

Equipment: Supply of High Performance Liquid Chromatography with PhotoDiode Array Detector and Electrochemical Detector (HPLC-PDA-ECD)

The system shall comprise the following

- I) Binary Solvent Delivery Pump
 - II) Post-Column Solvent Delivery Pump
 - III) Degassing Unit
 - IV) Auto-injector
 - V) Thermostat Column Compartment
 - VI) PhotoDiode Array Detector (PDA)
 - VII) Electrochemical Detector (ECD)
 - VIII) Data processing and chromatographic software
 - IX) Computer, printer and others
 - X) Installation, commissioning and training
 - XI) Warranty
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TECHNICAL SPECIFICATIONS

A. Binary Solvent Delivery Pump

- 1. It should come with a binary high-pressure solvent delivery pump configuration of up to 66MPa
- 2. Preferably have a minimum settable flow range between 0.0001 to 3 ml/min [to 66 MPa] and 3.0001 ml/min to 5.0 ml/min [to 44 MPa]
- 3. Flow rate accuracy shall not exceed:
 - i) $\pm 1\%$ or $\pm 2 \mu\text{l}/\text{min}$ [at 1.0 to 40 MPa]; and
 - ii) $\pm 2\%$ or $\pm 2 \mu\text{l}/\text{min}$ [for set value within 40 to 60 MPa] whichever is larger
- 4. Flow rate precision: preferably within $\pm 0.06\%$ RSD
- 5. Pressure pulsation: preferably not exceeding 0.5 bar (0.05MPa)
- 6. The precision of composition must be less than 0.6% RSD.
- 7. It should employ active check valves that allow stable delivery of even non-polar organic solvents such as hexane and the parts should be compatible with non-polar solvents
- 8. Automatic rinsing of plunger must be available.
- 9. It must have a leak sensor as safety feature

B. Post-Column Solvent Delivery Pump

- 1. Pressure setting range should be at least 1-40 MPa
- 2. Ability to function in isocratic mode
- 3. Preferably have a minimum settable flow range between 0.0001 to 10 ml/min

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C. Degassing Unit

1. Membrane degassing unit for at least 2 flow lines should be available
2. Maximum operating flow rate of up to 10ml/min per flow line
3. An internal capacity of at least 400 µl per flow line should be available for decreasing the time
4. Pressure resistance: maintained at ± 0.1 MPa preferably
5. It must have a leak sensor as a safety feature
6. Error status should be transferrable to the operating software
7. It should include a drain-pan
8. Self-cleaning capability that extends vacuum pump life by drawing in air when the pump is running
9. The liquid contact surfaces of the degasser should employ special synthetic polymers designed for all solvents

D. Auto-Injector

1. Maximum operating pressure should not be less than 60 MPa
2. Sample injection volume should be variable, preferably between 0.1 µl to 100 µl, with the option to expand the injection volume to either 500 µl or 2000 µl
3. Injection system should be variable injection volume type with zero sample loss during injection
4. It must be capable of fast injection time of less than 25sec/sample
5. Sample capacity must be able to hold more than 100 x 1.5 ml vials.
6. It should be equipped with a block cooling/heating sample cooler capable of minimum settable temperature from 4°C to 40 °C
7. Flow line rinse capability both before and after sampling should be possible
8. Needle aspiration speed should be variable from 0.1 to 15µl/sec
9. Rinse aspiration rate should be variable from 1 to 35µl/sec
10. It must be capable of a carry-over not more than 0.0035 %
11. Injection volume accuracy not more than 1%
12. The injection precision should be preferably less than 0.35% of RSD value
13. It should have a leak sensor, automatic rack and vial recognition as safety feature
14. It should have functions for maintenance and validation which are accessible by a dedicated operation button
15. It should be capable of coupling to an automatic rack changer in the future for high throughput analysis.

E. Thermostat Column Compartment

1. It should have a circulation type for uniform temperature distribution with a quick feedback mechanism to maintain constant temperature level even when power source voltage fluctuates
2. The temperature control range should be preferably 10°C below room temperature to 85°C; settable at 1°C steps
3. Temperature control precision should be within $\pm 0.1^\circ\text{C}$

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4. The oven should have temperature limit device and temperature fuse to prevent overheating and a solvent leak sensor for detecting mobile phase leaks
5. It should have functions for maintenance and validation which are accessible by a dedicated operation button
6. Capable of complex temperature programming in linear and step programs
7. It should have built-in slots for valve control functions
8. The oven capacity should be able to handle at least 3 x 30 cm columns

F. Photodiode Array Detector (PDA)

1. The wavelength range should be at least 190 nm - 700 nm
2. The photo-diode array detector should have 1024 elements and an element resolution of 0.5 nm/element must be available.
3. The detector must preferably have 2 modes of operation using a variable slit: High Resolution mode at a slit width of 1nm and a High Sensitivity mode at a slit width of 8nm
4. A Standard flow cell [1.0 µL volume, 10 mm cell path length, 8 MPa pressure max.] with temperature control preferably.
5. A High Sensitivity flow cell [8.5 µL volume, 85 mm cell path length, 6 MPa pressure max.] with temperature control should preferably be available as an option
6. Wavelength accuracy within ± 1 nm inclusive
7. A deuterium lamp [D2] must be available as light source for UV and visible wavelengths respectively.
8. The drift must be equal or smaller than 0.5×10^{-3} AU/Hour
9. The noise level must be equal or smaller than 0.4×10^{-5} AU
10. Linearity should be equal or more than 2.0AU (ASTM method)
11. Preferably able to monitor at least 3 compound specific wavelengths simultaneously

G. Electrochemical Detector (ECD)

1. Must be able to operate in at least DC, PULSE and SCAN modes
2. Must be able to comply with USP or BP Pharmacopeia requirements
3. Must be able to accommodate at least 2 flow cells
4. Oven temperature must be preferably $+7^{\circ}\text{C}$ above ambient temperature to 60°C , with accuracy of within 0.5°C
5. DC mode requirement as follows:
 - working range from at least 10 pA - 200 µA in 1, 2, 5 increments
 - potential from at least -2.50 V to + 2.50 V with 10 mV increments
 - data range: at least 1 - 100 Hz in 1, 2, 5 increments, dependent on filter setting
 - noise not more than 2 pA
6. PULSE mode requirements as follows:
 - Working range from at least at least 10 nA - 200 µA in 1, 2, 5 increments
 - potential from at least -2.50 V to + 2.50 V with 10 mV increments

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- data range: at least 1/(pulse duration) Hz
 - waveform: at least 5 potential steps
 - pulse times: at least 0 – 2000 ms in 10 ms increments.
7. SCAN more requirements as follows:
- working range from at least 10 nA - 200 µA in 1, 2, 5 increments
 - potential from at least -2.50 V to + 2.50 V with 10 mV increments
 - data range: at least 1 Hz
 - scan rate: at least 1 - 100 mV/s in 1, 2, 5 increments
8. Working electrodes should be easily exchangeable and comes with polishing kit if applicable

H. Data processing and chromatographic software

1. The instrument must be able to acquire the signal of all detectors seamlessly. Thus, additional software or communication module must be provided for processing of data from the 2 detectors if required.
2. Original copy of application software must be provided. Electronic licences are accepted.
3. Operation of the system should be very easy and intuitive via a state-of-the-art Windows 10 based software
4. It should cover full one-point digital instrument control, qualitative and quantitative processing, report creation and self-diagnosis
5. There should be an on-line help function
6. The report format to be generated via software must be flexible and customizable by the Laboratory
7. The data can be converted to other formats such as “.doc”, “.xls”, “pdf and csv files.
8. The software should allow automatic execution of system checks, auto-purge and baseline checks
9. The software must allow the setting of accessibility to folders and data for different user roles.
10. Software must have its own log files.
11. System suitability, System security as well as System check functions must be provided which comply with Good Laboratory Practice (GLP)

I. Computer, Printer & Others

1. All modules in HPLC system must be able to communicate with each other. System controller to allow and ensure the functioning of the HPLC with the detectors must be provided if applicable.
2. Computer and Printer
 - Intel Core I5-6500 processor
 - At least 8.0GB RAM
 - At least 1TB Hard Disk
 - At least 20” LCD Monitor
 - DVD-RW
 - Pre-loaded with Window 10

PART 3: REQUIREMENT SPECIFICATIONS**HSA000ETT18300085**

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- Laserjet Printer, duplex printing, black and white, with at least 1200x1200dpi, 1200 MHz processor, 128MB memory, 100 sheet MPT, 250 sheet input tray, Hi-speed USB 2.0, Host USB

J. Installation, Commissioning and Training

1. At least 2 on-site training for operating the system and performing maintenance must be provided respectively for approximately 30 laboratory staffs.
2. Contractor shall provide comprehensive training for approximately 4 lab staffs at Contractor's Training Centre or on-site, including at least 1 method setup according to BP or USP. Contractor is required to coordinate training if the detectors are from different company.
3. The price quoted shall include Installation Qualification and Operation Qualification (IQ/OQ) to be performed for the HPLC system and on all the detectors.
4. Proper documentation is to be supplied along with the delivery of the equipment. These shall include the operator's electronic manuals/software manual, equipment manuals, electrical circuits/ manuals and service manuals

K. Warranty

1. System must come with at least two-year warranty upon successful of commissioning. Warranty shall minimally include:
 - Total 2 preventive maintenance (PM) shall be provided (with 1PM/year) for 1st and 2nd year;
 - Replacement of defective electronic parts;
 - Unlimited breakdown calls during Office Hours i.e. 8am to 6pm from Monday to Friday excluding Saturday, Sunday and Public Holidays; and
 - Provision of updates for all software including operating software

COMPLIANCE TO REQUIREMENT SPECIFICATIONS

I hereby confirm that I can meet all the Requirement Specifications as stated above.

YES / NO*

*Please indicate any non-compliance here should there be any.

Reference To	Remarks