Technical specifications of integrated C2-C12 ambient air non methane hydrocarbons (NMHCs)

analysis system based on thermal desorption- gas chromatography equipped with flame ionization detection

1. System should have single point PC software control and communication with all individual components of the system including the thermal desorption system, gas chromatographs (GCs) and columns (dual; one for C2-C5 another for C6-C12), ovens and flame ionization detectors (dual; one for C2-C5 and the other for C6-C12) and routine maintenance parameters
2. System must have Electronic pneumatic control (EPC) control or equivalent with compensation for atmospheric pressure and temperature variations for accurate and reproducible measurements of the target compounds
3. System must have RTL (Retention time locking feature) for reproducible results
4. System must have Capillary Flow Technology with reliable, leak-free, in-oven capillary connections that stand up to repeated GC oven cycling over time to make it easier to analyze complex matrices and unknowns, and provide gains in productivity and data integrity for routine analyses via 2-dimensional heart cutting, detector splitting, and column back flushing
5. Highly accurate pressure setting functionality with set point tolerance ±7 Pa in the range of 0 to 650000 Pa
6. Temperature set point resolution: Should be 1 °C or better
7. The Column Oven should be able to accommodate two 100 m (length) × 0.5 mm id (inner diameter) or equivalent columns for effective separation and quantification of the 55 NMHCs listed in the US EPA list of ozone precursors (Given below and Table 4-2 accessible at : http://www.epa.gov/airtrends/aqtrnd96/chapter4.pdf)
8. Sampling from canisters should be as per standard canister methods such as US EPA Method TO-15. Required features include thermostatted flow paths and automatic addition of gas-phase internal standard
9. For trapping of the ozone precursor compounds in particular C2 hydrocarbons, the cold trap should have atleast 3 sorbent beds
10. Cooling should be cryogen free as field deployment with limited manpower is envisaged
11. For each analysis the user interface for sample volume choices should be provided and recorded
12. Detection and quantification limits accomplished by the system for ambient air samples containing the NMHCs should be as follows: For C2-C5 hydrocarbons: (Detection: 50 ppt or better; Quantification: 100 ppt or better). For C4-C12 hydrocarbons: (Detection : 30 ppt or better; Quantification : 60 ppt or better)
13. Temporal resolution of the data for all 55 NMHCs should be hourly or better
14. System should be quoted with 12 compatible re-usable passivated whole air canister samplers which have been certified for stable storage (at least 4 weeks) of the 55 NMHCs listed below
15. The system should be capable of both online ambient air measurements of the 55 NMHCs as well as measuring whole air ambient samples collected in passivated canisters (6 L capacity).
16. In both online ambient air mode OR canister mode, the system should be able to carry out analysis of samples round the clock with minimal operator intervention. For canister based sampling it should be able sample and measure automatically from at least 12 (of 6 L capacity) canisters at a time.
17. System should have suitable dryer to remove water and very polar compounds prior to trapping /pre concentration step so as to minimize interferences and all characterization data of the dryer should be provided
18. System should be quoted with compatible gas generators for nitrogen, zero air and hydrogen along with suitable air compressor

19. System should be quoted with compatible automated canister cleaning system for re-use of the canisters
20. System should be stable and give reproducible results at ambient temperature range of air samples from 4 °C to 45 °C.
21. The thermal desorber must be compatible with the **entire TD application range;** *i.e.* It must be possible to analyse compounds ranging in volatility from C_2 to C_{12} hydrocarbons plus labile compounds on the same system, without modification in a single analysis
22. It must be possible to quantitatively retain ultra-volatiles such as acetylene from over 2 L of air or gas without liquid cryogen; in order to facilitate unattended online monitoring, with optimum sensitivity and minimal user intervention
23. The TD system must be compatible with samples containing trace (*i.e.* sub ppb) and high (ppm/low %) concentration levels.
24. The dimensions, sorbent mass and heating rate of the focusing trap plus the design of the sample flow path downstream of the focusing trap should facilitate **splitless operation even with high resolution capillary GC, GC-FID operating at flow rates of 2 mL/min or below**.
25. The flow of dry gas required for purging the cold trap area to prevent build-up of ice during system operation, should be less than 100 ml/min to minimise gas consumption and operator intervention.
26. The system should facilitate electronic carrier (gas) control at all stages of TD operation, to enable total flow read-out, enhanced leak diagnostics and pneumatic programming that is directly linked to the GC oven programme. Additionally it should be possible to configure the thermal desorber with column head pressure regulation to offer retention time stability independent of split flow, trap temperature, tube/trap packing
27. The accessories should connect to **a minimum of three** channels to facilitate automatic sequencing between sample, standard and NMHC free gas streams and be quoted with a suitable gas standard including accessories for calibration purposes
28. Turn top inlet sealing system must be built in standard with S/SL inlet for quick, easy, injector liner changes
29. System should be compatible with power supply of 220V/50Hz and quote for suitable UPS system may be enclosed
30. System must be quoted with a 3 year CMC post the 1 year warranty period clearly mentioning the number of preventive maintenance visit and mandatory consumables included in CMC

Hydrocarbons		
Ethylene	2,3-Dimethylbutane	3-Methylheptane
Acetylene	2-Methylpentane	n-Octane
Ethane	3-Methylpentane	*Ethylbenzene
Propylene	2-Methyl-1-Pentene	*m&p-Xylenes
Propane	*n-Hexane	*Styrene
Isobutane	Methylcyclopentane	*o-Xylene
1-Butene	2,4-Dimethylpentane	n-Nonane
n-Butane	*Benzene	Isopropylbenzene
t-2-Butene	Cyclohexane	n-Propylbenzene
c-2-Butene	2-Methylhexane	m-Ethyltoluene
Isopentane	2,3-Dimethylpentane	p-Ethyltoluene
1-Pentene	3-Methylhexane	1,3,5-Trimethylbenzene
n-Pentane	*2,2,4-Trimethylpentane	o-Ethyltoluene
Isoprene	n-Heptane	1,2,4-Trimethylbenzene
t-2-Pentene	Methylcyclohexane	n-Decane
c-2-Pentene	2,3,4-Trimethylpentane	1,2,3-Trimethylbenzene
2,2-Dimethylbutane	*Toluene	m-Diethylbenzene
Cyclopentane	2-Methylheptane	p-Diethylbenzene
		n-Undecane

List of 55 NMHCs as per US EPA ozone precursor target compound list