

AP29 ECO

Sampling Probe



User's Manual



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1. Introduction

1.1. General

The Sampling Probe AP29 ECO forms together with the Hydrogen Leak Detector Sensistor ISH2000 a complete industrial leak-detection unit.

Sampling probe AP29 ECO is intended for intermittent or continuous sampling of a test point or test chamber. It performs quick and accurate accept/reject testing.



Note!

Sample Probe AP29 ECO can only be controlled by Sensistor ISH2000 Leak Detector with software version 3.00 or higher. An upgrade kit can be ordered from your supplier.

Typical applications for the AP29 ECO are:

- Integral testing in accumulating test chamber
- Point testing of pipe joints. For example, refrigeration and automotive pipes
- Automatic surface or weld seam scanning

1.2. Equipment

The equipment which is delivered is:

- Sampling Probe AP29 ECO
- Disk with driver software
- File Transfer Cable (female to female RS232)
- Bus Cable (male-to-male, pin-to-pin, 25 pin D-type)*
- BUS Adapter Cable (0.5m, 3 green Phoenix connectors in one end, 25 pin D-type other end)
- Sensor Cable (3m, black with 5 pin LEMO connectors)*
- User's Manual

* Other lengths available.

1.3. Safety Aspects



Warning!

Make sure there is proper ventilation. The recommended tracer gas mixture contains no oxygen. Releasing large amounts of gas in confined spaces may displace the air and create a risk for asphyxiation.

**Warning!**

Pure Hydrogen is a flammable gas. Use only ready-made mixtures of 5% Hydrogen in Nitrogen. This is a standard, industrial gas mixture used in various industrial applications. Whenever the word Hydrogen is used throughout this manual it implies that hydrogen gas is safely mixed with Nitrogen in proportions 5% H₂ – 95% N₂.

**Warning!**

The normal risks with all compressed gases must also be considered.

**Warning!**

Before connecting tracer gas: confirm that your connectors or test fixture is designed for working at the specified test pressure.

**Warning!**

Always carefully secure gas bottles before connecting pressure regulator. Compressed gases contain much energy.

**Note!**

The tracer gas used is a mixture of 5% Hydrogen (H₂) in 95% Nitrogen (N₂). It is not flammable, non-poisonous and environmentally friendly.

2. System Description

Considerably **higher sensitivities can be achieved** for point testing applications by using the accumulation technique supported by the Sensistor ISH2000 software. Consult your supplier for best system design for your particular application.

The AP29 ECO is equipped with two separate sniffer flow channels, Sampling and Analysing flow. This configuration makes it possible to perform true steady-state measurements.

The constant sniffer flows are created by an electrical pump pulling air through two high precision ruby orifices. A critical flow type situation is obtained.

The orifices are protected by built-in filters. The flow is supervised by two differential pressure switches activated by the pressure drop across the orifices. The switches are factory set to open at 75% of the nominal sniffer flow.

The Sampling probe AP29 ECO is equipped with an overexposure protection mode purging the sensor with reference air as soon as the signal goes above the rejection threshold. This reduces the recovery time of the sensor enabling the system to work with high speed testing applications.

The unit is also equipped with a reference mode. This allows for fast and automatic calibration adjustment, with a certified gas mixture of Hydrogen in Air. Optional software driver can be ordered if calibration with reference leak is preferred.

See the calibration section below.

The Sensistor ISH2000 system offers 24 VDC logic signals for valve control, leak alarms, sniffer flow alarm, etc. for easy interfacing to any PLC system. The AP29 ECO is designed for minimum maintenance and easiest possible service.

2.1. ILS500 based test system

INFICON offers a range of products that can be combined for making up most of your entire test system. The design work can therefore, often be kept to an absolute minimum. You will only need to design the test fixture. See Figure 1 on how to combine the different parts to form a complete test system.

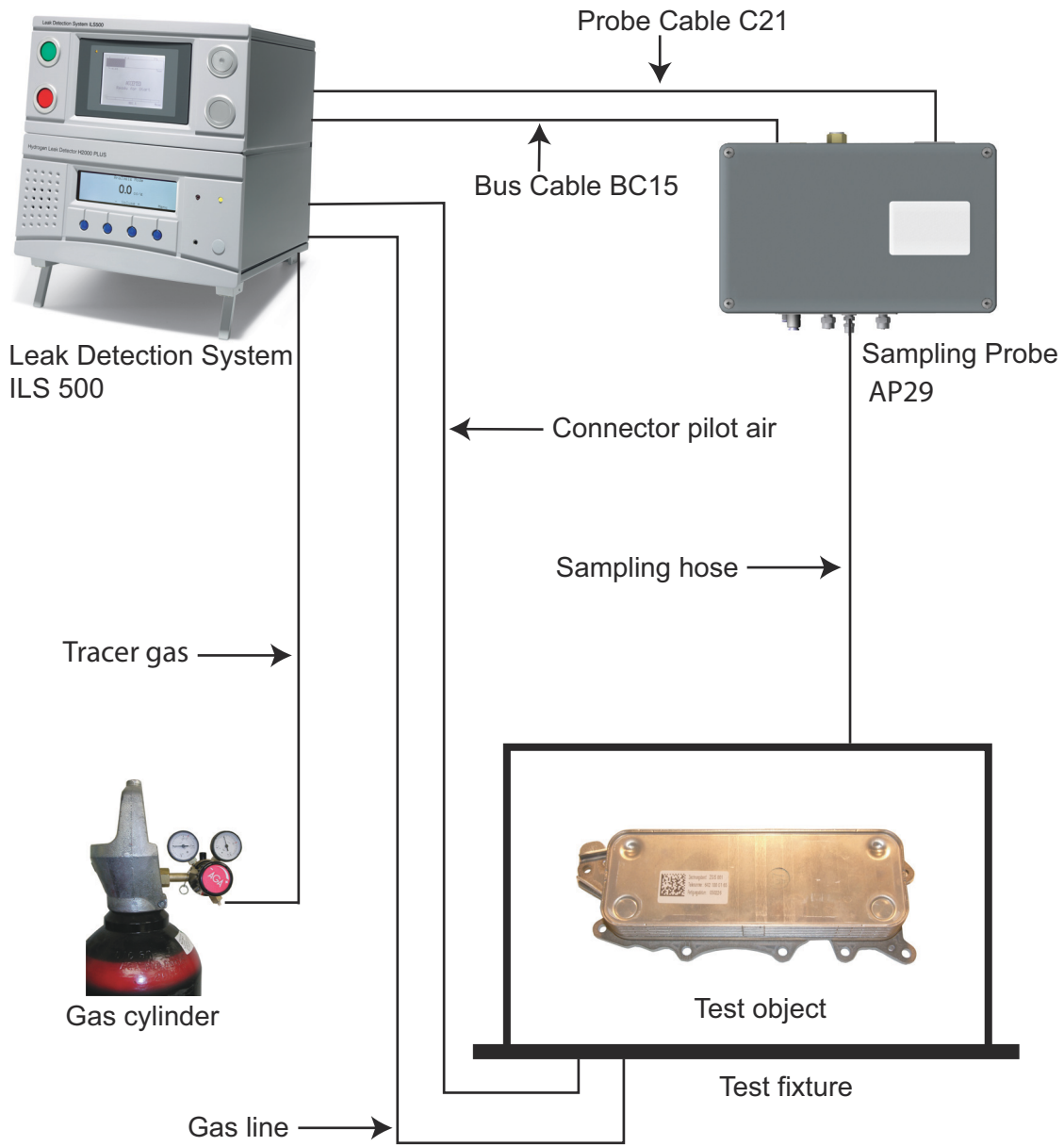


Figure 1 ILS500 based test system.

2.2. System based on table-top Sensistor ISH2000 Detector

If you have acquired a table-top model of the Sensistor ISH2000, you need an extra BUS-cable and a HUB. See Figure 2

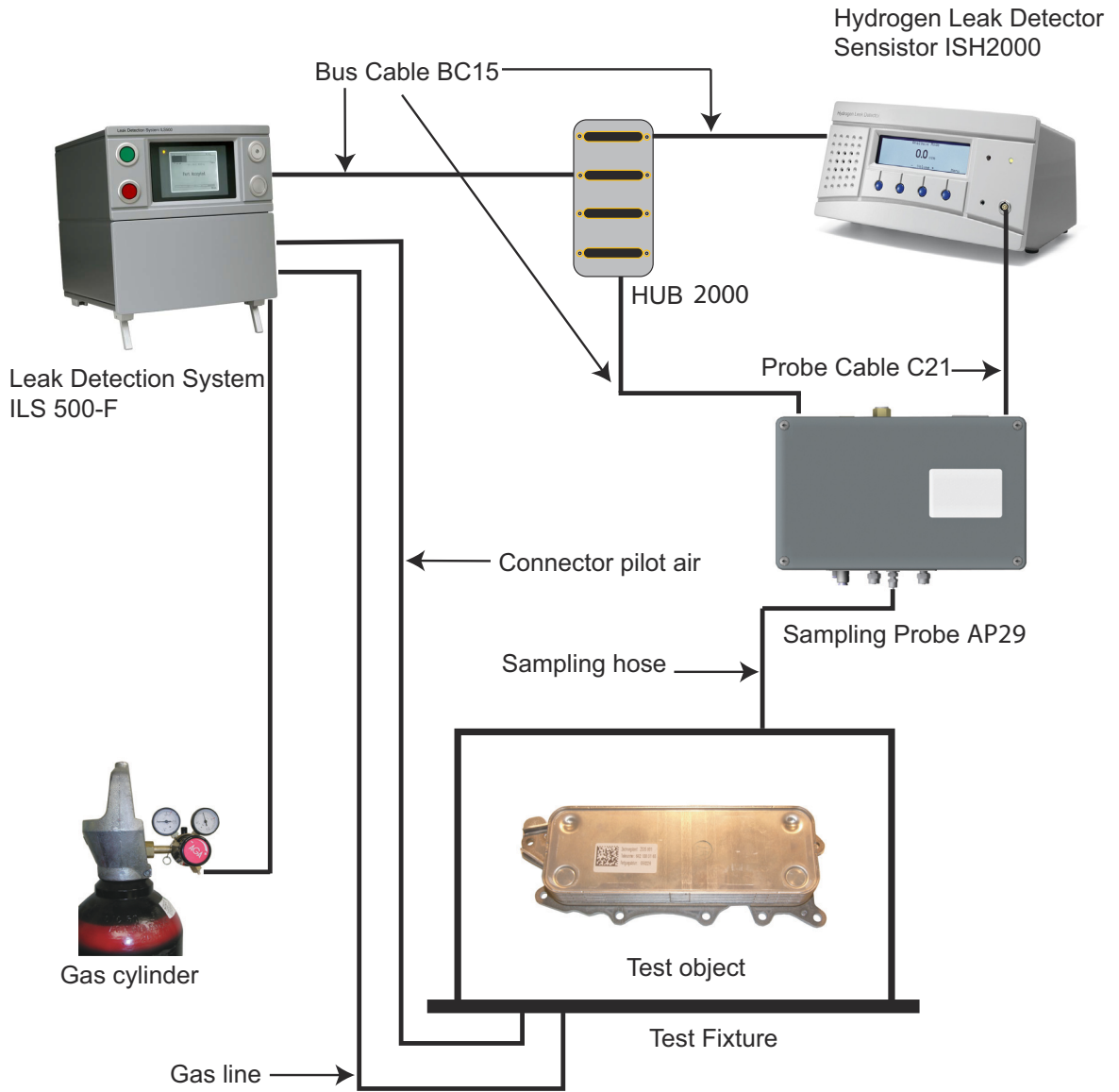


Figure 2 System based on table-top Sensistor ISH2000.

2.3. Test Sequence

There are four major steps in the test sequence. (Timers are set in the Sensistor ISH2000):

1. Accumulation
2. Sampling
3. Analysis
4. Purging

See Figure 3.

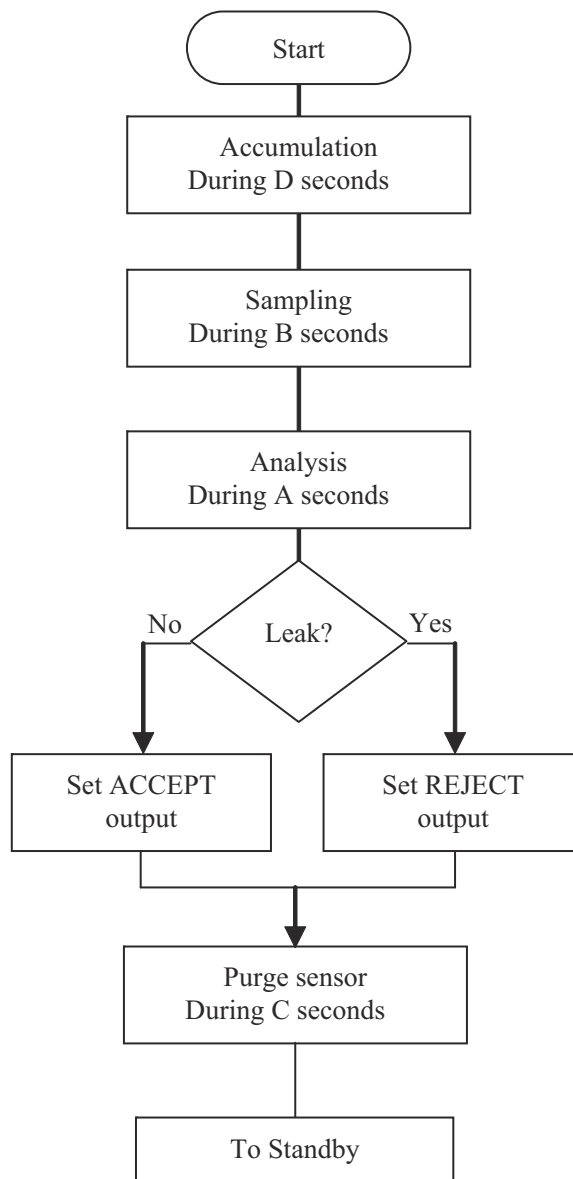


Figure 3 Test sequence.

2.3.1. Accumulation (Timer D in APC Settings menu)

This is the delay time, from that the test object is filled with tracer gas, until a sample is taken from the test point. Accumulation is used to improve the sensitivity of a test chamber. The concentration in the test chamber will increase linearly during the accumulation time.

2.3.2. Sampling (Timer B in APC Settings menu)

This is the time needed to draw a sample from the test point to the AP29 ECO. If sampling time is too short, the sample will not reach the sensor. An excessively long sample time may pump away the sample in a small open chamber.

The setting of the Sampling time depends on sample hose length and diameter. Test correct time for your set-up.

2.3.3. Analysis (Timer A in APC Settings menu)

The sample is passed over the sensor during the Analysis time. The Analysis timer can be set to 3 seconds if your alarm level corresponds to 10 ppm or higher. For lower levels and fine tuning, see under "*Sampling parameters*" below.

2.3.4. Purging (Timer C in APC Settings menu)

You can set the AP29 ECO to purge the sample hose direction the AP29 ECO after each completed test. The purge time is set by timer C. Timer C can normally be set to 0 seconds.

2.3.5. Other important software parameters:

- **Leak Alarm Level** (*General Settings* menu)

Gas signals above the Leak Alarm Level result in REJECT.

Gas signals below the Leak Alarm Level result in ACCEPT.

- **Calibration coefficient** (*General Settings* menu)

If you calibrate against a reference gas you should set C equal to the concentration of Hydrogen in your reference gas. Example for 10 ppm Hydrogen set C = 10 ppm.

For further details refer to the Sensistor ISH2000 manual.

For optimization of test parameters, see under "*Setting up your application*" below.

3. Quick Start

This quick start guide can be used to quickly set up your system for evaluation and laboratory testing.



Note!

Read this manual carefully before you finalize the design of your test system. You must understand all aspects of the detector and probe before you can realize a fully reliable test system.

3.1. Installation



Warning!

Always switch power off before disconnecting or connecting any cable. Failure to comply with this rule can result in personal injury or serious damage to the equipment.



Caution!

The 25-pin D-type connector on the back of the instrument is not a computer or printer port. Connecting a printer or any other computer device may cause permanent damage to the connected device.

- Install and secure the BUS cable and sensor cable.
- Connect Master Control signal to manual switches or to supervising computer. See “Active Probe Control Signals”, “Master Control” and “Electric diagram” below.
- Install pneumatic hoses according to the Table 2 under “Installation / Pneumatic Connections” below.
- Switch on the Sensistor ISH2000. Open the “APC Settings” menu, and select AP29 ECO. If AP29 ECO is missing you must install the driver as described under “Software driver”.

3.2. Controlling the Probe

The simplest way to control the AP29 ECO is to connect it to a ILS500 or ILS500-F (filler version). Simply set the ILS500 in APC mode and press START (See ILS500 manual).

Controlling the AP29 ECO by PLC or manual switches:

- To start a test sequence set MEAS_REQ (IN_0) high for ≥ 40 ms (pulse trig).
- To start a calibration sequence set CAL_REQ (IN_1) high for ≥ 40 ms.

Refer to Table 1 under “*Installation / Active Probe Control Signals*” for more information.

4. Installation

Installation of the AP29 ECO is very simple, follow the instructions below. The APC system of the Sensistor ISH2000 handles all vital functions. All you need to do is to provide Measure Request and Calibration Request Signals. Accept or Reject signal will be sent upon completion of each test cycle.

See Chapter 9 for electric diagram and Chapter 10 for pneumatic diagram.



Warning!

Make sure that all electric and pneumatic supplies are switched off when connecting or disconnecting any supplies to the probe or detector. Failure to comply with this rule can result in personal injury or serious damage to the equipment.



Caution!

*The 25-pin D-type connector on the back of the instrument is **not** a computer or printer port. Connecting a printer or any other computer device will cause permanent damage to the connected device.*

4.1. Placement of Sample Probe

Place the sample probe as close as possible to the test object. This is done to minimize the length of the sampling hose and thereby the length of the test cycles.

The probe can be installed in any position. We recommend that the AP29 ECO is placed with the ventilation grid facing down. This makes it harder for dirt or dust to collect inside the box.

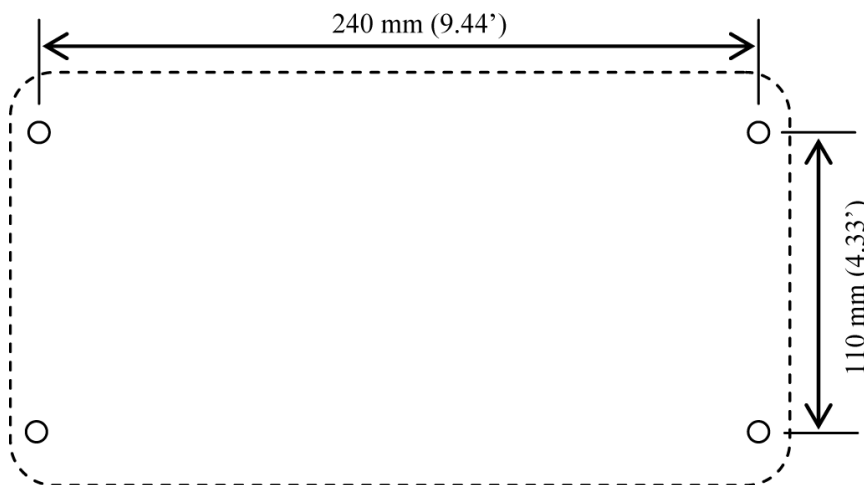


Figure 4 Placement of Sample Probe.

The box is fastened with four screws.

- Max thread diameter is 6 mm (0.25’)
- Max head diameter is 11 mm (0.43’)
- Length is 20 mm (0.8’) + grip

For placement of the screws, see Figure 4.

4.2. Cable Connections

4.2.1. Sensor Cable



Warning!

Turn off power before you connect or disconnect the sensor cable. The sensor can be destroyed if power is on!

The sensor inside the AP29 ECO is connected to the Sensistor ISH2000 with a C21 cable. Standard length is 3 m. Several different cable lengths are available. See sensor cable in Figure 5.



Figure 5 Sensor cable.

Align the red mark on the cable contact with the red mark on the panel contact and push straight in. The contact will snap in and lock.

To disconnect, hold around the knurled part of the connector and pull straight out.

**Warning!**

Always switch power off before disconnecting or connecting any cable. Failure to comply with this rule can result in personal injury or serious damage to the equipment.

**Caution!**

The 25-pin D-type connector on the back of the instrument is not a computer or printer port. Connecting a printer or any other computer device may cause permanent damage to the connected device.

The bus cable carries control signals of the Active Probe Control (APC) system in the Sensistor ISH2000. The APC system controls the pneumatic and electric functions of the AP29 ECO.

The control cable is a 25-pin D-type cable with complete pin-to-pin configuration. Several different cable lengths are available.

Connect the cable and tighten the locking screws on both ends.

The APC Bus is a simple discrete I/O bus. Each digital input and output has its own pin/wire on the bus. See Table 1 below for description of which pins are used for controlling the AP29 ECO. Further details of the APC System can be found below and in the Sensistor ISH2000 Technical Manual (TM-Sensistor ISH2000).

4.3. Active Probe Control Signals

**Warning!**

The +24V pin in the bus is intended for the supply of power to switches etc. Do not connect this pin to another power supply. If you connect this pin to another power supply it can cause serious damage to the detector!

**Warning!**

Make sure that the inductive loads connected to the flow alarm switch have arc suppression circuits.

See Table 1 for the active probe control signals.

Signal name	Specific function:	Signal type	BUS pin	H2000P pin
	AP29 ECO to Sensistor ISH2000 signals			
IN_2	Sensor flow alarm	IN	6	C2 pin 8
IN_4	By-pass flow alarm	IN	8	C2 pin 10
24 VDC	Flow alarm supply	OUT*	25	C2 pin 1
OUT_0	Purging pump (positive terminal)	OUT	19	C4 pin 5
GND	Purging pump (negative terminal)	GND	12	C3 pin 3
OUT_1	Solenoid valve –Y01 (positive terminal)	OUT	20	C4 pin 6
GND	Solenoid valve –Y01 (negative terminal)	GND	1	C2 pin 3
OUT_2	Solenoid valve –Y02 (positive terminal)	OUT	21	C4 pin 7
GND	Solenoid valve –Y02 (negative terminal)	GND	1	C2 pin 4
OUT_3	Solenoid valve –Y03 (positive terminal)	OUT	22	C4 pin 8
GND	Solenoid valve –Y03 (negative terminal)	GND	2	C2 pin 5
OUT_4	Solenoid valve –Y04 (positive terminal)	OUT	23	C4 pin 9
GND	Solenoid valve –Y04 (negative terminal)	GND	3	C3 pin 1
OUT_5	Solenoid valve –Y05 (positive terminal)	OUT	24	C4 pin 10
GND	Solenoid valve –Y05 (negative terminal)	GND	11	C3 pin 2
CAL_CONF	Sampling pump positive terminal	OUT	9	C3 pin 9
GND	Sampling pump negative terminal	OUT	13	C3 pin 3
	Master control signals			
DET_ON	HIGH when detector power is on.	OUT	16	C3 pin 6
LEAK_OUT	REJECT. Test result signal	OUT	15	C3 pin 5
OUT_6	ACCEPT. Test result signal	OUT	10	C3 pin 10
DET_ERROR	Summing error from detector or probe	OUT	14	C3 pin 4
DET_WAIT	HIGH while detector warms up	OUT	18	C3 pin 7
DET_SIGNAL	LOW when sensor recovered to zero	OUT	17	C3 pin 8
IN_0	Measure request	IN	4	C2 pin 6
IN_1	Calibration request	IN	5	C2 pin 7
IN_3	Forced purge request	IN	7	C2 pin 9

Table 1 Active Probe Control Signals.

4.4. Software Driver

Sample Probe AP29 ECO is an accessory to the Hydrogen Leak Detector Sensistor ISH2000. Before you can use it the software driver must be installed in the Sensistor ISH2000.

4.4.1. Equipment

For driver installation you will need the following:

- APC Driver software disk (delivered with the AP29 ECO)
- File transfer cable (delivered with the AP29 ECO)
- PC computer with Windows 95 or later and with COM port. Note that a USB to COM port converter can't be used. For help contact the supplier.

4.4.2. Instructions

Follow the instructions below carefully:

1. Check if driver has been installed before shipping:
 - a. Switch the detector ON, wait until start-up sequence has terminated.
 - b. Enter the "APC Settings" menu.
 - c. Enter the "Probe Type" sub menu.
 - d. If driver is installed you will find the correct driver name in the right position (see label on driver disk).
2. To install driver, insert the disk into the disk drive of your computer.
3. Double click the "APC" icon.
4. Switch off the Sensistor ISH2000.
5. Connect the file transfer cable between the Sensistor ISH2000 serial port and a COM-port on your computer.
6. Select desired language.
7. Select desired calibrate method.
8. Select the COM-port that you connected the cable to.
9. Press the OK button in the window.
10. Switch on the Sensistor ISH2000
11. Wait until the message 'The driver is installed' is shown.
12. Switch off Sensistor ISH2000 and disconnect the file transfer cable.
13. The installation is completed. Quit the program.



Note!

For more information press the "Help"-button in the program.

If necessary, you can customise you driver as described in the Sensistor ISH2000 Technical Manual. The necessary software (APC Compiler) can be ordered from your supplier.

Modifications of the driver can also be ordered from the supplier.

4.5. Pneumatic Connections for AP29 ECO

Figure 6 shows the pneumatic connections of AP29 ECO.

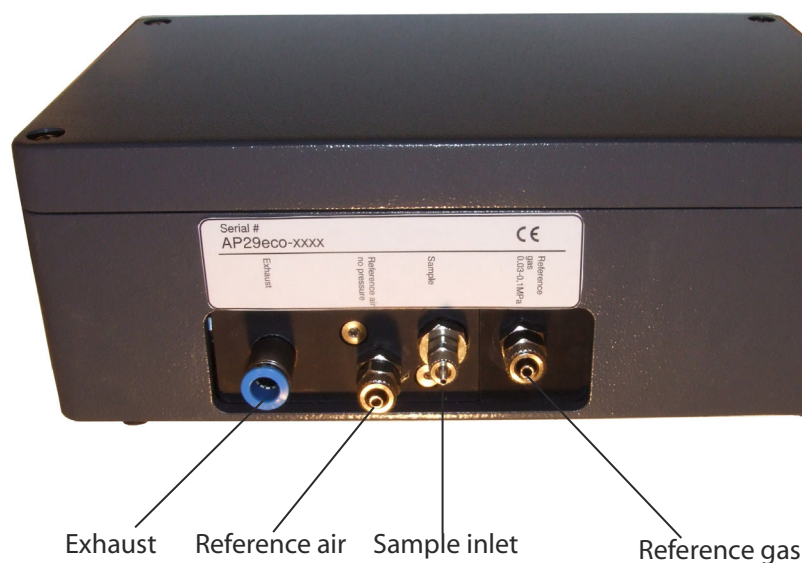


Figure 6 Pneumatic connections of the AP29 ECO.

See Table 2 for more information about the pneumatic connections.

Type	Specification	Port thread	Original tubing
Exhaust	Exhaust of the sample pump. Connect to ventilation system.	BSP 1/8" (ISO 228/1-G1/8)	OD 8.0 mm
Reference Air	Hydrogen-free, ambient air. Preferably taken from outer wall of the building Atmospheric pressure You <u>must</u> install an external filter in the reference air hose.	BSP 1/8" (ISO 228/1-G1/8)	OD/ID 6.0 /4.0 mm
Sample Inlet	This is the test port Standard flow: 3 atm cc/s	ISO724 M5x0.8 * (UNF1032 can normally be used)	ID 2 – 2.5 mm
Reference Gas	See Sensistor ISH2000 User Manual. Typically 10 ppm H ₂ in Air 0.03 – 0.10 MPa / 0.3 – 1.0 barg / 4.5 – 15 psig	BSP 1/8" (ISO 228/1-G1/8)	OD/ID 6.0 /4.0 mm

Table 2 Pneumatic Connection.

*The M5 port is in a BSP1/8 to M5 converter. The converter holds a filter disk protecting the manifold. External filter is recommended to prolong service intervals of port filter. External filter must have small internal volume. Every cc volume adds 0.4 seconds to cycle time!

For more information, see under “Port filters” below.

4.5.1. Sample Inlet

The sample inlet is your test point. What is pulled in through the end of the sample hose is what will be analysed in the AP29 ECO.

The Sample Inlet port is in a BSP1/8 to M5 converter. The converter holds a filter disk protecting the manifold. See further under “ *Port filters* “ below.

Consider the following when installing the sample hose:

- Install your AP29 ECO as close as possible to your test point.

This will minimise the sample hose length and consequently the sampling time.

- The integrated sample inlet dust filter has limited capacity.

If you know that your environment is dirty or dusty, we recommend that an external filter be fitted to the sample hose. Choose a filter grade of 10-40 um in a filter cartridge with small internal volume. Excess filter volume can add several seconds to the sampling time.

- The sniffer flow alarm can not detect if the hose is cut off or missing.

The sample hose must therefore be protected from sharp objects and mechanical wear. (A plugged or restricted hose, however, will be detected by the sniffer alarm.)

We strongly recommend that you incorporate a system check that checks the integrity of the sample hose at the start of each shift. The simplest way is to run a leak master at every shift start to confirm that all systems are working as expected.

- Make sure that the position of the sample inlet is as close as possible to the primary leak point.

The main application for the AP29 ECO is leak testing. By placing the inlet close to the main leak point you minimise the risk that a malfunction in the test system will result in leaking objects being passed as not leaking. An example is a broken circulation fan in a test chamber. In this case, if the sample inlet is placed far away from the leak the tracer gas will not reach the inlet. By placing the inlet close to the primary leak point, there is a good chance that the leak will be detected even if the circulation fan is broken.

4.5.2. Reference Gas

The reference or calibration gas is used to calibrate the hydrogen sensor. Gas sensors are inherently different from physical sensors in that they are less “stable”. The sensitivity changes over time. You will need to calibrate your sensor much more often, typically every day for best accuracy.

Using reference gas is the most reliable and fast way of calibrating your sample probe.

Reference Gas Specification

Typically 10 ppm Hydrogen in Air with certificate of analysis. The exact hydrogen concentration should be within the range of 1 – 400 ppm. For best accuracy order a concentration within +/- 50% of the leak alarm level used. For example, if your alarm level is 10 ppm, use a reference gas with 5 to 15 ppm Hydrogen.

Quality of constituents is not critical.

A 20 liter cylinder with 150 – 200 bar (5 gallon / 2500 psi) will normally last for 1 – 2 years, if calibrating once daily.

Pressure of reference gas should be 0.03 – 0.10 MPa / 0.3 – 1.0 barg / 4.5 – 15 psig.

To connect the reference gas do the following steps:

1. Secure gas cylinder safely.
2. Open the cylinder valve briefly to blow out dirt that may have collected in the outlet.
3. Install gas regulator on cylinder.
4. Back regulator to zero output pressure.
5. Open the cylinder valve briefly to pressure gauge. Close the cylinder valve immediately.
6. Turn regulator to higher pressure and let the gas flow out in the air.
7. Repeat cleaning procedure 5 and 6 two times to make sure that contaminated gas can not reach the gas cylinder.
8. Connect a 6/4 mm hose between the reference gas port and the pressure regulator.
9. Open cylinder valve and set regulator to 0.03 – 0.10 MPa / 0.3 – 1.0 barg / 4.5 – 15 psig.
10. Open regulator outlet valve (if any).



Note!

If preferred you can calibrate against a calibrated reference leak. This can be a good way of checking your total system performance. You can, for example, install a reference in a leak master. Note that not all reference leaks are suitable for leak masters. Contact your supplier for additional information.

4.5.3. Pressure regulator

A simple, single stage regulator has a pronounced input pressure dependence. The output pressure can increase to twice the set pressure or more, as the bottle pressure decreases.

The best way of avoiding this kind of problem is to buy a good two-stage regulator. They do not exhibit such pressure dependence.

Recommended specification:

Two-stage regulator. Output pressure range: 0 – 0.10 MPa / 0 – 1 barg / 0 – 15 psig.

4.5.4. Reference Air

The reference air is your signal background. The hydrogen content in your samples will be compared with the reference air. Variations in the hydrogen concentration in the reference air can, therefore, result in significant measurement errors. Fast increases in hydrogen concentration in the reference air can even result in a temporarily “locking” of the detector, while it adapts to the new higher concentration.

Hydrogen concentrations higher than the normal 0.5 ppm, found in ambient air can also have negative effect on system accuracy. The hydrogen concentration in the reference air should always be lower than the lowest concentration that you need to detect. Hydrogen content should also be less than 25% of the reference gas concentration used for calibration.

One of the most important design considerations of your test system is to safeguard the quality of the reference air and the fresh air. See further under “*Fresh Air*”.

**Caution!**

Install a filter in the reference air hose. We recommend the use of a conventional compressed air filter. Filter grade should be 40 µm or finer. This will greatly reduce the maintenance of your sample probe.

**Caution!**

The reference air must always be the same as the fresh air supplied over your test area! We recommend that you take the reference air and fresh air from the outer wall of your building.

**Caution!**

Make sure that reference and fresh air intake is not affected by tracer gas exhaust or exhaust from nearby combustion engines.

Install the reference air intake in the air duct carrying fresh air from the outer wall to the test area.

Try to keep the hose relatively short (< 2 m). This will minimise the time needed to restart the system if you should happen to get hydrogen in your fresh air intake.

4.5.5. Exhaust

Connect the exhaust to the tracer gas exhaust duct. See further under “*Tracer gas exhaust*” below.

4.6. Master Controls

The Sensistor ISH2000 Leak Detector and AP29 ECO Sample Probe will automatically perform a complete sampling and analysing cycle. The test must be initiated from a master control. The result from the test must be received by a master deciding what should happen to the test object when the detector has judged it good or bad.

The simplest way to build a complete test system is to connect the AP29 ECO to an INFICON tracer gas controller ILS500 as shown in the Chapter 2 of this manual. The AP29 ECO can also be controlled by manual switches or by a supervising computer such as a

programmable logic controller. This section describes the different signals used for controlling and interpreting the test.

4.6.1. ILS500

Connect the AP29 ECO to ILS500 with a BUS-cable. If you have a Leak Detection Unit with integrated detector then that is all you need. If you have an ILS500-F with the detector separate you will need an extra BUS-cable and a hub (see spare parts list).

Set up the controller in APC mode as described in the ILS500 manual.

To start a test sequence push the START button. According to the settings of the ILS500, the test cycle will terminate automatically upon completion and a detected leak will be indicated by the red LEAK lamp.

4.6.2. Manual switches

For manual control, you only need two switches and two lamps. The other inputs and outputs are optional for manual operation. Refer to Table 3 for manually operated functions.



Warning!

*The +24V pin in the bus is intended for the supply of power to switches etc. Do **not** connect this pin to another power supply. If you connect this pin to another power supply it can cause serious damage to the detector!*

Function	Signal name	Bus Pin	H2000P pin
(Read warning below)	+24VDC	25	C2 pin 1, 2
Sample request	IN_0	4	C2 pin 6
Calibration request	IN_1	5	C2 pin 7
Purge request (optional)	IN_3	7	C2 pin 9
ACCEPT signal	OUT_6	10	C3 pin 10
REJECT signal	LEAK_OUT	15	C3 pin 5
Power on signal (optional)	DET_ON	16	C3 pin 6
Error signal (optional)	DET_ERROR	14	C3 pin 4
Detector warming up (optional)	DET_WAIT	18	C3 pin 7
Gas signal above zero (optional)	DET_SIGNAL	17	C3 pin 8
	GND	1, 12	C3 pin 1-3

Table 3 Functions operated manually.

4.6.3. Programmable Logic Controller etc.

The AP29 ECO is designed to be controlled by any standard PLC using 24 VDC logic.

The detectors have 24 VDC transistor outputs capable of delivering 0.5 A each (max 2.5 A).

The detector is certified to fulfill all the EMC (EMI) requirements of the European Union. No further noise cancelling should be necessary.

See further specifications in the user manual and technical manual of the Sensistor ISH2000.

If you have acquired a panel mounted detector (H2000P) then you connect the signal wires from the green screw terminals on the detector directly to your PLC.

If you have a table top model (Sensistor ISH2000) then you must use a hub and a D-type connector to screw terminal converter. These items can be ordered from your supplier (see spare parts list).

Table 4 below shows the signals which are recommended to be routed to the controller.

Name	Descriptio	Type	Table top pin nr	Panel mount pin nr
DET_ON	HIGH when detector power is on.	OUT	16	C3 pin 6
LEAK_OUT	REJECT. Test result signal	OUT	15	C3 pin 5
OUT_6	ACCEPT. Test result signal	OUT	10	C3 pin 10
DET_ERROR	Summing error from detector or probe	OUT	14	C3 pin 4
DET_WAIT	HIGH while detector warms up	OUT	18	C3 pin 7
DET_SIGNAL	LOW when sensor recovered to zero	OUT	17	C3 pin 8
IN_0	Measure request	IN	4	C2 pin 6
IN_1	Calibration request	IN	5	C2 pin 7
IN_3	Forced purge request	IN	7	C2 pin 9

Table 4 Signals routed to the controller.

See under “*Operation*” for further details on the signal logics.

4.7. Test area

This chapter gives some basic advice on how to design and set-up your test area. For further information refer to application note “*The Hydrogen Method*”.

4.7.1. Tracer gas supply

The tracer gas (5% Hydrogen / 95% Nitrogen) is best ordered from your regular gas supplier. It costs typically 5 USD per 1000 litre. It is much cheaper in bulk delivery or if delivered from a Liquid Nitrogen tank with hydrogen mixer.



Note!

No gas = no leak, is only true if object is properly filled with gas. Install alarm on tracer gas fill pressure!

Do not order the mix from a special or medical gas supplier, and do not order the gas with a certificate of analysis. This will make the gas up to ten times more expensive.

To ensure that the tracer gas reaches all parts of the test object it is important to evacuate before filling with tracer gas. This is normally done to 50-80% vacuum.

Evacuation is especially important when testing a narrow tube, which can be suspected to leak at the far end. Such an object may have to be evacuated down to just a few mbar, to avoid an "air cushion" at the far end. If the tube is open in the far end, it is often better to connect an extra volume to that end into which remaining air can escape when the gas pressure is applied.

If any opening in the test object is difficult to plug, you can use a so-called ventilated plug. This has built in local ventilation pulling any spillage of gas out. This makes it possible to test an object for leaks and eliminating the effect of bad connections.

Tracer gas testing proves an object to be leak free if no gas is found. Therefore it is essential that the filling of tracer gas is carried out correctly and that all relevant parameters are properly controlled and supervised. We strongly recommend the use of one of INFICON's tracer gas controllers.

4.7.2. Pressure regulator



Warning!

Pure Hydrogen is a flammable gas. Use only ready-made mixtures of 5% Hydrogen in Nitrogen. This is a standard, industrial gas mixture used in various industrial applications.

A simple, single stage regulator has a pronounced input pressure dependence. The output pressure can increase double the set pressure or more, as the bottle pressure decreases.

The best way of avoiding this kind of problem is to buy a good two-stage regulator. They do not exhibit such pressure dependence.

4.7.3. Tracer gas exhaust

Tracer gas exhaust should be transported directly out of the building. The exhaust should be placed on the roof of the building far away from the fresh air intake. Electric duct fan and an optional wind extractor is recommended.

Diameter of exhaust duct must in all cases be at least 100 mm. Using too narrow exhaust can result in two major problems:

- Back flow of tracer gas to test area.
- Reversal of tracer gas controller evacuation. This results in tracer gas leakage inside tracer gas controller and tracer gas will be left in test object after testing.

4.7.4. Fresh air

For a stable and reliable leak test it is important that the test area and especially the sample point is kept free of hydrogen contamination. A small but stable hydrogen background is generally not a problem. Quick changes in concentration as well as high background levels, however, will effect the leak test.



Caution!

Do not use compressed air as fresh air supply. Industrial compressed air often contains varying and substantial amounts of hydrogen. Up to 50 ppm is common. For the same reason, we recommend the use of fans rather than compressed air for purging of test chambers etc.

Fortunately, the hydrogen mix is very easy to control. The gas is light and will readily be blown away by even the smallest air movement.

The best way of creating a stable environment is to create a fresh air curtain around the test area. This is easily done by letting a slow but wide stream of fresh air, flow down over the test area. It is also wise to keep the general hydrogen concentration low in the ambient test area. Even a perfectly designed fresh air curtain will “leak” when the operator moves in and out of the curtain.

The most common hydrogen sources are:

- **Tracer gas exhaust.** This is always the most important hydrogen source. The reason for tracer gas interference from exhaust is poor installation. Most commonly too narrow exhaust hose/duct.
- **Leaking connectors.** Leaking connectors are the most common interference. A gas connector can be designed with double seal and ventilation in between. This very safe method is not possible with the pressure decay method.
- **Combustion engines.** Vehicles inside and outside of your building can produce large amounts of hydrogen. It is common that such exhaust gases are carried into the general ventilation system. Do not take fresh air from ventilation system.
- **Lead battery charging stations.** Charging of lead acid batteries develops hydrogen. Locate any charging station and evaluate the risk for interference.
- **Aluminium machining.** A freshly cut aluminium surface will oxidise quickly. The oxidising process involves splitting water into oxygen and hydrogen. The hydrogen thus formed is released as hydrogen gas. The machining of aluminium creates large areas of fresh metal that will oxidise.
- **Compressed air system.** It is quite common that the shop air contains hydrogen. This sometimes comes from a nearby lead battery charging station, but can also stem from corrosion in air system.

- **Cigarette smoke.** Incomplete combustion of organic materials results in the production of hydrogen.

Design tips for fresh air curtain:

- Place fresh air intake on outer wall of building.
- Place air intake far away from cargo bays and tracer gas exhaust.
- Try to create a laminar flow over the test area.
- Make sure that the curtain covers the entire test area (test hood or sample point) and extends at least 0.5 meters outside the area.
- Make sure that air speed in curtain is rather low, typically 0.1 m/s.
- You can set up additional small fan(s) within the curtain for directional purging of test chamber etc.

The Figures 7 and 8 below show the design of exhaust and fresh air supplies and the principle of air curtain design.

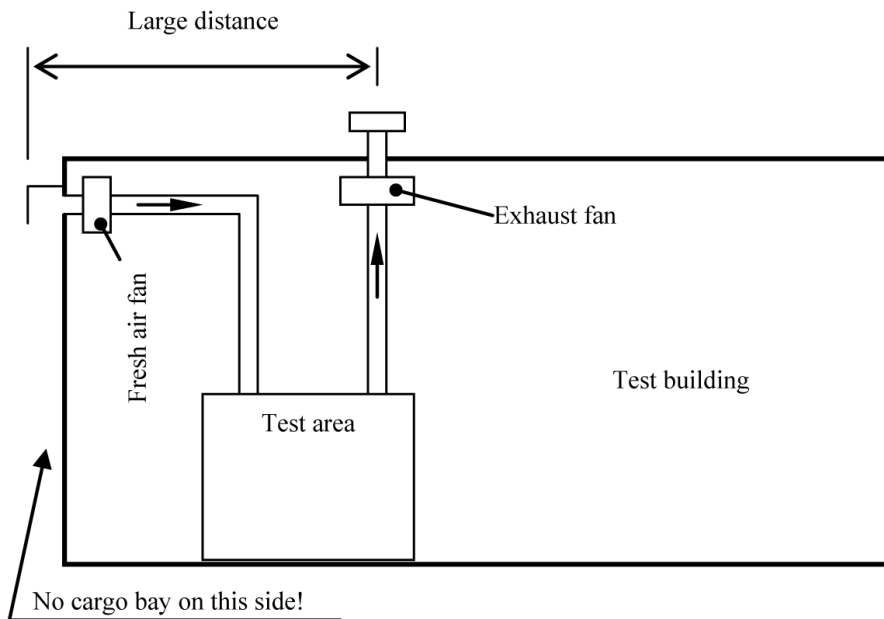


Figure 7 Design of exhaust and fresh air supplies.

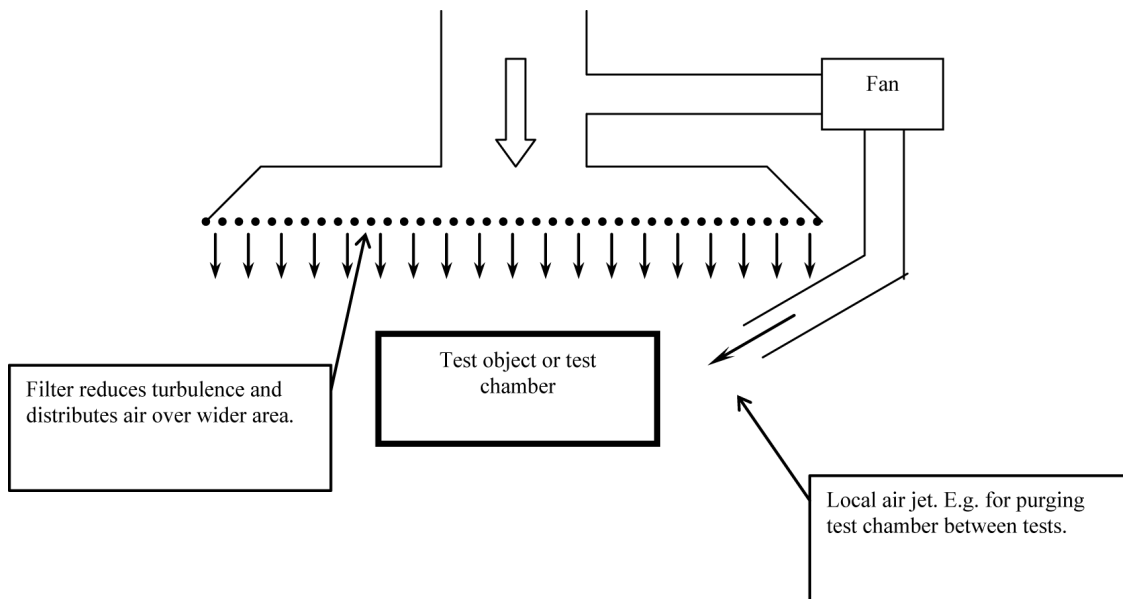


Figure 8 Principle of air curtain design.

5. Operation

5.1. Measure Sequence Flow Chart

The measure sequence is shown in the Figure 9 below.

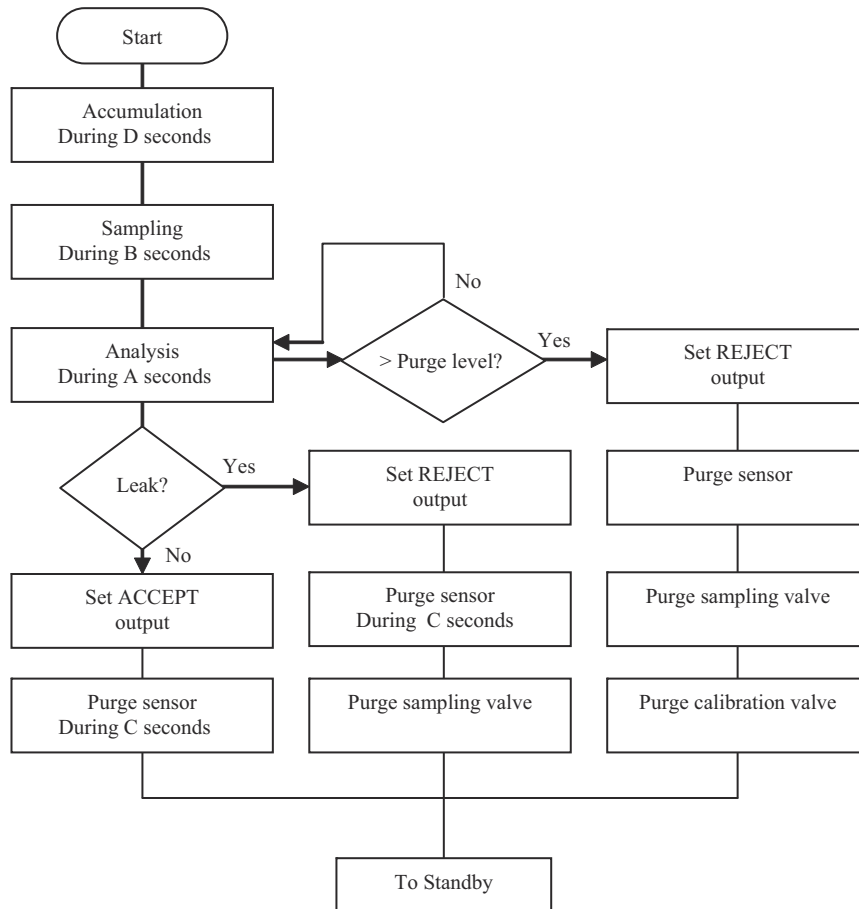


Figure 9 Measure sequence flow chart.

5.2. Measure Sequence Signals

Measure sequence signals are shown in the Table 5. See under “*Installation*” for pin numbers.

Signal name	Description
MEAS_REQ	Give pulse (high ≥ 40 ms) to initiate calibration.
ACCEPT	High after completed test cycle showing no leak Goes low again after 10s or at start of next sequence.
REJECT	High after completed test cycle showing leak . High if test cycle is terminated by error or purge request. Goes low again after 10s or at start of next sequence.
PURGE_REQ	Give pulse (high ≥ 40 ms) to initiate forced purging the sample hose with air outwards. Hold high for continuous purging. A purge request terminates a test sequence.

Table 5 Measure sequence signals.

5.3. Reference Gas Calibration Sequence Flow Chart

The reference gas calibration sequence is shown in the Figure 10.

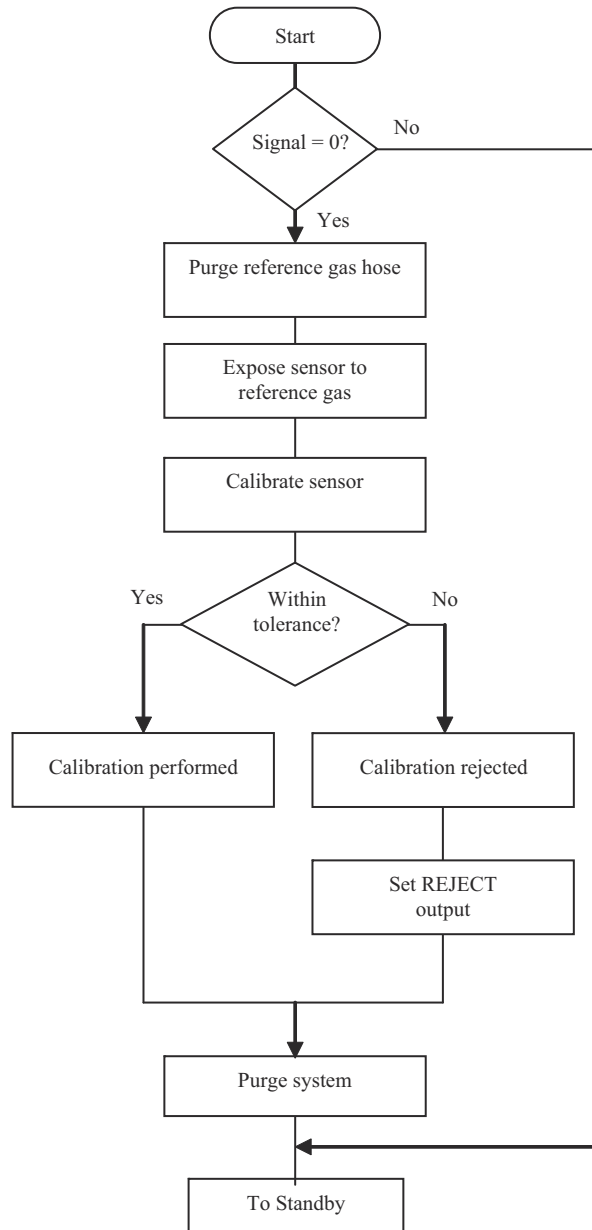


Figure 10 Reference gas calibration sequence flow chart.

5.4. Sample Calibration Sequence Flow Chart

The sample calibration sequence is shown in the Figure 11.

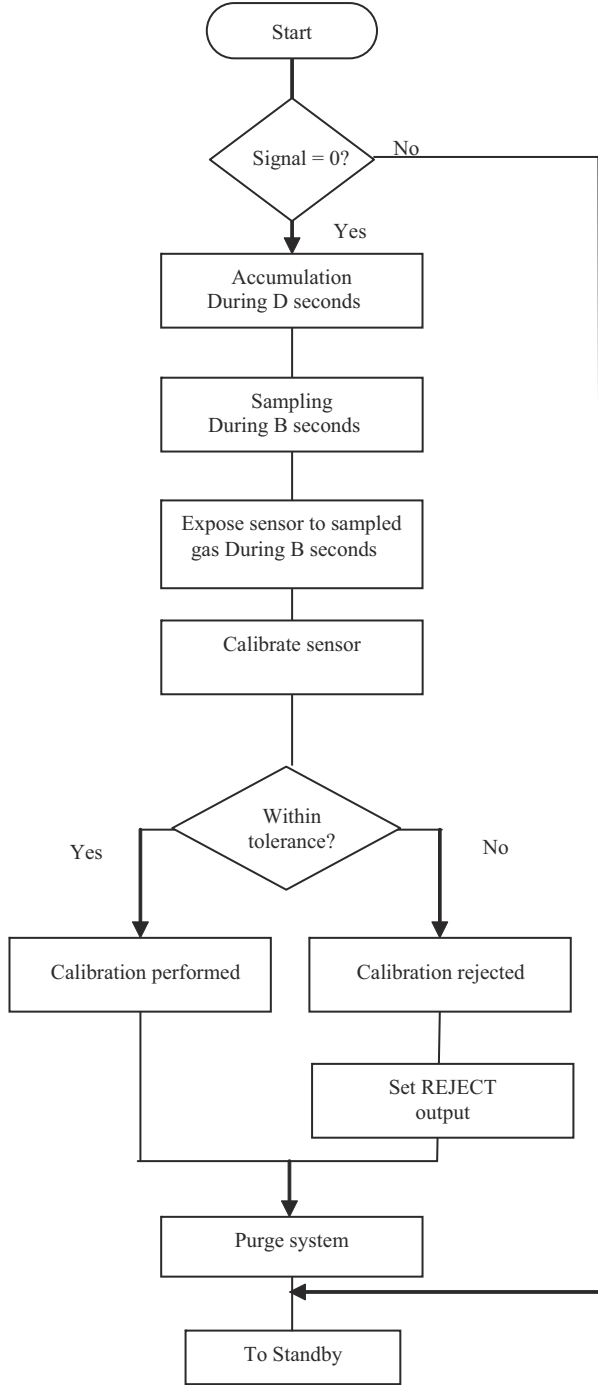


Figure 11 Sample calibration sequence flow chart.

5.5. Calibration Sequence Signals

Calibration sequence signals are shown in the Table 6. See under “*Installation*” for pin numbers.

Signal name	Description
CAL_REQ	Give pulse (high ≥40 ms) to initiate calibration.
LEAK_OUT = REJECT	High on calibration failure. Goes low again at start of next sequence

Table 6 Calibration sequence signals.

5.6. Setting up your Application

This section will list the more important of the software parameters of the Sensistor ISH2000 system. It is our intention that this section will guide you when adjusting the test parameters to suit your specific application. Note that every application is unique and that you need a deeper understanding of the behavior of the tracer gas mix to get the most of your leak detection equipment.

We strongly recommend that you study “*The Hydrogen Method*” and other application notes edited by INFICON. INFICON also offers training courses for application builders.

The calibration of your test system is also described under 5.7 below. Read that section carefully. Instructions on how to modify the setting of the different parameters can be found in the Sensistor ISH2000 manual.

5.6.1. Parameters

The parameters from 1-4 in the Table 7 are the general parameters. Parameters from 5-10 are the sampling parameters. They are further described in sections below.

Parameter	Range	Default value
1. Leak Rate Unit	Max 12 characters	“PPM”
2. Calibration coefficient	1.00E-37 – 1.00E37	1.00E+00 = 1
3. Calibration Time	Min Calibration Time – 30 s	10 s
4. Password	Max 12 characters	“” = No password
5. Leak Alarm Level	1.00E-37 – 1.00E37	1.00E+01 = 10
6. Purge Level	Leak Alarm Level – 1.00E37	1.00E+02 = 100
7. Analysing time (A)	0.0 – 6000.0 s	10.0 s
8. Sampling time (B)	0.0 – 6000.0 s	0 s
9. After test purging time (C)	0.0 – 6000.0 s	0 s
10. Accumulating time (D)	0.0 – 6000.0 s	0 s

Table 7 General and sample parameters.

5.6.2. General Parameters

All general parameters described in this section (except Password) must be correctly set before you can optimise the test parameters.

1. Leak Rate Unit

Leak rates will be presented on the Sensistor ISH2000 display in this unit. Leak rate unit is set to PPM as default. You can change this to whatever unit you prefer.



Note!

The leak rate unit is just a text string. The leak values are converted to your unit by setting the correct Calibration coefficient (C and K-Factors in old program version).

For details, refer to the Sensistor ISH2000 Manual.

2. Calibration coefficient (C- and K-factor in old program version)

For information on calibration coefficient settings, refer to the Sensistor ISH2000 Manual.

3. Calibration Time

For reference gas calibration, set *Calibration Time* = 5 seconds.

For reference leak calibration, use the routine for optimising the analysis time to find the correct setting for the *Calibration Time*.

For leak master calibration, set *Calibration Time* = *Analysing time*.

4. Password

We recommend that you password protect your parameters. As default, no password is set.

Refer to the Sensistor ISH2000 Manual, for instructions on how to set a password.

5.6.3. Sampling parameters

For shortest possible cycle times, you should settle for simple ACCEPT/REJECT testing. That means that all signals below the leak limit are regarded acceptable and all signals above the limit leads to rejection of the test object. No recording is being done on how much above or below the limit any particular test is.

Having made this decision, you can set the probe to immediately terminate a test if the signal goes above the limit. You can also set the analysing time a bit shorter than if you want to measure the size of leaks smaller than the limit. See further under “*Analysing time*” and “*Purge level*” below.

5. Leak Alarm Level

The Leak Alarm Level is the reject level:

- Gas signals above the Leak Alarm Level result in REJECT.
- Gas signals below the Leak Alarm Level result in ACCEPT.
- Set the Leak Alarm Level equal to the defined leak limit of your test object.

6. Purge Level

A test will immediately be terminated and purging air outward the hose starts if the sensor detects a gas signal above the Purge Level. This feature is used to decrease the recovery times after a large leak has been detected. For shortest possible cycle time, set *Purge Level* = *Leak Alarm Level*.



Note!

Leaks that are larger than the Purge Level will not be correctly recorded. Every leak above the purge level, however, will result in REJECT. Purge Level can not be set lower than the Leak Alarm Level.

7. Analysing time

This is *Timer A* under the *APC Settings* menu.

The sample is passed over the sensor during the *Analysing* time. This time should be long enough to allow the sensor to reach full signal.

If you use several different *Leak Alarm Levels* for different objects, you should find a specific *Analysing* time for each *Leak Alarm Level*. If optimised cycle time is not critical, you can instead use one time that fits the lowest of the *Leak Alarm Levels*.

Find the best analysing time for ACCEPT/REJECT testing as follows:

- a. Set *Leak Alarm Level* equal to your reject limit.
- b. Set *Analysing* time (Timer A) to 10 seconds (default value).
- c. Set up your leak tester with a leak master or reference. This should generate the same concentration of hydrogen as would a real leaking object with a leak equal to the alarm limit.
- d. Run a test and note the reading on the detector.
- e. Decrease the *Analysing* time with 1 seconds.
- f. Wait 30 seconds.
- g. Repeat steps c through e until signal drops considerably.
- h. Increase *Analysing* time with 1 seconds.

8. Sampling time

This is *Timer B* under the *APC Settings* menu.

This is the time needed to draw a sample from the test point into the AP29 ECO. If sampling time is too short, the sample will not reach the sensor. An excessively long sample time may pump away the sample in a small open chamber.

The setting of the Sampling time depends on sample hose length and diameter.

Find the correct sample time as follows:

- a. Set *Analysing* time (Timer A) to 0 seconds.
- b. Set *Sampling* time (Timer B) to 10 seconds.

- c. Set up your leak tester with a leak master or reference. This should generate the same concentration of hydrogen as would a real leaking object with a leak equal to the alarm limit.
- d. Run a test and note the reading on the detector.
- e. If you get a signal, decrease the *Sampling* time with 1 second. (If no signal, double the *Sampling* time).
- f. Wait 30 seconds.
- g. Repeat steps c through e to find the shortest time that gives a reading on the display.
- h. Decrease *Sampling* time with 1 second.

9. After test purging time

This is *Timer C* under the *APC Settings* menu.

You can set the AP29 ECO to purge the sample hose with air inwards after each completed test. Timer C sets the purge time. Set timer C initially to 0 seconds.

The best setting of the *After Test Purging* time can only be found by experience. If you experience that you sometimes get “false” rejects after large leaks you should increase the *After Test Purging* time.

The actual setting is a compromise between lowest possible cycle time and the inconvenience of experiencing some false rejects.

10. Accumulating time

This is *Timer D* under the *APC Settings* menu.

This is the delay time, from that the test object is filled with tracer gas, until a sample is taken from the test point. Accumulation is mainly used to improve the sensitivity of a test chamber. The concentration in the test chamber will increase linearly during the accumulation time.

We recommend that you try to achieve an alarm limit of 5 ppm or more. Lower alarm limits can be used but you must pay more attention to the general design of you test system.

5.7. Calibrating and Approving your System

Before commissioning your test system to production, you must test and assess that, it will measure a leak correctly. This means that the whole sequence of events must function in a co-ordinated manner.

We call this test System Calibration. A system calibration must be performed when the test system is new as well as after any modification or repair that in any way can influence the performance of the system.

The system calibration is best performed by using a reference leak or calibrated flow meter to set up a limit leak. By introducing a limit leak in the system you can find the exact value that the detector records for that leak size. Having this, you can set your leak limit correctly.

No test chamber or sampling “mouthpiece” has a perfectly uniform sensitivity. A leak in one corner can give a very different signal than the same leak would give in another corner. Test the uniformity of your chamber. If very non-uniform, try to improve your circulation

**Note!**

*All accumulation chambers must have forced circulation for an even mixing of the sample. Tracer gas will not spontaneously rise to top of chamber!
Density of tracer gas mix is same as air!*

**Note!**

*Do not rely on theoretical calculations alone when setting your alarm level.
Use a calibrated leak flow to test the overall system performance.*

In addition to a system calibration, we recommend that a self-test is made at the start of every shift. This self-test should include a test of every step required for the safe detection of a leak. This includes testing the gas filling, sample mixing, sampling, sample analysis, result-reporting etc.

**Note!**

The system calibration described above is in addition to the regular sensor calibration. Sensor calibration should be performed at least weekly. For partly or fully automated systems we recommend that sensor calibration is performed once per shift.

System calibration, self test, and sensor calibration can sometimes be combined into one single operation. This can be achieved by using a calibrated leak master that is passed through the tester regularly. The advantage with this method is that you get the most relevant test of the whole system.

Ask your detector supplier for a quotation on a calibrated leak master.

Do not use home-made leak masters for calibration purposes. A faulty leak master can jeopardise your production quality.

6. Preventive Maintenance

The AP29 ECO has been designed for a minimum of maintenance. The best way to keep maintenance at a minimum is to fit external fine grade filters on reference air and sample inlets. Recommended filter grade is 40 µm or finer.

A extra filter in the sample hose will, of course, add volume and time to each sample sequence. The choice of filter (or no filter) in the sample line is therefore a balance between shortest possible cycle time and lowest possible maintenance.

Procedures for cleaning the port filters and for replacing the gas sensor are described in subchapters 6.3 and 6.5 below. For other maintenance or repairs contact the service center.

6.1. Toolkit

Below is a list of all tools you need for regular maintenance and most repairs:

- Wrenches (9, 12, 14, 15, and 16 mm)
- Allen keys (2.0, 2.5, 4.0, and 5.0 mm)
- Screwdriver, Phillips or Pozidrive 1, and a small regular screw driver
- Soldering pen

6.2. Maintenance plan

The inspection intervals given below are for a “typical” application. There are, however, large deviations between the actual best intervals depending on the specific application. You will have to make up your own maintenance schedule based upon your own experience.

Details of each maintenance point are described under the respective headline below. Refer to Table 8 for the maintenance plan.

Item	Interval	Inspection
Port filters	1-6 months*	Check and clean filters.
Gas sensor	3 months	Check sensitivity and response time. **

Table 8 Maintenance Plan.

* Inspection interval for the port filters depends greatly on the quality of your supply and external filters. If proper external filters are installed you should in principle not need to clean the port filters.

An external filter in the sample hose will, however, add volume and thereby time to the sampling step.

Therefore, the choice of an external sample filter is a balance between short cycle times and low maintenance.

If you know that your environment is dirty or dusty, we recommend that an external filter be fitted to the sample hose. Chose a filter grade of 10-40 µm, in a filter cartridge with small internal volume. Excess filter volumes can add many seconds and even minutes to the sampling time.

** The gas sensor check in the maintenance plan can not replace the regular sensor calibration. Sensor calibration should be carried out typically every day as part of the total test system self-check.

6.3. Cleaning Port Filters

There are three port filters. These are sintered bronze disks with 10µm pore size. The filters are fitted behind the inlet connectors of the following ports: Sample, Reference Air, and Reference Gas. See Figure 12.

These filters will not be dirty if proper external filters are installed. External filtration of sample hose is, however, a balance between increased cycle time and reduced maintenance.



Note!

Reference gas and reference air filters should not become dirty. If so, install proper external filter! Recommended filter grade is 40µm or finer. We also recommend external filter in sample hose. This, however, will give longer cycle times.

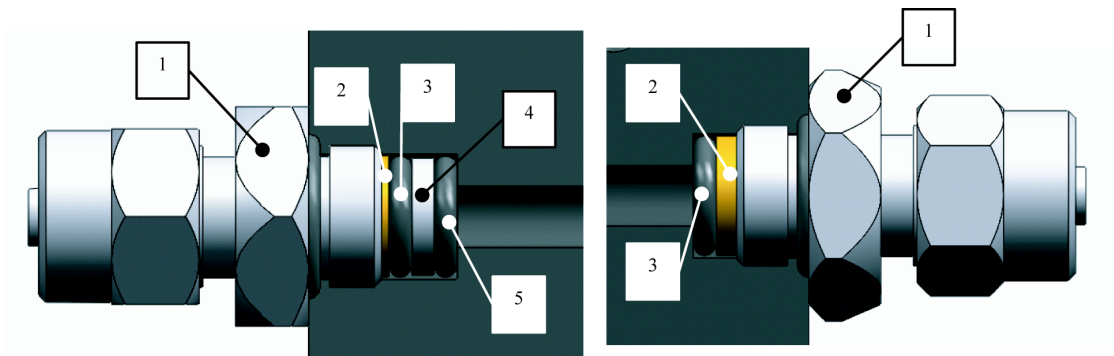


Figure 12 Cleaning port filters.

1	Connector
2	Filter disc
3	O-ring
4	Orifice disc
5	O-ring

Table 9 Key to Figure 12.

Refer to Figure 12 and clean filter as follows:

1. Switch off system power.
2. Shut off all gas and air supplies.
3. Remove hose from connector (1).

4. Remove connector (1) from valve manifold.
5. Take out filter disk (2) and o-ring (3).
6. For reference gas port: Take out the orifice disk (4) and second o-ring (5).
7. Inspect filter disk (2) and orifice disc (4). If necessary, clean filter disk (2) and orifice disc (4) with air jet or in solvent. Dry the parts thoroughly.
8. Place o-ring (2) flat on the bottom of filter compartment.
9. For reference gas port: Place the orifice disk (4) and then second o-ring (5) on top of first o-ring.
(O-rings 2 and 5 are same type.)
10. Place filter disk (2) flat on top of o-ring (2).
11. Install and tighten connector (1). Filter is now fixed in position.
12. Reinstall hose.

6.4. Membrane Pump

The membrane pumps are used for sampling, analysing, and for sensor and sample hose purging. Inadequate filtering of reference air supply may lead to decreased flow capacity as pump check valves become dirty.

6.5. Replacing Gas Sensor

The status of the sensor is automatically checked at every calibration. The detector will indicate when the sensor needs to be replaced.

Replace the sensor when this message is shown at calibration:

“Sensitivity too low for alarm level”

This means that a leak, equal to the set alarm level, may not be detected. This is because the sensitivity of the sensor has become too low for your application.

Check the current status of the sensor as follows:

1. Look up the alarm level in the Sensistor ISH2000.
2. Note the current setting and reduce the alarm to half the current setting.
3. Calibrate the detector.
4. If calibration succeeds without showing *“Sensitivity too low for alarm level”* your sensor is OK and you do not need to replace it.
5. If detector shows *“Sensitivity too low for alarm level”*, prepare for sensor change. Order a spare sensor. You will need to replace the sensor within a few months.
6. Reset the alarm level to original setting.
7. Recalibrate sensor.

Change sensor as follows:

1. Switch off the Sensistor ISH2000.
2. Disconnect the sensor cable from the sensor.
3. Use a 16 mm wrench to remove the sensor.
4. Check that the sensor o-ring comes out with the sensor.
5. Check that o-ring is in place over neck of new sensor.

6. Install new sensor.



Note!

*The threads are rather short. It is important that you hold the sensor straight when screwing it into place. **USE FINGERS ONLY UNTIL THE SENSOR IS PROPERLY IN PLACE!***



Note!

If you have problems to mate the threads, try to rotate sensor counter-clockwise while pressing it gently against the threads of the port. Rotate until you feel the sensor “pop” in place. Now, rotate clockwise until sensor sits in place.

7. Tighten the sensor with the wrench.
8. Connect sensor cable. Make sure it has locked by pulling gently on the cable.
9. Switch on detector again.
10. Calibrate the new sensor!

7. Trouble Shooting

See the Table 10 below for trouble shooting.

Symptom / Message	Cause	Remedy
<i>“Probe Error”</i> on Sensistor ISH2000 display.	Sample inlet filter is clogged.	Clean or replace filter.
	Sample pump is clogged or damaged.	Clean or replace pump.
	Valves –Y01, -Y02, -Y03, -Y05 are blocked.	Clean or replace blocked valve.
	Sample hose has collapsed.	Check and/or replace hose.
No gas at calibration	Calibrate gas pressure too low.	Check that pressure is 0.03 – 0.10 MPa / 0.3 – 1.0 barg / 4.5 – 15 psig
	Calibrate filter is clogged.	Clean or replace filter.
	Valves -Y04, -Y05 are blocked.	Clean or replace blocked valve.
Low <i>analysing</i> or <i>sampling</i> flow but no alarm.	Clogged flow orifice.	Replace orifice and readjust flow alarm.
	Wrongly adjusted or defect flow alarm switch.	Adjust or replace flow alarm switch.
<i>“Sensor or cable error”</i> on Sensistor ISH2000 display.	Sensor cable is not connected.	Connect cable properly.
	Sensor cable is broken.	Replace cable.
	Sensor is broken.	Replace probe.
First sample after big signal is always LEAK	Inadequate purging.	Increase “After test purge” time: Timer C
	Purge pump is defect.	Check pump membrane.
Every test shows LEAK	Increased background concentration of hydrogen.	Check for leaks in tracer gas supply.
		Check that exhaust of filling equipment is properly installed.
		Check that workplace ventilation works properly.

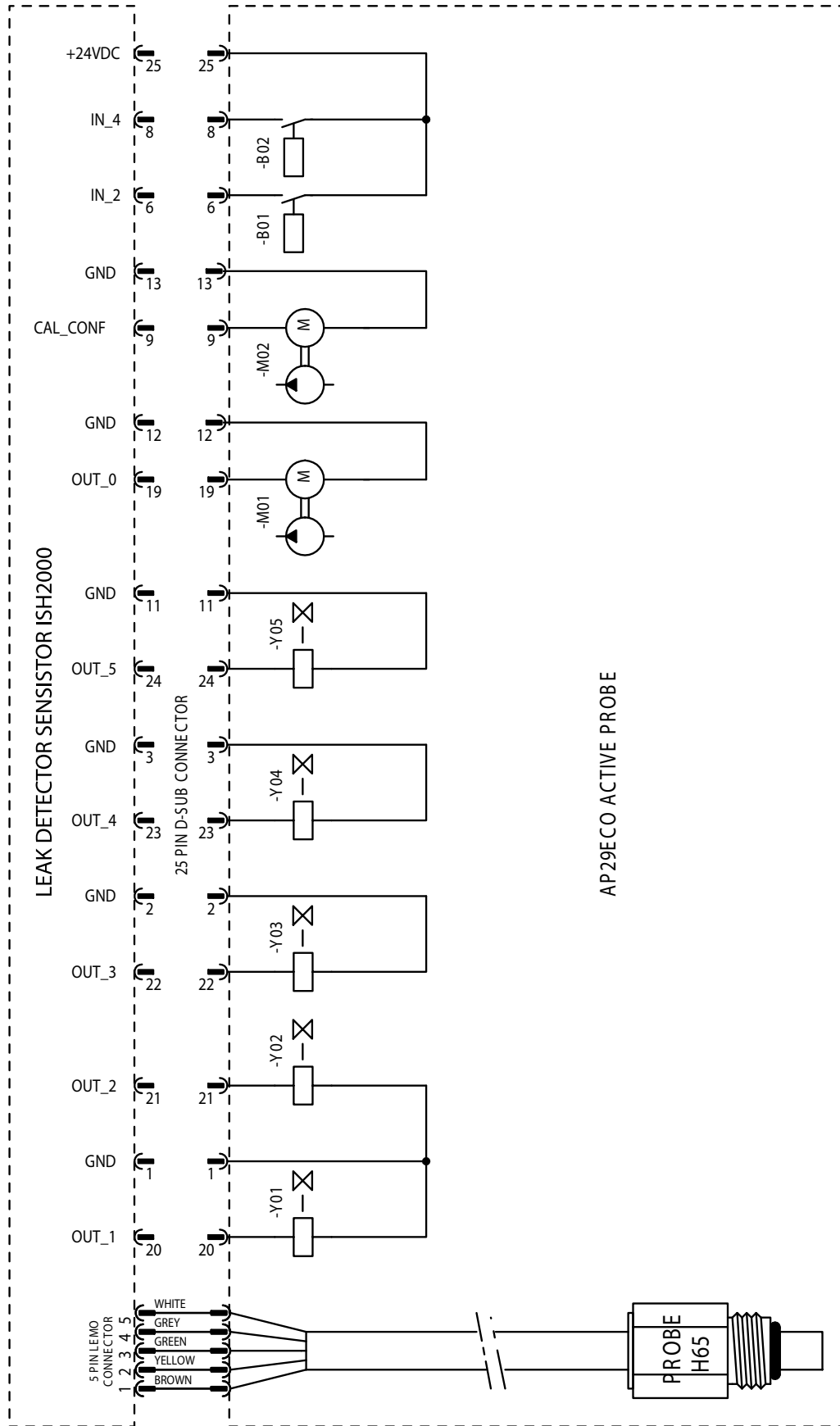
Table 10 Trouble shooting.

8. Spare Parts

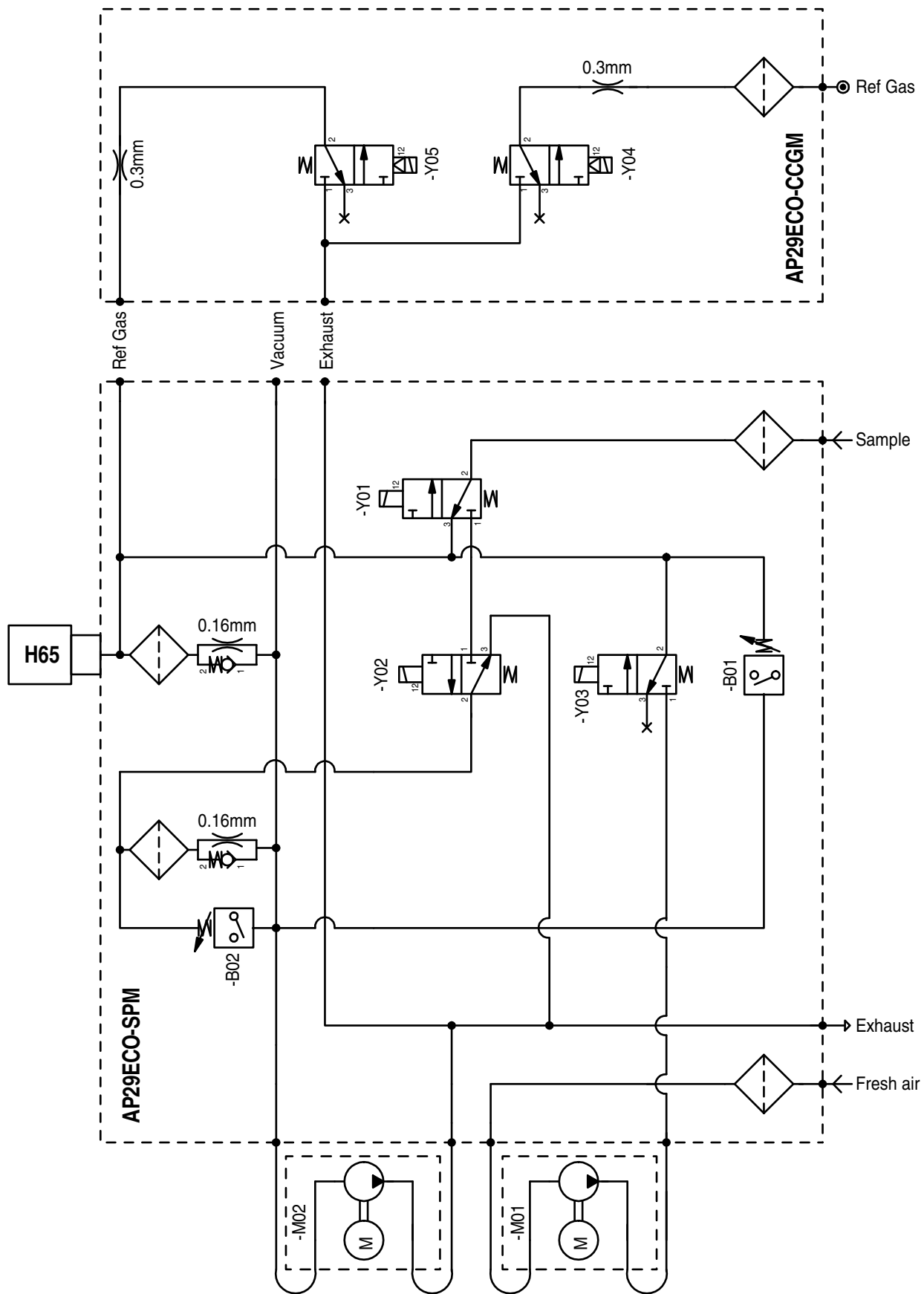
Description	INFICON order number	Alternative supplier	Order number
Gas sensor	590-250		
Sensor cable	590-160		
Bus cable	591-420		
Hub	590-545		
Port filter disk (10µm)	591-173		
Port filter o-ring (5.1 x 1.6 mm)	591-177		
Reference gas port orifice disk	598-041		

Table 11 Spare parts list.

9. Electric Diagram



10. Pneumatic Diagram



11. Technical Data

11.1. General

11.1.1. Sensitivity

- Concentration: Same as detector.
- Using 5% H₂ tracer gas: 0.5 ppm or 3x10⁻⁵ atm cc/s for direct sniffing with standard sniffer flow

11.1.2. Sniffer flow alarm

Set to 75% of nominal flow.

11.1.3. Reference gas

Most commonly 10 ppm H₂ in air. Hydrogen concentration should be within 1 to 400 ppm and within +/- 50% of alarm level.

- Pressure: 0.03 – 0.1 MPa / 0.3 – 1 barg / 4.3 – 15 psig
- Consumption: Typically 15 std. cc/s at 0.05 MPa / 0.5 barg / 7 psig.

11.1.4. Temperature range

10 – 50°C (50 – 122°F)

11.1.5. Protection rating

IP54 (if mounted with ventilation grid facing downwards)

11.1.6. Dimensions

90 x 161 x 260 mm

11.1.7. Weight

4.5 kg

11.1.8. Electrical ratings

- Pumps: 24 VDC±10%, typical 130 mA
- Solenoid valves: 24 VDC±10%, 0.35 W each.

11.1.9. Electromagnetic Compatibility

ISO4414:1998, JIS B 8370

11.2. Sniffer Flow Options

- 11.2.1. Standard flow
3 atm. cc/s with std 0.16 mm orifice.

- 11.2.2. Optional flow 1
1 atm. cc/s with 0.10 mm orifice.



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