

## Photometric Analyzers (IPS-4, 9xx and 4xxx series) Concentrations of Liquids, Gases and Vapors Measured Continuously with AMETEK Photometric Analyzers

Concentrations of many liquids, gases and vapors can be reliably measured using AMETEK Photometric Analyzers. In general, all aromatics, carbonyls, and inorganic salts absorb radiation from the choice of light sources available in the analyzers. Concentrations of such materials can be measured accurately, assuming appropriate measuring and reference wavelengths can be selected in the ultraviolet/visible/near infrared range. Straight chain hydrocarbons, inorganic gases, and the lower alcohols generally do not absorb visible or ultraviolet radiation. They act as transparent background materials. Air and moisture vapor are transparent background materials at ultraviolet/visible wavelengths.

The following is a partial list of liquids, gases, and vapors whose concentrations can be detected with AMETEK Photometric Analyzers:

Material	Phase	Minimum Full Scale
Acetal	Vapor	30,000 ppm
Acetaldehyde	Liquid (H <sub>2</sub> O) Vapor	5450 x 10 <sup>-6</sup> g/L 730 ppm
Acetic Acid	Liquid (H <sub>2</sub> O)	25.8 x 10 <sup>-3</sup> g/L
Acetic Anhydride	Liquid	6.12 x 10 <sup>-3</sup> g/L
Acetone	Liquid (Alcohol) Vapor	5.22 x 10 <sup>-3</sup> g/L 730 ppm
Acetyl Chloride	Vapor	216 ppm
Acrolein	Vapor	640 ppm
Acrylonitrile	Liquid (Alcohol)	26.5 x 10 <sup>-3</sup> g/L
Ammonia	Vapor	400 ppm
i-Amyl Alcohol	Vapor	1670 ppm
Aniline	Liquid Vapor	37 x 10 <sup>-6</sup> g/L 11 ppm
Anisole	Vapor	5.5 ppm
Anthracene	Liquid Vapor	2.67 x 10 <sup>-6</sup> g/L 0.12 ppm
Anthraquinone	Liquid Vapor	11.9 x 10 <sup>-6</sup> g/L 0.47 ppm
Benzaldehyde	Liquid Vapor	16.9 x 10 <sup>-6</sup> g/L 1.3 ppm
Benzene	Liquid Vapor	663 x 10 <sup>-6</sup> g/L 70 ppm
Benzonitrile	Liquid Vapor	66.6 x 10 <sup>-6</sup> g/L 9.1 ppm
Benzoyl Chloride	Vapor	20 ppm
Benzyl Chloride	Vapor	40 ppm
Bisphenol-A	Liquid (NaOH)	3.88 x 10 <sup>-6</sup> g/L
Bromine	Vapor	47 ppm
Bromobenzene	Vapor	40 ppm
1,3 Butadiene	Vapor	111 ppm

i-Butyraldehyde	Vapor	622 ppm
n-Butyraldehyde	Vapor	1060 ppm
Caprolactam	Liquid (H <sub>2</sub> O)	23 x 10 <sup>-6</sup> g/L
Carbon Disulfide	Vapor	226 ppm
Carbonyl Sulfide	Vapor	445 ppm
Carbon Tetrachloride	Vapor	4040 ppm
Chlorine	Vapor	125 ppm
Chlorine Dioxide	Liquid (H <sub>2</sub> O) Vapor	61.4 x 10 <sup>-6</sup> g/L 7 ppm
Chloroamine (Mono)	Vapor	212 ppm
Chlorobenzene (Mono)	Liquid	461 x 10 <sup>-6</sup> g/L
Chlorobenzene	Vapor	74 ppm
o-Chlorophenol	Liquid	758 x 10 <sup>-6</sup> g/L
m-Chlorophenol	Liquid	1066 x 10 <sup>-6</sup> g/L
p-Chlorophenol	Liquid	809 x 10 <sup>-6</sup> g/L
o-Chlorotoluene	Vapor	44 ppm
Chromium (as Cr <sup>6+</sup> )	Liquid (H <sub>2</sub> O)	0.12 x 10 <sup>-6</sup> g/L
Copper (as Cu <sup>++</sup> )	Liquid (H <sub>2</sub> O)	42 x 10 <sup>-6</sup> g/L
o-Cresol	Liquid	71.3 x 10 <sup>-6</sup> g/L
m-Cresol	Liquid	71.3 x 10 <sup>-6</sup> g/L
p-Cresol	Liquid	71.3 x 10 <sup>-6</sup> g/L
Crotonaldehyde	Liquid	245 x 10 <sup>-6</sup> g/L
Cumene	Vapor	64 ppm
Cyclohexanone	Liquid	7.55 x 10 <sup>-3</sup> g/L
1,3 Cyclopentadiene	Vapor	13.3 ppm
p-Cymene	Vapor	19.3 ppm
Decahydronaphthalene	Vapor	1330 ppm
Diacetone Alcohol	Vapor	817 ppm
Diacetyl	Liquid (Alcohol)	4.3 x 10 <sup>-3</sup> g/L
o-Dibutylphthalate	Liquid	73.8 x 10 <sup>-6</sup> g/L
o-Dichlorobenzene	Vapor	33 ppm
m-Dichlorobenzene	Vapor	33 ppm
p-Dichlorobenzene	Vapor	30 ppm
Dichloro Butane	Vapor	3500 ppm
Diethylketone	Vapor	750 ppm
Di-Isopropylketone	Vapor	1000 ppm
Dimethylacetamide	Vapor	110 ppm
Dimethylamine	Vapor	2530 ppm
Dimethylaniline	Vapor	2.33 ppm
Dimethylformamide	Liquid (H <sub>2</sub> O) Vapor	<1800 x 10 <sup>-6</sup> g/L 312 ppm
Dimethylterephthalate	Liquid (Glycol)	<1900 x 10 <sup>-6</sup> g/L
Dioxane	Vapor	10,000 ppm
Dipentene	Vapor	220 ppm
Diphenyl	Liquid Vapor	4.9 x 10 <sup>-6</sup> g/L 0.9 ppm
Diphenyloxide	Vapor	66 ppm
Divinylacetylene	Vapor	1.7 ppm
Ethylbenzene	Liquid Vapor	636 x 10 <sup>-6</sup> g/L 133 ppm
Ethylbromide	Vapor	2700 ppm
Ethylenebromide	Vapor	578 ppm

The minimum full scale range (with accuracies of 2% of full scale) are listed in parts per million for vapor samples, and grams/liter for liquids. For liquids with a density of 1.0 g/mL, a concentration of 1 x 10<sup>-6</sup> g/L corresponds to about one part per billion (w/w). The minimum full scale listed is based on a 1 m cell length for gases with no interferences. Lower minimum full scale ranges often can be provided for vapors by increasing the absolute pressure of the sample. The minimum full scale listed is based on a 50.8 cm cell length for liquids. Solvent is hydrocarbon unless otherwise noted.

Material	Phase	Minimum Full Scale
Ethylene chlorohydrin	Liquid (H <sub>2</sub> O)	50.3 x 10 <sup>-3</sup> g/L
Ethyl Mercaptan	Liquid Vapor	1200 x 10 <sup>-6</sup> g/L 59 ppm
i-Fenchone	Vapor	133 ppm
Ferric Chloride	Liquid (H <sub>2</sub> O)	1460 x 10 <sup>-6</sup> g/L
Ferrous Chloride	Liquid (H <sub>2</sub> O)	381 x 10 <sup>-3</sup> g/L
Ferrous Sulfate	Liquid (H <sub>2</sub> O)	380 x 10 <sup>-3</sup> g/L
Flourine	Vapor	1530 ppm
Formaldehyde	Liquid (H <sub>2</sub> O) Vapor	5.9 g/L 3200 ppm
Formic Acid	Vapor	13,300 ppm
Furan	Liquid Vapor	20.4 x 10 <sup>-3</sup> g/L 57,800 ppm
Furfural	Liquid Liquid (H <sub>2</sub> O) Vapor	6.24 x 10 <sup>-6</sup> g/L 9.2 x 10 <sup>-6</sup> g/L 0.5 ppm
Hydrazine	Liquid (H <sub>2</sub> O)	8.32 x 10 <sup>-3</sup> g/L
Hydrogen Iodide	Liquid (H <sub>2</sub> O) Vapor	15 x 10 <sup>-6</sup> g/L 240 ppm
Hydrogen Peroxide	Liquid (H <sub>2</sub> O)	163.2 x 10 <sup>-6</sup> g/L
Hydrogen Sulfide	Vapor	25 ppm
Hypochlorous Acid	Liquid (H <sub>2</sub> O)	241 x 10 <sup>-6</sup> g/L
Iodine	Liquid (Alcohol)	876 x 10 <sup>-6</sup> g/L
Iodoform	Liquid (Alcohol)	177 x 10 <sup>-6</sup> g/L
Ketene	Liquid	3360 x 10 <sup>-6</sup> g/L
Lithium Bromide	Liquid (H <sub>2</sub> O)	16.5 x 10 <sup>-3</sup> g/L
Lithium Iodide	Liquid (H <sub>2</sub> O)	9.1 x 10 <sup>-3</sup> g/L
Maleic Anhydride	Liquid	1470 x 10 <sup>-6</sup> g/L
Manganous Sulfate	Liquid (H <sub>2</sub> O)	1736 x 10 <sup>-3</sup> g/L
Mercury	Vapor	0.0018 ppm
Mesityl Oxide	Vapor	74 ppm
Methyl Butyl Ketone	Vapor	580 ppm
Methyl Ethyl Ketone	Vapor	450 ppm
Methyl Formate	Vapor	9000 ppm
2-Methyl Furan	Vapor	1350 ppm
Methyl Iodide	Vapor	39 ppm
Methyl Isobutyl Ketone	Vapor	450 ppm
2-Methyl-1, 3-Butadiene	Vapor	200 ppm
Methyl Mercaptan	Liquid	13.6 x 10 <sup>-6</sup> g/L
4-Methyl-1, 3-Pentadiene	Vapor	1030 ppm
Methyl Vinyl Pyridine	Vapor	4.8 ppm
Monochloroacetic Acid	Liquid (H <sub>2</sub> O)	64.2 x 10 <sup>-3</sup> g/L
Monoethanolamine	Vapor	212 ppm
Monovinyl Acetylene	Vapor	38 ppm
Naphthalene	Liquid Vapor	83.2 x 10 <sup>-6</sup> g/L 2.5 ppm
a-Naphthylamine	Liquid	27.5 x 10 <sup>-6</sup> g/L
b-Naphthylamine	Liquid	27.9 x 10 <sup>-6</sup> g/L
b-Naphthol	Liquid	10.8 x 10 <sup>-6</sup> g/L
Nickel Carbonyl	Vapor	1.4 ppm
Nickel Sulfate	Liquid (H <sub>2</sub> O)	235 x 10 <sup>-3</sup> g/L
Nitric Acid	Liquid (H <sub>2</sub> O)	14.5 x 10 <sup>-3</sup> g/L
Nitroaniline	Liquid (H <sub>2</sub> O)	30.4 x 10 <sup>-6</sup> g/L
Nitrobenzene	Liquid Vapor	14.1 x 10 <sup>-6</sup> g/L 1 ppm
Nitrogen Dioxide (NO <sub>2</sub> )	Vapor	50 ppm
Nitrogen Tetraoxide	Vapor	18 ppm
o-Nitrotoluene	Vapor	11.5 ppm
m-Nitrotoluene	Vapor	3 ppm
p-Nitrotoluene	Vapor	7.5 ppm
Oxalic Acid	Liquid	2.7 x 10 <sup>-3</sup> g/L
Ozone	Vapor	2.2 ppm
Perchloroethane	Vapor	43 ppm

Phenol	Liquid Liquid (H <sub>2</sub> O) Liquid (NaOH) Vapor	72 x 10 <sup>-6</sup> g/L 67 x 10 <sup>-6</sup> g/L 56 x 10 <sup>-6</sup> g/L 35 ppm
Phosgene	Vapor	48 ppm
o-Phthalic Acid	Liquid (H <sub>2</sub> O)	<50 x 10 <sup>-6</sup> g/L
Phthalic anhydride	Vapor	10 ppm
Pinene	Vapor	5050 ppm
Piperdine	Vapor	110 ppm
Propionic Acid	Vapor	270 ppm
Pyridine	Liquid Vapor	47 x 10 <sup>-6</sup> g/L 3.0 ppm
Pyrocatechol	Liquid	74 x 10 <sup>-6</sup> g/L
Resorcinol	Liquid	74 x 10 <sup>-6</sup> g/L
Sodium Chlorate	Liquid (H <sub>2</sub> O)	12 x 10 <sup>-3</sup> g/L
Sodium Hydrosulfite	Liquid (H <sub>2</sub> O)	283 x 10 <sup>-6</sup> g/L
Sodium Hypochlorite	Liquid (H <sub>2</sub> O)	690 x 10 <sup>-6</sup> g/L
Sodium Nitrate	Liquid (H <sub>2</sub> O)	23.3 x 10 <sup>-3</sup> g/L
Sodium Nitrite	Liquid (H <sub>2</sub> O)	3.2 x 10 <sup>-3</sup> g/L
Sodium Sulfide	Liquid (H <sub>2</sub> O)	37 x 10 <sup>-6</sup> g/L
Sodium Sulfite	Liquid (H <sub>2</sub> O)	445 x 10 <sup>-6</sup> g/L
Styrene	Liquid Vapor	229 x 10 <sup>-6</sup> g/L 2.7 ppm
Sulfur	Liquid (Alcohol) Vapor	14 x 10 <sup>-6</sup> g/L 3.7 ppm
Sulfur Dioxide	Vapor	25 ppm
Sulfur Monochloride	Liquid	60.7 x 10 <sup>-6</sup> g/L
Sulfur Oxychloride	Liquid	17.5 x 10 <sup>-6</sup> g/L
Tetrachloroethane	Vapor	1610 ppm
Tetrachloroethylene	Vapor	90 ppm
Titanium Tetrachloride	Vapor	< 17 ppm
Toluene	Liquid Vapor	524 x 10 <sup>-6</sup> g/ 62 ppm
m-Toluidine	Vapor	5.4 ppm
n-Tributylamine	Vapor	4040 ppm
Trichlorobenzene	Liquid	544 x 10 <sup>-6</sup> g/L
Trichloroethylene	Vapor	1760 ppm
Trimethylamine	Vapor	622 ppm
Trinitrotoluene	Liquid (H <sub>2</sub> O)	1 ppm
Uranium Hexafluoride	Vapor	6.6 ppm
Uranyl Nitrate	Liquid (HNO <sub>3</sub> )	80 x 10 <sup>-3</sup> g/L
Urea	Liquid (H <sub>2</sub> O)	1.33 g/L
Vanadium	Liquid	190 x 10 <sup>-6</sup> g/L
Water	Liquid (H <sub>2</sub> O)	13.5 g/L
o-Xylene	Liquid Vapor	689 x 10 <sup>-6</sup> g/L 48 ppm
m-Xylene	Liquid Vapor	689 x 10 <sup>-6</sup> g/L 56 ppm
p-Xylene	Liquid Vapor	265 x 10 <sup>-6</sup> g/L 45 ppm

The following liquids, gases, and vapors act as transparent background materials when measuring with UV/visible light:

Acetylene	Ethylene	Nitrogen
Argon	Ethylene glycol	Oxygen
Butane	Helium	Propane
i-Butanol	Hydrochloric acid	Propylene
n-Butanol	Hydrogen	i-Propanol
Carbon dioxide	Krypton	n-Propanol
Carbon monoxide	Methane	Water
Ethane	Methanol	Xenon
Ethanol	Neon	



2876 Sunridge Way N.E., Calgary, AB T1Y 7H9  
Ph. +1-403-235-8400, Fax +1-403-248-3550  
www.ametekpi.com



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Tel: +91 80 6782 3200, Fax: +91 80 6782 3232

**SINGAPORE**  
Tel: +65 6484 2388, Fax: +65 6481 6588