

Technical specifications of Triple quad Inductively Coupled Plasma Mass Spectrometer (ICP-MS/MS) with Ion Chromatograph (IC) and Laser Ablation (LA) accessories

State-of-the art Triplequad Inductively Coupled Plasma Mass Spectrometer (ICP-MS/MS) capable of performing multi element analysis at major, minor, trace and ultra-trace levels in single run for different matrices namely environmental, chemical, biological and geological samples etc. The Ion chromatograph (IC) should have coupling option with the ICP-MS/MS and also be capable of functioning in standalone mode. Laser ablation (LA) accessory should be fully compatible with the ICP-MS/MS to obtain high end results for solid samples.

I. Technical specifications of ICP-MS/MS:

Sl.No	Feature	Requirement	Comply/ Not Comply	Ref. Page No.
1.	Sample Introduction system	<p>Sample Introduction system compatible for aqueous, organic, samples with high TDS and HF based samples to be provided.</p> <p>Peltier cooled spray chamber (-5 to 20 deg or better), inert torch tube, PFA/Glass/Quartz nebulizer, Ni sample and skimmer cones, Platinum sample and skimmer cones, Low pulsation, high precision multichannel peristaltic pump.</p> <p>Separate organic kit, HF kit, tubing set and MFC for oxygen to aspirate organic samples directly. Online internal standard kit with splitter and tubing set.</p> <p>Factory integrated dilution accessories with 100-fold or better dilution capabilities (UHMI/AMS/AGD) for direct aspiration of samples containing 25% TDS. Accessories must be fully automated and software controlled without any manual intervention necessary and without utilizing Internal Standard kit or tubing's.</p>		
2.	RF generator and torch	RF generator 27 MHz or more, 550-1600 W or better for automatic control of torch ignition, shutdown and system warm up. The plasma torch should have provision for software controlled alignment of horizontal, vertical position and sampling depth		
3.	Ion extraction Interface	Standard large orifice Ni sampler (1 ± 0.1 mm ID) and skimmer (0.45 ± 0.05 mm ID) cones with suitable diameters		
4.	Ion focusing system	The ion deflection system should have efficient mechanism for removing all neutrals from the Ion path. The ion path must be maintenance free and at a 90 deg deflection or off-axis or suitably designed		
5.	Cell Technology	The system should incorporate Standard mode, collision mode (He) with KED and reaction mode for interference removal in a single analytical method simultaneously. The system should have collision and reaction cell (CRC) with		

		controlled reaction capability to carry out mass shift reactions. Cell must be non-consumable with zero maintenance.		
6.	Gas control	The system should have factory fitted MFC (4 Nos) to control He (collision gas) and reaction gases like H ₂ , NH ₃ , O ₂ etc in a safe premix or pure form and compliant manner. System should have provision to handle an additional of minimum 15 CRC gases based on request. System should have dedicated MFC devices to control Ar flow for plasma, auxiliary and nebulizer and Ar + O ₂ flow for samples containing high TDS and O ₂ flow for organic samples.		
7.	Quadrupole assembly (for MS/MS Triple quadrupole system)	Quadrupole mass analyzer Q1 & Q3 must have unit mass (1 amu) resolution capability. User definable resolution from $\leq 0.3u$ to $\leq 1.0 u$ should be possible. Q2 should be Collision – Reaction based. “Tandem mass spectrometer comprising two transmission quadrupole mass spectrometers in series, with a (non-selecting) RF-only quadrupole (or other multipoles) between them to act as a collision cell” as defined by the International Union of Pure and Applied Chemistry (IUPAC) Mass calibration assessed and automatically updated. Mass range 4-260 u or better Scan speed >3700 amu/sec or better at 40 mass intervals		
8.	Ion detector assembly	Simultaneous dual mode discrete dynode electron multiplier. Dynamic range: 10 orders or more, without any Software/hardware adjustment Minimum dwell time of 100 μ s or better in pulse and analog		
9.	Vacuum system	Suitable corrosion resistant turbo pump and other backing pumps should be supplied. Vacuum level 1×10^{-5} Torr or better.		
10.	Performance specifications	Sensitivity (Millicounts Per Second/Parts Per Million) Low mass Li/Be : ≥ 65 or better Mid mass In/Y : ≥ 300 or better High mass U/Tl: ≥ 330 or better Detection limit no gas mode (Parts Per Trillion) Low mass Be/Li ≤ 0.5 or better Mid mass In/Y : ≤ 0.1 or better High mass Tl/U : ≤ 0.1 or better Oxide ratio(% RSD) CeO / Ce < 2 % or better Back ground (No gas/KED mode) for Low and High mass < 1 counts per second or better Short term & long term stability (% RSD) < 4 % or better Isotope ratio precision (% RSD): Ag ¹⁰⁷ / Ag ¹⁰⁹ ≤ 0.3 % or better		
11.	NPS module	Single nanoparticle comprehensive module for estimation of number of particles, particle concentration, particle size and distribution should be provided.		
12.	Autosampler	Suitable autosampler with ≥ 100 vials to be provided		

II. Technical specifications of Ion Chromatograph:

Sl.No.	Feature	Requirement	Comply/ Not Comply	Ref. Page No.
13.	Design aspects	Standalone Ion chromatograph suitable for analyzing anions, cations, transition metal ions, organic acids, amines etc by suppressed or non-suppressed mode conductivity measurements and speciation of Fe, Hg, As, Cr etc by coupling with ICP-MS/MS		
14.	Solvent delivery pump	Quarternary/ternary gradient pump with built in degassing system type Serial dual piston pump, microprocessor controlled, constant stroke, variable speed, Chemically inert, metal free PEEK pump heads and flow path, compatible with aqueous eluents from pH 0-14 and reverse phase solvents Pressure range: 0-5000 psi Flow range: 0.000 – 10 mL/min with settable flow increments at 0.001 mL/min Flow precision <0.1% Flow accuracy < 0.1% Pressure ripple <1% Temperature range : 30 to 60 deg		
15.	IC power cords	To be provided		
16.	Eluent organizer with four 2 L PP/PTFE bottles	To be provided		
17.	Inline eluent filters	To be provided		
18.	DC, Dual Independent Temperature zones, 6 port PEEK manual injection valve, Standard bore	To be provided		
19.	Detector	Thermostated microflow cell block Measurement range : 0-15000 μ S/cm or better Cell drive: 8 KHz square wave or 1.4 KHz sine wave Conductivity resolution: 0.005 nS/cm or better Linearity : 1 % or better Baseline noise: \pm 0.1nS or better Data sample rate : 10 ms or better Temperature range 20°C to 50 °C, user settable Temperature stability : \pm 0.001°C or better Temperature compensation : 0-3% per °C Flow Cell Volume : <1 μ L or better Cell electrodes: compatible with majority of the used eluents Detector should be upgradable in future. The accessory for		

		connection to ICP-MS detector for automatic triggering of data acquisition should be seamless integration (both ICP-MS/MS& IC).		
20.	Columns for Speciation analysis of Cr, As, Hg and Fe by interface with ICP-MS/MS	The following columns to be provided Analytical PEEK Column Guard PEEK Column		
21.	Suppressor	Suppressor should be of packed bed type with high loading and high back pressure (300 psi or more) tolerance with continuous regeneration. External chemical regeneration mode with controlled flow rate up to 10 mL /min. Should be 100 % solvent compatible.		

III. Technical specifications of Laser ablation system:

Sl.No	Feature	Requirement	Comply/ Not Comply	Ref. Page No.
22.	Laser	Frequency quintupled Nd:YAG laser 213 nm for good coupling with nearly all sample types, including highly transmitting materials. Energy : 3 mJ/pulse or higher Pulse width : 5 ns Energy output: 0-100% Spot sizes : 4 µm to 200 µm dia must be achievable with aperture imaging, with larger spots achievable via defocusing Sampling repetition rate : 1-20 Hz The number of laser transfer optics must be as low as possible, minimizing energy losses. Spot selection must be via ceramic aperture wheel.		
23.	CCD camera / Microscope	Resolution : 2 µm or better Field of view ≥ 6 mm of sample surface Optical zoom 2.5x to 32x or better		
24.	Lighting system	Software controlled high intensity LED for sample illumination (Incident & transmitted) and cross polariser		
25.	Sample cell / chamber	Fast washout HelEx II or equivalent cell to be provided Sample chamber 50mm or more in height Capable of measuring samples upto 12 mm or more X-Y stage resolution 0.16 µm or lower Stage travel 100 mm in the X and Y planes The washout performance of the chamber must be <1.5 s for washout to 1 % at any point in the cell area A sample cell gas purge system controlled by precision calibrated MFCs that uses Helium to transport and entrain the ablation particles into the argon stream of the ICP. Open architecture for maximum stability.		

IV. Common requirements for the entire system (ICP-MS/MS + IC+ LA)				
26.	Other items	<p>a) Latest PC's/workstations with 24" monitor and i7 OS compatible with ICP-MS/MS, IC and LA applications. The main system should have inbuilt hardware features required for seamless integration of Ion Chromatograph and Laser ablation accessories. An original licensed copy of the windows-based software which includes all features required for ICP-MS/MS operation, NPS module, Inorganic speciation and Laser ablation studies to be provided.</p> <p>b) Suitable noise free OEM make recirculating chiller should be provided.</p> <p>c) Exhaust system for ICP-MS/MS should be provided.</p> <p>d) Gas purification panel, manifold double stage for Argon cylinder, manifold single stage for He, H₂, O₂ Ar:O₂ mixture (for organic analysis) and NH₃ cylinders and gas regulators for all the gases mentioned above to be provided.</p> <p>e) Vibration free bench for housing ICP-MS/MS, IC and LA to be provided.</p>		
27.	Warranty	Three years standard warranty from the date of installation/acceptance, covering all the units / accessories of the instrument to be provided.		
28.	UPS	High performance online UPS (20KVA or more) with in-built isolation transformer compatible for all the three modules namely ICP-MS/MS, IC and LA operating simultaneously with battery backup for 1-hour (at full load) to be provided		

V. Optional items:

1. Additional comprehensive warranty for two years for all parts and peripherals to be quoted separately.
2. Suitable auto sampler for IC and LA to be quoted separately.
3. Suitable PEEK analytical and guard columns for determination of anions and cations to be quoted separately.
4. Suitable PEEK analytical and guard columns for determination of transition metal ions to be quoted separately.
5. Suitable column oven to be quoted separately.
6. Suitable detector for determination of transition metal ions to be quoted separately.

VI. General Terms & Conditions :

1. Price for each item/accessory of the instrument should be quoted separately. However, the evaluation for arriving L1 on LCS will be done based on the overall value of all major items given in Sl.Nos. I, II III and IV.

2. Certified calibration standards and solvents required for smooth operation of ICP-MSMS, IC and LA for the first five years should be provided along with the instrument.

a) Suitable aqueous standards (individual/ multielement/internal) and organometallic standards in suitable organic solvents for ICP-MSMS applications should be provided.

- b) Standards, cationic and anionic buffers and mobile phase modifiers required for speciation of Fe, Cr, Hg and As using IC should be provided.
- c) Glass standards (610, 612, 614, 616) and other glass standards for elements (Be, Mg, P, S, V, Ge, Br, Y, Zr, Rh, Pd, Sn, Cs, Ta, W, Pt, Hg, Bi and Pr) for LA applications should be provided.
3. Software upgrades should be incorporated by the vendor as and when the new versions are released at no additional cost.
4. Spares and consumables needed for smooth operation of ICP-MSMS, IC and LA for the first five years to be provided along with the instrument.
5. Accessories such as UPS and Chiller may be supplied locally. Complete technical details along with manuals of items supplied locally or from an outsourced vendor, should be submitted along with the quotation.
6. One week onsite training for the operation and general maintenance must be provided.
7. The vendor should attach a list of similar equipment (not mandatory as a set) sold in India during the last 5 years.