SELECTRON S.A.

SELECTRON BUILDING
79 Koletti & Moutsopoulou str., 18537 Piraeus, GREECE
Tel: (+30) 210 4599995, Fax: (+30) 2104599905
e-mail: info@selectron.gr, Web: www.selectron.gr

SELFUEL VISCOMETER

Technical manual

1.1.A two-part equipment

The measuring chain is composed of two inseparable elements: the sensor and the electronic device that controls it. The sensor cannot be used with another electronic device because they are matched together as one vibrating system, and vice versa.

The provided viscosity information is relative. In the same fluid and under the same environmental conditions, the information is the same. For two fluids with a different rheological behavior, the response can be different. Since it is perfectly repeatable , it just needs a different correlation.

The active part of the sensor is composed of a vibrating rod held in oscillation at resonance frequency by driving magnets. When the rod is immersed into a viscous material, the amplitude of the vibration is dampened. The vibration amplitude varies according to the product viscosity where the rod is immersed.

The sensor receiving coil detects the response and the signal is converted to a viscosity value through the electronic device. The factory calibration is performed with standard oils.

The electronic device acquires the coils' amplitudes and generates various signals. These signals represent the properties being measured. It is also in charge of powering the whole system.

It gives viscosity information through two kinds of output:

- 4/20mA current output
- Serial communication through RS485 Modbus protocol

1.2.Checking the equipment after receipt

a) First and foremost, check the conformity with the ordered equipment , that is to say mainly check if the needed parts for mounting the equipment are delivered.

b) Place the sensor on a soft foam plate, connect a 24 VDC power supply and switch it on . The rod shall start vibrating and the viscosity indication is close to zero (or the current output gives a signal close to 4 mA). When touching the rod, the value has to increase.

In cade of a subnormal operation occurs in *a) or b)* , check as follows:

- Power supply, connections, cables
- The good conditions of the vibrating rod (no bending, no damages,…).

1.3.Checking the equipment when placed in line

Before starting the process, check that the viscosity information is stable (vibrating rod in air). If not , check the strength of the sensor fitting. Choose the position where the information is the most stable.

Locate this position in order to restore it when the sensor is removed and put back again. Adjust the mounting offset, at room temperature. The rod is vibrating in the air.

When possible, note the viscosity information when a cleaning or rinsing solution is flowing.

If the original calibration is convenient , one of the 2 above mentioned values can be taken as reference for periodic controls of the equipment. This operation must be done each time in the same conditions (rod in air, or the cleaning solution). Such a control can be assimilated to a self-checking.

If the original calibration has been modified , the reference values will of course be those obtained with the new calibration.

1.4.Periodic Checking

Conformity to regulations relative to Quality Insurance implicates a periodic control of the measuring equipment used in the manufacturing operations, taking in consideration (or correcting) their drift in time.

It is proved that this equipment drift is negligible. However, it is good to check their aspect and their response once a year, at the same time as the other process equipments.

A quick control is possible from time to time, if the sensor active part is in air, or immersed in a cleaning or rinsing solution. As long as these values stay similar , we can say that the sensor operation is right among its whole range (if no intermediate re-programming occurred).

1.4.1.Offset adjustment in air

The clean and dry rod is vibrating in the air when the offset adjustment is carried out.

The amplitude , corrected with an offset , is shifted so that the viscosity value is 0 cP.

The zero adjustment in the air procedure is described in § 4.

1.4.2.Modification of the previous calibration

The device has been programmed in order to perfectly answer to the customer's needs. These features are noted in the factory specification pages at the end of this document.

At first, be sure that the modification is necessary , and not consecutive of a non-coherent comparative information (different measuring conditions, bad standards, Inaccurate or wrong laboratory measurements,…).

The calibration parameters are protected and can only be modified at SELECTRON

For any modification of the calibration , contact SELECTRON.

1.5.ATEX certification option

If the option is selected, selfuel sensors are in agreement with 94/9/EC directive (ATEX) for equipments installed in explosive gas atmospheres:

II 2G/D Ex d II T3 to T6

Be sure the sensor's certification is in accordance with the security level required on your process location: area classification ,equipments group, protection method, gas type. Temperature codes…

Area classification and equipments installation rules are detailed in IEC 7910 and EN 60 079 standards for gas.To always keep the maximum security level of the viscometer, do not open it.

Check periodically that the information marked

on the sensor identification plate is still visible.

2.1.Sensor installation

It operates in any position, even upside down. Its active part has to be permanently immersed into the fluid (low part of the network or reactor). If the fluid temperature varies widely and fast, choose the up-side down or horizontal position, in order to allow a convenient air convection among the sensor body.

It is screwed to its mounting flange by means of 4 screws M6*100. The mounting flange has to be welded close to the device generating the viscosity variations (heater, mixer, reactor, etc,…).

Retention, high flow velocities, strong vibrations and high magnetic fields have to be avoided.

2.1.1.Elbow mounting

The flange is welded on a right tee as indicated to the figure 1.
The minimal pipe diameter is of 32mm.
The flange and the pipe have to be superjasent.
The flow direction is as indicated on figure 1 (unless for fibrous fluids where the flow is inverted and the rod protector removed. (see §2.2.5).
A free area of at least 150mm length is necessary .
Advice: Choose a sensor position in order to assure a permanent fluid renewal and to avoid the existence of " dead zones ".

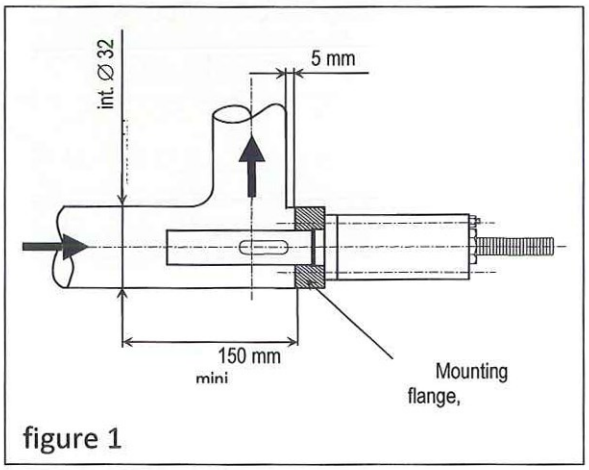


figure 1

2.1.2.Plane side mounting

The flange is welded on a metal plate as indicated on figure 2

The free area around the vibrating rod has to be at least Ø 40, 150 mm length.

In order to avoid parasitic vibrations, the plate where the flange is welded must be thicker than 5 mm.

Advice: Preferably choose a horizontal position for the rod placement with all the liquid flows turned to the top in order to avoid the apparition of bubbles.

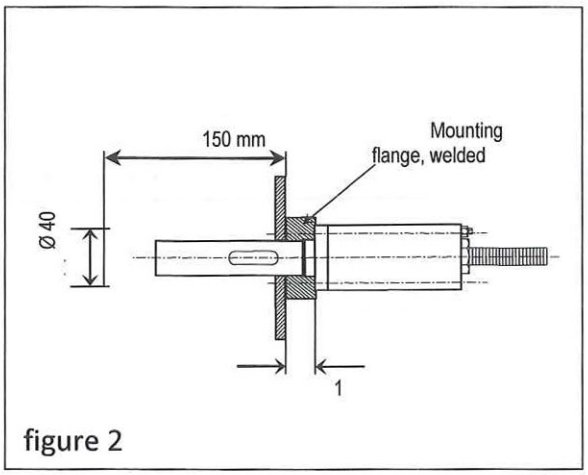
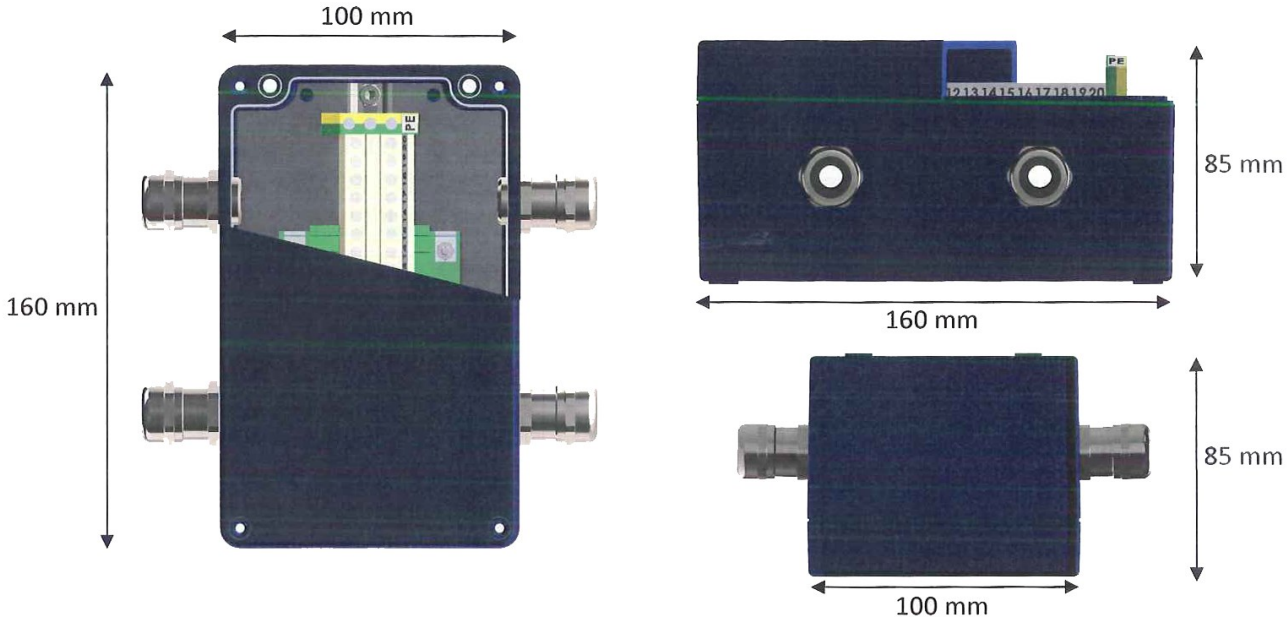


figure 2

3.1.General features

Here under are the different views of the electronics



The processor must be connected to a **24 VDC** (±2.4 V) stabilized and filtered power supply.

The operating temperature for this electronic device is up to 50 ºC.

This enclosure is equipped with four M16 cable glands.

It has a special EMC conduit seal and marine-painting surface finishing.

The electronic device delivers the viscosity and temperature information through current outputs and serial communication (Modbus protocol, code RTU).

To ensure the proper behavior of the two 4-20 mA current outputs, it is highly recommended to connect them to a PLC or a regulator through a galvanic isolated device(one for each current output).

3.2.System connection

All the connections to the electronic device are made on the terminal block located inside the blue enclosure.

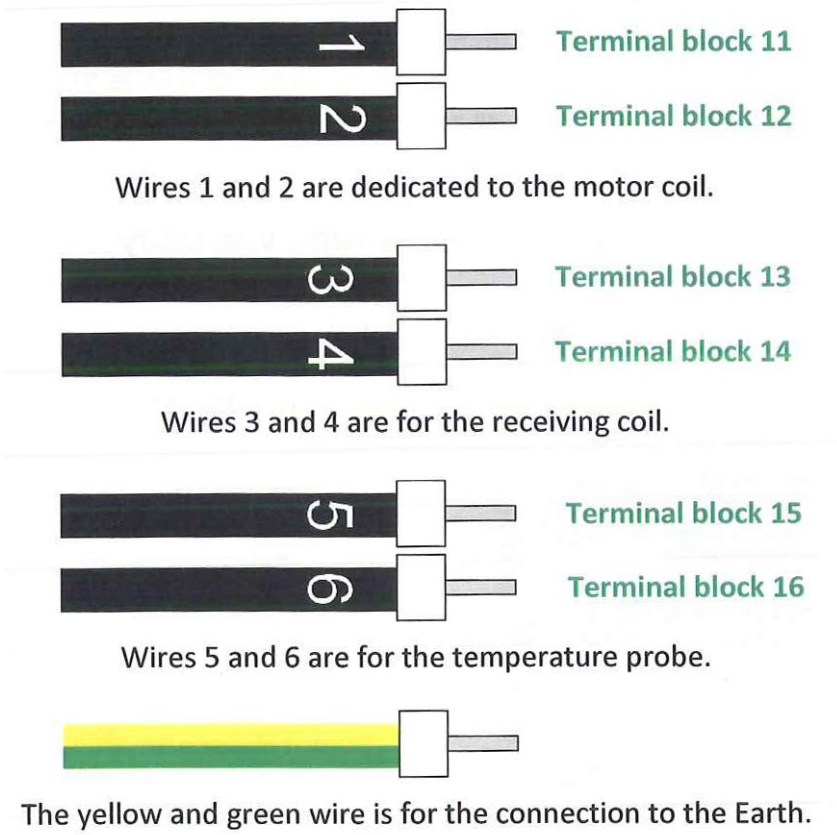
All the wiring between the electronic board and the terminal block <u>are not</u> to be touched.

Only the link between the sensor and the terminal block has to be operated by the user according to the following description

Wiring done by Selectron (DO NOT TOUCH)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	PE
+ 24 VDC	0 V	4/20 viscosity (-)	4/20 viscosity (+)	4/20 temperature (-)	4/20 temperature (+)	RS 485 (+)	RS 485 (-)			Sensor (1)	Sensor (2)	Sensor (3)	Sensor (4)	Pt100 (5)	Pt100(6)					Earth
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	PE

The wires at the end of the cable have the following allocations



Air is used as reference fluid in order to adjust the amplitude signal during the installation.

The offset adjustment must be done:

- For each new installation of the sensor on the process.
- For each observation of a signal drift **in the air**: if the viscosity is different from 0 (readable via RS485, see §6) or if the 4/20 mA output is more the 4,02 mA or less than 3,98 mA.

BEFORE STARTING THE PROCESS, IT IS VERY IMPORTANT TO

PROCEED TO THE ZERO ADJUSTMENT IN AIR.

4.1.Preparing the sensor

1. Clean and dry the sensor rod;
2. Be sure the process is empty. The sensor must vibrate in air;
3. Install the sensor on the process and fix it with the clamp collar;
4. Power on the device;
5. Wait for the sensor to warm up and for the entire installation to be stable (the viscosity value has to remain stable ± 0.1 cP);

4.2.Adjusting the zero

- In the manager mode

Click on the button ”New Offset”. Follow instructions.

- In the distributor mode

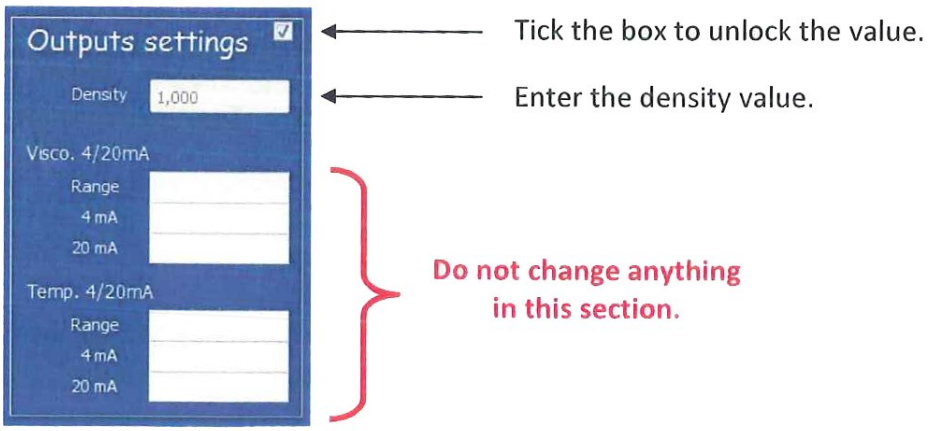
Go in the “options” tab and select “offset setting” . Follow the instructions.

4.3.Setting a density value for kinematic viscosity

This is only accessible with the distributor session.

Tick the box in the “outputs settings” and choose the density value.

The kinematic viscosity is directly calculated in the viscosity value box and for the 4/20 current output val-



Goal: read viscosity, raw amplitude, coil value and Pt100 value using RS-485

S: send from the console to the board

R: response from the board to the console

Viscosity: viscosity calculated in cP

Raw amplitude: signal read before correction, offset and without linearization

Coil: raw signal which is an image of the sensor inner temperature

Pt100: value in Celsius degrees of the temperature read by the probe (if there is one)

COM port characteristics

Speed : 9600 bits/s number of bits: 8 Parity: none Stop bit : 1

Generic frame format (if the software needs decimal values)

S= XX 3 YY YY ZZ ZZ <CRC>

R= XX 3 AA BB BB CC CC DD DD DD DD EE EE FF FF <CRC>

XX: slave number **3:**reading function

YY YY: starting point for the addresses to be read **ZZ ZZ :** number of words to be read

AA: read bytes number **BB BB:** viscosity (*10)

CC CC: multiplying coefficient for the viscosity **DD DD DD DD :** raw signal

EE EE: coil rough signal **FF FF :** Pt100 temperature(*10)

<CRC> : checksum (automatic)

Examples

S= 17 3 00 60 00 06 07 54

R= 17 3 12 00 172 00 01 00 00 03 248 03 116 00 230 99 09

17: slave number 3: reading function

00 60 : start reading from address 00 60 00 06 : six words to be read

07 54: checksum

12: twelve bytes 00 172: viscosity in cP (*10), here 17,2 cP

00 01 : multiplying coefficient: *1 00 00 03 248: 3*256+248=1016

03 116 : 3*256+116=884 00 230: Pt100 temp(*10), here 23°C

99 09: checksum

SERIAL N°: EPL 300022			
Visco.range	25 mPa.s	**Temp.range**	180ºC
frequency	286 Hz	**offset**	-8mV

CALIBRATION DATA			
Yo	962.7	**C**	-2.1034
a	1562.2984	**d**	6.5692
1/b	3.0030	**10 000e**	304.0
aoffset	0.030662	**acoil**	0.106913
boffset	6.492792	**bcoil**	-507.9
coffset	967.0	**firmware**	V3.9.1
delay	13 000	**Gain 1**	5.33
threshold	4 000	**Gain 2**	8.00

CURRENT OUTPUTS (mA)			
viscosity		temperature	
4	0	**4**	0
20	25	**20**	200

SESSION CODES			
User	None	**technician**	1111
Manager	1111	**distributor**	369

date	23/12/14	**visa**	KEV	