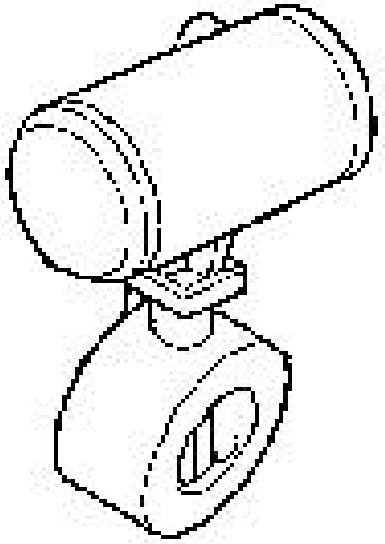
Sympton	Possible cause	Action
6. Flow indicated by current ouput responds to changes in flow above minimum flow rate but does not correspond to the actual value of flow.	• Meter not properly centred on pipe. • Gaskets at the Meter protruding into the pipe bore. • Pipe inside diameter different from that of the Meter. • Irregularities on the surface of the pipe bore. • Signal falsified due to a bi-phase medium. • Incorrect angular position of Meter. • Insufficient upstream/ downstream pipe lengths.	• The axis of the Meter bore should be aligned with that of the pipe. • See Section 4.6 for proper installation of gaskets. • See Section 3.4 for correct values of inside diameter for each Meter size. • The pipe bore should be free from irregularities at the welded joints, dirt, deposits and excessive surface roughness. • Bi-phase media are not permitted. Use a moisture separator for wet steam applications to remove moisture droplets from the steam. Use suitable filters in gas applications to remove solid particles from the flowing gas. • See Section 4.2 for correct angular position. • See Section 4.3.1 for proper lengths of upstream/downstream pipes.
7. Current output indicates flow ~ 1.5 times above normal for flows between the minimum and	• Flow direction reversed.	• See Section 4.2 for correct flow direction.

Spirax Sarco Ind.e Com.Ltda.
Rod. Raposo Tavares Km 31-Portão
CEP 06700-000 - Cotia - SP
Tel (011) 7925-9000 - Fax (011) 7925-9007

Medidor de Vazão Vortex - VFM 2000

Manual de Instalação e Manutenção



1. Introdução

This booklet gives full details of the recommended procedures for the installation of the **Spirax Sarco VFM 2000 Vortex** pipeline units, (Wafer and Flanged). It also covers commissioning of the system together with maintenance and fault finding procedures.

2. Geral

The Spirax Sarco vortex flow metering system consists of two main elements:-

2.1 The VFM 2000 Vortex Pipeline Unit:

This is installed in the pipeline at the point where the flow is to be monitored and operates using the Karman vortex street principle to measure the volumetric flowrate of gases and vapours/ steam. The VFM 2000 (primary head) converts this into an 4 - 20 mA analogue signal for onward transmission to the readout unit or other equipment.

2.2 The Readout Unit:

Various different types of Readout Units are available to accept and process the output signal from the primary head. Additional inputs from a PTX pressure transmitter and/or a TTX temperature transmitter may be acceptable depending on the particular application and type of readout in use.

3. Detalhes Técnicos

3.1 Princípio de Operação

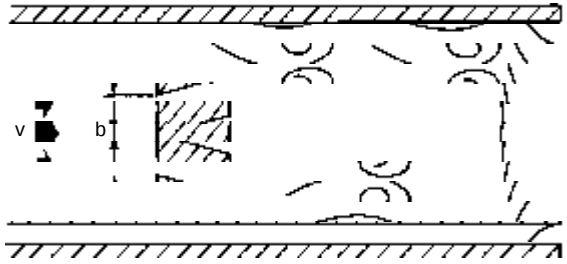
The vortex flowmeter is used for measuring the flow velocity of gases and steam in pipelines. The measuring principle is based on the development of a Karman vortex shedding street in the wake of a body built into the pipeline. In theory, this process enables measurements to be carried out in turbulent flows with a Reynolds number Re > 3000, but linear measurements are only possible where Re > 20 000.

The periodic shedding of vortices occurs first from one side and then from the other side of a bluff body (vortex-shedding body) installed perpendicular to the pipe axis. Vortex shedding generates a so-called “Karman vortex street” with alternating pressure conditions whose frequency **f** is proportional to the flow velocity **v**. The non-dimensional Strouhal number **S** (primary head constant) describes the relationship between vortex shedding frequency **f** (in Hz), width **b** (in metres) of the body, and mean flow velocity **v** (m/s.)

$$f = \frac{S \times v}{b}$$

The flexural vibration of the vortex-shedding body is picked up in the primary head via sensors and analysed in the signal converter. In the case of gaseous flowing media, the vibration frequency ranges between 10 and 1000 Hz.

To calculate the mass flowrate, pressure and/ or temperature transmitters will be required to give density compensation.



3.2 Unidades do Vortex: Diâmetros e Conexões

	Range Availability						
Size	25	40	50	80	100	150	200
	1"	1½"	2'	3'	4'	6'	8'
Wafer PN	40,100	40,100	40,64,100	40,64,100	16,40,64	-	-
ANSI	300	300	150,300	150,300	150,300	-	
Flanged PN	40,100	40,100	40,64,100	40,64,100	16,40,64	16,40	10,16
ANSI	150,300	150,300	150,300	150,300	150,300	150,300	150,300

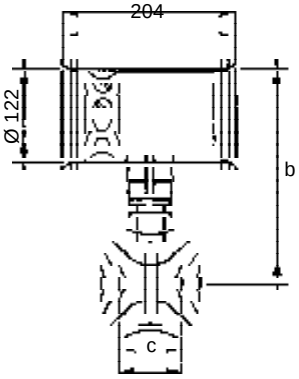
3.3 Condições Limites

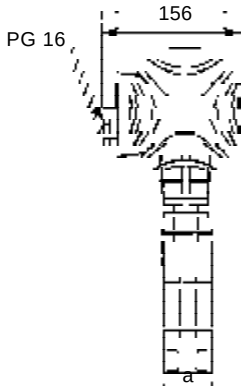
The maximum pressure and temperature limitations depend on the materials of construction and the flange specified.

Operating temperature:
Standard version -20 to +180°C
High temperature version (optional) -20 to +220°C

3.4 Dimensões

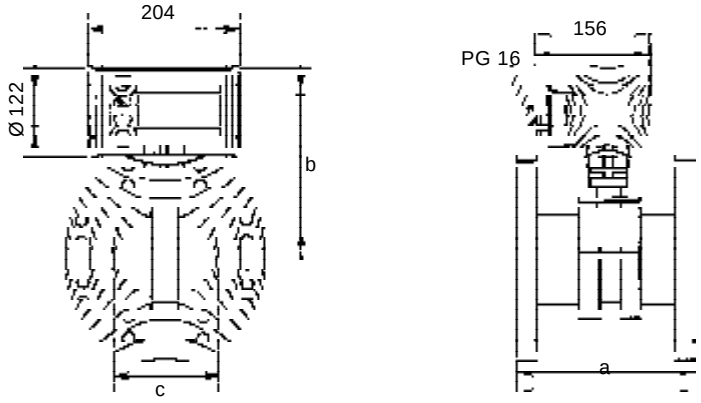
3.4.1 Unidades





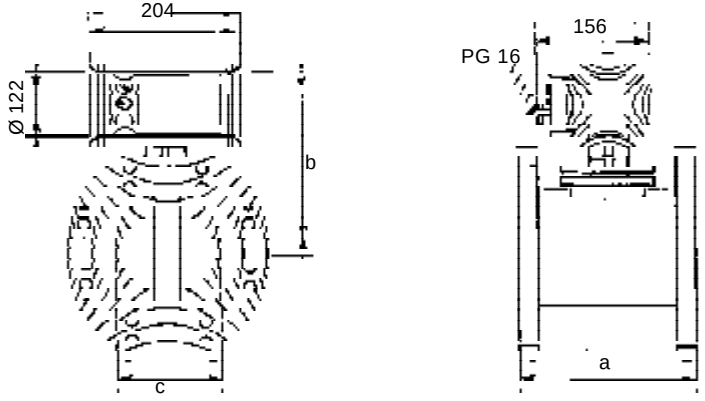
ANSI SIZE	DN SIZE	WAFER Dimensions (mm)				WEIGHT kg
		a	b	c	c	(Max)
1"	25	65	258.5	26.7	28.5	3.8
1½"	40	6.5	269.5	40.9	43.1	4.6
2'	50	65	273.0	52.6	54.5	4.9
3'	80	65	293.0	78.0	82.5	6.8
4'	100	65	301.5	102.4	107.1	7.5

3.4.2 Unidade Flangeada (DN 25 à 100 e 1" à 4")



ANSI SIZE	DN SIZE	FLANGED Dimensions (mm)				WEIGHT kg
		a	b	c	c	(Max)
1"	25	250	258.5	26.7	28.5	6.3
1½"	40	250	269.5	40.9	43.1	9.8
2'	50	250	273.0	52.6	54.5	10.5
3'	80	250	293.0	78.0	82.5	16.3
4'	100	250	301.5	102.4	107.1	18.2
6'	150	250	368.5	154.2	159.3	25.9
8'	200	300	401.0	202.7	207.3	43.7

3.4.3 Unidade Flangeada (DN 150 & 200, ANSI 6" & 8")



4. Instalação

4.1 Geral

4.1.1 Accuracy
In order that the flowmeter can meet its specified accuracy and performance, it is essential that the following guidelines for installation are followed carefully.

Ensure that all debris is removed from the line prior to and during installation and that no weld scale or other swarf can find its way into the unit.

4.1.2 Temperatura e Pressões mensuraveis
To determine the temperature and/or pressure of the piped product (e.g. for calculation of the mass flowrate), suitable measuring points must be provided.

Installation upstream of flow meter -
Min. distance: 20 x D (D = meter size)

Installation downstream of flow meter -
Min. distance: 10 x D (D = meter size)

If fitted downstream allowance must be made for the pressure drop in the flow meter, such that the correction value for operating conditions prevailing are the same as upstream of the flow meter.

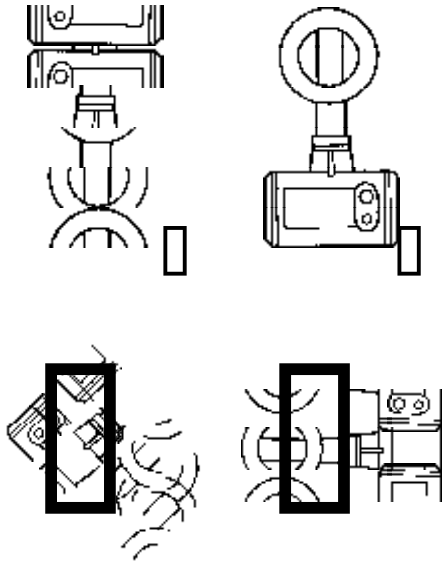
4.1.3 Items included with shipment
VFM-2000 flowmeter
Mounting bolts, washers, nuts and centring sleeves (supplied with wafer version)
Installation and operating instructions

4.1.4 Items to be provided by customer
All cables for electrical connection.
Gaskets between VFM-2000 and pipeline

4.2 Direção da Vazão e posição do Medidor

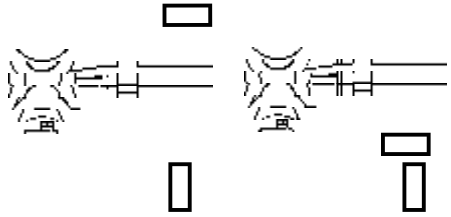
4.2.1 Horizontal Pipe Run
The VFM 2000 vortex meter must always be installed with the flow in the direction of the arrow, bluff side of vortex-shedding body facing incoming flow i.e. upstream side, and with the buff body lying perpendicular to the flow, see below:-

4.2.2 Tubulação Vertical Run
The VFM 2000 may be installed in a vertical pipe run, see below:-



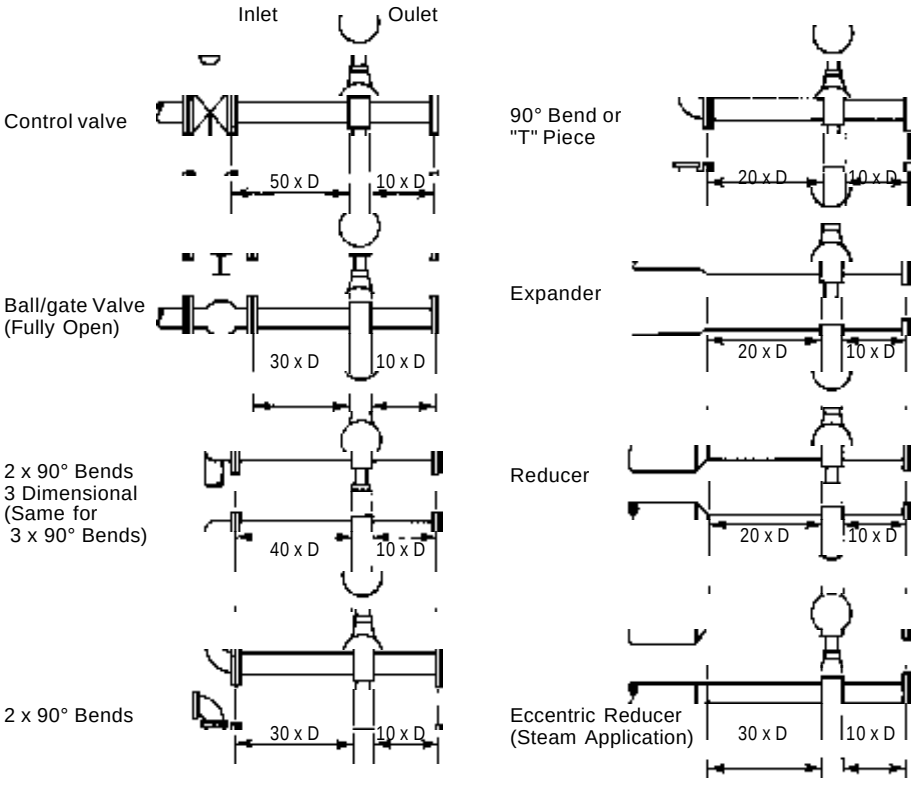
4.3 pipework

4.3.1 Upstream/downstream pipework



Ensure that the upstream and downstream pipes where the vortex meter is to be installed are of adequate length, see below.

4.3.2 Pipeline along a wall
To ensure easy access for the electrical connections and for maintenance purposes, the

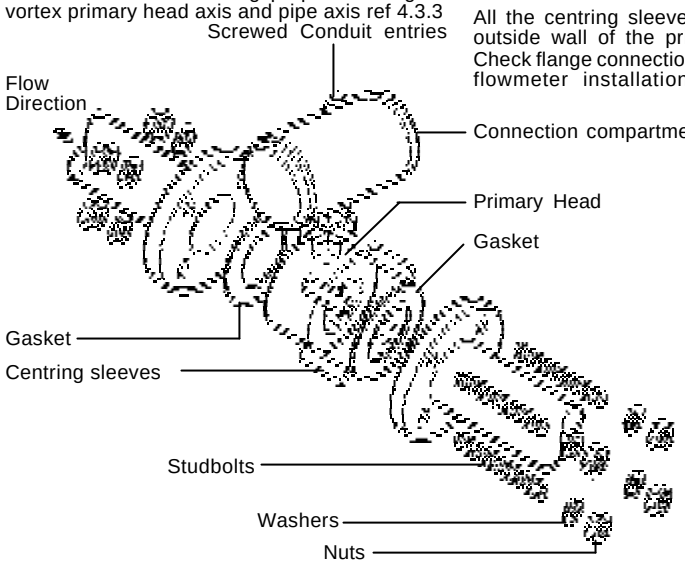


distance between pipe centreline and the wall should be greater than 0.5 m. If this is to be less then first connect all cables to the terminals in the connection compartment (screwed conduit entry side) and run them via an intermediate connection box (see also Section 4.7) before installing the flowmeter.

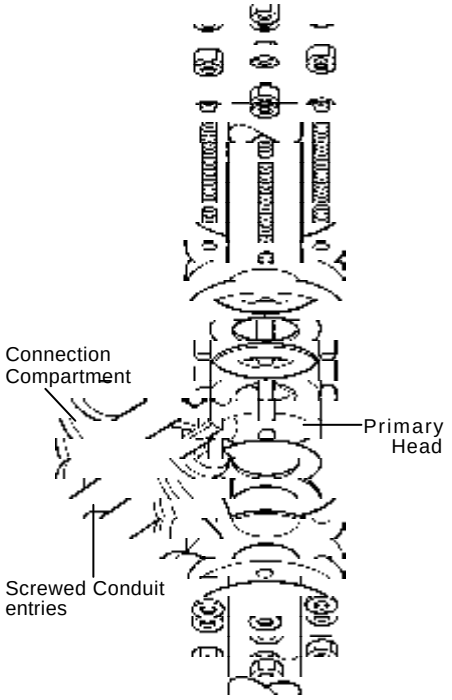
4.3.3 Vibração da Tubulação
Ensure that pipe vibration caused, for example, by the action of pumps, valves, etc., is kept to a minimum as this will affect accuracy, particularly at low flow velocities. Support the pipeline on both sides of the flowmeter in a horizontal plane.

4.4 Instalação do Wafer

4.4.2 Tubulação Vertical run
Install VFM 2000 ensuring proper centring of vortex primary head axis and pipe axis ref 4.3.3



All the centring sleeves must rest against the outside wall of the primary head.
Check flange connections for leak-tightness after flowmeter installation



by utilising centring sleeves provided.

4.4.1 Tubulação Horizontal run
Install VFM 2000 ensuring proper centring of vortex primary head axis and pipe axis ref 4.3.3 by utilising centring sleeves provided.

4.5 Instalação do Flangeado

Centre the flowmeter by sight before tightening bolts.

4.6 Gaskets

Gaskets inside diameter must be greater than the inside bore diameter (Ø) of the VFM 2000, e.g. use flat gaskets to DIN 2690. Gaskets must not project into the effective pipe cross sectional area.

4.7 Instalação Elétrica

4.7.1 Geral
Ensure that screw thread of housing covers is well greased at all times.

System operates off a two-wire 4 to 20 mA DC. current interface.

4.7.2 Power supply requirements
Supply power U_B: 24 V DC (15 to 30 V DC), rms ripple voltage 100 mV

Load R_B:

Calculation $R_B = U_B - 15\ V$ 750 ohms
20 mA

Loop load into positive lead

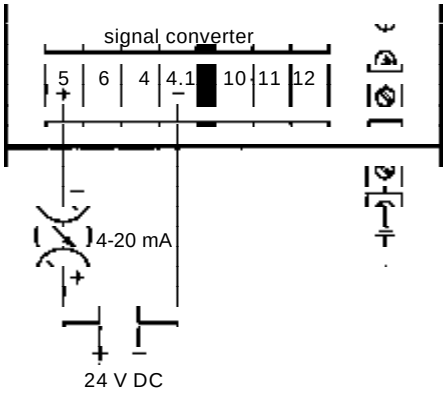
Note: load resistance to ground greater than 3M ?

4.7.3 Earthing (Grounding)
The flowmeter must be earthed by the external clamp-type terminal.

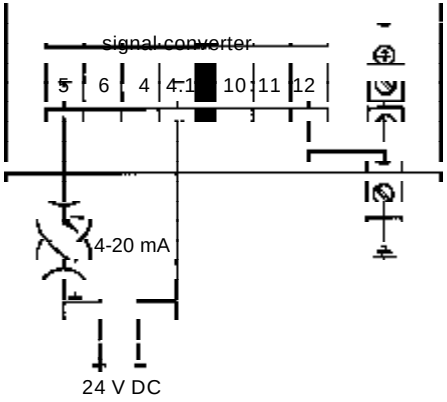
The electronics must be correctly earthed, see connection diagrams.

4.7.4 Electrical connections (standard)
Connect the signal converter to power supply using a 2-core, 1 mm² diameter cable ensuring that the polarity of supply is correct. The maximum cable length acceptable is 500 m. The cable is not to be run in the immediate vicinity of power cables.

4.7.5 Electrical connection (EEX)
Note: Ensure that the VFM 2000 supplied is suitable for use in a hazardous area.



Power supply non-grounded



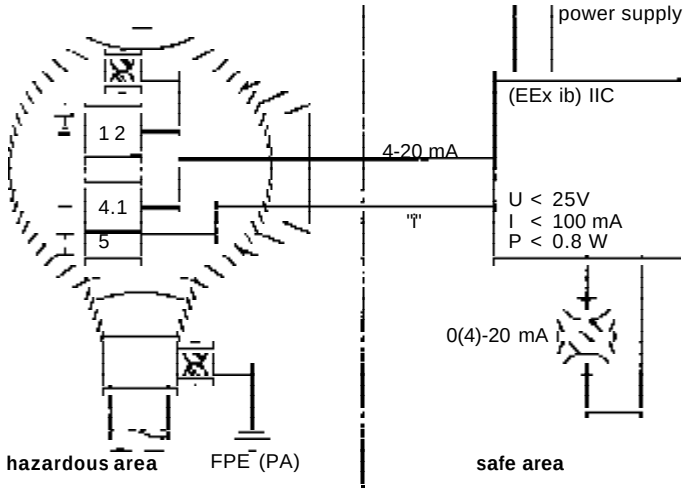
Power supply grounded to negative potential

Connection to the signal converter from the power source must be via a suitable certified **IS** interface. It may be connected via multicore cables provided that they contain only **IS** circuits and that these circuits are not interconnected unless specifically permitted.

Circuits are regarded as separate if each conductor is insulated to a thickness of at least 0.2mm (Europe) or 0.25mm (USA & Canada) and the cable is protected against damage. This is to reduce the probability of sparks due to earth faults when there are differences in earth potential. Any overall screen must be insulated and earthed at one point.

5. Start - Up

After all mechanical and electrical work has been completed, the initial start up procedure should be followed.



5.1 Power - Up

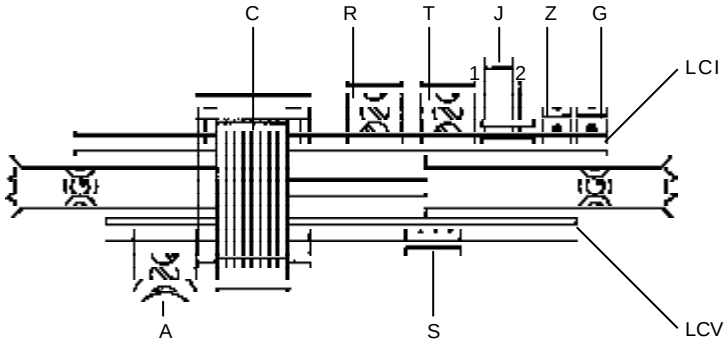
Open housing lid which exposes the electronics and disconnect the connecting wire from the sensor.
Power-up the signal converter and check that the loop current is 4 mA. If this is not the case investigate using the Fault Finding Chart, ref. Section 7.
Reconnect the sensor wire and recheck the loop current. This should still be at 4 mA. If this is not the case then check whether the current is steady and of value = (50 Hz ÷ Fmax x 16) + 4 mA. (Fmax (Hz) is equal to Qmax(m^3/h) X k-factor (pulses/m^3) ÷ 3600). Fmax is also indicated on the label on electronic assembly. If this is so, then the loop needs to be in the grounded mode. See section 4.7.3. If the current value is other than this ensure that pipe vibration is eliminated. The flow meter is ready for service 15 minutes after switching on the power source. Increase flow velocity slowly and steadily avoiding abrupt changes of pressure in the pipeline. Check that the output increases as per the flow.
If the output current does not increase with flow investigate using Fault Finding Chart ref section 7.
If the process product is steam, condensate may form initially and cause faulty measurements when the system is started up for the first time.

5.2 Elementos de Operação

The operating elements are accessible after unscrewing the cover of the electronics compartment (opposite screwed conduit entries).

5.3 Setando

5.3.1 Range changes



LCV	Signal amplifier board
LCI	Signal converter board
A	Potentiometer, analogue threshold (do not readjust)
C	Ribbon cable, connection between LCV and LCI boards
G	Potentiometer, gain (do not readjust)
J	Jumper socket (see Section 5.3.1)
R	Switch, range setting (see Section 5.3.1)
S	Socket, sensor connection
T	Switch, time constant (see Section 5.3.2)
Z	Zero potentiometer (do not readjust)

Switch off the power to the VFM 2000 before opening the housing covers.

The measuring range can be halved from 75 m/s to 37.5 m/s by using switch R and jumper J without making any readjustment. Basic factory setting is 1:1 (see Table 3).

To calculate the actually measurable maximum flowrate at specific flowing conditions refer to the relevant T.I.S.

Table 3

5.3.2 Time Constant

Switch off power source before opening the housing covers. Four different time constants (t in seconds) can be selected with switch T. See table 4

Table 4

Basic factory setting is in position 3 ? 3 seconds

Pos.T	t (s)
1	0.5
2	1.0
3	3.0
4	10.0

Steady flow reduce t to position 1 or 2
Unsteady display set to position 4 = 10 seconds

Meter Size	Range 1:1			Range 1:2		
	Vmax (m/s)	Pos R	Jmp J	Vmax (m/s)	Pos R	Jmp J
25 /1"	75	1	2	37.5	2	1
40 /1½"	75	1	1	37.5	2	1
50 /2"	75	1	1	37.5	2	1
80 /3"	75	2	1	37.5	3	1
100 /4"	75	2	1	37.5	3	1
150 /6"	75	2	1	37.5	3	1
200 /8"	75	3	1	37.5	4	1

6. Manutenção

6.1 Tubulação com Unidade VFM 2000

Properly installed and used, the VFM 2000 vortex pipeline unit will give many years of trouble free service. However, periodic cleaning and removal of dirt and deposits from in the bore is advisable. This will prevent excessive build up altering the dimension of the inside diameter of the meter bore and adversely effecting its performance.

Also, it is advisable to visually inspect the sealing 'O' rings and replace if showing signs of fatigue.

7. Análise de Falhas

Sympton	Possible cause	Action
1. Output current available supply/current 0 mA both with & without flow.	• Power supply not • Check power at Signal Converter. • Power supply connected with reverse polarity. • Electronics faulty.	connections. Refer to Section 4.7.4 for details. • If power supply is available with correct polarity replace electronics. • Replace electronics.
2. Output current between 0 & 3.6mA both with & without flow.	• Insufficient supply voltage. • Electronics faulty.	• Check if supply voltage at the Signal Converter is between 15 & 30V dc. If not, reduce the current loop resistance. See section 4.7.2, for maximum loop resistance. • Replace electronics.
3. Output current greater than 20 mA both with & without flow.	• Excessive mechanical vibration in the pipe. • Electronics faulty.	• Check whether the output current falls to 4mA if either the sensor cable is disconnected from the electronics or the flow meter is discounted from the vibrating pipe. If so, support the pipe near the flow meter perpendicular to both the axis of the pipe and the axis of the bluff (sensor) body and/ or if possible, isolate the flow meter from the source of vibration with suitable flexible piping. • If by disconnecting the sensor cable from the electronics the current does not return to 4 mA then replace electronics.
4. Output current steady between 4 & 20 mA with no flow.	• Excessive mechanical vibration in pipe. • Mains interference due to improper earthing • Electronics faulty	• Same as (3). • Ensure that the housing is properly earthed. Also see Section 4.7.3 for operation of the Signal Converter in earthed condition. • Check if by disconnecting the sensor cable from electronics, the output current falls to 4mA. If not, replace the electronics.
5. Output current stays at 4 mA and does not respond to increase or decrease in flow above the minimum flow rate.	• Sensor cable disconnected or not properly connected to electronics. • Sensor faulty. • Electronics faulty.	• Connect the sensor cable to the electronics at connector 'S' (see Section 5.2). • Disconnect the sensor cable from the electronics. Check the capacitance of the sensor between the centre pin and each outer pin of the cable connector separately. The value should be between: 2.7 & 3.5 nF for flowmeter sizes from DN80 (3") to DN200 (8"); 2 & 2.4nF for DN40 (1½")/DN50 (2"); and 0.8 to 1.5 nF for DN25 (1"). If the capacitance is not as per these value, replace the primary head. • Check the insulation resistance (using a DMM) between the centre pin and the outer pins of the sensor cable connector. The value should be >100M Ω. Similarly check the insulation resistance between all three pins of the sensor cable connector and the body of the primary. If the resistance is not as expected, replace the primary head. • Disconnect the sensor cable and feed a signal of 50 mVp-p with a frequency in Hz equal to [Q max (m^3/h) x k-factor ($pulses/m^3$)] ÷ 3600, between the centre pin and either one of the outer pins of the sensor input connector 'S' of the electronics (see Section 5.2). The output current should be about 20 mA. If not so, check that the Threshold potentiometer 'A' (Section 5.2) is set at two graduations before the maximum clockwise position. If this does not help replace the electronics.