

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

Equipment 3: High Performance Liquid Chromatography Tandem Mass Spectrometer (LC-MS/MS) Location: CML Quantity: 1	Compliances (Yes/ No) <i>**If No, please indicate reason of non-compliances.</i>
<u>Technical Specifications</u>	
1. The system must be a high performance liquid chromatography (HPLC) coupled to a tandem mass spectrometer (MS/MS). The modules must be capable of standalone operation and have internal diagnostics to monitor the system's performance. The system must have one single software to control all individual modules. 2. The LC-MS/MS must be a highly sensitive, bench-top triple quadrupole mass spectrometer. This system must allow both qualitative and quantitative analyses to be carried out in a single experiment and essentially come with a built-in integrated switching valve.	Yes/No
3. The entire system including LC-MS/MS and controlling computer must not be larger than 900 mm width, 1250 mm depth, and 1550 mm height in order to pass through the cleanroom material "shower".	Yes/No
(A1) High Performance Liquid Chromatograph	
i. Must offer a high pressure binary pump system to enable at least 4 individual solvent lines to be utilised concurrently.	Yes/No
ii. Must be able to switch among four different mobile phases (at least two of the four) by programmable software, allowing the switch between two different installed columns using at least two of the four mobile phases.	Yes/No
iii. Must offer integrated diagnostic functions that pre-empts system malfunction.	Yes/No
iv. Must offer an integrated built-in degassing unit.	Yes/No
v. Must enable settable flow range set points from 0.001- 5 mL/min, in 0.001mL/min increments.	Yes/No
vi. Must offer flow precision of ≤ 0.07 % Relative Standard Deviation (RSD) or ≤ 0.02 minute Standard Deviation (SD), whichever is greater; based on retention time at constant room temperature.	Yes/No
vii. Flow accuracy of $\pm 1\%$ or better.	Yes/No
viii. Operating pressure (with LC column) with at least 100 MPa (1,000 Bar).	Yes/No
ix. Selectable compressibility compensation, based on mobile phase compressibility.	Yes/No
x. Support and function in the pH range of 2 – 12 (minimally).	Yes/No
xi. Permit gradient formation such as low pressure binary mixing/gradient capability using high-speed proportioning valve.	Yes/No

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xii.	The flow composition must be user-selectable. The working range must be at least from 1 to 99 % in at least 0.2% increment.	☒ Yes/ No
xiii.	Composition precision of ≤ 0.2 % RSD or ≤ 0.04 min SD, whichever is greater.	☒ Yes/ No
xiv.	The system must be controlled by software and/or local control functions.	☒ Yes/ No
xv.	Shall have 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.	☒ Yes/ No
xvi.	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 predefined and user settable limits and feedback messages. Electronic records of maintenance and errors shall be provided.	☒ Yes/ No
xvii.	The system must have the ability to support and be able to upgrade for multiple heart-cutting 2D-LC applications in future. Please quote the cost of upgrading in Annex C – Price and Information Submission, Price Schedule .	☒ Yes/ No
(A2) Auto-Sample Injector		
i.	Sample injection volume must be variable between 0.1 μ L to 25 μ L inclusive with zero sample loss during injection.	Yes/ ☒ No
ii.	Must be able to process automatically the number of samples and random access for a minimum of 50 positions for 1.5 to 2 ml vial volume.	☒ Yes/ No
iii.	To perform customised continuous analyses according to the conditions specified for each sample, including pre-treatment, injection and analysis conditions. Priority samples must be allowed to be inserted in the queue during automated run.	☒ Yes/ No
iv.	Must have flow line rinsing capability both before and after sampling.	☒ Yes/ No
v.	Carry over must be $\leq 0.1\%$.	☒ Yes/ No
vi.	Injection precision must be $\leq 0.25\%$ of RSD value.	☒ Yes/ No
vii.	Must have a leak sensor, automatic rack and vial recognition as a safety feature.	☒ Yes/ No
viii.	Sample holder must have the capability to control the temperature, range covering minimally from 4 °C to 40 °C.	☒ Yes/ No
(A3) Column Compartment		☒ Yes/ No
i.	Must have uniform temperature distribution that can maintain constant temperature level even when power source voltage fluctuates.	☒ Yes/ No

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ii. Allow a temperature range of 15 °C to 80 °C.	☒ Yes/ No
iii. Temperature control precision should be ±0.1 °C or better.	☒ Yes/ No
iv. Must have temperature limit device and temperature fuse.	☒ Yes/ No
v. Capable of temperature programming.	☒ Yes/ No
vi. Able to accommodate at least two columns with a minimum length of 30 cm.	☒ Yes/ No
vii. Must have a user programmable selector valve head for switching between columns.	☒ Yes/ No
(B) Tandem Mass Spectrometer	
i. The system must be a bench top triple quadrupole mass spectrometer designed for LC-MS/MS analyses. The system must have features which allow both qualitative and quantitative analyses to be carried out in a single experiment. It must also support fast chromatography applications with a large number of analytes.	☒ Yes/ No
ii. The system must have a minimum mass range (m/z) of 5 - 2,000 Da.	☒ Yes/ No
iii. The system must have a minimum scan speed of 10,000 Da/sec.	☒ Yes/ No
iv. The mass spectrometer must offer computer controlled concurrent polarity switching functions, with not more than or equal to 25 milliseconds of polarity switching time.	☒ Yes/ No
v. The mass spectrometer must have sensitivity (signal-to-noise ratio in MS/MS mode) must be equal to or higher than 500,000:1 using 1 pg of reserpine on column. This is for running very low concentration samples at parts per trillion/billion level analytes in complex matrices.	☒ Yes/ No
vi. The mass spectrometer must offer linear dynamic range of at least equal or greater than 5.5 orders of magnitude inter-scan linear dynamic range without signal reduction.	☒ Yes/ No
vii. The mass spectrometer should have a mass stability of at least 0.1 Da over 24 hours with normal operating temperature and after the mass spectrometer has reached vacuum and electronics equilibrium.	☒ Yes/ No
viii. The system must have no significant crosstalk detectable for reserpine (0.17 picomol/μL infused) while monitoring the MRM transitions of 609/195 and 100/195 with a 1 millisecond dwell time and 3 millisecond inter-MRM pause time.	☒ Yes/ No
ix. The minimum MRM dwell time must be at least 1.0 millisecond.	☒ Yes/ No
x. The system must be equipped with a source housing hosting interchangeable APCI probe and ESI probe.	☒ Yes/ No

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xi. The ESI source probe must be provided as standard with the system. The ESI probe must be able to allow optimisation of ionisation with minimal adduct formation.	☒ Yes/ No
xii. The ESI source probe must be able to operate at flow rate from at least 5 to 2,000 µl/min without splitting. xiii. The ionisation probes switching must be tool free. xiv. The ion source must have a flow rate compatibility in ESI mode which cover the range of at least 5 µL/min to 2,000 µL/min. xv. The ESI nebulizer gas must be user selectable. xvi. The desolvation temperature must be user selectable covering the range from ambient temperature to at least 550 °C. xvii. All ion source parameters except sprayer positioning must be computer-controllable. xviii. The cleaning and maintenance of desolvation line must be able to carry out without breaking the vacuum. xix. The source must be able to be removed from the host system without tools and without breaking the vacuum.	☒ Yes/ No
xx. The mass spectrometer must allow both qualitative and quantitative analyses to be carried out in a single experiment.	☒ Yes/ No
xxi. The mass spectrometer must be able to provide at least full scan MS, selected ion for both Q1 and Q3, product ion scan and multiple reaction monitoring (MRM).	☒ Yes/ No
xxii. Programmable software-controllable flow switching valve for diverting the flow to waste must be available.	☒ Yes/ No
xxiii. Auto-tuning must be standard with a syringe pump that delivers accurate calibrant injection under full workstation control in both positive and negative modes. Manual tuning must also be allowed.	☒ Yes/ No
xxiv. Provide 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 µL/min must be achieved.	☒ Yes/ No
xxv. A LC-MS start-up kit must be supplied as standard.	☒ Yes/ No
xxvi. A cover to reduce the noise of rough pump is to be provided preferably.	☒ Yes/ No
Sample Testing Requirement: xxvii. The LC-MS/MS must be able to analyse organic analytes in low abundance level. Tenderers will be provided with two samples and the samples must be tested without further manipulation and using the conditions provided in the <i>Instructions on Sample Analysis</i> . The details for the identity of the samples will be provided upon sample collection.	☒ Yes/ No

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Sample Collection Details: Shortlisted Tenderers are required to collect the <i>Instruction on Sample Analysis</i> and samples between 0830 to 1200 7 days upon receipt of email notification from the Authority at: Health Sciences Authority, 1 Science Park Road, #01-05/06, The Capricorn, Singapore Science Park II, Singapore 117528. Contact number: 6775 1605 ext 112 or 116 - The sample must be analysed on the system proposed in this tender. The sample result including raw and processed data shall be submitted via email (in an EXCEL file) not later than 3 weeks from sample collection date. - The sample testing results (data analysis by CML using raw data) must meet the following requirements: • The relative standard deviation of the isotope peak area ratio from four injections for each calibration blend and sample blend must be $\leq 10\%$ (See Instructions for Sample Analysis for details). • The calibration curve must have a goodness-of-fit for linear regression (R^2) ≥ 0.995. • The percentage deviation (%D) of the sample results from the certified value(s) of the certified reference material(s) used to prepare the sample(s) will be calculated. The difference for each sample shall not exceed 20%. • The difference of %D between 2 samples shall not exceed 10%.	
(C) Software and computer	
i. The system PC provided must be network ready.	☒ Yes/ No
ii. Minimum configuration: 3.8 GHz dual core processor or equivalent, 16 GB RAM, 2 TB hard drives, wireless modem 802.11a/b/g/n/ac, USB 3.0, DVD RW (CD RW capable), mouse and keyboard, high resolution 24 inch flat screen color monitor. A laser-jet printer must be provided.	☒ Yes/ No
iii. Must provide Window 10 Professional Operating System and Microsoft Office and any other computer interfaces, cables and software drivers for the system to be usable.	☒ Yes/ No
iv. Single software platform must be provided for a seamless control of all the modules of LC and MS/MS.	☒ Yes/ No
v. The software must be able to optimise MS parameters automatically or manually through software tuning programs.	☒ Yes/ No
vi. The software must allow the generation of sample run sequence table through the use of cut/paste function from MS Excel.	☒ Yes/ No

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vii.	The software must be able to generate both standard and customisable reports to suit different needs.	☒ Yes No
viii.	The software must be able to generate the result reports of chromatograms during and after the sample sequence run.	☒ Yes No
ix.	The software must be able to perform manual integration of single and group peaks capability for better peak identification.	☒ Yes No
x.	The software must be able to perform automatic integration of single and group peaks with both standard perimeters and user settable perimeters.	☒ Yes No
xi.	The software must be able to generate numeric data compatible with Microsoft Excel for plotting chromatogram.	☒ Yes/ No
xii.	The software must be able to monitor the operating status of the system.	☒ Yes/ No
xiii.	The software must be able to view the real-time plot for chromatograms and system parameters (both LC and MS/MS) and print a real-time plot report.	☒ Yes No
xiv.	The software must have the capability to reprocess all stored data – samples and standards without having to rerun the samples and standards again.	☒ Yes/ No
xv.	The software must allow addition of samples into the sequence during an analysis without having to stop and restart the sequence.	☒ Yes/ No
xvi.	Free software upgrade must be provided throughout the warranty period. If the upgraded software is not compatible with the existing computer and/or existing operation system, new/upgraded computer and/or operation system must be provided at free-of-charge.	☒ Yes/ No
xvii.	The PC(s) must be under 3-year full warranty and accompanied with their system recovery CDs or DVDs.	☒ Yes/ No
<u>(D) Miscellaneous</u>		
i.	The system shall consist, but not be limited to, the above listed major components, complete with all the accessories and interfacing necessary to make a fully functional and operable system.	☒ Yes No
ii.	The power supply must be suitable for use in Singapore.	☒ Yes No
iii.	The Contractor must provide for site preparation, installation and any potential necessary modifications to the system (e.g extra/ longer vacuum lines) for the system to be operational free-of-charge.	☒ Yes/ No
iv.	Please refer to Appendix 2 for the floor plan of the area.	
v.	Prices quoted must include installation, commissioning, initial calibration and operator training at Chemical Metrology Laboratory. The operator	☒ Yes/ No

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training shall be conducted after the system commissioning for not more than twelve (12) personnel. The system must come with a minimum 1 year warranty and the PC(s) must come with 3-year warranty. vi. The warranty must minimally include: - unlimited breakdown calls and on-site support services during Office Hours from 8:00 am to 5:30 pm Monday to Friday excluding Saturday, Sunday and Public Holidays; and - Provision of at least 1 preventive maintenance (PM). Any PM kit, wear and tear parts/consumables and replacement parts that required to complete the PM must be provided at no additional cost. Tuning solution must be provided, if applicable; and - Supply of all replacement of parts; and - Supply of all consumables that required for repair; and - Provision of software upgrade or revisions and include Clause C(xvi).	
vii. Contractor must validate the LC-MS/MS system on-site and a copy of the validation report must be submitted upon completion of validation. Contractor must supply the calibration standards with their certificate of analysis, and all other accessories that required to carry out the validation checks and maintenance of the system.	☒ Yes/ No
viii. Tenderer is required to quote for the option to exercise 3-year post warranty comprehensive maintenance contract that covers the overall system (both hardware and software) in Annex C – Price and Submission Information, Price Schedule. The post warranty comprehensive maintenance contract shall minimally include the following: a) Unlimited breakdown calls and on-site support services during Office Hours; and b) Direct engagement with engineer for maintenance and breakdown through phone call and on-site; and c) All replacement parts (both electronic and mechanical in nature), required consumables and labour during preventative maintenance and all non-scheduled maintenances and breakdown; and d) 1 PM (includes both labour, all required consumables and replacement parts, both electronic and mechanical in nature) per year, and cover the overall system (both hardware and software) per year with PM kit (inclusive of any tuning solution, if applicable) provided free-of-charge; and e) Supply of all consumables that required for repair; and f) Update of software revision whenever available and include Clause C(xvi).	☒ Yes/ No
ix. Standard consumables that are required for the set up and commissioning of the system must be provided. In addition to the standard consumables, the Tenderer must provide the list of consumables parts required for preventative maintenance or non-scheduled maintenance and the frequency of change of such part, for	☒ Yes/ No

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the respective modules in a separate form , preferably to be submitted together with the proposal or upon request.	
x. A declaration of Conformity certificate must be provided upon commissioning of equipment.	☒ Yes/ No
xi. The delivery of the equipment must be coordinated with the Laboratory. Risk assessment report in 5x5 matrix must be provided prior to the delivery of the system.	☒ Yes/ No
xii. The LC-MS/MS must be fully commissioned within one month upon delivery.	☒ Yes/ No
xiii. The Contractor must be able to provide after-sales support from engineers and application chemists based in Singapore. The tenderer must have track record in providing personalised and responsive after-sales support in Singapore, that is, the company must provide: (a) Contacts (non-call centre number/ handphone number and email) of at least two engineers experienced with the system (please provide information in Annex C – Price and Submission Information, Local Service Support); and (b) immediate instruction for trouble shooting by telephone when requested; and (c) on-site service within 1 working day when requested; and (d) replacement of parts (refer to Clause E(xii) – Performance of Services),	☒ Yes/ No
xiv. Tenderer shall provide past 3 years track records (at least 1 track record must be submitted) for the sale and provision of maintenance support services for the model proposed in this tender or same brand of LC-MSMS models in Annex C - Price and Submission Information, Track records where applicable and available. The sale and provision of maintenance support services cited must be in Singapore.	☒ Yes/ No
xv. Contractor shall guarantee that the spare parts, consumables and services for the system will be available for a period of at least seven (7) years from the date of discontinuation of the system and shall further undertake to locally supply or make available these parts/consumables for the said period.	☒ Yes/ No
xvi. Contractor must be able to provide on-site instrument operation and user maintenance training by certified engineer(s). The certificate(s) shall be provided upon request.	☒ Yes/ No
<u>(E) TRAINING AND TECHNICAL SUPPORT</u>	
i. The price quoted shall include training and technical support as defined in this section. ii. Contractor shall provide on-site instrument operation, trouble shooting and user maintenance training by certified engineer(s) (1 training with 2 refresher sessions). The certificates shall be provided upon request.	☒ Yes/ No

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iii. Contractor must have application and maintenance support through the provision of local technical specialist to assist in method developments, on-site training (hands-on as well as theory), as well as readily available parts and consumables on demand. iv. The training shall include LC-MS/MS theory, equipment overview, method optimisation, data acquisition, data processing, report formatting and general maintenance. A proposal training program/outline shall preferably be appended with the tender submission. v. Refresher training course (for maximum up to twelve (12) personnel can be trained, should be conducted for free at frequency of once per year for the first 2 years from the date of commissioning, upon request from users.	
(F) Performance of Services	
The Contractor shall perform the services in the manner as specified in the tender in order to maintain the equipment in good working order. The services to be performed by the Contractor shall consist of Preventive Maintenance and Corrective Maintenance as described below. (I) Preventive Maintenance: a. The Preventive Maintenance shall consist of 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 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 manufacturer's recommendation. c. The Preventive Maintenance shall be carried out and completed during Operating Hour. (II) Corrective Maintenance: a. Upon receipt of oral or written notice from the Authority, the Contractor shall use its best endeavours to ensure that suitably qualified and duly authorised representatives attends to the Authority onsite, within the response time of not more than 24 hours upon receipt of oral/written notification if the urgent request (e.g. project with strict deadline) is made on a Working Day. The representative shall provide immediate instruction for trouble shooting by telephone, when requested. If the urgent request (e.g. project with strict deadline) is made on a non-working day, the Contractor shall respond onsite within the first 24 hours of the beginning of the next Working. b. For urgent breakdowns (e.g. project with strict deadline), the Contractor is to complete any on-site service, repair, or replacement or adjustment of components within 2 working days when parts are available in Singapore, within 5 working days when parts are not available in	☒ Yes/ ☐ No

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Singapore and are needed to be ordered from overseas from and including the date on which the Contractor was given notice pursuant to Clause II(a) unless the Authority had agrees in writing to have the time period extended.	
(G) Replacement of Components	
i. 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. ii. 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. All replacement components shall be provided free-of-charge during the period of warranty period and post warranty comprehensive maintenance contract.	☒ Yes / No

Please indicate any non-compliance to requirement specifications here should there be any.

Reference To	Remarks
A1 (v)	Flow rate range from 0.001 ml/min to 2.000 ml/min.
A2 (i)	Sample injection volume from 0.1 ul to 10.0 ul.