



Overview of Measurement Technologies for Air Pollutants and Air Quality Metrics

Pollutant Type:

Gaseous Pollutant

Pollutant/Metric Name:

Ozone

#	Technology	Characteristics and performance	Availability and current use of instruments	Suggested area of application
1	Ozone by ultraviolet photometry, with transportable/portable monitoring systems that require recalibration or calibration checks every year	<ul style="list-style-type: none"> European reference method - EN 14825: 2005 and revised method EN 14825:2012 to be published – see also MMTO ozone photometry document Measures gaseous ozone in ambient atmospheres high time resolution (up to 10 second with degraded sensitivity) Detection limit of the order of 1 ppb – different manufacturers may be better or worse than this. Possible cross interference from certain aromatic hydrocarbons, if not filtered out before the spectroscopic cell. Calibration generally carried out using a Standard Reference Photometer (SRP) usually operated at a national level – see below. 	Commercial; pre-dominantly used in monitoring networks. Also research applications	Industrial Urban Rural Remote
2	Standard Reference Photometers using ultraviolet photometry	<ul style="list-style-type: none"> High time resolution (up to a few minutes) Detection limit < 0.3 ppb Supplied by NIST USA or BIPM France; Used generally as primary calibration methods for portable ozone monitors Countries compare the SRPs at a national level with those maintained as primary standards at the BIPM, France, under formal comparison procedures defined by the BIPM CCQM, and the results are published in Metrologia. 	Mainly calibration and research with a few in monitoring stations (e.g. EMEP)	Generally used to calibrate portable photometers operated in Networks; Also operated as high quality monitors at rural or remote locations.



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3	<p>Differential optical absorption spectroscopy (DOAS)</p> <ul style="list-style-type: none"> – EN standard method 16253:2012 - but not EU reference method – May be used for multi-pollutant monitoring – see MMT0 for DOAS; – For ambient air and industrial and urban diffuse emissions monitoring (with other pollutants) – Open atmospheric path (100 m to >2 km) double ended monitoring system using ultraviolet source of radiation (400 nm to 220nm) and UV detection, with an infrared optional system – Requires regular calibrations (annually) to provide optimal detection sensitivity and minimum cross interference – Can be operated near ground level to provide averaged integrated path concentrations in real time – Can also be operated in upward-looking mode using the sun as a source or as the scattered solar radiation to provide concentration profiles into the stratosphere from ground level. 	<p>Commercial; re-search and at a number of monitoring locations worldwide for ozone concentration profiling with altitude.</p>	<p>Industrial (as fenceline monitors with other industrial air pollutants) Urban (with other atmospheric pollutants) Rural Remote</p>
4	<p>Ozone by gas phase titration of NO_x standards</p> <ul style="list-style-type: none"> – ISO standard 15337 uses gas phase titration for the calibration of ozone analysers – by means of stoichiometric conversion of NO to NO₂ which are then measured by a NO_x chemiluminescent analyser. – Requires known concentration calibration standard of NO, generally in high pressure cylinder; – Comparisons of the gas phase titration technique have been made at an international level with ozone analyzers that are calibrated by SRPs using ozone photometry, and a bias of 1% - 2% is observed. 	<p>Laboratory and field calibration of ozone analyzers, often when no SRP is available; re-search. NO_x chemiluminescent analysers are commercial but the gas phase titration is not;</p>	<p>Urban Rural</p>



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5	Infrared in-situ absorption spectroscopy	<ul style="list-style-type: none"> – Carried out using tuneable diode laser spectroscopy or Fourier transform interferometry in the mid-infrared (near infrared detection does not have sufficient sensitivity) – New use of cavity ring down spectroscopy and cavity enhanced ring down spectroscopy – Coupled to a multi-pass optical absorption cell or cavity ring down cell that must be inert to contain the atmospheric ozone concentrations without losses. – More difficult to operate routinely and not a reference method. 	Commercial: Industrial multi-pollutant monitoring, and research monitoring applications	Industrial Urban Rural
6	Electrochemical and chemical detection sensing technology	<ul style="list-style-type: none"> – Small sensors that are either passive and chemically coated, or use electrochemical conversion of ozone. – Detection sensitivities are not so good as the reference methods – Sensor drifts and cross interferences are not as good as the reference method. – Capable of being deployed with greater spatial density to measure inhomogeneity in the atmosphere. – Sensors generally need individual calibrations; – Capabilities are improving with more research; 	Generally for atmospheric screening and research applications;	Industrial Urban

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http://www.bipm.org/en/scientific/chem/gas_metrology/ozone.html
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