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FTIR REMOTE SENSOR MINIMUM DETECTION LIMITS (MDL'S)

Cerex Statement on MDL's (Minimum Detection Limits)…

Currently there are a number of definitions of "detection limits" used to characterize the performance of air monitoring systems. A common definition of is the magnitude of the absorbance spectra that is twice the system noise. The Environmental Protection Agency's "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air - Second Edition Compendium Method TO-16 Long-Path Open-Path Fourier Transform Infrared Monitoring Of Atmospheric Gases" defines detection limits as the following:

The detection limit of the UVSentry systems is a dynamic quantity that will change as the atmospheric conditions change. The variability of the target gas, water vapor, and all of the other interfering species concentrations contributes to the variability of this measurement. The detection limit as determined in this procedure is the result of a calculation using a set of 15 individual absorption spectra. The 16 individual single beam spectra used for this determination are acquired in 5-min intervals and no time is allowed to elapse between them. The absorption spectra are then created by using the first and the second single beam spectra, the second and the third, and the third and the fourth, and so on until the 15 absorption spectra are obtained. These absorption spectra are analyzed in exactly the same way that all field spectra are to be analyzed and over the same wave number region. The analysis should result in a set of numbers that are very close to zero because most of the effects of the gas variability have been removed. The numerical results should be both positive and negative and for a very large set of data should average to zero. Three times the standard deviation of this calculated set of concentrations is defined to be the detection limit.

Using the detection limit definition described in TO-16, CEREX developed the detection limits that are listed in this attachment. However it should be noted that the actual detection limits achieved in the field will vary. This is primarily due to the fact that variations in interfering species will result in variability in detection limits. Cerex considers the detection limits listed to be a very conservative estimate. The end-user of the equipment will likely achieve much better results in the field. Cerex believes it is a good policy to not oversell a capability to our potential customers.

Under optimum conditions, the following LDL's can be achieved. Path integrated concentrations are for 100 meter path length from FTIR to retroreflector (200 meters roundtrip distance).
This is a partial list…other compounds are available.

Compound Name	Path Integrated Concentration PPM-M	Path Averaged Concentration PPB
Acetaldehyde	0.61	3.0
Acetic Acid, monomer	1.4	7.0
Acetone	2.9	14.5
Acetonotrile	13	65
Acetl Chloride	0.67	3.35
Acetylene	0.77	3.85
Acrolein	0.85	4.25
Acrylic Acid	0.46	2.3
Acrylonitrile	1.5	7.5
Ammonia	0.20	1.0
Aniline	3.9	19.5
Arsine	1.7	8.5
Benzene	3.4	17
Bis-dichloroethylether	0.70	3.5
Boron Trichloride	0.20	1.0
Bromomethane	8.2	41
Butadiene	0.93	4.65
n-Butane	2.1	10.5
2-Butanone	2.1	17
Carbon Disulfide	3.4	100
Carbon Monoxide	1.3	6.5
Carbon Tetrachloride	0.23	1.15
Carbon Tetrafluoride	.2	1.0
Carbonyl Sulfide	.48	2.4
Chlorobenzene	1.5	7.5
Chlorodifluoromethane	0.21	1.05
Chloroethane	2.0	10
Chloroform	0.25	1.25
Chloromethane	9.4	47
Chlorotrifluoromethane	0.60	3.0
Crotonaldehyde	0.76	3.8
Cyclohexane	0.20	1.0
Cyclohexene	0.71	3.55

Cyclopentene	1.3	6.5
Cyclopropane	2.0	10
1,2 Dibromoethane	2.3	11.5
m-Dichlorobenzene	1.2	6
o-Dichlorobenzene	0.94	47
Dichlorodifluoromethane	0.20	1.0
1,1 Dichloroethane	1.1	5.5
1,2 Dichloroethane	7.3	36.5
1,1 Dichloroethene	0.68	3.4
1,2 Dichloroethene	2.0	10
Dichloromethane	1.3	6.5
1,2 Dichlorotetrafluorethane	0.20	1.0
Diethyl Ether	0.26	1.3
Dimethylamine	0.73	3.65
Dimethyl Ether	0.91	4.55
1,1 Dimethyl Hydrazine	0.35	1.75
Dimethyl Sulfide	.3	6.5
Ethane	1.6	8
Ethanol	0.89	4.45
Ethyl Benzene	3.4	17
Ethylene	0.64	3.2
Ethylene Oxide	1.1	5.5
Ethyl Vinyl Ether	1.2	6.0
Fluorobenzene	1.7	8.5
Formaldehyde	0.45	2.25
Formic Acid, Monomer	0.78	3.9
Furan	1.1	5.5
n-Hexane	0.45	2.25
Hydrogen Bromide	1.2	6.0
Hydrogen Chloride	0.61	3.05
Hydrogen Cyanide	6.8	34
Hydrogen Fluoride	0.2	1.0
Hydrogen Sulfide	450	2250
Isobutane	0.74	3.7
Isobutanol	0.34	1.7
Isobutylene	0.41	2.05
Isoctane	0.59	2.95
Isoprene	0.45	2.25
Isopropanol	1.1	5.5
Mesitylene	0.92	4.6
Methane	3.5	17.5
Methanol	0.41	2.05
Methyl Acetate	0.80	4.0
Methyl Acrylate	0.66	3.3
Methylamine	2.9	14.5
2-Methyl 2-Butene	4.7	23.5
3-Methyl 1-Butene	1.6	8.0
Methyl Formate	1.5	7.5
Methyl Methacrylate	0.65	3.25
Methyl Nitrite	0.66	3.3
2-Methyl Pentane	1.1	5.5
3-Methyl Pentane	0.60	3.0
2-Methyl 1-Pentene	1.7	8.5
2-Methyl 2-Pentene	0.90	4.5
4-Methyl 2-Pentene	1.2	6.0
Methyl Vinyl Ether	1.4	7.0
Methyl Vinyl Ketone	1.9	9.5
Nitric Acid	0.63	3.15
Nitric Acid	23	115
Nitro Benzene	1.3	6.5
Nitro Ethane	3.0	15
Nitrogen Dioxide	2.9	14.5

Nitro Methane	8.1	45
Nitrous Acid	0.22	1.1
Nitrous Oxide	1.9	9.5
Octane	0.25	1.25
Ozone	0.65	3.25
n-Pentane	0.85	4.25
1-Pentene	1.0	5.0
2-Pentene	1.5	7.5
trans-3-Pentene nitrile	0.59	2.95
Phosgene	0.20	1.0
Phosphine	2.7	13.5
Propane	1.9	9.5
Propionaldehyde	0.49	2.45
Propionic Acid	2.2	11
Propylene	1.4	7
Propylene Oxide	2.2	11
Styrene	1.2	6
Sulfur Dioxide	4.5	22.5
Sulfur Hexafluoride	0.2	1.0
1,1,1,2 Tetrachloroethane	0.38	1.9
1,1,1,2 Tetrachloroethane	40	200
Tetrachloroethene	0.20	1.0
Tetrahydrothiophene	0.89	4.45
Toluene	3.4	17
1,1,1 Trichloroethane	0.55	2.75
1,1,2 Trichloroethane	1.4	7.0
Trichloroethene	0.23	1.15
Trichlorofluormethane	0.20	1.0
Trochlorotrifluoroethane	0.20	1.0
Vinyl Acetate	0.75	3.75
Vinyl Chloride	1.6	8
Vinylidene Chloride	0.69	3.45
m-Xylene	1.5	7.5
o-Xylene	2.7	13.5
p-Xylene	1.4	7.0