



PROMOCHROM
TECHNOLOGIES



Sample Preparation Solutions for Trace Analysis

VivaCe™ Duo

2-Channel | 30 Sample SPE system

For high efficiency and throughput solid phase extraction of small food and biological samples, as well as clean up of environmental extracts.



Proudly Canadian and supporting the local industry

Products designed, built and tested at our Richmond and Surrey locations

ABOUT PROMOCHROM

PromoChrom Technologies focuses on the development of sample preparation solutions for trace analysis. Our highly versatile systems have helped customers automate even the most challenging sample extraction processes.

Since **2005**, PromoChrom has developed the SPE-01 and SPE-03 cleanup stations, SPE-04 online/offline SPE's, LC-04 online SPE, RT-01 sample purifier and SPE-06 mini-SPE. Each of the instruments targeted specific applications

In **2017**, "Two-tier online SPE" was invented by PromoChrom which uses a second SPE column for online SPE. This method significantly increased the detection sensitivity and mitigated column compatibility and clogging issues commonly found in online SPE systems

By **2019**, the SPE-03 is widely used by government and commercial labs for PFAS extraction following EPA, DOD, ISO, modified and other proprietary methods. To expand production, a new office location was opened in Richmond

In **2011**, the **flow-path-integration technique** was patented for multi-channel liquid handling. It combines various switching valves into one liquid handling module. This simplified our instruments considerably, making them more cost-effective and reliable

In **2018**, the MOD-004 **sample bottle rinsing** function and MOD-005 **minimal-Teflon** option were added to fully automate PFAS extraction in drinking water

In **2020**, we transitioned to remote installation support which allowed greater focus on R&D. This led to exciting new features such as MOD-00P **Volume-Matrix Plus** option for large volume surface/waste water samples, **integrated sample bottle resonators** for MOD-004 and inline sample filters for samples with particulates

Today, we continue to seek new breakthroughs in laboratory process automation

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- two-channel parallel operation
- positive pressure system
- minimal-Teflon option
- 0.5 - 30mL sample loading
- sample vial rinsing
- sample Back-Draw
- SPE cartridge conditioning/washing/elution
- SPE cartridge blockage detection
- nitrogen dry
- air purge
- programmable wait
- needle wash
- 2 fractions per sample
- 2 waste channels
- 1/3/6 mL SPE cartridges
- 5" touch interface
- up to 100 methods
- customizable

Vivace (Quick and Lively) **Duo** (Two-Channel)

A dedicated workhorse for small samples such as food extract, biological fluids (plasma/serum/urine/cell lysate) and environmental extracts (soil/solid/tissue). It can swiftly process up to 30 samples, two at a time, allowing a day's worth of extraction to be offloaded.

Up to **4 Different Methods** can be applied in each run for different sample requirements or method development. Edit and store up to 100 methods using the touch interface.

Built-in **Sample Vial Rinsing** achieves maximum recovery for compounds with adsorption to sample vials.

The **Back-Draw** feature eliminates analyte contact with the syringe pump to minimize carry over and improves recovery of compounds that are difficult to elute.



Working Principle

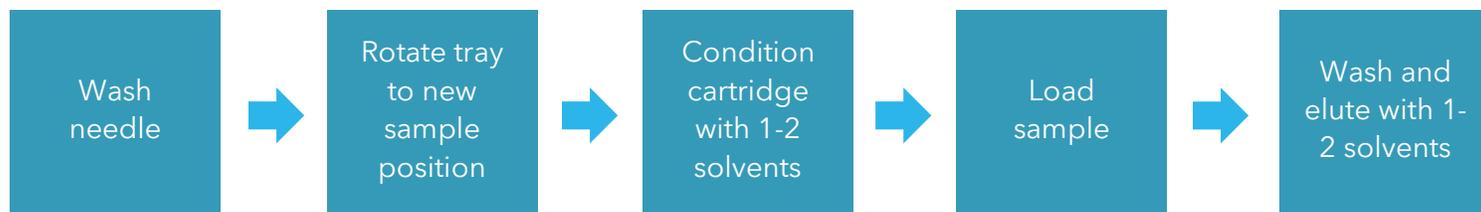
Simple and robust design

Up to 30 sample/fraction vials and SPE cartridges can be loaded onto the circular tray. The needle head controls 2 sets of needles for samples/fractions and a set of plungers that form a seal around the SPE cartridges to deliver fluid via positive pressure.

Sample and fraction vials can hold up to 15mL of liquid each. They can be used interchangeably to double the sample and fraction capacity. Choose from Sample 1 or 2 and Fraction 1 or 2 when designing your method.

The system uses two uniquely designed multi-channel valves to perform all typical SPE procedures and other flexible operations such as sample/fraction vial rinsing, sample Back-Draw and directing samples to two separate waste channels either through or bypassing the SPE cartridges.

Typical Extraction Procedure



FEATURES

Versatile and Easy to Use

■ 2-Channel System

The Vivace™ Duo can run two samples simultaneously, saving significant time when extracting large batches of food and biological samples as well as environmental extracts.

■ Simple User Interface

The Vivace Duo comes with a 5-inch touch controller that can store and edit up to 100 different methods. There is no need for an external computer.



■ Sample and Fraction Containers

The Vivace™ Duo is compatible with 16 x 100 mm or smaller glass or plastic sample vials. Sample and fraction containers can be used interchangeably to double the sample and fraction volumes.

■ Automated Needle Wash

Using the “Needle Wash” action, the system automatically performs cleaning of the inside and outside of sampling needles on the washing station.

■ Cartridge Blockage Detection

The system can detect the blockage of SPE cartridges and reduce the flow rate accordingly. If blockage continues, an alarm will sound and the instrument will pause for the user to step in.

■ Sample Container Rinsing

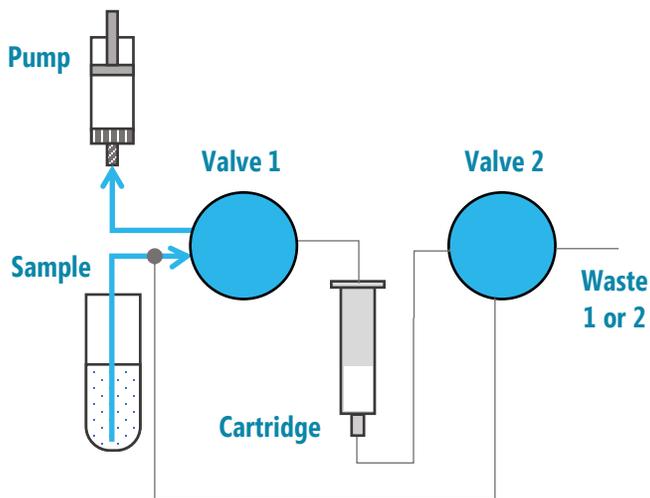
The integrated sample lines feature rinse ports that allow rinsing of sample and fraction vials with desired solvents. This enables analytes to be washed off container walls and sampling needles



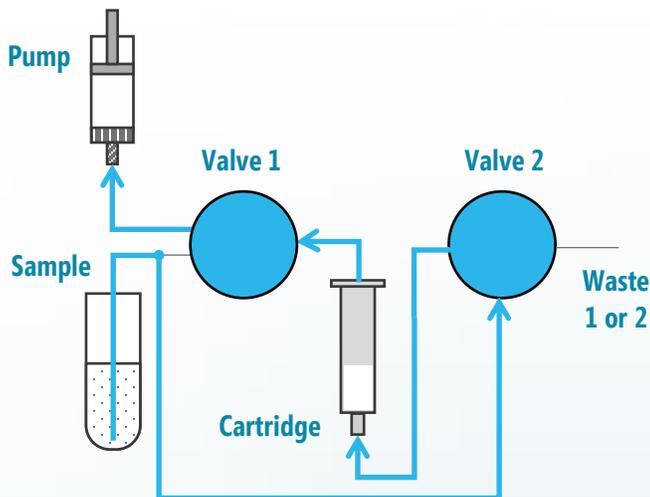
■ Sample Back-Draw Feature

Using the innovative valve technology, samples can be drawn directly into the SPE cartridge using the "Back Draw" action which bypasses the syringe pump.

Under normal sample loading, the pump draws sample directly through valve 1 and pushes it through the SPE cartridge.



Using the Back-Draw feature, analytes are first trapped by the SPE cartridge, eliminating carry over.



Back-Draw is recommended for use with PromoChrom's specialized SPE cartridges designed for bottom loading. These cartridges have a narrower particle size distribution and frits that are more tolerant to clogging.

■ Nitrogen Drying

Nitrogen drying of sorbent material can be programmed into the methods. This step can be time-controlled or until the user wishes to resume.

■ Dedicated Methods

If required, samples can be divided into 4 groups to run, each with its own individual method. This provides flexibility for method development or running different types of samples.

MOD-005

Minimal -Teflon Option

Non-PTFE solvent and sample tubing

A widely tested and proven solution for applications that are sensitive to Teflon (such as PFCs and PFAS in drinking water). Request MOD-005 when ordering.



APPLICATION EXAMPLE

ANALYSIS OF PATENT BLUE V IN WATER

Patent blue V is a food color additive. It can be extracted from water using a C18 SPE cartridge and analyzed by HPLC with a UV detector. This compound is used to demonstrate the operation and performance of Vivace™ Duo solid phase extraction system.

Materials and Methods

Preparation of Standard Solutions and Spiked Samples

A stock standard solution with concentration of 10 mg/mL was obtained by dissolving 100 mg of patent blue V with 10 mL methanol. It was diluted to 10 µg/mL with water to make a working standard solution for spiking samples and HPLC analysis. Spiked samples for SPE with concentration of 2 µg/mL was obtained by further dilution of the working standard solution with water.

Solid Phase Extraction Procedures

Two types of PromoChrom SPE cartridges were used in this experiment.

1. 500mg/6mL C18 Cartridge (Part # 18-050-06C)
2. 200mg/6mL C18 Cartridge (Part # 18-020-06CB) optimized for back-drawing samples from the bottom inlet. It utilizes a narrower particle size distribution and a frit that is more tolerant to blockage.

Two solid phase extraction methods were used, one for each type of SPE cartridge. The first method loads sample from the top of cartridge (herewith referred to as normal method). The other method loads sample from the bottom of the cartridge (herewith referred to as Back-Draw method). For each method, 4 samples (2 pairs) were run to check recovery and repeatability.

Procedures of Normal Method

Solvent 1 = methanol, Solvent 2 = water

Sample volume = 12.5 mL placed in sample 1 position.

SPE cartridges = 500 mg/6 mL C18

Processing time for a pair of samples is 17 minutes.



| Action | Inlet | Target | Flow | Volume | Remarks |
|-------------|-----------|------------|------|--------|-----------------------------------------------------------------------------------------------------------------------|
| Wash Needle | Solvent 1 | Waste 2 | 10 | 6.0 | <i>Clean sampling needles with methanol</i> |
| Elute | Solvent 1 | Waste 2 | 5 | 5.0 | <i>Condition cartridges with methanol</i> |
| Elute | Solvent 2 | Waste 1 | 10 | 5.0 | <i>Condition cartridges with water</i> |
| Add Sample | Sample 1 | Waste 1 | 10 | 15 | <i>Ensure all 12.5 mL of samples are loaded</i> |
| Rinse | Solvent 2 | Sample 1 | 35 | 5.0 | <i>Rinse sample containers with water</i> |
| Add Sample | Sample 1 | Waste 1 | 10 | 15 | <i>Transfer rinsate to cartridges. Extra 10 mL is for air purging cartridges.</i> |
| Rinse | Solvent 1 | Sample 1 | 35 | 2.6 | <i>Rinse sample containers with methanol</i> |
| Collect | Sample 1 | Fraction 2 | 5 | 5.0 | <i>These 3 steps produce a 5.0 mL fraction consisting of methanol and water (1:1). It is ready for HPLC analysis.</i> |
| Collect | Solvent 2 | Fraction 2 | 10 | 2.5 | |
| Air Purge | Air | Fraction 2 | 15 | 5.0 | |

Procedures of Back-Draw method

Solvent 1 = methanol, Solvent 2 = water

Sample volume = 12.5 mL placed in sample 2 position

SPE cartridges = 200 mg/6 mL C18 optimized for Back-Draw

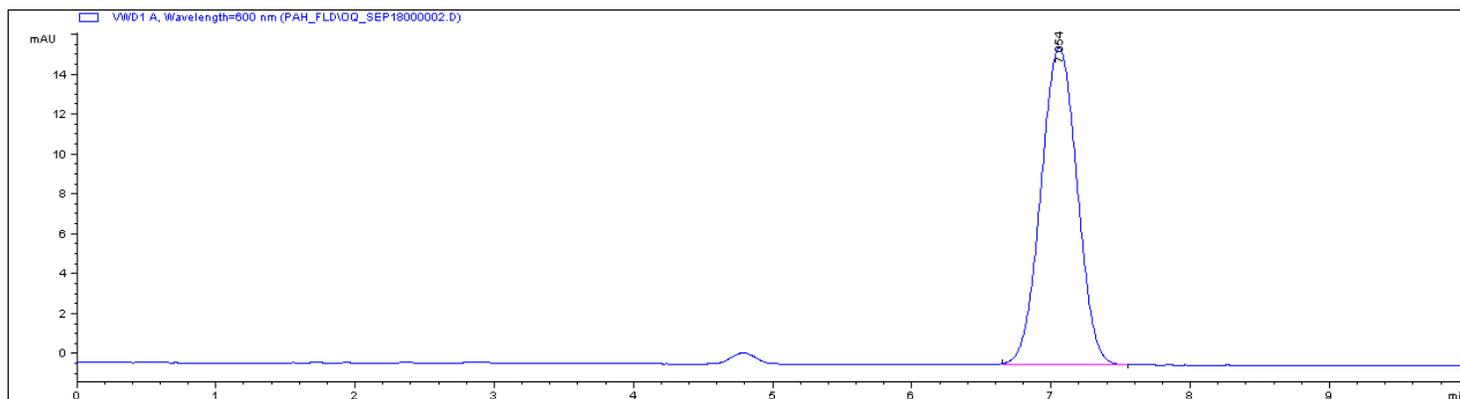
Back-Draw flow rate is set as 10 mL/min. Processing time for a pair of samples is 17.5 minutes.

| Action | Inlet | Target | Flow | Volume | Remarks |
|-------------|-----------|--------------|------|--------|-----------------------------------------------------------------------------------------------------------------------|
| Wash Needle | Solvent 1 | Waste 2 | 10 | 6.0 | <i>Clean sampling needles with methanol</i> |
| Elute | Solvent 1 | Waste 2 | 5 | 5.0 | <i>Condition cartridges with methanol</i> |
| Elute | Solvent 2 | Waste 1 | 10 | 5.0 | <i>Condition cartridges with water</i> |
| Back Draw | Sample 2 | Waste 1(dir) | 40 | 20 | <i>Sample volume is 12.5 mL. Extra 7.5 mL is to ensure complete transfer of sample</i> |
| Rinse | Solvent 2 | Sample 2 | 35 | 5.0 | <i>Rinse sample containers with water</i> |
| Back Draw | Sample 2 | Waste 1(dir) | 40 | 10 | <i>Back-Draw rinsate to cartridges</i> |
| Air Purge | Air | Waste 1 | 10 | 10.0 | <i>10 mL air to purge cartridges.</i> |
| Rinse | Solvent 1 | Sample 2 | 35 | 2.6 | <i>Rinse sample containers with methanol</i> |
| Collect | Sample 2 | Fraction 1 | 5 | 5.0 | <i>These 3 steps produce a 5.0 mL fraction consisting of methanol and water (1:1). It is ready for HPLC analysis.</i> |
| Collect | Solvent 2 | Fraction 1 | 10 | 2.5 | |
| Air Purge | Air | Fraction 1 | 15 | 5.0 | |

HPLC Analysis

Conditions for HPLC Analysis

An Agilent 1100 HPLC with a G1312A binary pump and a G1314A UV-Vis detector was used for the analysis. The mobile phase is methanol + water (50:50). Flow rate is 1.2 mL/min. Column is AQ-C18 4.6 x 200 mm from PromoChrom. Detection wavelength is 600 nm. Injection volume is 20 μ L. The detection limit for patent blue V is 5 ng/mL. Below is a typical chromatogram using a 4 μ g/mL standard solution in methanol + water (50:50).



Recovery and Repeatability

Four spiked samples were extracted using the normal method and another 4 spiked samples were extracted using the Back-Draw method. The collected fractions were analyzed by HPLC. Below are the recovery results.

| | Sample 1 | Sample 2 | Sample 3 | Sample 4 | %RSD |
|-------------------------|----------|----------|----------|----------|------|
| Normal Method | 100.9% | 101.9% | 95.4% | 100.2% | 2.9% |
| Back-Draw Method | 96.4% | 99.4% | 97.5% | 98.0% | 1.3% |

The Back-Draw method can be very useful for two situations: 1) When the analytes or sample matrix tend to stick inside the pump syringes; 2) When the analytes are difficult to elute from the SPE cartridges. This experiment indicates that the Back-Draw method can produce comparable results as the normal method.

Evaluation of Cross Contamination

To evaluate carry over contamination from one sample pair to another, a pair of blank water samples were extracted immediately after a pair of spiked samples using the normal method, without additional cleaning steps in between.

When the spiked sample is at 2 μ g/mL level, there was no detection of patent blue in the blank samples (below the detection limit of 5 ng/mL). To quantify the cross contamination, the spiking level was increased to 30 μ g/mL. The carry over was determined as 0.02%. (6 ng/mL). The carry over may be further reduced when necessary by increasing the solvent volume for needle wash or optimizing other elution parameters.

Vivace™ Duo

| | |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| No. of Samples | 30, 2-Channel |
| No. of fractions | 1 (2 if using fractions 1 and 2) |
| No. of waste channels | 2 |
| No. of solvents | 6 |
| Sample volume | 0.5 - 15 mL (30 mL if using samples 1 and 2) |
| Fraction volume | 0.2 - 15 mL (30 mL if using fractions 1 and 2) |
| SPE cartridge size | 1/3/6 mL (specify when ordering) |
| Flow rate | 0.5 - 65 mL/min |
| Fluid delivery | Positive pressure |
| Display | 5" resistive touch |
| No. of methods | 100 |
| Method actions | Cartridge pre-condition /soak/wash, add sample, Back-Draw, elution, sample vial rinsing, needle wash, air purge, solvent mixing, nitrogen dry, pause |
| Dimensions | 35 cm x 43 cm x 35.5 cm |
| Weight | 13 kg |
| Power | 1.5 A @ 24 VDC |

Customizations

MOD-005 Minimal-Teflon Option

Replaces all PTFE solvent and sample lines

SPE Cartridge sizes

System includes one tray, specify SPE cartridge size when ordering. Other tray sizes:

S04-R-1 for 1 mL SPE Cartridge

S04-R-3 for 3 mL SPE Cartridge

S04-R-6 for 6 mL SPE Cartridge

ORDERING INFO

| Part No. | Description |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vivace Duo | 2-Channel high throughput Vivace Duo system, one rotating tray, 24V power supply, touch screen stylus pen, solvent bottle adapters, waste tubing and user manual |
| S04-R-1 | Rotating tray for 1mL SPE cartridge size |
| S04-R-3 | Rotating tray for 3mL SPE cartridge size |
| S04-R-6 | Rotating tray for 6mL SPE cartridge size |
| MOD-005 | Minimal-Teflon option for PFAS applications |



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