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From: Director, CSIR-NPL
No. 14-VII/PS(3049-GTE)25PB/T-132 Dated:08.01.2026

CORRIGENDUM

With reference to NPL's Global Tender ID: **2025_CSIR_823537_1** for "**Gas Sensor Testing System**". All the prospective bidders are hereby informed that some changes have been made in the technical specification of captioned tender. Revised specifications are as follows:

Original Specifications	Final Specifications
As tendered	Attached as Annexure I

Revised Technical specifications (Annexure-I) is also ATTACHED with this Corrigendum. Accordingly, all the interested bidders may submit their Offer as per revised technical specification.

Please also note that bids submitted without taking these changes into consideration will be rejected summarily.

All other terms will remain the same. The same is also available on CSIR-NPL official website http://www.nplindia.org under Tender link.

Sr. Controller of Stores and Purchase

8.1.26

8/1/2026

FORM TO BE FILLED BY IO WHILE CONVENING PRE-BID MEETING OF TSC

File No.: 14-VII/PS(3049-GTE)25PB/T-132 Date: 30-12-2025

Pre-bid Meeting (To be typed clearly by the I/O)

Name of Indentor: Dr. Preetam Singh

Indent No.: PR3041632025/PB dated: 14.10.2025

Item Description: Gas Sensor Testing System

No. of Budgetary Quotes: Two

(1) A pre-bid meeting of TSC was held on **30-12-2025.**

(2) Following queries were raised by participating Bidders:

Name of the Firm	Queries Raised	Remarks, if any
M/s Airshed Planning Professional Pvt. Ltd. OEM: MCZ Germany	1. Query: Page 28: 1.1: Hydrazine is available in permeation tube only. No cylinder is available. In point 1.1 it is mentioned cylinder of hydrazine. 2. Query: Sr. no. 1.4, page 29: Mass flow controller pressure rating indicated as 64 bar, which needs to be corrected. No need to go above 7 bars. 3. Query: Page 31 (Oxygen Gas Analyser): Suitable oxygen analyser based on NDIR-bench, NDUV bench, Tunable Diode Laser System (TDLS), Photoionization detector (PID), or equivalent (vi) Integrated Paramagnetic Oxygen Sensor (POS) to be equivalent. The analyser shall be based on Paramagnetic Sensor, as it is the most accurate and reliable technology for oxygen measurements. 4. Query: Page 33 for CO_2/CH_4 Gas Analyser for High Concentrations no	--

	certification is available. However, ammonia shall be coupled with Certified NO-NO_x analyser 5. Query: Page 34 (VOC Analyser): Formaldehyde not detected by the analyser. Only able to detect benzene, toluene and ortho and meta and para. 6. Query: Page 34 (1.8): The system must have three test cells, Dimensions of the testing cell chamber are required. 7. Query: Page 36, point 6 (ii): ISO 6145-7 standard for Gas mixer. 8. When the PBG will be released (in 1 year or in 2 years) 9. What will be the delivery timeline after the issuance of purchase order.	
M/s ATOS Instruments Marketing Services OEM: ETG, Italy	1. N_2H_4 at page 28 only in permeation and not in cylinder, 9 cylinders only, and 9 pressure regulators only. 2. Pressure only up to 7 bars at page 29. 3. CO_2/CH_4 not required certification but linearity test from the BIDDER at page 33. 4. H_2S not required certification but linearity test from the BIDDER at page 32. 5. O_2 Paramagnetic accepted as technique at page 31 for O2 analysis. 6. Three different VOC's acetone,	--

	acetaldehyde, formaldehyde can't be detected by VOC analyser, we can supply ETG 9500 FTIR. List of gases detectable by SYNSPEC GC analyser that perfectly fits for the specification but does not indicate acetone, acetaldehyde, formaldehyde. We can detect with ETG 9500 FTIR Acetone in the range 0.1-100 ppm Acetaldehyde in the range 0.1-100 ppm Formaldehyde in the range 0.1-100 ppm We can certify in that ranges but the analyser has the following specifications. Characteristics • Optimized Gas cell and FTIR Assembly • Compact and rugged • Resolution of down to 0.5 cm^{-1} Higher than 0.5 cm^{-1} does not permit the detection • MCT Detector with high detectivity TE-cooled MCT detector 5000-830 cm^{-1} (2-12 µm) • 5m heated gas cell with small volume (0.2L) • Sw in Linux • Proprietary chemometric software with the three VOC, possible to expand the library 7. Details for the electrochemical cells at page 34 it's not indicated any specification about mechanical and electrical connections and there are many different suppliers in the world that have mechanical and electrical connections, we can do based on the indication of only 3 different mechanicals and electrical	

	connection that has to be given before the tender submission and it has to be specified if we record the high level signal as 4-20 ma or protocol output, or the low level signal from the pins of the cell. Details for the electrochemical cells at page 34 it's not indicated any specification about mechanical and electrical connections and there are many different suppliers in the world that have mechanical and electrical connections, we can do based on the indication of only3 different mechanicals and electrical connection that has to be given before the tender submission and it has to be specified if we record the high level signal as 4-20 ma or protocol output, or the low level signal from the pins of the cell, with indication of the different Resistance equivalent to the MOS Sensor. Details of hydrogen sensor Details for the electrochemical cells at page 34 it's not indicated any specification about mechanical and electrical connections and there are many different suppliers in the world that have mechanical and electrical connections, we can do based on the indication of only 3 different mechanicals and electrical connection that has to be given before the tender submission and it has to be specified if we record the high level signal as 4-20 ma or protocol output, or the low level signal from the pins of the cell. 8. As indicated at page 36 chapter 6 we require if possible to have the possibility to be authorized as supplier as used in the laboratory of NPL and being a metrology institute	

	is metrologically certifiable as the last certificate given in November 2025.	
M/s ALVI Automation (India) Pvt. Ltd.	No query	--

Indentor's recommendation

1. The comments, as received from bidders during PBC, and our response is as follows:

Tender Specification and its number	Comment of bidder	Response of Indentor (Accepted/ Not accepted)	Revised specification (If any)	Justification for non-acceptance
(i). One-year standard warranty of the entire system. (ii). One-year additional warranty --	1. When the PBG will be released (in 1 year or in 2 years) (MCJ and Airshed)	Accepted	PBG will be released in 1 year + 2 months to cover warranty period	--
	2. What will be the delivery timeline after the issuance of purchase order. (MCJ and Airshed)	Accepted	Within 6 months of LC opening	--
10 litres Aluminum Gas cylinders with an inlet pressure of 200 bar, and with an inlet filter and safety valve for the following gas concentrations	3. N_2H_4 at page 28 only in permeation and not in cylinder, 9 cylinders only, and 9 pressure regulators only. (ETG and ATOS) (MCJ and Airshed)	Accepted	Hydrazine may be provided in permeation tube. Rest all the gas cylinders with regulators (12 nos.) as Table 1.1 should be provided	--
Pressure rating: 100 bar/64 bar	4. Pressure only up to 7 bars at page 29. (ETG and ATOS) (MCJ and Airshed)	Accepted	Pressure rating: 7 bar or higher	--
Certifications: US EPA, EU: EN14211 TUV Rheinland, QAL1 Certified: EN15267, MCERTS: Sira, CNEMC standards	5. CO_2/CH_4 not required certification (ETG and ATOS) (MCJ and Airshed)	Not accepted	Certification is required for acceptable concentrations CO_2 (up to 30%) CH_4 (up to 80%)	Certifications are available up to defined concentrations CO_2 (up to 30%) CH_4 (up to 80%)
	6. H_2S not required certification	Accepted	Certification not	--

	(ETG and ATOS) (MCJ and Airshed)		required	
Suitable oxygen analyser based on NDIR-bench, NDUV-bench, Tunable Diode Laser System (TDLS), Photoionization detector (PID), or equivalent	7. O_2 Paramagnetic accepted as technique at page 31 for O2 analysis. (ETG and ATOS) (MCJ and Airshed)	Accepted	Suitable oxygen analyser based on Paramagnetic Oxygen Sensor (POS) technique	--
VOC analyser should have a gas chromatograph with a built-in pre-concentration system	8. Three different VOC's acetone, acetaldehyde, formaldehyde can't be detected by VOC analyser, we can supply ETG 9500 FTIR. List of gases detectable by SYNSPEC GC analyser that perfectly fits for the specification but does not indicate acetone, acetaldehyde, formaldehyde. We can detect with ETG 9500 FTIR (ETG and ATOS)	Not accepted	--	GC analysers are essential for higher accuracy. Suitable VOC analysers must be provided as per tender specifications
The system must have three test cells (i). One Testing Cell for metal oxide semiconductor (MOS) based gas sensors with controlled in temperature and humidity and heat able up to 500 °C.	9. Details for the electrochemical, MOS and hydogen cells at page 34 it's not indicated any specification about mechanical and electrical connections and there are many different suppliers in the world that have mechanical and	Not accepted	--	This is in the scope of the supplier to ensure that all the available technologies in the market should be covered.

Testing Cell should be capable of hosting 10 sensors simultaneously. (ii). One Testing Cell for electrochemical devices (ECD) and capable of hosting 10 sensors simultaneously. (iii). One Testing Cell dedicated to safety procedures for hydrogen utilization and capable of hosting 10 hydrogen sensors simultaneously.	electrical connections, we can do based on the indication of only 3 different mechanicals and electrical connections and it has to be specified if we record the high level signal as 4-20 ma or protocol output, or the low level signal from the pins of the cell. (ETG and ATOS)			
	10. As indicated at page 36 chapter 6 we require if possible to have the possibility to be authorized as supplier as used in the laboratory of NPL and being a metrology institute is metrologically certifiable as the last certificate given in November 2025. (ETG and ATOS)	The firm should provide proof of supplying the system to any NMI as per the tender terms and specifications	--	--

Final recommended specifications are as attached at Annexure 1 and signed by I/O: **With change**

Corrigendum to Tender may be issued/ ~~may not be issued~~.

Recommended Revised Date of Tender submission (if any) is ____

The specifications are generic and broad based.

Submitted to TSC for necessary approvals.

FORM TO BE USED BY TSC FOR FINALISING PRE-BID MINUTES

File No.: 14-VII/PS(3049-GTE)25PB/T-132 Date: 30-12-2025

TSC Minutes

Based on the Pre-bid meeting and recommendation of I/O, following changes have been made in the specifications:

Original Specifications	Final Specifications
As tendered	**Attached as Annexure 1**

The file is forwarded to Purchase Section for uploading the final specifications and TSC minutes on the website and CPPP Portal. **(With Change)**

Declaration: We hereby declare that we have no conflict of interest with any of the bidder in this tender

Gas Sensor Testing System

Complete Turnkey solution including specified hardware components and integrated accessories with a single software for making a fully automated system for testing all commercial air quality gas sensors. The system must consists dynamic gas mixing solution including water vapor, capable of control the flow, reference measurement systems (certified).

Key requirements of the system, along with other components:

Dynamic Gas Generation System: Consists of two calibrators (one dedicated to hydrogen) to automatically create a mixture with target concentrations of the following components: O_2, CO, NH_3, NO, NO_2, SO_2, H_2S, N_2H_4, CO_2, CH_4, LPG, H_2 and VOCs.

Other components:

S. No.	Detailed specifications of components
1.0	**Gas Sensor Testing System**
1.1	**Capable to generate mixer of gases and VOCs as per the requirements with moisture to simulate the ambient condition of gases (listed in Table 1.1 & 1.2).**

Table 1.1

Gas	Range	Lower Detection limit
H_2	0.1 - 4%	0.1%
O_2	0.5 - 25 %	0.5%
CO	20 ppb - 100 ppm	20 ppb
NH_3	1 ppb - 100 ppm	1 ppb
H_2O	0.01-3%	0.01%
NO	20 ppb - 100 ppm	20 ppb
NO_2	0.2 ppb - 20 ppm	0.2 ppb
SO_2	0.4 ppb - 20 ppm	0.4 ppb
H_2S	0.4 ppb - 10 ppm	0.4 ppb
N_2H_4	5 ppb - 1 ppm	5 ppb
CO_2	0.1 - 100%	0.1%
CH_4	0.1 - 100%	0.1%
LPG	0.1 - 100%	0.1%

Table 1.2

S. No.	Name of VOC	CAS Number
1.	Acetaldehyde (Ethanal)	75-07-0
2.	Acetone (Propanone)	67-4-1
3.	Benzene	71-43-2
4.	Formaldehyde (Methanal)	50-00-0
5.	Toluene	108-88-3

Calibrated gases and VOCs (Liquid) must be supplied by the vendor for the installation and testing of the system as per following details:

(i) Stainless steel (316L) Two-stage pressure regulators (12 Nos. compatible with 200 bar gas cylinder pressure, and outlet pressure 100 psi) suitable for each test gas (H_2, O_2, CO, NH_3, NO, NO_2, SO_2, H_2S, CO_2, CH_4 and LPG).

(ii) 10 litres Aluminum Gas cylinders with an inlet pressure of 200 bar, and with an inlet filter and safety valve for the gas concentrations as per Table 1.1.

(iii) N_2H_4 may be provided in permeation tube.

1.2	**Software controlled gas heating unit:**

	(i). Permeation oven to operate in hot and cold conditions must be provided (ii). Material of permeation oven: Borosilicate glass (iii). Adjustable temperature: 20-70 °C (iv). Control accuracy: +/- 0.1 °C
1.3	**Standard calibration system for chromatographs, mass spectrometers, and gas sensors:** (i) Through the combination of Mass flow controllers for liquid and gas phase concentrations, the desired concentrations should be produced. Mass spectrometers or gas chromatographs can be calibrated, as the reference stream should be highly reproducible and accurate. (ii) Flow range: up to 1200 g/hour for H_2O (iii) Max. heating temperature: 200 °C (iv) Heater capacity: 1000 W (v) Max. flow coefficient (Kv) value: 0.066 m^3/hour (vi) Pressure rating: up to 7 bar or higher (vii) Ingress protection: IP40 (viii) Material wetted parts: Stainless steel 316L or equivalent (ix) Sealing material: Metal-to-metal (x) Plunger material standard: FFKM or equivalent (xi) Process connections: Gas and liquid inlet, compression type or face seal couplings (xii) Vapour outlet: 1/4" tube (xiii) Purge connection: 1/8" OD or 1/8" face seal (xiv) Max. pressure: 5 to 40 bar (xv)Certification of approval: CE/UKCA **Liquid Mass Flow Controller (liquid flow based on H_2O)** (i) Flow ranges from 2 to 100 g/hour and 20 to 1000 g/hour (ii) Accuracy: ±1% Full Scale (iii) Repeatability: < 0.2% Full Scale (typical H_2O) (iv) Operating temperature: 5 to 50 °C (v) Fluid temperature: 5 to 50 °C (vi) Temperature sensitivity: ±0.1% Full Scale/°C (vii) Leak integrity, outboard: $< 2 \times 10^{-9}$ mbar litres/sec He (viii) Pressure rating: up to 7 bar or higher (ix) Ingress protection: IP40 (x) Material wetted parts: stainless steel 316L or comparable (xi) Sealing material: FFKM or equivalent (xii) Process connections: compression type, or face seal male couplings (xiii) Suitable power supply and Digital communication standard: RS232 or other suitable automation device for interconnecting control devices for data exchange, such as DeviceNet™, CANopen®, PROFIBUS DP, Modbus RTU/ASCII, FLOW-BUS, EtherCAT®, PROFINET, Modbus/TCP, EtherNet/IP, POWERLINK or equivalent (xiv) Electrical power supply: Indian standard, 220-240 V, 50Hz (xv) Certification of approval: CE
1.4	**Gas injection system with all fittings & fixtures:** **Mass flow controllers (MFCs)** (i) Flow ranges: 0 to 20 standard litres/min (SLM) (ii) Accuracy: ±0.5% of Reading Scale and ±0.1% of Full Scale (iii) Repeatability: <±0.2% Rd (or <±0.04% FS, whichever is greater) (iv) Control stability: ≤± 0.1% Full Scale (typical for 1 litre/min of N_2) (v) Operating temperature: -10 °C to +70 °C (vi) Temperature sensitivity: < 0.05% Full Scale /°C; span: < 0.05% Reading Scale/°C (vii) Leak integrity, outboard tested $< 2 \times 10^{-9}$ mbar litre/sec of He (viii) Pressure sensitivity 0.1% Reading Scale /bar typical for N_2; 0.01% Reading Scale /bar typical for H_2 (ix) Pressure rating: 7 bar or higher

	(x) Ingress protection: IP40 (xi) Material wetted parts: stainless steel 316L or equivalent (xii) Sealing and Plunger material standard: Resistance to high temperatures compatibility, and biocompatibility testing (such as Perfluoroelastomer (FFKM)/Viton or Ethylene Propylene Diene Monomer (EPDM) and USP Class VI approved or equivalent) **Water Vapour Generator** (i) The vapour generation system consists of a thermal liquid flow controller and a gas mass flow controller (MFC) for carrier gas. (ii) Temperature-controlled mixing and evaporation device. (iii) Suitable for mixing liquid flows of 1-1000 g/hour or better (iv) Saturated vapour flows of 50 millilitres/min up to 100 litres/min. (v) Accurate adjustment of dew or moisture and control from a few ppm to approximately 100%, whilst maintaining a very high stability in dew point. (vi) Full functionality should be retained with operating pressures up to 100 bar. **VOC Mixture Generator with Mass flow controller for dilution and continuous injection system:** **The injection system** (i) External device for continuous injection of the liquid component (ii) Heated injector port for evaporation of the liquid component (iii) Control unit for the dilution flow **Mechanical construction of the injector** (i) Electrically heated metal tube, covered from one side with a septum with a removable plastic membrane through which the external needle should be injected. (ii) On the other side, a heated tube must be provided to work as an evaporator. (iii) The metal tube should have a thin VA-wrapped pipe through which the carrier gas should flow into the injector. (iv) The carrier gas should be preheated to avoid cooling down of the injected component. **Technical Data of Standard Automatic Syringe** (i) Pump function: Infusion/Withdrawal/Programmable (ii) Flow rate maximum: ~ 39 millilitre/min or better using 60 ml syringe (iii) Flow rate minimum: 0.54 picolitre/min using 0.5 µl syringe (iv) Syringe size minimum: 0.5 µl (v) Syringe size maximum: 60 ml (vi) Max linear force: 35 lb @ 100% Force selection (vii) I/O TTL connectors: 15 pin D-Sub connector (viii) RS 232 connectors with suitable USB connectors (ix) Accuracy: ±0.4% or better (x) Non-volatile memory: Storage of all settings (xi) Drive motor: with 0.9° Stepper motor or better (xii) Motor drive control: Microprocessor with 1/16 microstepping (xiii) Number of microsteps per one rev of lead screw: 20, 480 (xiv) Step rate minimum: 27 sec/µstep or better (xv) Step rate maximum: 26 µsec/µstep or better (xvi) Step resolution: 0.03 µm/µstep or better (xvii) Pusher travel rate minimum: 0.068 µm/min (xviii) Pusher travel rate maximum: 70 mm/min or better (xix) Display: suitable color display with touchpad (xx) Environmental operating temperature: 0 °C to 40 °C

	(xxi) Environmental storage temperature: -10 °C to 70 °C (xxii) Environmental humidity: 20% to 80% RH, non-condensing (xxiii) Mode of operation: Continuous (xxiv) Concentration ranges: 10 ppb – 1000 ppm (xxv) Regulatory certifications: Standards such as CE, UL, CSA, CB Scheme, EU RoHS
1.5	**Automatic data acquisition system with time stamp**
1.6	**Certified reference measurement systems for gases listed in Table 1.1 & Table 1.2 with the specifications mentioned therein:** **Gas Analysis system for feedback with various analysers, each specifically designed to measure different species detected by the sensors must be provided** **H_2 Gas Analyser** (i). The H_2 analyser series operates without reference gases, even at the smallest measuring range (0.1 vol.%) of H_2 in Air. (ii). Measurement process: Thermal conductivity, 3xIR, (iii). Protection class: IP 65 (iv). Should withstand a pressure of 2 bars (absolute) (v). Ambient temperature range: -20 °C to 50 °C (vi). Communication: RS232 (vii). Suitable display must be provided (viii). On-site calibration (ix). Protection against condensate and dust (x). Suitable for inflammable gases (xi). Moisture measurement: Cross-sensitivity compensation (xii). Noise: < 1% of the smallest range (xiii). Drift at zero point per week: < 2% of the smallest range (xiv). Repeatability: < 1% of the smallest range (xv). Non-linearity: < 1% of range (xvi). Measuring error with ambient temperature: change per 10 °K < 1% of the smallest range (xvii). Flow influence: < 1% of the smallest range (xviii). Fault with measurement gas change: < 1% of the smallest range (xix). Suitable standard sample for calibration of the Analyser **Oxygen Gas Analyser** (i) Suitable oxygen analyser based on Paramagnetic Oxygen Sensor (POS) technique. (ii) LCD touch screen display and alarm (iii) Real-time data curve display (iv) Multi-point calibration function up to 9 points (v) Monitor the status of the analyzer and sensors with suitable communication (vi) Accurate reading with negligible cross-sensitivity to other gases. (vii) Smallest measuring range: 0-5% O_2 (viii) Standard measuring ranges: 0-100% O_2 (ix) Maximum flow 250 ml/min (x) Operating temperature: 5-40 °C or better (xi) Operating Relative Humidity: 0-90% RH (xii) Suitable standard sample for calibration of the Analyser **CO Gas Analyser** (i) Suitable CO analyser to measure low ranges of CO gas. (ii) Ranges min: 0 - 1 ppm (iii) Ranges max: 0 - 1000 ppm (iv) Measurement units: ppb, ppm, $\mu g/m^3$, mg/m^3 (selectable) (v) Noise: < 0.02 ppm (vi) Span noise: < 0.5% of reading above 5 ppm

(vii) Lower detectable limit: < 0.02 ppm
(viii) Zero drift: < 0.1 ppm/24 h
(ix) Span drift: < 0.5% of reading/24 h
(x) Linearity: 1% of full scale
(xi) Precision: 0.5% of reading (RMS) above 5 ppm
(xii) Flow rate: 800 cc/min ±10%
(xiii) Ports: 1×Ethernet, 2×RS232, 2×USB device
(xiv) 6×opto-isolated digital inputs and 8×opto-isolated digital outputs
(xv) Operating temperature range: 5 – 40 °C or better
(xvi) Suitable standard sample for calibration of the Analyser
(xvii) Certifications: US EPA, EU: EN14626 TÜV Rheinland, QAL1 Certified: EN15267, MCERTS: Sira, CNEMC standards.

NH_3 Gas Analyser

(i) Suitable NH_3 analyser based on chemiluminescence principle or equivalent to give stable and repeatable NH_3 gas measurements at very low levels and high gas concentrations
(ii) Software-controlled remote connection and data downloading capability.
(iii) Range min: 0 - 50 ppb
(iv) Range max: 0 – 100 ppm
(v) Highly selectable and independent of other gases such as NO, NO_2, NOx, NH_3, etc.
(vi) Measurement units: ppb, ppm, $\mu g/m^3$, mg/m^3 (selectable)
(vii) Zero noise: < 0.5 ppb
(viii) Span noise: < 1% of Reading Scale
(ix) Lower detectable limit: < 1 ppb
(x) Zero drift: < 0.5 ppb/24 h
(xi) Span drift: < 1% of Full Scale/24 h
(xii) Linearity: 1% of Full Scale
(xiii) Precision: 0.5%
(xiv) Sample flow rate: 1000 cc/min ±10%
(xv) Ports: 1×Ethernet, 2×RS232, 2×USB device
(xvi) 6×opto-isolated digital inputs and 8×opto-isolated digital outputs
(xvii) Operating temperature range: 5 – 40 °C or better
(xviii) Suitable standard sample for calibration of the Analyser
(xix) Certifications: US EPA, EU: EN14626 TUV Rheinland, QAL1 Certified: EN15267, MCERTS: Sira, CNEMC standards.

NOx (NO & NO_2) Gases Analyser

(i) Suitable NOx (NO & NO_2) analyser based on chemiluminescence principle or equivalent to give stable and repeatable NOx gas measurements at very low levels.
(ii) Range min: 0 - 50 ppb
(iii) Range max: 0 - 20 ppm
(iv) Measurement units: ppb, ppm, $\mu g/m^3$, mg/m^3 (selectable)
(v) Zero noise: < 0.1 ppb
(vi) Span noise: < 0.2% of Reading Scale
(vii) Lower detectable limit: < 0.2 ppb for NO_2 and < 20 ppb for NO
(viii) Zero drift: < 0.5 ppb/24 h
(ix) Span drift: < 0.5% of Full Scale/24 h
(x) Linearity: 1% of Full Scale
(xi) Precision: 0.5% of Reading Scale
(xii) Sample flow rate: 500 cc/min ±10%
(xiii) Ports: 1×Ethernet, 2×RS232, 2×USB device
(xiv) 6×opto-isolated digital inputs and 8×opto-isolated digital outputs
(xv) Digital alarm outputs
(xvi) Operating temperature range: 5 – 40 °C or better

(xvii) Suitable standard sample for calibration of the Analyser
(xviii) Certifications: US EPA, EU: EN14211 TUV Rheinland, QAL1 Certified: EN15267, MCERTS: Sira, CNEMC standards.

SO_2 Gas Analyser

(i) Suitable SO_2 analyser based on UV fluorescence principle or equivalent analyser for accurate measurements at low level SO_2 gas.
(ii) Range min: 0 - 50 ppb
(iii) Range max: 0 - 20 ppm
(iv) Measurement units: ppb, ppm, $\mu g/m^3$, mg/m^3 (selectable)
(v) Zero noise: < 0.2 ppb
(vi) Span noise: < 0.5% of Reading Scale
(vii) Lower detectable limit: < 0.4 ppb
(viii) Zero drift: < 0.5 ppb/24 h
(ix) Span Drift: < 0.5% of Full Scale/24 h
(x) Linearity: 1% of Full Scale
(xi) Precision: 0.5% of Reading Scale
(xii) Sample flow rate: 650 cc/min ±10%
(xiii) Ports: 1×Ethernet, 2×RS232, 2×USB device
(xiv) 6×opto-isolated digital inputs and 8×opto-isolated digital outputs
(xv) Operating temperature range: 5 – 40 °C or better
(xvi) Suitable standard sample for calibration of the Analyser
(xvii) Certifications: US EPA, EU: EN14211 TUV Rheinland, QAL1 Certified: EN15267, MCERTS: Sira, CNEMC standards.

H_2S Gas Analyser

(i) Suitable H_2S analyzer based on UV fluorescence principle or equivalent analyser for accurate measurements at low level of H_2S gas.
(ii) Range min: 0-50 ppb
(iii) Range max: 0-10 ppm
(iv) Measurement units: ppb, ppm, $\mu g/m^3$, mg/m^3 (selectable)
(v) Zero noise: < 0.2 ppb
(vi) Span noise: < 0.5% of Reading Scale
(vii) Lower detectable limit: < 0.4 ppb
(viii) Zero drift: < 0.5 ppb/24 h
(ix) Span drift: < 0.5% of Full Scale/24 h
(x) Linearity: 1% of Full Scale
(xi) Precision: 0.5% of Reading Scale
(xii) Flow rate 650 cc/min ±10%
(xiii) Ports: 1×Ethernet, 2×RS232, 2×USB device
(xiv) 6×opto-isolated digital inputs and 8×opto-isolated digital outputs
(xv) Operating temperature range: 5 – 40 °C or better
(xvi) Suitable standard sample for calibration of the Analyser

CO_2 Gas Analyser for Low concentrations

(i) Suitable CO_2 analyser based on infrared energy or equivalent analyser for accurate measurements at low level of CO_2 gas.
(ii) Range min: 0 - 4 ppm
(iii) Range max: 0 – 4000 ppm
(iv) Measurement units: ppb, ppm, $\mu g/m^3$, mg/m^3 (selectable)
(v) Zero noise: < 0.2 ppm
(vi) Span noise: < 1% of reading
(vii) Lower detectable limit: < 0.1%
(viii) Zero drift: < 0.5 ppm/24 h

(ix) Span drift: < 0.5% of Full Scale/24 h
(x) Linearity: 1% of Full Scale
(xi) Precision: 0.5% of Reading Scale
(xii) flow rate 800 cc/min ±10%
(xiii) Ports: 1×Ethernet, 2×RS232, 2×USB device
(xiv) 6×opto-isolated digital inputs and 8×opto-isolated digital outputs
(xv) Operating temperature range: 5 – 40 °C or better
(xvi) Suitable standard sample for calibration of the Analyser
(xvii) Certifications: US EPA, EU: EN14211 TUV Rheinland, QAL1 Certified: EN15267, MCERTS: Sira, CNEMC standards.

CO_2/CH_4 Gas Analyser for High Concentrations

(i) Suitable CO_2 analyser based NDIR - bench, NDUV-bench Tunable Diode Laser System (TDLS), Photo-ionisation detector (PID), or equivalent for the detection of CO_2 at high concentrations.
(ii) Real-time data curve display and alarm
(iii) Multi-point calibration function up to 9 points or better
(iv) Communication: RS485 MODBUS RTU
(v) Integrated with a two-channel measuring cell for
(vi) Ch.1: 0-100% CH_4
(vii) Ch. 2: 0-100% CO_2
(viii) Gas flow 0.1 - 1.5 litres/min
(ix) Lifetime of IR radiation source > 40000 h
(x) Detection limit: < 0.5% Full Scale
(xi) Linearity error: < ± 1% Full Scale
(xii) Repeatability: ± 0.5% Full Scale
(xiii) Long term stability (zero): < ± 2% full scale/week
(xiv) Long term stability (span): < ± 2% full scale/month
(xv) Temp. Influence zero: < 1% Full Scale
(xvi) Temp. Influence span: < 1% Full Scale
(xvii) Cross sensitivity: < 2% Full Scale
(xviii) Digital output signal: RS 232 (ASCII) or CAN-Bus
(xix) Operating temperature 5 - 40 °C or better
(xx) Suitable standard sample for calibration of the Analyser
(xxi) Certifications required for acceptable concentrations: for CO_2 up to 30% and for CH_4 up to 80%.
(xxii) Certifications: US EPA, EU: EN14211 TUV Rheinland, QAL1 Certified: EN15267, MCERTS: Sira, CNEMC standards.

N_2H_4 Gas Analyser

(i) Suitable analyser to detect the ultrasensitive gases, including hydrides, mineral acids, and amines.
(ii) Detection technique: Chemcassette tape-based or equivalent analyser with advanced self-monitoring optics design.
(iii) Hydrazine (N_2H_4) Gas range: 1 ppb to 1 ppm
(iv) Lower detection limit: 5 ppb
(v) Operating temperature: 5- 40 °C or better
(vi) Operating humidity: 0-100% RH
(vii) Should have the option to remove moisture in high RH conditions where condensing occurs.
(viii) Flow control with bypass system: 500 cc/min at tape
(ix) Suitable color LCD/TFT display
(x) Data Logging Rolling: up to 3 months
(xi) Ingress Protection rating: IP65
(xii) Suitable standard sample for calibration of the Analyser

	VOC Analyser (i) VOC analyser should have a gas chromatograph with a built-in pre-concentration system. (ii) Hydrocarbons should be pre-concentrated on Tenax GR, desorbed thermally, and separated in an appropriate column to reach optimal separation from interfering hydrocarbons. (iii) Should ensure highly specific sensitivity for benzene and aromatic hydrocarbons. (iv) A user-friendly software to store all the chromatograms on the hard disk, and data should be transferred by network and modem connection. (v) Suitable standard sample for calibration of the Analyser (vi) Technical Description: PID detector, Lowest detection level for benzene 0.1 $\mu g/m^3$ (0.03 ppbV), Range: standard 0-20 ppbV. (vii) Certificates: Approval for EN 14662-3, EN 15267-1, EN 15267-2, VDI-Richtlinie 4202 Blatt 1 and VDI-Richtlinie 4203 Blatt 3 or equivalent. CE approval for EMC conformity: EN 61010 incl. A1 and A2, EN 61000-6-2, EN 61000-6-3 and EN 61326 or equivalent. (viii) Standard Calibration: Standard 4-point calibration provided for BTX in the range 4 to 16 ppbV. (ix) Extra compounds measurement: The software of the analyser should measure up to 40 hydrocarbons. (x) Reproducibility: Typical <3% at 1 ppbV (benzene, with capillary column) (xi) Communication: Through touchscreen, keyboard or mouse, etc. External data communication: RS232, analog and digital outputs via TCP-IP. With suitable standard protocols such as ASCII terminal, Hessen, Gesytec and MODBUS, etc. (xii) Software: Direct control via touchscreen, keyboard or mouse via remote host (RS232/modem) or Ethernet. Software for running the instrument
1.7	**The system inbuilt with vibration test of sensors** (i). Rated peak force Sine /Random /Shock: 2700/2000/5500 N (ii). Frequency range: 2 - 4500 Hz (iii). Main resonance frequency: > 3800 Hz (iv). Max. displacement: Peak-Peak 25.4 mm (v). Max. velocity: Sine /Random /Shock: 1.5/1.5/2.5 m/s (vi). Max. acceleration: Sine/Random/Shock 110/70/180 g (vii). Suspension stiffness: 22 N/mm (viii). Effective moving mass: (±5%) 2.7 kg (ix). Max. payload mass: 120 kg (x). Magnetic stray field without/with degaussing: 8.5/<1.4 mT (xi). For long-term tests, the load must be reduced to 80%.
1.8	**The system must have three test cells with suitable dimensions, and with controlled temperature (heatable up to 70 °C) and humidity (10-95% RH) for the following requirements** (i). One Testing Cell for metal oxide semiconductor (MOS) based gas sensors and capable of hosting 10 sensors simultaneously. (ii). One Testing Cell for electrochemical devices (ECD) and capable of hosting 10 sensors simultaneously. (iii). One Testing Cell dedicated to safety procedures for hydrogen utilization and capable of hosting 10 hydrogen sensors simultaneously.

1.9	**Data handling unit with customized software, with a suitable display unit** A Custom-built operating system must be supplied to control all the pre-set defined hardware components and to control each parameter and create an automatic report. Software must be capable of the following: (i). Automation of the measurement process. (ii). Automatic reporting of all the data from the system with two communication protocols and a suitable analog output. (iii). Generation of Test and Calibration reports. (iv). The software must control the system in an advanced way and carry out the gas mixture generation, must read the analyser's feedback and the sensors acquisition board signals, and then record/transmit all the data in a continuous and completely automated way. (v). Communications interface: Modbus TCP protocol or equivalent version. (vi). All the data of the generated parameters should be recorded by the software, in the database managed by PostgreSQL or equivalent, and the same database should contain all the relevant information about the measurement and the testing report. (vii). Physical Report Generation Facility, and should be capable of printing color test reports with 35 ppm. **The system should be able to evaluate and perform automatically the following tests:** (i). Lack of fit (ii). Linearity (iii). Zero & Span drift (iv). Response time (v). Repeatability standard deviation at Zero & Span (vi). Cross sensitivity (vii). Influences of temperature (viii). Influences of gas flow (ix). Combined standard uncertainty
1.10	**The system must have integrated high purity Nitrogen, Hydrogen, and Zero Air gas generator with Automatic Selection Switch, Ventilation system and exhaust treatment, with leak detection:** **High-Purity (≥ 99.999%) Nitrogen Gas Generator** (i) The generator should be capable of directly extracting highly pure nitrogen from the air without the requirement of deoxidation. (ii) The generators should be suitable for all kinds of gas chromatographs and micro coulomb meters. (iii) Purity of produced Nitrogen should be ≥ 99.999% (iv) Output flow: 0-300 ml/min (v) Work pressure: 0 - 0.4 MPa (vi) Input air pressure: 0.4 - 0.5 MPa (vii) Power Supply: AC 220V/50Hz (viii) Input the air discharge: 600 ml/min **High-Purity (≥ 99.999%) Hydrogen Gas Generator** (i) The generator should produce Hydrogen gas with ≥ 99.999% (ii) Flow rate: 0-300 cc/min (iii) Output pressure: 0.2-4.0 bar (iv) Dew point: -65 °C (v) Water tank capacity: 3 litres (vi) Operating environment: 5-45 °C and < 80% RH

	(vii) Water resistivity: >1 MΩ.cm **Zero Air Gas Generator** (i) Zero Air supply should be with noise protection housing and consist of an absolute oil-free compressor, self-regenerating adsorption dryer, and 4 filter cartridges with chemical filters (ii) Output: max. > 50 litres/min at 5 bar (iii) Max. pressure: ~ 100 psi (iv) Tank capacity: 40 litres or better (v) Noise: 50dBA (vi) Dust particles removed > 0.01 µm diameter (vii) Dewpoint: - 40 °C or better **Ventilation system and exhaust treatment, with leak detection** (i). Sufficient number of extraction hoods that can accommodate the instrumentation (one for hydrogen and one for other gases). Gas analysers (feedback system), VOC generator (ii). Post-treatment of exhaust gas with a dilution system to reduce the concentration of harmful/hazardous compounds to near zero. (iii). A sensor-based system should be installed for detecting leakage and presence of toxic/hazardous gases inside the room, with alarms & display and predisposition to stop the generation and testing equipment. (iv). Dilution system for exhaust gases by ambient airflow with an exhaust fan. (v). Flow monitoring with alarm output and analog signal to the Programmable Logic Control (PLC) for monitoring and, if necessary, shutting down (auto ON) the system if the flow is below the set value or no longer present. (vi). The fan casing should be made of aluminum-zinc (Aluzinc) or equivalent materials. (vii). A heat and sound-insulating layer should be provided, made of polystyrene foam or equivalent materials. (viii). Suitable motor with a long service life, precise features, safe operation, and low noise, etc. (ix). Motor protection rating IP 44. (x). The fan with electronic temperature and speed control module should be provided for automatic control of the motor speed (air capacity) depending on air temperature in the air duct or in the room.

Other Requirements:

1. **Uncertainty Budget & Traceability:** The Supplier / Integrator must provide the traceable chart, calibration certificates & uncertainty budget with all relevant documentation of the entire facility at the time of installation.
2. **Installation & Commissioning of the system**: The integrator/supplier must install & commission the facility by its own resources (which includes standard gases, VOCs, all fitting/fixing & electrical connections) including pre-inspection visit by two NPL persons at the factory site to inspect the components/accessories of the customized system before shipment.

3. **Warranty:**
   (i). One-year standard warranty of the entire system.
   (ii). One-year additional warranty
   (iii). Support for spare parts for at least five years
   (iv). Software upgradation for at least five years
   (v). Calibration of various components at regular intervals

4. **Training**: Provide hands-on training to five persons with a training certificate.

5. **Acceptance Criteria:** The Vendor/OEM/Integrator must perform testing work for sensors provided by NPL and generate a sample report before handing over the system to CSIR-NPL.

6. **Other Important Points**:
   (i). Detailed Schematic diagram of the system and the signals for communication should be provided.
   (ii). Gas mixer with Mass flow controllers (MFCs) for gas dilution of the different span gases in compliance with ISO 6145-7, 6145-4, and 6145-10 standard (specifies a method for continuous preparation of calibration gas mixtures).
   (iii). Permeation oven and permeation tube for the generation of N_2H_4, in compliance with ISO 6145-10 (specifies a dynamic method using permeation membranes for the preparation of calibration gas mixtures containing component mole fractions must be provided).
   (iv). USP Class VI refers to certify that there are no harmful reactions or long-term bodily effects caused by chemicals that leach out of plastic materials.
   (v). Marking CE (a certification mark that indicates a product's compliance with European Union (EU) health, safety, and environmental protection standards), UKCA (UK Conformity Assessed).
   (vi). Gas generator with Mass flow controller for dilution and continuous injection system in compliance with ISO 6145-4 standard (Preparation of calibration gas mixtures using dynamic volumetric methods).
   (vii). Site preparation: The successful vendor needs to provide requirements for site preparation within 15 days of Acceptance of the Purchase Order (PO), for e.g., Electrical works, Civil works, etc.
   (viii). The supplier should have provided a similar type of system to the National Measurement Institute (NMI) of any country.

7. **Prices should be on Ex-works/FOB basis**