

## Centri 90 (Base unit with robotics)

### Specification sheet

Centri 90 is an automated sample concentration platform, maximising sensitivity for routine GC(-MS) analysis of VOCs and SVOCs. Compatible with solid, liquid and gas samples, Centri 90 combines PAL3 robotic automation with advanced trapping technology, delivering high-throughput analysis with exceptional concentration enhancements for several sampling modes.



### 1. System features

- **Sample extraction** from a variety of sample matrices using a range of dedicated sampling tools:
  - Headspace (HS) and HS-trap.
  - SPME and SPME-trap.
  - SPME Arrow and SPME Arrow-trap.
- When configured, a tube autosampler (optional upgrade to Centri 180 configuration), enables analysis of:
  - Thermal desorption tubes.
  - HiSorb™ high-capacity sorptive extraction probes.
- **Integrated inlet** for injection/desorption of HS, SPME and SPME Arrow samples to the focusing trap. Centri 90 is designed for **dual carrier gas compatibility**. This means:
  - Helium or nitrogen carrier gas **must** be used for analyte injection/desorption to trap, even when hydrogen is used as the carrier for GC(-MS) analysis.
    - If this is the case, a separate pneumatics regulator (U-GAS03) is required for the supply of helium or nitrogen carrier to the inlet, in addition to the U-GAS01-H (used for controlling hydrogen supply) provided with Centri 90.
  - If solely using helium or nitrogen as the GC carrier, an additional U-GAS03 regulator is not required.
- **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 vial extractions onto the focusing trap prior to injection to the GC.
- **Inert, uniformly heated flow-path** ensures complete recovery of analytes throughout the analytical system.
- **Use of automated tool-change robots** allows optimum unattended sequencing of HS, HS-trap, SPME, SPME-trap, SPME Arrow, SPME Arrow-trap and any other robot capability configured.
- **Direct sampling from vials** placed in vial tray with HS-trap and SPME Arrow-trap using Centri 90 methods only.
- **Supports PAL3 standard and custom scripts**, allowing flexible sequencing with Centri 90 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 be performed directly to the GC inlet (80 cm, 120 cm or 160 cm rail only).

- **Splitless, single- and double-splitting options** ensure compatibility with samples over a wide concentration range (ppt to percent).
- **Manual quantitative re-collection of trap** desorption split flow, to allow repeat analysis from any Centri 90 injection mode.  
  
N.B. For repeat analysis, a tube desorption system is required.
- **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 trap-enabled Centri modes.
- **Overlap capability:** Intelligent optimisation of sample management, allows the incubation and injection of a subsequent sample while a previous sample is being analysed. The system can also simultaneously prepare 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 easy changeover, traceability and maintenance counters.
- **PAL3 agitator module** for sampling up to six vials at any one time must be configured to ensure correct operation of Centri 90 methods.

## 2. System options

- Centri 90 supports the following sampling modes (which are also available as modular upgrade options from Markes):

### - HS and HS-trap module

- Includes choice of 1 mL, 2.5 mL and 5 mL HS tools with injection volumes ranging from 0.1–5 mL, compatible with Centri injection methods. These tools can also be used for standard HS methods, with injection *via* GC inlet, using an 80 cm, 120 cm or 160 cm rail.
- Syringe temperature: 40–150°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.

### - 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, using an 80 cm, 120 cm or 160 cm rail.
- SPME fiber lengths 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.
- For SPME applications, use of PAL system certified vials and caps is recommended:
  - Vial 20CV, 20 mL clear glass for headspace. 75.5 × 22.5 mm, DIN-crimp neck.
  - Headspace, SPME fiber and SPME Arrow crimp cap, 20 mm with 8 mm centre hole, silicone/PTFE septa 3.0 mm with thinned centre 1.5 mm.

### - SPME Arrow and SPME Arrow-trap module

- Includes SPME Arrow tool, compatible with Centri injection methods. These tools can also be used for standard SPME Arrow methods with injection *via* GC inlet, using an 80 cm, 120 cm or 160 cm rail (requires a GC-specific inlet adaptation kit).
- SPME Arrow fiber diameters 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.
- **Liquid handling and/or injection** (GC inlet injection with 80 cm, 120 cm or 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.
- **Upgradability of Centri 90** with a 100-position tube autosampler module (Centri 180 configuration) allows thermal desorption:
  - Capacity for 99 TD tubes (1 position for the split filter tube), offering unattended thermal desorption and automated re-collection of outlet split flows from all Centri trap-enabled modes.
  - Industry-standard 3½" tubes: Stainless-steel, inert-coated stainless-steel, and glass.
  - Analysis of HiSorb, high-capacity sorptive extraction probes sampled offline.
    - Accommodates short- and standard-length stainless-steel and inert-coated HiSorb probes.
  - Multiple tube (and HiSorb) samples can be desorbed to the focusing trap for enrichment (stacking) prior to GC injection for a single analysis.
- Centri 90 is available with any combination of the above modules pre-configured at manufacturing, or as future upgrade paths.
- A GC-specific mounting kit will be required for connecting the rail to the GC. Kits are available depending on GC model, and are quoted separately.
- Supported tray types are:
  - Tray holder.
  - Tray plate.
  - Tray cooler (For Series II robotics only with firmware version 3.1.21.1 or higher).
    - Peltier-cooled tray including power supply.
    - Depending on vial type, inserts may be required.

- 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 sampling modes.
  - Addition of new sequence to active sequences.
  - Overlap: Preparation and injection/desorption of a subsequent sample while a previous sample is still running.
  - ‘Prep-ahead’: Simultaneous preparation of multiple subsequent samples while a previous sample is still running.
  - Sample enrichment: Loading of multiple extracts from a single vial onto the focusing trap before injection to the GC column.
  - Sample stacking: Combining separate sample vial extractions onto the focusing trap before GC injection.
  - Rapid set-up of all sampling modes from pre-loaded ‘template methods’.
  - Pre-loading of a gas-phase internal standard onto trap.
  - 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 concentration to BenchTOF™ data acquisition and processing (English language only).

### 4. System specification

#### 4.1 Centri inlet

- Operating temperature:
  - Range: 50°C to 400°C.
  - Settable in 1°C increments.

- Compatible carrier gases:
  - Helium
  - Nitrogen
- Carrier gas regulation requirements:
  - A pressure-controlled 0–60 psig (0–415 kPa) supply of hydrogen, helium or nitrogen carrier gas under manual or electronic control.

N.B. If using hydrogen as the carrier gas for the GC, a secondary pressure controlled carrier gas, either helium or nitrogen, will be required for the Centri inlet operation and a pressure regulator (U-GAS03) also needed in this case.

#### 4.2 PAL3 agitator module

- Six positions for standard 10/20 mL vials.
- Required for use with Centri 90 methods, 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.

#### 4.3 PAL3 Heatex stirrer (necessary for SPME Arrow modes)

- 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-HTXINS10).
- Required for use with Centri 90 methods, PAL3 standard and custom scripts.

#### 4.4 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 60 mm 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.

#### 4.5 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.

#### 4.6 Pneumatics

- Centri 90 requires:
  - A pressure-controlled 0–60 psig (0–415 kPa) supply of hydrogen, helium or nitrogen carrier gas under manual or electronic control.

N.B. If using hydrogen as the carrier gas for the GC, a secondary pressure-controlled carrier gas, either helium or nitrogen, will be required for the Centri inlet operation and a pressure regulator (U-GAS03) also needed in this case.

- A pressurised supply of dry air or nitrogen (dewpoint below  $-50^{\circ}\text{C}$ ) at 50–60 psig (340–415 kPa). The dry gas is used for pneumatic actuation of the heated valve and, if configured, the internal standard accessory rotor valve, and for purging the focusing trap box.

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

- Electronic mass flow control is settable between 2–500 mL/min (helium and hydrogen), and 2–250 mL/min (nitrogen).
- Carrier gas and dry air or nitrogen pressure control is regulated by the hydrogen-approved pneumatic control accessory (U-GAS01-H) included in the shipping kit.
- An additional pneumatic control accessory (U-GAS03) is required for the Centri inlet carrier supply if hydrogen is used as the primary GC carrier gas.

#### 4.7 Gas consumption

- Dry air or nitrogen:
  - Average consumption:  $\sim 150$  mL/min.
- Carrier gas consumption: Method-dependent (typically 5–200 mL/min).

#### 4.8 System checks and controls

- Leak testing is available in all Centri 90 trap-enabled modes to safeguard sample integrity.
- The system diagnostics mode assesses Centri 90 for leaks and correct valve operation.

#### 4.9 Sample splitting/re-collection

- Centri 90 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 tube autosampler 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 (See Centri 180 specification sheet, document number L-0196 (090323-1)).

- Splitting options for HS-trap are:
  - During secondary (trap) desorption only (outlet split).
  - Splitless analysis.
- Splitting options for SPME-trap and SPME Arrow-trap are:
  - During primary (fiber/Arrow) desorption only (inlet split).
  - During secondary (trap) desorption only (outlet split).
  - During both desorption stages (double split).
  - 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 controller accessories (2–500 mL/min (helium and hydrogen) 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.

#### 4.10 Dimensions and weight

##### With 80 cm rail

- Depth: 560 mm (22.1").
- Height (including robot): 1285 mm (50.6")
- Height (not including robot or robot leg): 600 mm (23.6").
- Width: 315 mm (12.4").
- Weight of Centri 90: 40 kg (88.2 lb).
- Rail: 23 kg (51lb) depending on module configuration.

##### With 160 cm rail

- In addition to the Centri 90 unit dimensions and weight above:
- Width of robot: 1630 mm (64.2")
- Weight: 23 kg (51 lb) depending on module configuration.

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 (all widths) will require an additional 190 mm overhang space behind the base unit (950 mm total depth). Inclusion of a Peltier stack attached to the rail would require an additional 100 mm overhang space behind the base unit (1050 mm total depth).

#### 4.11 Ambient operating conditions

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

#### 4.12 Power requirements

- 100–240 V, 50/60 Hz, 1900 W (Centri 90 self-adjusts to local voltage input).

#### 4.13 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 90 communication with PC.

#### 4.14 GC remote cable connections

- Centri 90 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 focusing 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 in the mounting kits, enabling both

PAL3 scripts (injecting *via* GC inlet) and Centri methods (*via* Centri inlet) to be used on one platform.

#### 4.15 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.
  - IEC 60079-2/EN 60079-2.
  - 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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