Prep and Load Platform

COMBI-*xt*

The GC / GC-MS sample injector which grows with your needs

Environmental
Foods/Beverages
Consumer Products
Forensics
Petrochemicals/Polymers
Pharmaceuticals

PAL SYSTEM

Prep and Load Platform

Content

To learn more about the unique PAL Series of GC/GC-MS sample injection systems or any of our LC/LC-MS sample handling systems contact your PAL System distributor.

PAL COMBI-*xt*

Prep and Load Platform

Liquid Injection - Static Headspace –SPME – ITEX Extraction combined in one single instrument

PAL COMBI-***xt*** fits on any GC workstation

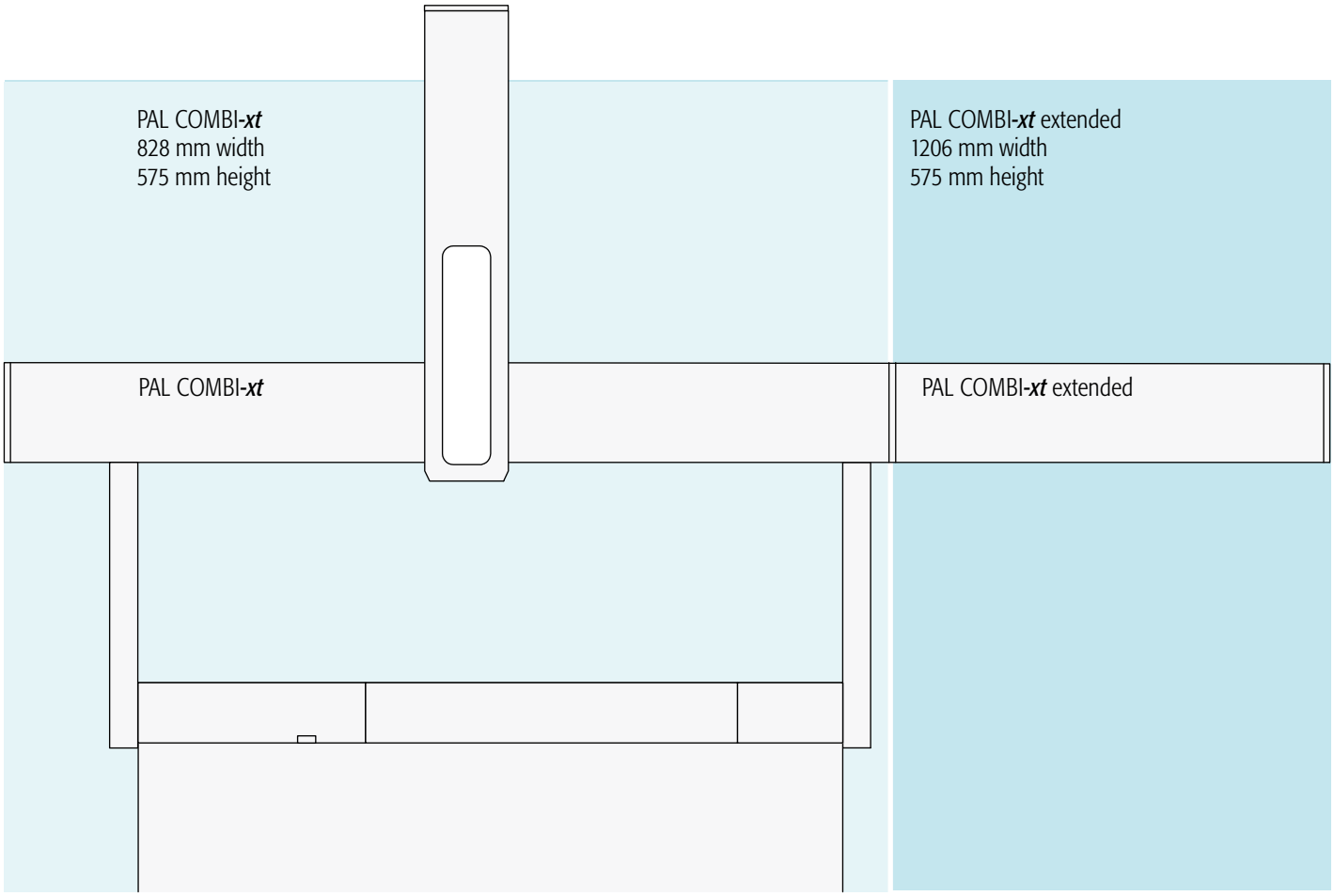
Top mounted on GC's saves valuable bench space

Interfaces with any major GC/GC-MS System

Ultrahigh sample capacity with extended X-axis of 120cm

CTC Analytic's objective is to supply instruments to customers which make chromatography sample processing simple and transparent. In line with today's laboratory equipment, requirements for speed, flexibility and precision, we have enhanced the already proven reliability and productivity of our GC Headspace and Liquid Injection Systems. The PAL COMBI-***xt*** is the only GC sample injection system that combines liquid, large volume, headspace, SPME and ITEX injection in one single instrument. This unique capability allows quick switching from one application to another on the same GC workstation. Regardless if your samples may be processed in headspace, liquid or SPME mode, or if method requires split/splitless or on-column injection, your new instrument setup is ready in a few minutes. The PAL COMBI-***xt*** provides powerful working capabilities, an investment you can grow with.

	PAL COMBI-***xt***	PAL COMBI-***xt*** extended
Dimensions	Width: 828mm Depth: 385mm Height: 575mm	Width: 1206mm Depth: 385mm Height: 575mm
Liquid injection	included	included
PAL Headspace Option	yes	yes
PAL SPME Option	yes	yes
PAL ITEX-2 Option	yes	yes
PAL MHE Option	yes	yes
PAL Dilutor Option	yes	yes
Flow Cell Option	yes	yes
Injection Volume	0.1µl – 5000µl	0.1µl – 5000µl
Sample Capacitiy*	up to 600 1ml micro vials 294 2ml vials 96 10ml/20ml vials 8 MT /DW plates (96/348 well) (* depends on GC model)	up to 1400 1ml micro vials 686 2ml vials 224 10ml/20ml vials 24 MT /DW plates (96/348 well) (* depends on GC model)
Sample Capacity Thermostatted	up to 600 1ml micro vials 294 2ml vials ** 96 10/20 ml vials ** 4 MT /DW plates (96 /348 well) (** Liquid Cooler only)	up to 600 1ml micro vials 294 2ml vials 96 10/20 ml vials 8 MT /DW plates (96/348 well)



PAL COMBI-*xt*

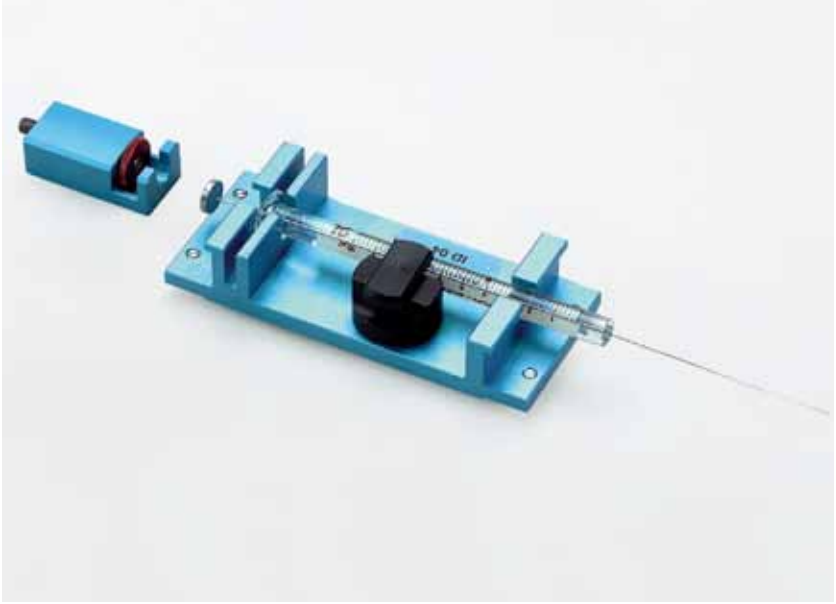
Liquid mode

Prep and Load Platform

- Every single injection step is individually controlled through PAL-***xt*** advanced software package
- Liquid injection volume up to 500µl for LVI applications
- Nanoliter injection mode
- Fast injection cycle time

Start with Liquid mode

In liquid injection mode, every single injection step, e.g. fill/inject speed, pre- and post injection delay times, pre- and post syringe cleaning, variable needle penetration depths, or standard addition is individually controlled through the PAL COMBI-***xt***'s advanced software package. LVI (Large Volume Injection) allows to inject samples up to 500µl in a single stroke without the usual degradation in chromatographic performance. The capability to inject larger volumes, eliminates the need to concentrate a sample through evaporation. This can translate into substantial time savings. For low volume samples the fast injection speed minimizes needle discrimination and reduces background interferences which means better results with less rework. The fast injection cycle time together with the nanoliter injection mode fits perfectly into the field of fast GC applications.



Liquid Syringe Kit

PAL COMBI-***xt*** equipped with Stacks for MT / DW plates

Specifications

Syringe sizes:

1.2µl	(0.1µl-1.2µl)
5µl	(0.5µl-5.0µl)
10µl	(1µl - 10µl)
25µl	(2.5µl - 25µl)
100µl	(10µl - 100µl)
250µl	(25µl - 250µl)
500µl	(50µl - 500µl)

Injection speed:
Selectable from 0.01µl/sec. up to 250µl/sec.

Sample capacity:

up to	600	1ml micro vials
	294	2ml standard vials
	96	10ml or 20ml vials
	4	deepwell microplates
	6	standard microplates

Syringe cleaning:
Wash Station for 2 different solvents and 1 standard liquid

Solvent reservoirs for Dilutions / Derivatisations

PAL COMBI-*xt*

Headspace Option

Prep and Load Platform

Eliminates dead volume and adsorption effect in sample loops and transfer lines

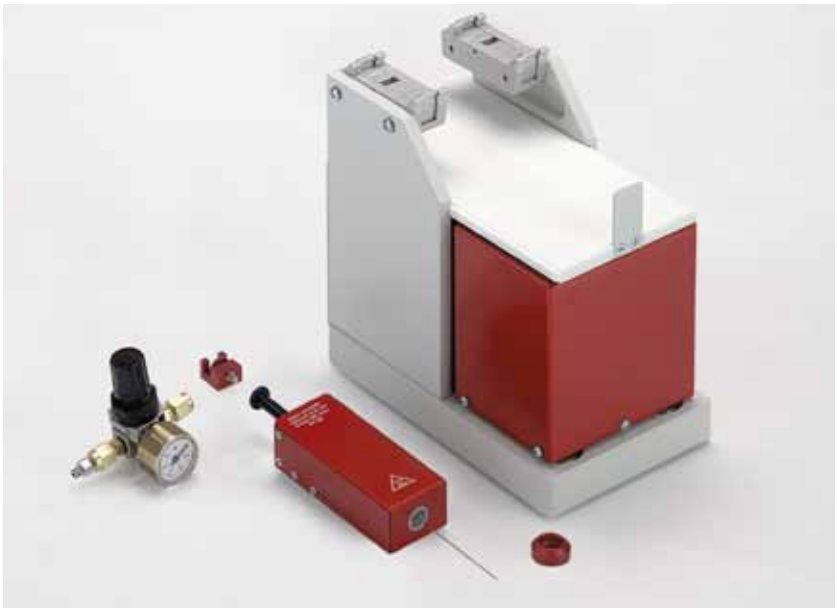
Permits adjustable sample volumes without sample loop changes

No sample dilution due to vial pressurization

Upgrade to Headspace mode

With the syringe only concept of the PAL COMBI-***xt*** a headspace technology has been introduced to eliminate the headaches commonly associated with conventional Autosamplers. The robotic vial processing operation allows sample analysis in a straightforward and systematic way. Sample vials are transported into the heated six position incubator for preconditioning. After reaching the equilibration, a heated gas-tight syringe is moved over the incubator and the headspace sample is withdrawn. After sample injection the hot syringe is automatically cleaned by purging with inert gas. No complicated error prone operations e.g. vial pressurization, valve switching, loop filling or heated transfer lines are involved. For maximum throughput, the intelligently controlled vial transfer into the incubator oven ensures that a sample is always ready to be injected when the previous run is completed.

Beside the simple and transparent sample operation the PAL COMBI-***xt*** offers even more advantages over conventional headspace sampling.



Headspace Upgrade Kit

PAL COMBI-***xt*** equipped with Tray Cooler (liquid version)

PAL COMBI-***xt*** equipped with Barcode Reader

Specifications in headspace mode

Syringe sizes:
1.0ml (0.1ml-1.0ml)
2.5ml (0.25ml-2.5ml)
5.0ml (0.5ml-5.0ml)

Injection speed:
Selectable from 0.01µl/sec. up to 5ml/sec.

Sample capacity:
up to 294 2ml standard vials
96 10ml or 20ml vials

Syringe cleaning:
Inert gas purging of heated syringe

Heated syringe:
+5°C above ambient - 150°C selectable in 1°C increments

Incubator oven:
6 heated vial positions for 2ml/10ml/20ml vials

Incubation temperature:
+5°C above ambient -200°C in 1°C increments

Agitation:
Interval shaking 250rpm-750rpm
Selectable in 1rpm increments

Incubation time:
Up to 999 minutes selectable in 1 second increments

PAL COMBI-*xt*

SPME Option

Prep and Load Platform

Forensic, food/flavor and pharmaceuticals compounds, characterization of environmental

Variable vial penetration for different types of sample extractions

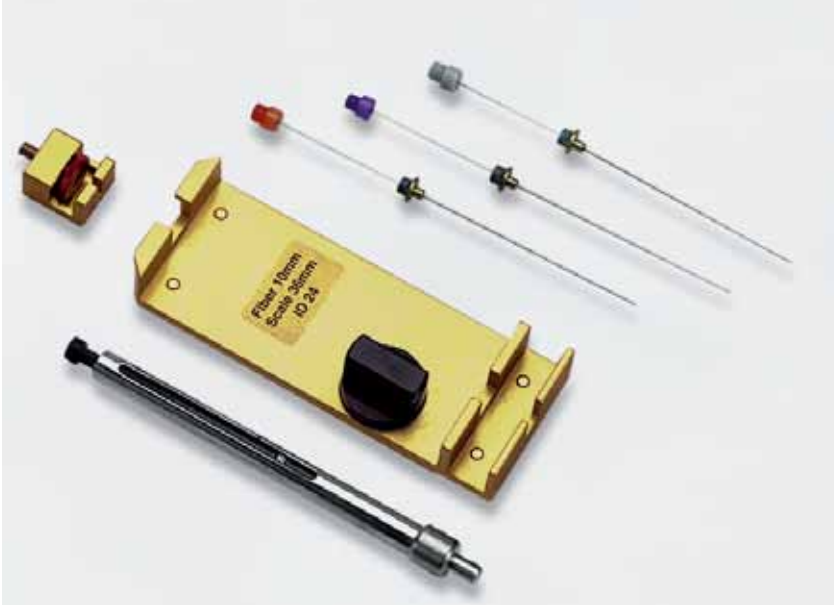
Sample shaking and heating prior/during extraction – reduction of analysis time

Upgrade to SPME mode

In the few years since it's introduction, solid phase microextraction(SPME*) has become a practical alternative for sample preparation for gaschromatography. SPME reduces the time required for sample preparation and eliminates the use of large volumes of extraction solvents. In SPME, analytes establish an equilibria among the sample matrix, the headspace above the sample and a stationary phase coated on a fused silica fiber. The adsorbed compounds are thermally desorbed from the fiber to a capillary GC column. Because no solvent is injected and the analytes are rapidly desorbed onto the column, minimum detection limits are improved and resolution is maintained. SPME is useful in many different analysis, including characterization of environmental, forensic, food/flavor and pharmaceutical compounds.

The PAL COMBI-***xt*** provides a fully automated SPME sample preparation process. All movements of the SPME fiber from precondition, adsorption and desorption are precisely controlled for optimum performance. Prior and during extraction the samples can be shaked and heated, which dramatically reduces analysis time for semivolatile compounds. Variable vial penetration depth allows to extract the compounds in liquid samples itself or in the headspace area above liquid/solid samples. After the compounds are thermally desorbed in the hot GC injector, the fiber may be fully cleaned again in a special heated and purged Fiber Conditioning Station.

*Solid Phase Microextraction (SPME) Technology licensed exclusively to Supelco Inc.



SPME Option Upgrade Kit

Specifications in SPME mode

SPME fiber holder for standard SPME fibers. Variable vial penetration depth for headspace or liquid extraction.
Samples can be agitated and / or heated during extraction

Sample capacity:
up to 294 2ml standard vials
96 10ml or 20ml vials

Fiber cleaning:
Optional fiber cleaning station
+5°C above ambient - 350°C, inert gas purging

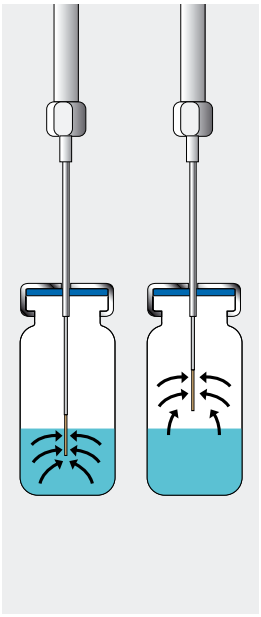
Incubator oven:
6 heated vial positions for 2ml/10ml/20ml vials

Incubation temperature:
+5°C above ambient -200°C selectable in 1°C increments

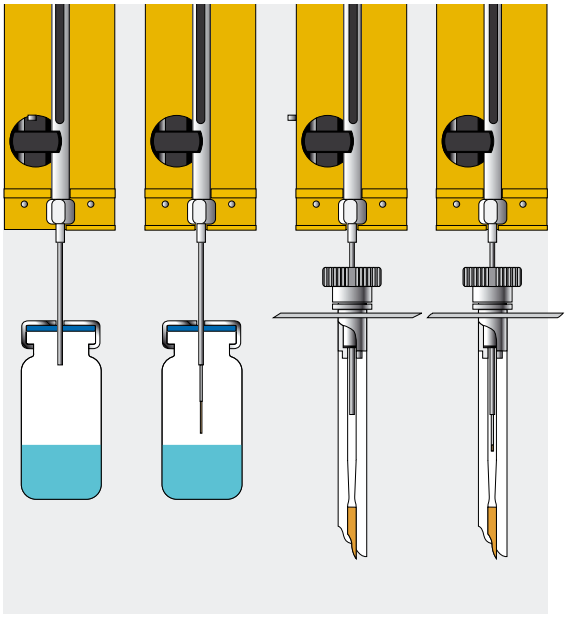
Agitation:
Interval shaking 250rpm-750rpm
Selectable in 1rpm increments prior extraction

Extraction time:
Up to 999 minutes selectable in 1 second increments

*Solid Phase Microextraction (SPME) Technology licensed exclusively to Supelco Inc. US patent #5,691,206 European patent #0523092



Variable vial penetration for different types of sample extractions



Fiber adsorption / desorption process

SPME Fiber cleaning and conditioning station

PAL COMBI-*xt*

ITEX-2 Option

Prep and Load Platform

Get P&T sensitivity without the cost of a P&T System

Rapid & efficient sample enrichment of volatile & semi-volatile compounds in solid, liquid and gaseous samples

In-tube extraction and direct thermal desorption using proven industry standard adsorbents

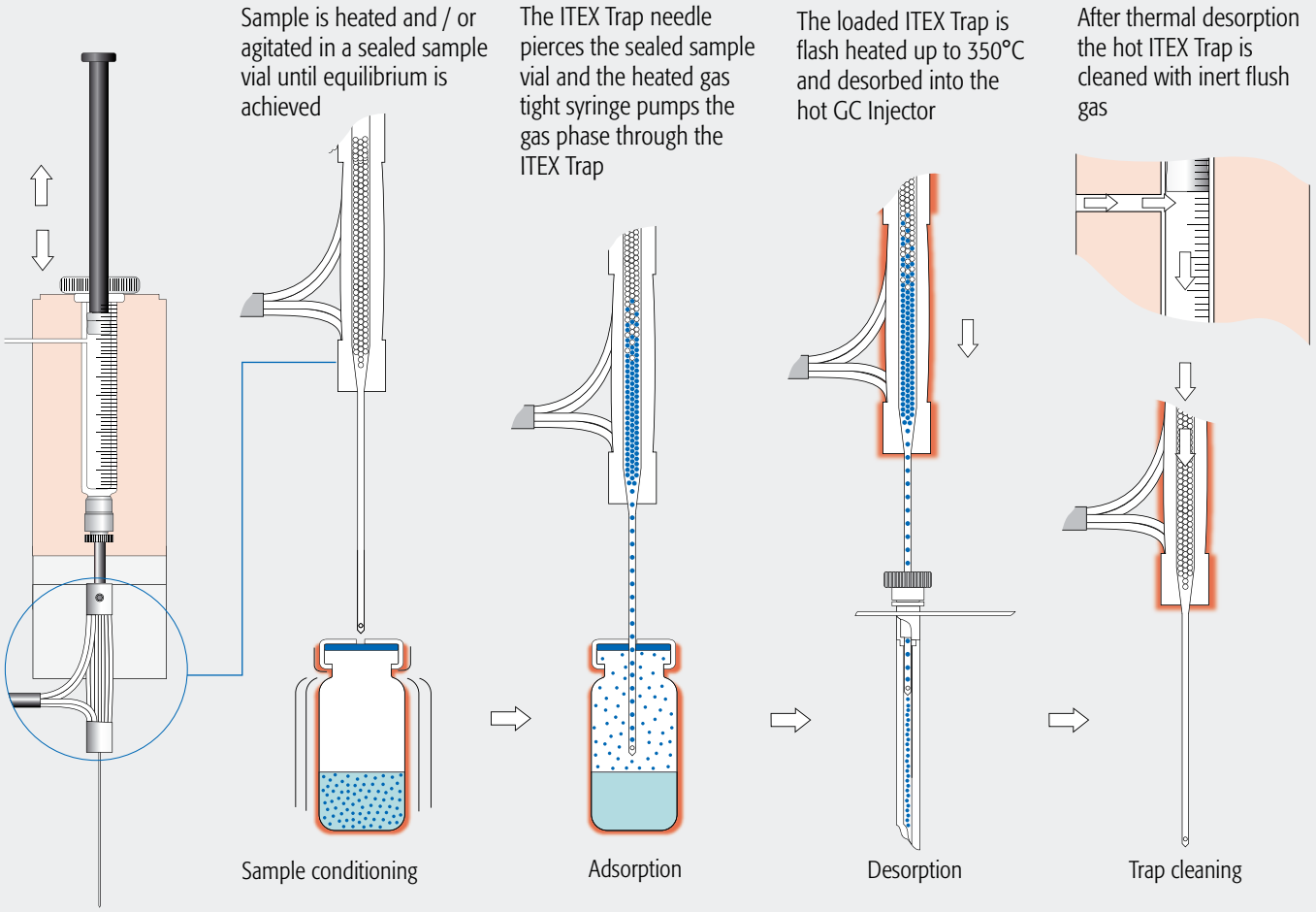
Syringe only concept for transparent sample handling, no sample loops, no transfer lines, no switching valves

Upgrade to ITEX-2 mode

CTC Analytic's objective is to supply instruments to customers which make the operation of sample processing simple and transparent. In-line with todays lab requirements for productivity, CTC expanded the application range of it's GC Injector System PAL COMBI-***xt*** introducing the ITEX-2 Option. The ITEX-2 Option consists of an add-on module which can be used with any existing or new PAL COMBI-***xt*** System. It performs enrichment of volatile or semi-volatile compounds during headspace analysis.
A microtrap filled with adsorbent material, such as Tenax or activated charcoal is placed between the heated PAL COMBI-***xt*** Headspace syringe and the syringe needle. Using the HS syringe as a pump, a part of the gaseous phase of the pre-conditioned sample vial is pumped repeatedly through the microtrap. This system setup allows rapid, simple and efficient extraction of volatile and semi-volatile sample compounds. To gain sensitivity simply the number of pumping strokes can be increased or several different vials containing the same sample can be extracted. During thermal desorption into the GC Injector the microtrap is rapidly flash heated and the analytes reach the GC column as a narrow band. No cryofocussing is needed to obtain sharp peaks. To prepare the next extraction, the hot trap is re-conditioned outside the injector with clean purge gas.

To learn more about the unique PAL ITEX-2 download the special PAL ITEX-2 Option brochure.

ITEX-2 Sample Extraction Procedure



Specifications ITEX-2 Option

Pumping Syringe Size: 1.3ml HD syringe with removable trap

ITEX-2 Trap: Stainless steel material, deacitvated by Siltek®:
Needle: Injection Needle gauge 23, Point style 5 (side hole)
Standard Trap Material: 44mg Tenax TA 80/100 mesh

Extraction Speed: selectable from 10µl/sec up to 1000µl/sec

Extraction Strokes: Selectable from 1 - 999

Extraction Volume: Selectable from 130µl - 1300µl/stroke

Desorption Temperature:
+5°C above ambient - 350°C selectable in 1°C increments

Heating-up rate: up to 12°C/s

Desorption Speed: 1µl/sec. - 500µl/sec.

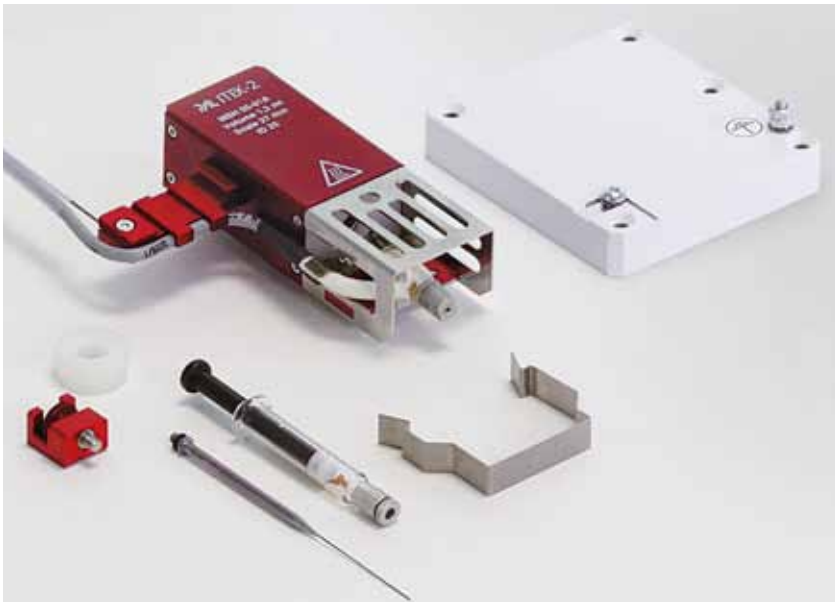
Pumping Syringe and Trap Cleaning:
Inert gas purging, 30sec. - 3600min.

Heated Pumping Syringe:
+5°C above ambient - 150°C selectable in 1°C increments

Incubator Oven:
6 heated vial positions for 2ml / 10ml / 20ml vials
+5°C above ambient - 200°C selectable in 1°C increments

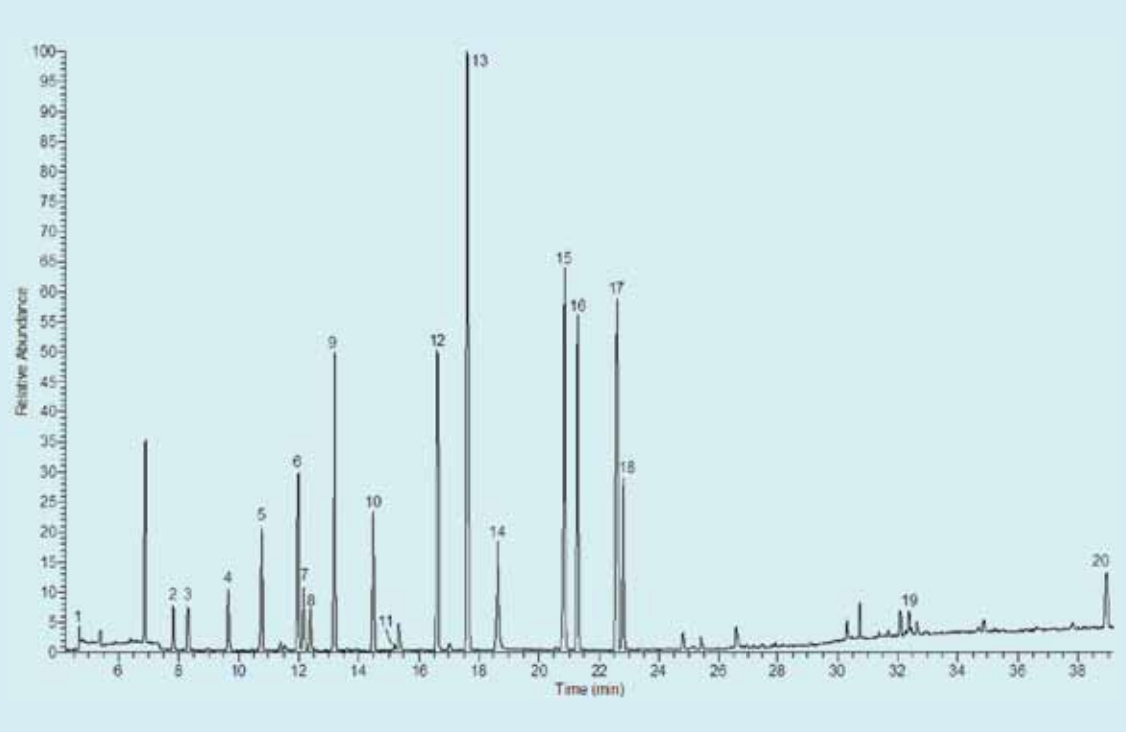
Agitation:
Interval shaking 250rpm - 750rpm, selectable in 1rpm increments

Incubation Time: Up to 999 minutes selectable in 1 second increments



ITEX-2 Option Upgrade Kit

ITEX ppt sensitivity for volatile or semi-volatile compounds



Example chromatogram in scan mode (m/z 49-180) at 1µg L-1. Target compounds: 1) vinylchloride, 2) dichloromethane, 3) methyl tert-butyl ether, 4) ethyl tert-butyl ether, 5) chloroform, 6) benzene, 7) tert-amyl methyl ether, 8) 1,2-dichloroethane, 9) trichloroethylene, 10) bromodichloromethane, 11) 1,4-dioxane, 12) toluene, 13) tetrachloroethylene, 14) dibromochloromethane, 15) ethylbenzene, 16) p-xylene, 17) o-xylene, 18) tribromomethane, 19) 2-methylisoborneol, 20) geosmin

Comparison of ITEX-2 with Purge & Trap

	ITEX-2					Purge & Trap	
Compound	MDL [ng L-1]	Linear range* [ng L-1]	R	Average RSD [%]	Recovery Y [%]	MDL [ng L-1]	RSD [%]
Vinylchloride	8	20-2000	0.999	5	103	82	
Dichloromethane	11	20-2000	0.999	5	97	13	6.22
MTBE	4	20-2000	0.999	6	88	404 / 13	
ETBE	0.8	5-2000	0.998	7	94	93	
Chloroform	4	5-2000	0.999	5	99	82	
Benzene	1.2	2-2000	0.999	5	89	23	
TAME	1.3	5-2000	0.999	6	95	133	
1,2-Dichloroethane	2	5-2000	0.999	5	97		
Trichloroethylene	1	5-2000	0.999	5	95	32	5.32
Bromodichloromethane	0.8	1-2000	0.999	6	97	72	5.22
1,4-Dioxane	70	100-2000	0.998	9	59		
Toluene	5	10-2000	0.998	7	96	13	
Tetrachloroethylene	1	2-2000	0.999	6	97	42	7.32
Dibromochlormethane	5	10-2000	0.999	6	98	12	4.12
Ethylbenzene	2	10-2000	0.999	9	93	13	
p-Xylene	4	10-2000	0.999	9	117	13	
o-Xylene	5	20-2000	0.999	7	90	23	
Tribromomethane	1.5	2-2000	0.999	6	94		
2-Methylisoborneol	33	100-2000	0.999	5	94		
Geosmin	57	100-2000	0.999	5	88		

* maximum investigated concentration 2000 ng L-1
Method detection limits (MDL) according to EPA method1 and corresponding linear ranges, compared to Purge & Trap methods
Author Application note: Jens Laaks, Maik A. Jochmann and Torsten C. Schmidt University Duisburg-Essen, Instrumental Analytical Chemistry

PAL COMBI-*xt*

MHE Option

Prep and Load Platform

MHE Syringe principle

Upgrade to Multiple Headspace Extraction mode (MHE)

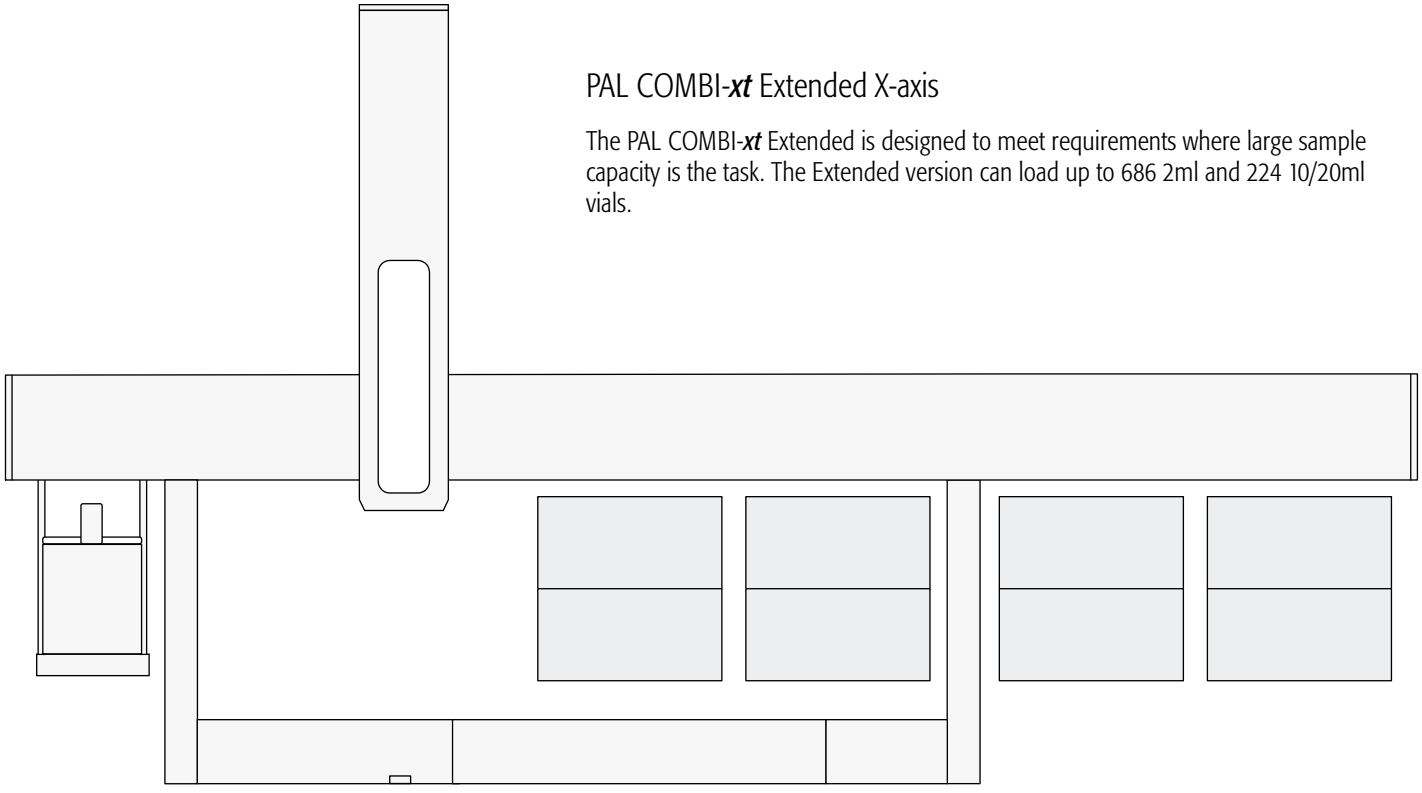
The PAL Multiple Headspace Extraction (MHE) Option is a new add-on module to extend the headspace mode of the PAL System COMBI-***xt*** Autosampler. In classical headspace technique one sampling is done per vial. The quantitative determination can be inaccurate in the presence of interfering matrices or in cases where a calibration standard cannot be made with the exact same matrix composition. The MHE option consists of a venting tool combined with a Park Station. The MHE technique requires a series of sampling cycles using the same vial. First, a sample is pressurized to a specific pressure. The vial is then sampled and vented. The vial is re-pressurized and sampled again. This process is repeated multiple times to obtain final results.

PAL COMBI-*xt* *Extended*

Prep and Load Platform

PAL COMBI-*xt* Extended X-axis

The PAL COMBI-*xt* Extended is designed to meet requirements where large sample capacity is the task. The Extended version can load up to 686 2ml and 224 10/20ml vials.



PAL COMBI-*xt* Options and Accessories

PAL Dilutor
The PAL Dilutor can be used to dispense liquid prior sample injection. This combines the "add liquid" and "inject" steps without user intervention or syringe change. Typical applications are dilutions, derivatisations, sample spiking or standard additions. Dilutor syringes up to 10ml are available to achieve large dilution ratios. The PAL Dilutor can be controlled by the Cycle Composer software.

Dilutor

PAL FlowCell
The PAL FlowCell can be used to monitor online processes such as chemical reactions, fermentation processes, waste or drinking water lines or gas streams by chromatography.

The Cell consists of a stainless steel body with 2pcs. 1/4 inch Swagelok connectors. The PAL instrument aspirates the sample through a PTFE coated septum which is located on top of the Flow Cell. The sampling intervals may be triggered by external signals or the Cycle Composer time table function. The FlowCell accessories can also be used to spike a liquid or gas stream at certain time intervals with a reagent or standard. A special maintenance port at the bottom ensures easy access to the inside of the Cell for maintenance.

Flow cell

Peltier Stack Cooler
Peltier cooled stack for storage of 2 standard/deepwell microplates (96/348 wells) or of 108 2 ml vials at 4°C to 40°C.

Stack Cooler 2 DW Peltier Version

PAL COMBI-*xt* General Specifications

System Type
XYZ robot with syringe only concept, no tubing in sample path

Local User Interface
Control panel with 4 function keys, graphical LCD display, unique scroll knob for teach functions

Remote Control
Cycle Composer control software Windows 2000 / XP
Third party instrument drivers for all major GC/GC-MS Systems

Maintenance
Accessibility to all maintenance parts from front
Preventative maintenance kits available

Electrical Control
1x RS232 / 1x LAN (with optional PAL-*xt* Electronics)
2x Opto Coupler Input
3x TTL Input, 2x Relay Output

Power Requirements
100-240V, 120W, 50/60Hz

Environment
4°C - 40°C constant temperature, < 80% humidity (non condensing)

Weight
~ 10kg (without accessories)

Dimension
Length 828mm Depth 385mm Height 575mm
Extended version: Length 1206mm, Depth 385mm, Height 575mm

Electrical Safety Standards
CAN/CSA C22.2 No. 61010-1 / ANSI/UL 61010-1 / EN 61010-1

GC Mounting Kits
Agilent Technologies 5890 / 6850 / 6890 | 7890 /5975T
Bruker GC 436, 451
Dani Master GC
GL Sciences GC 353 / 393 / 4000
Perkin Elmer Autosystem XL / Clarus 400 / Clarus 500 / Clarus 600
Shimadzu GC 14 / 17A / 2010 / 2014
Thermo Scientific GC 8000Top / TRACE GC / Focus GC
Varian GC 3400 / 3600 / 3800 / 3900 / 430 / 450

Instrument Options :
PAL Headspace Option (requires PAL COMBI or PAL COMBI-*xt* Liquid mode including HS Option)
PAL SPME Option (requires PAL COMBI or PAL COMBI-*xt* Liquid mode including HS Option)
PAL SPME Fiber Cleaning Station
PAL ITEX-2 Option
PAL Dilutor Option
PAL MHE Option
Thermostatted Trayholders for 1ml/2ml/10ml/20ml
Vials Barcode Reader (for common industry standard bar code symbols)
Sample stacks for standard or deepwell microplates (96/348 well)
Solvent/Reagent Reservoir
Large Volume Wash Station

Specifications are subject to change without notice

CTC Analytics
Where design meets performance

CTC Analytics AG
Switzerland
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www.palsystem.com

Distributed by:

- The PAL-*xt* Systems can be controlled by most of today's Chromatography Data Systems from all the major instrument manufacturers
- Superior accuracy and reproducibility combined with optimum injection flexibility
- Temperature controlled sample storage from 4°C up to 70°C
- Get P&T sensitivity without the cost of a P&T System
- Liquid Injection - Static Headspace - SPME -ITEX Extraction in one single instrument
- Rapid & efficient sample enrichment of volatile & semi-volatile compounds in solid, liquid and gaseous samples

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