

Should your offer be accepted, the Requirement Specifications as set out in this Part shall govern the Contract between the Authority and your company.

Introduction

This tender includes the specifications for the procurement of one (1) unit of liquid chromatograph triple-quadrupole mass spectrometer (LC-MS/MS) system. The Authority shall reserve all rights to award as a whole or partially for this tender.

The LC-MS/MS system is intended to use for the analysis of drug molecules, impurities and natural alkaloids in pharmaceutical, cosmetics and complementary health products.

General

A robust and sensitive bench top/stand-alone liquid chromatograph triple-quadrupole mass spectrometer (LC-MS/MS) system shall offer configurations as follows:

1. Liquid chromatograph (LC) mainframe
 2. Auto Sampler
 3. Column Oven
 4. Built-in or external infusion system/syringe pump
 5. Tandem triple-quadrupole mass spectrometer (MS/MS)
 6. Computer hardware and software
 7. Data management software system
 8. Roughing pump sound proof enclosure
 9. System bench and Uninterrupted Power Supply (UPS)
 10. Installation, commissioning and warranty
 11. Application and hardware maintenance training
 12. Technical support
 13. Post-Warranty Comprehensive Maintenance Contract
 14. Submission of supporting documents
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The LC-MS/MS system shall offer equivalent or superior functions as follow:

1. Liquid Chromatograph Mainframe

- 1.1 Must offer a high-pressure binary pump system to have at least 2 individual solvent lines for each pump.
- 1.2 Must offer integrated diagnostic functions that pre-empts system malfunction;
- 1.3 Must offer an integrated degassing unit;
- 1.4 Must enable settable flow range set points from 0.001- 5 mL/min, in 0.001 mL/min increments;
- 1.5 Must offer flow precision of ≤ 0.07 % Relative Standard Deviation (RSD) or ≤ 0.02 min Standard Deviation (SD), whichever is greater; based on retention time at constant room temperature;
- 1.6 Must offer flow accuracy of ± 1 % or better;
- 1.7 Must offer operating pressure (with LC column) with at least 100 MPa (1000 Bar);
- 1.8 Must offer user selectable compressibility compensation, based on mobile phase compressibility;
- 1.9 Must be able to support and function in the pH range of 1.0 – 12.5;

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- 1.10 Must permit gradient formation;
- 1.11 Must offer user-selectable flow composition ranges from 0 – 100 % in 0.1% increment;
- 1.12 Must offer composition precision of ≤ 0.2 % RSD or ≤ 0.04 min SD, whichever is greater;
- 1.13 Must offer software and local control functions;
- 1.14 Must enable communications via controller-area network. Remote: ready, start, stop and shut-down signals with optional LAN;
- 1.15 Must offer safety and maintenance features to support extensive diagnostics, error detection and display, leak detection, safe leak handling, leak output signal for shutdown of the pumping system. Low voltage in major maintenance areas; and
- 1.16 Must be able to notify the lab when the maintenance is due, early maintenance feedback to be provided for continuous tracking of system usage in terms of seal wear and volume of pumped mobile phase with pre-defined and user settable limits and feedback messages. Electronic records of maintenance and errors shall be provided.

2. Auto Sampler

- 2.1 Handles a minimum of 100 pieces of 2 mL HPLC vials with thermostat cooling function;
- 2.2 Programmable injection volume minimum range: 1 - 40 μ L;
- 2.3 Must have the injection volume accuracy of $\pm 1\%$ or better;
- 2.4 Must have the injection precision of $\leq 0.25\%$ RSD or better;
- 2.5 Sample washed out from needle on-line;
- 2.6 Temperature must be settable from 4°C to 40°C in 1°C increments;
- 2.7 Must have random, programmable access to vials and adjustment of needle depth; and
- 2.8 Must offer operating pressure (with LC column) with at least 100 MPa (1000 Bar).

3. Column Oven

- 3.1 Minimum Temperature range: 15°C to 80°C;
- 3.2 Temperature stability: ± 0.1 °C or better;
- 3.3 Temperature set point accuracy: ± 2 °C or better;
- 3.4 Heat up rate: Maximum 5 minutes from ambient to 40 °C; and Cool down rate: Maximum 10 minutes from 40 °C to 20 °C;
- 3.5 Column capacity: must be able to hold a minimum of 3 columns;
- 3.6 Able to handle column length from 10 – 300 mm; and
- 3.7 The tubing connect to column from pump must be finger tight fitting and capable of withstanding high pressure (at least 1000 bar).

4. Built-in or external infusion system/syringe pump

- 4.1 Must offer a built-in or external mechanical infusion system/syringe pump to support real-time data acquisition for MS method optimisation. A minimum infusion flow rate at 5 μ L/min must be achieved.

5. Tandem Triple-quadrupole Mass Spectrometer

- 5.1 The mass spectrometer must have a minimum scanning speed of 10,000 Da/sec;
- 5.2 The mass spectrometer must offer linear dynamic range of greater than 5 orders of magnitude inter-scan linear dynamic range without signal reduction;

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- 5.3 The mass spectrometer must offer computer controlled concurrent polarity switching functions, preferably with not more than 10 msec of polarity switching time;
- 5.4 The mass spectrometer must offer a minimum mass range of 5 – 2000 m/z;
- 5.5 The mass spectrometer must have a mass stability of at least 0.1 amu over 24 hrs with normal operating temperature and after the mass spectrometer has reached vacuum and electronics equilibrium;
- 5.6 The ionization source housing must allow the use of interchangeable APCI, ESI and Microflow source. No physical adjustment requirement to achieve the best sensitivity under all conditions and reduced user-to-user variation. The system must allow both micro and analytical flow for enhanced sensitivity compared to ESI alone
- 5.7 The ESI and APCI sources must be provided as standard with the system. The ESI must be able to allow effective optimization of ionization with minimal adduct formation;
- 5.8 Ion guide interface in the system must allow flexibility to detune so that interferences can be removed, and sensitivity increased;
- 5.9 The mass spectrometer must have a direct atmosphere-to-vacuum interface module with a curtain gas barrier for maintaining analyzer cleanliness and optimizing ion declustering;
- 5.10 The mass spectrometer must have an active source exhaust for the removal of gasses within the ionization source to ensuring system robustness;
- 5.11 The mass spectrometer must allow user to optimize the voltage across the interface region to discriminate against interference to improve sensitivity of a targeted compound;
- 5.12 The ESI source must be able to operate at flow rate from 5 to 2000 ul/min without splitting.
- 5.13 The design of the orifice must be easy to clean and can minimize/reduce the likelihood of contamination;
- 5.14 The mass spectrometer must be able to provide at least full scan MS, selected ion for both Q1 and Q3, product ion scan, multiple reaction monitoring, and MS³ scan; and
- 5.15 Sensitivity MRM mode – S/N for positive ESI Reserpine 1 pg on column must be greater than 1500,000, and S/N for negative ESI Chloramphenicol 1 pg on column must be greater than 1500,000.

6. Computer Hardware & Software

A data acquisition/ processing computer and a laserjet printer shall be provided with equivalent or better configurations as follows:

6.1 PC specifications:

- Operating System: Microsoft Windows 10 (latest build version) which is compatible with the data management software.
- Processor: Intel® Core™ that must be the latest certified hardware compatible to the system
- Monitor: Minimum 22" IPS LED Monitor with resolution 1280 x 1024 dpi
- Hard Disk: 2TB 7200 rpm SATA 6Gb/s HDD or better
- Memory: Minimum 16GB DDR4 RAM
- Available Network Interface Ports: Shall be built-in to the computer board or PCI card based with minimum 2 ports. (Depending on system requirements; 1 of the ports will be used for connecting to HSA Network)
- DVD-ROM drive
- 104 key Keyboard
- Optical mouse and mouse pad
- Must provide free update of the PC operation system software during warranty period.

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6.2 Printer specifications:

- Speed: at least 40 pages per minute
- Allow paper size: A4
- Auto Duplex: Yes
- Print Technology: Monochrome Laser
- Print resolution: 1200 x 1200 dpi
- Network printer: yes

7. Data Management Software System

- 7.1 Must be a flexible Windows-based data system that provides system control and data analysis and able to view system status, user information, and monitor runs.
- 7.2 Must work seamlessly with application-specific software modules;
- 7.3 Must generate results that can be quickly reviewed with the qualitative, quantitative and library browsers;
- 7.4 The acquisition software must be able to import the retention time from the acquired chromatogram to set up for MRM method with specific time frame setting;
- 7.5 Must have a workflow-oriented approach to high-throughput quantitation, integrating the processes of acquisition, processing and data review with a set of predefined and customisable data-oriented reports;
- 7.6 Must have fully automated auto tune function to ensure the tuning can be easily carry out by user and system health check is at instance.
- 7.7 Must have the ability to run in a fully automated manner, while also providing for sophisticated manual data evaluation;
- Must include the following features:
- Preconfigured processing methods
 - User-defined flags for different parameters
 - Automated retention time and ion ratio adjustment
 - The ability to associate a processing method with any previously saved calibration
 - Automatically generate reports
- 7.8 Must have the feature to protect testing methods from being tampered.
- 7.9 The software shall be able to control the LC-MS/MS through local area network (LAN) technology. The internet protocol (IP) address used on the system shall be in accordance to the standards of HSA Network plan.
- 7.10 The Tenderer shall ensure that the PC provided with the system is network ready and be able to connect to the HSA's network for interfacing with HSA's LIMS (Laboratory Information Management Software) system, e.g. LISA, LabWare, etc.
- 7.11 The system software must be able to interface with HSA's LIMS for the following:
- Raw Data Files archival & retrieval.
 - System test result report output to PDF for archival.
 - System test result report for result uploading.
 - To accept work list upload from HSA's LIMS, if applicable.
- 7.12 System shall be able to import and run a sequence file generated by the LIMS. The sequence file generated shall be in ".csv" or ".txt" file format.

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- 7.13 The Contractor shall work with HSA personnel for the following:
- a) To define and assign a Hostname and/or PC name given by has IT infrastructure team to facilitate the system management on HSA network.
 - b) To define the Raw Data file structure & directory assigned by HSA to facilitate the automation of electronic archival and retrieval of files.
 - c) To perform SIT and UAT to ensure the integration to HSA's LIMS system is running fine.
- 7.14 For the system report printing and extraction, the Contractor shall work with Laboratory to ensure the seamless integration and interface with HSA's LIMS.
- 7.15 The Computer system supplied with Microsoft Windows Operating system shall support Microsoft Active Directory Domain infrastructure.
- 7.16 The Computer system supplied shall use Active Directory based user accounts without the requirement of having Domain Administrator privileges.
- 7.17 The Computer system together with the operation of the required scientific shall not require the use of local system privilege's account or rights for its functional use.
- 7.18 Must have the feature to protect testing methods from being tampered.
- 7.19 The operation PC and data-process PC must come with the latest version of Microsoft Office with perpetual license. The Microsoft Office must be compatible with the system.

8 Roughing Pump Sound Proof Enclosure

- 8.1 Enclosure box/bench equipped with sound proof walls for minimisation of pump noise required.

9 System bench

- 9.1 The complete system must be able to fit into existing system bench area [175 cm (Length) x 70 cm (Depth) x 75 cm (Height)]. If the existing bench is unable to house the proposed system, Tenderer is required to provide mobile-table(s) with enclosure (see **Clause 8**) for the system.
- Contractor shall make a visit to the laboratory to finalize the material / colour scheme of the table(s) with the laboratory personnel if required.
- 9.2 The Tenderer shall provide UPS which is single phase with battery for not less than 5 mins back up time.

10 Installation, Commissioning & Warranty

- 10.1 The power supply must be suitable for Singapore use;
- 10.2 Prices quoted are to include delivery, installation, commission, calibration and training of operators.
- All proper documentation is to be supplied along with the system. These shall include the operator's manuals/software manual, and equipment manuals;
- 10.3 The price quoted for the system must also include Installation Qualification and Operation Qualification (IQ/OQ) that shall be performed during the commissioning of the LC-MS/MS system.
- 10.4 The warranty period for the entire system shall be minimum two (2) years and covers all hardware (e.g. electronic boards, pumps etc.) and software. The warranty shall minimally cover
- a) Annual Preventive Maintenance (PM)
- (Note: Commissioning of the system shall not be considered as a PM);
- b) Unlimited breakdown calls and on-site services must be provided during Office Hours i.e. 8.30 am to 5:30pm from Monday to Friday exclude public holidays;

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- c) Supply of all necessary kits and wear & tear parts (inclusive of all related tuning solutions with certified validity for the entire duration of the maintenance contract) when carry out PM and Corrective Maintenance for unforeseen breakdown (see **Clause 14**); and
 - d) Supply all replacement parts (includes electronic or mechanical in nature).
- 10.5 The Contractor must be able to perform risk assessment for the LC-MS/MS system that is located in the designated air-conditioned laboratory. A risk assessment report must be submitted before the installation of the system.
- 10.6 During the installation of the system, the Contractor must make sure the system is properly connected to the gas pipeline in the laboratory using necessary tubing, connectors and other necessities with no leaking;
- 10.7 During commissioning, the technical specialist/engineer must validate the LC-MS/MS system based on the contractor's installation specifications on-site. A copy of the validation report must be submitted to HSA – Pharmaceutical Laboratory after validation has been carried out on the LC-MS/MS system;
- 10.8 The Contractor must supply the calibration standards with their certificate of analysis attached, and all other accessories necessary to carry out validation checks and maintenance of the system. These accessories shall include syringes of appropriate sizes, as well as cleaning tissue and cleaning buds at no additional cost;
- 10.9 For the statement of coverage of each type of preventive maintenance plan (PMP), the service availability, materials, parts and services provided, telephone technical support, and coverage exclusions shall be clearly defined and stated;
- 10.10 The LC-MS/MS system power supply rating must be compatible with Singapore power supply to enable successful on-site installation and full commissioning. Power supply requirements can be obtained post tender award via on-site inspection;
- 10.11 The LC-MS/MS system must be fully commissioned within 1 month upon delivery;

11 Training

- 11.1 On-site training for all end-users in the Pharmaceutical Division that is approximately 30 staffs shall be provided by trained personnel(s), and shall cover topics including simple MS theory, system overview, MS method optimization, data acquisition, and general maintenance. In addition, a proposed training schedule shall be submitted upon request.
- 11.2 Advanced training for minimum 12 end-users must be provided including theory for adducts-formation mechanisms under ESI and APCI ionization modes and trouble-shooting.

12 Technical Support

- 12.1 Tenderer must have application and maintenance support through the provision of local technical specialist to assist in method developments, on-site training that stated in **Clause 11 Training**, as well as readily available parts and consumables on demand.
- 12.2 The service engineer and product specialist must be trained to provide training, technical and maintenance support for the model propose. The service engineer and product specialist must be trained by Original Equipment Manufacturer (OEM) to perform servicing for the system. A copy of the relevant certificates shall be submitted for evaluation upon request.
- 12.3 Contractor must be able to send its application specialist(s) to HSA Pharmaceutical Laboratory to complete at least 1 workflow development after the system is successfully commissioned.

13 Option requirement: Post-Warranty Comprehensive Maintenance Contract

- 13.1 Tenderer shall quote for the option to purchase post warranty comprehensive maintenance contract for the system for 3 years and another further 2 years in **Annex C to Part 3 - Price and Submission Information** as set out in this tender.
- 13.2 The Comprehensive Maintenance contract for the LC-MS/MS system shall minimally include the following:
- a) Annual PM;
 - b) Unlimited breakdown calls and on-site services must be provided during Office Hours;
 - c) Supply of all necessary kits and wear & tear parts (inclusive of all related tuning solutions with certified validity for the entire duration of the maintenance contract) when carry out PM and Corrective Maintenance for unforeseen breakdown (see **Clause 14**); and
 - d) Supply all replacement parts (includes electronic or mechanical in nature).
- 13.3 Tenderer is required to provide detailed information on the maintenance coverage for the price proposed in a separate form, if necessary.
- 13.4 The Contractor shall bill the Authority after the preventive maintenance is completed, together with relevant detailed signed service reports as supporting documents.

14 Performance of Services during warranty and post warranty comprehensive maintenance

The Contractor shall perform the Services in the manner as specified in the Contract in order to maintain the system in good working order. The Services to be performed by the Contractor shall consist of Preventive Maintenance (PM) and Corrective Maintenance as described below.

A) Preventive Maintenance

- i) The Preventive Maintenance performed shall be in compliance with the maintenance procedures and safety tests recommended by the manufacturer.
- ii) The Preventive Maintenance shall be carried out during Office Hours.
- iii) The Contractor shall notify the Authority before carrying out the PM at the Authority's premises.

B) Corrective Maintenance

- i) 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 2 hours upon receipt of oral/written notification if the request is made on a Working Day i.e. Monday to Friday (exclude Saturday, Sunday & Public Holiday). If the request is made on a non-Working Day, the Contractor shall respond within the next Working Day.
- ii) Under the circumstances when system malfunctioned for longer than two (2) calendar months from the date of notification is received, corresponding extension of the warranty (if applicable) or comprehensive maintenance contract must be provided or otherwise as agreed by the Authority.

B.1 Replacement and Purchase of Components

- a) The Contractor shall inform the Authority of any part or component of the System 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

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replacement components, which are required to maintain the system in good working order. All replacement components shall not be chargeable during the period of warranty period and post warranty comprehensive maintenance contract

B.2 Guarantee

The Contractor hereby warrants that all the System 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 System 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 System Guarantee Period and the Materials Guarantee Period shall collectively be known as the "Guarantee Period".

Please indicate any non-compliance here.

Reference To	Remarks