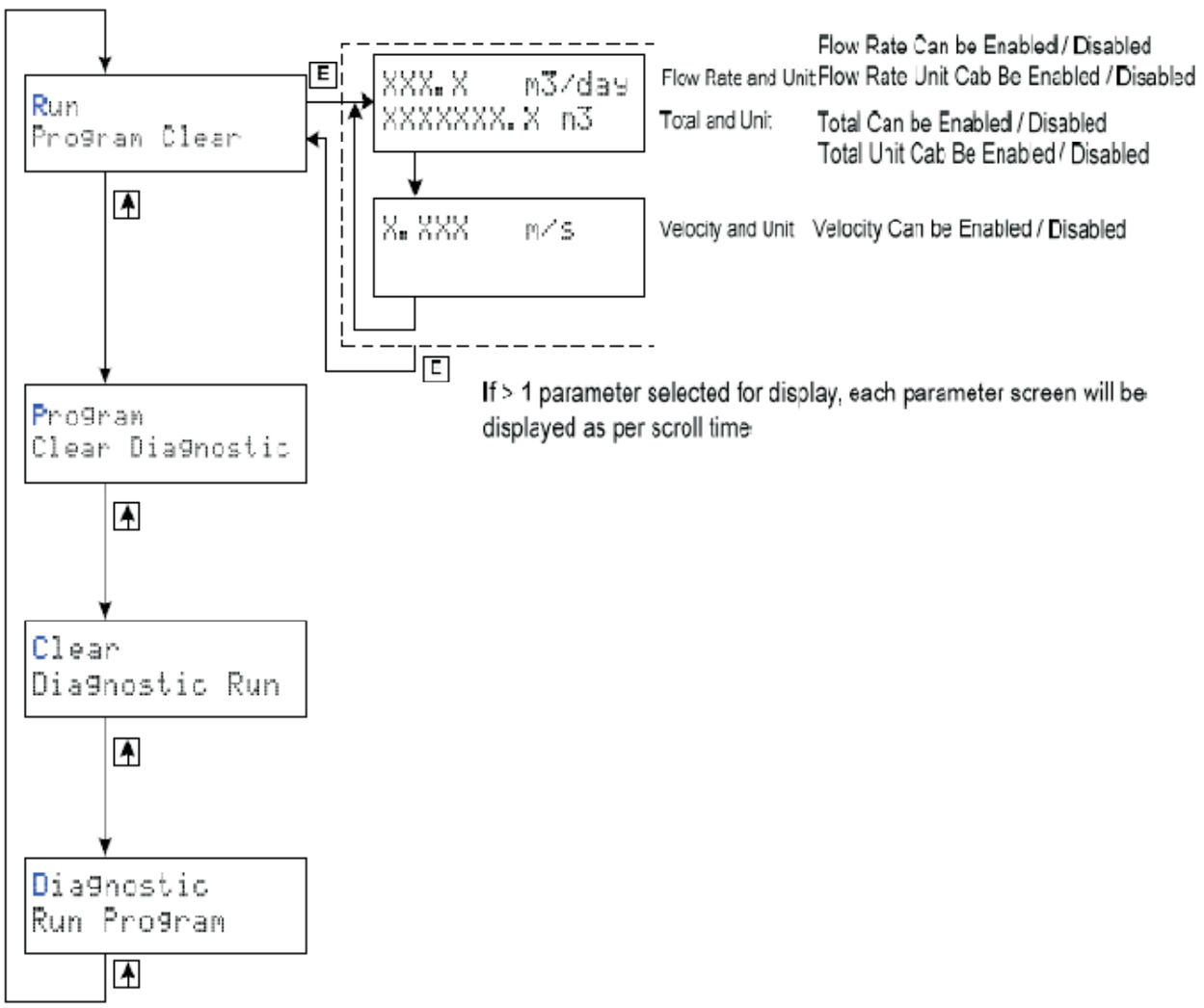
(Right) Enter Key

Use above keys is described in various Run and Configurations screens.

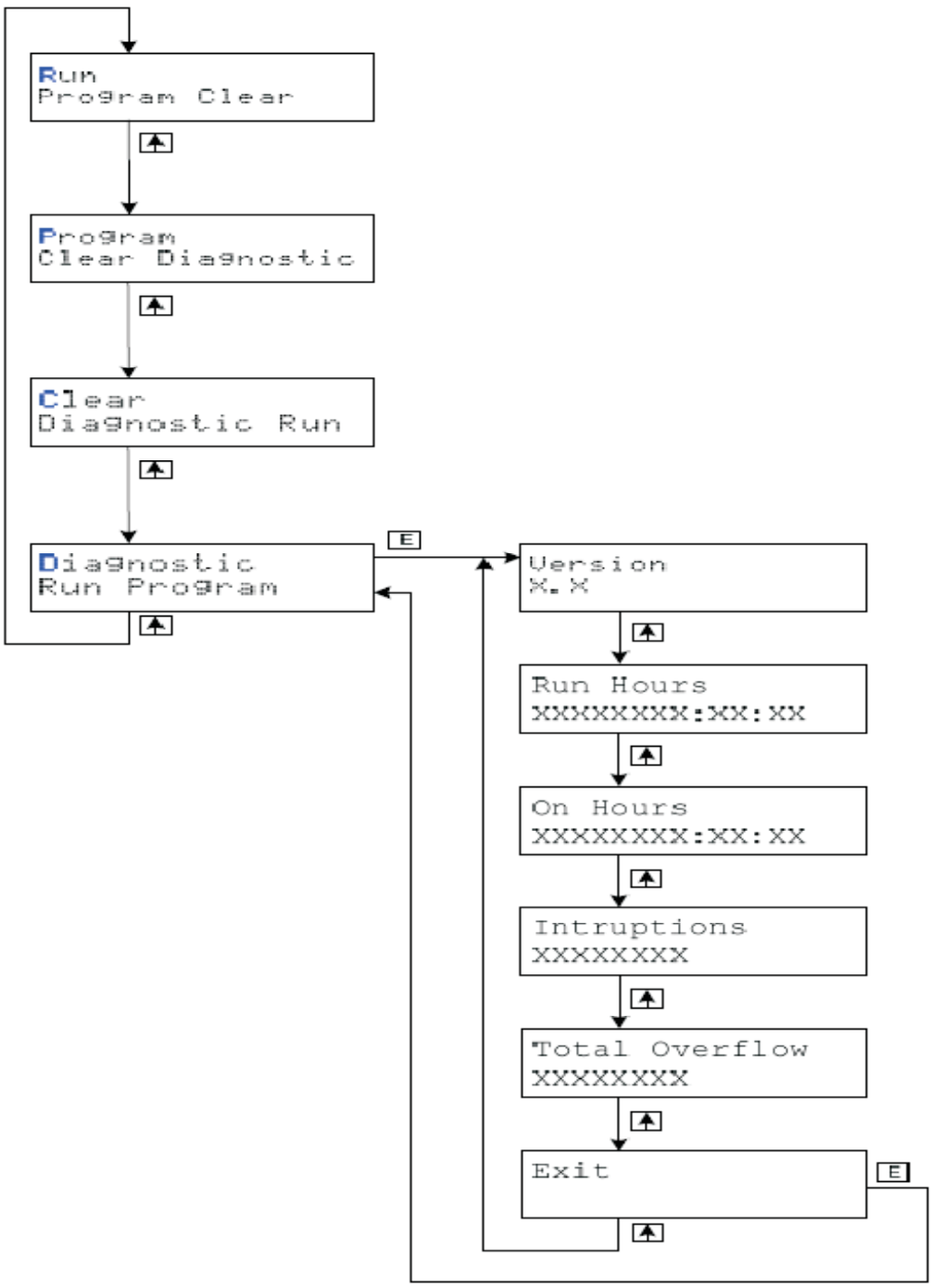
A standard fixed Password '4321' is used.

Run Mode Operation, Configurations are explained in the following Flow charts.

5.1 Run Mode: Various Run Mode Screen Options are available.

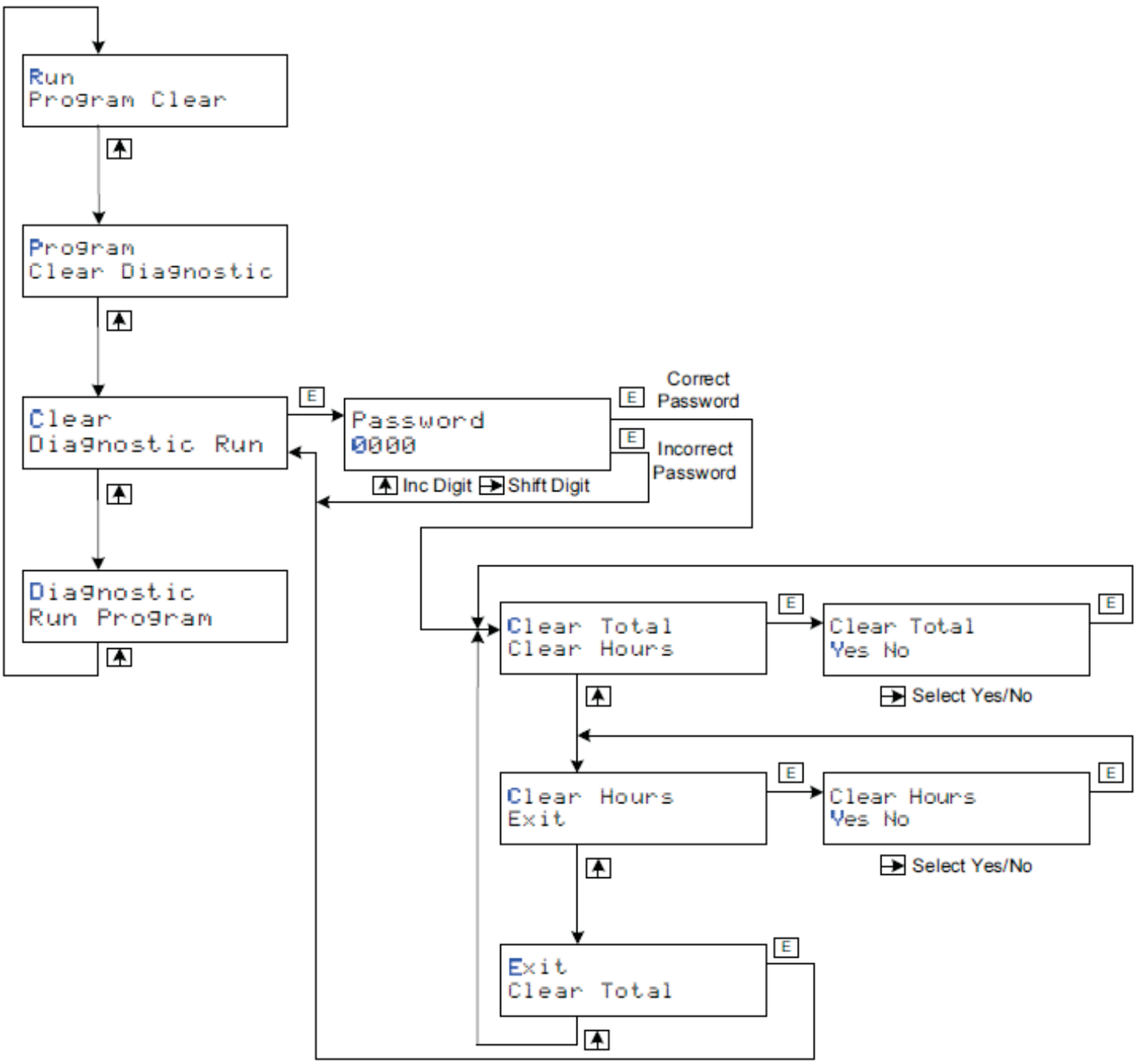


5.2 Diagnostic Mode



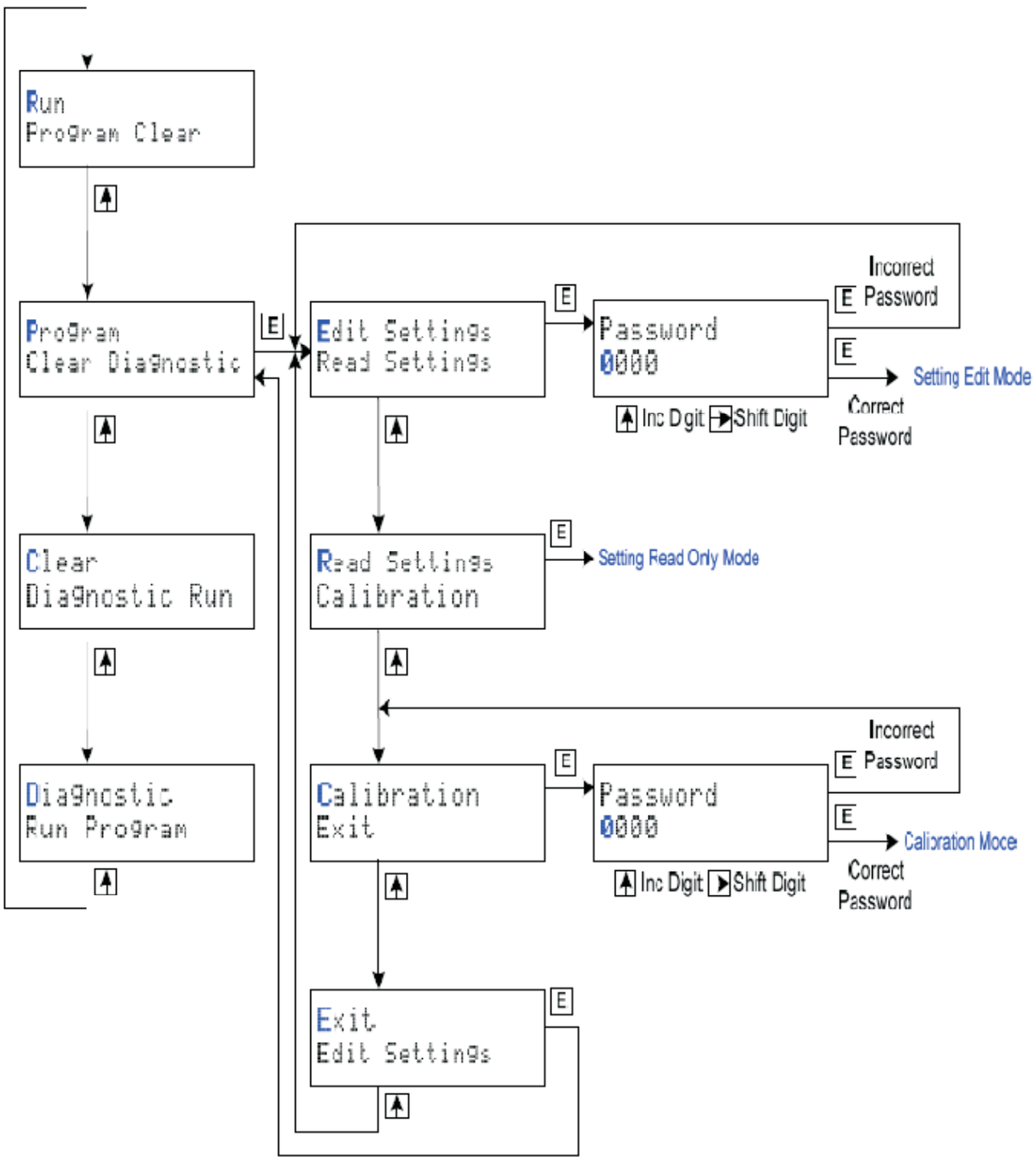
Current Firmware Version, On and Run Hours can be viewed. On Hours inform the time for which Flowmeter is on and Run Hours indicate the Flow Hours. INT indicate Power Fail Interruptions and T OF indicate numbers of Totaliser overflow.

5.3 Clear Mode



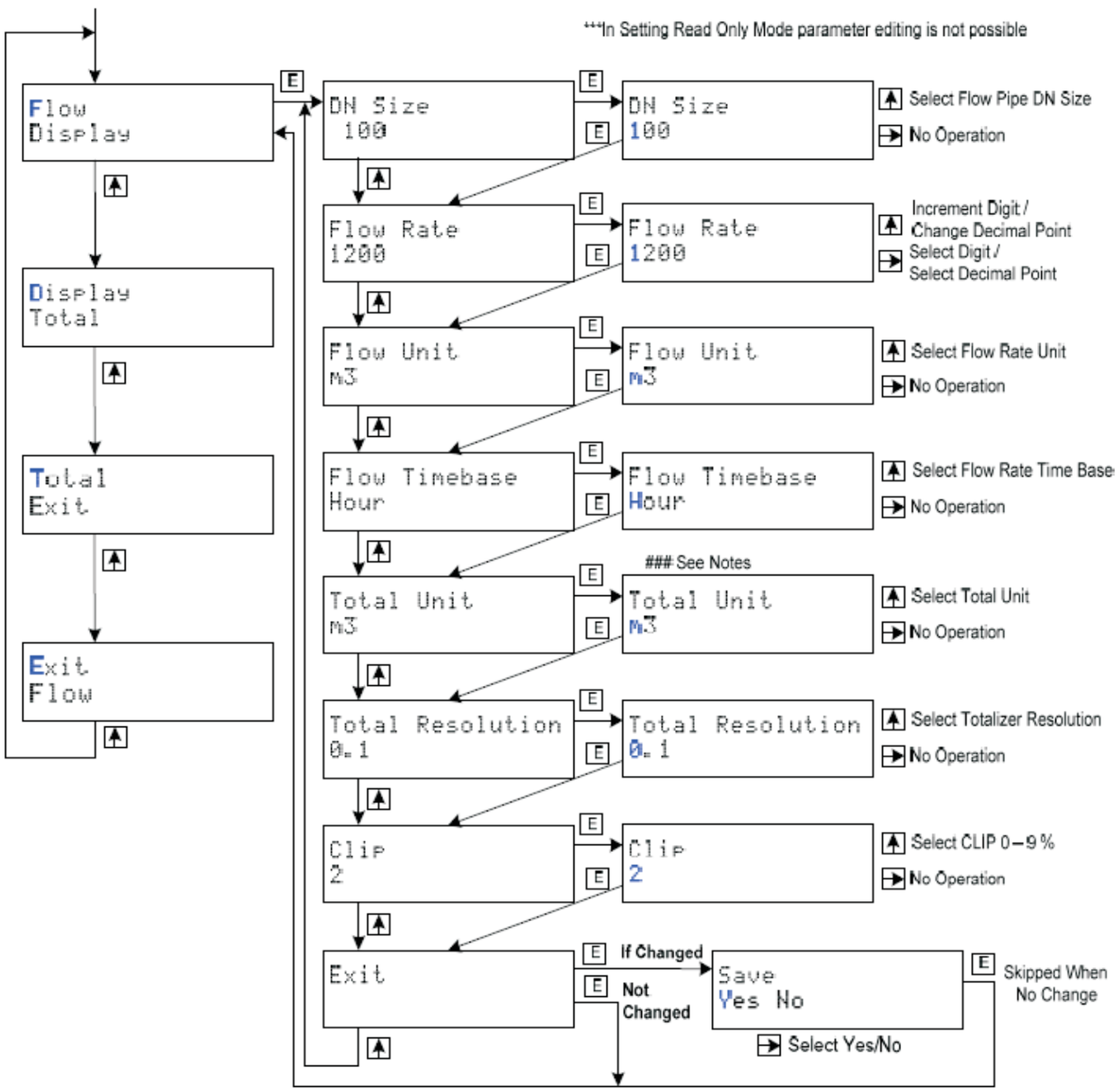
Totaliser, On & Run Hours can be cleared. **This mode is password protected.**

5.4 Program Mode:



In Program Mode, Flowmeter related settings can be edited or read.

Flowmeter Settings Read/Edit Mode



###

Flow Rate in Liter then Total can be in Liter or M3
Flow Rate in US Gallon then Total can be in US Gallon or FT3
Flow Rate in Imperial Gallon then Total can be in Imperial Gallon or FT3

Flow Rate in Million Liter then Total can be in only Million Liter
Flow Rate in M3 then Total can be in only M3
Flow Rate in US Million Gallon then Total can be in only US Million Gallon
Flow Rate in FT3 then Total can be in only FT3
Flow Rate in Imperial Million Gallon then Total can be in Imperial only Million Gallon

1) If user enters Edit or Read Mode, in all 4 sub menus are available. FLOW, DISP.

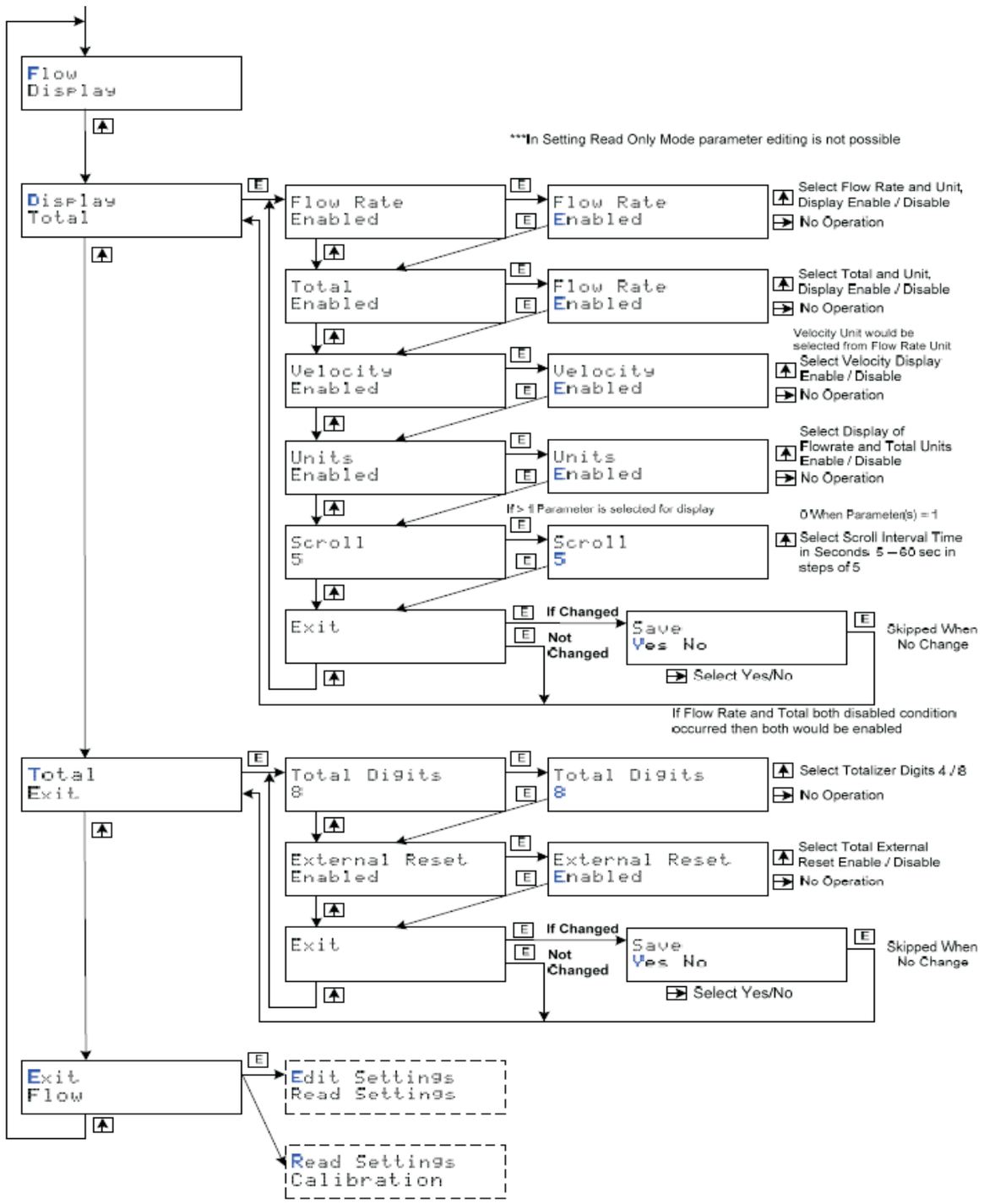
2) Under FLOW sub menu, Flowmeter related settings such as DN Size, Flow Rate, Flow Rate time base (such per Second, Minute,Hour) Flow Unit, Total Unit, Totaliser Resolution, %Clip can be viewed or edited.

3) The procedures for editing is explained on the right hand side of the chart.

4) Under DISP sub menu, Totaliser, Velocity can be enabled or disable for viewing. Based on the selections, different run mode screens will appear. Automatic Scrolling will be enable for more than one parameter selected for Run Mode. The scrolling time can also be set.

5) The structure of Read and Edit is identical. Modification is possible only in edit mode.

DISP Screens



6. OPERATIONAL PRECAUTIONS

1) Though the Terminal Box of the Flowtube is designed to work under Field conditions, we recommend it to protect it from open Sunlight/rains etc. to get extended life.

2) Maintain the colour of the Flowmeter by applying colour periodically to get extended life.

3) Take proper care of the cables and avoid any stretching or breaking of the cables.Keep the cable glands tight so as to avoid moisture entering in the Terminal box or Transmitter.

4) Connect proper Supply Voltage to get the desired accuracy and the life.

5) The liquid Flowing through Flowmeter should be free of abrasive slurry or particles if Flow rate is near its full scale. If liquid contains any type of abrasives, Flow rate should be limited to 3 m/sec. to avoid damage to the lining.

6) No strong magnetic field should exist in the vicinity of the Flowmeter. The magnetic field may modify the output signal of the Flowmeter.

7) Proper grounding should be maintained for accurate operation of Flowmeter This can be checked by checking zero of Flowmeter, in following way: Stop the Flow of liquid by using control valve downstream of the Flowmeter. In such case Flowmeter will remain full of lquid. Keep the power supply to the Flow meter ON. Measure the output signal by using accurate 3 ½ Digital multimeter. The output should be within 4 ± 0.01 mA DC.

If not, possible reasons are: **a)** Improper Ground
b) Contaminated Electrodes
c) Shifted Zero preset

The pulsed DC excitation of field coils ensure stable zero / auto zeroing if all other conditions are satisfactory.

8) Liquid Flowing should be without any gas bubbles. Gas bubbles will give misleading output.

7. Troubleshooting

The Trouble shooting guide is split in two viz. Flow Tube and Flow Transmitter(Converter).
Use 3&1/2 Digit Multimeter for various Tests.

7.1 Troubleshooting for Flowtube

Switch OFF the power supply, but do not disconnect the connection wires.

↓

Confirm the continuity of all wires between Flow Tube Junction Box and Transmitter. Continuity OK?

NO → Install proper wires

↓

YES

↓

Disconnect Coil Wire (Two Core wire) from the junction Box.
Measure resistance between C1 and C2 terminals on the Junction Box.
Value between 20 to 60 ohms?

NO → No Field coils are short or open. It has to be repaired at Factory.

↓

YES

↓

Remove Electrode wires (Three core wire) from the Junction Box. Measure Insulation Resistance between following terminals
1. E1 and Flow Tube Body (G)
2. E2 and Flow Tube Body (G)
3. C1C2 shorted and Flow Tube Body (G)
using 500V, 100 MOhm Megger.
Is the insulation Resistance above 200 Mohms?

NO → Leakage around Electrodes has occurred. It has to be repaired at Factory.

↓

YES

↓

Measure resistance between E1 & G and E2 & G terminals of Junction Box with ohmmeter, using same wire of ohmmeter on the terminals G. Are measured values nearly same?

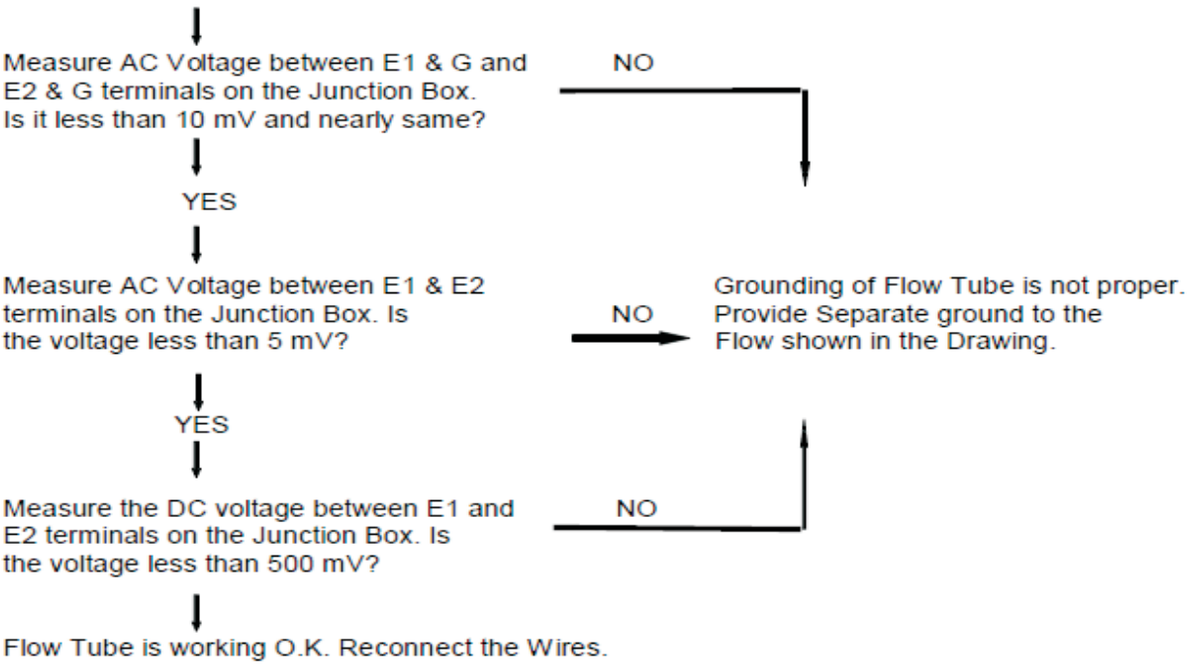
NO → Clean the Electrodes in the Flowtube using Clean Cloth or Zero Polish Paper.

↓

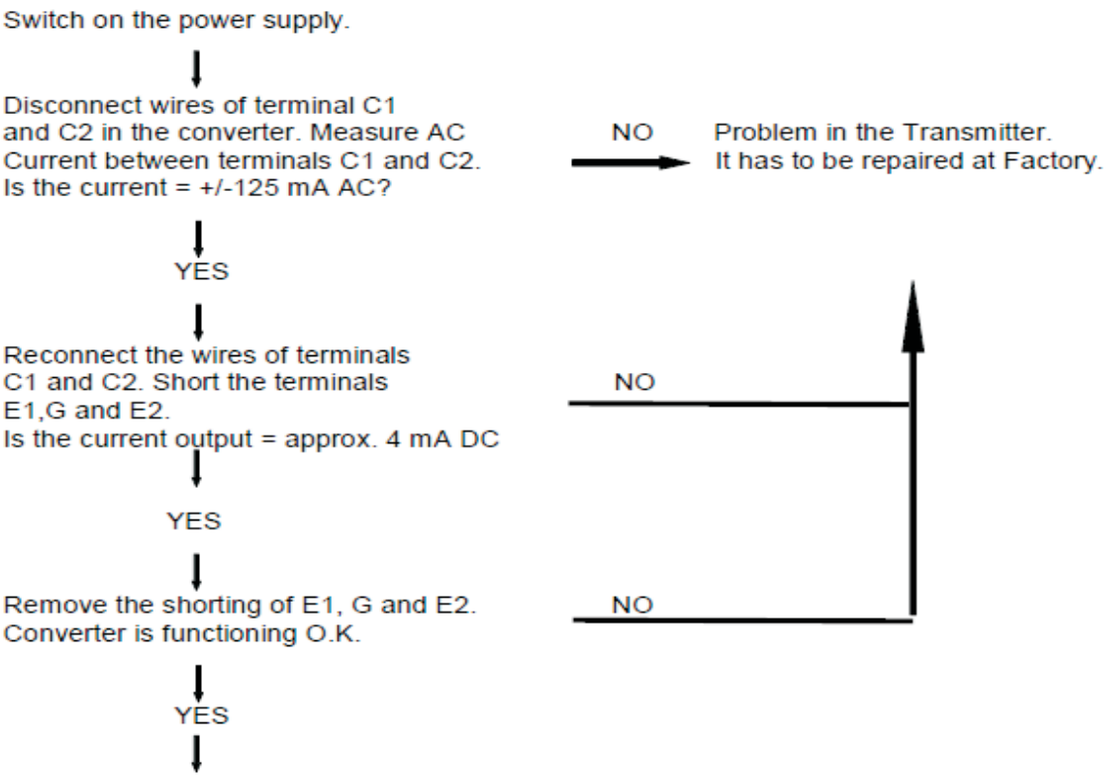
YES

↓

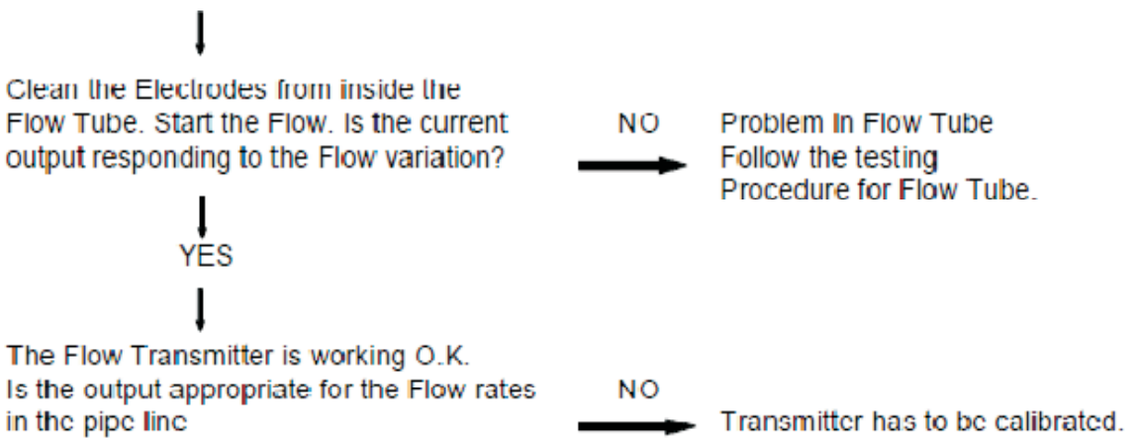
Contuned in Next Page .....



7.2 Troubleshooting for Transmitter



Contuned in Next Page .....



Important Check Points in Troubleshooting

1) Output current saturated
- **a)** Reverse Flow direction at 3.4 mA DC approx.
- **b)** Reverse coil wiring

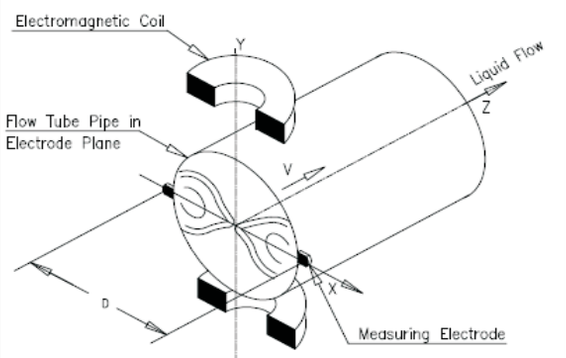
2) Output current saturated a) Flow rate higher than set by velocity potentiometer at about 26.5 mA DC b) Electrode open

3) Output not 4 mA DC
- **a)** Confirm whether Zero Flow is present at No Flow condition
- **b)** Trickle Flow present
- **c)** Grounding not proper
- **d)** Zero adjust preset P3 on PC 9502 disturbed

4) Output current not steady
- **a)** Flow not steady
- **b)** Gas / air bubbles in the Flow
- **c)** Varying Conductivity
- **d)** Grounding not proper

5) "**Err**" Displayed
- **a)** E1/G/E2 Wire Connections are open
- **b)** Reverse Flow
- **c)** Actual Flow Rate Higher than the set Rate
- **d)** C1/C2 Connections are open

Principle of Electromagnetic Flowmeter



E = K x B x v x D where E = Induced voltage, K = Flow tube constant, B = Magnetic field strength, v = Mean flow velocity, and D = Electrode spacing. Volume flow Q is calculated by equation: $Q = v \times D \times \pi/4$, therefore, $Q = \frac{E \times D \times \pi}{K \times B \times 4}$

FIG. 1

Recommended Flowmeter Locations

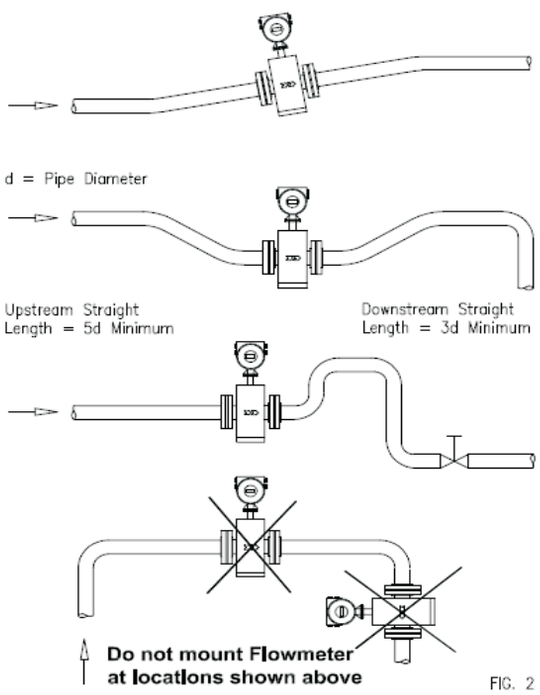


FIG. 2

Flowmeter with Integral Transmitter

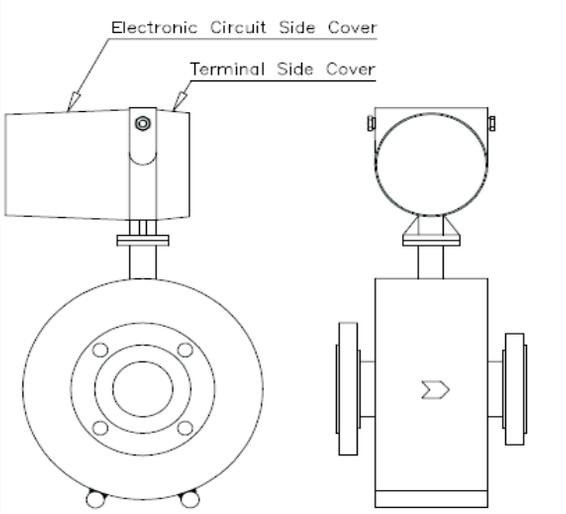


FIG. 3

Details of Mechanical Installation

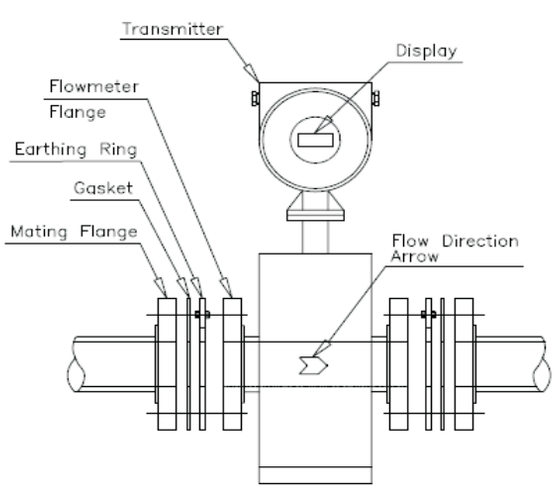


FIG. 4

Bolt Tightening Sequence

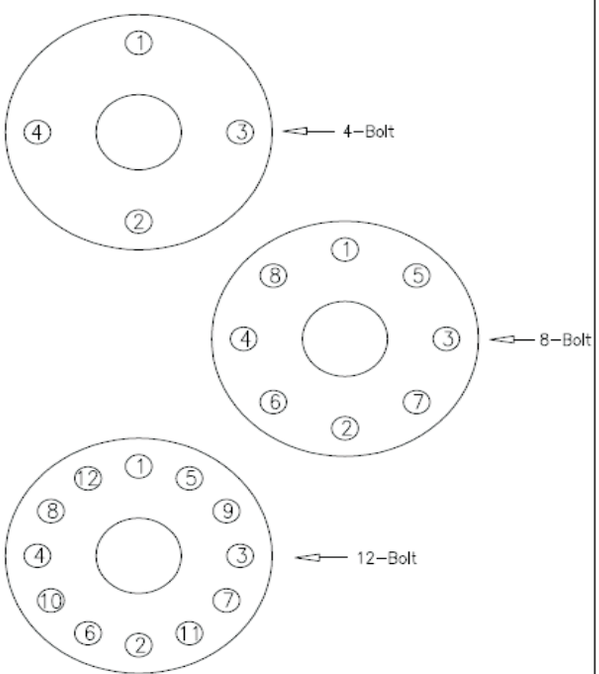
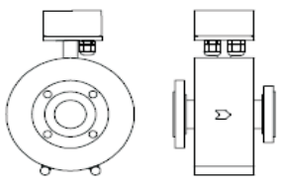
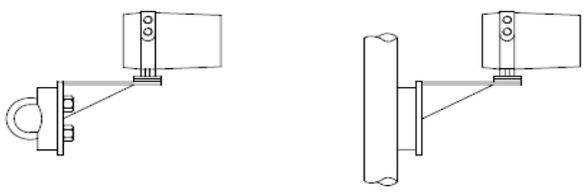


FIG. 5

Flowmeter with Remote Transmitter

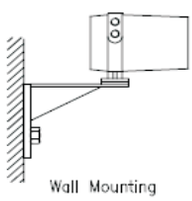


Remote Transmitter Mountings



Mounting on Horizontal Pipe

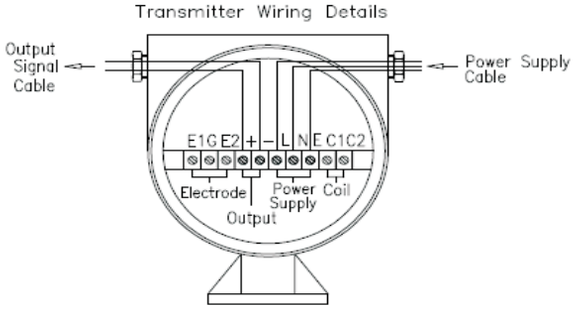
Mounting on Vertical Pipe



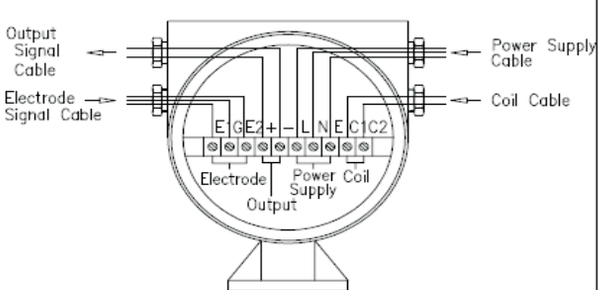
Wall Mounting

FIG. 6

Transmitter Wiring Details



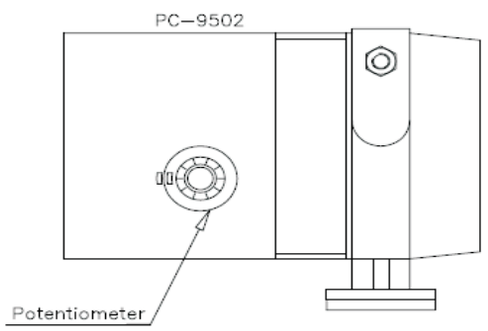
Flowmeter with Integral Transmitter



Flowmeter with Remote Transmitter

FIG. 7

Velocity Setting Potentiometer



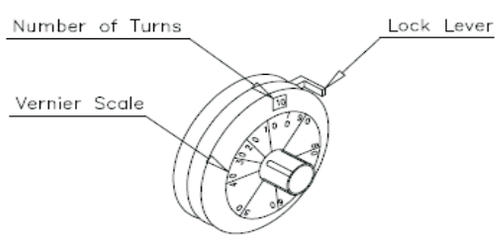


FIG. 8

Wiring Details Flow Tube to Remote Transmitter

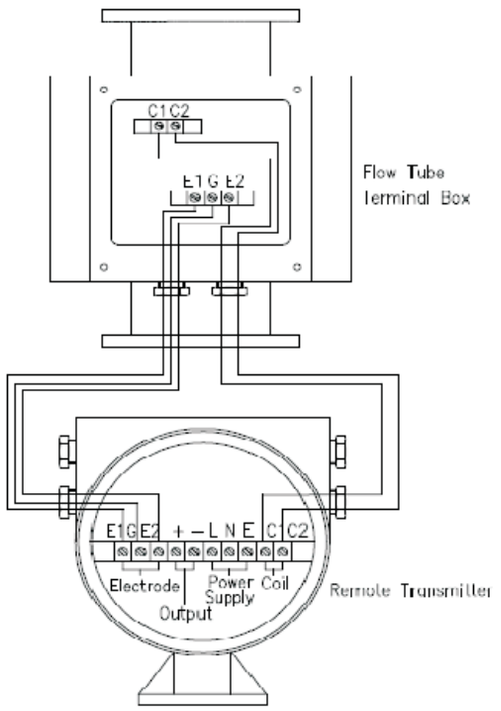


FIG. 9

Grounding Details

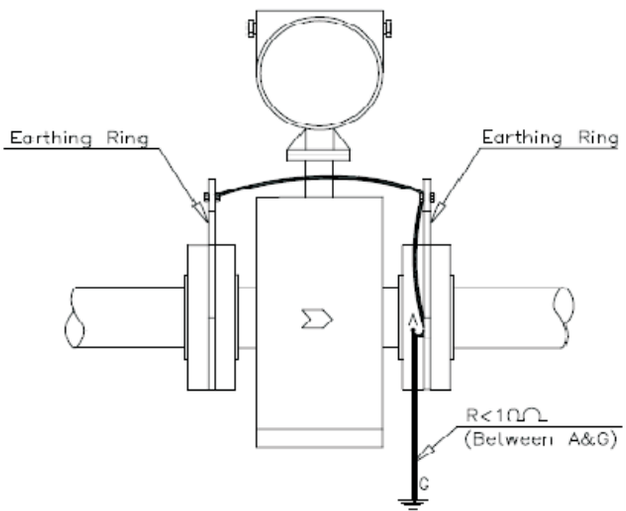


FIG. 10

Error Diagram

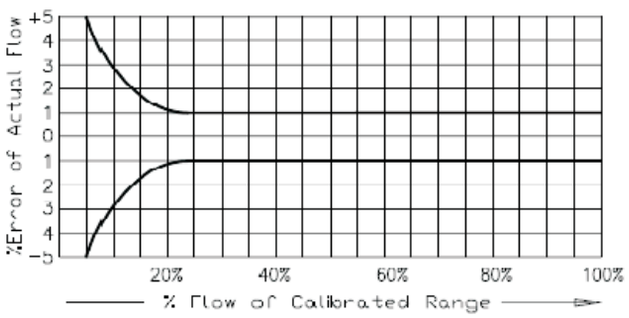
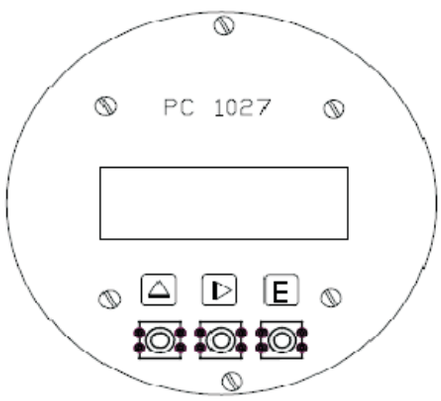


FIG. 11

Transmitter with Display



View when cover is removed

FIG. 12

Appendix

Flow Rate Table

(Flow Rate at V = 1 m/Sec.)

DN	m3/hr	LPM	LPS	USGPM
10	0.282	4.711	0.078	1.245
15	0.636	10.601	0.176	2.801
20	1.130	18.846	0.314	4.979
25	1.766	29.447	0.490	7.779
32	2.909	48.247	0.804	12.746
40	4.523	75.386	1.256	19.915
50	7.068	117.791	1.963	31.117
65	11.944	199.100	3.317	52.588
80	18.092	301.546	5.025	79.660
100	28.270	471.166	7.852	124.469
125	44.18	736.198	12.270	194.483
150	63.61	1060.125	17.668	280.055
200	113.08	1884.667	31.411	497.876
250	176.69	2944.792	49.080	777.932
300	254.43	4240.500	70.675	1120.221
350	346.31	5771.792	96.197	1524.75
400	452.32	7538.668	125.645	1991.51
450	572.47	9541.980	159.036	2520.50
500	706.75	11779.169	196.321	3111.73
600	1017.72	16962.003	282.702	4480.89