

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

The system shall comprise the following

- I) Quaternary Solvent Delivery Pump
 - II) Post-Column Solvent Delivery Pump
 - III) Degassing Unit
 - IV) Auto-injector
 - V) Thermostat Column Compartment
 - VI) Diode Array Detector (DAD)
 - 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. Quaternary Solvent Delivery Pump

- 1. It should have a flow rate resolution of at least 3 nl/min
- 2. Must 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 $\pm 2 \mu\text{l/min}$ [at 40 MPa]; and
 - ii) $\pm 2\%$ or $\pm 2 \mu\text{l/min}$ [for set value within 40 to 60 MPa] whichever is larger
- 4. Flow rate precision must be less than $\pm 0.06\%$ RSD
- 5. Pressure setting range should be at least 1- 66 MPa
- 6. Pressure pulsation must not exceed 0.5 bar (0.05MPa)
- 7. The gradient formation should be produced through low pressure gradient mixing functionality
- 8. The precision of composition must be less than 0.6% RSD.
- 9. 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
- 10. Automatic rinsing of plunger must be available.
- 11. Maintenance kit should be provided.
- 12. It should be capable of standalone operation
- 13. It should have min of 20 storage files
- 14. 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

C. Degassing Unit

1. Membrane degassing unit for at least 5 flow lines should be available
2. Maximum operating flow rate of at least 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 should be maintained at not more than ± 0.1 MPa
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
10. **Low noise and other environmental friendly features preferred.**

D. Auto-Injector

1. Maximum operating pressure should not be less than 60 MPa
2. Sample injection volume should be variable between 0.1 µl to 50 µl, with the option to expand the injection volume to either 100 µl, 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 at least 0.1 to 15µl/sec
9. Rinse aspiration rate should be variable from at least 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 less than 0.3% of RSD value
13. Maintenance kit should be quoted.
14. It should have a leak sensor, automatic rack and vial recognition as safety feature
15. It should have functions for maintenance and validation which are accessible by a dedicated operation button
16. It should be capable of coupling to an automatic rack changer in the future for high throughput analysis

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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 at least -10°C to 85°C; settable at 1°C steps
3. Temperature control precision should be within $\pm 0.1^\circ\text{C}$
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. Diode Array Detector (DAD)

1. Both sensitivity and resolution must be optimized with a fixed slit width design and available simultaneously without sacrificing one for the other
2. The Bandwidth should be 8nm
 - i) Wavelength range must be at least from 190 nm to 700 nm.
3. The flow cell must be temperature controlled from at least + 5°C to 50°C
4. Wavelength accuracy must be within $\pm 1\text{ nm}$
5. Wavelength reproducibility must be within $\pm 0.1\text{ nm}$
6. Drift should be less than $1 \times 10^{-4}\text{ AU/Hour}$
7. Noise level should be within $\pm 0.5 \times 10^{-5}\text{ AU}$
8. Wavelength scan must be adjustable in 1 to 5nm wavelength steps
9. It should be able to monitor and quantitate at least 2 wavelengths simultaneously
10. A conventional flow cell [approx. 12-15 μL volume for 10 mm cell path length, maximum pressure of at least 12MPa] with temperature control should be available as standard
11. A semi micro flow cell [approx. 2.5 μL volume for 5 mm cell path length, maximum pressure of at least 12 MPa] with temperature control should be available as option
12. Linearity should be equal or more than 2.5AU (ASTM method)
13. It should display sample and reference light intensity levels and accumulated lamp illuminated time
14. It should have self-diagnostics in standalone mode
15. A leak sensor and lamp replacement protection system (lamp automatically turned OFF) should be available.

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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 Pharmacopeia requirements
3. Must be able to accommodate at least 2 flow cells
4. Oven temperature must be at least +7°C 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 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/(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.
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.

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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
 - 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. Tenderer shall provide comprehensive training for approximately 2 lab staffs at Tenderer's Training Centre or on-site. Tenderer 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 manuals/software manual, equipment manuals, electrical circuits/ manuals and service manuals

PART 3: REQUIREMENT SPECIFICATIONS**HSA000ETT18300062****Equipment:** Supply of High Performance Liquid Chromatography with Diode Array Detector and Electrochemical Detector (HPLC-DAD-ECD)

K. Warranty

1. System must come with at least two-year warranty upon successful of commissioning.

Warranty shall minimally include:

- 1 preventive maintenance per year;
- Replacement of defective 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

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

Tenderer's (as *Principal/Agent)
Company or Business Registration No:

Tenderer's official
Stamp:

Authorized Signature

Name:

Designation:

(*Delete whichever is not applicable)

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

Reference To	Remarks