Original operating instructions

AP29ECO

Sampling Probe for Sentrac Desktop and Sentrac Panel

Catalog No.
590-035 (3 cc/sec sample flow), 590-036 (1 cc/sec sample flow)

From software version
4.01 or higher

INFICON

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1 Introduction

1.1 General

The Sampling Probe AP29ECO forms together with the Hydrogen Leak Detector Sensistor Sentrac Panel a complete industrial leak-detection unit.

Sampling probe AP29ECO is intended for intermittent or continuous sampling of a test point or test chamber. It performs quick and accurate accept/reject testing.

Sample Probe AP29ECO can only be controlled by Sensistor Sentrac Panel and Desktop Leak Detector with software version 4.01 or higher.

Typical applications for the AP29ECO 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:

- Sampling Probe AP29ECO
- Sentrac External DSUB IO Adapter
- Bus Cable (2 m, male-to-male, pin-to-pin, 25 pin D-type)*
- Sensor Cable (3 m, black with 5 pin LEMO connectors)*
- Operating instructions

* Other lengths available.

1.3 Safety Aspects

⚠ 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.

⚠ 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% H_2 – 95% N_2.

⚠ 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.

NOTICE

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 Sentrac software. Consult your supplier for best system design for your particular application.

The AP29ECO is equipped with one sniffer port that has one constant flow with two functions. One flow (Samplings flow) does not measure the hydrogen concentration while the other (Measuring flow) does. With that technology, you can e.g. take home a sample from an accumulation chamber to measure the hydrogen concentration or you can create a steady-state condition, e.g. obtain a leak point before measuring the hydrogen concentration.

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 AP29ECO 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 calibration mode. This allows for fast and automatic calibration adjustment, with a certified gas mixture of Hydrogen in Air.

See the calibration section below.

The Sensistor Sentrac system offers 24 VDC logic signals for valve control, leak alarms, sniffer flow alarm, etc. for easy interfacing to any PLC system. The AP29ECO is designed for minimum maintenance and easiest possible service.

2.1 Connect Tracer Gas filler

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.

2.2 System based on a Sensistor Sentrac, Desktop Model or Panel Model
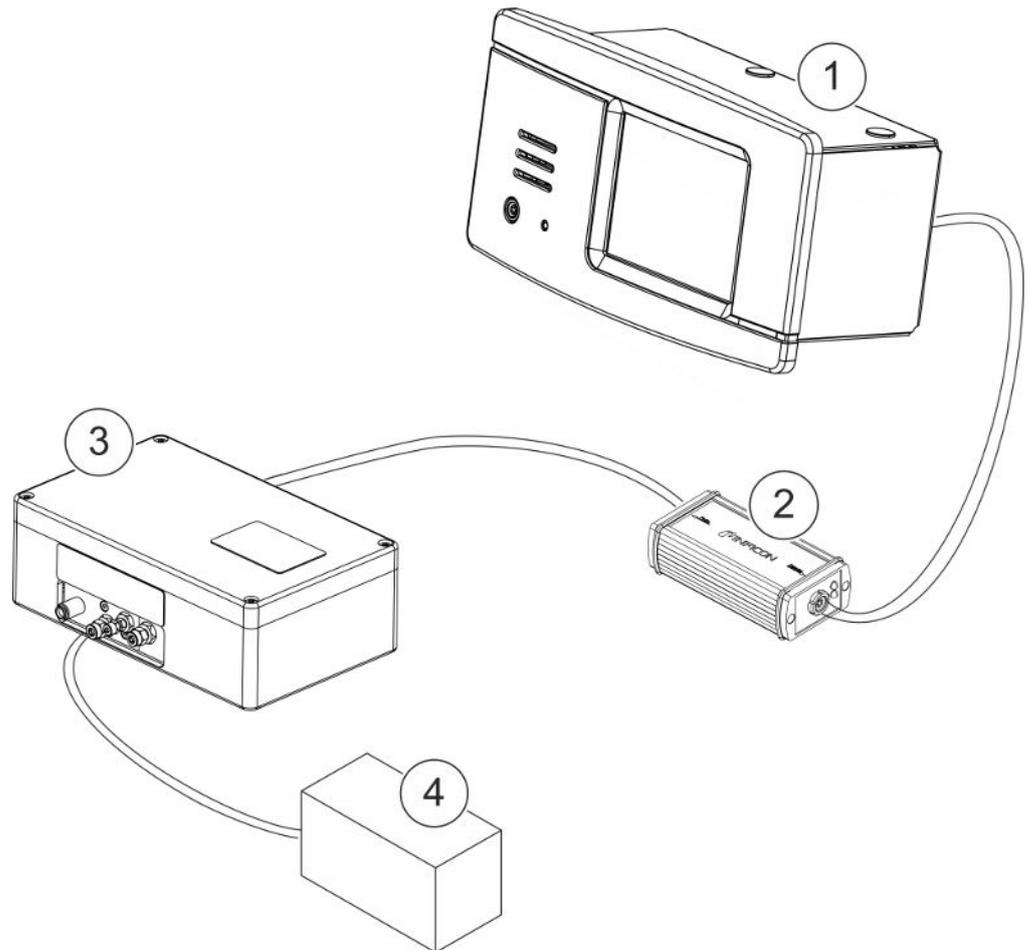
Fig. 1: System based on Sensistor Sentrac

1	Sensistor Sentrac Panel Model
2	COMBOX 60
3	AP29ECO
4	Accumulation Chamber

2.3 Test Sequence

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

1. Accumulation

2. Sampling

3. Measuring

4. Purging

See figure 2 below
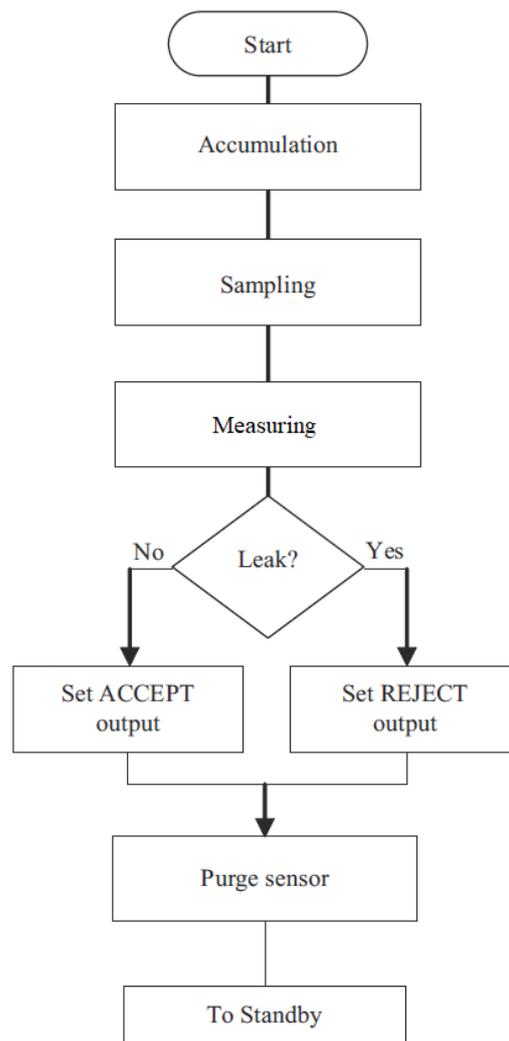
Fig. 2: Test sequence

2.3.1 Accumulating Time (Settings / Probe / APC 1)

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 increase the hydrogen concentration of a tracer gas into the test chamber. The concentration in the test chamber will increase linearly during the accumulation time.

2.3.2 Sampling Time (Settings / Probe / APC 1)

This is the time needed to draw a sample from the test point to the AP29ECO. 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 Measuring Time (Settings / Probe / APC 1)

The sample is passed over the sensor during the Measuring time. The Measuring time can be set to 3 seconds if your alarm level corresponds to 10 ppm or higher. For lower levels and fine tuning, see "Sampling parameters [▷ 33]".

2.3.4 After Test Purging Time (Settings / Probe / APC 1)

Purge the sampling tube with air blown out through the tube. Set the timer so that you are sure there are no samples left in the tube for the next measurement.

	08:08	⊙
Functions	APC 1	APC 2
Accumulating Time (s)		60.0
Sampling Time (s)		10.0
Measuring Time (s)		10.0
After Test Purge Time (s)		10.0
	Settings / Probe	
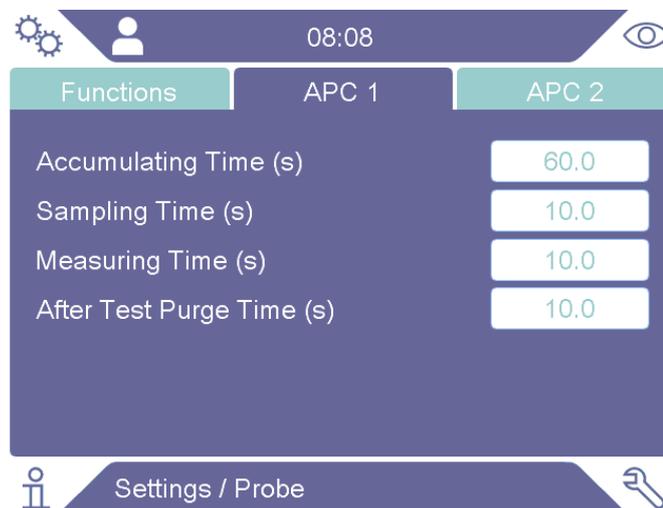
2.3.5 Purge Trigger (Settings / Probe / APC 2)

Gas signal above Reject Level immediately start purging the gas sensor with air, to avoid unnecessary tracer gas exposure. Can be set to a factor higher then Reject Level. Provides shorter recovery times when searching for large leaks.
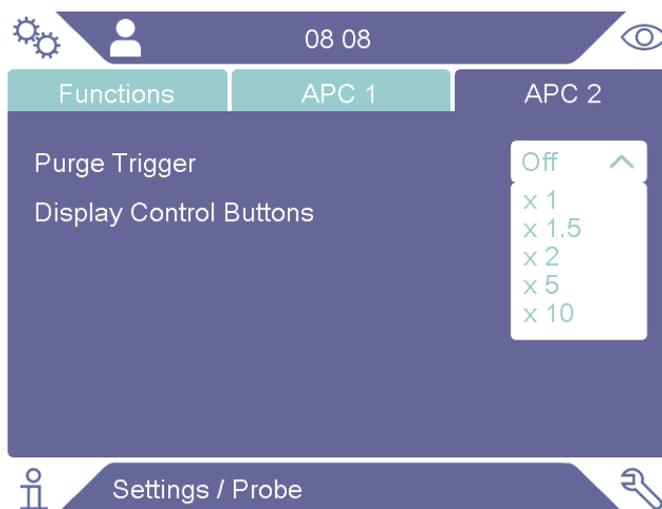
2.3.6 Other important software parameters

- **Reject Level (Settings / Measure Mode / Setup)**

  Gas signals above the Reject Level result in REJECT.

  Gas signals below the Reject Level result in ACCEPT.

- **Calibration Value (Settings / Calibration / Setup 1)**

  Calibrate against a Calibration gas you should set Calibration Value equal to the concentration of Hydrogen in your calibration gas. Example for 10 ppm Hydrogen set Calibration Value = 10 ppm.

  For further details refer to the Sensistor Sentrac manual.

  For optimization of test parameters, see "Setting up your Application [▶ 33]".

3 Quick Start

![info icon] 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.

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

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 Sentrac External DSUB IO Adapter (598-330) is not a computer or printer port. Connecting a printer or any other computer device may cause permanent damage to the connected device.

1   Connect Sentrac External DSUB IO Adapter to I/O (APC) port on the Sensistor Sentrac backside.
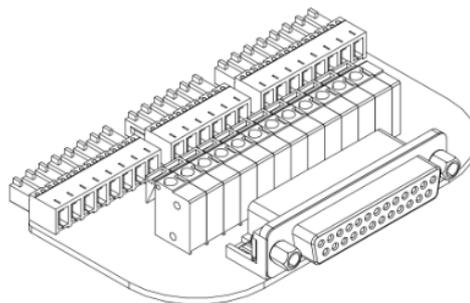
2   Connect Buscable to the Sentrac External DSUB IO Adapter and AP29ECO D-sub port.

3   Connect one Probe Cable C21 from Sentrac (front or rear) Probe Connection to Combox60 Detector port.

4   Connect one Probe Cable C21 from Combox60 Probe port and to AP29ECO sensor (H65).

5   Install hoses according to "Pneumatic Connections for AP29ECO [▶ 20]" below.

6   Pressurize calibrate gas with pressure in the range of 0.03 – 0.1 MPa / 0.3 – 1 barg / 4.3 – 15 psig.

3.2 Setup Settings

1 Open Settings / Probe / Functions and set probe Type to AP29ECO.

⚙	👤	08:10	👁
Functions	APC 1	APC 2	

Device   AP29ECO ⌄

ℹ   Settings / Probe   🔧

2 Open Settings / Probe / APC 1 and if necessary, optimize timers for shortest cycle time.

⚙	👤	08:08	👁
Functions	APC 1	APC 2	

Accumulating Time (s)	60.0
Sampling Time (s)	10.0
Measuring Time (s)	10.0
After Test Purge Time (s)	10.0

ℹ   Settings / Probe   🔧
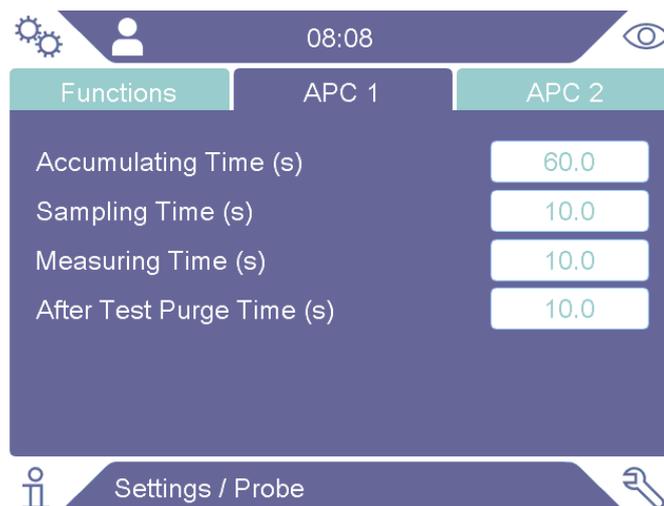
3.3 Measuring

1   Go to main menu

2   Press ▶ to start a Measuring

3   Press ⊗ to:

⇨ Abort Measuring

⇨ Go to Standby

⇨ Purge the sample hose more

3.4 Remote Control AP29ECO

Go to set up remote control instead of controlling from Sentrac display read:

Manual switches [▷ 25]

Programmable Logic Controller etc. [▷ 25]

4 Installation

⚠ 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.

► This also applies to the sensor cable. The sensor can be destroyed if the power is switched on!

⚠ CAUTION

The 25-pin D-type connector on the Sentrac External DSUB IO Adapter (598-330) is not a computer or printer port. Connecting a printer or any other computer device will cause permanent damage to the connected device.

Installation of the AP29ECO is very simple, follow the instructions below. The APC system of the Sensistor Sentrac handles all vital functions. The AP29ECO can also be controlled through the APC Bus via switches, sensors and indicators, or via a PLC/PC.

See "Electric Diagram [▶ 43]" "and "Pneumatic Diagram [▶ 44]".

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 AP29ECO is placed with the ventilation grid facing down. This makes it harder for dirt or dust to collect inside the box.
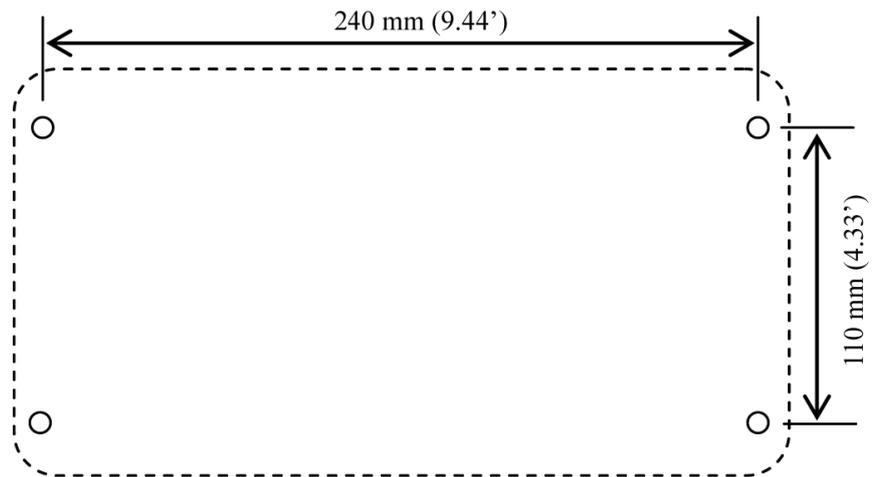
Fig. 3: Placement of AP29ECO

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 3.

4.2 Cable Connections

4.2.1 Sensor Cable

The sensor inside the AP29ECO is connected to the Sensistor Sentrac with two C21 cables and one COMBOX60. Several different cable lengths are available. See sensor cable in the figure below.

Fig. 4: 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.

4.2.2 Bus Cable

The bus cable carries control signals of the Active Probe Control (APC) system in the Sensistor Sentrac. The APC system controls the pneumatic and electric functions of the AP29ECO.

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 AP29ECO. Further details of the APC System can be found below and in the Sensistor Sentrac Interface Description.

4.3 Pneumatic Connections for AP29ECO

The figure 5 shows the pneumatic connections of AP29ECO.

Exhaust   Reference air   Sample Inlet   Calibrating gas
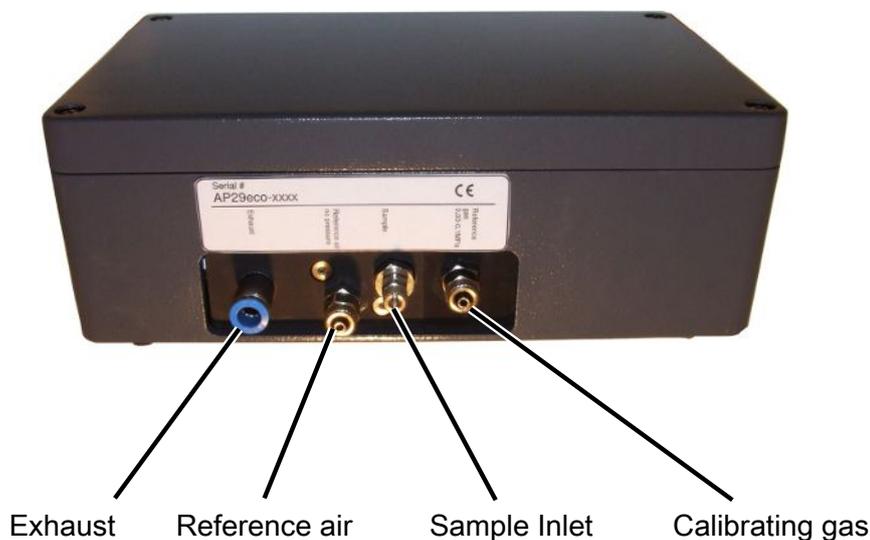
Fig. 5: Pneumatic connections of the AP29ECO

See table below 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 must 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
Calibration Gas	Typically 10 ppm H2 in Air (can be in range 1 to 400 ppm and within +/- 50% of Leak reject level) 0.03 – 0.10 MPa / 0.3 – 1.0 barg / 4.5 – 15 psig (Consumption: Typically 15 std. cc/s at 0.05 MPa / 0.5 barg / 7 psig)	BSP 1/8" (ISO 228/1-G1/8)	OD/ID 6.0 /4.0 mm

Table 1: 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.

4.3.1 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 AP29ECO.

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 AP29ECO 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. Chose 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 form 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 AP29ECO is leak testing. By placing the inlet close to the main leak point you minimize 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.

4.3.2 Calibration Gas

The 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 Calibration gas is the most reliable and fast way of calibrating your sample probe.

Calibration 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 Reject level used. For example, if your alarm level is 10 ppm, use a Calibration 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.

To connect the Calibration 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 cannot 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 pressure.

10   Open regulator outlet valve (if any).

4.3.3 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.

4.3.4 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 Calibration 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 [▷ 28]".

> ⚠ **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.

4.3.5 Exhaust

Connect the exhaust to the tracer gas exhaust duct. See further under "Tracer gas exhaust [▷ 28]".

4.4 Master Controls

The Sensistor Sentrac Leak Detector and AP29ECO Sample Probe will automatically perform a complete sampling and analysis 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 AP29ECO 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.

Status Output/ Input	Function	Description	Pin Designation Sentrac	Pin Designation AP29ECO	Pin Designation External DSUB IO Adapter VEC
	GND	GND for APC29ECO	P01	P01, P02	P12
	+24VDC	Sources electrical switches	P02	P25	P01
Out_5	OUTPUT	Control valve (Y05)	P03	P24	
Out_4	OUTPUT	Control valve (Y04)	P04	P23	
Out_3	OUTPUT	Control valve (Y03)	P05	P22	
Out_2	OUTPUT	Control valve (Y02)	P06	P21	
Out_1	OUTPUT	Control valve (Y01)	P07	P20	
Out_0	OUTPUT	Control Purge Pump (M01)	P08	P19	
ACCEPT	OUTPUT	Accept signal	P10	P10	P04
VACUUM PUMP	OUTPUT	Control Vaccum Pump (M02)	P11	P09	P05
	GND	GND for APC29ECO	P12	P03, P11	P12
Det_WAIT	OUTPUT	Wait signa during start up	P13	P18	
Det_SIGNAL	OUTPUT	Sensor gives signal indication	P14	P17	P07
DET_ON	OUTPUT	High when detector power is on	P15	P16	P06
CALIBRATION OK	OUTPUT	Calibration is ok	P16	Not Connected	
REJECT	OUTPUT	Rejectsignal	P17	P15	P03
Det_Error	OUTPUT	Error signal	P18	P14	P02
IN_1	INPUT	Sample Flow Signal	P19	P08	
IN_2	INPUT	Purge Request	P20	P07	P08
IN_3	INPUT	Measure Flow Sig	P21	P06	P11
IN_4	INPUT	Calibrate Request	P22	P05	P09
IN_5	INPUT	Measure Request	P23	P04	P10
	GND	GND for APC29ECO	P24	P12, P13	P12

4.4.1 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 the table below 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!

Status Output/ Input	Description	Pin Designation AP29ECO	Pin Designation Sentrac	
+24VDC	(Read warning below)	P25	P02	
IN_5	Sample request	P04	P23	
IN_4	Calibration request	P05	P22	
IN_2	Purge request (optional)	P07	P20	
OUT_6	ACCEPT signal	P10	P10	
LEAK_OUT	REJECT signal	P15	P17	
DET_ON	Power on signal (optional)	P16	P15	
DET_ERROR	Error signal (optional)	P14	P18	
DET_WAIT	Detector warming up (optional)	P18	P13	
DET_SIGNAL	Gas signal above zero (optional)	P17	P14	
GND		P01, P02, P03, P11, P12, P13	P01, P12, P24	

Table 2: Functions operated manually

4.4.2 Programmable Logic Controller etc.

The AP29ECO 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 together).

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 interface description of the Sensistor Sentrac.

The table below shows the signals which are recommended to be routed to the controller.

Status Output/ Input	Description	Function	Pin Designation AP29ECO	Pin Designation Sentrac
DET_ON	HIGH when detector power is on.	OUT	P16	P15
Reject	REJECT. Test result signal	OUT	P15	P17
Accept	ACCEPT. Test result signal	OUT	P10	P10
DET_ERROR	Summing error from detector or probe	OUT	P14	P18
DET_WAIT	HIGH while detector warms up	OUT	P18	P03
DET_SIGNAL	LOW when sensor recovered to zero	OUT	P17	P14
IN_5	Measure request	IN	P04	P23
IN_4	Calibration request	IN	P05	P22
IN_2	Forced purge request	IN	P07	P20

Table 3: Signals routed to the controller

See under "Operation" for further details on the signal logics.

4.4.3 Programmable Logic Controller with Sentrac External DSUB IO Adapter

If using Sentrac External DSUB IO Adapter connect the programmable Logic Controller to the adapter according to the table.

Status Output/Input	Function	Description	Pin Designation External DSUB IO Adapter VEC
	GND	GND	P12
	+24VDC	Sources electrical switches	P01
ACCEPT	OUTPUT	Accept signal	P04
VACUUM PUMP	OUTPUT	Control Vaccum Pump (M02)	P05
	GND	GND	P12
Det_SIGNAL	OUTPUT	Sensor gives signal indication	P07
DET_ON	OUTPUT	High when detector power is on	P06
REJECT	OUTPUT	Rejectsignal	P03
Det_Error	OUTPUT	Error signal	P02
IN_2	INPUT	Purge Request	P08
IN_3	INPUT	Measure Flow Sig	P11
IN_4	INPUT	Calibrate Request	P09
IN_5	INPUT	Measure Request	P10
	GND	GND	P12

Table 4: Sentrac External DSUB IO Adapter connect the programmable Logic Controller

4.5 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".

4.5.1 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 liters. It is much cheaper in bulk delivery or if delivered from a Liquid Nitrogen tank with hydrogen mixer.

ⓘ 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.

4.5.2 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.

4.5.3 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.

4.5.4 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 6 and 7 below show the design of exhaust and fresh air supplies and the principle of air curtain design.
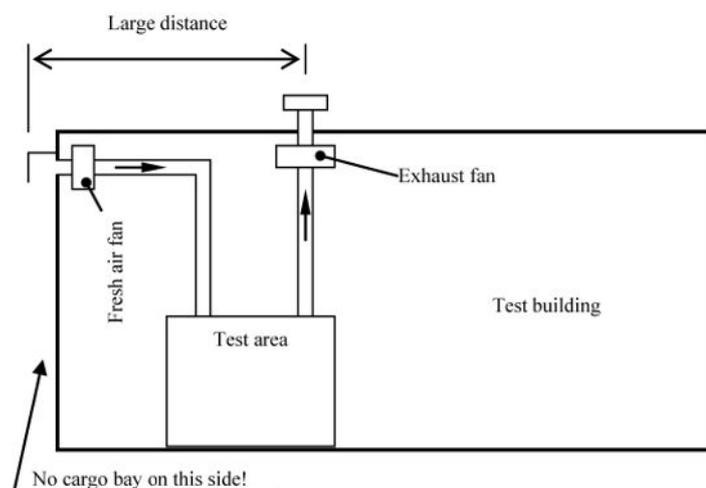
Fig. 6: Design of exhaust and fresh air supplies
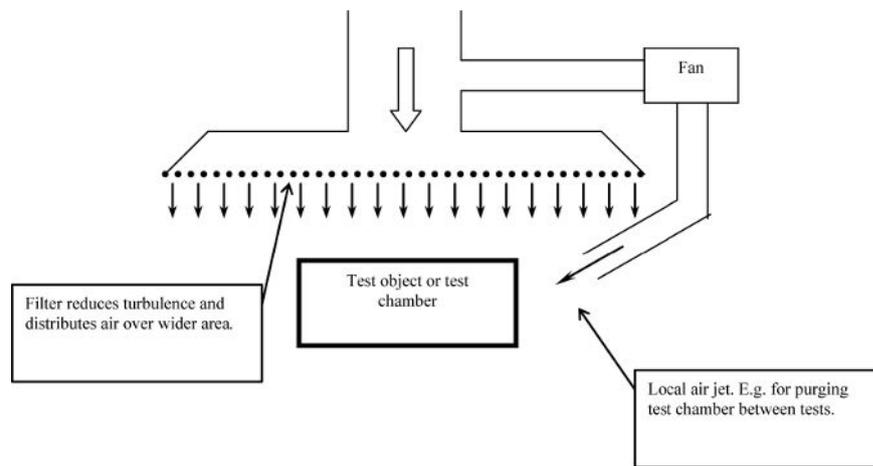
Fig. 7: Principle of air curtain design

5 Operation

5.1 Measure Sequence Flow Chart

The measure sequence is shown in the figure below.
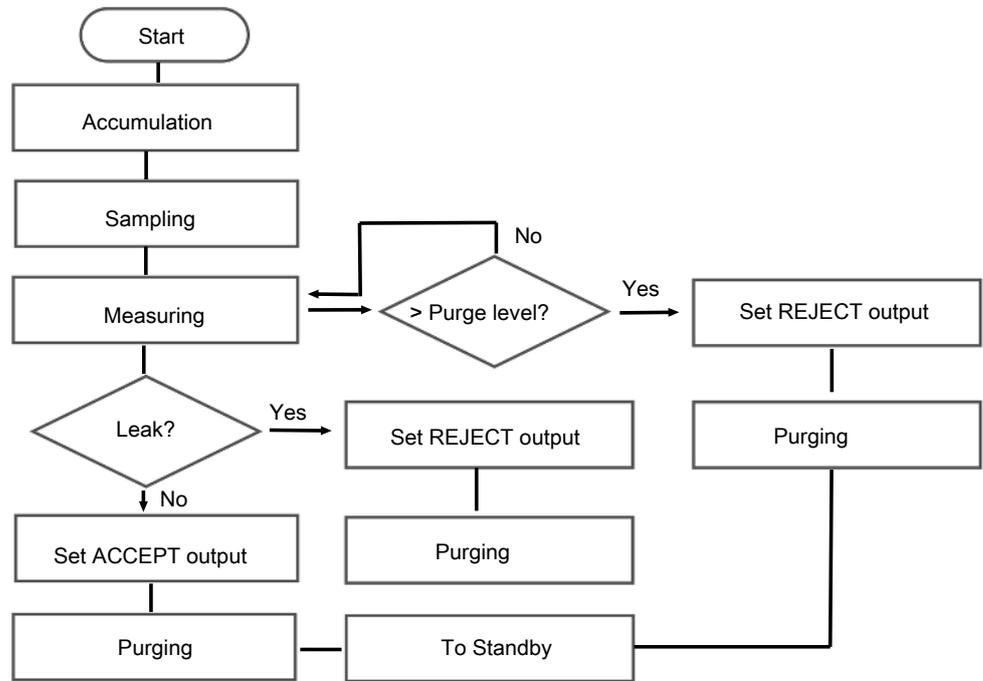
Fig. 8: Measure sequence flow chart

5.2 Measure Sequence Signals

Measure sequence signals are shown in the table below. See under "Installation" for pin numbers.

Signal name	Description
IN_5	Give pulse (high ≥ 40 ms) to initiate measuring
ACCEPT	High after completed test cycle showing no leak Goes low again 10 s after purging time has run out.
REJECT	High after completed test cycle showing leak High if test cycle is terminated by error or purge request Goes low again 10 s after purging time has run out.
IN_2	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 Calibration

Sentrac has a built-in calibration routine that you start via IN_4 or via the menu on the Sentrac. Follow the instructions on the Sentrac screen.

5.4 Calibration Sequence Signals

Calibration sequence signals are shown in the table below. See under "Installation" for pin numbers.

Signal name	Description
IN_2	Give pulse (high ≥40 ms) to initiate calibration.
REJECT	High on calibration failure. Goes low again at start of next sequence.
ACCEPT	High on calibration succeeded. Goes low again at start of next sequence.

Table 6: Calibration sequence signals

5.5 Setting up your Application

This section will list the more important of the software parameters of the Sensistor Sentrac 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.

Instructions on how to modify the setting of the different parameters can be found in the Sensistor Sentrac manual.

5.5.1 Parameters

The parameters from 1-4 in the table below 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. Reject Level	1.00E-37 – 1.00E37	1.00E+01 = 10
6. Purge Level	Reject Level – 1.00E37	1.00E+02 = 100
7. Measuring time	0.0 – 999999 s	10.0 s
8. Sampling time	0.0 – 999999 s	10.0 s
9. After test purging time	0.0 – 999999 s	10.0 s
10. Accumulating time	0.0 – 999999 s	60.0 s

Table 7: General and sample parameters

5.5.2 General Parameters

Refer to the Sensistor Sentrac Manual, for more information about general parameters.

5.5.3 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.

1. Reject Level

    The Reject level:

    – Gas signals above the Reject Level result in REJECT.

    – Gas signals below the Reject Level result in ACCEPT.

    – Set the Reject Level equal to the defined leak limit of your test object.

2. Purge Trigger

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

Leaks that are larger than the Purge Trigger will not be correctly recorded. Every leak above the Purge Trigger, however, will result in REJECT. Purge Trigger cannot be set lower than the Reject Level.

---

3. Measuring time

    This is the Timer under the APC Settings menu.

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

    If you use several different Reject Levels for different objects, you should find a specific Measuring time for each Reject Level. If optimised cycle time is not critical, you can instead use one time that fits the lowest of the Reject Levels. Find the best Measuring time for ACCEPT/REJECT testing as follows:

    a) Set Reject Level equal to your reject limit.

    b) Set Measuring time 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 Reject Level.

    d) Run a test and note the reading on the detector.

    e) Decrease the Measuring time with 1 second.

    f) Wait 30 seconds.

    g) Repeat steps through e until signal drops considerably.

    h) Increase Measuring time with 1 second.

4. Sampling time

    This is the Timer under the APC Settings menu.

    This is the time needed to draw a sample from the test point into the AP29ECO. 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 Measuring time to 0 seconds.

b) Set Sampling time 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 to find the shortest time that gives a reading on the display.

h) Decrease Sampling time with 1 second.

5. After test purging time

This is the Timer under the APC Settings menu.

You can set the AP29ECO to purge the sample hose with air inwards after each completed test. The Timer sets the purge time. Set the timer 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.

6. Accumulating time

This is the Timer 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.

6 Preventive Maintenance

The AP29ECO 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 um, 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 cannot 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 10 µm pore size. The filters are fitted behind the inlet connectors of the following ports: Sample, Reference Air, and Calibration Gas. See figures below.

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.

ⓘ Calibration gas and reference air filters should not become dirty. If so, install proper external filter! Recommended filter grade is 40 µm or finer. We also recommend external filter in sample hose. This, however, will give longer cycle times.
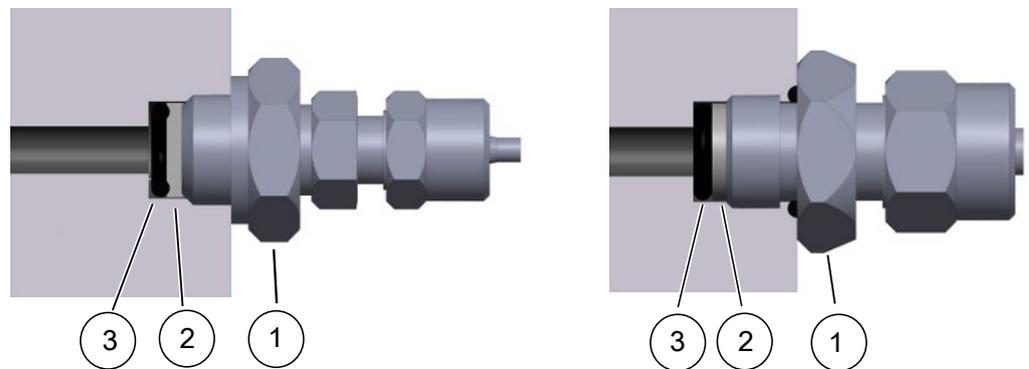
Fig. 9: Left: Sample Port, Right: Reference Air Port

1	Connector
2	Filter disc
3	O-ring
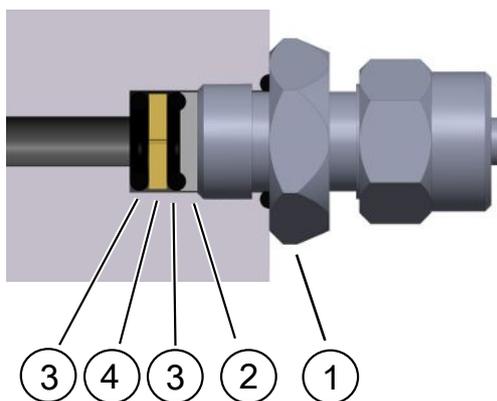
Fig. 10: Calibration Gas Port

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

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 Calibration gas port: Take out the orifice disk (4) and second O-ring (3).

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 (3) flat on the bottom of filter compartment.

9. For Calibration gas port: Place the orifice disk (4) and then second O-ring (3) on top of first O-ring. (Both O-rings are same type.)

10. Place filter disk (2) flat on top of O-ring (3).

11. Install and tighten connector (1). Filter is now fixed in its 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 Reject level"

This means that a leak, equal to the set Reject 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 Reject level in the Sensistor Sentrac.

2. Note the current setting and reduce the Reject level to half the current setting.

3. Calibrate the detector.

4. If calibration succeeds without showing "Sensitivity too low for Reject 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 Reject level to original setting.

7. Recalibrate sensor.

Change sensor as follows:

1. Switch off the Sensistor Sentrac.

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.

NOTICE

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!

NOTICE

If you have problems to mate the threads, try to rotate sensor counterclockwise 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

Symptom / Message	Cause	Remedy
"Sample flow error" or "Measure flow error"	Sample inlet filter is clogged.	Clean or replace filter.
	Sample pump (-M02) 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 analyzing or sampling 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.
"Sensor broken or not connected."	Voltage too high, Error E1	Change sensor or connect sensor.
	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
	Purge pump (-M01) 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 9: Trouble shooting

8 Spare Parts

Description	INFICON order number
Gas sensor	590-250
Sensor cable	590-161
Bus cable	591-282
Sentrac External DSUB IO Adapter	598-330
Port filter disk (10 µm)	591-173
Port filter O-ring (5.1 x 1.6 mm)	591-177
Calibration gas port orifice disk	598-041

Table 10: Spare parts list

9 Electric Diagram
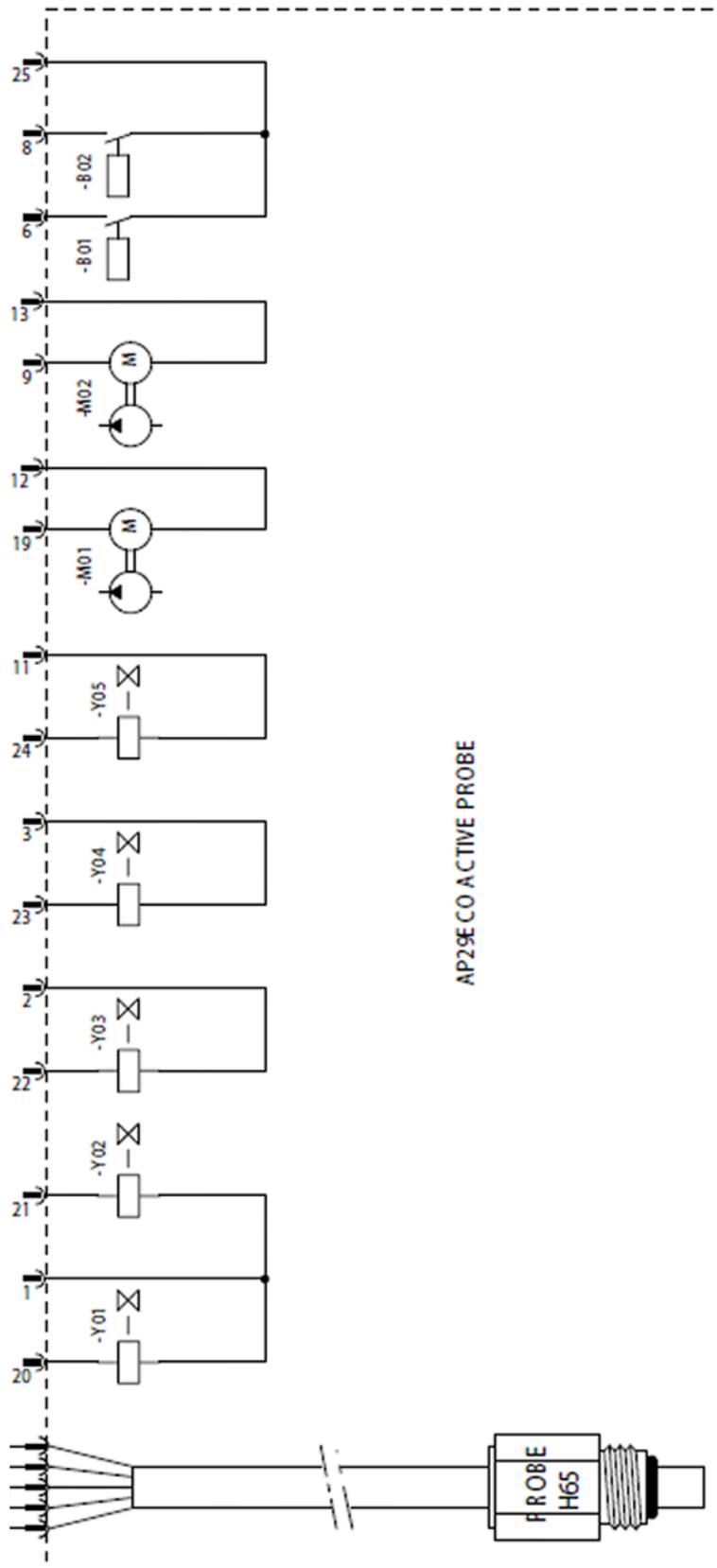
10 Pneumatic Diagram
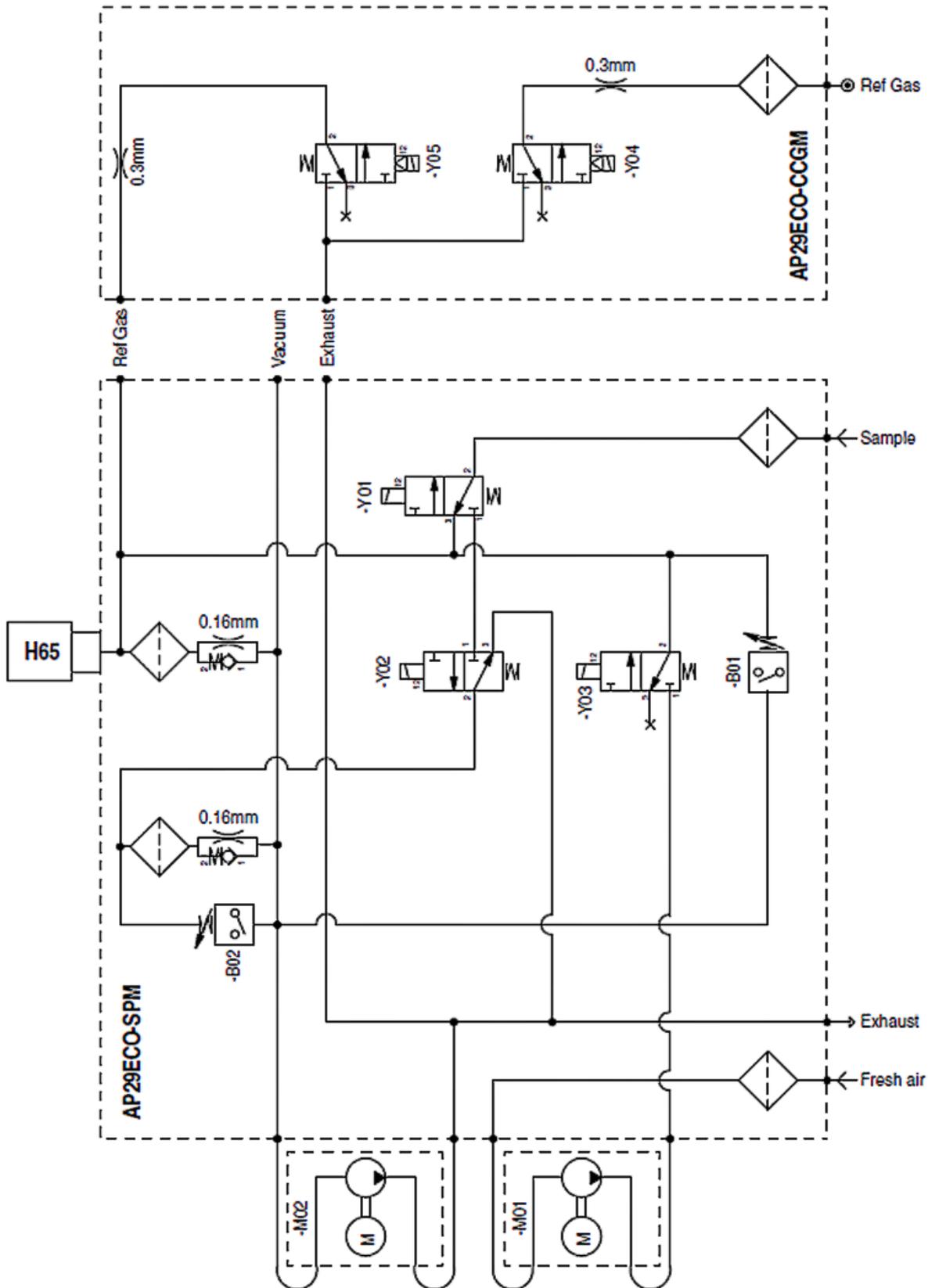
11 Technical Data

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 Calibration 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.

INFICON Inspired by visions. Proven by success.