

REVISED TECHNICAL SPECIFICATIONS AFTER PRE BID CONFERENCE ON 12.11.2018

TRIPLE QUADRUPOLE ICPMS WITH SPECIATION CAPABILITY & IC

1. BRIEF DESCRIPTION OF ICP-MS SYSTEM:

- 1.1. ICP-MS system along with its accessories should be compatible to the guidelines of international Standards and Regulatory Agencies and is applicable for elemental analysis in water & deposit /soil/food samples. It is to be latest in the category and capable to deliver ultra-trace analysis of ions at sub-ppb to low ppt level with adequate accuracy required for elemental Analysis in various environmental studies. All accessories must maintain integrity and aesthetic aspect of instrument. The instrument must be of high sensitivity and low on maintenance. The bidder must take ownership of entire integrated equipment set up as per technical specifications.
- 1.2. Performance of the equipment is to be demonstrated through analysis of 25 elements or more at low ppt/sub-ppb using supplied NIST certified standards. The equipment must have facility for both qualitative & quantitative scan.
- 1.3. The system must have two quadrupole mass filters with 1 amu resolution mass filter capability one before collision-reaction cell and another after collision-reaction cell. Appropriate collision and controlled reaction capability with true cell arrangement to measure isotope of interest by removing isobaric and polyatomic interference.

Detailed description is given below.

2. ICP-MS Sample introduction system

- 2.1. **Sample introduction system:** HF resistant sample introduction system comprises of multi-layer delivery pump with tubings, internally cooled HF resistant inert spray chamber with -5 or less to 20°C or wider, HF resistant torch nebulizer injector and appropriate platinum cone interface should be standard supply for HF digested samples. The entire system path should be appropriate for handling HF-digested sample & should contain entire accessories with detailed break-up to be mentioned in the quote.
- 2.2. **ICP torch & Precision torch adjustment facility:** Quartz torch with 2.5 mm ID injector or suitable close match should be quoted for routine samples. For organic samples, suitable sample introduction system comprising 1.5 mm ID injector torch, suitable nebulizer, spray chamber, multi-layer peristaltic pump tubings, Pt cones additional O₂ nebulizer gas flow line with mass flow controllers (MFC) and other items with detail break ups should be quoted. There should be minimum 4 MFC for Plasma, Nebulizer, Auxiliary and dilution argon gas. Instrument should contain minimum 4 MFC with separate gas channel/lines for collision and reaction capacity namely He, H₂, O₂ and NH₃. All adjustments for torch & gas flow must be completely computer controlled.

2.2.1. **Precision gas control:** System should be quoted with software controlled gas dilution to analyze sample with TDS of 20% or higher. It should be having variable gas flow control facility with dilution capability.

3. **Ion Source and RF Plasma:**

3.1. The ICPMS must have computer controlled RF generator operating on 27/30 MHz or more with automatic control of torch ignition, shutdown and system warm up.

3.2. Automatic shutdown of the plasma by the system after completion of analysis along with other safety features.

4. **Ion extraction interface:**

4.1. Suitable cooled interface under vacuum and with standard high performance Ni and Pt or better suitable sampling and skimming cones to suit all applications.

4.2. The cones/interface should be easily demountable with all torch movement, easily cleaned and replaced.

5. **Ion focusing system:** The ion focusing system capable of removing all neutral molecules from the ion path without causing any wear and tear to any part of the optics.

6. **Sensitivity:** sensitivity specifications are as follows: Unit of Measurement (UOM): MCPS/ppm

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- Low mass – min. 50 mcps/ppm
- Mid mass – min. 200 mcps/ppm
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- High mass – min. 300 mcps/ppm

Detection limit:

The offered MS/MS system should be capable of estimating specific analyte of interest in collision-reaction mode as per the specified detection limit and respective detection limits must be given in details in the quote for technical evaluation.

- S^{32} (as SO^+) < 270 PPT
- P^{31} (as PO^+) < 70 PPT
- Se^{78} < 10 PPT

7. **Cell Technology:**

7.1. **Mode of operation:** ICP MS shall incorporate a Cell offering three modes of operation: Standard Mode, Collision Cell Mode and Reaction Cell mode which utilize variety of reactive gases such as H₂, NH₃ and O₂. There should be dedicated 3 (three) Gas channels, One MFC for He, & other three more gas lines/channels with MFC for reactive Gases such as O₂, NH₃ and H₂. The purity of all the four gases involved must be of 99.99%.

7.2. **Control:** The switching of reaction and collision gases will be through software and automated. Unit will have the flexibility of applying both gases using single method for removal of interferences. The Cell should have the capability of 4 lines/channels with individual MFC for one collision gas and three reaction gases.

8. **Quadruple analyzer & Ion detector:**

8.1. The mass range should be from 2-275 amu or wider.

8.2. The dwell time should be as short as 0.1 ms or better for fastest settling.

8.3. Scan speed should be >4000 amu/s.

8.4. The Mass filter should consist of Three Quadruple design with first & third quadruple having unit mass resolution. Collision and reaction cell arrangement to be present for total Interference Free Analysis.

8.5. System should have dedicated MFC to control plasma, auxiliary, nebulizer, reaction gas and collision gas

8.6. The analyzer must have the ability to discretely control the resolution of selected mass regions dynamically without affecting the overall nominal resolution of the system.

8.7. Ion detection should consist of the electron multiplier & shall have minimum 10 order of linear dynamic range using simultaneous analog &/or pulse counting. It shall be possible to measure major and minor concentrations in a single analytical run.

9. **Autosampler:**

9.1. Auto sampler: Auto sampler should hold about 200 or more vials (capacity: 5-15 ml or suitable close match). It should control by same software from the same manufacturer of ICP-MS. It should have washing & random access to all sample vials.

9.2. System software should allow to automatically scheduling, instrument optimizations and procedures, including auto-start and shut down, tuning, and multi-method analyses.

9.3. System should have Fast Auto sampling technology such as SC4 DX or gas dilution technology for addressing high TDS>20%.

10. **Software-** The ICP MS software should be able to control full system including all accessories including Auto sampler & other external sampling set ups, It should have auto tune facility, automatic mass calibration on power on, real time system monitoring, Diagnostics & reporting templates, The system should be supplied with full compliant software including 21 CFR part II enabling server based

data storage, retrieval and integrity. The software should be able to integrate Ion Chromatography system under single control with seamless analysis from sample Injection to reporting for speciation applications without any manual intervention for the following Ion-Chromatograph system.

11. **IC Specifications** The Ion Chromatography system to be quoted must be latest and should have inert, nonmetallic PEEK (polyether ether ketone) fluidic components throughout the system to ensure solvent compatibility and metal contamination-free chromatography. Must meet the following specifications :- Ion Chromatography System with gradient facility to analyze various Anions like Cl⁻, F⁻, Br⁻, BrO₃⁻, NO₂⁻, NO₃⁻, PO₄³⁻, SO₄²⁻, perchlorate, Cations like Na⁺, K⁺, Li⁺, NH₄⁺, Ca⁺, Mg⁺, barium, strontium, Arsenic, Chromium, Mercury, selenium speciation etc. Alkanolamines, Cyanide and Sulfide etc.

Must be software configurable ion chromatograph consisting of at least a pump with the ability to include any or all of the following options; conductivity detector and cell, electrochemical detector and cell, UV-VIS Detector, column oven, degasser.

Solvent Delivery Pump The pump must be made of a nonmetallic material to reduce the possibility of corrosion as a result of coming in contact with acid and base eluents that are common with ion chromatography. The solvent delivery pump must be one set of Quaternary Gradient pump/ two sets of Binary gradient pump. The pump must be of a serial dual piston design to reduce maintenance cost and insure precision Must have a high pressure pump capable of continuously operating at pressures of 5000 psi

- The flow range must be 0.000–10.000 mL/min without changing pumps in settable flow increments at 0.001 mL/min.
- Flow Rate Precision & Accuracy : < ± 0.1%
- Pressure Ripple : < 1% at 1.0 mL/min, typical
- The pump must have as an option a piston seal wash, which can be continuously operated when connected to rinse solution supply.
- Must allow for user-selectable high- and low-pressure limits to automatically stop the pump in the event of leaks, flow restrictions, flow blockages, or empty eluent reservoirs.
- Must have as an option a built-in vacuum degas assembly which provides in-line degassing of eluents ensuring reproducibility and protection of eluents from contamination and decomposition.
- Must have option of any combination of an unlimited number of linear, convex, and concave positive and negative gradient profiles.
- 6-port injector valve with fast response time and controlled through software.
- Housing for column for thermal insulation.
- Column thermostat range: Ambient to 70 Deg C.
- Leak detection: Leak sensor optical, standard.
- Eluent organizer with all regulatory accessories for required application along with the Non metallic bottle (4 Nos.) for Solvent Reservoir with inert gas pressuring facility to provide constant pH of mobile phase with gas regulator and enclosure.
- Chromatography accessories and detector enclosure to mount various accessories

like sample injection valves, multiple columns with temperature of 10-70 deg. C it should have two detector electronics, one for electrochemical detector and second option can be for conductivity or second electrochemical detector have the temperature control from 1-40 deg. C

Suppression Device

To reduce the background conductivity, enhance the conductance of the analyte of interest, and remove the counter ion resulting in increased signal suppressor must be provided for both cations & Anion analysis. It must have the ability to perform gradients or isocratic, Binary & Quaternary runs without changing the device.

- Suppression of eluent must be available for Anion as well as Cation applications.
- The suppressor must be operated continuously.
- Suppressor regeneration must be carried out electrolytically in either recycle or external water mode or Chemical suppression mode
- Suppressor device must be able to suppress hydroxide or methanesulfonic acid or carbonate or nitric acid eluents as required for EPA, ASTM, ISO, or other standardized methods.

Columns

Metallic PEEK based Ion exchange column and its guard column compatible and suitable of 0-14 pH for anions (01 no.), cations (01 no.), Cyanide and sulfide (01 no.), Columns for speciation analysis including elements like, As, Hg, Se, Cr, I, Br etc. should be included.

Housing for columns with two independent temperature zone and one injection with following specifications:-

Upper Section Temp. Range: 10-40 °C

Lower Section Temp. Range: 10-70 °C

Temperature Accuracy: ± 0.5 °C

Temperature Stability: ± 0.2 °C

Temperature Precision: ± 0.2 °C

Lower Zone: (Analytical)

Injection valves: Six port Rheodyne PEEK injection valve.

Can house Up to two column sets, 1-9 mm, 250 mm length

Maximum column length: 250 mm

Pre-column heat exchangers: 2

Sample preparation cartridges - 80 numbers or more of polymer base reverse phase cartridges should be offered along with system.

Ion chromatograph detectors

UV-VIS Detector

It may permit a secure and reliable quantification of substance active in the ultraviolet or visible range. UV-Visible range for Vitamins analysis. One reference channel for speciation of Iron, chromium using compact post column derivatization unit with complete set of accessories. Post column derivatization should be with reagent delivery using Peristaltic Pump/Pneumatic pump. The detector should be of four channels variable wavelength type and the range should be 190 to 900 nm.

UV-Visible Detector for detection of Fe⁺², Fe⁺³, Copper, Nickel, Zinc, Cobalt, Cadmium, Manganese, Aluminum. Etc. along with Iron and Chromium speciation.

Light source: Deuterium & Tungsten Lamp

Wavelength Range: 190-900 nm or higher

Bandwidth: 6 nm or less
Wavelength accuracy: ± 1 or more nm.
Cell: PEEK, Volume : 11 μ L

Electrochemical Detector

Electrochemical Detector for carbohydrates, cyanide, sulphide should be quoted. The detailed specifications are as under:

The electrochemical detector must be capable of operating in an integrated amperometry, pulsed amperometry, DC Amperometry mode, or cyclic voltammetry or scan mode. Infinite waveforms and infinite integrations times must be supported to optimize detection conditions for individual analytes.

Three electrode measuring cell with relevant working Electrode.

Potential Range: ± 2.00 v in +2.00IV and increment of 0.001 V.

Measuring Range: 50 pC-200 μ C (Int, Amp) & 5 PA - 74 μ A (dc Amp)

For analysis with a gold working electrode, glassy carbon electrode and Pd reference electrode/ Ag-AgCl₂ and suitable working electrode.

Conductivity Detector:

Conductivity detector for analysis of anion and cation, should be microprocessor based digital signal processing with a thermo-stated (built-in temp. monitoring) micro-flowcell conductivity block with accuracy/stability of $\leq 0.001^\circ\text{C}$ with auto range output facility.

The user should be able to set temperature of the conductivity block between 20-50 deg C.

Conductivity measurement range: 0-14000 μ S/cm

Electronic noise < 0.1 nS/cm at 1 μ S/cm level

Housing for columns is in a thermostated block with temperature control range 10 $^\circ\text{C}$ to 70 $^\circ\text{C}$. The housing should be able to identify the columns and set the optimal operating conditions for column operations.

Autosampler

Must utilize nonmetallic fluid path components to reduce potential sources of contamination, eliminate corrosion, and be acid and base resistant. Must have displacement injection principle to allow loop and concentrator loading completely, high precision volume delivery, individual sample filtration, and prevent viscosity dependency. Must not require an external sampling pump.

- 1) The filter facilitates the removal of particulates during sample loading automatically. Each sample must be filtered with its own unique filter and not through reused, re-cleaned, or regenerated filter. Samples should be filtered inline before the loop is filled. Suitable provision accessory has to be provided.
- 2) Must be capable of handling vials sizes of 0.5 mL or 5mL and the vials must be polymeric.
- 3) Must have sample overlap capabilities to start sample preparation while the instrument is acquiring data.
- 4) Must have minimum 100 sample size vial tray.

Accessories

- 1) ICPMS tuning solutions

**required for
installation**

- 2) Spares kit containing drain, sample Peristaltic pump tubing-sample intake peristaltic pump tubing-Drain Peristaltic pump tubing-internal standard Gasket for cones, Rough pump oil
- 3) Micro mist nebulizer , Plasma Torch -min 2.5mm ID,
- 4) PFA inert kit containing Sapphire torch, sapphire injector, spray chamber, concentric nebulizer,
- 5) Pt Cones for sample and skimmer.
- 6) Additional quartz torch.
- 7) Multi-element standard with at least 20 elements (NIST certified). Required Grade-I exhaust system fumehood for the ICP-MS.
- 8) Highest purity Gas Cylinders and SS Regulators for Ar (4 qty.), He (2 qty.), H₂ (1 qty.), O₂ (2 qty.) and NH₃ (3 qty.) with desired purity. Ar gas cylinders should be supplied with automatic switching valve.
- 9) Sample tubing and drainage tubing
- 10) Gas purification panel and necessary fittings.
- 11) 20KVA online UPS with min 30 minutes backup
- 12) One HP/DELL All-in-one PC with i7 technology compatible with the complete system of 3QICP-MS-IC.

Additional Requirements:

Bidder must provide the list of end user using the equipments around as per given technical specification.

Delivery period must be 8-10 weeks from the date of purchase order/LC.

Services, spare parts and consumables for entire system must be provided by a bidder single handedly for qualification, calibration, method development, validation and training support for two years free of cost.

Training of NBRI staff (Scientists/Technical Officers) at appropriate place for handling of ICP-MS and IC and standardization of various parameters under testing as mentioned above must be given by the bidder.

Comprehensive Guarantee/Warranty on entire equipment for one year.

10 years written assurance for the maintenance and technical support of 3Q-ICP-MS with IC after sale.

Important notice to bidders:

Bidders may note that earlier specifications published with tender may be treated as replaced with these revised specifications and bidder may only quote according to the specifications mentioned herein above.

Stores & Purchase Officer