

## Centri 360

### Specification sheet

**Centri 360 is a highly versatile sample extraction and enrichment platform for GC(-MS) analysis of VOCs and SVOCs. Compatible with solid, liquid and gas samples, Centri 360 offers complete automation of several sampling modes for comprehensive sample characterisation.**



#### 1. System features

- **Flexible sample extraction** from a variety of sample matrices using a range of dedicated sampling tools:
  - HiSorb™ high-capacity sorptive extraction.
  - SPME Arrow and SPME Arrow-trap.
  - SPME and SPME-trap.
  - Headspace (HS) and HS-trap.
  - Thermal desorption.
- **Electrically cooled, cryogen-free focusing trap** enables analysis of compounds over a wide volatility range, including reactive and labile species:
  - Simultaneous analysis of VVOCs, VOCs and SVOCs.
  - Quantitative recovery of labile compounds.
  - Quantitative recovery of high-boiling compounds up to n-C<sub>44</sub>.
- **Sample stacking and enrichment:** Combine multiple tube samples and/or vial extractions onto the focusing trap prior to injection to the GC.
- **Automated tool change option** enables optimum unattended sequencing of several modes *within* the following two categories:
  - HS, HS-trap, SPME, SPME-trap, SPME Arrow, SPME Arrow-trap and tube desorption can be sequenced without user intervention.
  - HiSorb sorptive extraction and tube desorption can also be sequenced without user intervention.
- **Inert, uniformly heated flow-path** ensures complete recovery of analytes throughout the analytical system.
- **Direct sampling from vial** with HS, HS-trap, and SPME Arrow, SPME Arrow-trap using Centri methods only.
- **Sealing of tubes** with DiffLok™ caps prevents entry of contaminants into, and loss of volatiles from, the tubes before, during and after analysis.
- **Supports PAL3 standard and custom scripts**, allowing flexible sequencing with Centri methods, including liquid handling for addition of internal standard and derivatising agent. Liquid injection and PAL3 scripts, such as HS, SPME and SPME Arrow, can now be performed directly to the GC inlet (160 cm rail only).
- **Splitless, single- and double-splitting options** ensure compatibility with samples over a wide concentration range (ppt to percent).
- **Automated quantitative re-collection** (with TD50 module) of trap desorption split flow, to allow repeat analysis from any injection/extraction mode.
- **Trap heating rates** up to 100°C/s and backflush desorption combine to facilitate splitless operation at flows  $\geq 2$  mL/min, thus maximising sensitivity.
- **Pre-purge of air to vent** and selective elimination of water and solvents minimise analytical interference.

- **Internal standard** (optional accessory) allows introduction of 1 mL of gas-phase standard onto the focusing trap *via* loop (in all modes) or onto the sampling end of a sorbent tube (in the TD50 module).
- **Overlap capability:** Intelligent optimisation of sample management, allowing for the extraction and enrichment/desorption of a subsequent sample while a previous sample is being analysed. The system is also able to simultaneously extract multiple sample vials while a previous sample is being analysed ('prep-ahead'), optimising productivity further.
- **Extended standby mode** reduces instrument power consumption when not in use.
- **Intelligent diagnostics** for automated system self-checking, including valve operation and leak isolation.
- **Interface to GC** *via* direct coupling to the analytical column enables simple connection to all leading commercial GC(-MS) systems.
- **Supports PAL3 smart consumables** allowing for easy changeover, traceability and maintenance counters.

## 2. System options

- All Centri 360 extraction and enrichment modes are available as modular upgrade options. These include:
  - **HiSorb high-capacity sorptive extraction module:**
    - Includes HiSorb tool, probe storage modules and probe wash station.
    - Accommodates short- and standard-length stainless steel and inert-coated HiSorb probes.
    - Fully automated headspace and immersive sorptive extraction using robust probes supporting 30–65 µL of poly(dimethylsiloxane) (PDMS) sorptive phase. (Multiple-phase combinations available.)
    - Ability to wash and dry probes prior to desorption ensures removal of residual matrices, especially after immersive extraction.
    - Multiple extractions from the same vial (or multiple vials) onto the focusing trap for sample enrichment prior to a single GC injection.

### - **SPME Arrow and SPME Arrow-trap module:**

- Includes SPME Arrow tool, compatible with Centri injection methods. This tool can also be used for standard SPME Arrow methods with injection *via* GC inlet when using 160 cm rail (requires GC-specific inlet adaptation kit).
- SPME Arrow diameters of 1.1 mm and 1.5 mm.
- Multiple extractions (SPME Arrow-trap only) from the same vial (or multiple vials) onto the focusing trap for sample enrichment prior to a single GC injection.

### - **SPME and SPME-trap module:**

- Includes SPME tool, compatible with Centri injection methods. This tool can also be used for standard SPME methods with injection *via* GC inlet when using 160 cm rail.
- SPME fiber lengths of 10 mm or 20 mm.
- Multiple extractions (SPME-trap only) from the same vial (or multiple vials) onto the focusing trap for sample enrichment prior to a single GC injection.

### - **HS and HS-trap module:**

- Includes choice of 1 mL, 2.5 mL and 5 mL HS tools, compatible with Centri injection methods with injection volumes ranging from 0.1–5 mL. These tools can also be used for standard HS methods with injection *via* GC inlet when using 160 cm rail.
- Syringe temperature: 40°C–150°C, settable in 1°C increments.
- Syringe flush with inert gas flow through X-Y-Z rail.
- Multiple extractions (HS-trap only) from the same vial (or multiple vials) onto the focusing trap for sample enrichment prior to a single GC injection.

### - **TD50 module:**

- Capacity for 50 TD tubes, offering unattended thermal desorption and automated re-collection of outlet split flows from all Centri modes.
- Industry-standard-sized 3½" tubes: Stainless steel, inert-coated stainless steel and glass.

- Multiple tube samples can be desorbed to the focusing trap for enrichment (stacking) prior to a single GC injection.
- **Liquid handling and/or injection** via GC inlet (GC inlet injection with 160 cm rail only).
  - Dedicated tools, 57 mm or 85 mm syringe needle lengths.
  - Available syringe sizes ranging from 1.2 µL to 10,000 µL.
- Centri 360 is available with any combination of the above modules pre-configured at manufacturing, or as future upgrade paths.
- Supported tray types:
  - Tray holder.
  - Tray plate.
  - Liquid-cooled tray holder and sample tray.
  - Peltier stack 2DW and 6DW (PAL3 Scripts only, 6DW for 160 cm rail only).

### 3. System controls

#### 3.1 Control software

- **Markes Instrument Control (MIC)** allows:
    - Automated, unattended sequencing of the various extraction and injection modes.
- N.B. A minor modification to the inlet is required when changing between HS/SPME/SPME Arrow modes and HiSorb. User intervention is therefore required when changing between these modes.
- Addition and/or skipping of active sequences.
  - Overlap: Extraction or desorption of a subsequent sample while a previous sample is still running.
  - ‘Prep-ahead’: Simultaneous extraction of multiple subsequent samples while a previous sample is still running.
  - Sample enrichment: Multiple extractions from a single vial can be loaded onto the focusing trap before injection to the GC column.
  - Sample stacking: Combining separate sample vial extractions or tube desorptions onto the focusing trap before GC injection.
  - Rapid set-up of all sampling modes from pre-loaded ‘Template Methods’.

- Pre-loading of an internal standard onto a tube or trap (with ISDP accessory).
- Preventative maintenance feedback with usage counter indicates when parts could be replaced to avoid instrument downtime.
- Export of sequence history to .csv file.
- Set-up in English, Chinese or Japanese language.
- **TOF-DS™/ChromSpace®** allows complete control of the workflow, from Centri automated sample extraction and enrichment to BenchTOF™ data acquisition and processing (English language only).

### 4. System specifications

#### 4.1 Centri 360 inlet

- Operating temperature:
  - Range: 50°C to 400°C.
  - Settable in 1°C increments.
  - Maximum temperature limited to 300°C for HiSorb methods.

#### 4.2 Centri 360 integrated sample agitator

- Six positions for standard 10/20 mL headspace vials.
- Required for use with Centri methods.
- Agitation speed:
  - Range: 100–600 rpm.
  - Settable in 1 rpm increments.
- Incubation temperature:
  - Range: From 30°C (or ambient temperature + 10°C, whichever is higher) to 200°C.
  - Settable in 1°C increments.

#### 4.3 PAL3 agitator module

- Six positions for standard 10/20 mL vials.
- Required for use with PAL3 standard and custom scripts.
- Agitation speed:
  - Range: 250–750 rpm.
  - Settable in 1 rpm increments.
- Incubation temperature:
  - Range: From 30°C to 200°C.
  - Settable in 1°C increments.

#### 4.4 PAL3 Heatex Stirrer (necessary for SPME Arrow)

- Powerful mixing and heating.
- Temperature range: 30–150°C.
- Stirring speed up to 1600 rpm.
- Optimised for 20 mL vials (specific inserts required to accommodate 10 mL vials, U-CENTRI-S2-HTXINS10).

#### 4.5 Focusing trap

- Quartz focusing trap:
  - 2 mm i.d. (where packed) and 0.9 mm i.d. at the sample input/output end.
  - Easy to maintain: Collar at non-sampling end makes trap easy to change.
  - Central 60 mm packed with up to four sorbents.
- Backflush desorption ensures quantitative retention and release of compounds across a wide volatility range.
- Trap low temperature:
  - Range: –30°C to 50°C.
  - Settable in 1°C increments.
  - Uniform electrical cooling applied over full length of sorbent bed.
- Trap desorption:
  - Default setting is ballistic heating, which reaches rates of 100°C/s during the first critical stages of secondary (trap) desorption.
  - Alternatively, programmed trap heating rates from 1°C/s to 40°C/s can be selected.
- Trap high temperature:
  - Range: 35°C to 425°C.
  - Settable in 1°C increments.
  - Uniform heating applied over full length of sorbent bed.
  - Temperature limits are user-settable within the stated range.
- Hold time at trap high temperature:
  - Range: 0.1–60 min.
  - Settable in 0.1 min increments.

#### 4.6 Sample flow path

- Temperature range:
  - Valves: 50°C to 210°C.
  - Transfer line: 50°C to 250°C.
  - Both settable in 1°C increments.
  - Temperature limits are user-settable within the stated range.
- Constructed entirely of inert materials: PTFE, quartz, inert-coated stainless steel and uncoated, deactivated fused silica.

#### 4.7 Pneumatics

- Centri 360 requires:
  - A pressure-controlled 0–60 psig (0–415 kPa) supply of helium or nitrogen carrier gas under manual or electronic control.
  - A pressurised supply of dry air or nitrogen (dew point below –50°C) at 50–60 psig (340–415 kPa). The dry gas is used for pneumatic actuation of the heated/switch valve, Centri 360 wash station, Centri 360 agitator and for purging the focusing trap box.

N.B. Helium cannot be used as the dry gas supply.

- Electronic mass flow control is settable between 2–500 mL/min (helium) and 2–250 mL/min (nitrogen).
- Carrier gas and dry air or nitrogen pressure control is regulated by the pneumatic control accessory (U-GAS01) included in the shipping kit.

#### 4.8 Gas consumption

- Dry air or nitrogen:
  - Average consumption: ~150 mL/min.
  - Peak consumption: 9 L/min, during HiSorb probe drying (45 s duration).
- Carrier gas consumption: Method-dependent (typically 5–200 mL/min).

#### 4.9 System checks and controls

- Leak testing is available in all operating modes to safeguard sample integrity.
- The system diagnostics mode assesses Centri 360 for leaks and correct valve operation.

#### 4.10 Sample splitting/re-collection

- Centri 360 offers a number of sample splitting options, dependent on the sampling mode.
- The inlet split re-collection (when available) is always manual.
- In all cases, when a TD50 tube module is fitted, it is possible to automatically re-collect the outlet (trap desorption) split flow onto a clean sorbent tube, and then automatically analyse it.
- Splitting options for HiSorb sorptive extraction:
  - During primary (probe) desorption only (inlet split).
  - During secondary (trap) desorption only (outlet split).
  - During both desorption stages (double-splitting).
  - Splitless analysis.
- Splitting options for SPME-trap and SPME Arrow-trap:
  - During primary (fiber/Arrow) desorption only (inlet split).
  - During secondary (trap) desorption only (outlet split).
  - During both desorption stages (double-splitting).
  - Splitless analysis.
- Splitting options for HS-trap:
  - During secondary (trap) desorption only (outlet split).
  - Splitless analysis.
- Splitting options for direct HS/SPME/SPME Arrow (Centri methods only):
  - During direct injection/desorption to the GC via Centri inlet injection (inlet split) only.
- Splitting options for TD50 tube operation:
  - During primary (tube) desorption only (inlet split).
  - During secondary (trap) desorption only (outlet split).
  - During both desorption stages (double-splitting).
  - Splitless analysis.
- The split flows can be turned on or off during system standby and at any stage during pre-purge.
- Split and desorb flows are controlled electronically using mass flow controllers

(2–500 mL/min (helium) and 2–250 mL/min (nitrogen)), which allow split ratios from 0 to 125,000 : 1 to be used with standard capillary columns.

- The split vent line contains a charcoal filter in front of the control valves (and MFC) to prevent contamination of the valves/MFC and laboratory atmosphere. The charcoal filter is connected to the main heated valve via a short, inert, heated flow path.

#### 4.11 Dimensions and weight

##### With 80 cm rail

- Width (including legs): 620 mm (24.4").
- Width of robot: 855 mm (33.7").
- Height (not including robot): 610 mm (24.0").
- Height (including robot): 1285 mm (50.6").
- Depth: 610 mm (24.0").

N.B. Allow an additional  $\geq 200$  mm space between back of the equipment and wall to dissipate hot air and to connect all necessary plumbing..

The robotic arm will require an additional 190 mm overhang space behind the base unit (1000 mm total). Inclusion of a Peltier stack attached to the rail would require an additional 100 mm overhang space behind the base unit (1100 mm total).

- Weight:
  - Centri 360 base unit: 57 kg (126 lb).
  - Rail: 23 kg (51 lb) depending on module configuration.

##### With 160 cm rail

- Width (including legs): 620 mm (24.4").
- Width of robot: 1630 mm (64.2").
- Height (not including robot): 610 mm (24.0").
- Height (including robot): 1230 mm (48.4").
- Depth: 610 mm (24.0").

N.B. Allow an additional  $\geq 200$  mm space between back of the equipment and wall to dissipate hot air and to connect all necessary plumbing.

The robotic arm will require an additional 190 mm overhang space behind the base unit (1000



mm total). Inclusion of a Peltier stack attached to the rail would require an additional 100 mm overhang space behind the base unit (1100 mm total).

- Weight:
  - Centri 360 base unit: 57 kg (126 lb).
  - Rail: 23 kg (51 lb) depending on module configuration.

#### 4.12 Ambient operating conditions

- Temperature: 15°C to 30°C.
- Relative humidity: 5–95% RH (non-condensing).

#### 4.13 Power requirements

- 100–240 V, 50/60 Hz, 1900 W (Centri 360 self-adjusts to local voltage input).

#### 4.14 Minimum PC specification

- For system control:
  - CPU: 1 GHz 64-bit dual-core or better.
  - RAM: 4 GB.
  - Hard disk space: 2 GB.
  - Graphics card: DirectX® 9 or later.
  - Display: 1024 × 768 display.
  - Operating system: Windows® 10 64-bit.
  - Other requirements: Windows-compatible keyboard and mouse.
  - Two free USB connections and one free LAN connection for Centri 360 communication with PC.

#### 4.15 GC remote cable connections

- Centri 360 includes a GC interface cable that connects to the 'ready' output and 'start' input of the GC(–MS) and data-handling systems.
- The cable supports automatic start of the entire analytical system when the cold trap desorbs, and allows the system to check the 'ready' status of the analyser and associated data handling.
- The focusing trap will not desorb until it receives a 'ready' signal from the GC(–MS) system.
- A Y-splitter cable and PAL3 GC interface cable are included for the 160 cm rail, enabling PAL3 scripts (injecting *via* GC inlet) and Centri methods (*via* Centri inlet) to be used on one platform.

#### 4.16 Safety and regulatory certification

- The instrument is designed and manufactured under a quality system registered to ISO 9001.
- The instrument complies with the essential requirements of the following applicable European Directives, and carries the CE mark accordingly:
  - Low Voltage Directive 2014/35/EU.
  - EMC Directive 2014/30/EU.
- The instrument conforms to the following product safety standards:
  - IEC 61010-1/EN 61010-1.
  - Canada: CSA C22.2 No.61010-1.
  - USA: ANSI/UL 61010-1.
- The instrument conforms to the following regulation on electromagnetic compatibility (EMC):
  - IEC 61326-1/EN 61326-1.

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