

TECHNICAL SPECIFICATION FOR A HPLC/PDA SYSTEM FOR ATL-CFT**Part A – High Performance Liquid Chromatograph**

1. The HPLC shall include the following individual stackable self-contained modules:
 - A1: Ultra High Pressure Quaternary Pump Solvent Delivery System
 - A2: Autosampler with Accessories
 - A3: Thermostatted Column Compartment
 - A4: Photodiode-Array Detector
2. The HPLC shall have a flexible modular system that allows for the integration of additional detectors if necessary.
3. They must be capable of standalone operation and have internal diagnostics to monitor the equipment's performance and record in a logbook.

A1. Ultra High Pressure Quaternary Pump Solvent Delivery System:

1. The pump must be a high pressure quaternary gradient pump designed for ultra-high performance liquid chromatograph analyses on 2.1 mm i.d. column.
2. Flow range: Settable from 0.001 ml/min to at least 5 ml/min
3. Flow precision: $\leq 0.07\%$ RSD or 0.01 min SD, whichever is greater.
4. Flow accuracy: Within $\pm 1\%$ or $\pm 10 \mu\text{L}/\text{min}$, whichever is greater.
5. Operation pressure range: Up to at least 800 bar (11603 psi).
6. Pressure pulsation: $\leq 1\%$ amplitude or ≤ 5 bar, whichever is greater
7. It shall have stable solvent delivery to give good retention time reproducibility at ultra-high speed gradient conditions.
8. The compressibility compensation should be automatic.
9. Mobile phase composition range: Settable from 0 – 100 %
10. Composition precision: $\leq 0.15\%$ RSD or 0.02 min SD, whichever is greater
11. Composition accuracy: $\pm 0.4\%$ or better
12. A reservoir tray (with at least 4 independent solvent bottles complete with fittings) must be supplied.
13. It shall have a solvent selection valve in order to combine 2 out of 4 solvents for binary mixtures (isocratic and gradient) or to select different solvent for flushing column
14. It shall have an integrated degassing unit to allow fast change-over of solvents, and for purging and priming the pump.
15. Solvent resistant material must be used in all areas which may have contact with the mobile phases and solvents.
16. It shall have an automatic purge valve that allows automatic purging using automated software-controlled functionalities to save time
17. It shall have an active seal wash for handling of solvents containing salt buffers. so as to ensure longer lifetime of the seals when using higher buffer concentrations.
18. It shall have a software that allows seamless transfer of methods between other LCs in the lab that includes Agilent, Shimadzu, AB Sciex and Waters.
19. The software controlling the pump should include solvent bottle filling status (solvent counter).

A2. Autosampler with Accessories

1. The autosampler must offer a flow through design with variable injection volume to save on sample volume for precise injection.

2. Minimum Injection range: variable from 0.1 – 20 µL in 0.1 µL increments and up to at least 800 bar (11603 psi)
3. Injection precision: $\leq 0.25\%$ RSD of peak areas from 5 µL to 20 µL.
4. The injection system must be capable of performing rapid injection and have user settable draw and eject speed. It should also allow for user settable vial injection depth.
5. The autosampler tray must have at least 100 positions for 2 ml glass vials, and the temperature shall be controllable from 4°C to ambient.
6. It should have a flush port for rinsing of the needle to minimise carryover, which should be $\leq 0.004\%$.
7. Automatic processing and random access to any of the 100-vial positions must be allowed, including priority samples inserted in the queue during automated runs.
8. The software shall allow injector programming, automated needle wash control and overlapped injections.

A3. Thermostatted Column Compartment

1. It shall provide precise column thermostating for uniform temperature distribution to maintain constant temperature even when power source voltage fluctuates, such as the use of still-air operation.
2. Temperature range (minimum): From 10°C below ambient to 85°C, settable in steps of 0.1 °C.
3. Temperature stability: Within ± 0.1 °C
4. Temperature accuracy: Within ± 0.5 °C
5. Temperature precision: Within 0.05 °C.
6. It shall be able to provide for pre-column heating and post-column cooling, with minimal heat-up/cool-down time.
7. It shall have a column capacity for at least 2 columns of 15 cm length, and allow for column switching automatically through software.
8. It shall come with good and easy-to-use column fittings, without the need for a wrench to allow efficient and fast column exchange when necessary.
9. It should allow for traceable column history with column identification to track history of use for documentation of column type, major column parameters, and number of injections

A4. Photodiode Array Detector

1. The detector type should be based upon 1024-element diode array
2. It shall allow for the simultaneous detection of up to at least 8 specific wavelengths for increased sensitivity and selectivity.
3. Spectra and signal sampling rate: At least 120 Hz for fast analysis speeds and high chromatographic resolution
4. Minimal signal drift and noise level should be present at ≤ 0.5 mAU/h and within ± 0.6 µAU/cm for higher sensitivity as well as more reliable and robust peak integration.
5. Dynamic linear range: ≥ 2.0 AU.
6. Wavelength range: at least 190 – 640 nm, and programmable in steps of 1 nm
7. Wavelength accuracy: ± 1 nm or better,
8. Wavelength precision: ± 0.1 nm or better.
9. Detector cell path length shall be ≥ 10 mm for higher sensitivity.
10. Shall be able to select reference wavelength to eliminate background interference
11. Efficient temperature control mechanism should be present to provide maximum baseline stability under fluctuating ambient temperature and humidity conditions

12. Flow cells and lamps should be trackable (e.g. with radio frequency identification (RFID) technology) for electronic records of flow cell and UV lamp conditions (e.g. path length, volume, product number, serial number, test passed, usage).
13. Design should allow for easy changing of the flow cell and lamp without disassembling the equipment or major adjustment work (e.g. accessible from the front).
14. The spectra data analysis must have the following features:
 - Allow the building of in-house spectral library
 - Have peak purity functions for verification of separation quality
 - Allow automated spectral library searches for compound identification.
 - Spectra matching should result in more than one hit if the match quality threshold is achieved, and the results should show the UV match quality.
 - Spectra matching should also be accomplished within the least number of clicks, preferably one click
 - Allow for subtraction of background absorbance
 - Allow for the use and inter-transferring of the laboratory's existing spectral libraries with no data conversion required

Part B – Maintenance & Safety-related Features

1. For diagnostic purposes, module A1 should have the following:
 - Built-in pressure test to demonstrate the pressure tightness of the system
 - Built-in troubleshooting leak test to demonstrate the leak-tightness of the pump
 - Records and log files
 - Extensive diagnostics, error detection and display
2. For safety and maintenance, all modules as indicated in Part A:
 - Should have leak detection and safe leak handling design (such as leak output signal for shutdown of the pumping system)
 - Must be no hazardous/low voltage in major maintenance areas
3. In addition, modules A1, A2 and A4 should also include:
 - Early maintenance feedback for continuous tracking of equipment usages (e.g. seal wear or lamp burn time with user settable limits) with feedback messages
 - Electronic records of maintenance and errors

Part C – Data Management System

C1. Computer and Printer

The product proposed shall minimally fulfil the following requirements:

- Intel Core 2 Duo processor or better
- 8 GB RAM on board or better
- At least 500 GB hard disk
- 19" LCD colour monitor
- 101 keys keyboard and optical scroll mouse
- Pre-installed Windows 10 with Microsoft Office 2016 or newer version
- At least 2 Ethernet for the installation of LAN.

- A black and white network laser printer with the capacity to print duplex automatically and capacity of at least 250 sheets of paper or better
- Computer must have at least 3-year warranty.

C2. Software

1. Tenderer shall provide a single software platform for a seamless control of all the modules of LC and photodiode array detector.
2. Operation of the system must be easy and intuitive.
3. System suitability, system security as well as system check functions must be provided which comply with Good Laboratory Practice (GLP).
4. It shall allow for full digital instrument control, including access to all method parameters, qualitative and quantitative processing, data acquisition, data analysis, method automation, report creation, and self-diagnosis.
5. There should be an online help function available for users.
6. Software must be able to run simultaneously with other programs on the computer such as Microsoft Office.
7. Method files should allow simultaneous saving of all analysis parameters, data processing parameters, report format and data files.
8. Reporting format should be customisable. It should also be flexible and easy to use, and must enable the reporting of relative retention times and relative peak response in the report.
9. The report must include information such as sample name, operator, chromatogram, retention time, relative retention time, peak width, peak height, relative peak height, peak area, relative peak area, method name and compound name in one report.
10. The data should be able to be converted to other formats that includes. pdf, xls). Spreadsheet software and word-processing software can be readily employed to provide data in tables or graphs through industry standard protocols.
11. It shall have a built-in or integration path to HSA's scientific data management system to allow data to be extracted and uploaded for central secure long-term data storage.
12. The equipment control software provided must include both user and administrator access rights.
13. Software must have its own log files for complete audit trails.
14. An audio-visual aid for maintenance and troubleshooting must be provided.

Part D – Warranty, Training & Support

1. All system modules must be GLP compliant.
2. The system should come with at least one-year warranty that covers the system hardware, software and computer, with option to extend for another three (3) years' post warranty comprehensive service maintenance contract. The warranty and post warranty comprehensive service maintenance shall minimally include the following:
 - One (1) preventive maintenance (PM) yearly with PM kit if applicable;
 - Provision of unlimited breakdown calls, on-site service support, troubleshooting and repairs during Office Hours i.e. 8 am to 5.30pm from Monday to Friday excluding Saturday, Sunday and Public Holidays;
 - Supply of all replacement parts and repair consumables; and
 - Software upgrades or revisions such as versions up.
3. After installation and commissioning, the Contractor must provide hands-on training for operating the equipment to up to six (6) users of the equipment on site.

4. Training shall also be provided at the Contractor's application laboratory for up to two (2) persons. This training shall include the use of equipment software and/or HPLC techniques.

Details of the training program should be enclosed with the tender.

5. The Contractor must perform risk assessment and submit an endorsed copy of the form to the laboratory before the delivery and installation, and to oversee overall systems integration, site preparation, installation and necessary configuration of the system.
6. Contractor shall have the capability to provide after-sales service. Please provide the list of engineers who are trained to provide servicing and/or application support of the proposed equipment in **Annex E Performance Summary**.
7. Contractor must provide full assistance to the laboratory to complete the report customisation, method development and validation in terms of hardware, software and application support.
8. A Declaration of Conformity certificate must be provided.

Part E- Service Support Requirements during Warranty and Post Warranty Comprehensive Maintenance Contract

1. The Services to be performed by the Contractor shall consist of Preventive Maintenance and Corrective Maintenance described as follow:

- I. Preventive Maintenance

- a) The Preventive Maintenance shall consist of:
 - i. Routine maintenance of the equipment, including but not limited to the testing of functions and inspecting of the condition of the equipment in order to keep the equipment safe for use and in good working order; and
 - ii. Adjustment and/or repair of any defect in or malfunction of the equipment discovered by the Contractor's representatives during the course of routine maintenance checks.
- b) The Preventive Maintenance performed shall be in compliance with the maintenance procedures and safety tests specified by the manufacturer.
- c) The Preventive Maintenance shall be carried out during Office Hours.

- II. Corrective Maintenance

- a) Upon receipt of oral or written notice from the Authority, the Contractor shall use its best endeavours to ensure that the Contractor's suitably qualified and duly authorised representatives attends to the Authority, within the response time of not more than 4 hours upon receipt of oral/written notification if the request is made on a Working Day i.e. Monday to Friday (excluding Saturday, Sunday and Public Holiday). If the request is made on a non-Working Day, the Contractor shall respond within the response time of within the first four (4) hours of the beginning of the next Working Day.

2. Replacement and Purchase of Components

- a) The Contractor shall inform the Authority of any part or component of the equipment that needs to be replaced. Prior written approval must be issued by the Authority before the replacement may be effected unless the replacement required is deemed urgent by the Authority in which case a verbal approval (which shall subsequently be confirmed in writing) obtained from an authorised officer of the Authority shall suffice.
- b) The Contractor shall use all reasonable endeavours to supply only original or genuine replacement components, which are required to maintain the equipment in good working order.

3. Guarantee

- The Contractor hereby warrants that all the equipment and every part or unit thereof serviced by the Contractor shall conform to the requirements of this Contract and be free from any defect or deficiency in their performance or workmanship for a period of three (3 months) from the date of acceptance of the Services by the Authority (hereinafter referred to as "the Equipment Guarantee

Period"). The Contractor hereby also warrants that all materials and every part or unit thereof, used for the Services shall be free from any defect in manufacture or any defect arising out of design, workmanship or materials used or any failure or malfunction due to quality of material, workmanship, design, assembly, installation or integration for a period of three (3) months from the date of acceptance of the materials by the Authority (hereinafter referred to as "the Materials Guarantee Period"). The Equipment Guarantee Period and the Materials Guarantee Period shall collectively be known as the "Guarantee Period".

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.

<i>Reference To</i>	<i>Remarks</i>