

Tritium and Carbon-14 Samplers

V3H14C series



Equipment of the "V3H14C" family are designed for ^3H and ^{14}C sampling from the air.

Several versions are produced, ranging from a compact model for the sampling of tritium in the form of water, to a version enabling differential sampling of both the oxidised and unoxidised form of tritium, and the organic and inorganic form of ^{14}C .

Purpose

Equipment of the "V3H14C" family is designed for ^3H and ^{14}C sampling from the air. The samples are captured into sorbents, the standard sorbent for ^3H is silica gel (optionally another one), and the standard sorbent for ^{14}C is sodium hydroxide.

The equipment is produced in several versions. The version of the sampler is selected depending on the requirement of which radionuclides and forms are to be sampled.

Fully equipped model V3H14C includes two separate sampling lines for the sampling of different ^3H and ^{14}C forms. The first line is equipped with catalytic combustion and is designed for capturing ^3H and ^{14}C in all forms including H_2 , CO and C_xH_x . The second line is designed for ^3H and ^{14}C sampling, exclusively in the basic form H_2O and CO_2 . By comparing the difference in both captures, it is possible to determine the total amount of the substances under investigation in both forms - both the oxidised and unoxidised form of tritium, and organic and inorganic form of ^{14}C .

The V3H14Ca model with a single line without catalyst is designed for capturing ^3H and ^{14}C , exclusively in the basic form H_2O and CO_2 . Other modifications include independent samplers of tritium (V3H, V3Ha) or ^{14}C (V14C and V14Ca).

Desorption unit DJ-500 may also be part of the system, serving for releasing water captured in the silica gel sorbent.

The extracted samples are designed for subsequent laboratory analysis. Values of activity of samples, resulting from the analysis, serve for quantitative assessment of radioactive emissions of ^3H and ^{14}C and for comparing with the determined limits.

Main Advantages

- Easy, fast and secure replacement of mechanically resistant sampling recipient bottles
- When using silica gel longer sampling time or sampling of higher amount of tritium is possible compared to liquid sorption media
- Parallel arrangement of sampling lines (one line with a catalyst and one without it) provides a sufficient amount of a sample from both lines for further analysis; thanks to that the results are more accurate compared to serial arrangement
- Wide range and high accuracy of the flow rate adjustment
- Measurement of the humidity downstream the tritium capture (only certain models)
- Remote checking and control from the host system
- Proportional sampling relative to flow in the ventilation stack enables calculation of the amount of released ^3H and ^{14}C (optional)

Description

The equipment is designed for installation on a wall or other suitable structure. It is controlled using buttons on the control panel. On the graphic display, it is possible to read the total amount of sieved air, current flow rate through the sampling lines, time of operation and all monitored values, such as temperature, pressure, and humidity in the line, and the temperature of the catalyst (for models with a catalyst).

The air flow may be constant, or it may be adjusted proportionally to the value present at the equipment control input (typically to the flow through the ventilation system, from which the sample is being extracted). It is adjustable in each sampling line separately. The set flow rate influences the duration of the sampling campaign. The flow through the individual lines may be limited by the parameters of the sorbent, and by the catalyst filling. The pump is microprocessor-controlled, which enables high accuracy of flow rate adjustment (contrary to flow control with the help of a throttle valve).

It is possible to set alarm levels for the measured values and the equipment signals exceeded limits.

V3H14C includes a serial communication interface that enables checking the equipment status, reading of measured values, and remote controlling of the equipment using a PC from the host system. Software for remote checking and control is delivered as an optional accessory.

The equipment may be optionally equipped with an external cyclic archive LDL-01, enabling local storage of measured values and status messages. The saved values may be transferred to the host system using the RS-485 interface.



Assembled bottle array
for silica gel

Basic sorption media are **silica gel** (amorphous silica) for capturing ^3H and **sodium hydroxide** (NaOH) for capturing ^{14}C . These media enable reliable operation even in case of longer exposition at high sample humidity. (When requiring the use of another sorbent, contact the manufacturer, please.) When using silica gel with an indicator (addition of CoCl_2), capturing of humidity is indicated by progressive change of its colour.

The sorbents are filled into glass sampling bottles and the bottles are screwed into the holder in the laboratory; for safety reasons only assembled bottle arrays are handled at the sampler's location. During normal operation, the sorbent should be normally exchanged on a weekly basis.



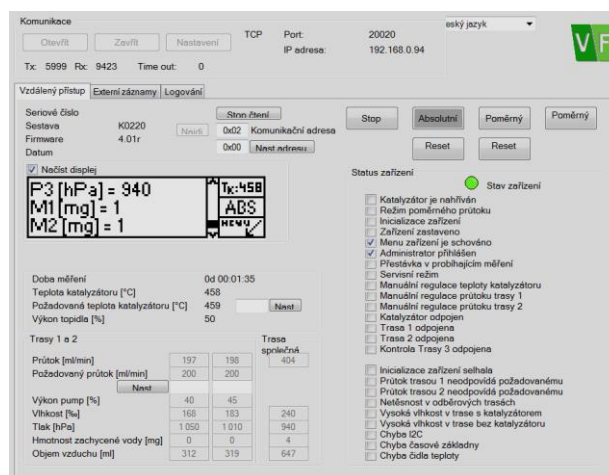
Assembled bottle array
for NaOH solution

Fully equipped **model V3H24C includes two lines** for the extraction of samples. In the common intake section, there is an aerosol filter, a flow meter, and meters of pressure, temperature and relative humidity. The first line includes a pump, a catalyst upstream the bottles with sorbents, sampling bottles with silica gel, a mass flow meter and sensors of pressure, temperature and relative humidity, an overflow trap bottle and the sampling bottles with NaOH. The second line is analogous, but does not include the catalyst. Within one extraction line, ^3H extraction precedes the ^{14}C extraction, and the sorption medium of ^{14}C is thus protected against humidity. Downstream the ^3H extraction, and upstream the ^{14}C extraction the humidity is measured, which enables the check of the efficiency of the extraction of water by silica gel. In the output section, there is a common output aerosol filter. It is possible to install a condensation vessel outside the equipment for draining condensate from the line behind the equipment.

The first line is equipped with heated platinum catalyst, the second one is not. Thanks to this arrangement, contrary to equipment with both lines (without and with a catalyst) in serial arrangement, sufficient amount of sample downstream/behind the catalyst is assured, and the activity uncertainty is thus lower. The catalyst temperature is adjustable in a broad range with high accuracy and is permanently measured and checked.



Control panel



PC screen of the V3H14C remote control

Description



Model V3Ha
(³H extraction in the form of H₂O, compact version)

The **V3H14Ca model with a single line without catalyst** is designed for capturing ³H and ¹⁴C, exclusively in the basic form of H₂O and CO₂.

Other modifications include equipment for **independent tritium or carbon sampling: The models V3H and V14C** enable sampling of ³H or ¹⁴C in two lines (they have a line with a catalyst), compact versions **V3Ha and V14Ca** enable independent sampling of ³H or ¹⁴C in one line (without catalyst).

An overview of all available versions is presented in the table on the last page.



Model V3H
(³H extraction, two extraction lines, possibility to expand to V3H14C)

Specification

Flow rate through one sampling channel, adjustable	50 ÷ 500 ml/min
Uncertainty of measured flow rate	max. ±5 %, usually ±1 %
Volume of sampling bottles in one bottle array	3 x 250 ml
Sorbents – silica gel – sodium hydroxide	fraction 3 ÷ 6 mm (grain size), 3 x 170 g (dry) in one bottle array solution, concentration 3 mol/l, max. 3 x 200 ml in one bottle array
Collection efficiency	95 % ±5 % collection H ₂ O in silica gel 99 % ±1 % collection CO ₂ in NaOH
Sorption capacity in one sampling bottle array (maximum, declared for specified efficiency)	30 g for Silica gel 18.5 g for NaOH
Minimum detectable concentration *	approx. 0.01 Bq/m ³
Volume of overflow trap bottle (for models with NaOH)	500 ml
Catalyst temperature, adjustable	250 ÷ 550 °C, pre-set to 460 °C (860 °F)
Power supply	100 ÷ 240 V AC
Power consumption – models with catalyst – models without catalyst	max. 140 W max. 25 W
Operation temperature range	+5 ÷ 40 °C
Dimensions (W x H x D) – V3H14C – V3Ha, V14Ca (compact version)	600 x 800 x 250 mm (24 x 31½ x 10 in) 300 x 400 x 200 mm (12 x 15¾ x 8 in)
Weight – V3H14C – V3Ha, V14Ca (compact version)	45 kg (99 lb) 13 kg (29 lb)
Electric protection	IP 31
Display	graphic, 120 x 32 dots
Communication interface	RS-485 / RS-232
Sampled air Temperature	+5 ÷ 40 °C (+41 ÷ 104 °F)
Sampled air Pressure	96 ÷ 106 kPa (720 ÷ 795 mmHg)
Sampled air Relative Humidity	max. 80%, non cond.

* Equipment of the "V3H14C" series only collects samples; the samples are analysed in the laboratory. The above mentioned values are based on ordinary laboratory LSC analysers (liquid scintillation counters), they correspond to performed tests, and are well proven in practice in nuclear power plants.

Standards and Certification

- **Type Approval Certificate** TCM 441/02-3773 issued by the Czech Metrology Institute
- **Electromagnetic compatibility (EMC)** in accordance with EN 55022, EN 61000-6-2, EN 61326-1
- **2004/2/EURATOM** Commission Recommendation on radioactive discharges into the environment

Models and Accessories

Model	Description
K0220-02	V3H14C, two sampling lines, one with catalyst, for ^3H a ^{14}C
K0220-00	V3H14Ca, one sampling line without catalyst, for ^3H a ^{14}C
K0221-02	V3H, two sampling lines, one with catalyst, for ^3H
K0221-00	V3Ha, one sampling line without catalyst, for ^3H , standard model allowing for expansion to V3H or V3H14C
K0221-01	V3Ha, one sampling line without catalyst, for ^3H , compact model, expansion not possible
K0222-02	V14C, two sampling lines, one with catalyst, for ^{14}C
K0222-00	V14Ca, one sampling line without catalyst, for ^{14}C , standard model allowing for expansion to V14C or V3H14C
K0222-01	V14Ca, sampling line without catalyst, for ^{14}C , compact model, expansion not possible
Optional Accessories	
S1302-01	Software application for remote control
K0220-91	LDL-01 Local Data Logger for V3H14C
K0220-52	KN-250 external condensation vessel (to be installed on line behind V3H14C)
K0220-92	Outdoor box for V3H14C
K0220-83	Transport box for sampling bottles in the holders
Consumables and Spare Parts	
K0220-72	Holder with sampling bottles for silica gel
K0220-73	Holder with sampling bottles for NaOH
-	A set of consumable parts for 1 year operation of V3H14C
Related Products	
K0223	DJ-500 Desorption Unit
K0518	OTK-01 Tritium Condensation Sampler



Sampling into NaOH solution



Insertion of the holder with sampling bottles with silica gel



DJ-500 Desorption Unit



www.vf.eu

Contact Address

Your supplier

Czech Republic

VF, a.s., Svitavská 588
CZ 679 21 Černá Hora
tel. +420 516 428 611
fax +420 516 428 610
info@vf.cz

Slovak Republic

VF, s.r.o., M. R. Štefánika 9
SK 010 02 Žilina
tel. +421 415 072 411
fax +421 415 072 410
info@vf.sk