ST-3805-2003

DRÄGER-TUBES-/CMS-HANDBOOK

DETECTION
PERSONAL PROTECTION
DIVING TECHNOLOGY
SYSTEM TECHNOLOGY
SERVICES

Drägersafety

Dräger-Tubes-/CMS-Handbook

Handbook for short term measurements in soil, water and air investigations as well as technical gas analysis.

14th edition

Dräger Safety AG & Co. KGaA,
Lübeck, 2005

This handbook is intended to be a reference source for the user. The information has been compiled to the best of our knowledge from relevent reference sources. However, the Dräger organisation is not responsible for any consequence or accident which may occur as the result of misuse or, misinterpretation of the information contained in this handbook.

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Publisher: Dräger Safety AG & Co KGaA
Dräger-Tubes-/CMS-Handbook: Handbook for short term measurements
in soil, water and air investigations as well as technical gas analysis.
Lübeck, 2005
ISBN 3-926762-06-3

Revalstrasse 1 I 23560 Luebeck I Germany
Printed in Germany
Technical Content: September 2005
ISBN 3-926762-06-3

Preface

The 'never ending story', or: The history of the Dräger Detector Tube Handbook'

Dräger Detector Tubes are an analysis system known all over the world that has been used for more than six decades as a simple means for easy, quick and reliable analysis by trained users in occupational safety and environmental protection. In 1919 the first application for a patent on a 'Detector Tube' was filed.

The big detector tube boom, however, only started in the beginning of the 1950's and hence the demand for additional information on these products, because in the meantime the number of Dräger-Tubes available had increased to over 50 different types.

At the beginning additional information and application instructions beyond that provided in the instructions for use enclosed to the Detector Tubes, was published in the 'Dräger Journals' that have been issued since 1912.
But in 1957 this source of information turned out to be insufficient and the then 'Father of the Dräger Detector Tube', Dr. Karl Grosskopf, published the series of 'Newsletters on the Dräger Gas Detector System' together with some additional information about the CO-tubes 0.001%'. These newsletters were sent to Dräger customers from time to time and provided helpful information.Through leaflets the user was provided with the most different information and instructions.
When by 1967 more than 90 different newsletters had found their way to the customer, the information overload had increased such that the successor to Dr. Karl Grosskopf - who died much too early in 1965 - Mr. Kurt-Leichnitz, Dipl.-Ing. issued the first 'Detector Tube Paperback' in 1969. This paperback completed the table 'Concentration measurements using Dräger Detector Tubes, gases and vapors, physical and toxicological data', the so-called 'Red Table 2340'.
Now the Dräger-Tube user was provided with two handy paperbacks, that could easily be carried in the pocket of the working clothes to the respective place of use.

But in 1973 again this was found to be insufficient and in May of the same year the 2. edition of the 'Detector Tube Paperback' was published as a combination of the description of all Dräger Detector Tubes and the 'Red Table 2340'. The number of Dräger-Tubes after all had increased to approximately 90 different types of tubes. At more or less regular intervals one edition followed the next. The ever increasing number of Dräger-Tubes caused the 'paperback' to become more and more voluminous so that with the 11th edition the 'paperback' was promoted to 'handbook'.

After in 1999 the brochure about the 'Dräger Chip Measurement System (CMS) edited by Detlef Ott, Dipl.-Ing. was published it was about time for another consolidation.

In 2001 the 12th edition of the 'Dräger-Tubes-/CMS-Handbook' - subtitled 'Handbook for short-term measurements in soil, water and air investigations as well as technical gas analysis' including an annex of tables: Physical and toxicological data - was provided to customers. Up to then the Dräger-Tubes described in the newsletters and paperbacks were shown in the form of drawings.The 12th edition now showed the used and unused tubes next to each other as a colour photo. This new way of presentation was well received by the users, because it was now easier to evaluate the indication on the tube. Now also the less trained user could see in advance what kind of discoloration of the indication layer was to be expected after measurement.

After almost 50 years from the publication of the first edition of the 'Newsletter on the Dräger Gas Detector System' and the meanwhile 14th edition of the Dräger-Tube/CMS-Handbook we do not exaggerate when speaking about a 'bestseller' and predict a 'never ending story'.
We will soon reach the number of 500,000 copies that have found their way to our customers and users of the Dräger analysis systems. It is obvious that this number of copies could not be reached in German language only. Over the many years of its existence this Dräger bestseller was translated into the following languages: English, French, Spanish, Danish, Polish, Russian, Chinese, Japanese. The publication is also partly used on modern media such as CDs.
This great success will be our incentive to continue to keep you, our customers and users of the Dräger Safety products constantly informed about state-of-the art technology.

Bernd Mussmann

Lübeck, October 2005 Dräger Safety

Table of Contents

1. List of Dräger-Tube-Measurement-System

1.1. Dräger-Gas Detector Pumps and Systems

Dräger accuro bellows pump	64 00 000
Dräger accuro Pump Kit	64 00 260
Extension hose set Dräger accuro, 3 m	64 00 077
Extension hose Dräger accuro, 10m	64 00 078
Dräger accuro spare parts kit	64 00 220
Automatic pump Dräger accuro 2000	64 00 200
Charger 6V/800mA	83 16 992
Battery pack Dräger accuro 2000	64 00 202
Gas detection case (without contents)	64 00 225
Hot air probe	CH 00 213
Vehicle exhaust probe	CH 00 214
Dräger-Tube opener TO 7000	64 01 200
Dräger Quantimeter 1000	81 01 000
Carrying bag for Dräger Quantimeter 1000	81 00 200
Battery pack Dräger Quantimeter 1000	81 00 230
Spare part kit Dräger Quantimeter 1000	81 01 005
Extension hose with tube holder for Quantimeter 1000	64 01 147
Battery charger for Dräger Quantimeter 1000	83 16 992
Adapter Charging	83 18 257
Adapter (when utilising standard Dräger Pumps with NIOSH pattern only)	67 28 639
DLE-Set Dräger Liquid Extraction set	64 00 030
Dräger Aerotest for measurement of air, medical gases and carbon dioxide:	
Dräger Aerotest Simultan HP	65 25 915
Dräger Aerotest Simultan LP	65 25 924
Dräger Aerotest Light SF6	65 25 952
Dräger Multitest medical gases	65 25 989
Dräger Simultan Test CO_2	65 26 170
Dräger Flow-Check, air flow indicator	64 00 761
Battery charger	83 16 993
Flow-Check ampoules (3 ampoules)	64 00 812
Adapter cable for in-car recharging	64 00 803
Battery pack	64 00 817

1.2. Dräger-Tubes for Short-Term Measurement

Dräger-Tubes	Order Code	Standard Range of Measurement [20°C, 1013 hPa]	Measurement Time [min.]	Page
Acetaldehyde 100/a	67 26 665	100 to 1000 ppm	5	73
Acetic Acid 5/a	67 22 101	5 to 80 ppm	30 s	74
Acetone 40/a	81 03 381	40 to 800 ppm	1	75
Acetone 100/b	CH 22 901	100 to12000 ppm	4	76
Acid Test	81 01 121	qualitative	3 s	77
Acrylonitrile 0.5/a (5)	67 28 591	1 to 20 ppm	2	78
		0.5 to 10 ppm	4	
Acrylonitrile 5/b	CH 26 901	5 to 30 ppm	30 s	79
Activation tube for use in conjunction with Formaldehyde 0.2/a tube	81 01 141			
Alcohol 25/a	81 01 631		5	80
Methanol		25 to 5000 ppm		
i-Propanol		50 to 4000 ppm		
n-Butanol		100 to 5000 ppm		
Ethanol		25 to 2000 ppm		
Alcohol 100/a	CH 29 701	100 to 3000 ppm	1.5	81
Amine Test	81 01 061	qualitative	5 s	82
Ammonia 0.25/a	81 01 711	0.25 to 3 ppm	1	83
Ammonia 2/a	67 33 231	2 to 30 ppm	1	84
Ammonia 5/a	CH 20 501	5 to 70 ppm	1	85
		50 to 700 ppm	6 s	
Ammonia 5/b	81 01 941	5 to 100 ppm	10 s	86
Ammonia 0.5%/a	CH 31 901	0.5 to 10 Vol%	20 s	87
Aniline 0.5/a	67 33 171	0.5 to 10 ppm	4	88
Aniline 5/a	CH 20 401	1 to 20 ppm	3	89
Arsine 0.05/a	CH 25 001	0.05 to 3 ppm	6	90
Benzene 0.5/a	67 28 561	0.5 to 10 ppm	15	91
Benzene 0.5/c (5)	81 01 841	0.5 to 10 ppm	20	92
Benzene 2/a (5)	81 01 231	2 to 60 ppm	8	93
Benzene 5/a	67 18 801	5 to 40 ppm	3	94
Benzene 5/b	67 28 071	5 to 50 ppm	8	95

Dräger-Tubes	Order Code	Standard Range of Measurement [20°C, 1013 hPa]	Measurement Time [min.]	Page
Benzene 15/a	81 01 741	15 to 420 ppm	4	96
Carbon Dioxide 100/a	81 01 811	100 to 3000 ppm	4	97
Carbon Dioxide 0.1%/a	CH 23 501	0.5 to 6 Vol%	30 s	98
		0.1 to 1.2 Vol%	2.5	
Carbon Dioxide 0.5%/a	CH 31 401	0.5 to 10 Vol%	30 s	99
Carbon Dioxide 1%/a	CH 25 101	1 to 20 Vol%	30 s	100
Carbon Dioxide 5%/A	CH 20 301	5 to 60 Vol%	2	101
Carbon Disulphide 3/a	81 01 891	3 to 95 ppm	2	102
Carbon Disulphide 5/a	67 28 351	5 to 60 ppm	3	103
Carbon Disulphide 30/a	CH 23 201	0.1 to 10 mg/L	1	104
Carbon Monoxide 2/a	67 33 051	2 to 60 ppm	4	105
Carbon Monoxide 5/c	CH 25 601	100 to 700 ppm	50 s	106
		5 to 150 ppm	4	
Carbon Monoxide 8/a	CH 19 701	8 to 150 ppm	2	107
Carbon Monoxide 10/b	CH 20 601	100 to 3000 ppm	20 s	108
		10 to 300 ppm	3.5	
Carbon Monoxide 10/c	81 01 951	10 to 250 ppm	1.5	109
Carbon Monoxide 10/d	81 03 321	100 to 3000 ppm	40 s	110
		10 to 300 ppm	6	
Carbon Monoxide 0.3%/b	CH 29 901	0.3 to 7 Vol%	30 s	111
Carbon Tetrachloride 0.2/b	81 01 791	0.2 to 10 ppm	5	112
		10 to 70 ppm	1	
Carbon Tetrachloride 1/a (5)	81 01 021	1 to 15 ppm	6	113
Carbon Tetrachloride 5/c	CH 27 401	5 to 50 ppm	3	114
Chlorine 0.2/a	CH 24 301	0.2 to 3 ppm	3	115
Chlorine 0.3/b	67 28 411	0.3 to 5 ppm	8	116
Chlorine 50/a	CH 20 701	50 to 500 ppm	20 s	117
Chlorobenzene 5/a (5)	67 28 761	5 to 200 ppm	3	118
Chloroform 2/a (5)	67 28 861	2 to 10 ppm	9	119
Chloroformate 0.2/b	67 18 601	0.2 to 10 ppm	3	120
Chloropicrin 0.1/a	81 03 421	0.1 to 2 ppm	8	121
Chloroprene 5/a	67 18 901	5 to 60 ppm	3	122
Chromic Acid 0.1/a (9)	67 28 681	0.1 to 0.5 mg/m^3	8	123
Cyanide 2/a	67 28 791	2 to 15 mg/m^3	2.5	124

Dräger-Tubes	Order Code	Standard Range of Measurement [20°C, 1013 hPa]	Measurement Time [min.]	Page
Cyanogen Chloride 0.25/a	CH 19 801	0.25 to 5 ppm	5	125
Cyclohexane 100/a	67 25 201	100 to 1500 ppm	5	126
Cyclohexylamine 2/a	67 28 931	2 to 30 ppm	4	127
Diethyl Ether 100/a	67 30 501	100 to 4000 ppm	3	128
Dimethyl Formamide 10/b	67 18 501	10 to 40 ppm	3	129
Dimethyl Sulphate 0.005/c (9)	67 18 701	0.005 to 0.05 ppm	50	130
Dimethyl Sulphide 1/a (5)	67 28 451	1 to 15 ppm	15	131
Epichlorohydrin 5/b	67 28 111	5 to 50 ppm	8	132
Ethyl Acetate 200/a	CH 20 201	200 to 3000 ppm	5	133
Ethyl Benzene 30/a	67 28 381	30 to 400 ppm	2	134
Ethyl Glycol Acetate 50/a	67 26 801	50 to 700 ppm	3	135
Ethylene 0.1/a (5)	81 01 331	0.2 to 5 ppm	30	136
Ethylene 50/a	67 28 051	50 to 2500 ppm	4	137
Ethylene Glycol 10 (5)	81 01 351	10 to 180 mg/m^3	7	138
Ethylene Oxide 1/a (5)	67 28 961	1 to 15 ppm	8	139
Ethylene Oxide 25/a	67 28 241	25 to 500 ppm	6	140
Fluorine 0.1/a	81 01 491	0.1 to 2 ppm	5	141
Formaldehyde 0.2/a	67 33 081	0.5 to 5 ppm	1.5	142
Activation tube for use in conjunction with 81 01 141 Formaldehyde 0.2/a tube				
Formaldehyde 2/a	81 01 751	2 to 40 ppm	30 s	143
Formic Acid 1/a	67 22 701	1 to 15 ppm	3	144
Halogenated Hydrocarbons 100/a (8)	81 01 601	100 to 2600 ppm	1	145
Hexane 100/a	67 28 391	100 to 3000 ppm	3	146
Hydrazine 0.25/a	CH 31 801	0.25 to 10 ppm	1	147
		0.1 to 5 ppm	2	
Hydrocarbon 2	CH 25 401	3 to 23 mg/L	5	148
Hydrocarbons 0.1%/b	CH 26 101	0.1 to 1.3 Vol%	3	149
Hydrochloric Acid 1/a	CH 29 501	1 to 10 ppm	2	150
Hydrochloric Acid 50/a	67 28 181	500 to 5000 ppm	30 s	151
		50 to 500 ppm	4	
Hydrochloric Acid/ Nitric Acid 1/a	81 01 681	1 to 10 ppm	3	152
Hydrochloric Acid		1 to 10 ppm	1.5	
Nitric Acid		1 to 15 ppm	3	

Dräger-Tubes	Order Code	Standard Range of Measurement [20°C, 1013 hPa]	Measurement Time [min.]	Page
Hydrocyanic Acid 2/a	CH 25 701	2 to 30 ppm	1	153
Hydrogen 0.2%/a	81 01 511	0.2 to 2.0 Vol%	1	154
Hydrogen 0.5%/a	CH 30 901	0.5 to 3.0 Vol%	1	155
Hydrogen Fluoride 0.5/a	81 03 251	0.5 to 15 ppm	2	156
		10 to 90 ppm	25 s	
Hydrogen Fluoride 1.5/b	CH 30 301	1.5 to 15 ppm	2	157
Hydrogen Peroxide 0.1/a	81 01 041	0.1 to 3 ppm	3	158
Hydrogen Sulphide 0.2/a	81 01 461	0.2 to 5 ppm	5	159
Hydrogen Sulphide 0.2/b	81 01 991	0.2 to 6 ppm	55 s	160
Hydrogen Sulphide 0.5/a	67 28 041	0.5 to 15 ppm	6	161
Hydrogen Sulphide 1/c	67 19 001	10 to 200 ppm	20 s	162
		1 to 20 ppm	3.5	
Hydrogen Sulphide 1/d	81 01 831	10 to 200 ppm	1	163
		1 to 20 ppm	10	
Hydrogen Sulphide 2/a	67 28 821	20 to 200 ppm	20 s	164
		2 to 20 ppm	3.5	
Hydrogen Sulphide 2/b	81 01 961	2 to 60 ppm	30 s	165
Hydrogen Sulphide 5/b	CH 29 801	5 to 60 ppm	4	166
Hydrogen Sulphide 100/a	CH 29 101	100 to 2000 ppm	30 s	167
Hydrogen Sulphide 0.2%/A	CH 28 101	0.2 to 7 Vol%	2	168
Hydrogen Sulphide 2%/a	81 01 211	2 to 40 Vol%	1	169
Simultaneous Tube Hydrogen Sulphide + Sulphur Dioxide 0.2%/A	CH 28 201	0.2 to 7 Vol%	2	170
Mercaptan 0.1/a	81 03 281	0.1 to 2.5 ppm	10	171
Mercaptan 0.5/a	67 28 981	0.5 to 5 ppm	5	172
Mercaptan 20/a	81 01 871	20 to 100 ppm	2.5	173
Mercury Vapour 0.1/b	CH 23 101	0.05 to 2 mg/m^3	10	174
Methyl Acrylate 5/a	67 28 161	5 to 200 ppm	5	175
Methyl Bromide	81 03 391	0.2 to 2 ppm	5	176
		2 to 8 ppm	2	
Methyl Bromide 0.5/a	81 01 671	5 to 30 ppm	2	177
		0.5 to 5 ppm	5	
Methyl Bromide 3/a (5)	67 28 211	10 to 100 ppm	1	178
		3 to 35 ppm	3	
Methyl Bromide 5/b	CH 27 301	5 to 50 ppm	1	179

Dräger-Tubes	Order Code	Standard Range of Measurement [20°C, 1013 hPa]	Measurement Time [min.]	Page
Methylene Chloride 100/a	67 24 601	100 to 2000 ppm	3	180
Natural Gas Odorization, Tertiary Butylmercaptan	81 03 071	3 to 15 mg/m^3	3	181
		1 to 10 mg/m^3	5	
Natural Gas Test (5)	CH 20 001	qualitative	40 s	182
Nickel Tetracarbonyl 0.1/a (9)	CH 19 501	0.1 to 1 ppm	5	183
Nitric Acid 1/a	67 28 311	5 to 50 ppm	2	184
		1 to 15 ppm	4	
Nitrogen Dioxide 0.5/c	CH 30 001	5 to 25 ppm	15 s	185
		0.5 to 10 ppm	40 s	
Nitrogen Dioxide 2/c	67 19 101	5 to 100 ppm	1	186
		2 to 50 ppm	2	
Nitrous Fumes 0.5/a	CH 29 401	0.5 to 10 ppm	40 s	187
Nitrous Fumes 2/a	CH 31 001	5 to 100 ppm	1	188
		2 to 50 ppm	2	
Nitrous Fumes 20/a	67 24 001	20 to 500 ppm	30 s	189
Nitrous Fumes 50/a	81 01 921	250 to 2000 ppm	30 s	190
		50 to 1000 ppm	1	
Nitrous Fumes 100/c	CH 27 701	500 to 5000 ppm	1.5	191
		100 to 1000 ppm	1.5	
Oil Mist 1/a	67 33 031	1 to 10 mg/m^3	25	192
Olefine 0.05%/a	CH 31 201		5	193
	Propylene	0.06 to 3.2 Vol%		
	Butylene	0.04 to 2.4 Vol%		
Organic Arsenic Compounds and Arsine	CH 26 303	0.3mg/m^3 as AsH_3	3	194
Organic Basic Nitrogen Compounds	CH 25 903	1mg/m^3 threshold value	1.5	195
Oxygen 5%/B (8)	67 28 081	5 to 23 Vol%	1	196
Oxygen 5%/C	81 03 261	5 to 23 Vol%	1	197
Ozone 0.05/b	67 33 181	0.05 to 0.7 ppm	3	198
Ozone 10/a	CH 21 001	20 to 300 ppm	20 s	199
Pentane 100/a	67 24 701	100 to 1500 ppm	3	200

Dräger-Tubes	Order Code	Standard Range of Measurement [20°C, 1013 hPa]	Measurement Time [min.]	Page
Perchloroethylene 0.1/a	81 01 551	0.5 to 4 ppm	3	201
		0.1 to 1 ppm	9	
Perchloroethylene 2/a	81 01 501	20 to 300 ppm	30 s	202
		2 to 40 ppm	3	
Perchloroethylene 10/b	CH 30 701	10 to 500 ppm	40 s	203
Petroleum Hydrocarbons 10/a	81 01 691	10 to 300 ppm	1	204
Petroleum Hydrocarbons 100/a	67 30 201	100 to 2500 ppm	30 s	205
Phenol 1/b	81 01 641	1 to 20 ppm	5	206
Phosgene 0.02/a	81 01 521	0.02 to 1 ppm	6	207
		0.02 to 0.6 ppm	12	
Phosgene 0.05/a	CH 19 401	0.04 to 1.5 ppm	11	208
Phosgene 0.25/c	CH 28 301	0.25 to 5 ppm	1	209
		0.01 to 0.3 ppm	8	
Phosphine 0.01/a	81 01 611	0.1 to 1 ppm	2.5	210
Phosphine 0.1/a	CH 31 101	0.1 to 4 ppm	6	211
Phosphine 1/a	81 01 801	20 to 100 ppm	2	212
		1 to 20 ppm	10	
Phosphine 0.1/b in Acetylene	81 03 341	1 to 15 ppm	20 s	213
		0.1 to 1 ppm	4	
Phosphine 25/a	81 01 621	200 to10000 ppm	1.5	214
		25 to 900 ppm	13	
Phosphine 50/a	CH 21 201	50 to 1000 ppm	2	215
Phosphoric Acid Esters 0.05/a	67 28 461	0.05 ppm Dichlorvos	5	216
Polytest	CH 28 401	qualitative 1.5		217
Pyridine 5/A	67 28 651	5 ppm 20		218
Styrene 10/a	67 23 301	10 to 200 ppm	3	219
Styrene 10/b	67 33 141	10 to 250 ppm	3	220
Styrene 50/a	CH 27 601	50 to 400 ppm	2	221
Sulfuryl Fluoride 1/a	81 03 471	1 to 5 ppm	3	222

Dräger-Tubes	Order Code	Standard Range of Measurement [20°C, 1013 hPa]	Measurement Time [min.]	Page
Sulphur Dioxide 0.1/a	67 27 101	0.1 to 3 ppm	20	223
Sulphur Dioxide 0.5/a	67 28 491	1 to 25 ppm	3	224
		0.5 to 5 ppm	6	
Sulphur Dioxide 1/a	CH 31 701	1 to 25 ppm	3	225
Sulphur Dioxide 20/a	CH 24 201	20 to 200 ppm	3	226
Sulphur Dioxide 50/b	81 01 531	400 to 8000 ppm	15 s	227
		50 to 500 ppm	3	
Sulphuric Acid 1/a (9)	67 28 781	1 to 5 mg/m^3	100	228
Tetrahydrothiophene 1/b (5)	81 01 341	1 to 10 ppm	10	229
Thioether	CH 25 803	1 mg/m^3 threshold value	1.5	230
Toluene 5/b	81 01 661	50 to 300 ppm	1	231
		5 to 80 ppm	5	
Toluene 50/a	81 01 701	50 to 400 ppm	1.5	232
Toluene 100/a	81 01 731	100 to 1800 ppm	1.5	233
Toluene Diisocyanate 0.02/A (9)	67 24 501	0.02 to 0.2 ppm	20	234
Trichloroethane 50/d (5)	CH 21 101	50 to 600 ppm	2	235
Trichloroethylene 2/a	67 28 541	20 to 250 ppm	1.5	236
		2 to 50 ppm	2.5	
Trichloroethylene 50/a	81 01 881	50 to 500 ppm	1.5	237
Triethylamine 5/a	67 18 401	5 to 60 ppm	2	238
Vinyl Chloride 0.5/b	81 01 721	5 to 30 ppm	30 s	239
		0.5 to 5 ppm	3	
Vinyl Chloride 1/a	67 28 031	5 to 50 ppm	2	240
		1 to 10 ppm	8	
Vinyl Chloride 100/a	CH 19 601	100 to 3000 ppm	4	241
Water Vapour 0.1/a	81 01 321	0.1 to 1.0 mg/L	1.5	242
Water Vapour 1/b	81 01 781	20 to 40 mg/L	20 s	243
		1 to 15 mg/L	40 s	
Water Vapour 0.1	CH 23 401	1 to 40 mg/L	2	244
Xylene 10/a	67 33 161	10 to 400 ppm	1	245

1.3. Dräger Diffusion Tubes with Direct Indications

Dräger-Tube	Order Code	Standard Range of Meas. for 1 h [20°C, 1013 hPa]	Standard Range of Measurement for 8 h [20°C, 1013 hPa]	Page
Acetic Acid 10/a-D	81 01 071	10 to 200 ppm	1.3 to 25 ppm	267
Ammonia 20/a-D	81 01 301	20 to 1500 ppm	2.5 to 200 ppm	268
Butadiene 10/a-D	81 01 161	10 to 300 ppm	1.3 to 40 ppm	269
Carbon Dioxide 500/a-D	81 01 381	500 to 20000 ppm	65 to 2500 ppm	270
Carbon Dioxide 1%/a-D	81 01 051	1 to 30 Vol%	0.13 to 4 Vol%	271
Carbon Monoxide 50/a-D	67 33 191	50 to 600 ppm	6 to 75 ppm	272
Ethanol 1000/a-D	81 01 151	1000 to 25000 ppm	125 to 3100 ppm	273
Hydrochloric Acid 10/a-D	67 33 111	10 to 200 ppm	1.3 to 25 ppm	274
Hydrocyanic Acid 20/a-D	67 33 221	20 to 200 ppm	2.5 to 25 ppm	275
Hydrogen Sulphide 10/a-D	67 33 091	10 to 300 ppm	1.3 to 40 ppm	276
Nitrogen Dioxide 10/a-D	81 01 111	10 to 200 ppm	1.3 to 25 ppm	277
Perchloroethylene 200/a-D	81 01 401	200 to 1500 ppm	25 to 200 ppm	278
Sulphur Dioxide 5/a-D	81 01 091	5 to 150 ppm	0.7 to 19 ppm	279
Toluene 100/a-D	81 01 421	100 to 3000 ppm	13 to 380 ppm	280
Trichloroethylene 200/a-D	81 01 441	200 to 1000 ppm	25 to 125 ppm	281

1.4. Dräger Sampling Tubes & Systems

1.5. List of substances

1.6. Dräger VOICE

THE DRÄGER VOICE DATABASE OF HAZARDOUS SUBSTANCES IS AVAILABLE ON THE INTERNET EITHER DIRECTLY VIA THE URL HTTP://WWW.DRAEGER.COM/VOICE OR VIA THE DRÄGER SAFETY WEBSITE HTTP://WWW.DRAEGER-SAFETY.DE.

It provides up-to-date information about more than 1,600 hazardous substances and recommendations for the products offered by Dräger Safety to measure these hazardous substances and to protect oneself against them. It also includes instructions on how to handle and use the products recommended. The program starts with a search template that searches the requested hazardous substance by entering a chemical name, CAS, EINECS or UN number, the chemical formula or one of the substance's synonyms. Detailed continuously updated information about the substance selected can be retrieved such as:

Dräger Voice

- German and international limit values
- various physical-chemical properties such as molar mass, density, melting point, boiling point and explosion limits in air
- markings such as danger symbols, Kemlerzahl, R&S safety standards, regulatory and safety data, and danger notices
- synonyms

The Dräger-Tubes that are recommended for detection of the selected substance are categorised in short-term and long-term tubes and chip measurement system. Usually the following information about the products is available:

- picture and enlarged view
- order number
- list of measuring ranges and stroke numbers for different media
- instructions for use and measurement instructions
- related products

Detailed view of a Dräger-Tube.

2. Introduction

2.1. Dräger-Tube Measurement

TODAY, DETECTOR TUBES ARE ONE OF THE CLASSICAL MEASUREMENT TECHNIQUES OF GAS ANALYSIS.

The first detector tube patent appeared in America in 1919. Two Americans, A.B. Lamb and C.R. Hoover, impregnated pumice with a mixture of iodine pentoxide and sulphuric acid. This preparation, which they put in a vial, became the first chemical sensor for measuring or rather detecting carbon monoxide (Fig. 4). Before this early detector tube, canaries were used as ”sensors“ in coal mining.

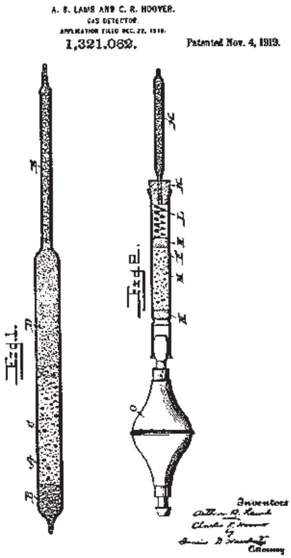


Fig. 4: Patent drawing by Lamb and Hoover

This first detector tube was only used for qualitative detection of the presence of carbon monoxide, quantitative measurement was not yet possible. Today the Dräger-Tubes provide quantitative results with a high degree of accuracy and selectivity. Since the development of the first Dräger-Tube, more than 60 years ago, Dräger has expanded the product line to more than 200 Dräger-Tubes capable of measuring more than 350 different gases and vapours (Fig. 5 shows early tubes and pump)


1-282-50

Fig. 5: Gas Sampling Pump 1950

In comparison with the first detector tube patent, the basic shape and structure of a tube may appear not to have changed; however, closer inspection reveals the contents have changed dramatically. What is a Dräger-Tube? Simplistically, it is a vial which contains a chemical preparation that reacts with the measured substance by changing colour. To achieve the normal shelf life of 2 years the tube tips are fused on both ends. Thus, the vial provides an inert package for the reagent system. Most of the Dräger-Tubes are scale tubes and it should be emphasized that the length-of-stain discoloration is an indication of the concentration of the measured substance.

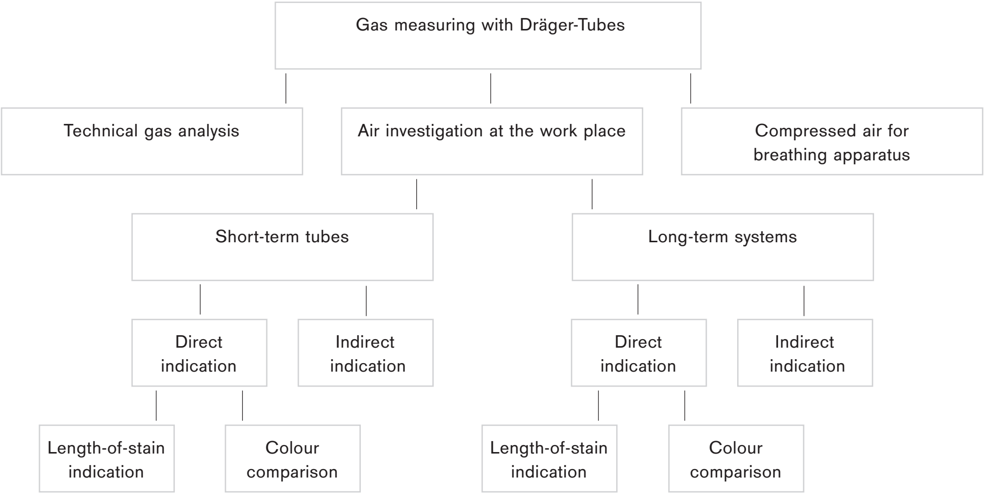
The printed scale allows a direct reading of the concentration. Thus, calibration by the user is not necessary. Of course the length-of-stain discoloration does not correspond to the concentration as a direct measure but is, strictly speaking, a measure of the mass reaction of the air contaminant with the Dräger-Tube preparation. Since the information that 25 grams of nitrogen dioxide has reacted is not practical information for the workplace, the calibration scale is prepared in the engineering units ppm or volume percent (Fig. 6).

For many years, only a few gases could be measured with detector tubes. The main area of application was and still is the measurement of air contaminants at the workplace, in the concentration range of the occupational exposure limits. Decreasing occupational exposure limits have made it necessary to develop more sensitive Dräger-Tubes. In addition, efforts to better understand the exposure profile in the workplace have resulted in special Dräger-Tubes for long-term measurement which determine time weighted averages over given time periods.

Fig. 6: Dräger-Tube Nitrogen Dioxide 0.5/c

ST-139-2001

Dräger-Tubes can be schematically classified utilizing the following criteria:



Distinction is made according to the fundamentally different areas of application:

- **Air investigation in the workplace**
  Measurements in the range of the occupational exposure limits.
- **Technical gas analysis**
  Dräger-Tube measurements in the area of emission concentrations.
- **Compressed air for breathing apparatus**
  Specially calibrated Dräger-Tubes used with the Dräger Aerotest to determine the quality of compressed breathing air. The typical contaminants are CO, CO_2, water and oil.

Short-term tubes are designed for on-the-spot measurements at a particular location over a relatively short time period. Short-term tube measurements may last from 10 seconds to 15 minutes or so depending on the particular Dräger-Tube and sampling pump. Some applications for short-term tubes are the evaluation of concentration fluctuations in the workplace, the measurement of contaminants in the workers' breathing zone, the investigation of confined spaces (e.g. grain silos, chemical tanks, sewers) prior to entry and to check for gas leaks in process pipelines.

The Dräger short-term tubes and gas detector pumps are designed and calibrated as a unit. The use of other types of pumps with Dräger short-term tubes is not recommended. Although the volume may be the same, the difference in the flow characteristics of the pump and tube can result in considerable measurement errors.

Suitable pumps for Dräger short-term tubes are:
- **Gas detector pump Dräger accuro or the previous Model 31 pump**
- **Automatic pump Dräger accuro 2000 with the gas detector pump accuro**
- **Dräger Quantimeter 1000**

Long-term tubes provide integrated measurements that represent the average concentration during the sampling period. The long-term tubes are used for measurements between one and eight hours. Long-term tubes can be used economically as personal monitors or area monitors to determine the time weighted average concentration.

In addition to the long-term tubes, there are also direct reading diffusion tubes and badges used for long-term measurements (Fig. 7). In contrast to long-term tubes, no pump is necessary for sampling with these measurement devices. The contaminant molecules automatically move into the tube or onto the badge, according to Fick's First Law of Diffusion. The driving force for this movement of the contaminant molecules is the concentration differential between the ambient air and the inside of the tube or badge.

Since the diffusion tubes and badges do not require a pump, they are particularly effective as personal gas monitors, while the long-term tubes and suitable sampling pump can be used for stationary measurements in the workplace.

When complex substances or components that are chemically very similar, like methanol, ethanol, and propanol are present, direct reading Dräger-Tubes approach their limits of use. A colourimetric reaction system based on a chromate indicator cannot distinguish between the three alcohol types and indicates the sum of the concentration. In this example, the alcohols are indicated with almost the same sensitivity. Solvents usually consist of three to five different components, all chemically very similar. The use of a single Dräger-Tube in this case would not yield reliable results without any previous knowledge because of possible and probable cross sensitivities. In cases such as these, a sample should first be collected using a sampling tube which is then sent to a laboratory for analysis (Fig. 8). The analysis will be conducted using gas chromatography or a photometric analysis technique.

Dräger sampling tubes contain coconut shell charcoal, different types of silica gel, or molecular sieve. The sampling tubes do not produce a colour change and therefore can be described as indirect indicators. The sampling of isocyanates is accomplished using a specially prepared Dräger sampler which is analyzed after sampling via HPLC procedures.

After the analysis with sorbent sampling tubes it is often possible for subsequent measurements to be performed economically with direct reading short-term or long-term tubes targeted for particular components of a mixture.


ST-1350-2004

Fig. 7: Direct reading diffusion tube with holder


ST-174-2004

Fig. 8: Dräger diffusion sampler ORSA

In order to choose the best Dräger-Tube for the particular application, an assessment of the measurement with regard to the ambient conditions and the possible limits of use is very important. This assessment ensures that the advantage of the Dräger-Tube method does not turn into a disadvantage due to unforeseen cross sensitivities. In any case, although the Dräger-Tube is an easily operated gas measurement method, it belongs in the hands of specialists. People trained in the field of industrial hygiene should be capable of determining the time and place to monitor, to recognise possible cross sensitivities, and to interpret measurement results correctly.

For all gas analysis tasks Dräger provides competent and extensive service beyond the initial sale of its products. This service includes:

- free consultation for specific questions on measurements with Dräger-Tubes,
- free consultation for the use of Dräger-Tubes outside the normal operating parameters,
- *analysis of loaded samplers in the laboratory of the Dräger analysis service
- *measurement and sampling on site with analysis in the laboratory of the Dräger analysis service according to official regulations,
- Internet information system VOICE: www.draeger.com/voice

*This service is currently available in Germany.

2.2. Chemical Basis – Reaction Mechanisms

THE BASIS OF ANY DIRECT READING DRÄGER-TUBE IS THE CHEMICAL REACTION OF THE MEASURED SUBSTANCE WITH THE CHEMICALS OF THE FILLING PREPARATION.

Since this reaction leads to a discoloration, the Dräger-Tubes can also be called colourimetric chemical sensors. The substance conversion in the Dräger-Tube is proportional to the mass of the reacting gas. Generally it is possible to indicate this substance conversion as a length-of-stain indication. When a length-of-stain indication is not practical, the alternative is a Dräger-Tube with the indication based on interpretation of colour intensity according to a given reference standard or set of standards.

The filling layers of Dräger-Tubes are comprised of different reagent systems. There are essentially 14 reagent systems used in Dräger-Tubes and in some cases these reagents are combined in the same tube to give desired effects. For the Dräger-Tube user the selectivity of the individual tube is very significant. The spectrum of selectivity of Dräger-Tubes ranges from the substance selective Dräger-Tubes for carbon dioxide to tubes which are selective to substance groups (e.g. chlorinated hydrocarbons), to the class selective Dräger-Tube like the Polytest tube which indicates many easily oxidizable substances. The Dräger-Tube user has many options available when using Dräger-Tubes. This handbook is intended to help sort out those options.

One of the classic Dräger-Tube reactions is the conversion of iodine pentoxide under acidic conditions to iodine by reaction with carbon monoxide. While it is basically a class selective reaction for the measurement of easily oxidizable substances, the selectivity can be increased by suitable prelayers:

$$5\,CO + I_2O_5 \xrightarrow{H_2SO_4} 5\,CO_2 + I_2$$

Precipitation reactions of metal salts are the basis of hydrogen sulphide tubes. Metal salts react with hydrogen sulphide and form slightly soluble metal sulphides. This is a fast ion reaction which is nearly independent of the flow rate through the Dräger-Tube. In order to make this reaction occur, a small amount of water, i.e. humidity, is necessary:

$$H_2S + Cu^{2+} \longrightarrow 2\,H^+ + CuS$$

Nitrogen dioxide and elementary halogens react with aromatic amines by forming intensely coloured compounds:

$$Cl_2 + \text{o-Tolidine} \longrightarrow \text{orange reaction product}$$

Since chlorinated hydrocarbons are not indicated by direct colourimetric reaction, an oxidative cleavage of the molecule is necessary as a first step. This reaction is either done with potassium permanganate or chromium (VI) compounds, which forms elementary chlorine. The chlorine then reacts with the reagent preparation in the indicating layer to produce the colourimetric reaction product.

The measurement of carbon dioxide is done by oxidation of hydrazine hydrate in the presence of crystal violet as an oxidation-reduction (redox) reaction:

$$CO_2 + N_2H_4 \longrightarrow NH_2\text{–}NH\text{–}COOH$$

Typically carbon dioxide will be present at a substantially higher concentration than any potentially cross sensitive substances, therefore this reaction is very selective. Possible interferences by hydrogen sulphide and sulphur dioxide are not expected since these interferences can only occur with unusually high concentrations.

Another large group of Dräger-Tube reactions is based on pH indicators, for example:

$$NH_3 + \text{bromophenol blue} \longrightarrow \text{blue reaction product}$$

This type of reaction is valid for basic as well as acid gases.

Compounds containing the $C \equiv N$-group are measured using multiple stage reactions. In the case of acrylonitrile, the first step is a reaction with a chromium (VI) compound. In the next step the cyanide ion reacts with mercury chloride to form hydrochloric acid and undissociated mercury cyanide. The hydrochloric acid is indicated in the last partial step of this complex reaction system by means of a pH indicator. Suitable prelayers are used to ensure a selective measurement. A similar reaction principle is also used in the most sensitive hydrogen phosphide (i.e. phosphine) tubes, Phosphine 0.01/a. The hydrogen phosphide also reacts with mercury chloride, but in this case yields mercury phosphide and hydrochloric acid. Again, the hydrochloric acid is indicated by means of pH-indicator.

Most hydrides of the elements from group III or V of the periodic table (e.g. borane or arsine), react because of their reducing characteristics with gold salts by forming elemental gold.

Aromatics condense under strongly acidic conditions with formaldehyde to form intensely coloured quinoid compounds with different molecular structures. Each of these reaction partners can be measured on this basis; aromatics like benzene and xylene as well as formaldehyde. For ethylene oxide and ethylene glycol an additional oxidation reaction is necessary, in which both substances are converted into formaldehyde.

The oxidation effect which sulphur dioxide has on iodine complexes (i.e. iodine with starch) results in a bleaching or discoloration of the coloured indicator to a neutral white. This reaction is the basis of several Dräger-Tubes for sulphur dioxide.

Chromium (VI) compounds under acidic conditions have a strong oxidising effect, so that they are suitable for the measurement of a lot of organic compounds. The Dräger Alcotest tube for the measurement of alcohol in the breath is based on a chromium (VI) salt. In this case the chromium (VI) is reduced to green chromium (III). The oxidising effect of the chromium (VI) compounds forms esters (other than acetic acid) which can be oxidised further. However, the colour of these chromate tubes is only based on the green chromium (III) ion, so the colourless oxidation products do not interfere with the actual measurement.

Substituted aromatic amines react relatively selectively with acetic chlorides and phosgene, where the latter can be seen as dichloride of the carbonic acid. Carbon tetrachloride is oxidised by a strong oxidation agent into phosgene, so that this type of reaction is also suitable for the measurement of carbon tetrachloride.

The oxidation reaction of C=C double bonds with potassium permanganate is the basic reaction of the Dräger-Tubes for the measurement of olefins (i.e. alkenes). Other substances which are oxidised by permanganate (e.g. perchloroethylene) will also be indicated.

Another reduction reaction of metal salts permits the measurement of ethylene and some acrylates. Molybdate salts show an intensive discoloration from light yellow to dark blue when reduced from the highest oxidation stage to a lower one.

Substance selective reactions which have not been mentioned include:
- ketone detection with hydrazine derivates,
- oxidation of titanium (III) salts by oxygen,
- nickel detection by dimethylglyoxime.

The limits of the gas detection method must be considered when attempting to conduct an analytical determination. It is important with regard to the selectivity to know about potential cross sensitivities. Considering the exhaustive list of potential chemical substances, it is not possible to list all potential interferences. When questions about Dräger-Tubes arise, they should be directed to the local Dräger Safety subsidiary or distributor.

2.3. Dräger-Tube Measurement System

THE DRÄGER-TUBE MEASUREMENT SYSTEM CONSISTS OF A DRÄGER-TUBE AND A DRÄGER GAS DETECTOR PUMP.

Each Dräger-Tube contains a very sensitive reagent system that produces accurate readings when the technical characteristic of the gas detector pump precisely match the reaction kinetics of the reagent system in the tube. Therefore, a gas detector pump delivering the correct volume must also pull the sample through the Dräger-Tube at the proper rate (Fig. 9). In effect, the pump and tube form a sampling unit. To interchange the pumps and tubes of various manufacturers can lead to erroneous results. These requirements are referenced in international as well as national detector tube standards or norms which require or recommend that detector tubes be used with a matching gas detector pump from the same manufacturer.

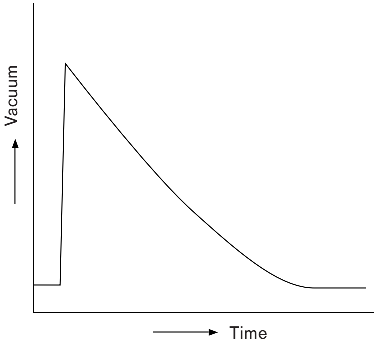


Fig. 9: Suction characteristic of a Dräger bellows pump

When taking short- and long-term measurements we distinguish between two different types of pumps the short-term and long-term pumps.

Dräger short-term gas detector pumps

The following gas detector pump can be used suitably for the measuring of momentary concentrations, e. g. concentration peaks, spot measurements and worst case measurement:.

- Gas Detector Pump Dräger accuro
- Automatic Pump Dräger accuro 2000 with Gas Detector Pump Dräger accuro
- Dräger Gas Detector Pump, Model 21/31
- Dräger Quantimeter 1000

The air sample is sucked strokewise through the Dräger-Tubes with these gas detector pumps. Basically all gas detector pumps are to be used according to the appropriate instructions for use.

Technical Data	Dräger Gas Detector Pump, Mod. 21/31	Gas Detector Pump Dräger accuro
Application	For short-term measurements with a small number of strokes	For short-term measurements with a small number of strokes
Design	Bellows pump worked by hand Single-handed operation	Bellows pump worked by hand Single-handed operation
Number of Strokes	1 to 50 and higher	1 to 50 and higher
Stroke volume	100 mL (±5%)	100 mL (±5%)
Size (H x W x D)	85 x 150 x 50 mm	85 x 170 x 45 mm
Weight	app. 250 g	app. 250 g
Kind of protection	(not required)	(not required)
Battery	(not required)	(not required)

For the Gas Detector Dräger accuro and Pump Model 21/31 the pump body (bellows) is pressed together completely. Both pumps are easily operated with one hand and supply 100 mL with one stroke, during which the air contained in the pump chamber escapes through the exhaust valve. The suction process runs automatically after the bellows are set free. The exhaust valve is closed during the opening phase of the bellows so that the gas sample flows into the pump chamber through the Dräger-Tube connected in series. After the complete opening of the pump body into its original position the suction process is finished. The end of stroke is visible by the completely stretched distance claim for the Gas Detector Pump Model 21/31 and by an end of stroke indication for the Gas Detector Pump Dräger accuro. An internal scissor mechanism in the Dräger accuro ensures complete even compression of the bellows and an automatic stroke counter which is integrated in the pump head records the number of strokes.

Fig. 10: Gas Detector Pump Dräger accuro

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The gas detector pumps are independent of external energy sources. Therefore there are no usage restrictions in areas of explosion hazard.

For the Automatic Pump Dräger accuro 2000 the Gas Detector Pump Dräger accuro is the principal item of the measuring device. The Gas Detector Pump Dräger accuro is automatically compressed in the Automatic Pump Dräger accuro 2000 after the number of strokes necessary for the measurement has been preselected. The measuring process is finished when the programmed number of strokes has been performed. Since the Dräger accuro 2000 and Dräger Quantimeter 1000 do not comply with the explosion hazard regulations, measurements in areas with explosion hazards can only be performed manually with the gas detector pump Dräger accuro.

1-271-91

Fig. 11: Pump System Dräger accuro 2000

The Dräger Quantimeter 1000 is a microprocessor controlled automatic gas detector pump. The number of strokes can be preselected from n = 1 to n = 199 corresponding to an air volume from 0.1 to 19.9 litres. Continuous operation is also possible. It features two LC displays indicating the preselected number and the actual number of strokes. The apparatus is operated with a rechargeable battery which can be exchanged.

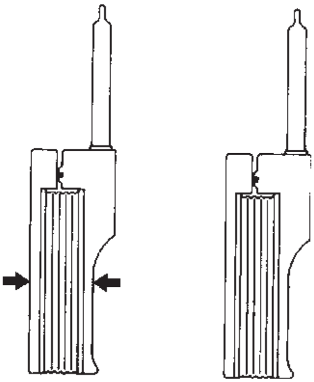
ST-1372-2004

Fig. 12: Dräger Quantimeter 1000

Technical Data	Automatic Pump Dräger accuro 2000	Dräger Quantimeter 1000
Application	For short-term measurements with higher number of strokes or in continuous operation	For short-term measurements with higher number of strokes or in continuous operation
Design	Electrically operated, automatic pump for the operation of the Gas Detection Dräger Pump accuro	Electrically operated, micropro cessor controlled bellows pump in compact contruction
Number of strokes	1 - 199 pre-selectable or contiuous operation	1 - 199 pre-selectable or contiuous operation
Stroke volume	100 mL (±5%)	100 mL (±5%)
Size (H x W x D)	270 x 190 x 100 mm	180 x 165 x 62 mm
Weight	app. 2,4 Kg	app. 1,8 Kg
Battery	Nominal voltage 6 V / 1 Ah	Nominal voltage 6 V / 1 Ah

Maintenance of gas detector pumps

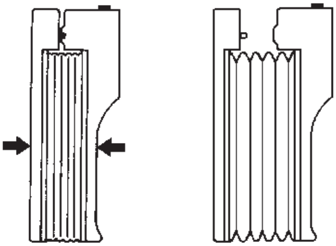
To help ensure precise measurement results, it is particularly important to confirm that the pump is operating properly. Short-term pumps should be checked before each measurement for leaks and suction capacity according to the operating manual (Fig. 13 and 14). In addition, after a measurement short-term pumps should be flushed with clean air by performing several strokes without a Dräger-Tube in the pump. This purges the pump of reaction products which enter the bellows due to the reaction in the tube. The long-term pumps such as the Polymeter should be checked for flow volume according to the operating manual.



Insert an unopened Dräger-Tube and squeeze the pump completely.

After releasing the position of the pump body should not change within one minute.

Fig. 13: Quick test to check bellows pump for leaks



Squeeze the pump completely.

After releasing, the pump must open instantly.

Fig. 14: Quick test to evaluate the suction capacity of the bellows pump

2.4. Dräger-Tubes for Short-Term Measurements

SHORT-TERM TUBES ARE INTENDED FOR THE MEASUREMENT OF MOMENTARY CONCENTRATIONS. THE DURATION OF A SHORT-TERM MEASUREMENT IS USUALLY IN THE RANGE OF 10 SECONDS TO 15 MINUTES THE MEASURED VALUE SHOWS THE ACTUAL CONCENTRATION DURING THE TIME PERIOD COVERED BY THE TEST.

The design of the short-term tube depends on the measurement task, particularly on the substance to be measured and the concentration range to be determined. There are several types of Dräger short-term tubes:

- tubes with an indication layer,
- tubes with one or more prelayers plus an indication layer,
- combination of two tubes,
- tubes with connecting tubes,
- tubes with a built in reagent ampoule,
- tubes for simultaneous measurement

Short-term tubes with a single indication layer

The whole filling layer in these tubes serves as the indication layer (Fig. 15).

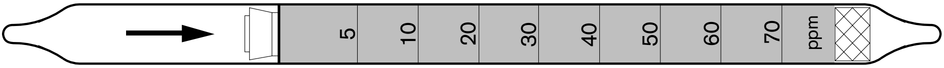


Fig. 15: Dräger-Tube with an indication layer

Examples include: Acetone 100/b
Ammonia 5/a.

Short-term tubes with one or more prelayers

In addition to the indication layer they have one or more prelayers (Fig. 16). These prelayers are designed to: adsorb moisture
or trap interfering substances
or convert substances into measurable substances

Examples include: Alcohol 100/a
Hydrocyanic Acid 2/a.

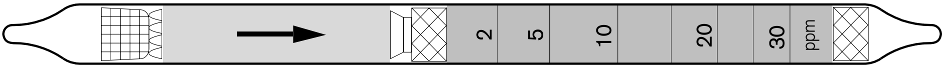


Fig. 16: Dräger-Tube with one prelayer

Combination of two Dräger-Tubes

Two Dräger-Tubes, a pretube and an indication tube, are connected with shrink wrap tubing (Fig. 17). Prior to the measurement, both inner tips and outer tips must be opened to allow air to be drawn through both tubes. The preparation in the pretube serves a purpose similar to the prelayer of a single tube.

Examples include:	Halogenated Hydrocarbons 100/a Formaldehyde 0.2/a

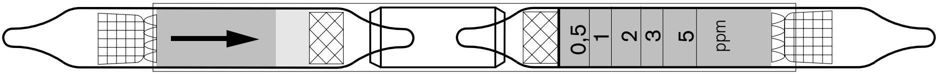


Fig. 17: Combination of two Dräger-Tubes

Short-term tubes with connecting tubes

These tubes consist of one indication tube and an additional tube (Fig. 18). After breaking off the tube tips both tubes are connected with a short piece of rubber tubing supplied with the tubes. The additional tube must be connected in front of or behind the indication tube according to the instructions for use. If connected behind the indication tube, it functions as an adsorption layer for reaction products which result from the reaction in the indication tube. If it is connected in front of the indication tube, it functions similarly to the prelayer in a standard Dräger-Tube.

Examples include:	Oxygen 5%/B Benzene 2/a

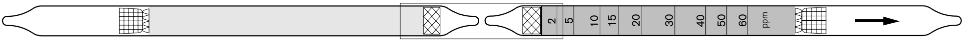


Fig. 18: Dräger-Tube with pretube

Short-term tubes with a built in ampoule

Due to chemical incompatibility some reagents must be kept separate until just before the actual measurement. These tubes feature a built-in reagent ampoule in addition to the indication layer (Fig. 19). The compound in the ampoule can be vapourous, liquid, or solid (i.e. granular).

Examples include: Oil Mist 1/a Methyl Bromide 5/b

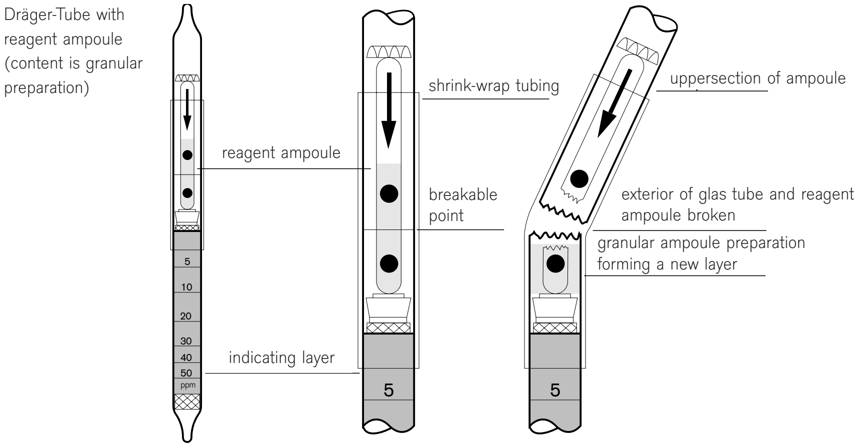


Fig. 19: Dräger-Tube with built-in reagent ampoule

Dräger-Tubes for simultaneous measurement

A set of five specially calibrated tubes are provided in a rubber fixture (Fig. 20). Each tube has one or two calibration marks (approximately 1 x and 5 x the TLV) depending upon the respective calibration curve. The tips of all five tubes are broken and the set is connected to a five tube adapter which is connected to the gas detector pump (e.g. Dräger accuro) and the air sample is drawn through all five tubes simultaneously. Since the test sets are designed as a system, the use of other tubes is not recommended and will lead to erroneous results.

Examples include:

Dräger Simultaneous Test Set I and II measurement of inorganic combustion gases.
Dräger Simultaneous Test Set III measurement of organic vapours.

Fig. 20: Test Set I for simultaneous measurement of inorganic combustion gases.

2.5. Evaluation of Dräger-Tubes

THE EVALUATION OF THE INDICATION ON THE DRÄGER-TUBE IS ANOTHER IMPORTANT FACTOR TO BE TAKEN INTO CONSIDERATION. THE FOLLOWING ARE GUIDELINES FOR INTERPRETING THE INDICATION:

- continuously observe the tube during the measurement
- evaluate the indication immediately following the measurement according to the instructions for use
- use sufficient lighting
- compare with an unused tube

Observing the tube during the measurement is particularly important to make sure that a complete discoloration of the tube has not happened without being realised. This complete discoloration can sometimes occur abruptly with high concentrations even during the course of the first stroke.

A sufficient lighting source is necessary. However, direct sunlight should be avoided because the UV-radiation of the sun may cause a change in the discoloration. Since such a change can sometimes occur even after a longer period of time.

The reading of the tube must be done immediately following the measurement.

Also, keeping the used tube as proof is not useful in most cases, because even tubes which have been sealed with rubber caps will show a change in the indication over time.

A light background (white paper) is very helpful, in improving the readability of the discoloration. When there is no source of ambient lighting the reflector of a switched-on flashlight will suffice.

The comparison of a used tube with an unused one is yet another way to more accurately evaluate the discoloration.

In all cases the entire length of the discoloration must be read. This means the sum of all colours (e.g. carbon monoxide tubes produce light brownish green discolorations).

It must also be pointed out that an individual's perception of a particular colour or intensity of a colour is somewhat subjective. It is possible, for example, that one person calls a colour light brown whereas another person calls the same colour brown. These deviations in the individual perception of colour or sense of colour should not be overemphasised unless colour blindness is an issue.

2.6. Hot Air Probe

THE HOT AIR PROBE WAS DEVELOPED FOR THE MEASUREMENT OF HOT GASES. THIS PROBE IS REQUIRED WHEN THE TEMPERATURE LIMIT (USUALLY UP TO 40° C) GIVEN IN THE OPERATING INSTRUCTION SHEET IS EXCEEDED.

At a higher temperature the volume of air drawn with the Dräger gas detector pump changes. Normally, the volume is 100 cm^3 per pump stroke at 20 °C. The temperature dependence of the volume can be explained with Gay-Lussac's law.

$$V_t = \frac{V_0}{T_0} T$$

The hot air probe is designed to cool down hot gases so they can be measured directly with the Dräger-Tube system. The dead air space of the probe is so small that it can be ignored while measuring.

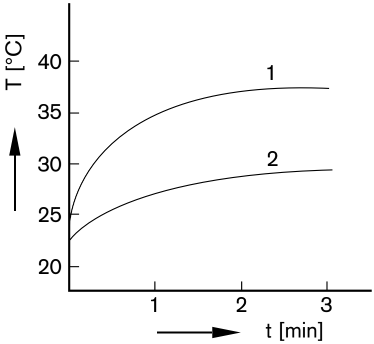


Fig. 21: Cooling effect of the hot air probe
gas temperature : 650°C
ambient temperature : 20°C
In 3 minutes 1 litre of gas was drawn
and the temperature in the tube rose
according to the above curves
(1) with one hot air probe
(2) with two hot air probes

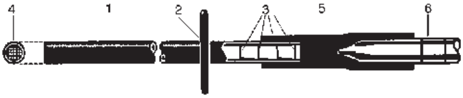


Fig. 22: Sketch of the hot air probe
(1) probe, (2) plate to restrict insertion, (3) cooling baffles, (4) front view of the probe, (5) rubber connecting hose, (6) Dräger-Tube

2.7. Extension Hose

AN EXTENSION HOSE PROVIDES A CONVENIENT MEANS TO TEST THE AIR QUALITY IN DIFFICULT TO ACCESS AREAS SUCH AS GRAIN SILOS, STORM DRAINS, SEWERS AND TANKS, PRIOR TO ENTRY.

One end of the hose is equipped with an adapter to connect the extension tube securely to the gas detector pump. The other end of the hose has a tube holder assembly which provides a gas tight fit when the Dräger-Tube is inserted. The extension hose is made of a fuel resistant synthetic rubber.

Since the Dräger-Tube is connected at the inlet of the extension hose and the gas detector pump is connected at the outlet end of the extension hose, the volume of the hose has no influence on the reading. However, when extension hoses longer than the standard 3 metre hose are used, correction factors or additional time to draw the sample may be required and should be reviewed with the local Dräger subsidiary or distributor.

2.8. Determination of the Carbon Monoxide Content in Exhaled Air

THE RESPIRATORY CO TEST IS USED FOR THE DETERMINATION OF THE CONCENTRATION OF CARBON MONOXIDE IN THE BLOOD.

There is a very close relationship between the carbon monoxide content of exhaled air (alveolar air) and the level of carbon monoxide saturation of the blood. The Respiratory CO Test provides a convenient and reliable means to measure the carboxyhemoglobin (COHb) content of the blood.

As a follow-up to the carbon monoxide measurements made at the work place, the Respiratory CO Test provides vital information about the exposure to the individual. People working in areas where the carbon monoxide concentration is fluctuating (e.g. highway toll booths, parking garages) should be checked regularly.

Fig. 23: Respiratory CO Test measurement

To conduct the test, exhaled air is blown through a resistance tube into a 1 L sampling bag. The air sample is drawn out of the sampling bag through a Dräger-Tube (calibrated in percent carboxyhemoglobin) using the Dräger gas detector pump (Fig. 23).
The exhaled air consists of a mixture of alveolar air and tidal air. Since the test subject must blow hard through the resistance tube to fill the sampling bag, the alveolar air makes up approximately 70% of the sample air. This is a highly reproducible ratio test after test.

2.9. The Analysis of Breathing Air, Medical Gases and Carbon Dioxide

As per DIN EN 12 021 compressed air that is used as breathing air has to meet certain quality requirements - for instance air expanded to normal pressure must not contain more than 15 ppm carbon monoxide and not more than 500 ppm carbon dioxide. At a filling pressure of 200 bar the water content of air expanded to normal pressure must be below 50 mg/m^3 while at a filling pressure of 300 bar it must be below 35 mg/m^3. Moreover, air expanded to normal pressure has to be odorless and tasteless (in general this is ensured, if the oil content is below 0.1 mg/m^3). In addition the water content of air expanded to normal pressure supplied by the compressor must not exceed 25 mg/m^3 over the whole pressure range [DIN EN 12 021].

The Dräger Aerotest product line provides for quantitative measurements in order to check these parameters and to meet the application and country-specific requirements on the different media. Dräger has been active in the field of compressed air analysis for more than 100 years. Our latest development in this field is the Dräger Aerotest product line that enables the simultaneous measurement of contaminants in the air discharged as well as in oxygen and carbon dioxide. The measurements are performed with Dräger-Tubes. The combination of the Dräger Aerotest Simultan with the detector tubes enables measurements within five minutes only. The flow required for the measurement of contaminants (flow through the Dräger-Tubes used) is ensured via a precise pressure reducer and special dosage. Independent of the admission


K-153

Fig. 24: Dräger Aerotest Simultan

pressure of the compressor (max. 300 bar), the ring pipeline or the respective residual filling pressure in the cylinders a constant flow is built up. The Dräger Aerotest Simultan has a compact design and can be connected to conventional compressors, storage cylinders or ring pipelines without any additional tools.

Dräger Aerotest Simultan HP, complete 65 25 951

To analyze the breathing air in the high pressure range. As per EN 12021 the quality of the breathing air is checked by quantitative measurement (of the contaminants) in the compressed air discharged. Quick-check measurement with high accuracy within 5 minutes. The measuring system (G 5/8" connection DIN 477) can be connected with the high pressure compressed-air ductwork system to be checked. All Dräger Aerotest Simultan HP components are packed in a case ready to hand.


ST-1342-2004

Fig. 25: Dräger Aerotest Simultan HP, complete

Dräger Aerotest Alpha, complete 65 27 150

For monitoring breathing air in low pressure range from 3 to 15 bar. The quality of the breathing air can be tested in accordance to the valid purification standards by means of quantitative measurements of the contaminations. Different regulations can be fulfilled (e.g. DIN EN 12021). The measuring device, barbed nipple, can be connected to the low pressure compressed air supply systems. All components of Dräger Aerotest Simultan Alpha are arranged in a carrying case and ready for use.


ST-1338-2004

Fig. 26: Dräger Aerotest Alpha, complete

Dräger MultiTest med. Int., complete 65 27 320

To check medical gases in gas supply systems for contaminants. In combination with Dräger-Tubes MultiTest med. Int. detects contaminants in compressed air, nitrous oxide, carbon dioxide and oxygen according to USP (United States Pharmacopeia) requirements. Dräger-Tubes are used for quantitative measurement of water vapour, Oil, CO_2, SO_2, H_2S, NO_x, CO and other contaminants in medical gases. The measuring device is connected with different barbed nipple adapters. All components of the Dräger MultiTest med. Int. are arranged in a carrying case and ready for use.

ST-1368-2004

Fig. 27: Dräger MultiTest med. Int., complete

Dräger Simultan Test CO_2, complete 65 26 170

To analyze carbon dioxide (CO_2) in the low pressure range 3 bar. The carbon dioxide is checked by means of a quantitative measurement (of the contaminants) in the carbon dioxide discharged. Via a plug-in adapter the measurement system can be connected with the carbon dioxide pipeline system to be checked.
Dräger Detector Tubes are used for the quantitative measurement of the contents of NH_3, NO_X, CO, SO_2, H_2S and water vapor as well as other contaminants in the carbon dioxide.
All components of the Dräger Simultan Test CO_2 measurement system are stored in a case ready to hand.

ST-1339-2004

Fig. 28: Dräger Simultan Test CO_2, complete

Dräger Aerotest Navy, complete **65 25 960**

The device is designed fpr the quantitative determination of water vapour, Oil, CO_2, Co and O_2 as well as other impurities to be contained in the compressed air supplied from high pressure compressors or compressed air to max. 300 bar (4.500 psi). The pressure is reduced by a reducer. The air to be tested is continously extracted via a measurement type float. The compressed air is routed through a special direct reading detector tube which permits quantitative evaluation. The quality demands placed are specified in DIN EN 12021 „Compressed Air". All components of the Dräger Aerotest Navy are arranged in a carrying case and ready for use.


ST-1344-2004

Fig. 29: Dräger Aerotest Navy, complete

2.10. Proposed Strategy for Determining Gas Hazards

Dräger-Tubes provide reliable results about the level of toxic gases in the workplace and at hazardous incidents (hazardous waste sites, accidents involving chemicals, fires, etc.). In approximately 60 to 65% of all hazardous incidents, flammable substances and thus an explosion hazard exists. Therefore, the determination of an explosion hazard and a check of the oxygen content should be conducted before Dräger-Tubes are used.

For these special applications, Dräger has developed multiple test sets for carrying out simultaneous measurements. Each set consists of five specially calibrated tubes assembled in a rubber fixture. At this time there are two sets available for the measurement of inorganic combustion gases (Dräger Simultaneous Test-Set I and II) and a third set, for the measurement of organic substance groups (Dräger Simultaneous Test-Set III).

The use of such multiple measurement devices has substantial advantages compared with individual Dräger-Tube measurements:

- **significant reduction of the measuring time**
- **detection of five contaminants and the relative concentrations at once**

The Dräger Simultaneous Test-Sets are delivered preassembled and are connected to the gas detector pump via an adapter after opening the tube tips.

The Dräger-Tubes that make up each set do not have complete calibration scales. Instead, they have one or two calibration marks at approximately 1 x and 5 x the TLV. To achieve the same air flow through each tube, the individual flow resistances of the Dräger-Tubes are very carefully matched, therefore, no other detector tubes may be used as substitutes in the rubber fixture.

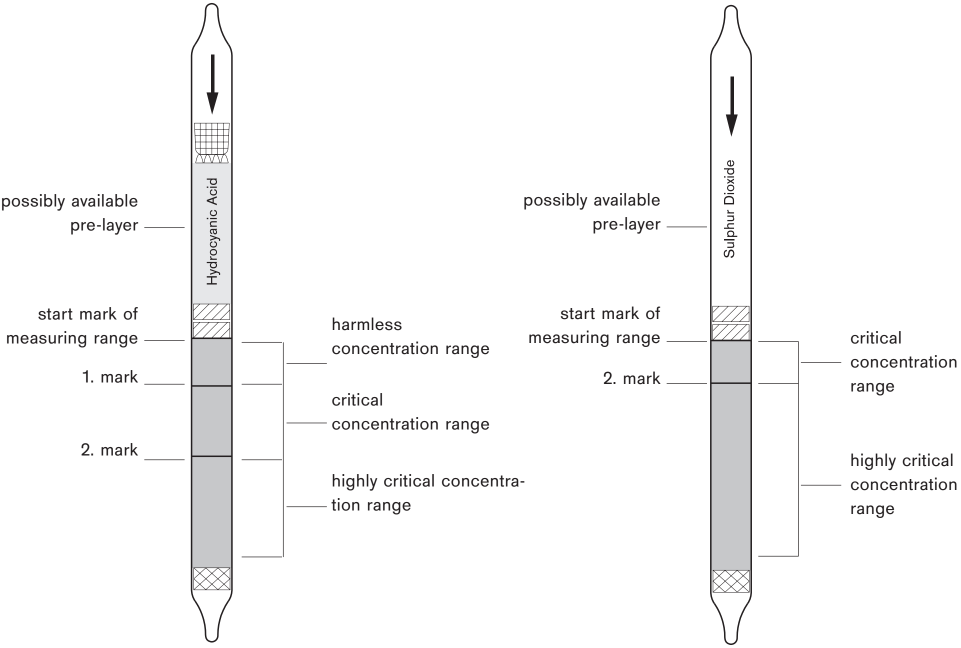


Fig. 30: Evaluation of the Dräger Simultaneous Test Sets

If any of the tubes show discolorations which extend beyond either calibration mark, the actual concentration for this gas should be retested with the relevant Dräger-Tube.

Measurement of combustion and decomposition gases

In every fire, combustion and decomposition gases are evolved. Studies have shown that more than 450 substances are evolved as the result of fire. While all of these gases are not present in every fire, there are 11 inorganic gases that are most commonly present.

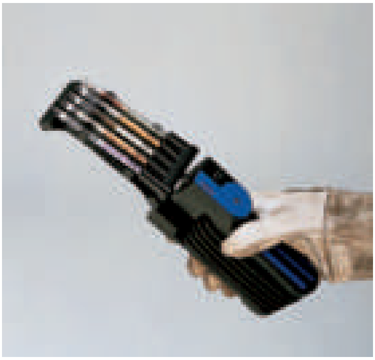


Fig. 31: Measuring with the Dräger Simultaneous Test-Set

Ten of these gases are measurable using Dräger Simultaneous Test-Sets I and II. The eleventh gas is hydrogen phosphine which occurs in fertilizer fires or in connection with fumigation agents. In these cases an additional measurement is performed with the Dräger-Tube Phosphine 0.01/a

Although Dräger Simultaneous Test-Sets I and II were developed to provide measurements in the immediate area of a fire (either during the fire or during the clean-up), they are also very useful to assess the spread of the combustion and decomposition gases to other areas (Fig. 30).

There is danger of combustion and decomposition gases developing in higher concentrations during and after the fire. These gases present a significant toxicity hazard for persons in the immediate as well as adjacent areas.
These areas include:

- adjoining rooms
- adjacent floors
- adjacent buildings
- neighboring streets

To realise the full benefit of these tests, both sets must be used, otherwise hazardous gases with poor warning properties could be overlooked.

Measurement strategy

Dräger-Tubes are suitable for obtaining quick assistance when determining certain dangers due to gases on dumpsites for hazardous waste or after accidents, during fires etc. A statistical analysis of such events in which the individual toxic substances could be identified revealed that in 60 to 65 % of all cases combustible substances were present and there was therefore danger of explosion.

For this reason principally the danger of explosion should be determined before using the Dräger-Tubes, preferably combined with measurement of the oxygen and carbon monoxide levels. The Dräger X-am 7000 for example, may be used to this end, being equipment with catalytic/electrochemical sensors.

The Dräger Simultaneous Test Sets were developed so as to obtain information concerning health hazards by rapid measurements in the immediate vicinity. Apart from registering individual substances, they are also designed to record groups of substances, since the reaction systems they use are deliberately chosen to be non-specific. In certain circumstances information about acidic substances may, for example, be sufficient to be obtain a more detailed characterisation.

In addition to the measurements using the Dräger Simultaneous Test Sets, which are meant to offer quick assistance in decision-making when determining dangers due to gas, the full range of classical Dräger-Tubes is available for measuring more precisely. When necessary, samples can be taken on site, to be analysed subsequently in the laboratory.

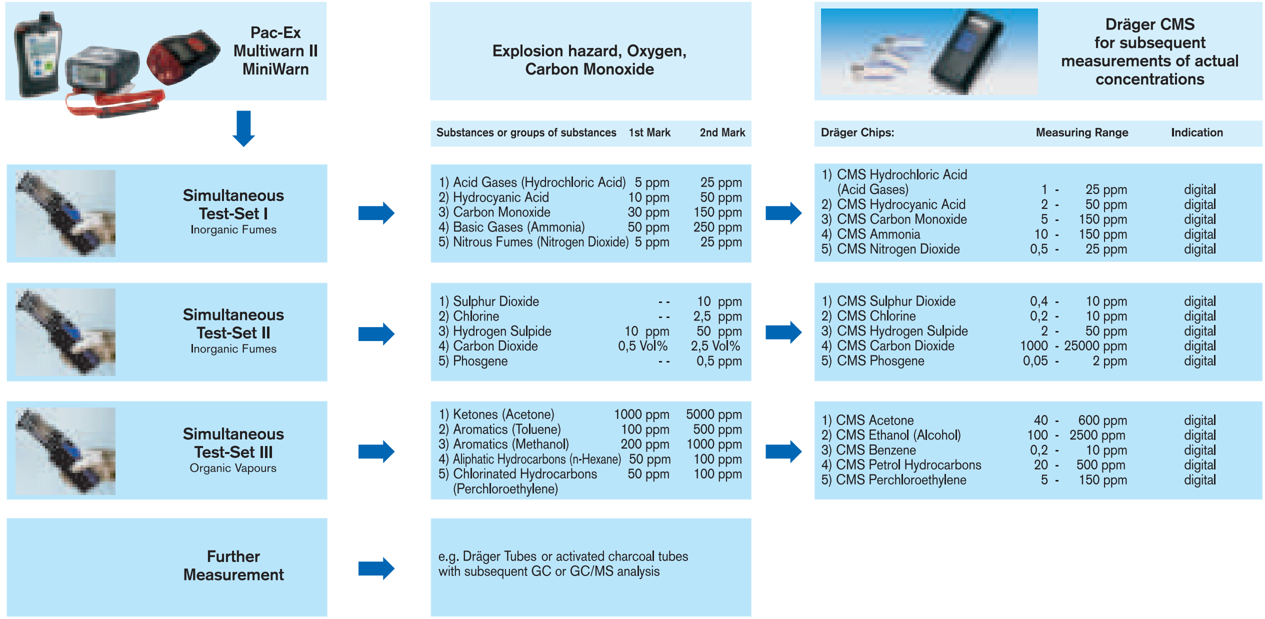
The Dräger X-am 7000 and the Dräger Simultaneous Test Sets I, II and III complement one another. Together they constitute a recommended strategy. In practical situations, this suggested strategy forms the basis for the action to be taken in over 85% of cases. The results of the measurements hold only for the place and the time at which the measurement is taken (momentary concentrations). Specific circumstances that differ from case to case, may call for other special strategies.

Evaluation of the Dräger Simultaneous Test Sets

Whenever the concentration of a gas is critical or highly critical the actual concentration of this gas is verified using the respective Dräger-Tube.

A decision about possible measures always depends on how the concentration of the emerging gas will develop. In addition, the individual ambient conditions must be taken into account. Therefore, decisions can principally only be made by the fire chief on site.

Strategy for the determination of gas hazards



Pac-Ex
Multiwarn II
MiniWarn

Explosion hazard, Oxygen, Carbon Monoxide

Dräger CMS for subsequent measurements of actual concentrations

	Substances or groups of substances	1st Mark	2nd Mark	Dräger Chips:	Measuring Range	Indication
Simultaneous Test-Set I Inorganic Fumes	1) Acid Gases (Hydrochloric Acid)	5 ppm	25 ppm	1) CMS Hydrochloric Acid (Acid Gases)	1 - 25 ppm	digital
	2) Hydrocyanic Acid	10 ppm	50 ppm	2) CMS Hydrocyanic Acid	2 - 50 ppm	digital
	3) Carbon Monoxide	30 ppm	150 ppm	3) CMS Carbon Monoxide	5 - 150 ppm	digital
	4) Basic Gases (Ammonia)	50 ppm	250 ppm	4) CMS Ammonia	10 - 150 ppm	digital
	5) Nitrous Fumes (Nitrogen Dioxide)	5 ppm	25 ppm	5) CMS Nitrogen Dioxide	0,5 - 25 ppm	digital
Simultaneous Test-Set II Inorganic Fumes	1) Sulphur Dioxide	- -	10 ppm	1) CMS Sulphur Dioxide	0,4 - 10 ppm	digital
	2) Chlorine	- -	2,5 ppm	2) CMS Chlorine	0,2 - 10 ppm	digital
	3) Hydrogen Sulpide	10 ppm	50 ppm	3) CMS Hydrogen Sulpide	2 - 50 ppm	digital
	4) Carbon Dioxide	0,5 Vol%	2,5 Vol%	4) CMS Carbon Dioxide	1000 - 25000 ppm	digital
	5) Phosgene	- -	0,5 ppm	5) CMS Phosgene	0,05 - 2 ppm	digital
Simultaneous Test-Set III Organic Vapours	1) Ketones (Acetone)	1000 ppm	5000 ppm	1) CMS Acetone	40 - 600 ppm	digital
	2) Aromatics (Toluene)	100 ppm	500 ppm	2) CMS Ethanol (Alcohol)	100 - 2500 ppm	digital
	3) Aromatics (Methanol)	200 ppm	1000 ppm	3) CMS Benzene	0,2 - 10 ppm	digital
	4) Aliphatic Hydrocarbons (n-Hexane)	50 ppm	100 ppm	4) CMS Petrol Hydrocarbons	20 - 500 ppm	digital
	5) Chlorinated Hydrocarbons (Perchloroethylene)	50 ppm	100 ppm	5) CMS Perchloroethylene	5 - 150 ppm	digital
Further Measurement	e.g. Dräger Tubes or activated charcoal tubes with subsequent GC or GC/MS analysis					

Fig. 32: Strategy for the determination of gas hazards

The measurements with the Simultaneous Test-Set and the named Dräger-Tubes and Dräger CMS refer to the substances or groups of substances listed in the table. For other substances which might be present, it may be necessary to carry out further measurements using other methods. The above mentioned ranges of measurements are valid for 1013 hP and 20 °C.

2.11. Determination of Volatile Contaminants in Liquid Samples

The Dräger Liquid Extraction method (DLE) is used for the determination of volatile contaminants in water. The measurement basically consists of two steps:

- the extraction of the contaminant
- the measurement of the contaminant

During the extraction process, the contaminant in the water sample is transferred from the liquid phase into the gas phase. A 200 ml sample of water is poured into a specially calibrated gas washing bottle. An activated charcoal tube is attached to the inlet of the bottle to prevent any airborne contaminants from entering the water during the test. The Dräger-Tube is attached to the outlet of the bottle and a specific volume of air is drawn through the water sample. The porous frit in the bottle produces a high number of small air bubbles in the water which extract the contaminant as they break at the surface. The extracted contaminant is measured from the headspace of the bottle in the Dräger-Tube (Fig. 33).

Since the measurement process is a function of a number of substance and device specific parameters, the measurement result has to be calculated by including various constants. The cali-

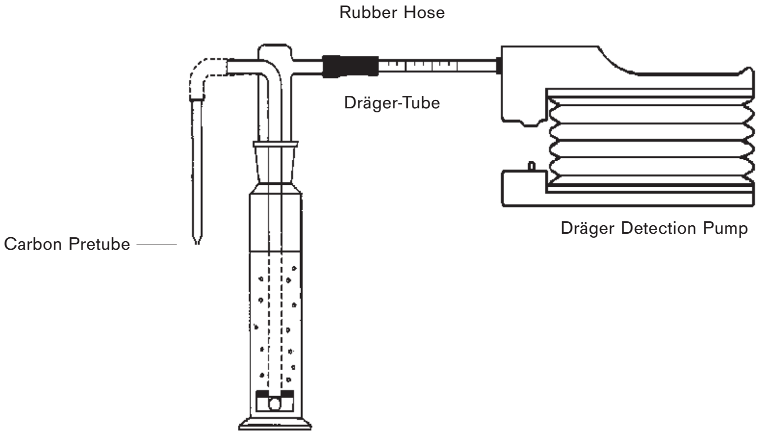


Fig. 33: Measurement system of the Dräger Liquid Extraction method

bration constant A is a rate for the extraction efficiency of the gas washing bottle and is given on the bottle and the bottle insert. The system constants B and C are a function of the sample temperature, the extraction volume, and the substance specific parameters. The B and C constants are given in the special DLE instructions published by Dräger Safety AG & Co. KGaA. The calculation of the contaminant concentration Y is done with a linear equation, in which the colourimetric indication X read off the Dräger-Tube is usually given in ppm. The contaminant concentration e.g. in a water sample can be calculated by:

$$Y[\mathrm{mg/L}] = A \cdot B \cdot (x[\mathrm{ppm}] + C)$$

Substance	Measuring Range [1013 hPa]	Dräger-Tubes	Order Code
Inorganic Substances			
Ammonia	1.5 - 10 mg/L	Ammonia 0.25/a	81 01 711
	10 - 100 mg/L	Ammonia 0.25/a	81 01 711
Hydrocyanic Acid	0.5 - 10 mg/L	Hydrocyanic Acid 2/a	CH 25 701
Hydrogen Sulphide	50 - 500 µg/L	Hydrogen Sulphide 0,2/a	81 01 461
(total sulphide)	0.2 - 1 mg/L	Hydrogen Sulphide 1/c	67 19 001
	0.5 - 10 mg/L	Hydrogen Sulphide 5/b	CH 29 801
Aliphatic hydrocarbons			
Fuels	0.5 - 30 mg/L	Petroleum Hydrocarbons 10/a	81 01 691
Diesel fuels	0.5 - 5 mg/L	Petroleum Hydrocarbons 10/a	81 01 691
Jet fuels	0.5 - 5 mg/L	Petroleum Hydrocarbons 10/a	81 01 691
n-Octane	0.1 - 2 mg/L	Petroleum Hydrocarbons 10/a	81 01 691
	2 - 25 mg/L	Petroleum Hydrocarbons 100/a	67 30 201
Aromatic hydrocarbons			
Benzene	0.5 - 5 mg/L	Benzene 2/a	81 01 231
Toluene	1 - 10 mg/L	Toluene 50/a	81 01 701
Xylene (o, m, p)	0.3 - 10 mg/L	Xylene10/a	67 33 161
BTX-Aromatics	0.2 - 5 mg/L	Toluene 5/b	81 01 161
BTX-Aromatics (soil analysis)	2 - 50 mg/Kg	Toluene 5/b	81 01 161
BTX-Aromatics (oil muds / -emulsions)	qualitaive	Toluene 5/b	81 01 161
Halogenated hydrocarbons (volatile)			
Soil analysis	qualitative	Perchloroethylene 0,1/a	81 01 551
	qualitative	Perchloroethylene 2/a	81 01 501
Multphase system	qualitative	Methyl Bromide 0,5/a	81 01 671
	qualitative	Perchlorethylene 0,1/a	81 01 551
	qualitative	Perchlorethylene 2/a	81 01 501
	qualitative	Trichloroethane 50/d	CH 21 101
Oil muds / -emulsions	qualitative	Methyl Bromide 0,5/a	81 01 671
	qualitative	Perchloroethylene 0,1/a	81 01 551
	qualitative	Perchloroethylene 2/a	81 01 501
	qualitative	Trichlorethane 50/d	CH 21 101

Substance	Measuring Range	Dräger-Tubes	Order Code
Carbon Tetrachloride	0.2 - 4 mg/L	Carbontetrachloride 5/c	CH 27 401
		+ Activation tube	81 01 141
Chlorinated hydrocarbons (volatile)			
Dichloromethane	5 - 100 mg/L	Methylene Chloride 100/a	67 24 601
Perchloroethylene	10 - 80 µg/L	Perchloroethylene 0,1/a	81 01 551
	0.1 - 4 mg/L	Perchloroethylene 2/a	81 01 501
1,1,1-Trichloroethane	0.5 - 5 mg/L	Trichloroethane 50/d	CH 21 101
Trichloroethylene	10 - 100 µg/L	Perchloroethylene 0,1/a	81 01 551
	0.1 - 1 mg/L	Perchlorethylene 2/a	81 01 501
	0.2 - 3 mg/L	Trichlorethylene 2/a	67 28 541
Organic acids			
Acetic acid	0.5 - 20 g/L	Acetic acid 5/a	67 22 101
Formic acid	1 - 20 g/L	Acetic acid 5/a	67 22 101
Organic acids (sumparameter)	0.5 - 15 g/L	Acetic acid 5/a	67 22 101
Propionic acid	0.3 - 10 g/L	Acetic acid 5/a	67 22 101

2.12. Soil Gas Analysis with Dräger-Tubes

The soil probe Dräger Professional along with a suitable Dräger-Tube can be used to evaluate the distribution of volatile contaminants in soil gas (Fig. 34). The results are obtained quickly, economically and are reproducible.

Although soil gas measurements do not permit statements about the total contaminant concentration, they are very important for determining the relative contaminant concentration in the soil gas. Soil gas measurements are thus suitable for centralising the concentration and tracing contaminant trails.

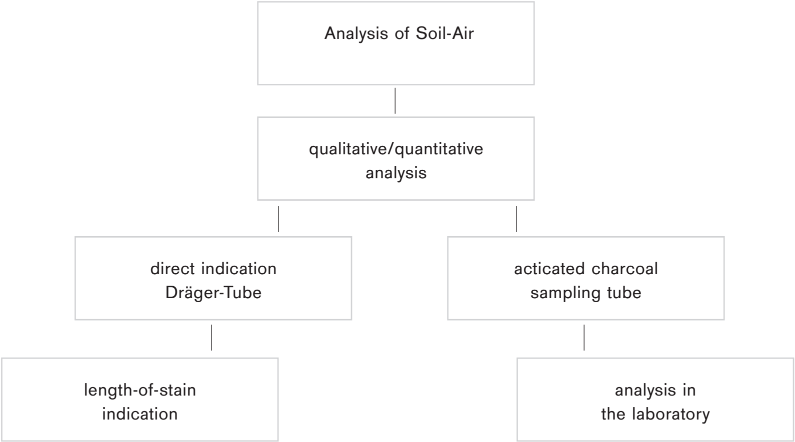


Fig. 34: Dräger-Tubes for soil air analysis

Principle of the procedure

The soil gas investigation should be performed according to a standardized measurement plan using a fixed measurement grid or individually defined probe sites.

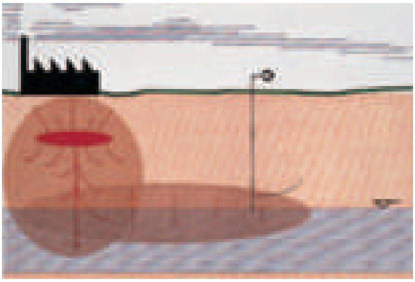


Fig 35: Distribution of chlorinated hydrocarbons in the soil gas

It is important to take into consideration the distribution mechanism of the contaminants in the soil gas. For example, when volatile chlorinated hydrocarbons get into the soil gas, they sink into the subsoil more or less uniformly. A part of the substance transfers to the gas phase, due to the relatively high vapour pressure, and enters the available pore space. Another portion gets into the ground water where it is distributed in the direction of the ground water current.
Now a transport of the contaminant from the ground water into the soil gas above the water occurs due to diffusion processes and an increase in the contaminant concentration in the soil gas can be determined.
To conduct a measurement with the Dräger-Professional Probe, the probe is hammered to the desired depth using a heavy plastic mallet or motor driven

hammer. Next, the Dräger-Tube is inserted into the sampling chamber of the capillary probe and the capillary probe is inserted into the drill bit (Fig. 36). The gas detector pump is attached to the outlet of the capillary probe and a specific air volume is drawn through the Dräger-Tube.

The contaminant in the soil gas causes a discoloration in the direct reading short-term tube. The concentration of the contaminant is read directly from the Dräger-Tube. If the soil gas concentration is below the measurement range of the direct reading Dräger-Tube, a sample can be collected using an activated charcoal sampling tube which is then sent to the laboratory for analysis.

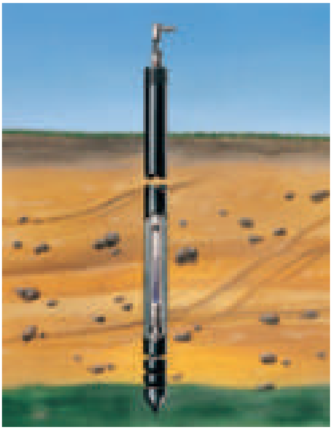


Fig. 36: Cross section of the Dräger-Professional Probe

Dräger-Tubes	Order Code	Calibration valid for	Range of measurement [20°C, 1013Pa]
Dräger sampling tubes			
Activated Charcoal Type B	67 33 011		
Activated Charcoal Type G	67 28 831		
Activated Charcoal Type NIOSH	67 28 631		
Direct reading Dräger-Tubes			
Acetic Acid 5/a	67 22 101	acetic acid	5 - 80 ppm
Acid Test	81 01 121		qualitative
Ammonia 5/a	CH 20 501	ammonia	5 - 700 ppm
Organic Arsenic Compounds and Arsine	CH 26 303	organic arsenic compounds and arsine	qualitative
Benzene 2/a	81 01 231	benzene	2 - 60 ppm
Carbon Dioxide 0,01%/a	CH 30 801	carbon dioxide	0.01 - 0.3 Vol.%
Carbon Dioxide 0,5%/a	CH 31 401	carbon dioxide	0.5 - 10 Vol.%
Carbon Dioxide 5%/A	CH 20 301	carbon dioxide	5 - 60 Vol.%

Dräger-Tubes	Order Code	Calibration valid for	Measuring Range [20°C, 1013Pa]			
Carbon Tetrachloride 1/a	81 01 021	carbon tetrachloride	1	-	15	ppm
Chloroform 2/a	67 28 861	chloroform	2	-	10	ppm
Hydrocyanic Acid 2/a	CH 25 701	hydrocyanic acid (cyanide)	2	-	30	ppm
Hydogen Sulphide 1/c	67 19 001	hydrogen sulphide	1	-	200	ppm
Mercaptan 0,5/a	67 28981	mercaptan	0.5	-	5	ppm
Methylene chloride 100/a	67 24 601	dichloro methane	100	-	2000	ppm
Natural Gas Test	CH 20 001			qualitative		
Organic Basic Nitrogen Compounds	CH 25 903	organic basic nitrogen compounds		qualitative		
Perchloroethylene 0,1/a	81 01 551	perchloroethylene	0.1	-	4	ppm
Perchloroethylene 2/a	81 01 501	perchloroethylene	2	-	300	ppm
Petroleum Hydrocarbons 10/a	81 01 691	n-octane	10	-	300	ppm
Petroleum Hydrocarbons 100/a	67 30 201	n-octane	100	-	2500	ppm
Perchloroethylene 10/b	CH 30 701	perchloroethylene	10	-	500	ppm
Phosgene 0,02/a	81 01 521	phosgene	0.02	-	1	ppm
Phosgene 0,25/b	CH 28 301	phosgene	0.25	-	75	ppm
Polytest	CH 28 401			qualitative		
Thioether	CH 25 803	thioether		qualitative		
Toluene 50/a	81 01 701	Toluene	50	-	400	ppm
Toluene 5/b	81 01 661	BTX-aromatics	5	-	300	ppm
Trichloroethane 50/d	CH 21 101	1,1,1-trichloroethane	50	-	600	ppm
Trichloroethylene 2/a	67 28 541	trichloroethylene	2	-	200	ppm
Trichloroethylene 50/a	81 01 881	trichloroethylene	50	-	500	ppm
Vinyl Chloride 1/a	67 28 031	vinyl chloride	1	-	50	ppm
Water Vapour 1/a	81 01 081	water vapour	1	-	20	mg/L
Xylene 10/a	67 33 161	o-xylene	10	-	400	ppm

2.13. Detection of Air Flows

In some areas the detection of air currents is of particular importance. Slight air currents must become visible to estimate their source, direction and speed. This is necessary e.g.:

- in mining
for the monitoring of firedamp in inaccessible places;

- in the industry
for detection of leaks in pipelines, of air currents in rooms or for combustion plants and in laboratory stacks;

- in the ventilation technique
for control and setting up of air conditioning plants

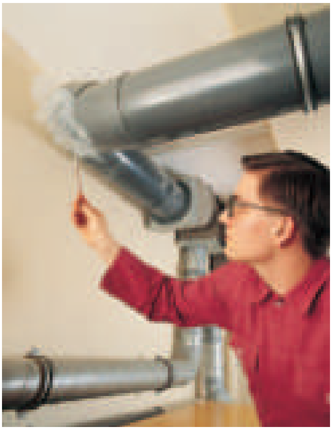


Fig. 37: Dräger air flow tester

In addition to this measurement of the air currents are also helpful when estimating e.g. the distribition of toxic substances at workplaces. The knowledge of the air flow pattern permits objective selection of the right measuring points for any air analysis.

With this aim in view the Dräger Safety AG & Co. KGaA developed an air flow tester. This Dräger-Tube consists of a porous carrier impregnated with fuming sulphuric acid.

After opening the tube tips the air is pumped through the tube with the help of a rubber bulb. The white smoke emerging from the tube is carried along by the air flow and makes its direction visible. The air flow tester can be used repeatedly until the smoke is finally exhausted. If the test is completed before the tube is exhausted, the tube should be sealed with the rubber caps provided.

Dräger Flow Check

The Dräger Flow Check air current indicator produces a harmless cloud of smoke that floats freely and easily, because it has the same density as ambient air. Consequently, slight air currents become visible.

The Dräger Flow Check consists of:
- an instrument for the production of the clouds
- an ampoule containing smoke- generating fluid

The ampoule contains a fluid that is a special mixture of alcohols developed at Dräger. A small heating element in the head of the instrument heats the fluid which condenses on contact with the ambient air. The temperature of the heating element and the quantity of the fluid is electrically balanced.

The Dräger Flow Check incorporates ergonomic form, low weight, and optimal operation into the instrument design. The instrument will generate clouds in any orientation.


ST-61-99

Fig. 38: Dräger Flow Check

Small, single clouds can be generated with a short press of a button. If a continous production of clouds is desired, the button can be held or locked in the "on" position. The fluid ampoule is located in a compartment in the handle of the instrument and can be inserted effortlessly into position. The amount of fluid contained in the ampoule is enough to generate approximately five minutes.


ST-64-98

Fig. 39: Dräger Flow Check

Power is supplied by a battery located in the handle of the instrument and can be charged while inside the instrument or separately.
A quickcharge option is also possible with the charger.
An adapter cable can be used to charge the device from a car mounted cigarette lighter.

2.14. Dräger-Measurement-Systems for Long-term Measurements

There are several direct reading Dräger measurement systems for the determination of time weighted average concentrations:

- Dräger long-term tubes
- Dräger diffusion tubes with direct indication

The Dräger long-term tubes, used in conjunction with the constant flow pump Polymeter, are active (requiring a pump) tubes designed for measurements of two to eight hours maximum duration. The long-term tubes are matched to the flow characteristics of the Polymeter (or other approved option) and indicate the concentration of the measured substance in absolute units (i.e. microlitres). After completing the measurement the scale reading is converted into an average concentration:

$$c = \frac{\text{indication in microlitres}}{\text{volume in litres}} \quad [\text{ppm}]$$

The Dräger diffusion tubes are direct reading systems used for the determination of time weighted average concentrations over the duration of one to eight hours. Since these are passive measurement systems, relying on the diffusion of contaminant molecules in air, they do not require a pump. The diffusion tubes are used with a plastic holder which is attached to the clothing (shirt collar, pocket, etc.).

The scale printed on the diffusion tube represents the product of the concentration and exposure time given e.g. as ppm x h, ppm x min, Vol.-% x h or mg/L x h. To determine the average concentration of the contaminant, the scale reading is divided by the exposure time (i.e. sampling time) according to the following:

$$c = \frac{\text{indication in ppm} \cdot \text{h}}{\text{time in h}} \quad [\text{ppm}]$$

2.15. Expiration Date, Storage and Disposal of Dräger-Tubes

Each Dräger-Tube contains a reagent system designed to undergo a chemical reaction with a particular substance. Since chemicals and chemical reagents are not stable indefinitely, each box of Dräger-Tubes is stamped with an expiration date. The tubes are suitable for use through the last day of the month of expiration. Tubes used beyond the expiration date cannot be relied upon to give accurate results.

To guarantee the accuracy of the tube indication, throughout the shelf life, Dräger-Tubes should be stored in the original package at room temperature. A note on the package indicates a maximum storage temperature of 25 °C (i.e. 77 °F). Avoid excessively low (less than 35 °F) or high (greater than 77 °F) temperatures during storage and do not subject the tubes to light for prolonged periods.

Do not dispose of used or expired Dräger-Tubes in domestic waste. Dräger-Tubes must be disposed of properly, since the reagent system of the tube contains chemicals, even though the chemicals are present in extremely small amounts.

The storage or disposal of chemicals must be conducted according to local, state and federal regulations. For example, in Germany the Gesetz über die Beseitigung von Abfällen (AbfG) (law for the disposal of waste) is in force.

Detector tubes are comprised primarily of glass and chemicals.

KEEP DETECTOR TUBES AND ALL CHEMICALS OUT OF THE REACH OF CHILDREN.

2.16. Dräger-Sampling-Systems

Monitoring hazardous substances in the air by means of measurements often requires a considerable expenditure with regard to the instrumentation and personnel. This is particularly true when the measurements are done on site and there is no direct reading Dräger-Tube available for the particular application. Under these conditions, a sample must be taken using a suitable collection device and sent to a laboratory for analysis.

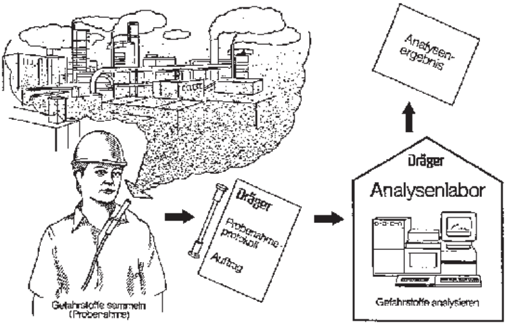


Fig. 40: Air investigations at the workplace by sampling on site followed by laboratory analysis.

Using the Dräger sampling system, hazardous substances in the air are collected using a suitable medium via adsorption or chemisorption(Fig. 41). The sample is then analysed in the laboratory by means of various analytical methods like gas chromatography (GC), high performance liquid chromatography (HPLC), UV-VIS photometry, or IR spectroscopy.

In the case of a stationary measurement the sampling system is placed at the chosen measurement site for the duration of sampling. When performing personal air monitoring the sampling system is attached to the clothing of the person as close as possible to the inhalation area.

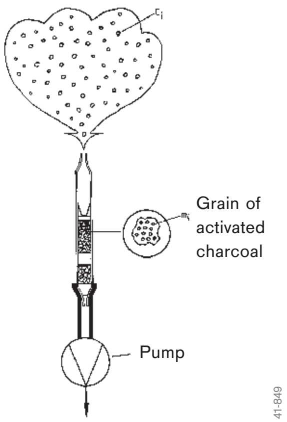


Fig. 41: Measurement principle of active sampling with Dräger activated charcoal tubes

Active Sampling

For active sampling the air to be evaluated is drawn through a sampling tube with a pump. The substance to be collected accumulates on the adsorbent (Fig. 42).

Taking the contaminant mass (mi), determined by the laboratory analysis and the air volume (V) drawn through the sampling tube, the concentration (ci), of the contaminant can easily be calculated:

$$ci = \frac{mi}{V} \ [mg/m3]$$

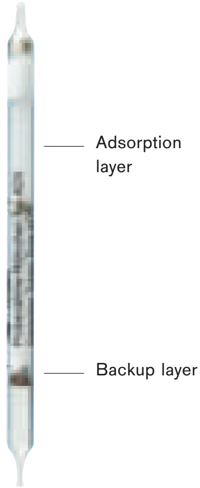


Fig. 42: Dräger sampling tube

The sampling tube features a primary adsorption layer and a secondary layer which are analysed separately in the laboratory (Fig. 41). This separate analysis determines whether the entire amount of the measured substance was adsorbed. During sampling the measured substance is first adsorbed at the primary adsorption layer. Sometimes the capacity of this layer is not sufficient, and there is break through resulting in additional adsorption at the secondary layer. When this occurs a new sample must be taken because it is not possible to be sure that the entire amount was adsorbed by the

two layers (i.e. the secondary layer could also have experienced break through).
The air volume to be drawn through the sampling tube is a function of the measured substance and the expected concentration. Usually the volume is between 1 and 20 L.

Since the air volume is used as a reference for the concentration calculation (following the laboratory analysis), the pump has to meet strict criteria. Within the context of the Dräger sampling system the gas detector pump Dräger accuro, or the Dräger Quantimeter 1000 are suitable for short-term measurements, the Polymeter is suitable for long-term measurements.

Sampling tubes for active sampling

Dräger-Tubes	Primary adsorption layer	Backup adsorption layer
Activated Charcoal Type NIOSH coconut shell charcoal	100 mg	50 mg
Activated Charcoal Type B coconut shell charcoal	300 mg	700 mg
Activated Charcoal Type G coconut shell charcoal	750 mg	250 mg
Silica Gel Tube Type NIOSH	140 mg	70 mg
Silica Gel Tube Type B	480 mg	1100 mg
Silica Gel Tube Type G	1100 mg	450 mg
Sampling Tube for Amines	300 mg	300 mg

Passive Sampling

Passive sampling is performed with diffusion samplers like the Dräger ORSA or the Dräger Nitrous Oxide diffusion samplers. In contrast to active sampling the transport of the contaminant molecules is achieved by diffusion processes and not by using a pump. Contaminant molecules from the ambient air follow a defined diffusion course and are adsorbed by the sorption agent of the diffusion sampler.

Fick's law of diffusion is used for the calculation of the adsorbed substance mass:

$$\Delta c_i = \frac{mi \cdot L}{D_i \cdot t \cdot A} \quad [mg/m^3]$$

In this context mi is the substance mass which in the time t diffuses through the sectional area A of the sampler vertically to the concentration grade and Δc_i is the concentration difference along the diffusion course L. Δc_i is basically equivalent to the ambient concentration. The diffusion coefficient D_i is substance specific.

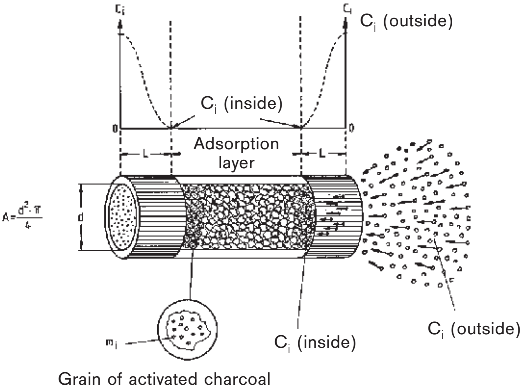


Fig. 43: Measurement principle of the Dräger Diffusion sampler ORSA

The diffusion samplers are generally designed to sample over a long period of time for the determination of average concentrations. They are usually used for 1 to 8 hours. In addition the diffusion sampler Dräger ORSA can be used for the investigation of lower concentration ranges over a period of time of up to 168 hours (e.g. for the sampling of perchloroethylene in living spaces).

Sampling tubes for passive monitoring

Diffusion sampler	Adsorption layer
Dräger ORSA	400 mg Activated Charcoal from coconut shell charcoal
Nitrous Oxide	400 mg Molecular Sieve

2.17. Measurement of Aldehydes and Isocyanates in the Workplace

Aldehydes are industrially produced in large volumes. They are applied in products of synthetic resin, rubber and adhesives. The different compounds of aldehydes are also found in disinfectants, colours, lacquers and plastics. The most important substances are formaldehyde, glyoxal, glutardialdehyde, acetaldehyde and acrolein.

Isocyanates are of particular interest for industrial applications because they readily react with polyalcohols to form polyurethanes. Polyurethanes are some of the most versatile thermoplastic polymers available. They are recognized for use as coatings because of their hardness, gloss, flexibility and abrasion resistance. As an elastomer they offer good resistance to abrasion, weathering and attack by organic solvents. As a foam they are excellent insulators.

Trying to monitor the occupational exposure limits for isocyanates with TLVs at 0.005 ppm is very demanding on a measurement method:

- low exposure limit,
- low cross sensitivity for other substances apart from isocyanates,
- sampling should be possible in the inhalation area of an employee,
- less qualified personnel should also be able to perform the sampling.

These requirements are met by two measurement methods which are analogous to using sampling tubes (i.e. sample collection followed by laboratory analysis) i.e. the Aldehyde- and Isocyanate-Sampling-Sets. In this case, a pump draws a specific volume of air onto a fiberglass filter treated with specific compounds. This filter is inside a cassette-type sampler. The flowrate specifications are 0.1 to 1 L/min (aldehyde) and 1 to 2 L/min (isocyanates). The sample volume should be 10 to 100 L (aldehydes) and 20 to 100 L (isocyanates).

During the sampling the aldehydes react with a hydrazine compound to form a stable hydrazone derivate. By using the Isocyanate Sampling Set the isocyanates react with an amine to form a stable urea derivative. After sampling, the loaded fiberglass filters must be stored in a cool place. In the laboratory, the fiberglass filters are analysed with high-performance liquid chromatography. To ensure a recovery rate of greater than 95 %, the filter must be analysed immediately.

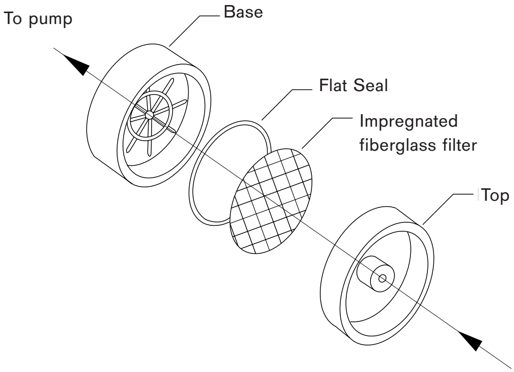


Fig. 44: Isocyanate sampler

The detection limits determined by the VDI-Richtlinie 2449 page 1 [18] as absolute units are:

formaldehyde		10 ng
glutardialdehyde		30 ng
toluene diisocyanate	(TDI)	1 ng
diphenylmethane-4,4'-diisocyanate	(MDI)	4 ng
hexamethylene diisocyanate	(HDI)	1 ng

and related to a sampling volume for 20 L:

formaldehyde		0.40 ppb
glutardialdehyde		0.36 ppb
toluene diisocyanate	(TDI)	0.007 ppb
diphenylmethane-4,4'-diisocyanate	(MDI)	0.019 ppb
hexamethylene diisocyanate	(HDI)	0.007 ppb

These methods allows the measurement far below the occupational exposure limits.

2.18. Quality Control for Dräger-Tubes

Fig. 45: Dräger-Tube quality control warehouse

Dräger-Tubes are normally used for the quantitative determination of contaminants in the air. The need to measure these contaminants may happen on a moments notice. A major advantage of the Dräger-Tube method is its constant state of readiness to provide answers during emergencies or routine monitoring. The extensive quality control program in operation at Dräger Safety AG & Co. KGaA assures the customer of a quality product that can be relied upon time and time again.

The development, production, and testing of Dräger-Tubes is done within the context of the Dräger quality system, an established company standard. This standard contains as a basic document, the Dräger quality handbook and other detailed quality standards as performance regulations. The quality control system meets international standards. The fact that the Dräger quality system conforms to the requirements of DIN ISO 9001 was confirmed by an independent institute.

Starting with the basic design idea, through all the detailed development stages, to serial production and eventually full production, Dräger builds quality into its Dräger-Tubes.

To verify the performance of Dräger-Tubes, Dräger takes several packages of each production batch and stores them for routine quality tests at regular intervals (Fig. 45).

Detector tube standards were established in various countries to ensure the user that the tubes are indicating properly. In the USA for instance, Dräger-Tubes and Dräger gas detector pumps are tested according to NIOSH Method/TCA/A-012, "Certification Requirements for Gas Detector Tube Units" for the Safety Equipment Institute Certification Program. Each manufacturer's detector tubes and gas detector pump(s) are tested as a unit by an independent, third party laboratory accredited by the American Industrial Hygiene Association (AIHA).

2.19. Concentration Specifications and Conversions

Concentrations are given as the content of a substance in a reference substance. For the measurement of contaminants in air, a concentration is used for the amount of the substance compared to the air. An appropriate engineering unit is chosen, to give simple, handy figures for indicating a concentration.

High concentrations are generally given in volume percent (Vol.-%), i.e. 1 part of a substance in 100 parts of air. Air consists of 21 Vol.-% oxygen. (i.e. 100 parts of air contain 21 parts of oxygen).

In smaller concentrations the engineering unit ppm = parts per million (mL/m^3) is used. The concentration ppm means 1 part of a substance in 1 million parts of air, ppb refers to 1 part of a substance in 1 billion parts of air.

The conversion of very small concentration units to Vol.-% is as follows:

		Vol.-%	ppm	ppb
Vol.-% =	10 L/m^3 1 cL/L	1	10^4	10^7
ppm =	mL/m^3 μL/L	10^{-4}	1	10^3
ppb =	μL/m^3 nL/L	10^{-7}	10^{-3}	1

		g/L	mg/L	mg/m^3
g/L =	10 L/m^3 1 cL/L	1	10^3	10^6
mg/L =	mL/m^3 μL/L	10^{-3}	1	10^3
ppb =	μL/m^3 nL/L	10^{-6}	10^{-3}	1

Tab. 1: Calibration factors

In addition to gaseous components the air also contains solid particles or liquid droplets, called aerosols. Since an indication in volume percent is not very useful due to the small size of the droplets or particles, the concentration of the aerosols is given in mg/m^3.

Since each volume is related to a corresponding mass, the volume concentrations of gaseous substances can be converted into mass per unit volumes and vice versa. These conversions must be done at a specified temperature and pressure since the gas density is a function of temperature and pressure. For measurements at work places, the reference parameters are 20 °C and 1013 hPa.

a) Conversion from mg/m³ to ppm

$$c\ [\text{ppm}] = \frac{\text{mole volume [L]}}{\text{molar mass [g]}} \cdot c\ [\text{mg/m}^3]$$

The mole volume of any gas is 24.1L at 20 °C and 1013 hPa, the molar mass (molecular weight) is gas specific.

Example for acetone:

mole volume	24.1	L/mole
molar mass	58	g/mole
assumed concentration	876	mg/m³

$$c\ [\text{ppm}] = \frac{24.1[\text{L}]}{58[\text{g}]} \cdot 876\ [\text{mg/m}^3]$$

Concentration in ppm: c = 364 ppm or mL/m³.

b) Conversion from ppm to mg/m³

$$c\ [\text{mg/m}^3] = \frac{\text{molar mass [g]}}{\text{mole volume [L]}} \cdot c\ [\text{ppm}]$$

with the assumed concentration of 364 ppm it is:

$$c\ [\text{mg/m}^3] = \frac{58[\text{g}]}{24.1[\text{L}]} \cdot 364\ [\text{ppm}]$$

Concentration in mg/m³ : c = 876 mg/m³.

2.20. Water Vapour and Humidity

Water vapour in the atmosphere is commonly called humidity. There are many sources for it, after all the surface of the earth consists of two thirds water. Humans also "produce" water vapour as a metabolic product with each breath that is exhaled.

A general statement about the effect of humidity on detector tube indications cannot be made. Some tubes, like hydrogen sulphide, need only a minimum amount of water vapour since the indicating reaction of this tube is an ion reaction. Also, because of the extraordinarily low solubility of metal sulphides, the upper limit of the humidity is not important with these tubes. However, with other types of tubes the reaction system can possibly be diluted with high humidity. Therefore, the limits of the humidity given for the respective detector tubes must be observed to prevent erroneous measurements.

As a general rule the upper and lower humidity limits are given in the operating instructions and Dräger-Tube handbook. When in doubt, measure the humidity using a water vapour Dräger-Tube.

Measuring result Dräger-Tube H_2O 0.1 (absolute humidity)

Tab. 2

mg/l	Relative humidity in %																																	
2	29	27	26	24	23	21	20	19	18	17	16	15	14	13	12	12	11	10	10	9	9	8	8	7	7	7	6	6	6	5	5	5	5	4
3	44	41	38	36	34	32	30	28	26	25	23	22	21	19	18	17	16	15	15	14	13	12	12	11	10	10	9	9	9	8	8	7	7	7
4	59	55	51	48	45	43	40	37	35	33	31	29	28	26	25	23	22	21	19	18	17	16	15	15	14	13	12	12	11	11	10	10	9	9
5	73	68	64	60	57	53	50	47	44	41	39	37	34	32	31	29	27	26	24	23	22	20	19	18	17	16	16	15	14	13	13	12	11	11
6	88	82	77	72	68	64	60	56	53	50	47	44	41	39	37	35	33	31	29	27	26	25	23	22	21	20	19	18	17	16	15	15	14	13
7	—	96	90	84	79	74	70	65	61	58	55	51	48	45	43	40	38	36	34	32	30	29	27	26	24	23	22	21	20	19	18	17	16	15
8	—	—	—	96	91	85	80	75	70	66	62	59	55	52	49	46	44	41	39	37	35	33	31	29	28	26	25	24	23	22	20	19	18	17
9	—	—	—	—	—	96	90	84	79	74	70	66	62	58	55	52	49	46	44	41	39	37	35	33	31	30	28	26	26	24	23	22	20	20
10	—	—	—	—	—	—	—	93	88	83	78	74	69	65	61	58	55	52	48	46	43	41	39	37	35	33	31	29	29	27	26	24	23	22
11	—	—	—	—	—	—	—	—	96	91	86	81	76	71	67	64	60	57	53	50	48	45	43	40	38	36	34	32	31	30	28	27	25	24
12	—	—	—	—	—	—	—	—	—	—	94	88	83	78	74	69	66	62	58	55	52	49	46	44	42	40	37	35	34	32	31	29	27	26
13	—	—	—	—	—	—	—	—	—	—	—	96	90	84	80	75	71	67	63	60	56	53	50	48	45	43	41	38	37	35	33	32	30	28
14	—	—	—	—	—	—	—	—	—	—	—	—	97	91	86	81	77	72	68	64	61	57	54	51	49	46	44	41	40	38	36	34	32	30
15	—	—	—	—	—	—	—	—	—	—	—	—	—	97	92	87	82	77	73	69	65	61	58	55	52	49	47	44	43	41	38	37	34	33
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98	93	87	82	78	73	70	66	62	59	56	53	50	47	46	43	41	39	36	35
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98	93	88	82	78	74	70	66	62	59	56	53	50	49	46	44	41	39	37
18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98	93	87	83	78	73	70	66	63	59	56	53	51	49	46	44	41	39
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98	92	87	83	77	74	70	66	63	60	56	54	51	49	46	43	41
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	97	92	87	82	77	74	70	66	63	59	57	54	51	49	45	43
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	96	91	86	81	77	73	69	66	62	60	57	54	51	48	46
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	96	90	85	81	77	73	69	65	63	59	56	54	50	48
23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	94	89	84	80	76	72	68	66	62	59	56	52	50
24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98	93	88	84	79	75	71	69	65	62	58	55	52
25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	97	92	87	82	78	74	71	68	64	61	57	54
26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	96	91	86	81	76	74	70	67	63	59	57
27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	94	89	84	79	77	73	69	66	61	59
28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	97	92	87	82	80	76	72	68	64	61
29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	96	91	85	83	78	74	71	66	63
30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	99	94	88	86	81	77	73	68	65
Air temperature	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38°C
100% Saturation	6,8	7,3	7,8	8,3	8,8	9,4	10,0	10,7	11,4	12,1	12,8	13,6	14,5	15,4	16,3	17,3	18,8	19,4	20,6	21,8	23,0	24,4	25,8	27,2	28,7	30,3	32	34	35	37	39	41	44	46

mg H_2O/l

3. Data and Tables

3.1. Explanation of the Data Given in the Dräger-Tube Descriptions

Dräger-Tube

The name, type designation and part number of the Dräger-Tube are given. The name of the tube indicates the particular contaminant that the tube has been calibrated to measure. The type designation consists of numbers and in most cases of a letter. As a general rule, the number indicates the lower end of the measuring range (in ppm, mg/m^3, mg/L or Vol.-%). The letter following the number designates some change to the tube, typically the result of some improvement by further development (e.g. the Dräger-Tube Acetone 100/b). To characterise the Dräger long-term tubes, direct indicating diffusion tubes and direct indicting badges, the letters "L", "D" are added respectively (e.g. the Dräger long-term tube Acetone 500/a-L, the diffusion tube Acetone 1000/a-D.

Standard Measuring Range

The standard measuring range is calibrated at 20 °C and 1013 hPa (i.e. 1013 mbar). Accordingly, the number of pump strokes for the short-term tubes and the sampling time intervals for the long-term and diffusion tubes must be observed.

The instruction sheet packaged with each box of Dräger-Tubes should be consulted for all pertinent details. Furthermore, the measuring range for the Dräger short-term and long-term Dräger-Tubes is valid only when the Dräger-Tubes are used in conjunction with a Dräger gas detector pump.

Number of Strokes (n)

The number of pump strokes listed for a given short-term Dräger-Tube reflects the calibrated sample volume necessary for a given measuring range, using the Dräger gas detector pump.

For the Dräger-Tubes with a printed scale (i.e. scaled tubes), only the number of strokes which relate directly to the numerical values of the scale are given. For colour intensity tubes (i.e. colour match tubes), the highest and lowest number of strokes necessary to obtain a certain discoloration (i.e. determine the concentration) are indicated.

Time for Measurement

The average time for the completion of one measurement, related to the standard measuring range is given in seconds or minutes.

Standard Deviation

The standard deviation is a measure of the incidental deviations of the indicated values from their mean value. The standard deviation, which is actually a coefficient of variation (i.e. relative standard deviation), is given as a percentage and relates to the mean value. According to the first confidence interval, as it applies to Dräger-Tubes, 68.3 % of all measured values are within this standard deviation range.

For example:

Mean value	500 ppm
Standard Deviation	50 ppm

Relative standard deviation $$\frac{50 \cdot 100}{500} = 10\ \%$$

Colour Change

The colour of the indicating layer in the unused Dräger-Tube and the expected colour change of the indicating layer in the presence of the particular contaminant is given (e.g. white —> brownish green) as well as with a colored photo.

Attention:

Differences in the color of the printed photo and the real tube are possible due to variations of the printing process!

Ambient Operating Conditions

Dräger-Tubes are calibrated at an atmospheric pressure of 1013 hPa (i.e. 1013 mbar). To correct for the influence of pressure, the value read from the tube scale must be multiplied by the following correction factor:

$$\text{Correction Factor} = \frac{1013\ \text{hPa}}{\text{actual atmospheric pressure in hPa}}$$

Reaction Principle

The reaction principle lists the basic reactants and the products of the reaction.

Cross Sensitivity

Dräger-Tubes are calibrated for a specific contaminant, but under other than ideal conditions, other interfering contaminants may also be present. Other contaminants that influence the indication are described as being cross sensitive.

The information given under the Cross Sensitivity section indicates which contaminants can influence the indication and which contaminants would not influence the indication. However, this information does not address all possibilities. The influence of other contaminants should be reviewed with the Dräger technical services department.

Extension of the Measuring Range

If the standard measuring range of a Dräger-Tube can be expanded by taking more or fewer pump strokes, the information, including pump strokes, correction factors, etc. will be given. If there is no information given, please contact the Dräger technical services group.

Additional Information

Supplementary points that must be considered when conducting a Dräger-Tube measurement are given here.

3.2.

Data about Dräger-Tubes for short-term measurements.

Order-No.
67 26 665

Acetaldehyde 100/a

Application Range

Standard Measuring Range:	100 to 1,000 ppm
Number of Strokes n:	20
Time for Measurement:	app. 5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	orange —> brownish-green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$CH_3CHO + Cr^{VI} \longrightarrow Cr^{III}$ + various oxidation products

Cross Sensity

The tube does not differentiate between different aldehydes. Ethers, ketones, esters, aromatics and petroleum hydrocarbons are indicated, but with different sensitivities.

ST-2-2001

Acetic Acid 5/a

Order Code
67 22 101

ST-40-2001

Application Range

Standard Measuring Range:	5 to 80 ppm
Number of Strokes n:	3
Time for Measurement:	app. 30 s
Standard Deviation:	± 10 to 15 %
Colour Change:	blue violet —> yellow

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

CH_3COOH + pH Indicator —> yellow reaction product

Cross Sensivity

It is impossible to measure acetic acid in the presence of other acids. Organic acids are indicated by the same colour change, but with different sensitivities.

Mineral acids (e.g. hydrochloric acid) are indicated by red discolorations and different sensitivities.

Order Code
81 03 381

Acetone 40/a

Application Range

Standard Measuring Range:	40 to 800 ppm
Number of Strokes n:	1
Time for Measurement:	app. 1 min
Standard Deviation:	± 15 to 20 %
Colour Change:	pale yellow -> yellow

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	5 to 40 mg H_2O / L

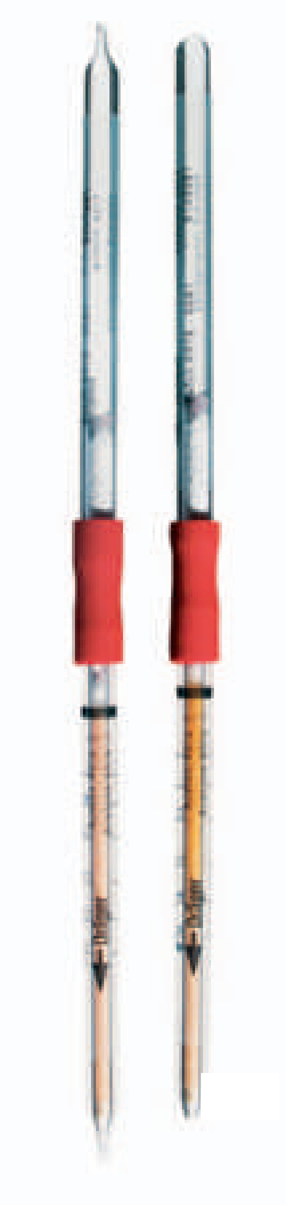
Reaction Principle

Acetone + 2.4-Dinitrophenylhydrazine -> yellow hydrazone

Cross Sensivity

Other ketones are indicated but with different sensitivities

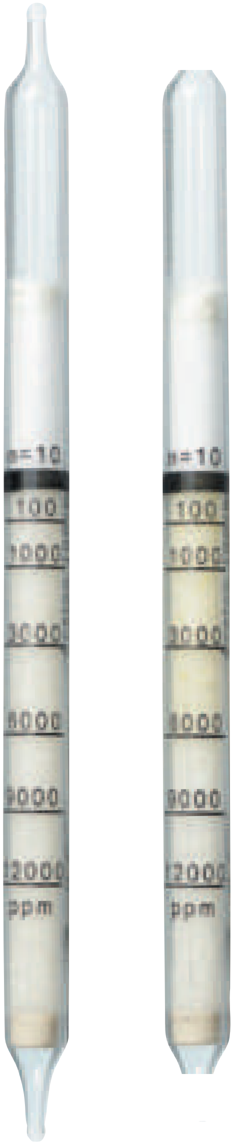
Aldehydes are indicated. 500 ppm ethylacetate does not affect the indication. Ammonia causes the indicating layer to turn yellowish brown.



ST-5791-2004

Acetone 100/b

Order Code
CH 22 901



ST-3-2001

Application Range

Standard Measuring Range:	100 to 12,000 ppm
Number of Strokes n:	10
Time for Measurement:	app. 4 min
Standard Deviation:	± 15 to 20 %
Colour Change:	pale yellow —> yellow

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	5 to 20 mg H_2O / L

Reaction Principle

Acetone + 2.4-Dinitrophenylhydrazine -> yellow hydrazone

Cross Sensivity

Other ketones are indicated but with different sensitivities

Aldehydes are indicated, but not esters.

Ammonia causes the indicating layer to turn yellowish brown.

Order Code
81 01 121

Acid Test

Application Range

Standard Measuring Range: Qualitative identification of acid gases.
Number of Strokes n: 1
Time for Measurement: app. 3 s
Standard Deviation: ± 30 %
Colour Change: blue violet —> yellow or pink yellow

Ambient Operating Conditions

Temperature: 0 to 40 °C
Absolute Humidity: 3 to 15 mg H_2O / L

Reaction Principle

e.g. HCl + pH Indicator —> pink yellow reaction product

Cross Sensivity

This tube indicates various acid gases with differing sensitivities and colours ranging from yellow to pink. It is impossible to differentiate them.

ST-115-2001

Acrylonitrile 0.5/a

Order Code
67 28 591

ST-183-2001

Application Range

Standard Measuring Range:	1 to 20 ppm / 0.5 to 10 ppm
Number of Strokes n:	10 / 20
Time for Measurement:	app. 2 min / app. 4 min
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow —> red

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	2 to 15 mg H_2O / L

Reaction Principle

a) CH_2=CH-CN + Cr^{VI} —> HCN

b_1) HCN + $HgCl_2$ —> HCl

b_2) HCl + methyl red —> red reaction product

Cross Sensivity

The indication is not affected by:

1,000 ppm acetone
20 ppm benzene
1,000 ppm ethyl acetate
1,000 ppm ethanol
10 ppm ethyl benzene
1,000 ppm hexane
100 ppm toluene

Styrene up to 50 ppm does not influence the indication.

Butadiene reacts with the oxidation layer; in the presence of butadiene, the acylonitrile indication will be too low (e.g. up to 50 % too low with 400 ppm butadiene).

Order Code
CH 26 901

Acrylonitrile 5/b

Application Range

Standard Measuring Range:	5 to 30 ppm
Number of Strokes n:	3
Time for Measurement:	app. 30 s
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow —> red

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	1 to 18 mg H_2O / L

Reaction Principle

a) CH_2=CH-CN + Cr^{VI} —> HCN

b_1) HCN + $HgCl_2$ —> HCl

b_2) HCl + methyl red —> red reaction product

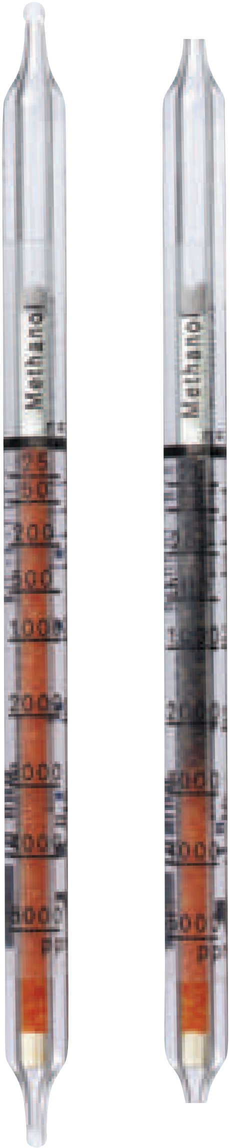
Cross Sensivity

Styrene up to 50 ppm does not influence the indication. Butadiene reacts with the oxidation layer; in the presence of butadiene, the acylonitrile indication will be too low (e.g. up to 50 % too low with 400 ppm butadiene).

ST-4-2001

Alcohol 25/a

Order Code
81 01 631



ST-5-2001

Application Range

Standard Measuring Range:	25 to 5,000 ppm Methanol 50 to 4,000 ppm i-Propanol 100 to 5,000 ppm n-Butanol 25 to 2,000 ppm Ethanol
Number of Strokes n:	10
Time for Measurement:	app. 5 min
Standard Deviation:	± 25 %
Colour Change:	brown —> brownish-black

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	max. 15 mg H2O / L

Reaction Principle

$CH_3OH + Cr^{VI}$ —> brownish-black reaction product

Cross Sensivity

500 ppm n-octane result in an overall discoloration of the tube.

400 ppm acetic acid ester = display of approx. 60 ppm methanol.

200 ppm tetrahydrofurane = display of approx. 900 ppm on Propanol scale.

1000 ppm acetone = display of approx. 200 ppm methanol.

400 ppm diethyl ether = display of approx. 1000 ppm methanol.

Order Code
CH 29 701

Alcohol 100/a

Application Range

Standard Measuring Range:	100 to 3,000 ppm
Number of Strokes n:	10
Time for Measurement:	app. 90 s
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow —> green

Ambient Operating Conditions

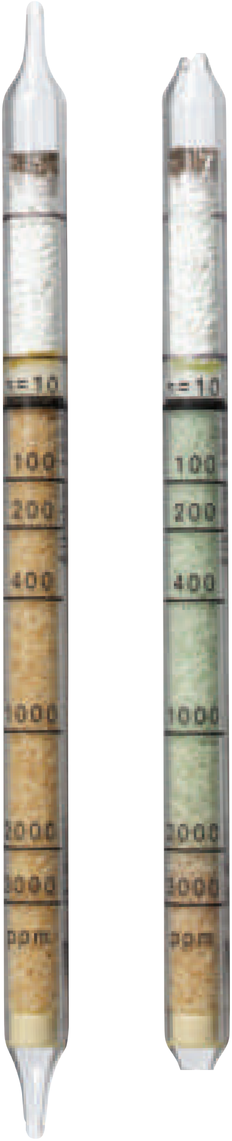
Temperature:	15 to 25 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

$\text{R-OH} + \text{Cr}^{\text{VI}} \longrightarrow \text{Cr}^{\text{III}}$ + various oxidation products

Cross Sensivity

The tube does not differentiate between different alcohols. Higher molecular weight alcohols are indicated with a markedly reduced sensitivity. Aldehydes, ethers, ketones and esters are indicated, but with different sensitivity. Aromates, petroleum and halogenated hydrocarbons are not indicated.



ST-6-2001

Amine Test

Order Code
81 01 061

ST-8-2001

Application Range

Standard Measuring Range:	qualitative
Number of Strokes n:	1
Time for Measurement:	app. 5 s
Standard Deviation:	± 30 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

Amine + pH indicator —> blue reaction product

Cross Sensivity

The tube indicates unspecifically basic reacting gases with different sensitivities. It is impossible to differentiate between the basic reacting gases.

Order Code
81 01 711

Ammonia 0.25/a

Application Range

Standard Measuring Range:	0.25 to 3 ppm
Number of Strokes n:	10
Time for Measurement:	app. 1 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	10 to 50 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

NH_3+ pH indicator —> blue reaction product

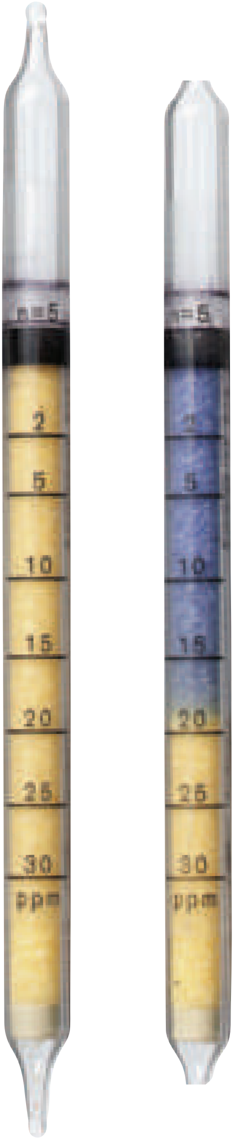
Cross Sensivity

Other basic substances such as e.g. organic amines are indicated as well, but with different sensitivity.

ST-9-2001

Ammonia 2/a

Order Code
67 33 231



ST-10-2001

Application Range

Standard Measuring Range:	2 to 30 ppm
Number of Strokes n:	5
Time for Measurement:	app. 1 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	10 to 50 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

NH_3 + pH indicator —> blue reaction product

Cross Sensivity

Other basic substances such as e.g. organic amines are indicated as well. The indication is not affected by:

300 ppm nitrous gases
2,000 ppm sulphur dioxide
2,000 ppm hydrogen sulphide

Order Code
CH 20 501

Ammonia 5/a

Application Range

Standard Measuring Range:	5 to 70 ppm
Number of Strokes n:	10
Time for Measurement:	app. 1 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow orange –> blue

Ambient Operating Conditions

Temperature:	10 to 50 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

NH_3 + pH indicator –> blue reaction product

Cross Sensivity

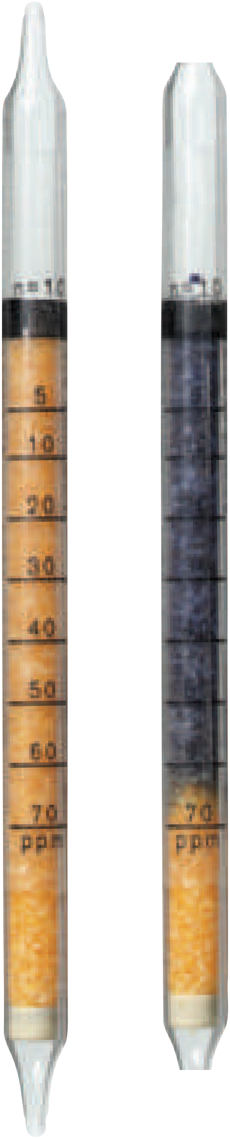
Other basic substances such as e.g. organic amines are indicated as well.

The indication is not affected by:

300	ppm nitrous gases
2,000	ppm sulphur dioxide
2,000	ppm hydrogen sulphide

Extension of the Measuring Range

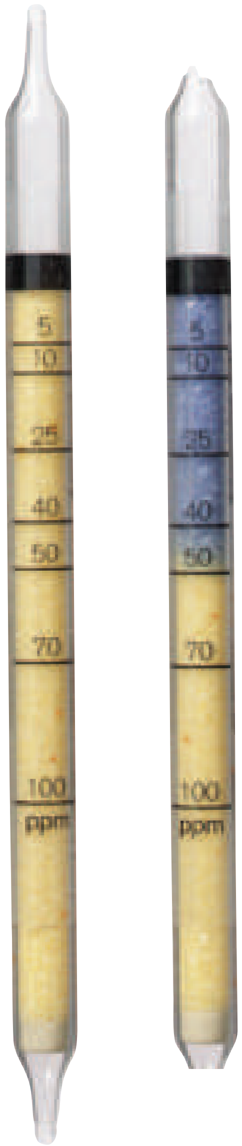
Using n= 1 stroke, multiply the reading by 10; the measuring range will be 50 to 700 ppm.



ST-11-2001

Ammonia 5/b

Order Code
81 01 941



ST-12-2001

Application Range

Standard Measuring Range:	5 to 100 ppm
Number of Strokes n:	1
Time for Measurement:	app. 10 s
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	10 to 50 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

NH_3 + pH-indicator —> blue reaction product

Cross Sensivity

Other basic substances such as e.g. organic amines are indicated as well.

The indication is not affected by:

300 ppm nitrous gases
2,000 ppm sulphur dioxide
2,000 ppm hydrogen sulphide

Extension of the Measuring Range

Using n= 2 strokes, divide the reading by 2; the measuring range will be 2.5 to 50 ppm.

Order Code
CH 31 901

Ammonia 0.5%/a

Application Range

Standard Measuring Range:	0.5 to 10 Vol.-%
Number of Strokes n:	1 + 1 desorption stroke in clean air
Time for Measurement:	10 s per stroke
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> violet

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	3 to 12 mg H_2O / L

Reaction Principle

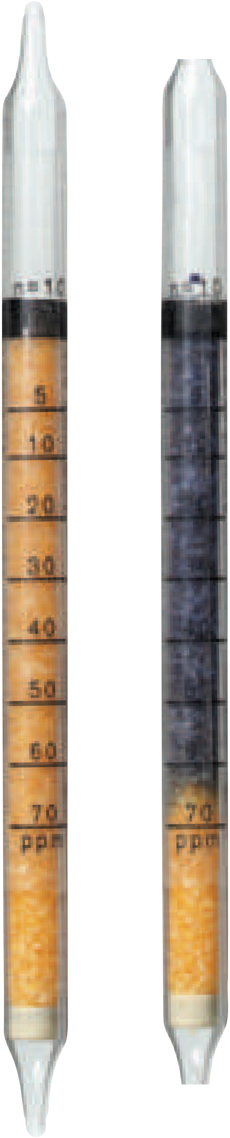
NH_3 + pH indicator --> purple reaction product

Cross Sensivity

Other basic substances such as e.g. organic amines are indicated as well.

Extension of the Measuring Range

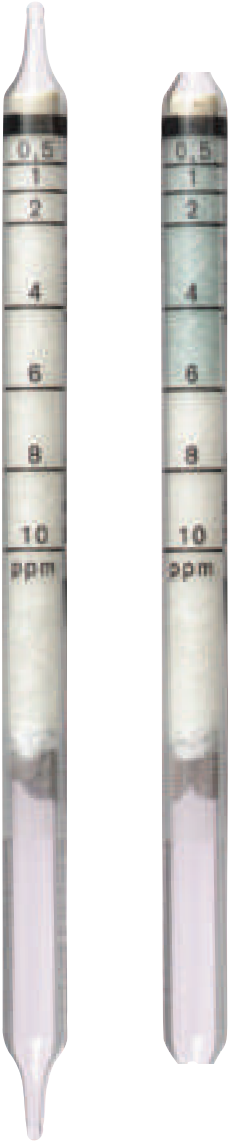
Using n= 10 strokes, divide the reading by 10; the measuring range will be 0.05 to 1 % by vol.



ST-115-2001

Aniline 0.5/a

Order Code
67 33 171



Application Range

Standard Measuring Range:	0.5 to 10 ppm
Number of Strokes n:	20
Time for Measurement:	app. 4 min
Standard Deviation:	± 15 to 20 %
Colour Change:	pale yellow —> pale green

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	7 to 12 mg H_2O / L

Reaction Principle

$C_6H_5NH_2 + Cr^{VI} \longrightarrow Cr^{III}$ + various oxidation products

Cross Sensivity

When methyl aniline and aniline are present at the same time, it is impossible to measure only the aniline concentration.

Ethers, ketones, esters, aromatics and petroleum hydrocarbons are indicated as well but with different sensitivities.

High aniline concentrations will not be indicated.

Order Code
CH 20 401

Aniline 5/a

Application Range

Standard Measuring Range:	1 to 20 ppm
Number of Strokes n:	25 to 5
Time for Measurement:	max. 3 min
Standard Deviation:	± 30 %
Colour Change:	white —> red

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	< 50 mg H_2O / L

Reaction Principle

Aniline + Furfurol —> Dianiline derivative of Hydroxyglutacondialdehyde

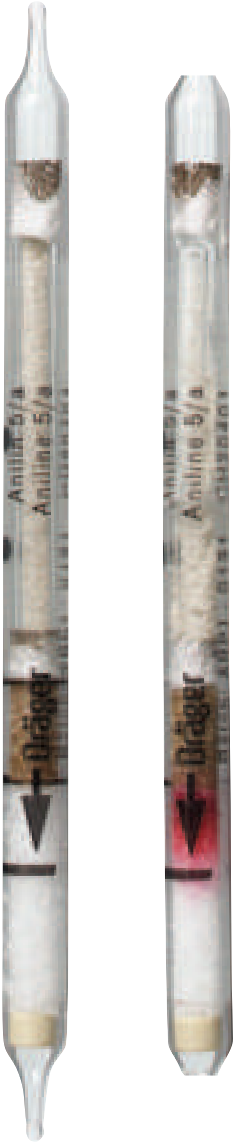
Cross Sensivity

N,N-Dimethylaniline is not indicated.

Ammonia concentrations up to 50 ppm do not affect the indication, higher ammonia concentrations will cause plus errors.

Additional Information

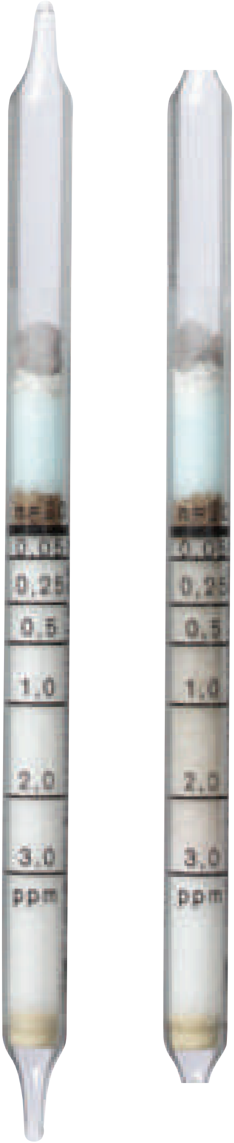
Before performing the measurement the reagent ampoule must be broken. The granular contents must be shaken out of the ampoule by tapping the side of the tube. During the measurement the Dräger tube must be held vertically with the inlet of the tube up.



ST-15-2001

Arsine 0.05/a

Order Code
CH 25 001



Application Range

Standard Measuring Range:	0.05 to 3 ppm
Number of Strokes n:	20
Time for Measurement:	app. 6 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> grey violet

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

$AsH_3 + Au^{3+} \longrightarrow Au$ (colloidal)

Cross Sensivity

Phosphine and antimony hydride are indicated as well, but with different sensitivities.

Hydrogen sulphide, mercaptans, ammonia and hydrogen chloride in the TLV range do not affect the indication.

Carbon monoxide and sulphur dioxides in the TLV range also do not affect the indication.

Order Code
67 28 561

Benzene 0.5/a

Application Range

Standard Measuring Range:	0.5 to 10 ppm
Number of Strokes n:	40 to 2
Time for Measurement:	max. 15 min
Standard Deviation:	± 30 %
Colour Change:	white –> pale brown

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$2\ C_6H_6 + HCHO \rightarrow C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2O$

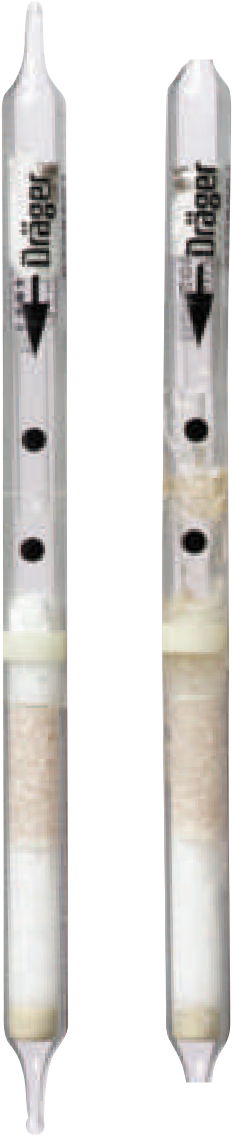
$C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2SO_4 \rightarrow$ p-chinoid compound

Cross Sensivity

Other aromatics (toluene, xylene, ethyl benzene) are indicated as well. It is impossible to measure benzene in the presence of these aromatics. Petroleum hydrocarbons, alcohols and esters do not affect the indication.

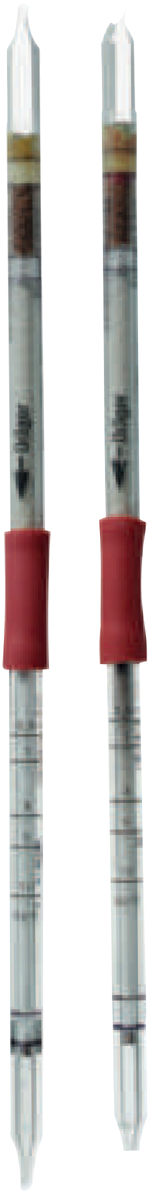
Additional Information

Before performing the measurement the ampoule must be broken and the liquid transferred onto the indicating layer so that it is completely saturated.



Benzene 0.5/c

Order Code
81 01 841



ST-113-2001

Application Range

Standard Measuring Range:	0.5 to 10 ppm
Number of Strokes n:	20
Time for Measurement:	app. 20 min
Standard Deviation:	± 30 %
Colour Change:	white –> brownish-yellow

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	1 to 30 mg H_2O / L

Reaction Principle

$2\ C_6H_6 + HCHO \rightarrow C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2O$

$C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2SO_4 \rightarrow$ p-quinoid compound

Cross Sensivity

The indication is not affected by:

100 ppm	n-butane
100 ppm	iso-butane
100 ppm	diethyl benzene
1,000 ppm	ethyl benzene
50 ppm	methyl (tert.) butyl ether
50 ppm	monostyrene
1,500 ppm	n-octane
300 ppm	iso-octane
600 ppm	pentane
100 ppm	toluene
100 ppm	triethyl benzene
100 ppm	xylene

Order Code
81 01 231

Benzene 2/a

Application Range

Standard Measuring Range:	2 to 60 ppm
Number of Strokes n:	20
Time for Measurement:	app. 8 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown grey

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	1 to 15 mg H_2O / L

Reaction Principle

$C_6H_6 + I_2O_5 + H_2SO_4 \longrightarrow I_2$

Cross Sensivity

Alkyl benzenes such as toluene or xylene up to a concentration of 200 ppm do not affect the indication. It is impossible to measure benzene in the presence of petroleum hydrocarbons and carbon monoxide.

ST-184-2001

Benzene 5/a

Order Code
67 18 801

ST-22-2001

Application Range

Standard Measuring Range:	5 to 40 ppm
Number of Strokes n:	15 to 2
Time for Measurement:	max. 3 min
Standard Deviation:	± 30 %
Colour Change:	white –> red brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 50 mg H_2O / L

Reaction Principle

$2\ C_6H_6 + HCHO \rightarrow C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2O$

$C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2SO_4 \rightarrow$ p-quinoid compound

Cross Sensivity

Other aromatics (toluene, xylene) are retained in the pre-layer causing a reddish brown discoloration. If the toluene or xylene concentrations are too high the entire pre-layer up to the indicating layer is discoloured making a benzene measurement impossible. Petroleum hydrocarbons, alcohols and esters do not affect the indication.

Order Code
67 28 071

Benzene 5/b

Application Range

Standard Measuring Range:	5 to 50 ppm
Number of Strokes n:	20
Time for Measurement:	app. 8 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white –> brown green

Ambient Operating Conditions

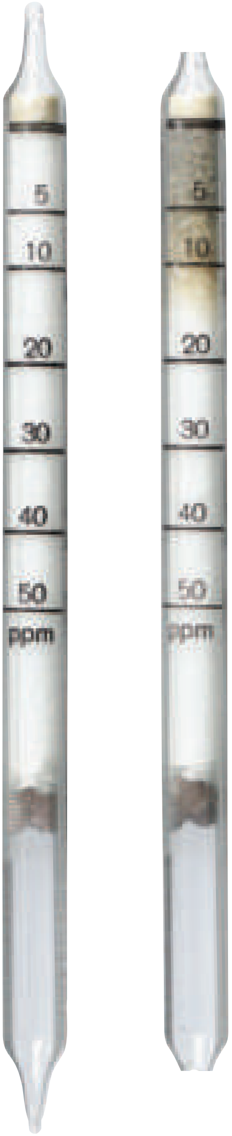
Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$C_6H_6 + I_2O_5 + H_2SO_4 \rightarrow I_2$

Cross Sensivity

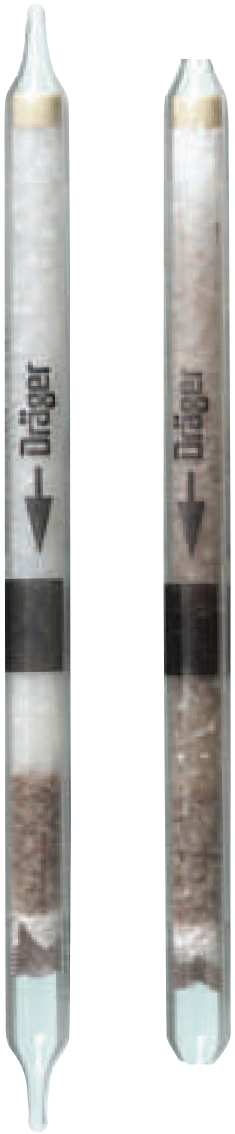
Many other petroleum hydrocarbons are indicated as well, but with different sensitivities. It is impossible to differentiate them. Other aromatics are indicated as well.



ST-23-2001

Benzene 15/a

Order Code
81 01 741



ST-24-2001

Application Range

Standard Measuring Range:	15 to 420 ppm
Number of Strokes n:	20 to 2
Time for Measurement:	max. 4 min
Standard Deviation:	± 30 %
Colour Change:	white –> red brown

Ambient Operating Conditions

Temperature:	0 to 30 °C
Absolute Humidity:	max. 30 mg H_2O / L

Reaction Principle

a) $2\ C_6H_6 + HCHO \longrightarrow C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2O$

b) $C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2SO_4 \longrightarrow$ p-quinoid compound

Cross Sensivity

Other aromatics (toluene, xylene) are retained in the pre-layer causing a reddish brown discoloration. If the toluene or xylene concentrations are too high the entire pre-layer up to the indicating layer is discoloured making a benzene measurement impossible. Petroleum hydrocarbons, alcohols and esters do not affect the indication.

Order Code
81 01 811

Carbon Dioxide 100/a

Application Range

Standard Measuring Range:	0.01 to 0.3 Vol.-%
Number of Strokes n:	10
Time for Measurement:	app. 200 s
Standard Deviation:	± 10 to 15 %
Colour Change:	white to pale violet –> blue violet

Ambient Operating Conditions

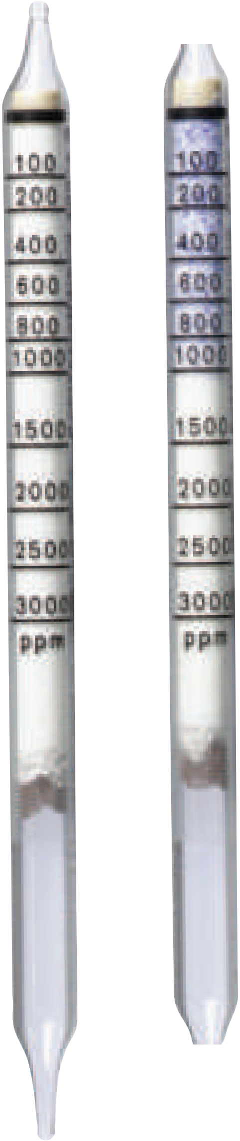
Temperature:	15 to 25 °C
Absolute Humidity:	max. 23 mg H_2O / L

Reaction Principle

$$CO_2 + N_2H_4 \xrightarrow{\text{Crystal Violet}} NH_2\text{-}NH\text{-}COOH$$

Cross Sensivity

Hydrogen sulphide and sulphur dioxide in the TLV range do not interfere.



ST-51-2001

Carbon Dioxide 0.1%/a

**Order Code
CH 23 501**

ST-55-2001

Application Range

Standard Measuring Range:	0.5 to 6	/ 0.1 to 1.2 Vol.-%
Number of Strokes n:	1	/ 5
Time for Measurement:	app. 30 s	/ app. 2.5 min
Standard Deviation:	± 5 to 10 %	
Colour Change:	white to pale violet —> blue violet	

Ambient Operating Conditions

Temperature:	0 to 30 °C
Absolute Humidity:	max. 30 mg H_2O /L

Reaction Principle

CO_2 + Amine —> blue violet reaction product

Cross Sensivity

Hydrogen sulphide and sulphur dioxide in the TLV range do not interfere.

Order Code
CH 31 401

Carbon Dioxide 0.5%/a

Application Range

Standard Measuring Range:	0.5 to 10 Vol.-%
Number of Strokes n:	1
Time for Measurement:	app. 30 s
Standard Deviation:	± 5 to 10 %
Colour Change:	white to pale violet —> blue violet

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 50 mg H_2O / L

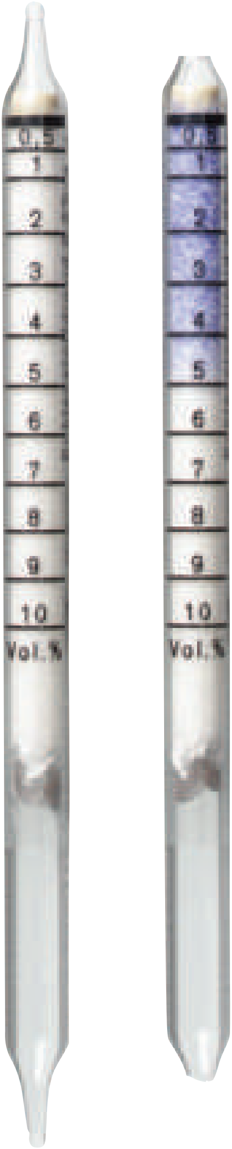
Reaction Principle

$CO_2 + N_2H_4 \rightarrow NH_2\text{-}NH\text{-}COOH$

Cross Sensivity

Hydrogen sulphide in the TLV range does not interfere.

In a range comparable to the calibrated range for carbon dioxide, sulphur dioxide is indicated. The sulphur dioxide sensitivity is approximately $^1/_3$ (e.g. 3 Vol.% sulphur dioxide gives an indication of 1 Vol.%).



ST-54-2001

Carbon Dioxide 1%/a

Order Code CH 25 101

ST-55-2001

Application Range

Standard Measuring Range:	1 to 20 Vol.-%
Number of Strokes n:	1
Time for Measurement:	app. 30 s
Standard Deviation:	± 5 to 10 %
Colour Change:	white to pale violet —> blue violet

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

$CO_2 + N_2H_4 \rightarrow NH_2\text{-}NH\text{-}COOH$

Cross Sensivity

Hydrogen sulphide in the TLV range does not interfere.

In a range comparable to the calibrated range for carbon dioxide, sulphur dioxide is indicated. The sulphur dioxide sensitivity is approximately $^1/_3$ (e.g. 6 Vol.% sulphur dioxide gives an indication of 2 Vol.%).

Order Code
CH 20 301

Carbon Dioxide 5%/A

Application Range

Standard Measuring Range:	5 to 60 Vol.-%
Number of Strokes n:	1
Time for Measurement:	app. 2 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white –> blue violet

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 50 mg H_2O / L

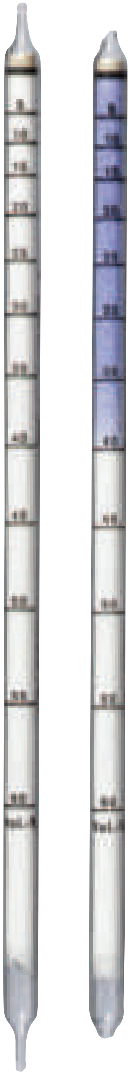
Reaction Principle

$CO_2 + N_2H_4 \rightarrow NH_2\text{-}NH\text{-}COOH$

Cross Sensivity

Hydrogen sulphide in the TLV range does not interfere.

In a range comparable to the calibrated range for carbon dioxide, sulphur dioxide is indicated with approximately the same sensitivity.



ST-190-2001

Carbon Disulphide 3/a

Order Code
81 01 891

ST-137-2001

Application Range

Standard Measuring Range:	3 to 95 ppm
Number of Strokes n:	15 to 1
Time for Measurement:	max. 2 min
Standard Deviation:	± 30 %
Colour Change:	pale blue —> yellow green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$2\ CS_2 + 4\ NHR_2 + Cu^{2+} \longrightarrow Cu\ (SCSNR_2)_2 + 2\ NH_2R_2^+$

Cross Sensivity

Hydrogen sulphide in the TLV range is retained in the prelayer and does not interfere.

Order Code
67 28 351

Carbon Disulphide 5/a

Application Range

Standard Measuring Range:	5 to 60 ppm
Number of Strokes n:	11
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$CS_2 + I_2O_5 \longrightarrow I_2$

Cross Sensivity

Aliphatic and aromatic hydrocarbons, carbon monoxide and hydrogen sulphide are indicated, but with different sensitivities. It is impossible to measure carbon disulphide in the presence of these substances.

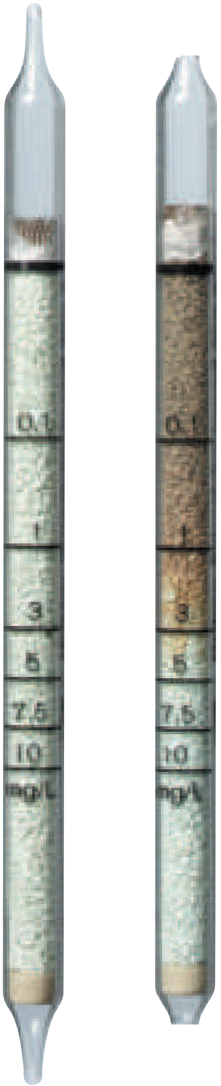
Additional Information

These tubes become very warm during the measurement.
Therefore these tubes should not be used in potentially combustible atmospheres.
The lower explosion limit for carbon disulphide is 1 Vol.-%.

ST-135-2001

Carbon Disulphide 30/a

Order Code
CH 23 201



ST-136-2001

Application Range

Standard Measuring Range:	0.1 to 10 mg/L
Number of Strokes n:	6
Time for Measurement:	app. 1 min
Standard Deviation:	± 15 to 20 %
Colour Change:	pale blue —> brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$2\ CS_2 + 4\ NHR_2 + Cu^{2+} \longrightarrow Cu(SCSNR_2)_2 + 2\ NH_2R_2^{+}$

Cross Sensivity

Hydrogen sulphide is indicated, producing a pale green discoloration. It is impossible to measure carbon disulphide in the presence of hydrogen sulphide.

Order Code
67 33 051

Carbon Monoxide 2/a

Application Range

Standard Measuring Range:	2 to 60 ppm
Number of Strokes n:	10
Time for Measurement:	app. 4 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brownish pink/green

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	2 to 20 mg H_2O / L

Reaction Principle

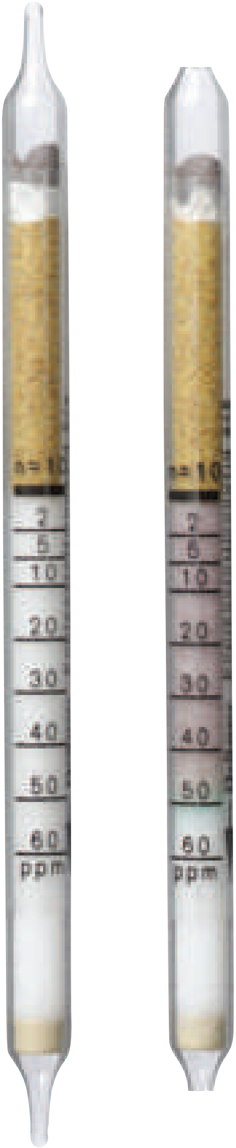
$5 CO + I_2O_5 \rightarrow I_2 + 5 CO_2$

Cross Sensivity

Acetylene reacts in the same way as CO, but with a different sensitivity. Petroleum hydrocarbons, benzene, halogenated hydrocarbons and hydrogen sulphide are retained in the precleanse layer. The capacity of the precleanse layer may not be sufficient for high concentrations of hydrocarbons and halogenated hydrocarbons. When in question, use a Dräger carbon pretube (CH 24101) in front of the CO tube. Practically all gases and vapors that would cause interference with the CO indication (e.g. propane, butane, trichloroethylene, perchloroethylene) are adsorbed by the activated charcoal in the pretube.
Easily cleaved halogenated hydrocarbons (e.g. trichloroethylene), in high concentrations can form chromyl chloride in the precleanse layer, which discolours the indicating layer yellowish brown. The carbon pretube can prevent this from happening.
It is impossible to measure CO in the presence of high olefin concentrations.

Extension of the Measuring Range

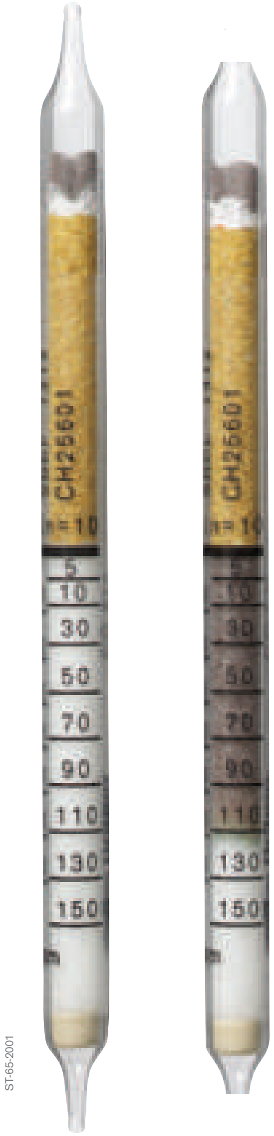
Using n = 2, multiply the reading by 5; the measuring range will be 10 to 300 ppm.



ST-64-2001

Carbon Monoxide 5/c

Order Code
CH 25 601



Application Range

Standard Measuring Range:	100 to 700	/ 5 to 150 ppm
Number of Strokes n:	2	/ 10
Time for Measurement:	app. 50 s	/ app. 4 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	white –> pale brown	

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	max. 50 mg H_2O / L

Reaction Principle

$$5\ CO + I_2O_5 \xrightarrow{H_2S_2O_7} I_2 + 5\ CO_2$$

Cross Sensivity

Acetylene reacts in the same way as CO, but with a different sensitivity. Petroleum hydrocarbons, benzene, halogenated hydrocarbons and hydrogen sulphide are retained in the precleanse layer. The capacity of the precleanse layer may not be sufficient for high concentrations of hydrocarbons and halogenated hydrocarbons. When in question, use a Dräger carbon pretube(CH 24101) in front of the CO tube. Practically all gases and vapors that would cause interference with the CO indication (e.g. propane, butane, trichloroethylene, perchloroethylene) are adsorbed by the activated charcoal in the pretube.
Easily cleaved halogenated hydrocarbons (e.g. trichloroethylene), in high concentrations can form chromyl chloride in the precleanse layer, which discolours the indicating layer yellowish brown. The carbon pretube can prevent this from happening.
It is impossible to measure CO in the presence of high olefine concentrations.

Order Code
CH 19 701

Carbon Monoxide 8/a

Application Range

Standard Measuring Range:	8 to 150 ppm Only for CO in H_2 > 95 Vol.-%
Number of Strokes n:	10
Time for Measurement:	app. 2 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown green

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	< 50 mg H_2O / L

Reaction Principle

$$5\ CO + I_2O_5 \xrightarrow{H_2S_2O_7} I_2 + 5\ CO_2$$

Cross Sensivity

Acetylene reacts in the same way as CO, but with a different sensitivity. Petroleum hydrocarbons, benzene, halogenated hydrocarbons and hydrogen sulphide are retained in the precleanse layer. The capacity of the precleanse layer may not be sufficient for high concentrations of hydrocarbons and halogenated hydrocarbons. When in question, use a Dräger carbon pretube(CH 24101) in front of the CO tube.

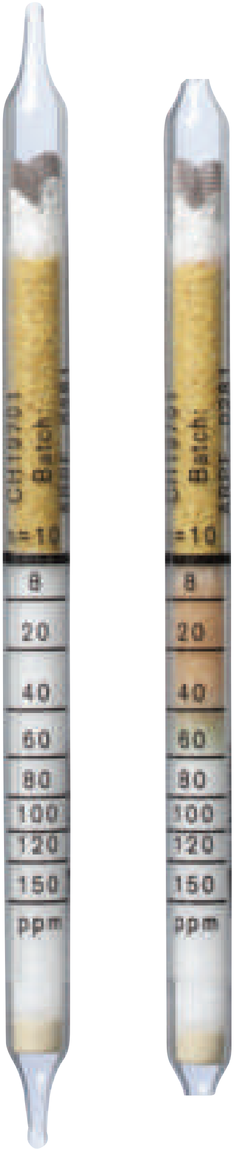
Practically all gases and vapors that would cause interference with the CO indication (e.g. propane, butane, trichloroethylene, perchloroethylene) are adsorbed by the activated charcoal in the pretube.

Easily cleaved halogenated hydrocarbons (e.g. trichloroethylene), in high concentrations can form chromyl chloride in the precleanse layer, which discolours the indicating layer yellowish brown. The carbon pretube can prevent this from happening.

It is impossible to measure CO in the presence of high olefine concentrations.

Additional Information

This particular tube is designed for the measurement of carbon monoxide in hydrogen.



ST-66-2001

Carbon Monoxide 10/b

Order Code
CH 20 601

ST-67-2001

Application Range

Standard Measuring Range:	100 to 3,000	/ 10 to 300 ppm
Number of Strokes n:	1	/ 10
Time for Measurement:	app. 20 s	/ app. 3.5 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	white —> brown green	

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	max. 50 mg H_2O / L

Reaction Principle

$$5\ CO + I_2O_5 \xrightarrow{H_2S_2O_7} I_2 + 5\ CO_2$$

Cross Sensivity

Acetylene reacts in the same way as CO, but with a different sensitivity. Petroleum hydrocarbons, benzene, halogenated hydrocarbons and hydrogen sulphide are retained in the precleanse layer. The capacity of the precleanse layer may not be sufficient for high concentrations of hydrocarbons and halogenated hydrocarbons. When in question, use a Dräger carbon pretube(CH 24101) in front of the CO tube.

Practically all gases and vapors that would cause interference with the CO indication (e.g. propane, butane, trichloroethylene, perchloroethylene) are adsorbed by the activated charcoal in the pretube.

Easily cleaved halogenated hydrocarbons (e.g. trichloroethylene), in high concentrations can form chromyl chloride in the precleanse layer, which discolours the indicating layer yellowish brown. The carbon pretube can prevent this from happening.

It is impossible to measure CO in the presence of high olefine concentrations.

Order Code
81 01 951

Carbon Monoxide 10/c

Application Range

Standard Measuring Range:	10 to 250 ppm
Number of Strokes n:	1
Time for Measurement:	app. 80 s
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brownish green

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	2 to 20 mg H_2O / L

Reaction Principle

$$5\ CO + I_2O_5 \xrightarrow{H_2S_2O_7} I_2 + 5\ CO_2$$

Cross Sensivity

Acetylene reacts similar to carbon monoxide, however, with less sensitivity.

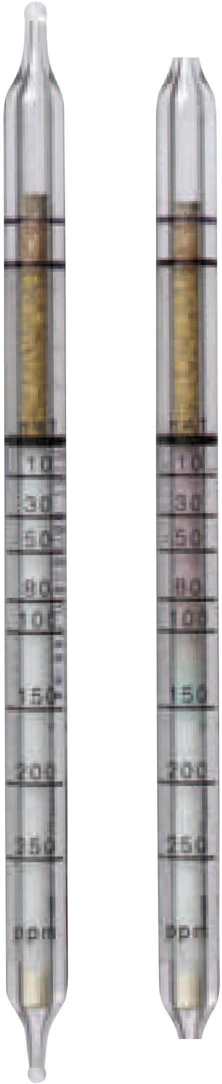
Petrol (gasoline), benzene, halogenated hydrocarbons and hydrogen sulphide are retained in the prelayer. In the case of higher concentrations of interfering hydrocarbons and halogenated hydrocarbons, use should be made of a carbon pretube (Order No. CH 24101).

Higher concentrations of easily cleavable halogenated hydrocarbons (e.g. trichlorethylene), may form chromyl chloride in the prelayer which changes the indicating layer to a yellowish brown.

Carbon monoxide determination is not possible in the case of high olefine concentrations.

Extension of the Measuring Range

Using n = 2, divide the reading by 2; the range of measurement is 5 to 125 ppm.



ST-68-2001

Carbon Monoxide 10/d

Order Code
81 03 321

ST-5759-2004

Application Range

Standard Measuring Range:	10 to 300 ppm / 100 to 3000 ppm
Number of Strokes n:	10 / 1
Time for Measurement:	app. 6 min / ca. 40 s
Standard Deviation:	± 15 bis 20 %
Colour Change:	yellow —> yellow or brown black

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	1 to 40 mg H_2O / L

Reaction Principle

$CO + Pd\text{-}Salt \rightarrow Pd + CO_2$

Order Code
CH 29 901

Carbon Monoxide 0.3%/b

ST-70-2001

Application Range

Standard Measuring Range:	0.3 to 7 Vol.-% CO
Number of Strokes n:	1
Time for Measurement:	app. 30 s
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown green

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	max. 50 mg H_2O / L

Reaction Principle

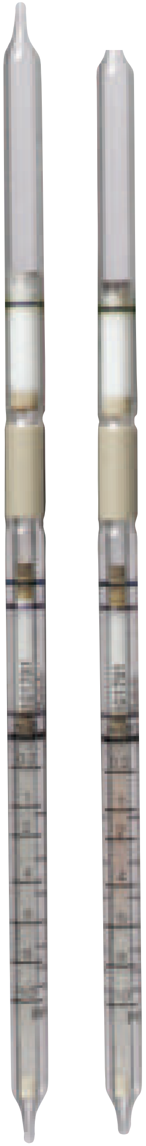
$$5\ CO + I_2O_5 \xrightarrow{H_2S_2O_7} I_2 + 5\ CO_2$$

Cross Sensivity

Acetylene reacts in the same way as CO, but with a different sensitivity. Petroleum hydrocarbons, benzene, halogenated hydrocarbons and hydrogen sulphide are retained in the precleanse layer. The capacity of the precleanse layer may not be sufficient for high concentrations of hydrocarbons and halogenated hydrocarbons. When in question, use a Dräger carbon pretube(CH 24101) in front of the CO tube. Practically all gases and vapors that would cause interference with the CO indication (e.g. propane, butane, trichloroethylene, perchloroethylene) are adsorbed by the activated charcoal in the pretube.
Easily cleaved halogenated hydrocarbons (e.g. trichloroethylene), in high concentrations can form chromyl chloride in the precleanse layer, which discolours the indicating layer yellowish brown. The carbon pretube can prevent this from happening.
It is impossible to measure CO in the presence of high olefine concentrations.

Carbon Tetrachloride 0.2/b

Order Code
81 01 791



ST-192-2001

Application Range

Standard Measuring Range:	10 to 70	/ 0.2 to 10 ppm
Number of Strokes n:	1	/ 5
Time for Measurement:	app. 1 min	/ app. 5 min
Standard Deviation:	± 20 %	
Colour Change:	white —> red	

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	max. 20 mg H_2O / L

Reaction Principle

a) $CCl_4 + H_2S_2O_7 \longrightarrow COCl_2$

b) $COCl_2$ + organic nitrogen compounds —> red reaction product

Cross Sensivity

With n = 5 strokes

10 ppm vinyl chloride, 50 ppm trichloroethene or 2 ppm 1,1-di-chloroethylene are not indicated.

200 ppm 1,2-dichloroethylene or 50 ppm perchloroethylene are indicated by a pale-pink discoloration (approx. 10 mm).

Order Code
81 01 021

Carbon Tetrachloride 1/a

Application Range

Standard Measuring Range:	1 to 15 ppm
Number of Strokes n:	5
Time for Measurement:	max. 6 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> yellow

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

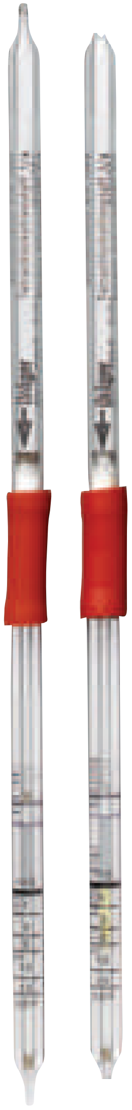
a) $CCl_4 + H_2S_2O_7 \rightarrow COCl_2$

b) $COCl_2$ + Aromatic nitrogen compounds —> yellow reaction product

Cross Sensivity

Chloropicrin and phosgene are indicated with the same sensitivity. It is impossible to measure carbon tetrachloride in the presence of chloropicrin and phosgene.

No interference by:	1 ppm	chlorine
	5 ppm	hydrochloric acid
	20 ppm	methyl bromide
	1,000 ppm	acetone



ST-197-2001

Carbon Tetrachloride 5/c

Order Code
CH 27 401

ST-148-2001

Application Range

Standard Measuring Range:	5 to 50 ppm
Number of Strokes n:	5
Time for Measurement:	app. 3 min
Standard Deviation:	± 20 to 30 %
Colour Change:	yellow —> blue green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

a) $CCl_4 + H_2S_2O_7 \rightarrow COCl_2$

b) $COCl_2$ + Aromatic amine —> blue green reaction product

Cross Sensivity

Phosgene is indicated with approximately the same sensitivity. It is impossible to measure carbon tetrachloride in the presence of phosgene. Other chlorinated hydrocarbons are also indicated, but only when they occur in higher concentrations.

Additional Information

Before carrying out the measurement the reagent ampoule must be broken. The granular contents must be shaken out of the broken ampoule by gently tapping the side of the tube. The tube must be held vertically with the inlet of the tube up during the measurement.

Order Code
CH 24 301

Chlorine 0.2/a

Application Range

Standard Measuring Range:	0.2 to 3 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> yellow orange

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 15 mg H_2O / L

Reaction Principle

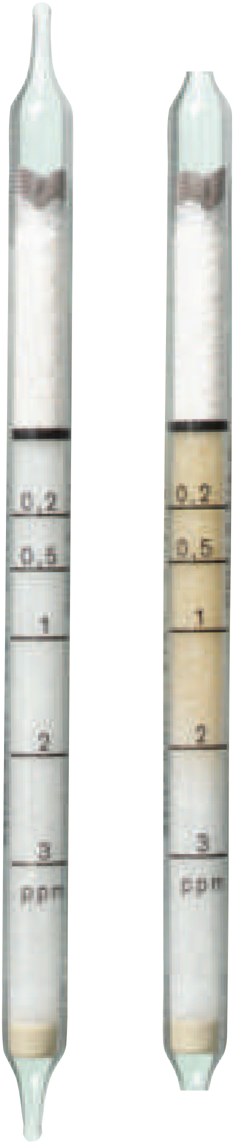
Cl_2 + o-tolidine —> yellow orange reaction product

Cross Sensivity

Bromine are indicated with the same sensitivity, but with a paler discoloration. Chlorine dioxide are indicated with different sensitivity. Nitrogen dioxide are indicated as well, but with a paler discoloration and lower sensitivity.

Extension of the Measuring Range

Using n = 1 stroke, multiply the reading by 10, the measuring range will be 2 to 30 ppm.



Chlorine 0.3/b

Order Code
67 28 411

ST-27-2001

Application Range

Standard Measuring Range:	0.3 to 5 ppm
Number of Strokes n:	20
Time for Measurement:	app. 450 s
Standard Deviation:	± 10 to 15 %
Colour Change:	pale green-grey —> brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 15 mg H_2O / L

Reaction Principle

Cl_2 + o-tolidine —> brown reaction product

Cross Sensivity

Bromine is indicated with the same sensitivity, but with a paler discoloration. Chlorine dioxide is indicated with different sensitivity.

Nitrogen dioxide is indicated as well, but with a paler discoloration and lower sensitivity.

Extension of the Measuring Range

Using n = 10 strokes, multiply the reading by 2, the measuring range will be 0.6 to 10 ppm.

Order Code
CH 20 701

Chlorine 50/a

Application Range

Standard Measuring Range:	50 to 500 ppm
Number of Strokes n:	1
Time for Measurement:	app. 15 s
Standard Deviation:	± 10 to 15 %
Colour Change:	grey green —> orange brown

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	< 40 mg H_2O / L

Reaction Principle

Cl_2 + o-tolidine —> orange brown reaction product

Cross Sensivity

Bromine is indicated with the same sensitivity, but with a higher standard deviation ± 25 to 30 %. Chlorine dioxide and nitrogen dioxide is indicated as well, but with a different sensitivity.

Chlorobenzene 5/a

Order Code
67 28 761

ST-185-2001

Application Range

Standard Measuring Range:	5 to 200 ppm
Number of Strokes n:	10
Time for Measurement:	app. 120 s
Standard Deviation:	± 10 to 15 %
Colour Change:	blue —> yellow grey

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

a) $C_6H_5Cl + Cr^{VI} \longrightarrow HCl$

b) HCl + bromophenol blue —> yellow reaction product

Cross Sensivity

Other chlorinated hydrocarbons are indicated as well, but with different sensitivities. Methylene chloride does not affect the indication. Chlorine and hydrogen chloride in the TLV range are absorbed in the pre-layer, but in such concentrations do not affect the indication.

Order Code
67 28 861

Chloroform 2/a

Application Range

Standard Measuring Range:	2 to 10 ppm
Number of Strokes n:	10
Time for Measurement:	app. 9 min
Standard Deviation:	± 20 to 30 % at 20 °C and 9 mg H_2O / L
Colour Change:	white –> yellow

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	9 mg H_2O / L

Reaction Principle

a) $CHCl_3 + Cr^{VI} \rightarrow Cl_2$

b) Cl_2 + o-tolidine –> yellow reaction product

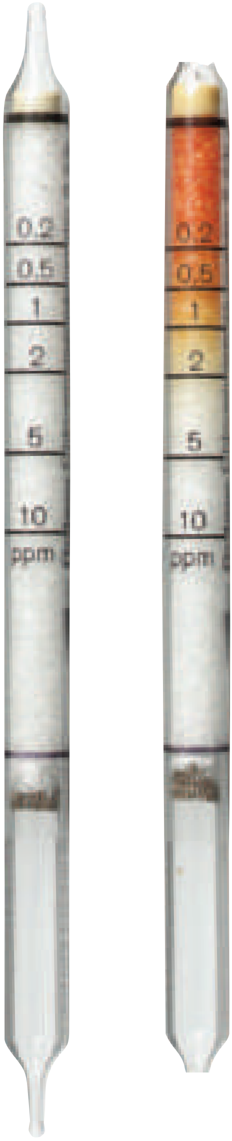
Cross Sensivity

Other chlorinated hydrocarbons are indicated, but with different sensitivities.

ST-188-2001

Chloroformate 0.2/b

Order Code
67 18 601



ST-29-2001

Application Range

Standard Measuring Range:	0.2 to 10 ppm
Number of Strokes n:	20
Time for Measurement:	app. 3 min
Standard Deviation:	± 20 to 30 %
Colour Change:	white —> yellow

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	5 to 15 mg H_2O / L

Reaction Principle

ClCOOR + 4-(4-nitrobenzyl)-pyridine —> yellow reaction product

Cross Sensivity

Methyl, ethyl and isopropylchloroformate are indicated with approximately the same sensitivity. It is impossible to differentiate them. Petroleum hydrocarbons, aromatics, alcohols and ketones in the TLV range do not affect the indication. It is impossible to measure chloroformate in the presence of phosgene.

Order Code
81 03 421

Chloropicrine 0.1/a

Application Range

Standard Measuring Range:	50 to 1 000 ppm
Number of Strokes n:	3
Time for Measurement:	app. 2 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> brown black

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$CCl_3NO_2 + H_2S_2O_7 \rightarrow COCl_2$

$COCl_2$ + diethylaniline + dimethylaminobenzaldehyde -> bluish-green reaction product

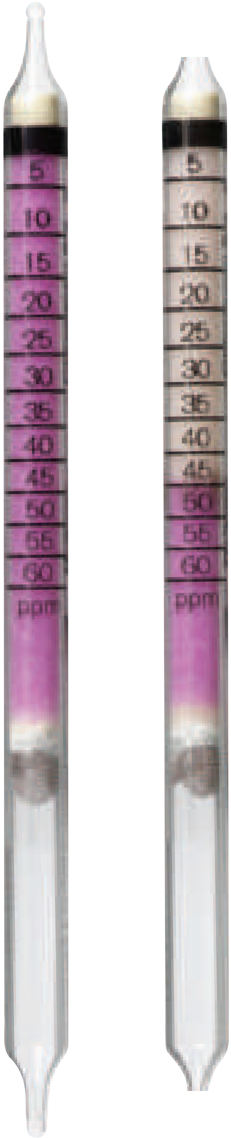
Cross Sensivity

The indication is not affected by:	50 ppm ammonia
	10 ppm hydrocyanic acid
	1 ppm ethylene oxide
	1 ppm phosphine
	5 ppm methyl bromide
	15 ppm sulphuryl fluoride
	10 ppm formaldehyde
	10 ppm chloroform

ST-5790-2004

Chloroprene 5/a

Order Code
67 18 901



ST-30-2001

Application Range

Standard Measuring Range:	5 to 60 ppm
Number of Strokes n:	3 + 3 desorption strokes in clean air.
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	violet —> yellow brown

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$CH_2{=}CH{-}CCl{=}CH_2 + MnO_4^- \longrightarrow Mn^{IV}$ + various oxidation products

Cross Sensivity

Many other organic compounds with C=C double bonds are indicated as well, but with different sensitivities. It is impossible to differentiate them. It is impossible to measure chloroprene in the presence of dialkyl sulphides.

Order Code
67 18 901

Chromic Acid 0.1/a

Application Range

Standard Measuring Range:	0.1 to 0.5 mg/m^3 Discoloration compared to colour standard.
Number of Strokes n:	40
Time for Measurement:	app. 8 min
Standard Deviation:	± 50 %
Colour Change:	white –> violet

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

a) $CrO_3 + H_2SO_4 \rightarrow Cr^{VI}$

b) Cr^{VI} + diphenylcarbazide –> Cr^{III} + diphenylcarbazone

Cross Sensivity

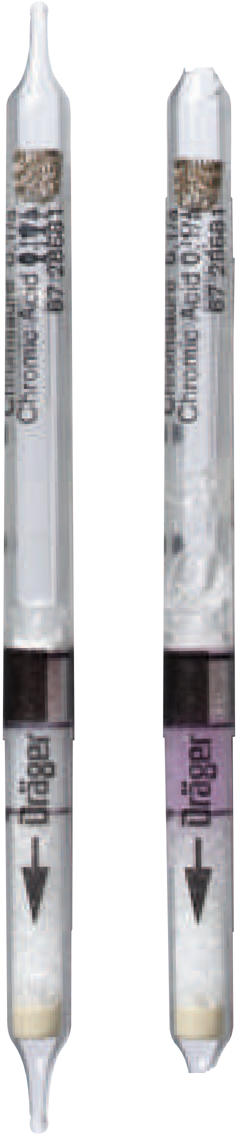
Metal chromates such as zinc or strontium chromate are indicated with about half the sensitivity.

CrIII compounds do not affect the indication.

Very high chromate concentrations lead to a rapid bleaching of the indication. Measurements should be repeated with less strokes.

Additional Information

After carrying out the required 40 pump strokes the reagent ampoule must be broken, the liquid transferred onto the indicating layer and carefully drawn through it using the pump.



ST-32-2001

Cyanide 2/a

Order Code
67 28 791

ST-33-2001

Application Range

Standard Measuring Range:	2 to 15 mg/m^3
Number of Strokes n:	10
Time for Measurement:	app. 2.5 min
Standard Deviation:	± 20 to 30 %
Colour Change:	yellow –> red

Ambient Operating Conditions

Temperature:	0 to 30 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

a) $2\ KCN + H_2SO_4 \rightarrow 2\ HCN + K_2SO_4$

b) $2\ HCN + HgCl_2 \rightarrow 2\ HCl + Hg(CN)_2$

c) HCl + methyl red –> red reaction product

Cross Sensivity

Free hydrogen cyanide is indicated already before breaking the ampoule.

Acid gases are indicated with different sensitivities.

A certain portion of the cyanide can have reacted with the CO_2 in the air through hydrolysis.

It is impossible to measure cyanide in the presence of phosphine.

Additional Information

After carrying out the 10 strokes the reagent ampoule must be broken, the liquid transferred onto the white separating layer and carefully drawn through it with two strokes in cyanide free air using the pump.

The indicating layer must not become moist.

Order Code
CH 19 801

Cyanogen Chloride 0.25/a

Application Range

Standard Measuring Range:	0.25 to 5 ppm
Number of Strokes n:	20 to 1
Time for Measurement:	max. 5 min
Standard Deviation:	± 30 %
Colour Change:	white –> pink

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	< 50 mg H_2O / L

Reaction Principle

a) ClCN + pyridine –> glutaconaldehyde cyanamide

b) Glutaconaldehyde + barbituric acid –> pink reaction product

Cross Sensivity

Cyanogen bromide is indicated as well, but with a different sensitivity. Calibration data is not available.

Additional Information

Before performing the measurement the reagent ampoule must be broken and the liquid transferred onto the indicating layer so that it is completely saturated.

ST-31-2001

Cyclohexane 100/a

Order Code
67 25 201

Application Range

Standard Measuring Range:	100 to 1,500 ppm
Number of Strokes n:	10
Time for Measurement:	app. 5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	orange —> green brown

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$C_6H_{12} + Cr^{VI} \longrightarrow Cr^{III}$ + various oxidation products

Cross Sensivity

Many petroleum hydrocarbons, alcohols, aromatics and esters are indicated as well, but with different sensitivities. It is not possible to differentiate between them.

Order Code
67 28 931

Cyclohexylamine 2/a

Application Range

Standard Measuring Range:	2 to 30 ppm
Number of Strokes n:	10
Time for Measurement:	app. 4 min
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

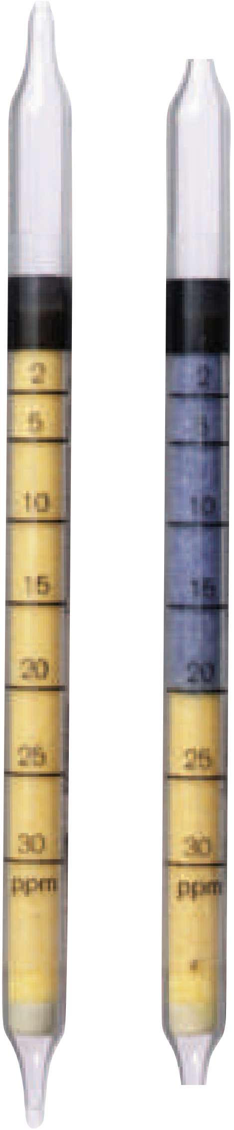
Temperature:	15 to 35 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$C_6H_{11}NH_2$ + pH-indicator —> blue reaction product

Cross Sensivity

Other basic substances such as organic amines and ammonia are indicated as well.



ST-35-2001

Diethyl Ether 100/a

Order Code
67 30 501

ST-36-2001

Application Range

Standard Measuring Range:	100 to 4,000 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 15 to 20 %
Colour Change:	orange –> green brown

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

C_2H_5-O-C_2H_5 + Cr^{VI} –> Cr^{III} + various oxidation products

Cross Sensivity

Many petroleum hydrocarbons, alcohols, aromatics and esters are indicated as well, but with different sensitivities. It is not possible to differentiate between them.

Order Code
67 18 501

Dimethyl Formamide 10/b

Application Range

Standard Measuring Range:	10 to 40 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 20 to 30 %
Colour Change:	yellow –> blue/grey

Ambient Operating Conditions

Temperature:	15 to 35 °C
Absolute Humidity:	3 to 12 mg H_2O / L

Reaction Principle

a) Dimethylformamide + NaOH –> NH_3

b) NH_3 + pH-indicator –> blue reaction product

Cross Sensivity

It is not possible to measure dimethyl formamide in the presence of other basic substances such as organic amines, ammonia and hydrazine.

ST-37-2001

Dimethyl Sulphate 0.005/c

Order Code
67 18 701

ST-38-2001

Application Range

Standard Measuring Range:	0.005 to 0.05 ppm Discoloration compared to colour standard.
Number of Strokes n:	200
Time for Measurement:	app. 50 min
Standard Deviation:	± 30 %
Colour Change:	white —> blue

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

Dimethyl sulphate + 4-(4-Nitrobenzyl)-pyridine —> colourless alkylation product

colourless alkylation product —> blue reaction product

Cross Sensivity

Phosgene and chloroformates cause a yellow discoloration of the indicating layer, and it is impossible to perform a dimethyl sulphate measurement. Alcohols, ketones, aromatics and petroleum hydrocarbons in the TLV range do not affect the indication.

Additional Information

After carrying out the required 200 pump strokes the reagent ampoule must be broken, the liquid transferred onto the indicating layer and carefully drawn through it using the pump. Wait five minutes before evaluating the indication. The tube must not be exposed to direct sunlight during the 5 minutes waiting period.

Order Code
67 28 451

Dimethyl Sulphide 1/a

Application Range

Standard Measuring Range:	1 to 15 ppm
Number of Strokes n:	20
Time for Measurement:	app. 15 min
Standard Deviation:	± 15 to 20 %
Colour Change:	violet —> yellow brown

Ambient Operating Conditions

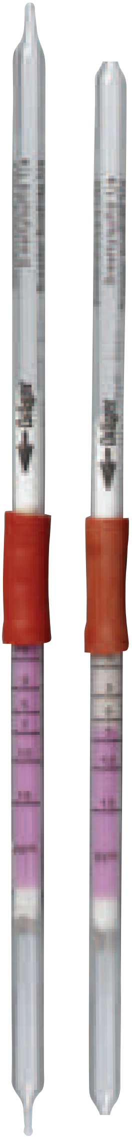
Temperature:	15 to 30 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

$(CH_3)_2S + KMnO_4$ —> Mn^{IV} + various oxidation products

Cross Sensivity

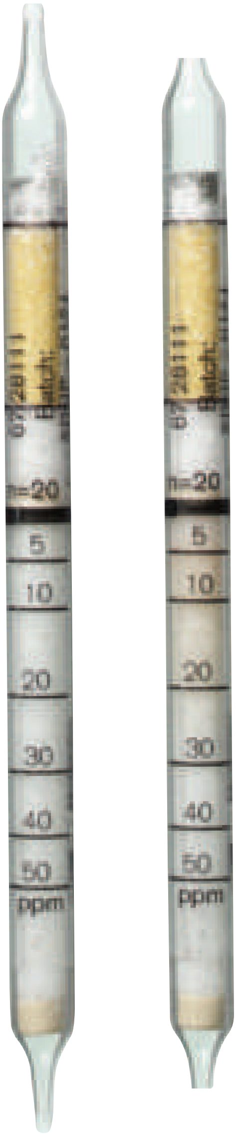
Many organic compounds with C=C double bonds are indicated as well, but with different sensitivities. It is impossible to differentiate between them. H_2S (hydrogen sulphide) is indicated with approximately twice the sensitivity. The tube H_2S 5/b can be used as filtering tube. Then with $n = 20$ pump strokes approx. 30 ppm H_2S are retained. Methyl mercaptan is indicated with approximately twice the sensitivity.



ST-186-2001

Epichlorohydrine 5/b

Order Code
67 28 111



ST-39-2001

Application Range

Standard Measuring Range:	5 to 50 ppm
Number of Strokes n:	20
Time for Measurement:	app. 8 min
Standard Deviation:	± 15 to 20 %
Colour Change:	pale gray —> orange

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	5 to 15 mg H_2O / L

Reaction Principle

Epichlorohydrin + $Cr^{VI} \longrightarrow Cl_2$

Cl_2 + o-tolidine —> orange reaction product

Cross Sensivity

Other chlorinated hydrocarbons are indicated as well but with different sensitivity.

It is not possible to measure epichlorohydrine in the presence of free halogens and hydrogen halides in the TLV range because they are indicated as well.

Petroleum hydrocarbons cause low readings.

Order Code
CH 20 201

Ethyl Acetate 200/a

Application Range

Standard Measuring Range:	200 to 3,000 ppm
Number of Strokes n:	20
Time for Measurement:	app. 5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	orange —> green brown

Ambient Operating Conditions

Temperature:	17 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$CH_3COOC_2H_5 + Cr^{VI} \longrightarrow Cr^{III}$ + various oxidation products

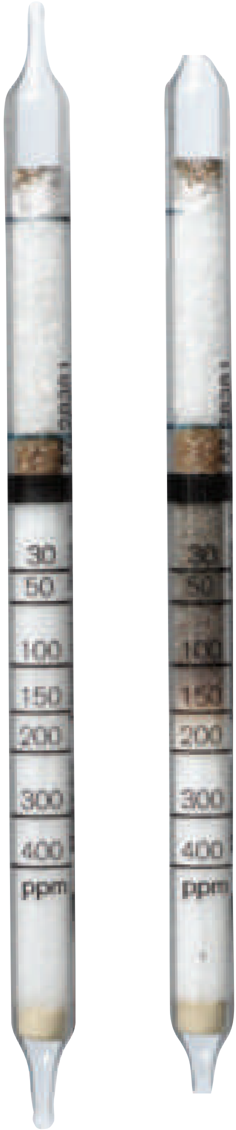
Cross Sensivity

Many petroleum hydrocarbons, alcohols, aromatics and esters are indicated, but with different sensitivities. It is impossible to differentiate between them.

ST-48-2001

Ethyl Benzene 30/a

Order Code
67 28 381



ST-41-2001

Application Range

Standard Measuring Range:	30 to 400 ppm
Number of Strokes n:	6
Time for Measurement:	app. 2 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

$C_6H_5 - C_2H_5 + I_2O_5 \rightarrow I_2$

Cross Sensivity

Many petroleum hydrocarbons and aromatics are indicated, but with different sensitivities. It is impossible to differentiate them.

Extension of the Measuring Range

Using n = 4, multiply the reading by 1.5; the measuring range will be 45 to 600 ppm.

Order Code
67 26 801

Ethyl Glycol Acetate 50/a

Application Range

Standard Measuring Range:	50 to 700 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 20 to 30 %
Colour Change:	yellow –> turquoise green

Ambient Operating Conditions

Temperature: 19 to 21 °C

For temperatures outside the 19 to 21°C range, multiply the tube reading by the following factor (K):

T [°C]	10	15	18	22	25	30	35
K	2.1	1.8	1.3	0.9	0.7	0.6	0.5

Absolute Humidity: 5 to 12 mg H_2O / L

Reaction Principle

Ethyl glycol acetate + Cr^{VI} –> Cr^{III} + various oxidation products

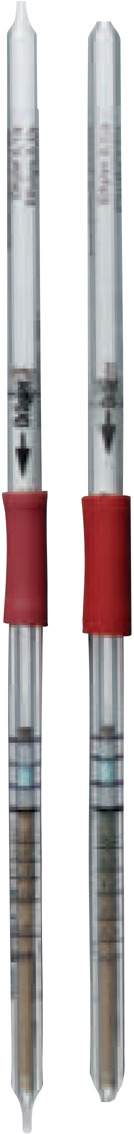
Cross Sensivity

Alcohols, esters, aromatics and ethers are also indicated, but with different sensitivities. It is impossible to differentiate between them.

ST-59-2001

Ethylene 0.1/a

Order Code
81 01 331



ST-189-2001

Application Range

Standard Measuring Range:	0.2 to 5 ppm
Number of Strokes n:	20
Time for Measurement:	app. 30 min
Standard Deviation:	± 30 to 40 %
Colour Change:	pale yellow –> blue

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	5 to 20 mg H_2O / L

Reaction Principle

$CH_2{=}CH_2$ + Pd-Molybdate complex –> blue reaction product

Cross Sensivity

Other compounds with C=C double bonds are indicated, but with different, usually lower, sensitivities. It is impossible to differentiate between them.

50 ppm H_2S gives an indication up to 0.4 ppm.

25 ppm CO colours the entire indication layer grayish blue

Extension of the Measuring Range

With n = 40 strokes the indication of 0.2 ppm corresponds to a concentration of 0.1 ppm.

Order Code
67 28 051

Ethylene 50/a

Application Range

Standard Measuring Range:	50 to 2,500 ppm
Number of Strokes n:	3
Time for Measurement:	app. 4 min
Standard Deviation:	± 20 to 30 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$CH_2=CH_2$ + Pd-Molybdate complex —> blue reaction product

Cross Sensivity

Organic compounds with C=C double bonds are indicated, but with different sensitivities. It is impossible to differentiate them. In the presence of CO, the indicating layer is coloured blue depending upon the CO concentration. H_2S is indicated by a black colour, but with considerably lower sensitivity.

ST-43-2001

Ethylene Glycol 10

Order Code
81 01 351

ST-198-2001

Application Range

Standard Measuring Range:	10 to 180 mg/m^3 Corresponds to 4-70 ppm.
Number of Strokes n:	10
Time for Measurement:	app. 7 min
Standard Deviation:	± 20 to 30 %
Colour Change:	white –> pink

Ambient Operating Conditions

Temperature:	10 to 35 °C
Absolute Humidity:	2 to 15 mg H_2O / L

Reaction Principle

a) $OH\text{-}C_2H_4\text{-}OH \rightarrow HCHO$

b) $HCHO + C_6H_4(CH_3)_2 + H_2SO_4 \rightarrow$ quinoid reaction products

Cross Sensivity

Styrene, vinyl acetate and acetaldehyde are indicated with a yellowish brown discoloration.

It is impossible to measure ethylene glycol in the presence of formaldehyde and ethylene oxide because they produce the same discoloration.

Additional Information

The reagent ampoule must be broken before carrying out the measurement.

Order Code
67 28 961

Ethylene Oxide 1/a

Application Range

Standard Measuring Range:	1 to 15 ppm
Number of Strokes n:	20
Time for Measurement:	app. 8 min
Standard Deviation:	± 20 to 30 %
Colour Change:	white –> pink

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

a) Ethylene Oxide –> HCHO

b) HCHO + $C_6H_4(CH_3)_2$ + H_2SO_4 –> quinoid reaction products

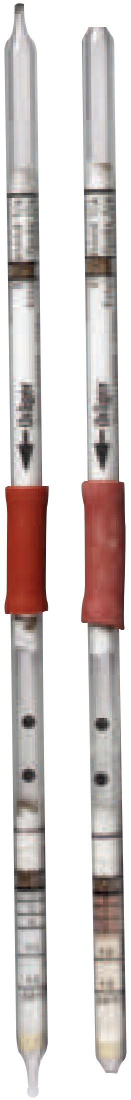
Cross Sensivity

Styrene, vinyl acetate and acetaldehyde are indicated with a yellowish brown discoloration.

It is impossible to measure ethylene oxide in the presence of ethylene glycol and formaldehyde because they produce the same discoloration.

Additional Information

The reagent ampoule must be broken before carrying out the measurement.



ST-204-2001

Ethylene Oxide 25/a

Order Code
67 28 241

ST-42-2001

Application Range

Standard Measuring Range:	25 to 500 ppm
Number of Strokes n:	30
Time for Measurement:	app. 6 min
Standard Deviation:	± 20 to 30 %
Colour Change:	pale yellow —> turquoise green

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

Ethylene oxide + Cr^{VI} —> Cr^{III} + various oxidation products

Cross Sensivity

Alcohols, esters and aldehydes are also indicated, but with different sensitivities. It is impossible to differentiate between them.
Propylene oxide is also indicated, but with a different sensitivity.
Ethylene, ketones and toluene in the TLV range do not interfere.

Order Code
81 01 491

Fluorine 0.1/a

Application Range

Standard Measuring Range:	0.1 to 2 ppm
Number of Strokes n:	20
Time for Measurement:	app. 5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> yellow

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 10 mg H_2O / L

Reaction Principle

a) $F_2 + Mg\,O_2 \rightarrow Cl_2 + Mg\,F_2$

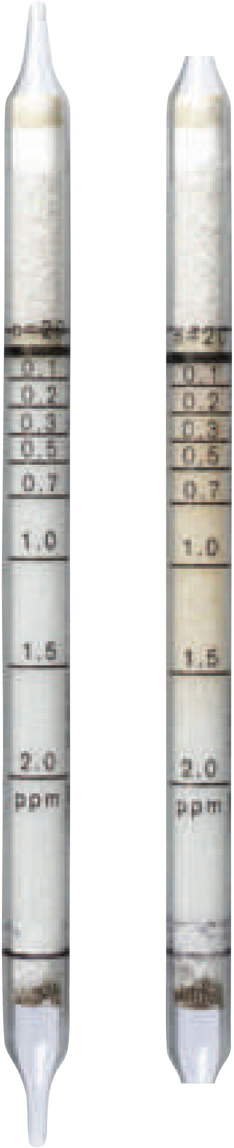
b) Cl_2 + o-Tolidine —> yellow reaction product

Cross Sensivity

Nitrogen dioxide, chlorine and chlorine dioxide are indicated, but with different sensitivities.

Extension of the Measuring Range

Using n = 40, divide the reading by 2; the measuring range will be 0.05 to 1 ppm.



ST-44-2001

Formaldehyde 0.2/a

Order Code
67 33 081

ST-46-2001

Application Range

Standard Measuring Range:	0.5 to 5 / 0.2 to 2.5 ppm
Number of Strokes n:	10 / 20
Time for Measurement:	app. 1.5 min / app. 3 min
Standard Deviation:	± 20 to 30 %
Colour Change:	white –> pink

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$HCHO + C_6H_4(CH_3)_2 + H_2SO_4 \rightarrow$ quinoid reaction products

Cross Sensivity

Styrene, vinyl acetate, acetaldehyde, acrolein, diesel fuel and furfuryl alcohol are indicated with a yellowish brown discoloration.

500 ppm Octane, 5 ppm nitric oxide and 5 ppm nitrogen dioxide have no effect.

Extension of the Measuring Range

The measuring range can be extended in conjunction with the activation tube (P/N 8101141). The following information applies to the n = 20 stroke scale:

Pump Strokes	Scale divided by	Range
40	2	0.1 to 1.25 ppm
80	4	0.05 to 0.63 ppm
100	5	0.04 to 0.5 ppm

Order Code
81 01 751

Formaldehyde 2/a

Application Range

Standard Measuring Range:	2 to 40 ppm
Number of Strokes n:	5
Time for Measurement:	app. 30 s
Standard Deviation:	± 20 to 30 %
Colour Change:	white —> pink

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

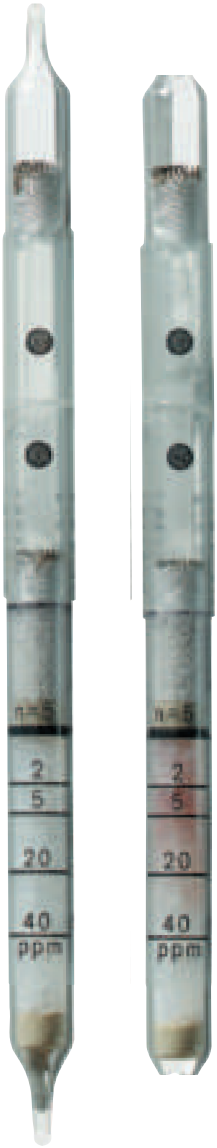
$HCHO + C_6H_4(CH_3)_2 + H_2SO_4 \longrightarrow$ quinoid reaction products

Cross Sensivity

Styrene, vinyl acetate, acetaldehyde, acrolein, diesel fuel and furfuryl alcohol are indicated with a yellowish brown discoloration.
500 ppm Octane, 5 ppm nitric oxide and 5 ppm nitrogen dioxide have no effect.

Additional Information

The reagent ampoule must be broken before carrying out the measurement.



Formic Acid 1/a

Order Code
67 22 701

ST-7-2001

Application Range

Standard Measuring Range:	1 to 15 ppm
Number of Strokes n:	20
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	blue violet —> yellow

Ambient Operating Conditions

Temperature:	10 to 50 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

HCOOH + pH indicator —> yellow reaction product

Cross Sensivity

It is impossible to measure formic acid in the presence of other acids. Organic acids are indicated by the same colour change, but partly with different sensitivity. Mineral acids, e.g. hydrochloric acid are indicated with different sensitivity and by red colour.

Order Code
81 01 601

Halogenated Hydrocarbons 100/a

Application Range

Standard Measuring Range:	200 to 2,600 ppm R 113/R 114 100 to 1,400 ppm R 11 200 to 2,800 ppm R 22
(on inquiry)	1,000 to 4,000 ppm R 134a The indication is in mm and must be compared to the calibration curves.
Number of Strokes n:	3
Time for Measurement:	app. 1 min
Standard Deviation:	± 30 %
Colour Change:	blue —> yellow to grayish green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	1 to 15 mg H_2O / L

Reaction Principle

For Example:

a) R113 [Pyrolysis] —> HCl

b) HCl + pH Indicator —> yellow reaction product

Cross Sensivity

Other halogenated hydrocarbons, free halogens and hydrogen halides are indicated.

Perchloroethylene is indicated with the same sensitivity as R113.

Additional Information

The tubes become very warm during the measurement. Therefore, these tubes should not be used in potentially combustible atmospheres. A combustible gas monitor should be used to qualify any questionable area before conducting a measurement with one of these tubes.

ST-199-2001

Hexane 100/a

Order Code
67 28 391

ST-45-2001

Application Range

Standard Measuring Range:	100 to 3,000 ppm
Number of Strokes n:	6
Time for Measurement:	app. 3 min
Standard Deviation:	± 15 to 20 %
Colour Change:	orange —> green-brown

Ambient Operating Conditions

Temperature:	15 to 35 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

C_6H_{14} + Cr^{VI} —> Cr^{III} + various oxidation products

Cross Sensivity

Alcohols, esters, aromatics, petroleum hydrocarbons and ethers are also indicated, but with different sensitivities. It is impossible to differentiate between them.

Extension of the Measuring Range

Using n = 11, divide the reading by 2; the measuring range will be 50 to 1,500 ppm.

Order Code
CH 31 801

Hydrazine 0.25/a

Application Range

Standard Measuring Range:	0.25 to 10	/ 0.1 to 5 ppm
Number of Strokes n:	10	/ 20
Time for Measurement:	app. 1 min	/ app. 2 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	yellow —> blue	

Ambient Operating Conditions

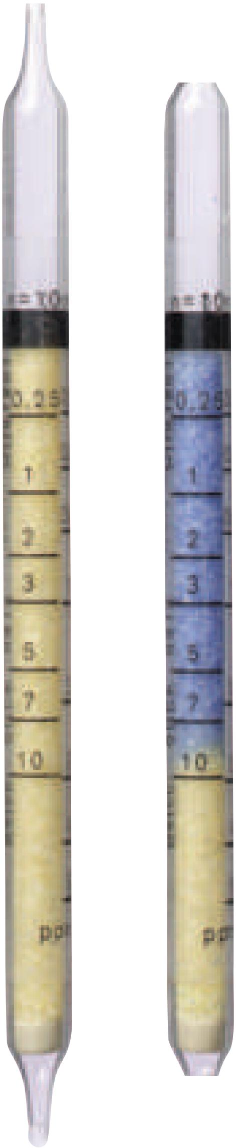
Temperature:	10 to 50 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

NH_3+ pH Indicator —> blue reaction product

Cross Sensivity

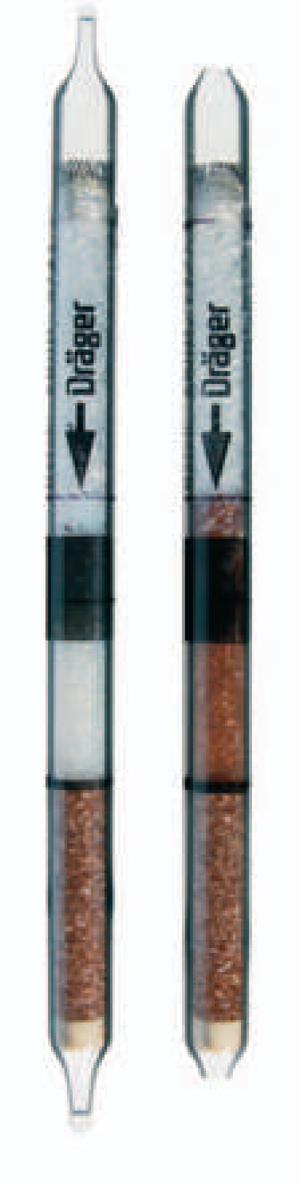
This tube indicates other basic gases (e.g. organic amines and ammonia).



ST-50-2001

Hydrocarbons 2

Order Code
CH 25 401



Application Range

Standard Measuring Range:	3 to 23 mg hydrocarbon / L
Number of Strokes n:	24 to 3
Time for Measurement:	app. 5 min
Standard Deviation:	± 30 to 40 %
Colour Change:	pale yellow –> brown

Ambient Operating Conditions

Temperature:	0 to 35 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$C_8H_{18} + SeO_2 \longrightarrow$ brown reaction product

Cross Sensivity

Aliphatic and aromatic hydrocarbons are indicated. It is impossible to differentiate them.

Aromatic hydrocarbons (e.g. benzene, toluene) produce a reddish colour in the indication layer, the aromatic content of a mixture should not exceed 50%.

Carbon monoxide in the TLV range does not interfere.

Additional Information

The standard deviation is valid for hydrocarbon mixtures with boiling points in the range of 50°C to 200°C and in technical gases, (e.g. extraction benzene and carburetor fuels).

Order Code
CH 26 101

Hydrocarbons 0.1%/b

Application Range

Standard Measuring Range:	0.5 to 1.3 Vol.-% Propane
	0.1 to 0.8 Vol.-% Butane
Number of Strokes n:	15 to 7 Propane
	15 to 3 Butane
Time for Measurement:	app. 3 min
Standard Deviation:	± 30 to 40 %
Colour Change:	white —> brown gray

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$C_3H_8/C_4H_{10} + I_2O_5 \longrightarrow I_2$

Cross Sensivity

Methane and ethane are not indicated.

Many petroleum hydrocarbons are indicated, but with different sensitivities. It is impossible to differentiate them.

Hydrocarbons with double bonds are indicated.

Acetylene and ethylene are indicated, but with different discolorations and sensitivities.

Carbon monoxide is indicated with a green colour, but a different sensitivity.

ST-75-2001

Hydrochloric Acid 1/a

Order Code
CH 29 501

Application Range

Standard Measuring Range:	1 to 10 ppm
Number of Strokes n:	10
Time for Measurement:	app. 2 min
Standard Deviation:	± 10 to 15 %
Colour Change:	blue —> yellow

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	max. 15 mg H_2O / L

Reaction Principle

HCl + Bromophenol blue —> yellow reaction product

Cross Sensivity

Hydrogen sulphide and sulphur dioxide in the TLV range do not interfere. It is impossible to measure hydrochloric acid in the presence of other mineral acids.

Chlorine and nitrogen dioxide are indicated, but with different sensitivities.

Order Code
67 28 181

Hydrochloric Acid 50/a

Application Range

Standard Measuring Range:	500 to 5,000	/ 50 to 500 ppm
Number of Strokes n:	1	/ 10
Time for Measurement:	app. 30 s	/ app. 4 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	blue —> white	

Ambient Operating Conditions

Temperature:	10 to 50 °C
Absolute Humidity:	max. 15 mg H_2O / L

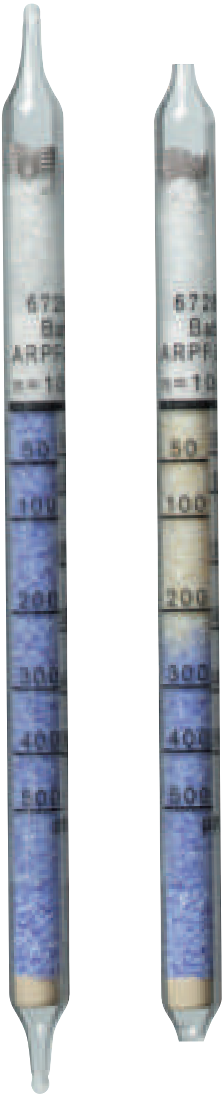
Reaction Principle

HCl + Bromophenol blue —> white reaction product

Cross Sensivity

Hydrogen sulphide and sulphur dioxide do not interfere in the TLV range. It is impossible to measure hydrochloric acid in the presence of other mineral acids.

Chlorine and nitrogen dioxide are indicated, but with different sensitivities.



ST-116-2001

Hydrochloric Acid/Nitric Acid 1/a

Order Code
81 01 681

ST-156-2001

Application Range

Hydrochloric Acid

Standard Measuring Range:	1 to 10 ppm
Number of Strokes n:	10

Nitric Acid

Standard Measuring Range:	1 to 15 ppm
Number of Strokes n:	20
Time for Measurement:	app. 1.5 min or 3 min
Standard Deviation:	± 30 %
Colour Change:	blue —> yellow

Ambient Operating Conditions

Temperature: 5 to 40 °C for HCl

For HNO_3 measurements, the tube scales are appilcable only to 20°C. Where the temperature is different, the measuring result must be multiplied as follows:

Temperature °C	Factor
40	0.3
30	0.4
10	2

For values which are corrected by means of multication factor ± 50%

Absolute Humidity: 3 to 20 mg H_2O / L

Reaction Principle

HCl and/or HNO_3 + pH indicator —> yellow reaction product

Cross Sensivity

50 ppm nitrogen dioxide result in almost the same reading as 2 ppm nitric acid. 10 ppm hydrogen sulphide or 5 ppm nitrogen dioxide do not effect the reading. Chlorine concentrations in excess of 1 ppm change the entire indicating layer to a yellow-green.

Additional Information

Extension of measuring range for hydrochloric acid: depending on the stroke number, multiply the scale value by the following factor.

Measuring range (ppm)	Strokes	Factor
10 to 50	2	5
0.5 to 1	20	0.5

Order Code
CH 25 701

Hydrocyanic Acid 2/a

Application Range

Standard Measuring Range:	2 to 30 ppm
Number of Strokes n:	5
Time for Measurement:	app. 1 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow orange –> red

Ambient Operating Conditions

Temperature:	0 to 30 °C
Absolute Humidity:	max. 20 mg H_2O / L

Reaction Principle

a) $HCN + HgCl_2 \rightarrow HCl$

b) HCl + methyl red –> red reaction product

Cross Sensivity

100 ppm hydrogen sulphide, 300 ppm ammonia, 200 ppm sulphur dioxide, 50 ppm nitrogen dioxide and 1,000 ppm hydrogen chloride do not affect the indication.

Hydrogen sulphide causes the pre-layer to discolour to dark brown, but does not affect the hydrocyanic acid indication.

Ammonia concentrations above 300 ppm can cause the indication at the beginning of the indicating layer to discolour back to yellow.

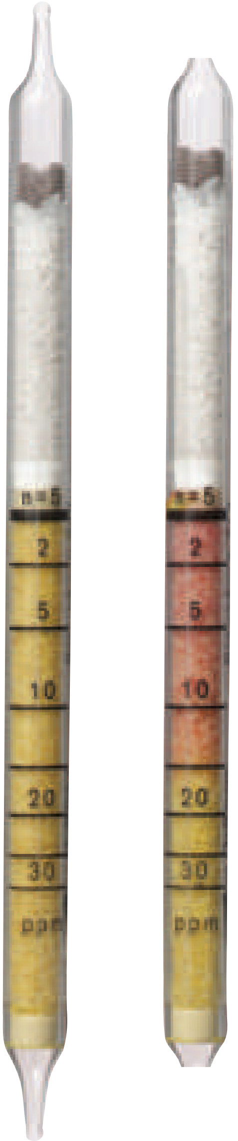
Acylonitrile up to a concentration of 1,000 ppm does not affect the indication.

It is impossible to measure hydrocyanic acid in the presence of phosphine.

Extension of the Measuring Range

Using n = 2 strokes, multiply the reading by 2.5; the measuring range will be 5 to 75 ppm

Using n= 1 stroke, multiply the reading by 5; the measuring range will be 10 to 150 ppm.



ST-25-2001

Hydrogen 0.2%/a

Order Code
81 01 511

ST-169-2001

Application Range

Standard Measuring Range:	0.2 to 2.0 Vol.-%
Number of Strokes n:	1
Time for Measurement:	app. 1 min
Standard Deviation:	± 10 to 15 %
Colour Change:	green yellow –> turquoise blue

Ambient Operating Conditions

Temperature:	20 to 40 °C
Absolute Humidity:	max. 50 mg H_2O / L

Reaction Principle

a) $H_2 + \frac{1}{2} O_2$ –> H_2O

b) H_2O + Indicator –> turquoise blue reaction product

Cross Sensivity

No interference by:	0.1 Vol.-% acetylene
	6 Vol.-% alcohol
	6 Vol.-% ammonia
	0.5 Vol.-% carbon monoxide

Additional Information

The indicating layer is heated up by hydrogen concentrations of more than by 10 Vol.-%. The air sample must not contain additional flammable substances whose ignition temperature is below 250°C – **Danger of explosion!**

Order Code
CH 30 901

Hydrogen 0.5%/a

Application Range

Standard Measuring Range:	0.5 to 3.0 Vol.-%
Number of Strokes n:	5
Time for Measurement:	app. 1 min
Standard Deviation:	± 10 to 15 %
Colour Change:	grey green —> pink

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

a) $H_2 + \frac{1}{2} O_2 \longrightarrow H_2O$

b) $H_2O + SeO_2 + H_2SO_4 \longrightarrow$ pink reaction product

Cross Sensivity

Up to 1,000 ppm CO has no influence on the indication; higher concentrations lead to lower measurement results. Acetylene and alcohols react similarly to hydrogen.

Additional Information

Do not use in potentially explosive areas. Qualify before use with a combustible gas monitor.

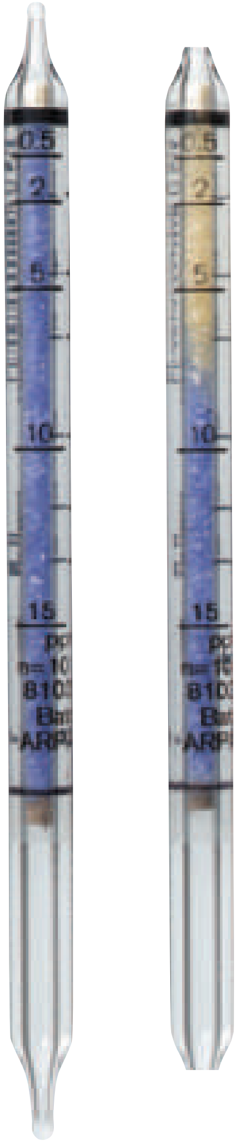
When the hydrogen concentration is above 3 Vol.-% the catalysis layer heats up during the measurement with a reddish glow.

Determination of hydrogen in air with at least 5 Vol.-% O_2.

ST-170-2001

Hydrogen Fluoride 0.5/a

Order Code
81 03 251



ST-62-2001

Application Range

Standard Measuring Range:	0.5 to 15	/ 10 to 90 ppm
Number of Strokes n:	10	/ 2
Time for Measurement:	app. 2 min	/ app. 25 s
Standard Deviation:	± 20 to 30 %	
Colour Change:	blue violet —> yellow	

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	30 to 80 %

Reaction Principle

HF + pH indicator —> yellow reaction product

Cross Sensivity

Other mineral acids, f.e. hydrochloric acid or nitric acid, are indicated. Alkaline gases, e.g. ammonia causes minus results or prevent the indication.

Order Code
CH 30 301

Hydrogen Fluoride 1.5/b

Application Range

Standard Measuring Range:	1.5 to 15 ppm
Number of Strokes n:	20
Time for Measurement:	app. 2 min
Standard Deviation:	± 15 to 20 %
Colour Change:	pale blue —> pale pink

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	max. 9 mg H_2O / L

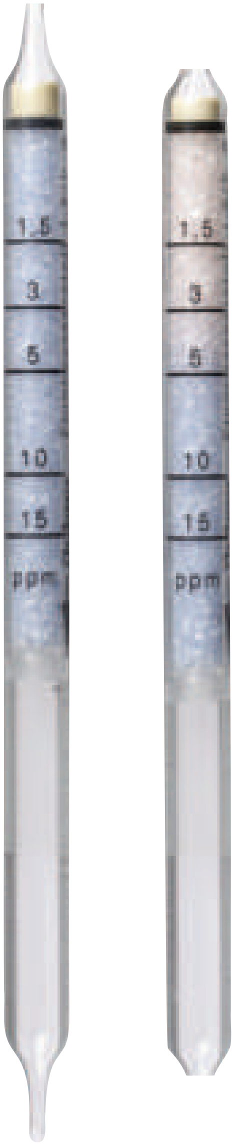
Reaction Principle

$HF + Zr(OH)_4/\text{Quinalizarin} \rightarrow [ZrF_6]^{2-} + \text{Quinalizarin}$

Cross Sensivity

In the presence of higher humidity (> 9 mg H_2O / L), hydrogen fluoride mist is generated, which cannot be quantitatively indicated by the detector tube (i.e. the indication is too low).

Other halogenated hydrocarbons in the TLV range do not interfere.



ST-63-2001

Hydrogen Peroxide 0.1/a

Order Code
81 01 041


ST-171-2001

Application Range

Standard Measuring Range:	0.1 to 3 ppm
Number of Strokes n:	20
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown

Ambient Operating Conditions

Temperature:	10 to 25 °C
Absolute Humidity:	3 to 10 mg H_2O / L

Reaction Principle

$2\ H_2O_2 + 2\ KI \longrightarrow I_2 + 2\ H_2O + O_2$

Cross Sensivity

It is impossible to measure hydrogen peroxide in the presence of chlorine or nitrogen dioxide.

Only hydrogen peroxide vapor is indicated, not the aerosols.

Order Code
81 01 461

Hydrogen Sulphide 0.2/a

Application Range

Standard Measuring Range:	0.2 to 5 ppm
Number of Strokes n:	10
Time for Measurement:	app. 5 min
Standard Deviation:	± 5 to 10 %
Colour Change:	white –> pale brown

Ambient Operating Conditions

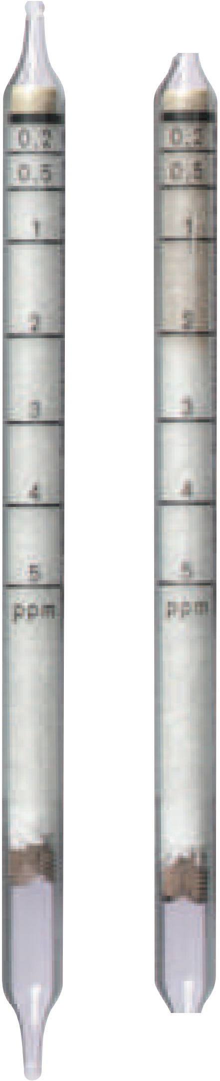
Temperature:	10 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$H_2S + Pb^{2+} \rightarrow PbS + 2 H^+$

Cross Sensivity

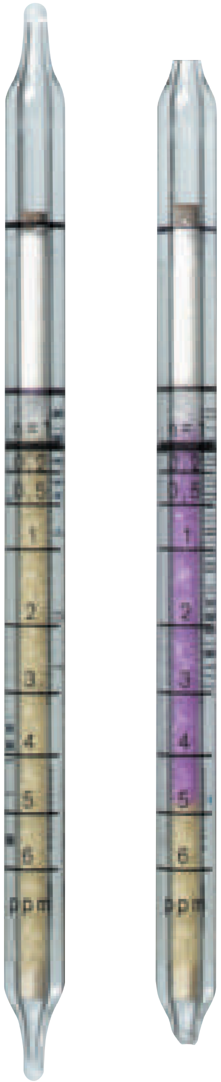
Sulphur dioxide and hydrochloric acid in the TLV range do not interfere.



ST-132-2001

Hydrogen Sulphide 0.2/b

Order Code
81 01 991



ST-127-2001

Application Range

Standard Measuring Range:	0.2 to 6 ppm
Number of Strokes n:	1
Time for Measurement:	app. 55 s
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow –> pink

Ambient Operating Conditions

Temperature:	15 to 40 °C In case of temperature between 0 °C and 10 °C, the reading has to be multiplied by 1.5; standard deviation: ± 30%.
Absolute Humidity:	max. 20 mg H_2O / L

Reaction Principle

$H_2S + HgCl_2 \rightarrow HgS + 2\,HCl$

Cross Sensivity

Up to 1000 ppm, sulphur dioxide has no influence on the reading. Within the range of their TLV, mercaptanes, arsine, phosphine and nitrogen dioxide are also indicated, however, with differing sensitivity. Within its TLV, hydrogen cyanide changes the colour of entire indicating layer to a light orange. The reading of hydrogen sulphide is not affected.

Order Code
67 28 041

Hydrogen Sulphide 0.5/a

Application Range

Standard Measuring Range:	0.5 to 15 ppm
Number of Strokes n:	10
Time for Measurement:	app. 6 min
Standard Deviation:	± 5 to 10 %
Colour Change:	white –> pale brown

Ambient Operating Conditions

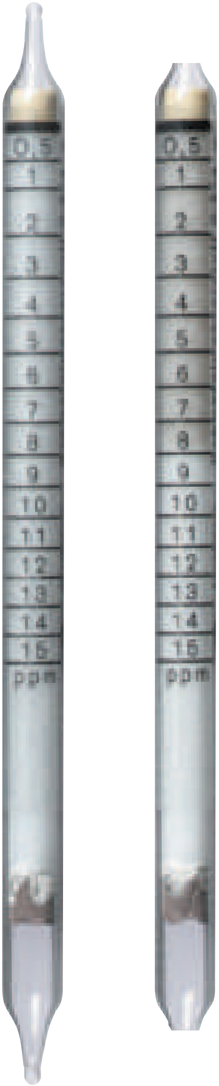
Temperature:	0 to 40 °C
Absolute Humidity:	3 to 30 mg H_2O / L

Reaction Principle

$H_2S + Hg^{2+} \rightarrow HgS + 2\ H^+$

Cross Sensivity

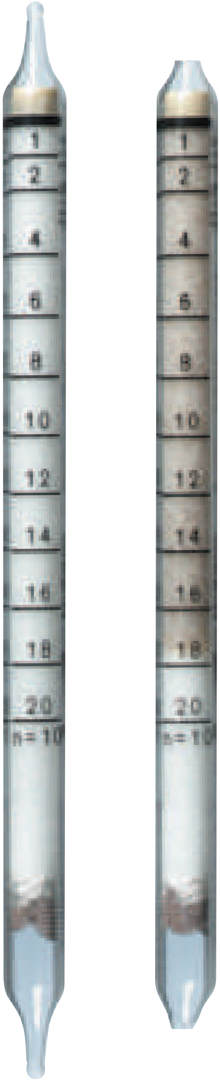
No interference by:	100 ppm sulphur dioxide 100 ppm hydrochloric acid 100 ppm ethyl mercaptan



ST-126-2001

Hydrogen Sulphide 1/c

Order Code
67 19 001



ST-130-2001

Application Range

Standard Measuring Range:	10 to 200	/ 1 to 20 ppm
Number of Strokes n:	1	/ 10
Time for Measurement:	app. 5 min	/ app. 3.5 min
Standard Deviation:	± 5 to 10 %	
Colour Change:	white —> pale brown	

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$H_2S + Pb^{2+} \longrightarrow PbS + 2\ H^+$

Cross Sensivity

Sulphur dioxide in the TLV range does not interfere, however, higher concentrations can cause plus errors of up to 50%. Sulphur dioxide alone does not discoulor the indicating layer.

Order Code
81 01 831

Hydrogen Sulphide 1/d

Application Range

Standard Measuring Range:	10 to 200 / 1 to 20 ppm
Number of Strokes n:	1 / 10
Time for Measurement:	app. 1 min / app. 10 min
Standard Deviation:	± 15 %
Colour Change:	white —> brown

Ambient Operating Conditions

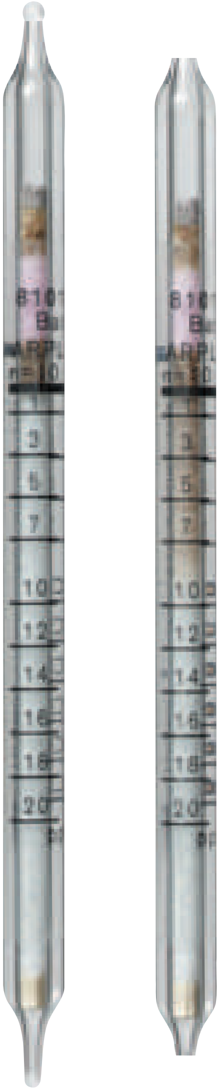
Temperature:	2 to 40 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

$H_2S + Cu_2 \longrightarrow CuS + 2 H^+$

Cross Sensivity

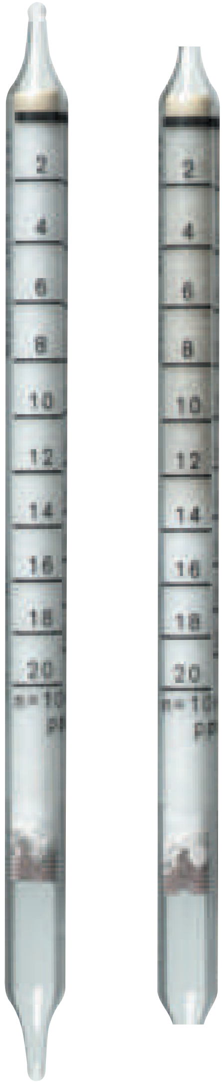
500 ppm hydrochloric acid, 500 ppm sulphur dioxide, 500 ppm ammonia or 100 ppm asine do not interfere with the reading. Methyl mercaptan and ethyl mercaptan change the entire indicating layer to a pale yellow. When mixed with hydrogen sulphide, the reading is extended by app. 30%.



ST-131-2001

Hydrogen Sulphide 2/a

Order Code
67 28 821



ST-133-2001

Application Range

Standard Measuring Range:	20 to 200	/ 2 to 20 ppm
Number of Strokes n:	1	/ 10
Time for Measurement:	app. 30 s	/ app. 3.5 min
Standard Deviation:	± 5 to 10 %	
Colour Change:	white —> pale brown	

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 30 mg H_2O / L

Reaction Principle

$H_2S + Hg^{2+} \longrightarrow HgS + 2\,H^+$

Cross Sensivity

No interference by:	100 ppm sulphur dioxide 100 ppm hydrochloric acid 100 ppm ethyl mercaptan

Order Code
81 01 961

Hydrogen Sulphide 2/b

Application Range

Standard Measuring Range:	2 to 60 ppm
Number of Strokes n:	1
Time for Measurement:	app. 3 s
Standard Deviation:	± 5 to 10 %
Colour Change:	white —> pale brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 20 mg H_2O / L

Reaction Principle

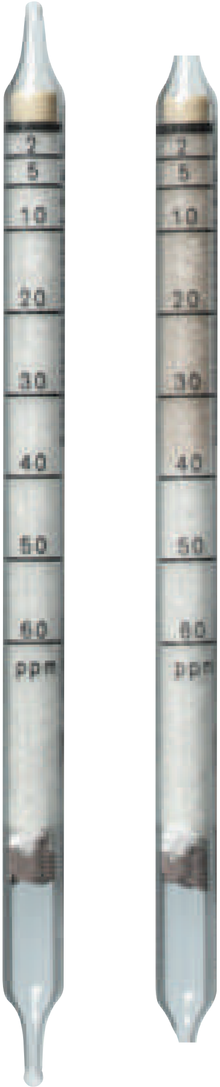
$H_2S + Pb^{2+} \rightarrow PbS + 2\,H^+$

Cross Sensivity

Hydrochloric acid, mercaptan and sulphur dioxide in the TLV range does not interfere.

Extension of the Measuring Range

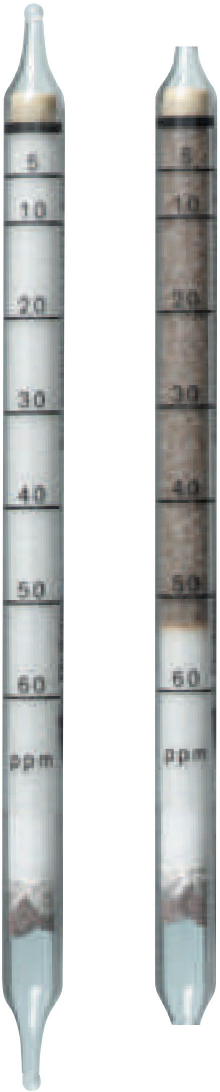
Using n = 2, divide the reading by 2; the measuring range will be 1 to 30 ppm.



ST-128-2001

Hydrogen Sulphide 5/b

Order Code
CH 29 801



ST-125-2001

Application Range

Standard Measuring Range:	5 to 60 ppm
Number of Strokes n:	10
Time for Measurement:	app. 4 min
Standard Deviation:	± 5 to 10 %
Colour Change:	white —> brown

Ambient Operating Conditions

Temperature:	0 to 60 °C
Absolute Humidity:	< 40 mg H_2O / L

Reaction Principle

$H_2S + Pb^{2+} \longrightarrow PbS + 2\,H^+$

Cross Sensivity

Sulphur dioxide can cause plus errors of up to 50%. Sulphur dioxide alone does not discolour the indicating layer.

Extension of the Measuring Range

Using n = 1, multiply the reading by 10; the measuring range will be 50 to 600 ppm.

Order Code
CH 29 101

Hydrogen Sulphide 100/a

Application Range

Standard Measuring Range: 100 to 2,000 ppm

Number of Strokes n: 1

Time for Measurement: app. 30 s

Standard Deviation: ± 5 to 10 %

Colour Change: white —> brown

Ambient Operating Conditions

Temperature: 0 to 40 °C

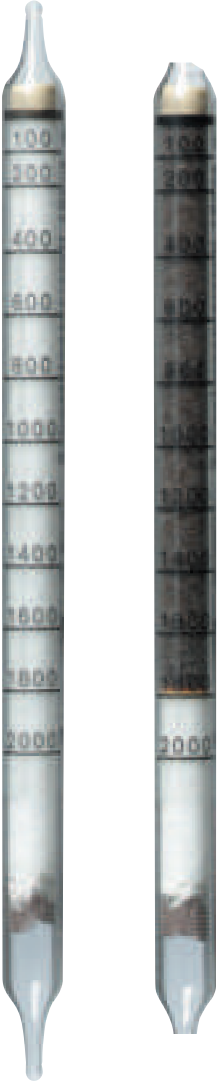
Absolute Humidity: 3 to 40 mg H_2O / L

Reaction Principle

$H_2S + Pb^{2+} \longrightarrow PbS + 2\ H^+$

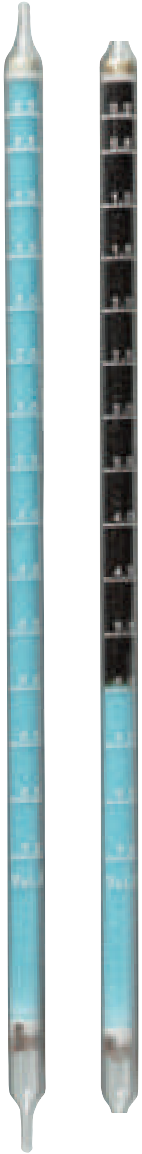
Cross Sensivity

No interference by: 2,000 ppm sulphur dioxide
100 ppm nitrogen dioxide



Hydrogen Sulphide 0.2%/A

Order Code
CH 28 101



ST-194-2001

Application Range

Standard Measuring Range:	0.2 to 7 Vol.-%
Number of Strokes n:	1 + 2 desorption strokes in air
Time for Measurement:	app. 2 min
Standard Deviation:	± 5 to 10 %
Colour Change:	pale blue —> black

Ambient Operating Conditions

Temperature:	0 to 60 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

$H_2S + Cu^{2+}$ —> $CuS + 2 H^+$

Cross Sensivity

In the presence of sulphur dioxide, the indicating layer can change to a yellowish colour, but the hydrogen sulphide measurement is not affected. Comparable concentrations of mercaptan will interfere with the reading.

Order Code
81 01 211

Hydrogen Sulphide 2%/a

Application Range

Standard Measuring Range:	2 to 40 Vol.-%
Number of Strokes n:	1
Time for Measurement:	app. 1 min
Standard Deviation:	± 5 to 10 %
Colour Change:	pale blue –> black

Ambient Operating Conditions

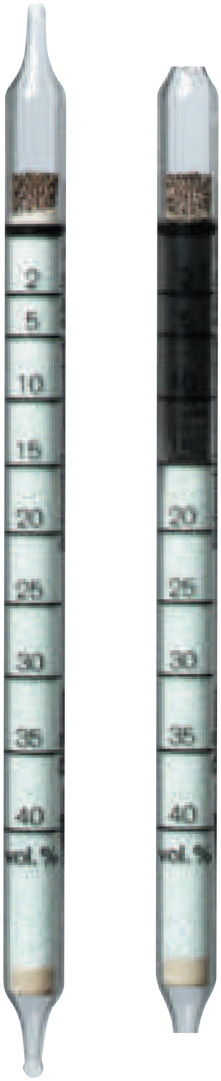
Temperature:	0 to 40 °C
Absolute Humidity:	3 to 20 mg H_2O / L

Reaction Principle

$H_2S + Cu^{2+} \longrightarrow CuS + 2\,H^+$

Cross Sensivity

No interference by:	5,000 ppm sulphur dioxide 1,000 ppm hydrochloric acid 1,000 ppm ethyl mercaptan



ST-134-2001

Hydrogen Sulphide + Sulphur Dioxide 0.2%/A

Order Code CH 28 201

ST-195-2001

Application Range

Standard Measuring Range:	0.2 to 7 Vol.-%
Number of Strokes n:	1 + 2 desorption strokes in air
Time for Measurement:	app. 2 min
Standard Deviation:	± 5 to 10 %
Colour Change:	brown –> pale yellow

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

$H_2S + I_2 \rightarrow 2\,HI + S_x$

$SO_2 + I_2 + H_2O \rightarrow 2\,HI + H_2SO_4$

Cross Sensivity

All substances oxidized by iodine are indicated, but with different sensitivities. It is impossible to measure hydrogen sulphide and sulphur dioxide in the presence of such substances.

Extension of the Measuring Range

Using n = 10, divide the reading by 10; the measuring range will be 0.02 to 0.7 Vol.-%.

Order Code
81 03 281

Mercaptan 0.1/a

Application Range

Standard Measuring Range:	0.1 to 2.5 / 3 to 15 ppm
Number of Strokes n:	10 / 2
Time for Measurement:	app. 3 min / app. 40 s
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> red

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	2 to 40 mg H_2O / L

Reaction Principle

$2\ R\text{-}SH + HgCl_2 \rightarrow Hg(CH_3S)_2 + 2\ HCl$

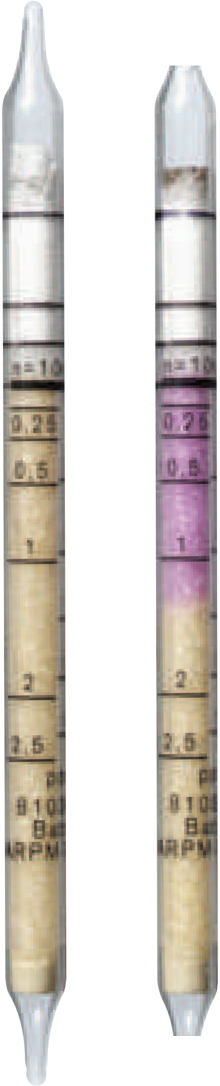
HCl + pH-indicator —> reddish reaction product

Cross Sensivity

Propylmercaptan and tert.-butyl-mercaptan are indicated, but with different sensitivities.

4 ppm ethylene, 30 ppm CO, 10 ppm tetrahydrothiophene do not affect the indication. and 200 ppm hydrogen sulphide do not affect the indication.

Hydrogen sulphide changes the pre-layer to black.



ST-180-2001

Mercaptan 0.5/a

Order Code
67 28 981

ST-58-2001

Application Range

Standard Measuring Range:	0.5 to 5 ppm
Number of Strokes n:	20
Time for Measurement:	app. 300 s
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> yellow

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$2\ R\text{-}SH + Pd^{2+} \longrightarrow Pd(RS)_2 + 2\ H^+$

Cross Sensivity

Higher molecular weight alkyl mercaptans (e.g. propyl- and butyl-mercaptans) are indicated with approximately the same sensitivity.
1,000 ppm ethylene, 2,000 ppm carbon monoxide and 200 ppm hydrogen sulphide do not affect the indication.
Hydrogen sulphide discolours the pre-layer black.
Dimethyl sulphide: 10 ppm H_2S no influence, but the colour of the mercaptan indication is paler.
Dimethyl disulphide: 2 ppm no influence.

Order Code
81 01 871

Mercaptan 20/a

Application Range

Standard Measuring Range:	20 to 100 ppm
Number of Strokes n:	10
Time for Measurement:	app. 2.5 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> yellow brown

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	3 to 30 mg H_2O / L

Reaction Principle

a) $2\ R\text{-}SH + Cu^{2+} \rightarrow Cu(RS)_2 + 2\ H^+$

b) $Cu(RS)_2 + S \rightarrow$ yellow brown copper compound

Cross Sensivity

Higher molecular weight alkyl mercaptans (e.g. propyl- and butyl-mercaptans) are indicated with approximately the same sensitivity. Hydrogen sulphide is indicated with approximately twice the sensitivity of the mercaptans (e.g. 10 ppm hydrogen sulphide gives an indication of 20 ppm).

Additional Information

After performing the required ten pump strokes the reagent ampoule must be broken. The liquid of the ampoule must be transferred to the indicating layer and carefully drawn through it using the pump.
After completing measurement wait for 3 min prior to evaluation.

ST-57-2001

Mercury Vapour 0.1/b

Order Code CH 23 101

Application Range

Standard Measuring Range:	0.05 to 2 mg/m^3
Number of Strokes n:	40 to 1
Time for Measurement:	max. 10 min
Standard Deviation:	± 30 %
Colour Change:	pale yellow grey —> pale orange

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

Hg + CuI —> Cu-Hg-complex

Cross Sensivity

Free halogens cause substantial minus errors. It is impossible to measure mercury vapor in the presence of halogens.

Arsine, phosphine, hydrogen sulphide, ammonia, nitrogen dioxide, sulphur dioxide and hydrazine in the TLV range do not interfere.

Order Code
67 28 161

Methyl Acrylate 5/a

Application Range

Standard Measuring Range:	5 to 200 ppm
Number of Strokes n:	20
Time for Measurement:	app. 5 min
Standard Deviation:	± 30 to 40 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	15 to 35 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

$CH_2{=}CH\text{-}COOCH_3$ + Pd-Molybdate complex —> blue reaction product

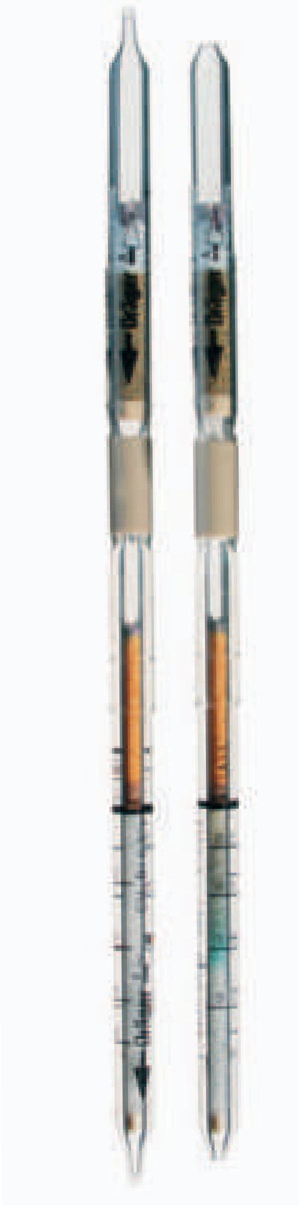
Cross Sensivity

Other compounds with C=C double bonds are indicated, but with different sensitivities. It is impossible to differentiate between them.
It is not possible to measure methyl acrylate in the presence of hydrogen sulphide. Hydrogen sulphide will discolour the indicating layer black.
Carbon monoxide in high concentrations discolours the indication layer a pale blue grey.

ST-60-2001

Methyl Bromide

Order-No.
81 03 391



ST-5753-2004

Application Range

Standard Measuring Range:	0.2 – 2 ppm / 2 – 8 ppm
Number of Strokes n:	5 / 2
Time for Measurement:	app. 8 min. / app. 4 min.
Standard Deviation:	± 15 to 20 %
Colour Change:	light color -> green

Ambient Operating Conditions

Temperature:	2 to 40 °C
Absolute Humidity:	< 20 mg/L

Reaction Principle

$CH_3\ Br + H_2S_2O_7 + \text{chromate} \rightarrow Br_2$

Cross Sensivity

Vinyl chloride or carbon tetrachloride: < 2 ppm no indication Methyl bromide cannot be measured in the presence of perchloroethylene or trichloroethylene.

Sulphuryl fluoride, phosphane, ethylene oxide, ammonia, hydrocyanic acid, chloropicrin and formaldehyde below their MAK/TLV values are not indicated.

Ethylene dibromide is indicated with 1.2 times its sensitivity.

Order Code
81 01 671

Methyl Bromide 0.5/a

Application Range

Standard Measuring Range:	5 to 30	/ 0.5 to 5 ppm
Number of Strokes n:	2	/ 5
Time for Measurement:	app. 2 min	/ app. 5 min
Standard Deviation:	± 15 to 20 %	
Colour Change:	white —> blue green	

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 20 mg H_2O / L

Reaction Principle

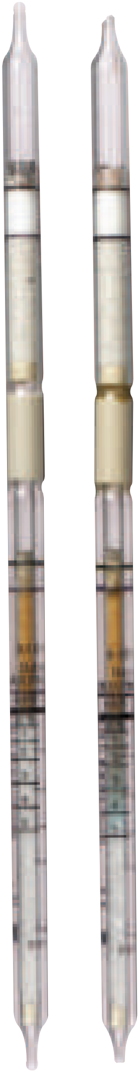
a) $CH_3Br + H_2S_2O_7 \longrightarrow HBr$

b_1) $HBr + Cr^{VI} \longrightarrow Br_2$

b) Br_2 + o-tolidine —> blue reaction product

Cross Sensivity

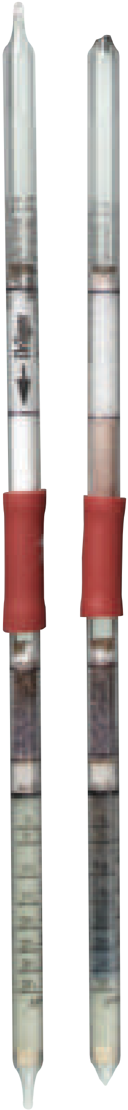
Vinyl chloride:	2 ppm no reading.
Carbon tetrachloride:	2 ppm no reading
Perchloroethylene and Trichloroethylene:	5 ppm changes the indicating layer to a light yellow.
1.2-dichloroethylene:	20 ppm result in a reading of app. 3 ppm.
1.1-dichloroethylene:	up to 2 ppm the sensitivity is the same as with methyl bromide.



ST-201-2001

Methyl Bromide 3/a

Order Code
67 28 211



ST-202-2001

Application Range

Standard Measuring Range:	10 to 100 / 3 to 35 ppm
Number of Strokes n:	5 activation strokes before testing.
	2 / 5
Time for Measurement:	app. 1 min / app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	pale grey —> green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

a) $CH_3Br + H_2S_2O_7$ —> gaseous cleavage product

b_1) gaseous cleavage product + $KMnO_4$ —> Br_2

b_2) Br_2 + Diphenylbenzidine —> blue grey reaction product

Cross Sensivity

Other chlorinated hydrocarbons are indicated, but with different sensitivities.

Order Code
CH 27 301

Methyl Bromide 5/b

Application Range

Standard Measuring Range:	5 to 50 ppm
Number of Strokes n:	5
Time for Measurement:	app. 45 s
Standard Deviation:	± 20 to 30 %
Colour Change:	green —> brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

a) $CH_3Br + SO_3 + MnO_4^- \longrightarrow Br_2$

b) Br_2 + o-Dianisidine —> brown reaction product

Cross Sensivity

Several other halogenated hydrocarbons and free halogens are indicated, but not all of them.

The sensitivity to the other halogenated hydrocarbons varies, in some cases higher and in others lower. Examples:

5 ppm Hydrogen chloride gives an indication of 1 - 2 mm in length.

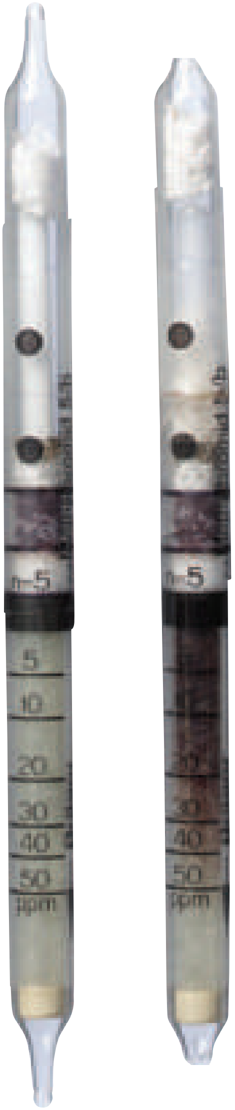
50 ppm Hydrogen chloride and hydrogen bromide give an indication of 20 - 30 ppm.

1,2-Dibromoethane is indicated with about the same sensitivity.

100 ppm 1,1,1-Trichloroethane gives an indication of 5 - 10 ppm.

Additional Information

Before carrying out the measurement the reagent ampoule must be broken. The granular contents must be shaken out of the broken ampoule by gently tapping the side of the tube. The tube must be held vertically with the inlet of the tube up during the measurement.



ST-72-2001

Methylene Chloride 100/a

Order Code
67 24 601

ST-76-2001

Application Range

Standard Measuring Range:	100 to 2,000 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown green

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

a) $CH_2Cl_2 + Cr^{VI} \longrightarrow$ gaseous cleavage product

b) gaseous cleavage product + $I_2O_5 \longrightarrow I_2$

Cross Sensivity

Other halogenated hydrocarbons are indicated, but with different sensitivities.

Carbon monoxide and petroleum hydrocarbons are indicated.

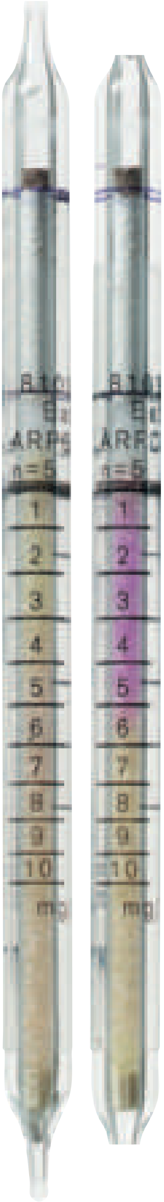
It is impossible to measure methylene chloride in the presence of carbon monoxide and petroleum hydrocarbons.

Extension of the Measuring Range

Using 20 strokes divide the reading by 2, the measuring range will be 50 to 1,000 ppm methylene chloride.

Order Code
81 03 071

Natural Gas Odorization Tertiary Butylmercaptan



Application Range

Standard Measuring Range:	3 to 15 mg/m³	/ 1 to 10 mg/m³
Number of Strokes n:	2	/ 5
Time for Measurement:	3 min	/ 5 min
Standard Deviation:	± 15 to 20 %	
Colour Change:	yellow —> pink	

Ambient Operating Conditions

Temperature:	20 to 35 °C for temperature below 20 °C see additional information
Absolute Humidity:	< 15 mg H_2O / L

Reaction Principle

TBM + $HgCl_2O_7$ —> HgS + 2 HCl

HCl + pH-indicator —> pink reaction product

Cross Sensivity

Hydrogen sulphide, sulphur dioxide, mercaptans, arsine, nitrogen dioxide and phosphine are indicated as well, but with different sensitivity.

Additional Information

For applications in an environment with temperatures below 20 °C use temperature correction. To do so refer to the instructions for use.

T [°C]	0	5	10	15
C	1.5	1.4	1.3	1.2

Natural Gas Test

Order Code CH 20 001

ST-187-2001

Application Range

Standard Measuring Range:	Qualitative determination of natural gas; 0.5 vol.% methane, 0.05 vol.% ethane or propane discolours the indicating layer.
Number of Strokes n:	2
Time for Measurement:	app. 40 s
Colour Change:	white –> brown green to grey violet

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

a) $CH_4 + KMnO_4 + H_2S_2O_7 \rightarrow CO$

b) $CO + I_2O_5 \rightarrow I_2 + CO_2$

Cross Sensivity

Due to the reaction principle a number of other organic compounds such as propane, butane are indicated as well.

Carbon monoxide is also indicated.

It is not possible to differentiate between different compounds.

Order Code
CH 19 501

Nickel Tetracarbonyl 0.1/a

Application Range

Standard Measuring Range:	0.1 to 1 ppm Discoloration compared to colour standard.
Number of Strokes n:	20
Time for Measurement:	app. 5 min
Standard Deviation:	± 50 %
Colour Change:	yellow —> pink

Ambient Operating Conditions

Temperature:	0 to 30 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

a) $Ni(CO)_4 + I_2 \longrightarrow NiI_2 + 4\ CO$

b) NiI_2 + Dimethylglyoxime —> pink coloured complex

Cross Sensivity

Iron pentacarbonyl is indicated with a brown discoloration and with a lower sensitivity than nickel tetracarbonyl.

Hydrogen sulphide and sulphur dioxide react with the iodine preparation and can suppress the nickel tetracarbonyl indication. The Instructions for Use of this tube describe how the interference can be quickly recognized.

Additional Information

After performing the required 20 pump strokes the reagent ampoule must be broken and the liquid carefully drawn onto the indication layer using the pump.

ST-74-2001

Nitric Acid 1/a

Order Code
67 28 311

ST-117-2001

Application Range

Standard Measuring Range:	5 to 50	/ 1 to 15 ppm
Number of Strokes n:	10	/ 20
Time for Measurement:	app. 2 min	/ app. 4 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	blue —> yellow	

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

HNO_3 + Bromophenol blue —> yellow reaction product

Cross Sensivity

Hydrogen sulphide and nitrogen dioxide in the TLV range do not interfere, however, 50 ppm nitrogen dioxide gives an indication similar to 3 ppm nitric acid.

It is impossible to measure nitric acid in the presence of other mineral acids.

Chlorine discolours the indication layer grey, and this makes it difficult to evaluate the nitric acid indication. If chlorine is present in the TLV range, this leads to slightly higher nitric acid indications.

Order Code
CH 30 001

Nitrogen Dioxide 0.5/c

Application Range

Standard Measuring Range:	5 to 25	/ 0.5 to 10 ppm
Number of Strokes n:	2	/ 5
Time for Measurement:	app. 15 s	/ app. 40 s
Standard Deviation:	± 10 to 15 %	
Colour Change:	pale grey —> grey green	

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 30 mg H_2O / L

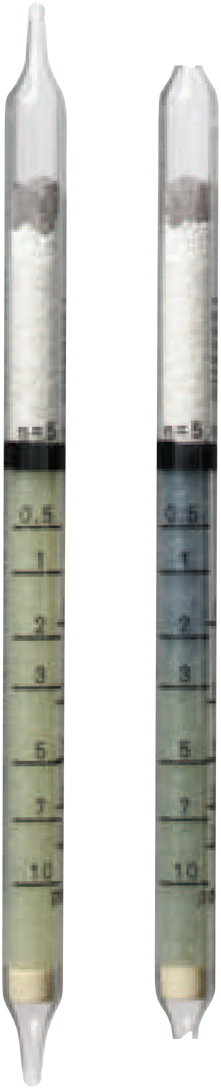
Reaction Principle

NO_2 + Diphenylbenzidine —> blue grey reaction product

Cross Sensivity

Chlorine and ozone is also indicated, but with different sensitivity.

Nitric oxide is not indicated.



ST-139-2001

Nitrogen Dioxide 2/c

Order Code
67 19 101

Application Range

Standard Measuring Range:	5 to 100	/ 2 to 50 ppm
Number of Strokes n:	5	/ 10
Time for Measurement:	app. 1 min	/ app. 2 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	yellow —> blue grey green	

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

NO_2 + Diphenylbenzidine —> blue grey reaction product

Cross Sensivity

Within theirTLV, ozone or chlorine do not interfere with the reading. Higher concentrations are indicated, however with differing sensitivity period Nitrogen monoxide is not indicated.

Order Code
CH 29 401

Nitrous Fumes 0.5/a

Application Range

Standard Measuring Range:	0.5 to 10 ppm
Number of Strokes n:	5
Time for Measurement:	app. 40 s
Standard Deviation:	± 10 to 15 %
Colour Change:	pale green —> blue grey

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 40 mg H_2O / L

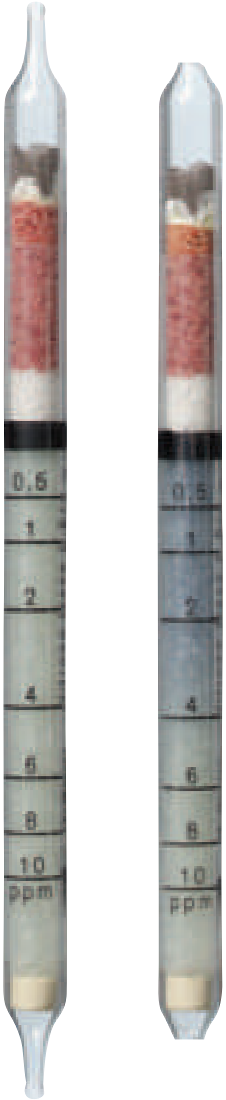
Reaction Principle

a) $NO + Cr^{VI} \longrightarrow NO_2$

b) NO_2 + diphenylbenzidine —> blue grey reaction product

Cross Sensivity

In case of nitrogen dioxide in concentrations above 300 ppm the indication layer can bleach. Chlorine and ozone are indicated as well, but with different sensitivity.



ST-78-2001

Nitrous Fumes 2/a

Order Code
CH 31 001


ST-79-2001

Application Range

Standard Measuring Range:	5 to 100	/ 2 to 50 ppm
Number of Strokes n:	5	/ 10
Time for Measurement:	app. 1 min	/ app. 2 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	yellow —> blue grey	

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	max. 30 mg H_2O / L

Reaction Principle

a) $NO + Cr^{VI} \longrightarrow NO_2$

b) NO_2 + Diphenylbenzidine —> blue grey reaction product

Cross Sensivity

There is no influence of chlorine and ozone, if these gases are in range of their TLVs. Higher concentrations are indicated with different sensitivity.

Order Code
67 24 001

Nitrous Fumes 20/a

Application Range

Standard Measuring Range:	20 to 500 ppm
Number of Strokes n:	2
Time for Measurement:	app. 30 s
Standard Deviation:	± 10 to 15 %
Colour Change:	pale grey —> red brown

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

a) $NO + Cr^{VI} \longrightarrow NO_2$

b) NO_2 + o-Dianisidine —> red brown reaction product

Cross Sensivity

There is no influence of chlorine and ozone, if these gases are in range of their TLVs. Higher concentrations are indicated with different sensitivity.

ST-80-2001

Nitrous Fumes 50/a

Order Code
81 01 921

ST-909-2001

Application Range

Standard Measuring Range:	50 to 1,000	/ 200 to 2,000 ppm
Number of Strokes n:	2	/ 1
Time for Measurement:	80 s	/ 40 s
Standard Deviation:	± 10 to 15 %	
Colour Change:	white —> yellowish green	

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	max. 30 mg H_2O / L

Reaction Principle

a) $NO + Cr^{VI} \longrightarrow NO_2$

b) NO_2 + aromatic amine —> yellowish green reaction product

Cross Sensivity

There is no influence of chlorine and ozone, if these gases are in range of their TLVs. Higher concentrations are indicated with different sensitivity.

Order Code
CH 27 701

Nitrous Fumes 100/c

Application Range

Standard Measuring Range:	100 to 1,000 / 500 to 5,000 ppm
Number of Strokes n:	5 / 1 + 4 desorption strokes in clean air.
Time for Measurement:	app. 1.5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	grey —> red brown

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	max. 30 mg H_2O / L

Reaction Principle

a) $NO + Cr^{VI} \longrightarrow NO_2$

b) NO_2 + o-Dianisidine —> red brown reaction product

Cross Sensivity

There is no influence of chlorine and ozone, if these gases are in range of their TLVs. Higher concentrations are indicated with different sensitivity.

ST-81-2001

Oil Mist 1/a

Order Code
67 33 031

ST-97-2001

Application Range

Standard Measuring Range:	1 to 10 mg/m^3 Discoloration compared to colour standard.
Number of Strokes n:	100
Time for Measurement:	app. 25 min
Standard Deviation:	± 30 %
Colour Change:	white —> brown

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

Oil mist + H_2SO_4 —> brown reaction product

Cross Sensivity

The tube indicates only mineral and synthetic oil aerosols (mist). Oil vapors and vapors of other higher molecular weight organic compounds are not indicated.

Additional Information

After performing the required 100 pump strokes the reagent ampoule must be broken and the liquid carefully drawn onto the indication layer using the pump.

Order Code
CH 31 201

Olefine 0.05%/a

Application Range

Standard Measuring Range:	0.06 to 3.2 Vol.-% Propylene 0.04 to 2.4 Vol.-% Butylene
Number of Strokes n:	20 to 1
Time for Measurement:	max. 5 min
Standard Deviation:	± 30 %
Colour Change:	violet —> pale brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$CH_3\text{-}CH_2\text{-}CH{=}CH_2 + MnO_4^-$ —> MnIV + various oxidation products

Cross Sensivity

Many organic compounds with C=C double bonds are indicated, but with different sensitivities. It is impossible to differentiate them.

It is impossible to measure olefines in the presence of dialkyl sulphides.

ST-84-2001

Organic Arsenic Compounds and Arsine

Order Code
CH 26 303

ST-17-2001

Application Range

Standard Measuring Range: Qualitative
0.1 ppm Arsine and 3 mg org. arsenic/m^3 are the minimum detectable concentrations.
Number of Strokes n: 8 to 16
Time for Measurement: max. 3 min
Standard Deviation: ± 50 %
Colour Change: yellow —> grey

Ambient Operating Conditions

Temperature: 0 to 40 °C
Absolute Humidity: < 50 mg H_2O / L

Reaction Principle

a) $AsR_3 + Zn/HCl \longrightarrow AsH_3$
b) $AsH_3 + Au/Hg\text{-complex} \longrightarrow Au$ (colloidal)

Cross Sensivity

Phosphine and arsine are indicated before the ampoule is broken, but with different sensitivities.

Additional Information

Arsine is present if a grey ring appears in the indicating layer after performing 8 pump strokes. If there is no indication, the ampoule must be broken and the liquid transferred onto the indicating layer such that it is completely saturated. Then an additional eight pump strokes must be performed.

Order Code
CH 25 903

Organic Basic Nitrogen Compounds

Application Range

Standard Measuring Range:	1 mg/m^3 corresponds to a discoloration of 1 to 2 mm in length.
Number of Strokes n:	8
Time for Measurement:	app. 1.5 min
Standard Deviation:	± 50 %
Colour Change:	yellow –> orange red

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 50 mg H_2O / L

Reaction Principle

$NR_3 + KBiI_4$ –> orange red reaction product

Cross Sensivity

Various organic basic nitrogen compounds are indicated. It is impossible to differentiate between them.

ST-77-2001

Oxygen 5%/B

Order Code
67 28 081

ST-191-2001

Application Range

Standard Measuring Range:	5 to 23 Vol.-%
Number of Strokes n:	1
Time for Measurement:	app. 1 min
Standard Deviation:	± 5 to 10 %
Colour Change:	blue black —> white grey

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

a) $O_2 + TiCl_3 \longrightarrow Ti^{IV}$-compound

b) The connecting tube contains silica gel to trap hydrochloric acid generated during the reaction.

Cross Sensivity

Carbon dioxide, carbon monoxide, solvent vapors, halogenated hydrocarbons and nitrous oxide do not affect the indication.

Additional Information

These tubes become very warm during the measurement, reaching temperatures of approximately 100 °C. Therefore these tubes should not be used in potentially combustible atmospheres. If in doubt, test the area before using the tube with a combustible gas monitor.

Order Code
81 03 261

Oxygen 5%/C

Application Range

Standard Measuring Range:	5 to 23 Vol.-%
Number of Strokes n:	1
Time for Measurement:	app. 1 min
Standard Deviation:	± 10 to 15 %
Colour Change:	blue black –> white grey

ST-236-2001

Ambient Operating Conditions

Temperature:	5 to 50 °C
Absolute Humidity:	0 to 40 mg H_2O / L

Reaction Principle

a) $O_2 + TiCl_3 \rightarrow Ti^{IV}$-compound

b) Adsorbtion of the hydrochloric acid, generated during reaction, by a silica gel filter layer.

Cross Sensivity

Carbon dioxide, carbon monoxide, solvent vapors, halogenated hydrocarbons and nitrous oxide do not affect the indication.

Additional Information

These tubes become very warm during the measurement, reaching temperatures of approximately 100 °C. Therefore these tubes should not be used in potentially combustible atmospheres. If in doubt, test the area before using the tube with a combustible gas monitor.

Ozone 0.05/b

Order Code
67 33 181

ST-118-2001

Application Range

Standard Measuring Range:	0.05 to 0.7 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	pale blue —> white

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	2 to 30 mg H_2O / L

Reaction Principle

O_3 + Indigo —> Isatine

Cross Sensivity

No interference by:

- 1 ppm sulphur dioxide
- 1 ppm chlorine
- 1 ppm nitrogen dioxide

Higher concentrations of chlorine and nitrogen dioxide discolour the indicating layer white to pale grey.

Extension of the Measuring Range

Using n = 5, multiply the reading by 2; the measuring range will be 0.1 to 1.4 ppm.

Using n = 100, divide the reading by 10; the range of measurement is 0.005 to 0.07 ppm.

Order Code
CH 21 001

Ozone 10/a

Application Range

Standard Measuring Range:	20 to 300 ppm
Number of Strokes n:	1
Time for Measurement:	app. 20 s
Standard Deviation:	± 10 to 15 %
Colour Change:	greenish blue —> yellow

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	2 to 30 mg H_2O / L

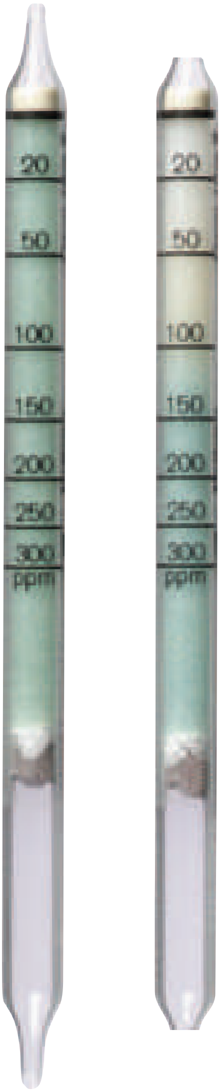
Reaction Principle

O_3 + Indigo —> Isatine

Cross Sensivity

No interference by:	1 ppm sulphur dioxide 1 ppm chlorine 1 ppm nitrogen dioxide.

Higher concentrations of chlorine and nitrogen dioxide discolour the indicating layer a diffuse yellowish grey.



Pentane 100/a

Order Code
67 24 701

ST-88-2001

Application Range

Standard Measuring Range:	100 to 1,500 ppm
Number of Strokes n:	5
Time for Measurement:	app. 3 min
Standard Deviation:	± 15 to 20 %
Colour Change:	orange —> green brown

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$C_5H_{12} + Cr^{VI} \longrightarrow Cr^{III}$ + various oxidation products

Cross Sensivity

Alcohols, esters, aromatics, petroleum hydrocarbons and ethers are indicated, but with different sensitivities. It is impossible to differentiate them.

Order Code
81 01 551

Perchloroethylene 0.1/a

Application Range

Standard Measuring Range:	0.5 to 4 ppm / 0.1 to 1 ppm
Number of Strokes n:	3 / 9
Time for Measurement:	app. 3 min / app. 9 min
Standard Deviation:	± 20 to 25 %
Colour Change:	light grey —> blue

Ambient Operating Conditions

Temperature:	15 to30 °C
Absolute Humidity:	max. 30 mg H_2O / L

Reaction Principle

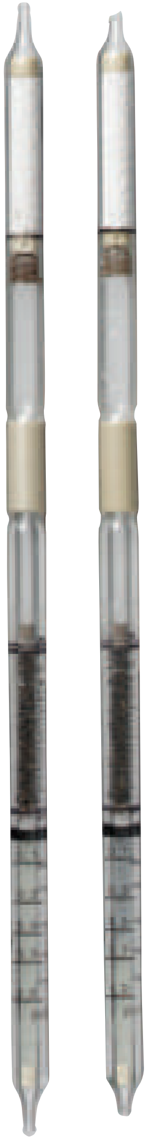
a) $CCl_2{=}CCl_2 + MnO_4^-$ —> Cl_2

b) Cl_2 + Diphenylbenzidine —> blue reaction product

Cross Sensivity

Halogenated hydrocarbons and free halogens are indicated. Petroleum vapours reduce the perchloroethylene indication if they exceed the following concentrations:

40 ppm at n=9
160 ppm at n=3



ST-193-2001

Perchloroethylene 2/a

Order Code
81 01 501

ST-90-2001

Application Range

Standard Measuring Range:	20 to 300 ppm / 2 to 40 ppm
Number of Strokes n:	1 / 5
Time for Measurement:	app. 30 s / app. 3 min
Standard Deviation:	± 15 to 20 %
Colour Change:	slightly greenish –> grey blue

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	< 25 mg H_2O / L

Reaction Principle

a) $CCl_2=CCl_2 + MnO_4^- \longrightarrow Cl_2$

b) Cl_2 + Diphenylbenzidine –> grey blue reaction product

Cross Sensivity

Halogenated hydrocarbons and free halogens are indicated. Petroleum vapours reduce the perchloroethylene indication if they exceed the following concentrations:

50 ppm at n=5
500 ppm at n=1

Order Code
CH 30 701

Perchloroethylene 10/b

Application Range

Standard Measuring Range:	10 to 500 ppm
Number of Strokes n:	3
Time for Measurement:	app. 40 s
Standard Deviation:	± 15 to 20 %
Colour Change:	grey —> orange

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

a) $CCl_2{=}CCl_2 + MnO_4^- \longrightarrow Cl_2$

b) Cl_2 + o-Tolidine —> orange reaction product

Cross Sensivity

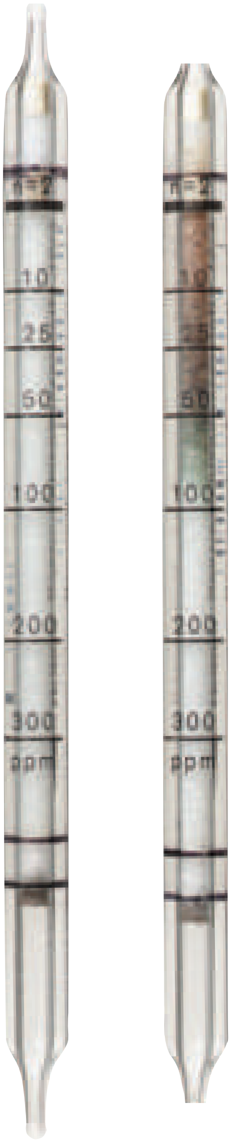
Halogenated hydrocarbons and free halogens are indicated.

Petroleum vapours reduce the perchloroethylene indication.

ST-89-2001

Petroleum Hydrocarbons 10/a

Order Code
81 01 691



ST-19-2001

Application Range

Standard Measuring Range:	10 to 300 ppm for n-Octane.
Number of Strokes n:	2
Time for Measurement:	app. 1 min
Standard Deviation:	± 25 %
Colour Change:	white —> brownish green

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	1 to 20 mg H_2O / L

Reaction Principle

$C_8H_{18} + I_2O_5 \longrightarrow I_2$

Cross Sensivity

In addition to n-octane other organic or inorganic compounds are indicated as well.

50 ppm n-hexane indicates a discoloration of approx. 70 ppm
100 ppm n-heptane indicates a discoloration of approx. 150 ppm
10 ppm iso-octane indicates a discoloration of approx. 15 ppm
100 ppm iso-octane indicates a discoloration of approx. 150 ppm
200 ppm iso-octane indicates a discoloration of approx. 350 ppm
50 ppm n-nonane indicates a discoloration of approx. 50 ppm
50 pppm perchloroethylene 50 indicates a discoloration of approx. 50 ppm
30 ppm CO indicates a discoloration of approx. 20 ppm

Order Code
67 30 201

Petroleum Hydrocarbons 100/a

Application Range

Standard Measuring Range:	100 to 2,500 ppm for n-Octane.
Number of Strokes n:	2
Time for Measurement:	app. 30 s
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$C_8H_{18} + I_2O_5 \longrightarrow I_2$

Cross Sensivity

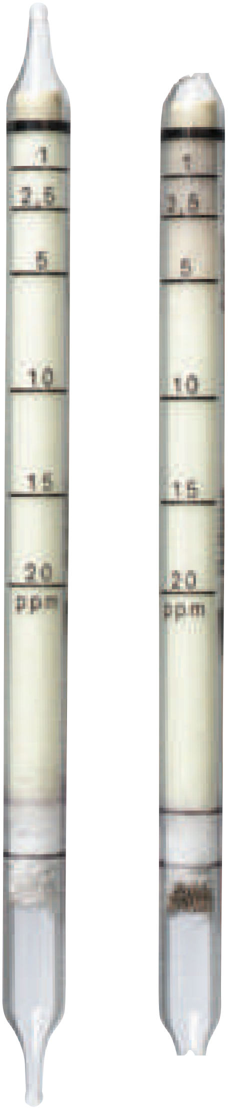
Many other petroleum hydrocarbons are indicated as well, but with different sensitivities. It is impossible to differentiate them. Aromatics are indicated, but only with low sensitivities.

Carbon monoxide is indicated in comparable concentrations with about half the sensitivity.

ST-20-2001

Phenol 1/b

Order Code
81 01 641



ST-95-2001

Application Range

Standard Measuring Range:	1 to 20 ppm
Number of Strokes n:	20
Time for Measurement:	app. 5 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> brown grey

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	1 to 18 mg H_2O / L

Reaction Principle

$C_6H_5OH + Ce(SO_4)_2 + H_2SO_4$ —> brown grey reaction product

Cross Sensivity

Cresols are alse indicated, but with different sensitivities. To determine m-cresol multiply the indication by 0.8.

Benzene, toluene and other aromatics without the hydroxyl group are not indicated.

Aliphatic hydrocarbons and alcohols are not indicated.

Additional Information

At a temperature of 0 °C the resulting indication must be multiplied by 1.3, at a temperature of 40 °C it must be multiplied by 0.8.

Order Code
81 01 521

Phosgene 0.02/a

Application Range

Standard Measuring Range:	0.02 to 1 ppm / 0.02 to 0.5 ppm
Number of Strokes n:	20 / 40
Time for Measurement:	app. 6 min / app. 12 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> red

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

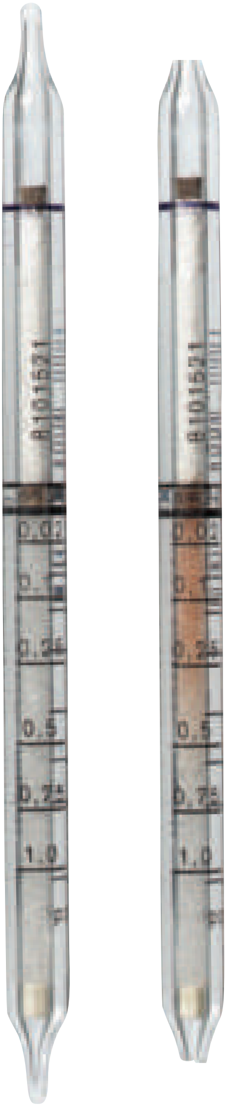
$COCl_2$ + Aromatic amine —> red reaction product

Cross Sensivity

Chlorine and hydrochloric acid lead to plus errors and, at higher concentrations, to bleaching of the indicating layer.
Concentrations of phosgene above 30 ppm will also lead to bleaching of the indicating layer.

Additional Information

High concentrations of phosgene will be not indicated!



ST-98-2001

Phosgene 0.05/a

Order Code CH 19 401

ST-99-2001

Application Range

Standard Measuring Range:	0.04 to 1.5 ppm
Number of Strokes n:	33 to 1
Time for Measurement:	max. 11 min
Standard Deviation:	± 20 to 30 %
Colour Change:	yellow —> green

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

$COCl_2$ + Ethylaniline +

Dimethylaminobenzaldehyde —> blue green reaction product

Cross Sensivity

Carbonyl bromide and acetyl chloride are indicated.

Order Code
CH 28 301

Phosgene 0.25/c

Application Range

Standard Measuring Range:	0.25 to 5 ppm
Number of Strokes n:	5
Time for Measurement:	app. 1 min
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow —> blue green

Ambient Operating Conditions

Temperature:	5 to 35 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$COCl_2$ + Ethylaniline +
Dimethylaminobenzaldehyde —> blue green reaction product

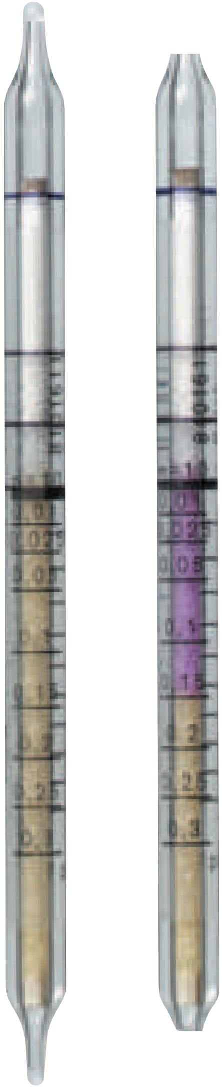
Cross Sensivity

No interference by up to 100 ppm hydrochloric acid.
Carbonyl bromide and acetyl chloride are indicated, but with different sensitivities. It is impossible to measure phosgene in the presence of carbonyl bromide or acetyl chloride.

ST-96-2001

Phosphine 0.01/a

Order Code
81 01 611



ST-110-2001

Application Range

Standard Measuring Range:	0.1 to 1.0 ppm	/ 0.01 to 0.3 ppm
Number of Strokes n:	3	/ 10
Time for Measurement:	app. 2.5 min	/ app. 8 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	yellow –> red	

Ambient Operating Conditions

Temperature:	2 to 40 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

$PH_3 + HgCl_2 \rightarrow HCl + \text{Hg-Phosphide}$

$HCl + \text{pH Indicator} \rightarrow \text{red reaction product}$

Cross Sensivity

Arsine is indicated with different sensitivity.

Up to 6 ppm sulphur dioxide or 15 ppm hydrochloric acid does not interfere, but higher concentrations cause plus errors.

More than 100 ppm ammonia leads to minus errors.

300 ppm Hydrocyanic acid does not affect the 3 stroke test, but with the 10 stroke test minus errors up to 50% can occur.

Order Code
CH 31 101

Phosphine 0.1/a

Application Range

Standard Measuring Range:	0.1 to 4 ppm
Number of Strokes n:	10
Time for Measurement:	app. 6 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> grey violet

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

$PH_3 + Au^{3+} \rightarrow Au$ (colloidal)

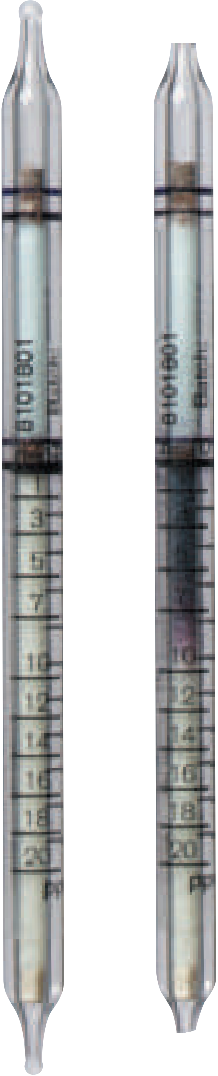
Cross Sensivity

Arsine and antimony hydride are indicated, but with different sensitivities. Hydrogen sulphide, mercaptans, ammonia, carbon monoxide, sulphur dioxide and hydrochloric acid in the TLV range do not interfere.

ST-112-2001

Phosphine 1/a

Order Code
81 01 801



ST-111-2001

Application Range

Standard Measuring Range:	10 to 100	/ 1 to 20 ppm
Number of Strokes n:	2	/ 10
Time for Measurement:	app. 2 min	/ app. 10 min
Standard Deviation:	± 15 to 20 %	
Colour Change:	yellow —> dark-brown	

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	max. 30 mg H_2O / L

Reaction Principle

$PH_3 + Au^{3+} \longrightarrow Au$ (colloidal)

Cross Sensivity

Ammonia, hydrogen chloride, hydrogen sulphide and mercaptans are retained in the prelayer.

Arsine and stibine are also indicated, however, with less sensitivity.

Order Code
81 03 341

Phosphine 0,1/b in Acetylene

Application Range

Standard Measuring Range:	0,1 to 1 ppm	/ 1 to 15 ppm
Number of Strokes n:	10	/ 1
Time for Measurement:	app. 4 min	/ app. 20 s
Standard Deviation:	± 15 to 20 %	
Colour Change:	gelborange —> rotviolett	

Ambient Operating Conditions

Temperature:	2 to 40 °C
Absolute Humidity:	< 20 mg / L

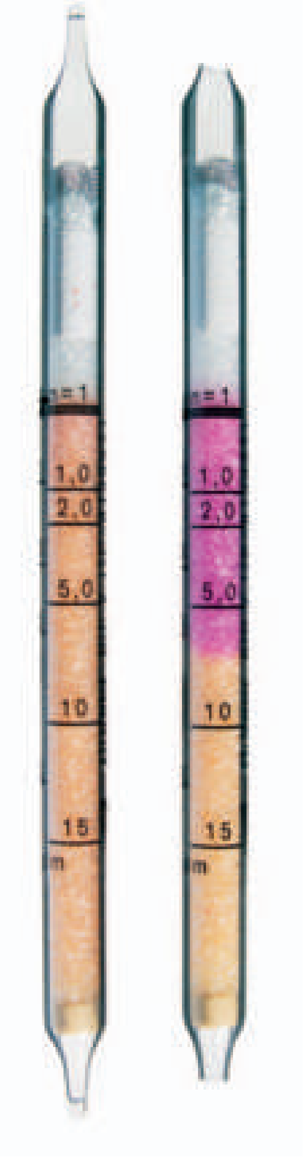
Reaction Principle

$PH_3 + HgCl_2 \rightarrow$ Hg-Phosphide + HCl

HCl + pH-Indicator —> redviolett reaction product

Cross Sensivity

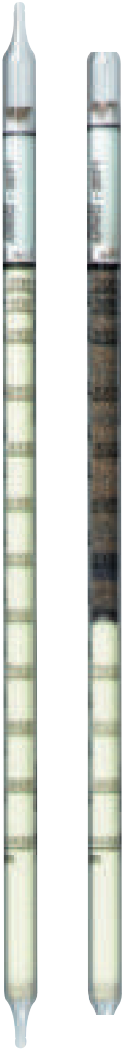
Arsin and Hydrogen Sulfide will be indicated with other sensivities.



ST-7558-2004

Phosphine 25/a

Order-No.
81 01 621



ST-200-2001

Application Range

Standard Measuring Range:	200 to 10,000	/ 25 to 900 ppm
Number of Strokes n:	1	/ 10
Time for Measurement:	app. 1.5 min	/ app. 13 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	yellow –> dark brown	

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$PH_3 + Au^{3+} \rightarrow Au$ (colloidal)

Cross Sensivity

Arsine and antimony hydride are indicated, but with lower sensitivities. Hydrogen sulphide, ammonia, hydrochloric acid and mercaptans are retained in the precleanse layer.

Order-No.
CH 21 201

Phosphine 50/a

Application Range

Standard Measuring Range:	50 to 1,000 ppm
Number of Strokes n:	3
Time for Measurement:	app. 2 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> brown black

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	< 40 mg H_2O / L

Reaction Principle

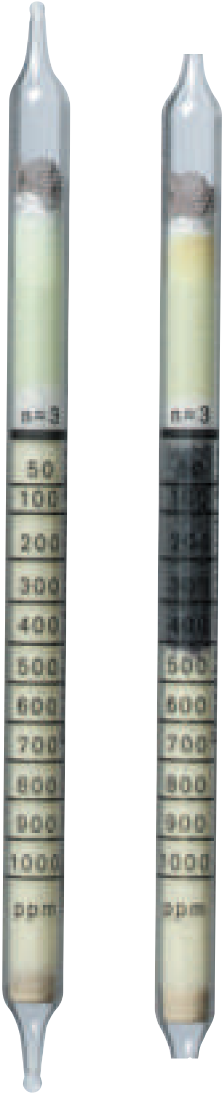
$PH_3 + Au^{3+} \longrightarrow Au$ (colloidal)

Cross Sensivity

Arsine and antimony hydride are indicated, but with different sensitivities. Hydrogen sulphide, mercaptans, ammonia, carbon monoxide, sulphur dioxide and hydrochloric acid in the TLV range do not interfere.

Extension of the Measuring Range

Using n = 10, multiply the reading by 0.3; the range of measurement is 15 to 300 ppm.



ST-113-2001

Phosphoric Acid Esters 0.05/a

Order-No.
67 28 161

ST-144-2001

Application Range

Standard Measuring Range:	0.05 ppm Dichlorvos
Number of Strokes n:	10
Time for Measurement:	app. 5 min
Standard Deviation:	± 30 %
Colour Change:	yellow –> red

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	3 to 18 mg H_2O / L

Reaction Principle

a) $(CH_3O)_2PO_2\text{-}CH{=}CCl_2$ + Cholinesterase –> inactive enzyme

b) Butyrylcholine iodide + H_2O –> Butyric acid

c) Butyric acid + Phenol red –> yellow reaction product

If phosphoric acid esters are present the enzyme is inactivated and butyric acid will not form, thus the weak alkali solution colours the indicating layer red and must be stable for 1min.
If the enzyme remains active, phosphoric acid esters are not present, and the indicating layer remains yellow because of butyric acid formation.

Cross Sensivity

Other phosphoric acid esters than dichlorvos are also indicated, but with different sensitivities.

Additional Information

After performing the required 10 pump strokes the reagent ampoule must be broken and the liquid transferred to the enzyme layer by gently tapping the side of the tube. The substrate layer must not become wetted! After waiting one (1) minute the liquid must be carefully drawn up to the marking line using the pump. Wait another minute before drawing the liquid onto the indication layer using the pump.

Order-No.
CH 28 401

Polytest

Application Range

Standard Measuring Range:	Qualitative determination of easily oxidised substances.
Number of Strokes n:	5
Time for Measurement:	app. 1.5 min
Colour Change:	white —> brown, green or possibly violet

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	max. 50 mg H_2O / L

Reaction Principle

$CO + I_2O_5 \longrightarrow I_2 + CO_2$

Cross Sensivity

Based on the reaction principle, many easily oxidised compounds are indicated, several examples are shown below:

2000 ppm	Acetone	10 ppm	Acetylene
50 ppm	Ethylene	1 ppm	Arsine
10 ppm	Octane	50 ppm	Benzene
500 ppm	Propane	100 ppm	Butane
5 ppm	Carbon Monoxide	10 ppm	Styrene
1 ppm	Carbon Disulphide	20 ppm	Perchloroethylene
2 ppm	Hydrogen Sulphide	10 ppm	Toluene, Xylene

Methane, ethane, hydrogen and carbon dioxide are not indicated.

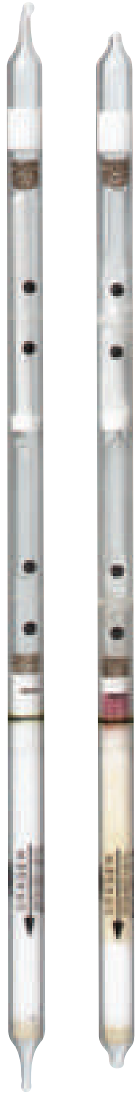
ST-173-2001

Additional Information

The absence of an indication does not mean there are no oxidisable substances present. The Polytest detector tube is strictly a screening tube, designed to qualify the presence of easily oxidised substances. In some instances, particularly when dealing with the potential of flammable gases and vapours near the lower explosion limit (and with toxic substances), the result of the Polytest should be verified with another method.

Pyridine 5/A

Order-No.
67 28 651



ST-203-2001

Application Range

Standard Measuring Range:	5 ppm
Number of Strokes n:	20 An additional 5 strokes is taken in clean air after opening the second reagent ampoule.
Time for Measurement:	app. 20 min
Standard Deviation:	± 30 %
Colour Change:	white —> brown red

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

Pyridine + Aconitic acid + Acetic anhydride —> brown red reaction product

Cross Sensivity

Ammonia in the TLV range does not interfere.

Additional Information

Before carrying out the measurement the lower reagent ampoule must be broken and the liquid transferred to the indication layer so that it is saturated. After performing 20 pump strokes, the upper reagent ampoule must be broken. The granular contents must be shaken out of the broken ampoule by gently tapping the side of the tube. The tube must be held vertically with the inlet of the tube up during the 5 additional pump strokes.

Order-No.
67 23 301

Styrene 10/a

Application Range

Standard Measuring Range:	10 to 200 ppm
Number of Strokes n:	15 to 2
Time for Measurement:	app. 3 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> pale yellow

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	< 15 mg H_2O / L

Reaction Principle

$C_6H_5\text{-}CH{=}CH_2 + H_2SO_4 \longrightarrow$ pale yellow reaction product

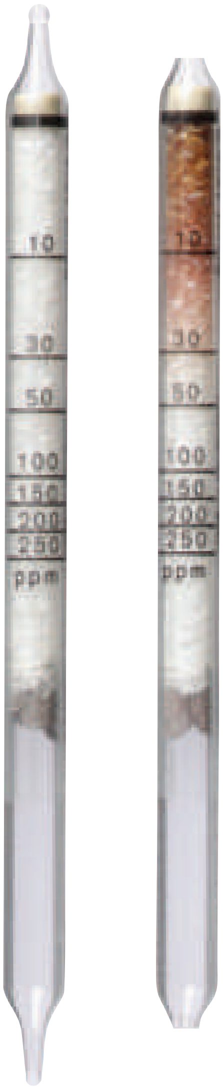
Cross Sensivity

Other organic compounds which tend toward polymerization (e.g. butadiene) are indicated, but with different sensitivities. It is impossible to measure monostyrene in the presence of these compounds.

ST-146-2001

Styrene 10/b

Order-No.
67 33 141



ST-145-2001

Application Range

Standard Measuring Range:	10 to 250 ppm
Number of Strokes n:	20
Time for Measurement:	app. 3 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> red brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

C_6H_5-CH=CH_2 + HCHO —> red brown reaction product

Cross Sensivity

Other organic compounds, which react with the formaldehyde/sulphuric acid indicating system (e.g. xylene, toluene, butadiene and ethyl benzene) affect the indication. It is impossible to measure monostyrene in the presence of these compounds.

No interference by:

200 ppm methanol
500 ppm octane
400 ppm ethyl acetate

Order-No.
CH 27 601

Styrene 50/a

Application Range

Standard Measuring Range:	50 to 400 ppm
Number of Strokes n:	11 to 2
Time for Measurement:	app. 2 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> yellow

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	< 15 mg H_2O / L

Reaction Principle

$C_6H_5\text{-}CH{=}CH_2 + H_2SO_4$ —> yellow reaction product

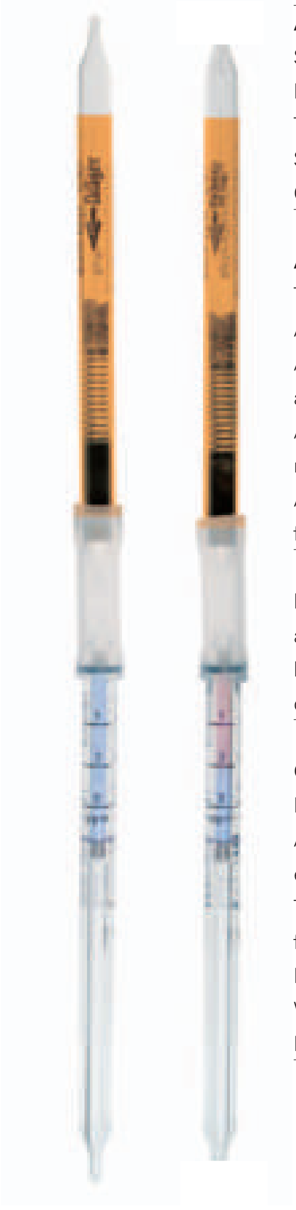
Cross Sensivity

Other organic compounds which tend toward polymerization (e.g. butadiene) are indicated, but with different sensitivities. It is impossible to measure monostyrene in the presence of these compounds.

ST-147-2001

Sulfuryl Fluoride 1/a

Order-No.
81 03 471



ST-1783-2005

Application Range

Standard Measuring Range:	1 to 5 ppm
Number of Strokes n:	6
Time for Measurement:	app. 3 min
Standard Deviation:	± 30 %
Colour Change:	light blue —> light pink

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	15 to 90 % r.h.

At 0 to 10 °C, concentrations of sulfuryl fluoride are displayed with approximately half sensitivity.

At 30 to 40 °C and air humidity < 30% r.h. the displays can only be recognised as of >2 ppm.

At 30 to 40 °C and air humidity > 60% r.h., concentrations of sulfuryl fluoride are displayed with approximately half sensitivity.

Reaction Principle

a) pyrolysis sulphuryl fluoride —> HF

b) HF + zircon / quinalizarin —> pink reaction product (HF destroys the quinalizarin/zircon complex by complexation of the zircon

Cross Sensivity

Fluorinated hydrocarbons are also displayed with different sensitivities.

Ammonia and other basic gases could, depending on the concentrations, either shorten or prevent the colour change.

The following chemicals have no influence on the display of 3 ppm sulfuryl fluoride: 2 ppm Formaldehyde, 5 ppm Methyl Bromide and 1 ppm Phosphine.

When the oxygen concentration decreases, the sensitivity decreases! For example, the 3 ppm display at 18 % oxygen is very weak.

Order-No.
67 27 101

Sulphur Dioxide 0.1/a

Application Range

Standard Measuring Range:	0.1 to 3 ppm
Number of Strokes n:	100
Time for Measurement:	app. 20 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> orange

Ambient Operating Conditions

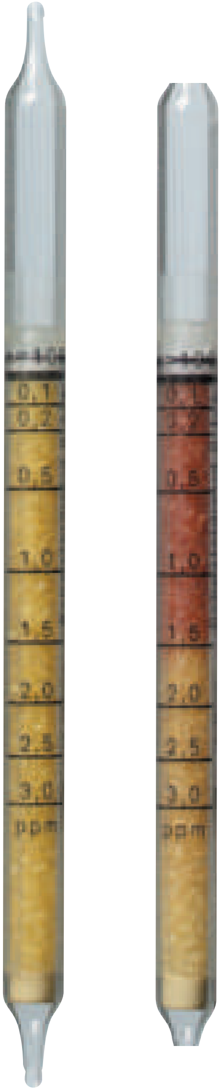
Temperature:	10 to 30 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$SO_2 + Na_2[HgCl_4] + \text{Methyl red} \rightarrow Na_2[Hg(SO_3)_2] + 4\ HCl$

Cross Sensivity

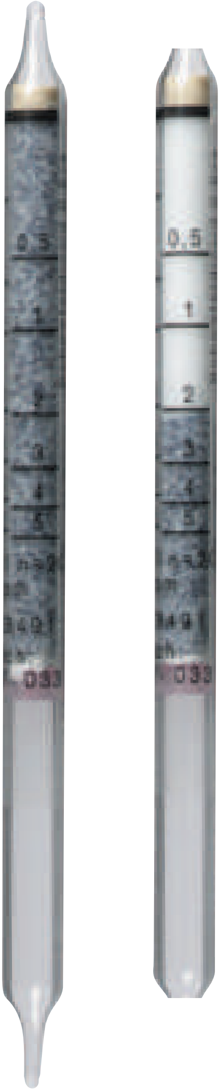
It is impossible to measure sulphur dioxide in the presence of other acidic gases.



ST-120-2001

Sulphur Dioxide 0.5/a

Order-No.
67 28 491



ST-121-2001

Application Range

Standard Measuring Range:	1 to 25 ppm / 0.5 to 5 ppm
Number of Strokes n:	10 / 20
Time for Measurement:	app. 3 min / app. 6 min
Standard Deviation:	± 10 to 15 %
Colour Change:	grey blue –> white

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	3 to 20 mg H_2O / L

Reaction Principle

$$SO_2 + I_2 + 2\ H_2O \xrightarrow{\text{starch}} H_2SO_4 + 2\ HI$$

Cross Sensivity

Hydrogen sulphide is also indicated, however, with differing sensitivity. Nitrogen dioxide will shorten the reading.

Order-No.
CH 31 701

Sulphur Dioxide 1/a

Application Range

Standard Measuring Range:	1 to 25 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	grey blue —> white

Ambient Operating Conditions

Temperature:	15 to 25 °C
Absolute Humidity:	3 to 20 mg H_2O / L

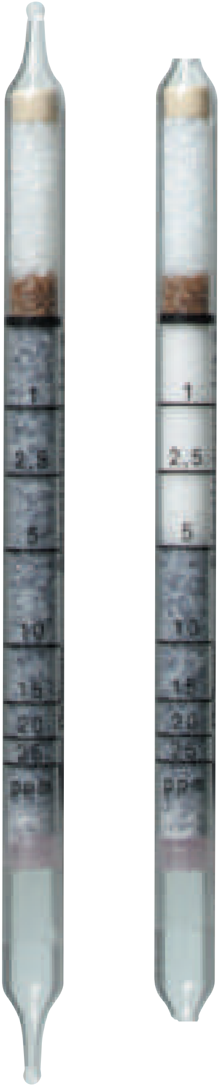
Reaction Principle

$SO_2 + I_2 + 2\ H_2O \longrightarrow H_2SO_4 + 2\ HI$

Cross Sensivity

Hydrogen sulphide in the TLV range is retained in the prelayer and does not interfere.

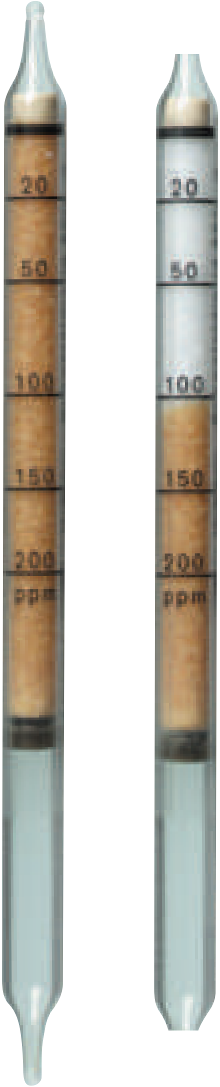
Nitrogen dioxide will shorten the reading.



ST-122-2001

Sulphur Dioxide 20/a

Order-No.
CH 24 201



Application Range

Standard Measuring Range:	20 to 200 ppm
Number of Strokes n:	10
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	brown yellow —> white

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$SO_2 + I_2 + 2\ H_2O \longrightarrow H_2SO_4 + 2\ HI$

Cross Sensivity

Hydrogen sulphide is indicated, but with a different sensitivity.
It is impossible to measure sulphur dioxide in the presence of hydrogen sulphide.
If sulphur dioxide and nitrogen dioxide are present at the same time, the indication will not correspond to the expected sulphur dioxide concentration. These gases react with one another in the gas phase before entering the detector tube.

Extension of the Measuring Range

Using n = 1+3 desorption strokes, multiply the reading by 10; the range of measurement is 200 - 2,000 ppm.
The desorption strokes are to be taken in clean air (i.e. free of sulphur dioxide) immediately following the single pump stroke.

Order-No.
81 01 531

Sulphur Dioxide 50/b

Application Range

Standard Measuring Range:	400 to 8,000	/ 50 to 500 ppm
Number of Strokes n:	1	/ 10
Time for Measurement:	app. 15 s	/ app. 3 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	blue —> yellow	

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	1 to 15 mg H_2O / L

Reaction Principle

$SO_2 + IO_3^- \longrightarrow H_2SO_4 + I^-$

Cross Sensivity

Hydrochloric acid is indicated in high concentrations.
10,000 ppm Hydrochloric acid corresponds to an indication
of 150 ppm sulphur dioxide.

No interference by:

500 ppm nitric oxide
100 ppm nitrogen dioxide

ST-124-2001

Sulphuric Acid 1/a

Order-No.
67 28 781

ST-142-2001

Application Range

Standard Measuring Range:	1 to 5 mg/m^3 Discoloration compared to colour comparison tube.
Number of Strokes n:	100
Time for Measurement:	app. 100 min
Standard Deviation:	± 30 %
Colour Change:	brown —> pink violet

Ambient Operating Conditions

Temperature:	5 to 40 °C
Absolute Humidity:	< 15 mg H_2O / L

Reaction Principle

H_2SO_4 + Barium chloroanilate —> Chloranilic acid + Ba SO_4

Cross Sensivity

Sulphur trioxide in the gaseous form is not indicated, but in the presence of atmospheric humidity this forms sulphuric acid aerosols, which are indicated.

Soluble sulphates and other aerosol forming acids are also indicated but with different sensitivities. It is impossible to measure sulphuric acid in the presence of these substances.

Additional Information

After performing the required 100 pump strokes the reagent ampoule must be broken and the liquid transferred completely onto the brown reagent layer. Wait one minute before drawing the liquid carefully through the brown layer with $\frac{1}{4}$ pump stroke into the indication chamber.

The measurement must be evaluated immediately!

Order-No.
81 01 341

Tetrahydrothiophene 1/b

Application Range

Standard Measuring Range:	1 to 10 ppm
Number of Strokes n:	30
Time for Measurement:	app. 15 min app. 10 min for a measurement in natural gas.
Standard Deviation:	± 15 to 20 %
Colour Change:	violet —> yellow brown

Ambient Operating Conditions

Temperature:	0 to 35 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

a) Adsorption with H_2S
b) THT + $KMnO_4$ —> yellow brown reaction product

Cross Sensivity

Up to 10 ppm hydrogen sulphide is adsorbed in the pretube, causing a brown discoloration.

It is impossible to measure tetrahydrothiophene in the presence of mercaptans.

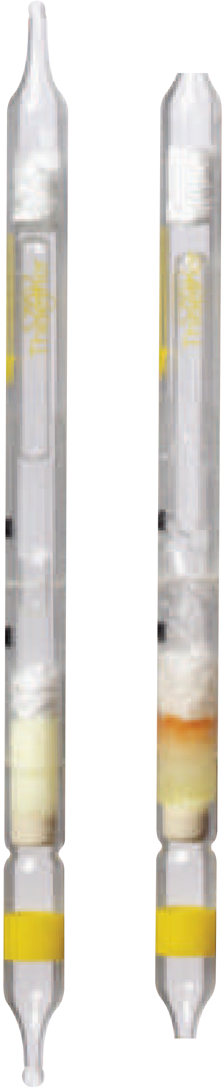
Up to 100 ppm of olefines (e.g. ethene, propene) will cause the colour of the indicating layer to become lighter, at higher concentrations the olefins cause plus errors.

Up to 200 ppm methanol does not interfere.

ST-206-2001

Thioether

Order-No.
CH 25 803



ST-149-2001

Application Range

Standard Measuring Range:	1 mg/m³ is the minimum detectable concentration.
Number of Strokes n:	8
Time for Measurement:	app. 1.5 min
Standard Deviation:	± 50 %
Colour Change:	yellow –> orange

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 50 mg H_2O / L

Reaction Principle

R'-S-R + $AuCl_3$ + Chloramide –> orange reaction product

Cross Sensivity

Various thioethers are indicated, but it is impossible to differentiate between them.

Additional Information

After performing the required eight pump strokes the reagent ampoule must be broken and the liquid transferred completely onto the indication layer.

Order-No.
81 01 661

Toluene 5/b

Application Range

Standard Measuring Range:	50 to 300 ppm / 5 to 80 ppm	
Number of Strokes n:	2	/ 10
Time for Measurement:	app. 1 min	/ app. 5 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	white —> pale brown	

Ambient Operating Conditions

Temperature:	2 to 40 °C
Absolute Humidity:	max. 20 mg H_2O / L

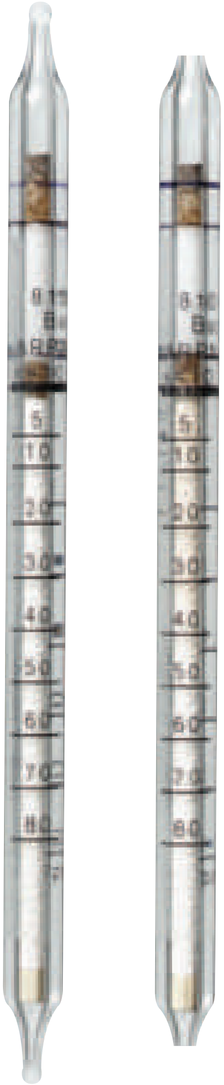
Reaction Principle

Toluene + I_2O_5 + H_2SO_4 —> I_2

Cross Sensivity

10 ppm phenol, 1000 ppm acetone, 1000 ppm ethanol and 500 ppm octane are not indicated.

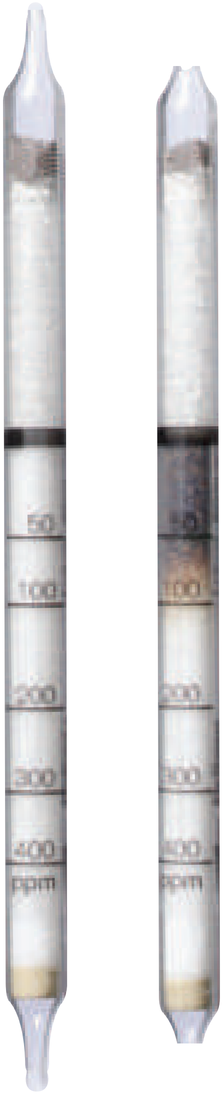
Xylene (all isomers) and benzene are indicated with the same sensitivity. The discoloration in the presence of p-xylene is violet, and yellowish-green with benzene.



ST-151-2001

Toluene 50/a

Order Code
81 01 701



ST-152-2001

Application Range

Standard Measuring Range:	50 to 400 ppm
Number of Strokes n:	5
Time for Measurement:	app. 1,5 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

Toluene + I_2O_5 + H_2SO_4 —> I_2

Cross Sensivity

Xylenes will be indicated with different sensivitites.

Benzene causes a total discolouration into yellow.

Petrol Hydrocarbons cause a total discoloration into red brown.

Methanol, Ethanol, Acetone and Ethyl Acetate do not disturb the discolouration in the range of MAK-valves.

Order Code
81 01 731

Toluene 100/a

Application Range

Standard Measuring Range:	100 to 1,600 ppm
Number of Strokes n:	10
Time for Measurement:	app. 1.5 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brown violet

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

Toluene + SeO_2 + H_2SO_4 —> brown violet reaction product

Cross Sensivity

Xylenes are indicated with approximately the same sensitivity, but with a bluish violet colour.

Benzene discolours the entire indicating layer a diffuse yellow brown.

Petroleum hydrocarbons discolour the entire indicating layer a diffuse reddish brown.

Methanol, ethanol, acetone and ethyl acetate do not interfere.

ST-153-2001

Toluene Diisocyanate 0.02/A

Order Code
67 24 501

ST-247-2001

Application Range

Standard Measuring Range:	0.02 to 0.2 ppm Discoloration compared to colour comparison tube.
Number of Strokes n:	25
Time for Measurement:	app. 20 min
Standard Deviation:	± 30 %
Colour Change:	white —> orange

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	< 20 mg H_2O / L

Reaction Principle

a) Pyridylpyridinium chloride + NaOH —> Glutaconaldehyde sodium oletate
b) 2,4-TDI (also for 2,6-TDI) + HCl —> Aromatic amine
c) Aromatic amine + Glutaconaldehyde —> orange reaction product

Cross Sensivity

Other isocyanates are not indicated.

No interference by:

5 ppm aniline
10 ppm benzylamine
5 ppm toluene
20 ppm benzene

Mercaptans also discolour the indicating layer.

Additional Information

Before carrying out the measurement the lower reagent ampoule must be broken and the liquid transferred to the indication layer, so that it changes colour to yellow. Next, the upper reagent ampoule must be broken and the liquid transferred to the indication layer, so that it returns to a white colour. After performing 25 pump strokes wait 15 minutes before evaluating the indication.

Order Code
CH 21 101

Trichloroethane 50/d

Application Range

Standard Measuring Range:	50 to 60 ppm
Number of Strokes n:	2 + 3 desorption strokes in clean air
Time for Measurement:	app. 2 min
Standard Deviation:	± 10 to 15 %
Colour Change:	grey —> brown red

Ambient Operating Conditions

Temperature:	15 to 40 °C
Absolute Humidity:	5 to 15 mg H_2O / L

Reaction Principle

a) 1,1,1-Trichloroethane + $IO_3^-/H_2S_2O_7 \longrightarrow Cl_2$

b) Cl_2+ o-tolidine —> brown red reaction product

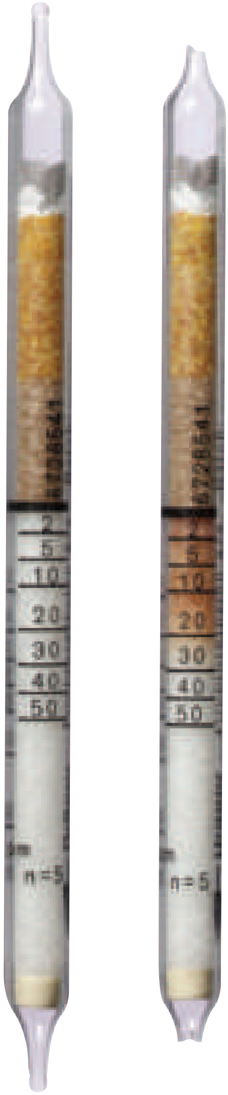
Cross Sensivity

Other chlorinated hydrocarbons are indicated, but with different sensitivities.

In the presence of aromatic hydrocarbons the indication is too low (e.g. 200 ppm 1,1,1-trichloroethane + 200 ppm toluene gives an indication of 50 ppm).

Trichloroethylene 2/a

Order Code
67 28 541



ST-157-2001

Application Range

Standard Measuring Range:	20 to 250 ppm	/ 2 to 50 ppm
Number of Strokes n:	3	/ 5
Time for Measurement:	app. 1.5 min	/ 2.5 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	pale grey –> orange	

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	5 to 15 mg H_2O / L

Reaction Principle

a) Trichloroethylene + Cr^{VI} –> Cl_2

b) Cl_2 + o-tolidine –> orange reaction product

Cross Sensivity

Other chlorinated hydrocarbons are indicated, but with different sensitivities.

Free halogens and hydrogen halides in the TLV range are also indicated. It is impossible to measure trichloroethylene in the presence of these substances.

Petroleum hydrocarbons cause low readings.

Order Code
81 01 881

Trichloroethylene 50/a

Application Range

Standard Measuring Range:	50 to 500 ppm
Number of Strokes n:	5
Time for Measurement:	app. 1.5 min
Standard Deviation:	± 10 to 15 %
Colour Change:	pale grey —> orange

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

a) Trichloroethylene + Cr^{VI} —> Cl_2
b) Cl_2 + o-tolidine —> orange reaction product

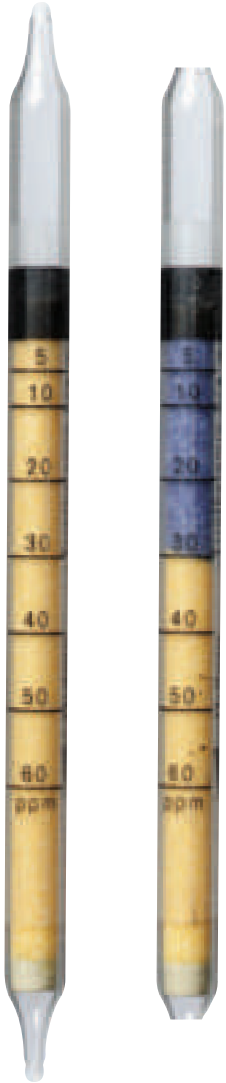
Cross Sensivity

Other chlorinated hydrocarbons are indicated, but with different sensitivities.
Free halogens and hydrogen halides in the TLV range are also indicated. It is impossible to measure trichloroethylene in the presence of these substances.
Petroleum hydrocarbons cause low readings.

ST-154-2001

Triethylamine 5/a

Order Code
67 18 401



ST-163-2001

Application Range

Standard Measuring Range:	5 to 60 ppm
Number of Strokes n:	5
Time for Measurement:	app. 3 min
Standard Deviation:	± 10 to 15 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	5 to 12 mg H_2O / L

Reaction Principle

$(C_2H_5)_3N$ + Acid —> blue reaction product

Cross Sensivity

Other basic substances such as organic amines and ammonia are indicated, but with different sensitivities.

Order Code
81 01 721

Vinyl Chloride 0.5/b

Application Range

Standard Measuring Range:	5 to 30 ppm / 0.5 to 5 ppm
Number of Strokes n:	1 / 5
Time for Measurement:	app. 30 s / app. 3 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> violet

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	max. 20 mg H_2O / L

Reaction Principle

a) $CH_2=CHCl + Cr^{VI} \longrightarrow Cl_2$

b) Cl_2 + dimethyl naphtidine —> violet reaction product

Cross Sensivity

Many organic compounds with C=C double bonds are indicated, but with different sensitivities. It is impossible to differentiate between them.
It is impossible to measure vinyl chloride in the presence of dialkyl sulphide.

ST-159-2001

Vinyl Chloride 1/a

Order Code
67 28 031

ST-160-2001

Application Range

Standard Measuring Range:	5 to 50 ppm	/ 1 to 10 ppm
Number of Strokes n:	5	/ 20
Time for Measurement:	app. 2 min	/ app. 8 min
Standard Deviation:	± 10 to 15 %	
Colour Change:	light grey –> yellow orange	

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	3 to 12 mg H_2O / L

Reaction Principle

a) $CH_2{=}CHCl + Cr^{VI} \longrightarrow Cl_2$

b) Cl_2 + o-Tolidine –> yellow orange reaction product

Cross Sensivity

Other chlorinated hydrocarbons are indicated, but with different sensitivities.

Chlorine and hydrochloric acid in the TLV range do not interfere.

Petroleum hydrocarbons cause low readings.

Order Code
CH 19 601

Vinyl Chloride 100/a

Application Range

Standard Measuring Range:	100 to 3,000 ppm
Number of Strokes n:	18 to 1
Time for Measurement:	app. 4 min
Standard Deviation:	± 30 %
Colour Change:	violet —> light brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	< 30 mg H_2O / L

Reaction Principle

$CH_2{=}CHCl + MnO_4^- \longrightarrow Mn^{IV}$ + various oxidation products

Cross Sensivity

Many organic compounds with C=C double bonds are indicated, but with different sensitivities. It is impossible to differentiate between them.
It is impossible to measure vinyl chloride in the presence of dialkyl sulphide.

ST-161-2001

Water Vapour 0.1/a

Order Code
81 01 321

ST-164-2001

Application Range

Standard Measuring Range:	0.1 to 1.0 mg/L
Number of Strokes n:	3
Time for Measurement:	app. 1.5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	0 to 30 °C

Reaction Principle

$H_2O + Mg(ClO_4)_2 \longrightarrow$ blue reaction product

Cross Sensivity

Generally basic substances cause plus errors and acidic substances cause minus errors.

No interference by:	1,200 ppm nitrogen dioxide
	6,000 ppm sulphur dioxide
	3,000 ppm hydrogen sulphide
	2,000 ppm ethanol
	2,000 ppm acetone

Additional Information

The first scale mark corresponds to 0.05 mg H_2O / L

Order Code
81 01 781

Water Vapour 1/b

Application Range

Standard Measuring Range:	20 to 40 mg/L	/ 1 to 15 mg/L
Number of Strokes n:	1	/ 2
Time for Measurement:	app. 20 s	/ app. 40 s
Standard Deviation:	± 15 to 20 %	
Colour Change:	yellow —> turquoise-blue	

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	up to 100% r.h. Condensation in the tube causes measurement errors! If high r.h. (in excess of 80%) is to be expected, the temperature of the tube should be at least 5 °C higher than ambient temperature. Given a r.h. below 80%, the temperature of the tube should be at least equal to the ambient temperature.

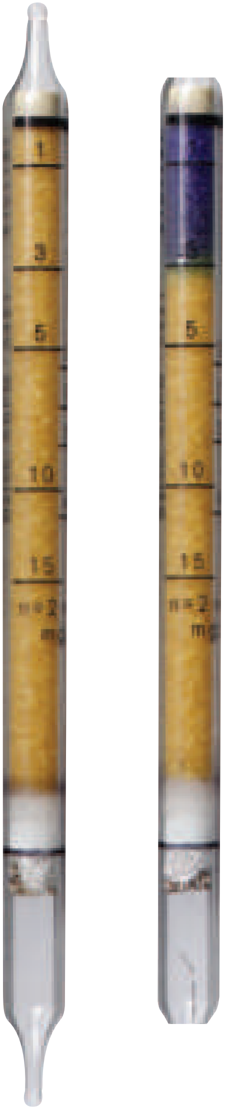
Reaction Principle

$H_2O + Mg(ClO_4)_2$ —> turquoise-blue reaction product

Cross Sensivity

Acid gases are liable to cause plus errors.

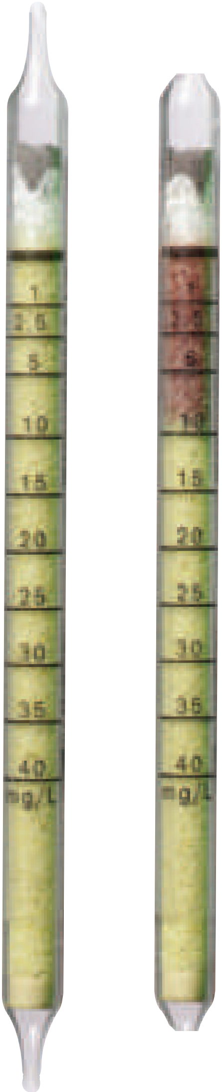
Basic gases are liable to cause minus errors.



ST-207-2001

Water Vapour 0.1

Order Code
CH 23 401



ST-167-2001

Application Range

Standard Measuring Range:	1 to 40 mg/L
Number of Strokes n:	10
Time for Measurement:	app. 2 min
Standard Deviation:	± 30 to 15 %
Colour Change:	yellow —> red brown

Ambient Operating Conditions

Temperature:	0 to 40 °C

Reaction Principle

$H_2O + SeO_2 + H_2SO_4$ —> reddish brown reaction product

Cross Sensitivity

Low molecular weight alcohols are indicated.

A variety of other organic compounds, such as petroleum hydrocarbons are indicated.

Order Code
67 33 161

Xylene 10/a

Application Range

Standard Measuring Range:	10 to 400 ppm
Number of Strokes n:	5
Time for Measurement:	app. 45 s
Standard Deviation:	± 20 to 30 %
Colour Change:	white —> red brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

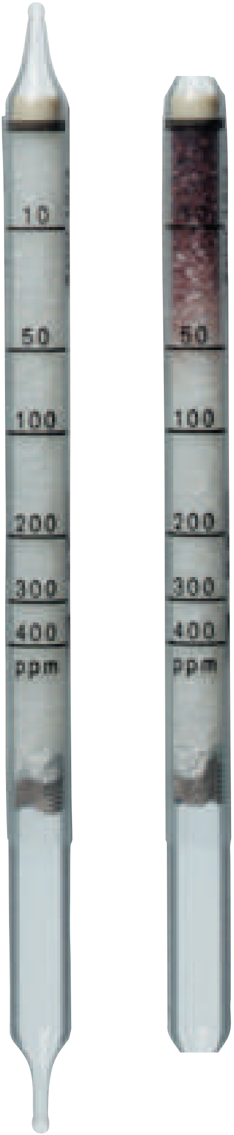
Reaction Principle

$C_6H_4(CH_3)_2 + HCHO + H_2SO_4 \longrightarrow$ quinoid reaction product

Cross Sensivity

Styrene, vinyl acetate, toluene, ethyl benzene and acetaldehyde are indicated, but with different sensitivities.

No interference by:	500 ppm octane 200 ppm methanol 400 ppm ethyl acetate



ST-172-2001

3.3.

Data about Dräger Simultaneous Test Set

Order Code
81 01 735

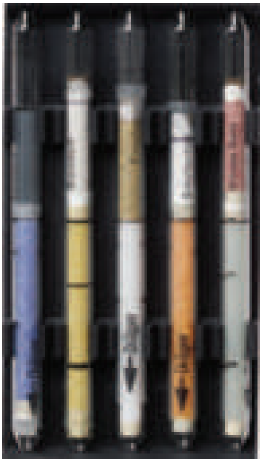
Simultaneous Test-Set I for inorganic fumes

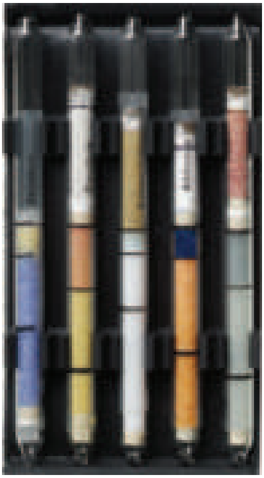
Application Range

Standard Measuring Range
and Colour Change:

Dräger-Tubes in Simultaneous Test-Set I	1. Scale Mark ppm	2. Scale Mark ppm
1. Acid gas	Hydrochloric Acid	
blue –> yellow	5	25
2. Hydrocyanic acid		
yellow –> red	10	50
3. Carbon Monoxide		
white –> brown green	30	150
4. Basic gas	Ammonia	
yellow –> blue	50	250
5. Nitrous gas	Nitrogen Dioxide	
pale grey –>blue grey	5	25

Number of Strokes n:	10
Time for Measurement:	app. 40 s


ST-238-2001


ST-237-2001

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	5 to 15 mg H_2O / L semi-quantitative measurements are also possible outside this range. Water aerosols may result in minus errors.

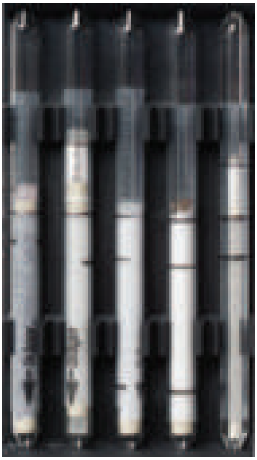
Attention

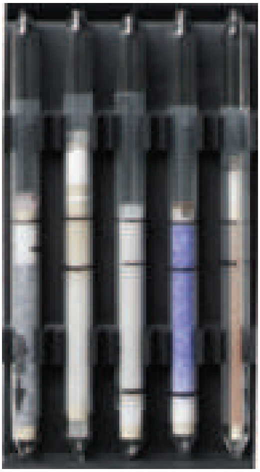
The Simultaneous Test Set was developed for the semi-quantitative measurement of fumes and decomposition gases. It is used to estimate and limit risks by obtaining information about health risks or possible intoxication hazards in the area of a fire.

The Simultaneous Test Set cannot be used to determine the risk of explosion. A negative result with the Simultaneous Test Set does not exclude the presence of other hazardous gases.

Simultaneous Test-Set II for inorganic fumes

Order Code
81 01 736


ST-240-2001


ST-241-2001

Application Range

Standard Measuring Range
and Colour Change:

Dräger-Tubes in Simultaneous Test-Set II	1. Scale Mark ppm	2. Scale Mark ppm
1. Sulphur Dioxide blue –> white	–	10
2. Chlorine white –> orange	–	2.5
3. Hydrogen Sulphide white –> pale brown	10	50
4. Carbon Dioxide white –> blue violet	5,000	25,000
5. Phosgene white –> red	–	0.5

Number of Strokes n:	10
Time for Measurement:	app. 40 s

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	5 to 15 mg H_2O / L semi-quantitative measurements are also possible outside this range. Water aerosols may result in minus errors.

Attention

The Simultaneous Test Set was developed for the semi-quantitative measurement of fumes and decomposition gases. It is used to estimate and limit risks by obtaining information about health risks or possible intoxication hazards in the area of a fire.
The Simultaneous Test Set cannot be used to determine the risk of explosion. A negative result with the Simultaneous Test Set does not exclude the presence of other hazardous gases.

Order Code
81 01 770

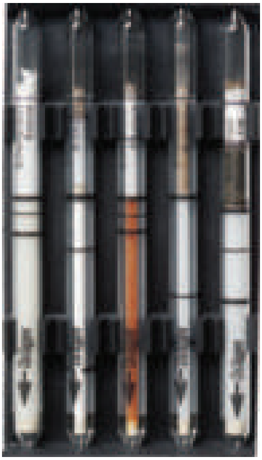
Simultaneous Test-Set III for organic vapours

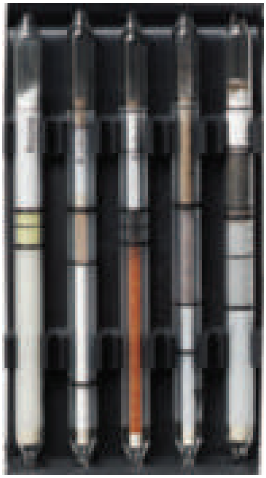
Application Range

Standard Measuring Range
and Colour Change:

Dräger-Tubes in Simultaneous Test-Set III	1. Scale Mark ppm	2. Scale Mark ppm
1. Ketones	Acetone	
pale yellow –> dark yellow	1,000	5,000
2. Aromatics	Toluene	
white –> brown	100	500
3. Alcohols	Methanol	
orange –> green brown	200	1,000
4. Aliphatics	n-Hexane	
white –> brown	50	100
5. Chlorinated hydrocarbons	Perchloroethylene	
yellow white –> grey blue	50	100

Number of Strokes n: 10
Time for Measurement: app. 40 s


ST-242-2001


ST-239-2001

Ambient Operating Conditions

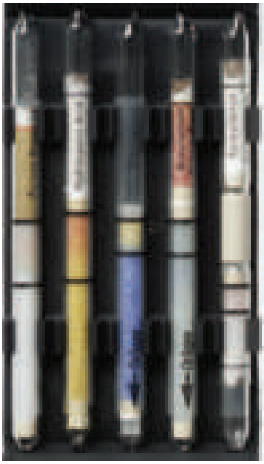
Temperature:	10 to 30 °C
Absolute Humidity:	5 to 15 mg H_2O / L The ranges given for temperature and humidity apply to calibrations with the original sub stances. Semi-quantitative measurements are also possible outside this range.

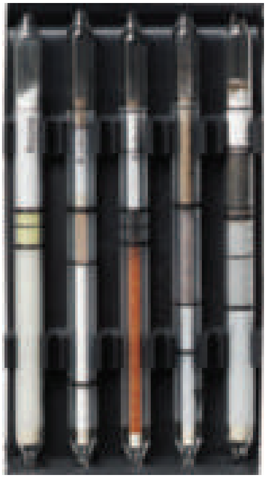
Attention

The Simultaneous Test Set was developed for the semi-quantitative measurement of organic vapours. It is used to estimate and limit risks by obtaining information about health risks or possible intoxication hazards in the area of a fire. The Simultaneous Test Set cannot be used to determine the risk of explosion. A negative result with the Simultaneous Test Set does not exclude the presence of other hazardous gases.

Simultaneous Test Set Conductive Compounds 10/01

Order Code
81 03 170


ST-226-2001


ST-239-2001

Standard measuring range and colour change

Dräger tube in Simultaneous Test Set	1. marking ETW (tolerance value for fire-fighters)
1. Carbon monoxide (CO)	33 ppm
2. Hydrocyanic acid	3.5 ppm
3. Hydrochloric acid	5.4 ppm
4. Nitrous gases (nitrogen oxides)	8.2 ppm
5. Formaldehyde	1 ppm

Number of strokes n:	20
Measurement period:	app. 40 s

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	5 to 15 mg H_2O / L semi-quantitative measurements are also possible outside this range. Water aerosols may result in minus errors.

Attention

The Simultaneous Test Set was developed for the semi-quantitative measurement of fumes and decomposition gases. It is used to estimate and limit risks by obtaining information about health risks or possible intoxication hazards in the area of a fire. The Simultaneous Test Set cannot be used to determine the risk of explosion. A negative result with the Simultaneous Test Set does not exclude the presence of other hazardous gases.

Order Code
81 03 380

Simultaneous Test Set Container Aeration I

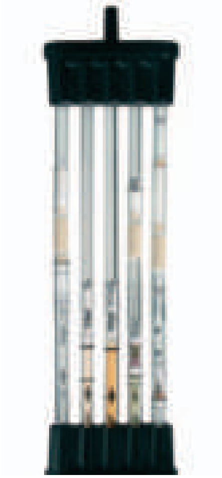
Application Range

Standard Measuring:

Range

Substance	Sensivity	Colour Change
Formaldehyde	1 ppm	white –> pink
Phospine	0,3 ppm	yellow –> red
Hydrocyanic Acid	10 ppm	yellow –> red
Methylbromide	0,5 ppm	green –> brown
Ethylenoxide	1 ppm	white –> pink

Number of strokes n:	50
Measurement period:	app. 4 min


ST-5786-2004

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	5 to 40 mg H_2O / L


ST-5787-2004

Attention

The Simultaneous Test Set was developed for the semi-quantitative measurement of organic vapours. It is used to estimate and limit risks by obtaining information about health risks or possible intoxication hazards in the area of a fire. The Simultaneous Test Set cannot be used to determine the risk of explosion. A negative result with the Simultaneous Test Set does not exclude the presence of other hazardous gases.

3.4.

Data about Dräger-Tubes used with Dräger Aerotest

Order Code
67 33 231

Ammonia 2/a for use in Aerotest CO_2

Application Range

Standard Measuring Range:	0,6 to 9 ppm
Test Volume:	1 L
Flow Rate:	0,2 L / min
Time for Measurement:	5 min
Standard Deviation:	± 25%
Colour Change:	yellow —> blue

Ambient Operating Conditions

Temperature:	10 to 50 °C
Absolute Humidity:	< 20 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

NH_2 + pH-indicator -> blue reaction product

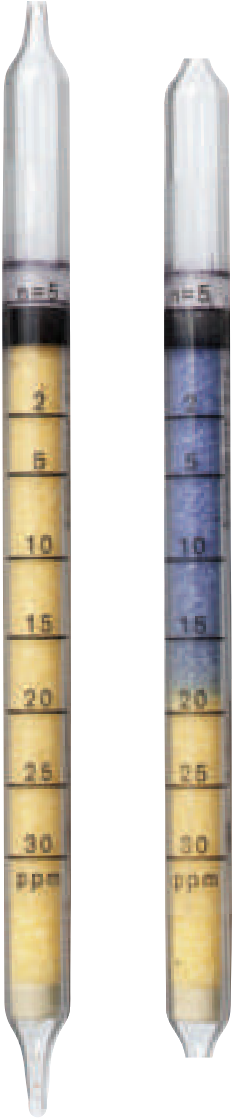
Cross Sensitivity

Other basic substances such as organic amines are indicated as well.

The indication is not affected by:

300 ppm nitrous gases
2000 ppm sulphur dioxide
2000 ppm hydrogen sulphide

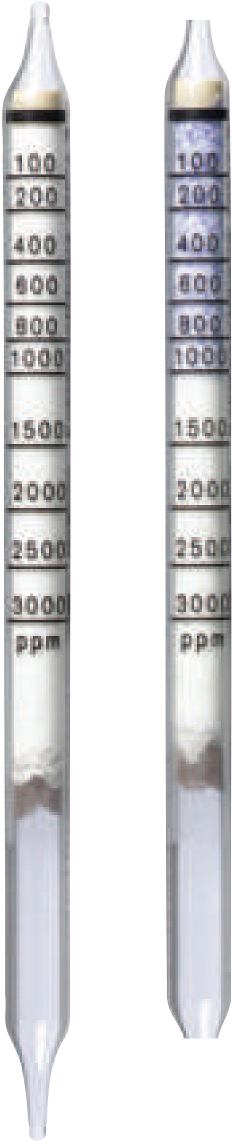
Evaluation	Reading on scale x 0.3 = ppm ammonia



ST-9-2001

Carbon Dioxide 100/a-P

Order Code
67 28 521



ST-51-2001

Application Range

Standard Measuring Range:	100 to 3,000 ppm
Test Volume:	1 L
Flow Rate:	0,2 L / min
Time for Measurement:	app. 5 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white –> violet

Ambient Operating Conditions

Temperature:	15 to 25 °C
Absolute Humidity:	max. 23 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$CO_2 + N_2H_4 \longrightarrow NH_2\text{-}NH\text{-}COOH$ Crystal violet

Cross Sensivity

Hydrogen sulphide and sulphur dioxide in the TLV range are not indicated.

Order Code
67 28 511

Carbon Monoxide 5/a-P

Application Range

Standard Measuring Range:	5 to 150 ppm
Test Volume:	1 L
Flow Rate:	0.2 L / min
Time for Measurement:	app. 5 min
Standard Deviation:	± 10 to 15 %
Colour Change:	white —> brownish-green

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	0 to 50 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$$5\ CO + I_2O_5 \xrightarrow{H_2S_2O_7} I_2 + 5\ CO_2$$

Cross Sensivity

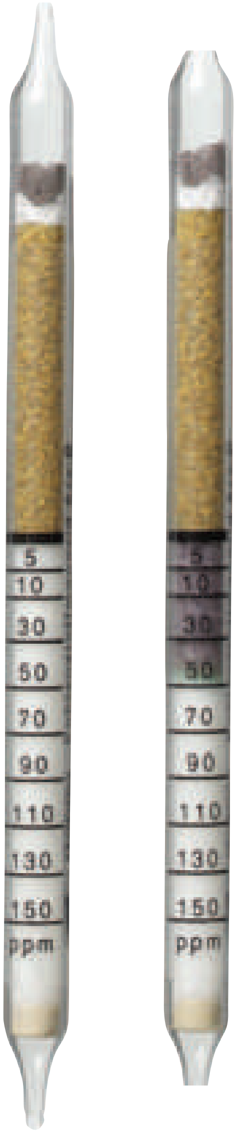
Acetylene reacts similarly to carbon monoxide but with less sensitivity. Petrol, benzene, halogenated hydrocarbons and hydrogen sulphide are retained in the pre-layer.

Higher concentrations of easily cleavable halogenated hydrocarbons (e.g. trichloroethylene) may from chromyl chloride in the pre-layer which changes the indicating layer to yellowish-brown.

In case of high olefine concentrations it is not possible to measure carbon monoxide.

Extension of the Measuring Range

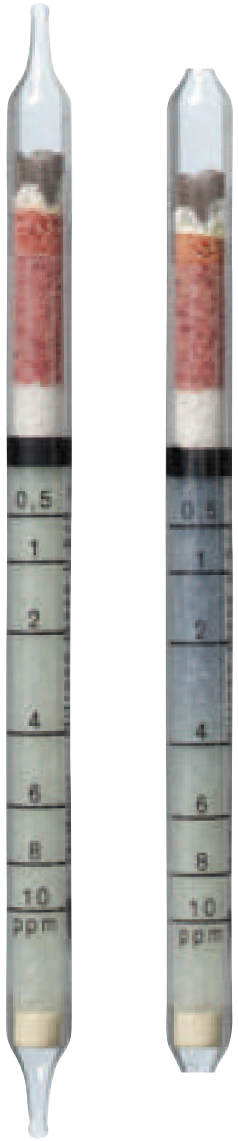
Using a test volume of 2 L divide the reading by 2, measuring range 2.5 to 75 ppm.



ST-71-2001

Nitrous Fumes 0.5/a for use in Multitest Med. Gases / Aerotest CO_2

Order Code
CH 29 401



ST-78-2001

Application Range

Standard Measuring Range:	0.5 to 10 ppm
Number of Strokes n:	5
Time for Measurement:	app. 40 s
Standard Deviation:	± 10 to 15 %
Colour Change:	pale green —> blue grey

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 40 mg H_2O / L

Reaction Principle

a) $NO + Cr^{VI} \longrightarrow NO_2$

b) NO_2 + Diphenylbenzidine —> blue grey reaction product

Cross Sensivity

It is impossible to measure nitrous fumes in the presence of ozone and/or chlorine in excess of their TLV's, this gases are also indicated with different sensitivity.

Nitrogen dioxide concentrations above 300 ppm can bleach the indication.

Order Code
67 28 371

Oil 10/a-P

Application Range

Standard Measuring Range:	0.1 to 1 mg/m^3
Time for Measurement:	(see details in
Standard Deviation:	operating instructions)
Colour Change:	white –> beige-yellow

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

Oil + H_2SO_4 –> beige-yellow reaction product

Cross Sensivity

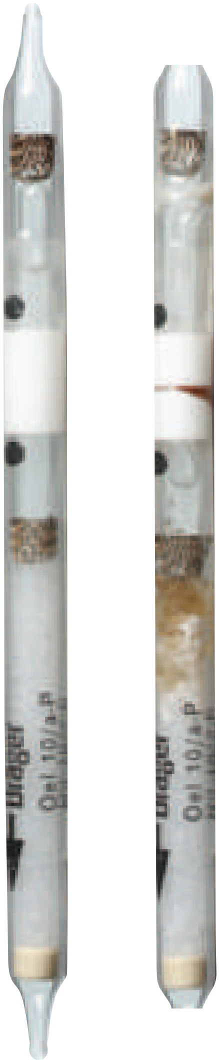
The total concentration of mineral and synthetic aerosols (mist) and oil vapours is indicated.

Other organic compounds with high molecular weights are indicated as well but with different sensitivity.

Polyethylene glycol and silicone oils are not indicated

Additional Information

In combination with a Dräger gas detector pump the oil tube can also be used to analyse the air in work rooms. The measurement period depends on the oil used. Please find a list of the oils tested under www.draeger-safety.de/voice.



ST-143-2001

Phosphine 0.1/a for use in Aerotest CO_2

Order Code
CH 31 101

ST-112-2001

Application Range

Standard Measuring Range:	0,1 to 4 ppm
Test Volume:	1 L
Flow Rate:	0,2 L / min
Time for Measurement:	5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	white —> greyviolet

Ambient Operating Conditions

Temperature:	0 to 50 °C
Absolute Humidity:	max 40 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$PH_3 + Au^{3+} \longrightarrow Au$ (colloidal)

Cross Sensitivity

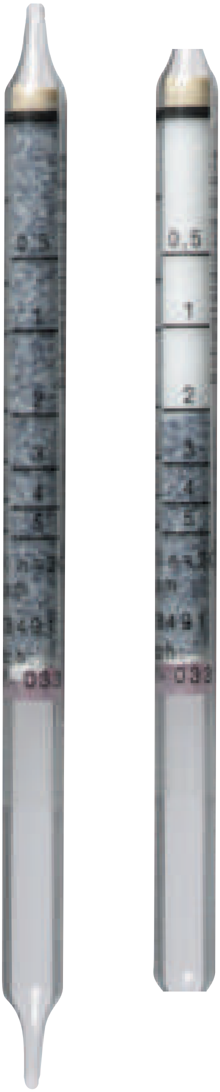
Hydrogen sulphide in the TLV range is retained in the pre-layer and thus does not affect the indication. Nitrogen dioxide will shorten the reading.

Evaluation

Scale reading = ppm phosphine

Order Code
67 28 491

Sulphur Dioxide 0.5/a for use in Multitest Med. Gases



ST-121-2001

Application Range

Standard Measuring Range:	1 to 25 ppm	/ 0,25 to 1 ppm
Test Volume:	1 L	/ 2 L
Flow Rate:	0,2 L	/ 0,2 L / min
Time for Measurement:	5 min	/ 10 min
Standard Deviation:	± 25 %	
Colour Change:	greyblue —> white	

Ambient Operating Conditions

Temperature:	15 to 30 °C
Absolute Humidity:	max. 20 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$$SO_2 + I_2 + 2\,H_2O \xrightarrow{\text{Starch}} H_2SO_4 + 2\,HI$$

Cross Sensivity

Hydrogen sulphide is indicated as well but with different sensitivity. Nitrogen dioxide will shorten the reading.

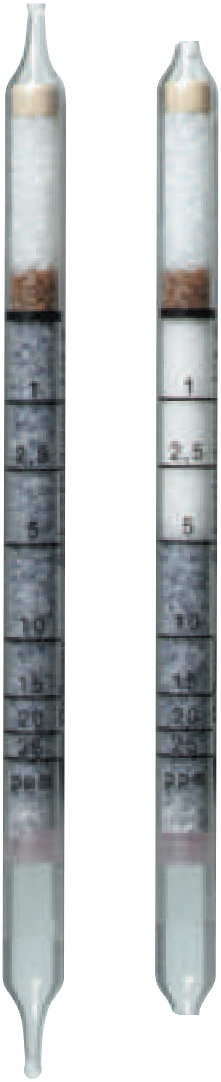
Evaluation

Measuring range 1 to 25 ppm:	Reading on the (n=10) scale = ppm
Measuring range 0.25 to 1 ppm:	Reading on the (n= 20) scale x 0.5 = ppm SO_2 (applies only for scale range 0.5 to 2 ppm)

Sulphur Dioxide 1/a

for use in Multitest Med. Gases / Aerotest CO_2

Order Code
CH 31 701



ST-122-2001

Application Range

Standard Measuring Range:	0,5 to 2 ppm
Test Volume:	2 L
Flow Rate:	app. 0,2 L / min
Time for Measurement:	in the Aerotest CO_2: 10 min
	in the Multi Test (for CO_2): 12 min
Standard Deviation:	± 30 %
Colour Change:	greyblue —> white

Ambient Operating Conditions

Temperature:	15 to 25 °C
Absolute Humidity:	max. 20 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$$SO_2 + I_2 + 2\ H_2O \xrightarrow{\text{starch}} H_2SO_4 + 2\ HI$$

Cross Sensitivity

Hydrogen sulphide in the TLV range is retained in the pre-layer and thus does not affect the indication. Nitrogen dioxide will shorten the reading.

Evaluation

reading on the (N=10) scale x 0.2 = ppm SO_2
(applies only for scale range 2.5 to 10 ppm)

Order Code
81 01 461

Hydrogen Sulphide 0.2/a for use in Aerotest CO_2

Application Range

Standard Measuring Range:	0,04 to 1 ppm
Test Volume:	4 L
Flow Rate:	0,8 L / min
Time for Measurement:	5 min
Standard Deviation:	± 25 %
Colour Change:	white —> palebrown

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity:	max. 15 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

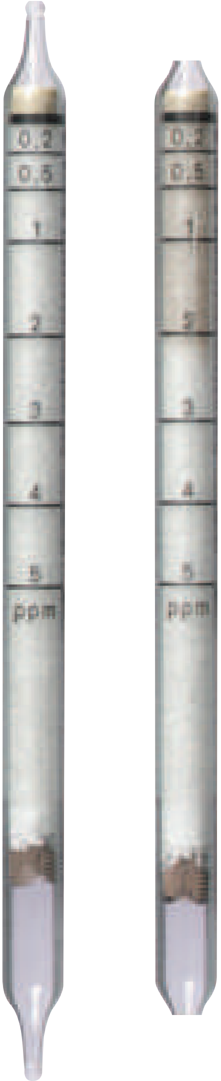
$H_2S + Pb^{2+} \longrightarrow PbS + 2\,H^+$

Cross Sensitivity

Sulphur dioxide and hydrochloric acid in the TLV range do not affect the reading.

Evaluation

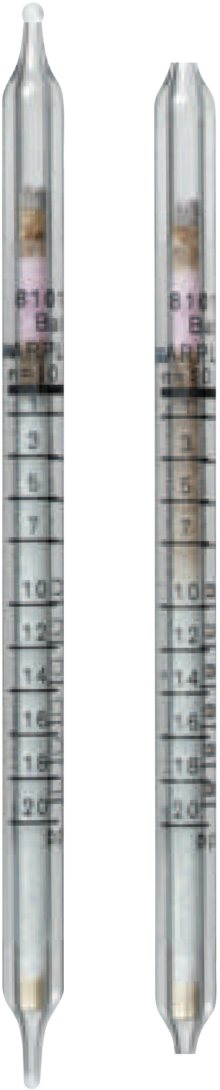
$$\frac{\text{Scale reading}}{5} = \text{ppm } H_2S$$



ST-132-2001

Hydrogen Sulphide 1/d for use in Multitest Med. Gases

**Order Code
81 01 831**



ST-131-2001

Application Range

Standard Measuring Range:	1 to 20 ppm
Test Volume:	1 L
Flow Rate:	0,17 L / min (CO_2)
Time for Measurement:	6 min
Standard Deviation:	± 15 %
Colour Change:	white —> brown

Ambient Operating Conditions

Temperature:	2 to 40 °C
Absolute Humidity:	max 40 mg H_2O / L
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$H_2S + Cu^{2+} \longrightarrow CuS + 2\,H^+$

Cross Sensitivity

500 ppm hydrochloric acid, 500 ppm sulphur dioxide, 500 ppm ammonia or 100 ppm arsine do not affect the indication.
Methyl mercaptan and ethyl mercaptan change the entire indicating layer to a pale yellow. when mixed with hydrogen sulphide the reading is extended by approx. 30 %.

Evaluation	reading on the (n= 10) scale = ppm H_2S

Order Code
67 28 531

Water Vapour 5/a-P

Application Range

Standard Measuring Range:	5 to 250 mg/m^3
Test Volume:	50 L
Flow Rate:	2 L / min
Time for Measurement:	app. 25 min
Standard Deviation:	± 15 to 22 %
Colour Change:	yellow —> reddish-brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$H_2O + SeO_2 + H_2SO_4 \longrightarrow$ reddish-brown reaction product

Cross Sensivity

Alcohols and unsaturated hydrocarbons of high concentrations may cause a diffused discoloration of the indicating layer.

Extension of the measuring range

The following evaluation applies for other volumes:

reading:	5	10	30	50	70	100	150	200 mgH_2O/m^3
25 L vol.:	10	20	70	110	160	220	340	450 mg H_2O/m^3
100 L vol.:	2	4	12	20	28	40	60	80 mg H_2O/m^3

i.e. given a test volume of 25 L the scale reading of 50 mg H_2O/m^3 corresponds to a measured value of 110 mg H_2O/m$_3$

Relative Standard Deviation:	± 25 to 30 % (25 L) ± 20 to 25 % (100 L)

Water Vapour 20/a-P

Order Code
81 03 061

ST-908-2001

Application Range

Standard Measuring Range:	20 to 100 mg H_2O/m^3 (10 min measuring time) 100 to 500 mg H_2O/m^3 (5 min measuring time)
Test Volume:	40 L / 20 L
Flow Rate:	4 L / min
Time for Measurement:	10 min / 5 min
Standard Deviation:	± 15 to 20 %
Colour Change:	yellow —> reddish-brown

Ambient Operating Conditions

Humidity:	cf. measuring range
Pressure:	The tube may only be used for depressurized compressed air

Reaction Principle

$H_2O + SeO_2 + H_2SO_4 \longrightarrow$ reddish brown reaction product

Cross Sensivity

Alcohols and unsaturated hydrocarbons of high concentrations may cause a diffused discoloration of the indicating layer.

3.5.

Description of Direct Indicating Dräger Diffusion Tubes

Order Code
81 01 071

Acetic Acid 10/a-D

Application Range

Standard Range	Measurement Time
10 to 200 ppm	1 h
5 to 100 ppm	2 h
2.5 to 50 ppm	4 h
1.3 to 25 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	blue violet —> yellow

Ambient Operating Conditions

Temperature	20 to 25 °C
Absolute Humidity	1 to 15 mg H_2O / L

Reaction Principle

Acetic acid + pH Indicator —> yellow reaction product

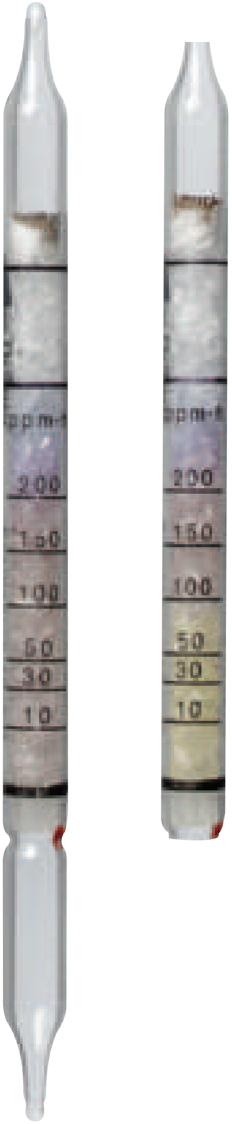
Cross Sensitivity

Other acid reacting substances are also indicated. It is impossible to measure acetic acid in the presence of other acids.

Formic acid and sulphur dioxide are indicated with about the same sensitivity and colour.

Hydrochloric acid is indicated with a lower sensitivity and pink colour.

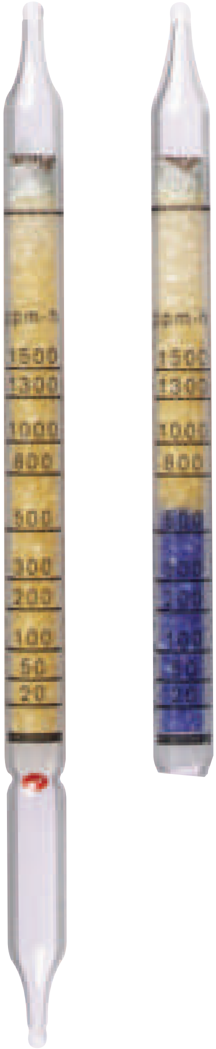
Nitrogen dioxide and chlorine also have an influence on the indication.



ST-229-2001

Ammonia 20/a-D

**Order Code
81 01 301**



ST-210-2001

Application Range

Standard Range	Measurement Time
20 to 1,500 ppm	1 h
10 to 750 ppm	2 h
4 to 300 ppm	5 h
2.5 to 200 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	yellow —> blue

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity	1 to 16 mg H_2O / L

Reaction Principle

NH_3 + Bromophenol blue —> blue reaction product

Cross Sensitivity

Other basic reacting compounds are also indicated. It is impossible to measure ammonia in the presence of other basic gases.

Order Code
81 01 161

Butadiene 10/a-D

Application Range

Standard Range	Measurement Time
10 to 300 ppm	1 h
5 to 150 ppm	2 h
2.5 to 75 ppm	4 h
1.3 to 40 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	pink —> light brown

Ambient Operating Conditions

Temperature	20 to 25 °C
Absolute Humidity	1 to 15 mg H_2O / L

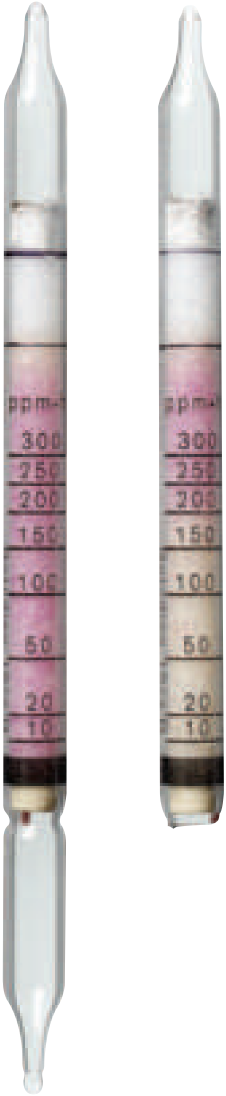
Reaction Principle

$H_2C=CH-CH=CH_2 + KMnO_4$ —> Mn^{IV} + various oxidation products

Cross Sensitivity

Other organic compounds with carbon - carbon double bonds are also indicated, for example:

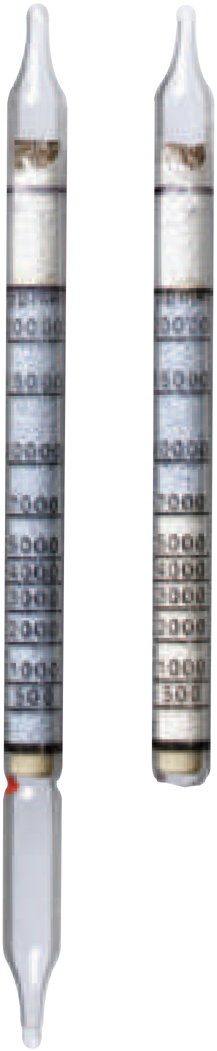
Substance measured	Concentration present	Measuring period	Indication
Chloroprene	10 mL/m³ (ppm)	5 hours app.	50 ppm x h
Ethylene	10 mL/m³ (ppm)	6 hours app.	50 ppm x h (diffuse)



ST-243-2001

Carbon Dioxide 500/a-D

Order Code
81 01 381


ST-175 -2001

Application Range

Standard Range	Measurement Time
500 to 20,000 ppm	1 h
250 to 10,000 ppm	2 h
125 to 5,000 ppm	4 h
65 to 2,500 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	blue –> white

Ambient Operating Conditions

Temperature:	10 to 30 °C
Absolute Humidity	1 to 16 mg H_2O / L

Reaction Principle

CO_2 + pH Indicator –> white reaction product

Cross Sensitivity

Other acid reacting substances are also indicated, but normally this is not a problem unless the concentrations exceed the TLVs. For example, the following substances do not interfere during a 4-hour measurement.

100 ppm ammonia
50 ppm sulphur dioxide
50 ppm nitrogen dioxide
50 ppm hydrogen sulphide
25 ppm hydrochloric acid

Order Code
81 01 051

Carbon Dioxide 1%/a-D

Application Range

Standard Range	Measurement Time
1 to 30 Vol.-%	1 h
0.3 to 10 Vol.-%	3 h
0.2 to 6 Vol.-%	5 h
0.13 to 4 Vol.-%	8 h

Standard Deviation	± 20 to 25 %
Colour Change	blue –> white

Ambient Operating Conditions

Temperature	10 to 30 °C
Absolute Humidity	1 to 15 mg H_2O / L

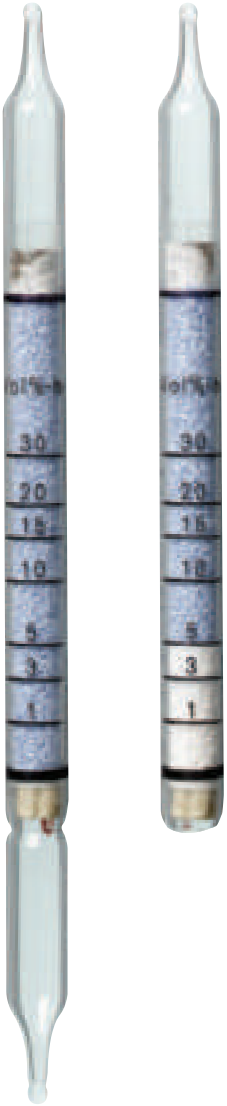
Reaction Principle

CO_2 + pH Indicator –> white reaction product

Cross Sensitivity

Other acid reacting substances are also indicated, but normally this is not a problem unless the concentrations exceed the TLVs. For example, the following substances do not interfere during a 4-hour measurement.

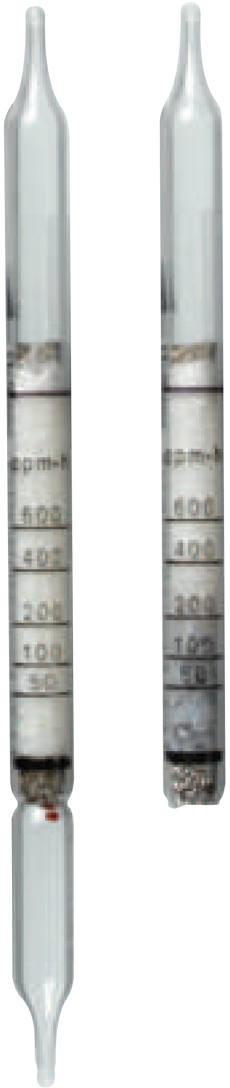
100 ppm ammonia
50 ppm sulphur dioxide
50 ppm nitrogen dioxide
50 ppm hydrogen sulphide
25 ppm hydrochloric acid



ST-245-2001

Carbon Monoxide 50/a-D

Order Code
67 33 191



ST-234-2001

Application Range

Standard Range	Measurement Time
50 to 600 ppm	1 h
25 to 300 ppm	2 h
10 to 120 ppm	5 h
6 to 75 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	yellow —> grey black

Ambient Operating Conditions

Temperature:	10 to 25 °C
Absolute Humidity	3 to 15 mg H_2O / L

Reaction Principle

$CO + \text{Pd-Salt} \longrightarrow CO_2 + Pd$

Cross Sensitivity

There is no interference during a 4-hour measurement by:

100 ppm ammonia
4 ppm sulphur dioxide
25 ppm nitrogen dioxide
2,000 ppm n-butane

Following a 4-hour exposure, 20 ppm hydrogen sulphide simulates an indication of approximately 50 ppm x h carbon monoxide.

Order Code
81 01 151

Ethanol 1000/a-D

Application Range

Standard Range	Measurement Time
1,000 to 25,000 ppm	1 h
500 to 12,500 ppm	2 h
200 to 5,000 ppm	5 h
125 to 3,100 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	yellow —> green

Ambient Operating Conditions

Temperature	0 to 40 °C
Absolute Humidity	1 to 16 mg H_2O / L

Reaction Principle

$H_3C\text{-}CH_2OH + Cr^{VI} \longrightarrow Cr^{III}$ + various oxidation products

Cross Sensitivity

Other organic compounds are also indicated, but with different sensitivities. It is impossible to differentiate them.

Methyl ethyl ketone and methanol are indicated with about twice the sensitivity (e.g. 500 ppm x h MEK gives an indication of 1,000 ppm x h).

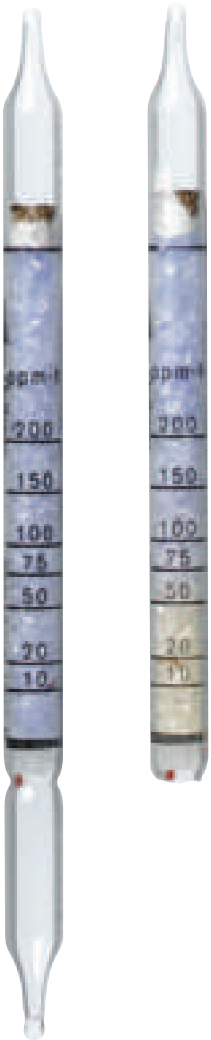
Isopropanol is indicated with about half the sensitivity.

Acetone and ethyl acetate in the TLV range have no influence on the indication.

ST-233-2001

Hydrochloric Acid 10/a-D

**Order Code
67 33 111**



ST-218-2001

Application Range

Standard Range	Measurement Time
10 to 200 ppm	1 h
5 to 100 ppm	2 h
2.5 to 50 ppm	4 h
1.3 to 25 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	blue –> yellow

Ambient Operating Conditions

Temperature:	18 to 22 °C
Absolute Humidity	3 mg H_2O / L

Reaction Principle

HCl + Bromophenol blue –> yellow reaction product

Cross Sensitivity

10 ppm Sulphur dioxide has no influence on the indication during an 8-hour measurement.

Other acid gases are also indicated, but with different discolorations and sensitivities.

Nitrogen dioxide discolours the indicating layer red brown.

After 4-hours, 5 ppm chlorine simulates a hydrochloric acid indication of 35 ppm x h.

Order Code
67 33 221

Hydrocyanic Acid 20/a-D

Application Range

Standard Range	Measurement Time
20 to 200 ppm	1 h
10 to 100 ppm	2 h
5 to 50 ppm	4 h
2.5 to 25 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	yellow –> red

Ambient Operating Conditions

Temperature	5 to 30 °C
Absolute Humidity	3 to 15 mg H_2O / L

Reaction Principle

a) $HCN + HgCl_2 \rightarrow HCl$

b) HCl + pH Indicator –> red reaction product

Cross Sensitivity

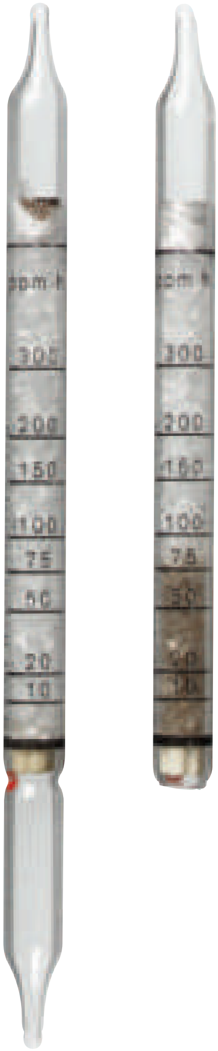
No interference by:

40 ppm ammonia
10 ppm hydrogen sulphide
5 ppm nitrogen dioxide
5 ppm hydrochloric acid
2 ppm sulphur dioxide

ST-230-2001

Hydrogen Sulphide 10/a-D

Order Code
67 33 091



ST-162-2001

Application Range

Standard Range	Measurement Time
10 to 300 ppm	1 h
5 to 150 ppm	2 h
2.5 to 75 ppm	4 h
1.3 to 40 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	white —> brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity	< to 15 mg H_2O / L

Reaction Principle

$H_2S + Pb_2+ \longrightarrow PbS + 2 H^+$

Cross Sensitivity

50 ppm Hydrochloric acid does not interfere.

In the presence of 50 ppm ammonia for 2 hours, the hydrogen sulphide indication will show minus errors of about 20%.

The influence of chlorine and nitrogen dioxide in the TLV range is negligible, but higher concentrations lead to minus errors.

The influence of sulphur dioxide in the TLV range is also negligible, but higher concentrations lead to plus errors.

Order Code
81 01 111

Nitrogen Dioxide 10/a-D

Application Range

Standard Range	Measurement Time
10 to 200 ppm	1 h
5 to 100 ppm	2 h
2.5 to 50 ppm	4 h
1.3 to 25 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	white –> yellow orange

Ambient Operating Conditions

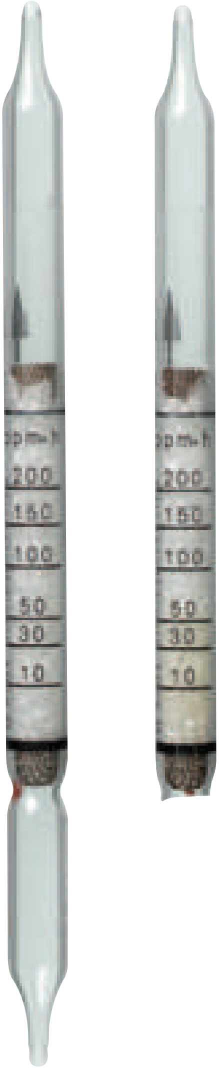
Temperature	0 to 40 °C
Absolute Humidity	5 to 15 mg H_2O / L

Reaction Principle

NO_2 + o-Tolidine –> yellow orange reaction product

Cross Sensitivity

Chlorine and ozone are also indicated with approximately half the indicating sensitivity (e.g. 20 ppm x h chlorine gives an indication of 10 ppm x h). No influence by 5 ppm sulphur dioxide and 100 ppm ammonia.



ST-235-2001

Perchloroethylene 200/a-D

Order Code 81 01 401

ST-221-2001

Application Range

Standard Range	Measurement Time
200 to 1,500 ppm	1 h
100 to 750 ppm	2 h
50 to 380 ppm	4 h
25 to 200 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	white –> yellow orange

Ambient Operating Conditions

Temperature:	0 to 35 °C
Absolute Humidity	5 to 12 mg H_2O / L

Reaction Principle

a) $Cl_2C{=}CCl_2 + Cr^{VI} \rightarrow Cl_2$

b) Cl_2 + o-Tolidine –> yellow orange reaction product

Cross Sensitivity

Other chlorinated hydrocarbons are also indicated, but with different sensitivities.

Trichloroethylene and 1,1,1-trichloroethane are indicated with about the same sensitivity.

Chlorine (above 10 ppm x h) and nitrogen dioxide (above 10 ppm x h) will discolour the indicating layer.

Order Code
81 01 091

Sulphur Dioxide 5/a-D

Application Range

Standard Range	Measurement Time
5 to 150 ppm	1 h
2.5 to 75 ppm	2 h
1.3 to 38 ppm	4 h
0.7 to 19 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	blue violet —> light yellow

Ambient Operating Conditions

Temperature	10 to 30 °C
Absolute Humidity	1 to 15 mg H_2O / L

Reaction Principle

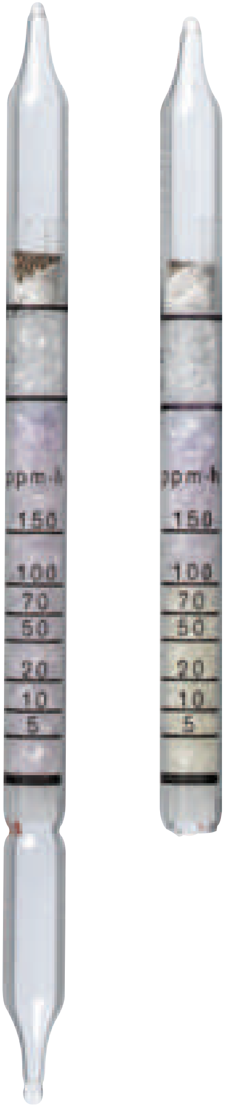
SO_2 + pH Indicator —> light yellow reaction product

Cross Sensitivity

It is impossible to measure sulphur dioxide in the presence of other acidic substances.

During a 6-hour measurement, 10 ppm hydrochloric acid produces a pink colour up to 25 ppm x h. During a 4-hour measurement, 20 ppm acetic acid produces a yellow colour up to 60 ppm x h.

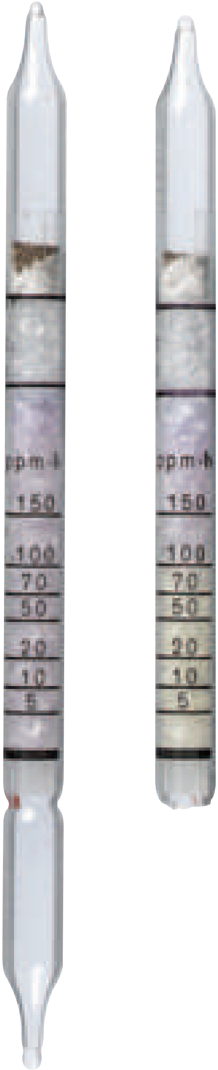
Nitrogen dioxide and chlorine also have an influence on the indication.



ST-244-2001

Toluene 100/a-D

Order Code 81 01 421



ST-224-2001

Application Range

Standard Range	Measurement Time
100 to 3,000 ppm	1 h
50 to 1,500 ppm	2 h
25 to 750 ppm	4 h
13 to 380 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	yellow —> brown

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity	1 to 15 mg H_2O / L

Reaction Principle

$C_6H_5CH_3 + Ce(SO_4)_2 \longrightarrow$ brown reaction product

Cross Sensitivity

Other aromatic hydrocarbons are also indicated, but with different sensitivities.

During a 6-hour measurement, 100 ppm ethyl benzene produces a diffuse indication up to 600 ppm x h.

During a 6-hour measurement, 100 ppm xylene produces an indication up to 300 ppm x h.

Benzene in the TLV range does not interfere.

Aliphatic hydrocarbons are not indicated.

Order Code
81 01 441

Trichloroethylene 200/a-D

Application Range

Standard Range	Measurement Time
200 to 1,000 ppm	1 h
100 to 500 ppm	2 h
50 to 250 ppm	4 h
25 to 125 ppm	8 h

Standard Deviation	± 20 to 25 %
Colour Change	white —> yellow orange

Ambient Operating Conditions

Temperature	0 to 35 °C
Absolute Humidity	5 to 12 mg H_2O / L

Reaction Principle

a) $HClC{=}CCl_2 + Cr^{VI} \rightarrow Cl_2$

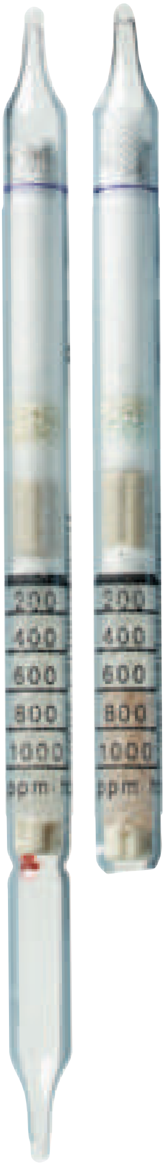
b) Cl_2 + o-Tolidine —> yellow orange reaction product

Cross Sensitivity

Other chlorinated hydrocarbons are also indicated, but with different sensitivities.

Perchloroethylene is indicated with a slightly higher sensitivity and 1,1,1-trichloroethane with about twice the sensitivity (e.g. 200 ppm x h 1,1,1-trichloroethane gives an indication of 400 ppm x h).

Chlorine and nitrogen dioxide in dosages higher than 10 ppm x h also discolour the indicating layer.



3.6.

Description of Dräger Sampling Tubes and Systems

Order Code
67 33 011

Activated Charcoal Tube Type BIA

ST-249-2001

Application Range	
Adsorbate	organic compounds which adsorb on activated charcoal
Sorption agent	coconut shell charcoal
Adsorption layer	300 mg
Backup layer	700 mg

Tube length	125 mm
Outside diameter	7 mm
Inside diameter	5 mm

Gas detector pumps	Dräger Gas Detector Pump accuro Dräger Automatic Pump accuro 2000 with the Dräger Gas Detector Pump accuro Dräger Quantimeter 1000

Advice for sample-taking

This construction is developed, for a high adsorption capacity of the sampling layer.This tube is typically sufficient for sampling in the range of limit value measurements. If higher concentrations of harmful substances are expected, the sampling tube must be inserted with the air flow opposite to the flow indicating arrow (long layer in front; note in the sampling record!). After sampling the tube should be sealed with the polyethylene supplied caps.

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Activated Charcoal Tube Type G

Order Code
67 28 831

ST-91-2001

Application Range	
Adsorbate	organic compounds which adsorb on activated charcoal
Sorption agent	coconut shell charcoal
Adsorption layer	750 mg
Backup layer	250 mg
Tube length	125 mm
Outside diameter	7 mm
Inside diameter	5 mm
Gas detector pumps	Dräger Gas Detector Pump accuro Dräger Automatic Pump accuro 2000 with the Dräger Gas Detector Pump accuro Dräger Quantimeter 1000

Advice for sample-taking

Because of the large quantity of activated charcoal in the sampling layer these activated charcoal tubes are specially suitable for the sampling of organic compunds which are present in high concentrations in the air sample. For example the analysis of exhaust air for the determination of the emission of a harmful substance.
After sampling the tube must be sealed with the polyethylene supplied caps .

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Order Code
67 28 631

Activated Charcoal Tube Type NIOSH


ST-101-2001

Application Range	
Adsorbate	organic compounds which adsorb on activated charcoal
Sorption agent	coconut shell charcoal
Adsorption layer	100 mg
Backup layer	50 mg

Tube length	70 mm
Outside diameter	6 mm
Inside diameter	4 mm

Gas detector pumps	Dräger Gas Detector Pump accuro Dräger Automatic Pump accuro 2000 with the Dräger Gas Detector Pump accuro Dräger Quantimeter 1000

Advice for sample-taking

The air to be analysed must be drawn through the tube at a constant flow rate between 0.01 and 0.2 L/min. During sampling the activated charcoal tube should be in a vertical position. This guarantees a constant flow of air through the activated charcoal.
NIOSH points out in its regulations that the absorption capacity of activated charcoal is affected by high air humidity, which may result in premature breakthrough of the substance to be measured into the control layer [8]. A special tube adapter (order no. 67 28639) is necessary in order to use Drager pumps for sampling. After sampling the tube should be sealed with the polyethylene supplied caps.

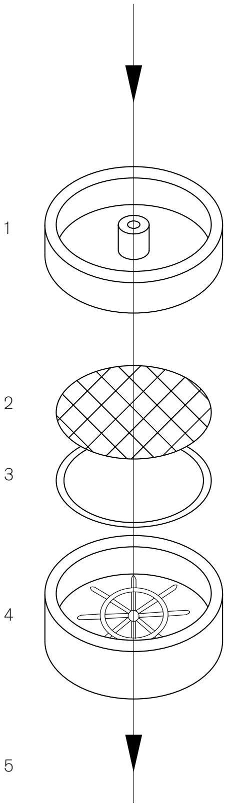
Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Aldehyde Sampling Set

Order Code
64 00 271



1 top
2 impregnated fibre glass filter
3 flat gasket
4 base
5 pump

Measurable substances	aldehydes, e.g. acetaldehyde acrolein formaldehyde glutardialdehyde
Reaction medium	with 2,4-dinitrophenylhydrazine impregnated fibreglass filter
Reaction product	hydrazone derivate
Flow	0.1 to 1 L/min
Total volume	10 to 100 L
Storage before Sampling	at 7 °C in a refrigerator, max. 2 months

Advice for sample-taking

After sampling the loaded fibreglass filter must be stored in a tightly closed container, stored in a cool place and analysed immediately in the laboratory.

The analytical determination is by high performance liquid chromatography (HPLC) after extraction of the filter.

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Order Code
81 01 271

Sampling Tube Amines

Application Range	
Adsorbate	primary, secondary and tertiary aliphatic amines, dialkyl sulphates, N-heterocyclene
Sorption agent	special silicagel
Adsorption layer	300 mg
Backup layer	300 mg
Tube length	125 mm
Outside diameter	7 mm
Inside diameter	5 mm
Gas detector pumps	Dräger Gas Detector Pump accuro Dräger Automatic Pump accuro 2000 with the Dräger Gas Detector Pump accuro Dräger Quantimeter 1000

Advice for sample-taking

Given a flow rate of 0.33 L/min (20 L/h) the pressure drop of the tube is max. 32 hPa. While sampling the air to be analysed should be sucked in the direction of the imprinted arrow through the tube with a constant flow between approximately 0.3 and 1 L/min. The volume of air to be sucked through is within the range of 1 to 100 L. After sampling the tube has to be sealed with the polyethylene caps supplies.

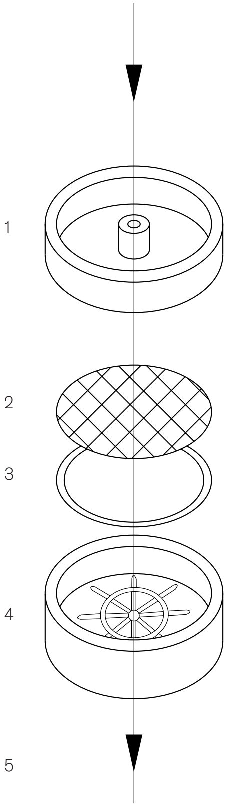
Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Isocyanate-Sampling-Set

Order Code
64 00 131



1 top
2 impregnated fibre glass filter
3 flat gasket
4 base
5 pump

Measurable substances	isocyanates, e.g. 2,4-toluylene diisocyanate (TDI) 2,6-toluylene diisocyanate (TDI) diphenylmethane-4,4' - diisocyanate (MDI) hexamethylene diisocyanate (HDI)
Reaction medium	with amine compound impregnated fibreglass filter
Reaction productr	urea derivate
Flow	1 to 2 L/min
Total volume	20 to 100 L
Storage before Sampling	at 7 °C in a refrigerator, max. 2 months

Advice for sample-taking

After sampling the loaded fibreglass filter must be stored in the tightly closed container, stored in a cool place and analysed immediately in the laboratory.

The analytical determination follows, after the extraction of the filter, by high performance liquid chromatography (HPLC).

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Order Code
81 01 472

Nitrous-Oxide Diffusion Sampler

ST-93-2001

Application Range	
Adsorbate	nitrous oxide (laughing gas)
Sorption agent	molecular sieve
Adsorption layer	400 mg
Standard range of measurement	2.5 to 500 ppm
Sampling period	8 h
Diffusion rate	0.03 µg/ppm x h
Sampling rate	0.27 mL/min
Adsorption capacity	120 µg
Tube length	115 mm
Outside diameter	7 mm
Inside diameter	5 mm

Permissible ambient conditions	
Temperature	5 to 35°C
Moisture	below 20 mg/L H_2O
Atmospheric pressure	below 1050 hPa
Air velocity	at least 1 cm/s

Advice for sample-taking

The sampling time of nitrous-oxide diffusion sampler depends on the expected oxide nitrous concentration in the air to be analysed. The following sampling times are recommended in the case of measure-ments in the range of 5 to 100 mL/m3 (ppm) nitrous oxide:

Nitrous oxide concentration	Recommended sampling time
5 ppm	4 to 8 h
25 ppm	1 to 8 h
50 ppm	30 min to 8 h
100 ppm	15 min to 8 h
500 ppm	10 min to 8 h

After sampling the tube must be sealed with the polyethylene supplied caps.

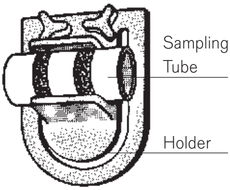
Note concerning the analysis

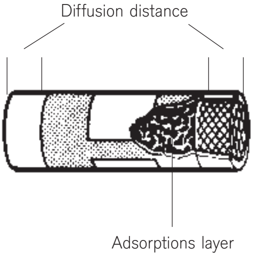
The analysis is made according to DFG method No. 2"Dinitrogen monoxide" via thermodesorption and infrared spectroscopy. For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Diffusion Sampler ORSA

Order Code
67 28 891 / 67 28 919 / 64 00 365

Transportation bottle with diffusion sampler





Application Range

Adsorbate	organic compounds which adsorb on activated charcoal by diffusion
Sorption agent	coconut shell coal
Adsorption layer	400 mg
Adsorption capacity	max. 10 mg, depends on substance
Diffusion rate	1 to 4 µg/ppm x h, depends on substance
Sampling rate	5 to 10 mL/min, depends on substance
Response time	approx. 2 s
Standard range of measurement	0.1- to 3-times the limit value for most organic solvents for a sampling period of 8 h
Sampling period	0.5 to 8 h for measurement in limit value range
Diffusion cross section	0.88 cm^2
Diffusion distance	0.5 cm
Diffusion barrier	acetate cellulose
Diffusion resistance coefficient	0.8
Apparatus constant	0.71 cm^{-1}

Permissible ambient conditions

Temperature	5 to 40°C
Moisture	5 to 80 % at 20°C
Atmospheric pressure	below 1050 hPa
Air velocity	at least 1 cm/s

Advice for sample-taking

Air sampling is carried out in the previously determined measuring period which should be documented. After sample-taking the sampling tube is sent to the laboratory for analysis in the tightly sealed glass bottle.

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE. For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Order Code
67 33 021

Silicagel Tube Type BIA

Application Range

Adsorbate	organic compounds which adsorb on silicagel
Sorption agent	silicagel
Adsorption layer	480 mg
Backup layer	1100 mg

Tube length	125 mm
Outside diameter	7 mm
Inside diameter	5 mm

Gas detector pumps	Dräger Gas Detector Pump accuro Dräger Automatic Pump accuro 2000 with the Dräger Gas Detector Pump accuro Dräger Quantimeter 1000

ST-250-2001

Advice for sample-taking

This construction is developed, for a high adsorption capacity of the sampling layer.This tube is typically sufficient for sampling in the range of limit value measurements. If higher concentrations of harmful substances are expected, the sampling tube must be inserted with the air flow opposite to the flow indicating arrow (long layer in front; note in the sampling record!). After sampling the tube must be sealed with the polyethylene supplied caps.

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Silicagel Tube Type G

Order Code
67 28 851

ST-108-2001

Application Range	
Adsorbate	organic compounds which adsorb on silicagel
Sorption agent	silicagel
Adsorption layer	1100 mg
Backup layer	450 mg
Tube length	125 mm
Outside diameter	7 mm
Inside diameter	5 mm
Gas detector pumps	Dräger Gas Detector Pump accuro Dräger Automatic Pump accuro 2000 with the Dräger Gas Detector Pump accuro Dräger Quantimeter 1000

Advice for sample-taking

Because of the large quantity of silicagel in the sampling layer these silicagel tubes are specially suitable for the sampling of organic compunds which are present in high concentrations in the air sample. For example the analysis of exhaust air for the determination of the emission of a harmful substance. After sampling the tube must be sealed with the polyethylene supplied caps.

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

Order Code
67 28 811

Silicagel Tube Type NIOSH

Application Range	
Adsorbate	organic compounds which adsorb on silicagel
Sorption agent	silicagel
Adsorption layer	140 mg
Backup layer	70 mg
Tube length	70 mm
Outside diameter	6 mm
Inside diameter	4 mm
Gas detector pumps	Dräger Gas Detector Pump accuro Dräger Automatic Pump accuro 2000 with the Dräger Gas Detector Pump accuro Dräger Quantimeter 1000

Advice for sample-taking

The air to be analysed must be drawn through the tube at a constant flow rate between 0.01 and 0.2 L/min. During sampling the silicagel tube should be in a vertical position. This guarantees a constant flow through the silicagel.
NIOSH points out in its regulations that the absorption capacity of silicagel is affected by high air humidity, which may result in premature breakthrough of the substance to be measured into the control layer [8].
A special tube adapter (order no. 67 28639) is necessary in order to use Drager pumps for sampling. After sampling the tube must be sealed with the polyethylene supplied caps.

Note concerning the analysis

The enriched volatile organic compounds are analysed in accordance with the procedures recommended by BIA, DFG, NIOSH, OSHA and HSE.

For evaluation of the sampling tubes and systems please make use of the Dräger (more detailed information can be found under www.Draeger.com/Analysenservice).

3.7.

Substances for Measurement with Dräger Sampling Tubes

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
Acetic Acid, Amyl Ester		X			
Acetic Acid, Butyl Ester	X	X			
Acetic Acid, Ethyl Ester	X	X			
Acetic Acid, sec-Hexyl Ester	X	X			
Acetic Acid, Methyl Ester	X	X			
Acetic Acid Propyl Ester	X	X			
Acetic Acid, Vinyl Ester	X	X			
Acetone	X	X			
Acetonitrile	X	X			
Acrolein					A4
Acrylic Acid, Ethyl Ester	X	X			
Acrylic Acid, Methyl Ester	X	X			
Acrylonitrile	X	X			
Allyl Alcohol		X			
Allyl Chloride	X	X			
Amine (aliphatic)				X	
Aminobutane (all isomers)				X	
Aminocyclohexane				X	
2-Aminoethanol				X	
2-Aminopropane				X	
Amyl Acetate	X	X			
iso-Amyl Alcohol	X	X			
Aniline			X		
Benzene	X	X			
Bromochlorotrifluoroethane	X	X			
2-Bromo-2-chloro-1,1,1-trifluoroethane	X	X			
Bromoethane	X	X			
Bromoform	X	X			
Bromomethane	X	X			
1,3-Butadiene	X	X			
Butanol (all isomers)	X	X			
2-Butanone	X	X			
1-Butoxy-2,3-epoxypropane		X			
2-Butoxyethanol	X	X			

I1 Isocyanate Sampling Set **H3** Sampling Tube for Hydrazine **A4** Aldehyde Sampling Set

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
Butyl Acetate (all isomers)	X	X			
n-Butyl Acrylate	X	X			
Butyl Alcohol	X	X			
Butylamine (all isomers)				X	
p-tert-Butyltoluene	X	X			
Camphor		X			
Carbon Bisulphide		X			
Carbon Disulphide	X	X			
Carbon Tetrachloride	X	X			
Chlorobenzene	X	X			
Chlorobromomethane	X	X			
2-Chloro-1,3-butadiene	X	X			
1-Chloro-2,3-epoxypropane	X	X			
Chloroethane	X	X			
2-Chloroethanol	X	X			
bis-(2-Chloroethyl) Ether	X	X			
Chloroform	X	X			
Chloromethane		X			
2-Chloroprene	X	X			
3-Chloropropene	X	X			
3-Chloro-1-propene	X	X			
2-Chlorotoluene	X	X			
2-Chloro-1,1,2-trifluoroethyl (difluoromethyl)-ether	X	X			
1-Chloro-2,2,2-trifluoroethyl (difluoromethyl)-ether	X	X			
Cresol (all isomers)			X		
Cumene	X	X			
Cyclohexane	X	X			
Cyclohexanol		X			
Cyclohexanone	X	X			
Cyclohexene	X	X			
Cyclohexylamine				X	
Diacetone Alcohol		X			

I1 Isocyanate Sampling Set **H3** Sampling Tube for Hydrazine **A4** Aldehyde Sampling Set **L2** Laughing Gas-Diffusion Sampler

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
1,2-Diaminoethane				X	
1,2-Dibromomethane	X	X			
1,2-Dichlorobenzene	X	X			
1,4-Dichlorobenzene	X	X			
o-Dichlorobenzene	X	X			
p-Dichlorobenzene	X	X			
2,2-Dichlorodiethyl Ether	X	X			
Dichlorodifluoromethane	X	X			
1,1-Dichloroethane	X	X			
1,2-Dichloroethane	X	X			
1,1-Dichloroethylene	X	X			
1,2-Dichloroethylene	X	X			
Dichlorofluoromethane	X	X			
Dichloromethane	X	X			
1,1-Dichloro-1-nitroethane	X	X			
1,2-Dichloropropane	X	X			
1,2-Dichloro-1,1,2,2-tetrafluoroethane	X	X			
Diethylamine				X	
Diethyl Ether	X	X			
Diethyl Sulphate				X	
Difluorobromomethane	X	X			
Difluorodibromomethane	X	X			
Difluoromonochloromethane	X	X			
Diisobutyl Ketone	X	X			
Diisopropyl Ether	X	X			
Dimethylamine				X	
N,N-Dimethylaniline		X			
Dimethylbenzene	X	X			
1,3-Dimethylbutyl Acetate	X	X			
1,1-Dimethylethylamine				X	
N,N-Dimethylethylamine				X	
Dimethylformamide				X	
Dimethyl Sulphate				X	
1,4-Dioxane	X	X			

I1 Isocyanate Sampling Set **H3** Sampling Tube for Hydrazine **A4** Aldehyde Sampling Set **L2** Laughing Gas-Diffusion Sampler

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
Diphenyl Ether (vapour)		X			
Diphenylmethane-4,4´-diisocyanate					I1
4,4´-Diphenylmethane Diisocyanate					I1
Enflurane	X	X			
Epichlorohydrin	X	X			
1,2-Epoxypropane		X			
1,2-Ethanediol	X	X			
Ethanol	X	X			
Ethanolamine				X	
Ether	X	X			
2-Ethoxyethanol	X	X			
2-Ethoxyethyl Acetate	X	X			
Ethyl Acetate	X	X			
Ethyl Acrylate	X	X			
Ethyl Alcohol	X	X			
Ethylamine				X	
Ethylbenzene	X	X			
Ethyl Bromide	X	X			
Ethyl Chloride	X	X			
Ethylene Chloride	X	X			
Ethylene Chlorohydrin	X	X			
Ethylenediamine				X	
Ethylene Dibromide	X	X			
Ethylene Dichloride	X	X			
Ethylene Glycol	X	X			
Ethylene Glycol Mono-					
butyl Ether	X	X			
butyl Ether Acetate	X	X			
ethyl Ether	X	X			
ethyl Ether Acetate	X	X			
methyl Ether	X	X			
methyl Ether Acetate	X	X			
Ethylene Oxide	X	X			
Ethyl Ether	X	X			

I1 Isocyanate Sampling Set **H3** Sampling Tube for Hydrazine **A4** Aldehyde Sampling Set **L2** Laughing Gas-Diffusion Sampler

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
Ethyl Formate	X	X			
Ethyl Glycol Acetate	X	X			
Ethyl Methyl Ketone	X	X			
Fluorotrichloromethane		X			
Formaldehyde			X		A4
Formic Acid Ethyl Ester	X	X			
Gasoline	X	X			
Glutaraldehyde					A4
Halothane	X	X			
HDI					I1
Heptane (all isomers)	X	X			
Hexachloroethane	X	X			
1,6-Hexamethylene Diisocyanate					I1
Hexamethylene Diisocyanate					I1
Hexane	X	X			
2-Hexanone	X	X			
Hexone	X	X			
sec-Hexyl Acetate	X	X			
Hydrazine					H3
4-Hydroxy-4-methylpetanone-2		X			
Iodomethane		X			
Isoamyl Alcohol	X	X			
Isocyanate					I1
Isoflurane	X	X			
Isophorone		X			
Isopropenyl Benzene	X	X			
Isopropyl Acetate	X	X			
Isopropyl Alcohol	X	X			
Isopropylamine				X	
Isopropylbenzene	X	X			
Isopropyl Ether	X	X			
Laughing Gas					L2
MDI					I1
Mesityl Oxide	X	X			

I1 Isocyanate Sampling Set **H3** Sampling Tube for Hydrazine **A4** Aldehyde Sampling Set **L2** Laughing Gas-Diffusion Sampler

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
Methanol			X		
2-Methoxyethanol	X	X			
2-Methoxyethyl Acetate	X	X			
Methyl Acetate	X	X			
Methyl Acrylate	X	X			
Methylamine				X	
Methylamyl Alcohol		X			
Methyl Alcohol			X		
Methyl Bromide	X	X			
Methyl Butyl Ketone	X	X			
Methyl Chloride		X			
Methyl Chloroform	X	X			
Methylcyclohexane	X	X			
Methylcyclohexanol		X			
Methylene Chloride	X	X			
4,4'-Methylenediphenyl Diisocyanate					I1
Methyl Ethyl Ketone	X	X			
Methyl Glycol Acetate	X	X			
Methyl Iodide		X			
Methylisobutyl Carbinol		X			
Methyl Isobutyl Ketone	X	X			
Methyl Methacrylate	X	X			
4-Methyl-2-pentanol		X			
4-Methyl-2-pentanone	X	X			
2-Methyl-2-penten-4-one	X	X			
4-Methyl-3-penten-2-one	X	X			
2-Methyl-2-propanol	X	X			
Methyl Propyl Ketone	X	X			
N-Methyl-2-pyrrolidone (vapour)				X	
alpha-Methylstyrene	X	X			
Methyl Styrene	X	X			
Monochlorodifluoromethane		X			
Naphthalene		X			
Nitrobenzene			X		

I1 Isocyanate Sampling Set **H3** Sampling Tube for Hydrazine **A4** Aldehyde Sampling Set **L2** Laughing Gas-Diffusion Sampler

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
Nitropropane			X		
2-Nitropropane			X		
Nitrotoluene			X		
Nitrous Oxide					L2
Octane	X	X			
Pentane (all isomers)	X	X			
2-Pentanone	X	X			
Pentyl Acetate		X			
Perchloroethane	X	X			
Perchloroethylene	X	X			
Phenol			X		
Phenylethylene	X	X			
Propanol (all isomers)	X	X			
2-Propenal					A4
2-Propen-1-ol		X			
Propyl Acetate (all isomers)	X	X			
Propyl Alcohol (all isomers)	X	aX			
Propylene Dichloride	X	X			
1,2-Propylene Oxide	X	X			
n-Propyl Nitrate		X			
Pyridine	X	X			
R-11		X			
R-12		X			
R-21		X			
R-112	X	X			
R-113	X	X			
R-114	X	X			
Styrene	X	X			
TDI					I1
1,1,1,2-Tetrachloro-2,2-difluoroethane	X	X			
1,1,2,2-Tetrachloro-1,2-difluoroethane	X	X			
1,1,2,2-Tetrachloroethane	X	X			
Tetrachloroethylene	X	X			
Tetrachloromethane	X	X			

I1 Isocyanate Sampling Set **H3** Sampling Tube for Hydrazine **A4** Aldehyde Sampling Set **L2** Laughing Gas-Diffusion Sampler

Substance	ORSA	Activated Charcoal	Silica Gel	Amine	Other
Tetrahydrofuran	X	X			
Toluene	X	X			
Toluene Diisocyanate					I1
Toluene-2,4-diisocyanate					I1
Toluene-2,6-diisocyanate					I1
1,1,1-Trichloroethane	X	X			
1,1,2-Trichloroethane	X	X			
Trichloroethylene	X	X			
Trichlorofluormethane	X	X			
Trichloromethane	X	X			
1,2,3-Trichloropropane	X	X			
1,1,2-Trichloro-1,2,2-trifluoroethane	X	X			
Triethylamine				X	
Trifluorobromomethane	X	X			
Trimethylbenzene	X	X			
3,5,5-Trimethyl-2-cyclohexen-1-one	X	X			
Turpentine		X			
Vinyl Acetate	X	X			
Vinylbenzene	X	X			
Vinyl Chloride		X			
Vinylidene Chloride	X	X			
n-Vinyl-2-pyrrolidone				X	
Vinyltoluene	X	X			
Xylene (all isomers)	X	X			

4. Dräger CMS®

Chip-Measurement-System for Spot Check Measurement of Gases and Vapors

4.1. The Philosophy of the Chip-Measurement-System Dräger CMS

The market for measuring hazardous substances in air is significantly affected by regulatory requirements, but it is also driven by growing awareness of workers, and the general public regarding workplace hazards. Continual changes of requirements and needs in the market have been the motivating factors guiding the measurement and detection of gases and vapors in the workplace.

Decreasing limit values and increasing measurement needs have driven a growing demand for more practical and especially direct indicating systems for spot measurements:

- Higher Sensitivity,
- Higher Selectivity,
- Higher Flexibility,
- Higher Reliability,
- Ease of Handling.

Dräger has recognized these demands and has responded with the Chip-Measurement-System

Today the Dräger CMS completes the range of existing measuring methods. It combines the practical needs of the user with the power of intelligent technology. It is one of the most accurate and reliable spot measurement systems currently available for measurement of gas and vapor components. The Dräger CMS represents the new standard in the range of various measurement instruments being used in the market.

The Dräger CMS is characterized by many and unique advantages:

Simple Operation	- simple commands in backlighted display, - system recognizes the measurement task without user input, - identical procedure for all substances, : - one-switch operation, - display text available in multiple languages.
Accuracy	- mass-flow regulated pump (= compensates for pressure fluctuations), - optical measurement and electronic evaluation, - results displayed in digital read out, - well-known and therefore controllable cross sensitivities.

Reliability	- automatic system self-test, - calibrated chips, - chip shelf life of up to two years, - robust analyzer.
Economical	- low training costs, - no calibration of chips necessary, - immediately available for measurement (no waiting for warm-up time), - saves time (quick measurements), - high flexibility.
Environmentally friendly	- fewer materials used in manufacturing, - least possible chemical reagent, - high recycleability of chips.

4.2. The Components of the Dräger CMS

The Chip-Measurement-System is a system for the quantitative determination of hazardous gas or vapor concentrations in air. The measurements are carried out in the workplace to monitor for hazardous gas concentrations, process control, and for measurements in confined spaces, etc. This system is designed for short-term measurements. The complete measuring system consists of two main key components:

- Substance-Specific Chips
- Analyzer

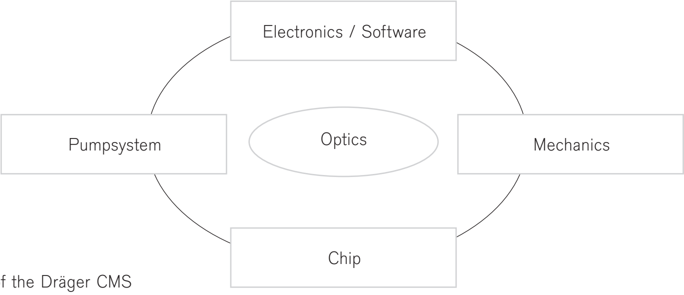

ST-156-2004

ST-1347-2004

The Chip-Measurement-System

The Chip-Measurement-System combines the advantages of five components:

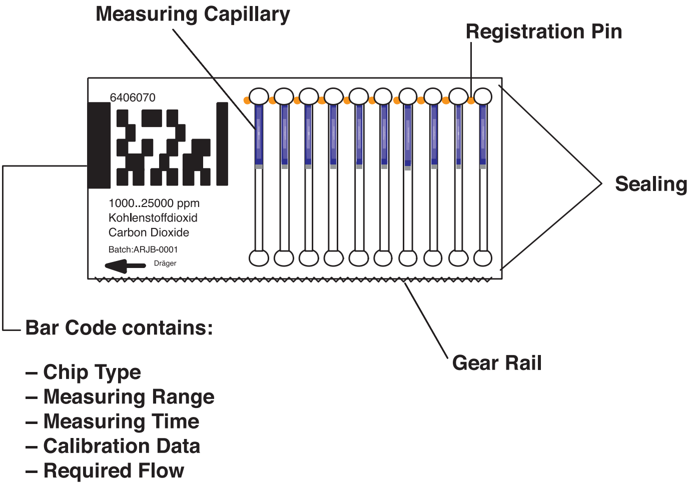
- the chip as capillary array for 10 possible measurements,
- optics for detection of the reaction products,
- the pump system with mass-flow controller to draw in ambient air and ensure a constant air mass-flow,
- mechanics designed to position the chip into the analyzer and to open and test the corresponding capillary in preparation for measuring,
- electronics and software to control and regulate the measuring procedure, to process the signal and of course to provide a digital display of the measured concentrations.



Five Components of the Dräger CMS

4.2.1. The Chip

Each chip contains ten measurement capillaries filled with a substance-specific reagent system. Compared to other measurement systems, chemical reagent systems have distinct advantages. One reason for this is, that it is possible to supplement the reacting layer with one or more pre-layers to adsorb moisture, to trap interfering substances, or to convent substances into measurable substances. This ensures that the result of the measurement will be substance-specific. Furthermore cross- sensitivities can be analyzed and tested in detail. This detailed knowledge provides a means for controlling and correcting for cross-sensitivities. The reactive preparations necessary for detection are kept in hermetically-sealed glass capillaries until needed. The housing of the chip also protects the capillaries from possible external mechanical or chemical influences.



The Chip

When the chip is inserted into the analyzer, all information required for detection is transfered to the analyzer by means of a bar code:

- type of gas,
- measuring range,
- measuring time,
- parameters for the calibration function,
- required flow rate.

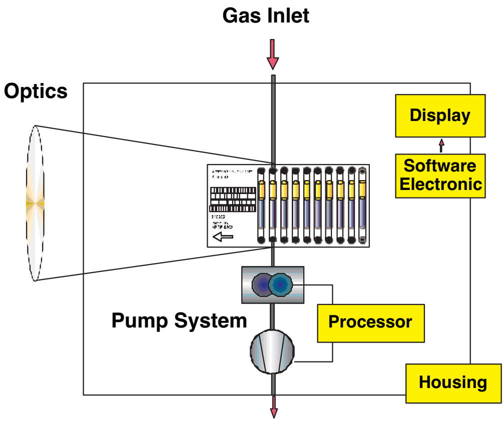
The measuring procedure is always the same, so there is no need to remember multiple procedures for different chips. This allows simple and short-time user training and makes working with this new system on a daily basis much easier.
The quantity of reagent used in each capillary is extremely small, resulting in high sensitivity to the measured gas. Furthermore, the use of smaller amounts of active chemicals has a considerable environmental benefit as regards disposal and preparation for re-use - the amount of work involved in this regard has been significantly reduced. The chip housings themselves can be recycled and reused without reprocessing.

4.2.2. The Analyzer

he analyzer records the measurement effect optoelectronically, thereby eliminating human factors. The gas inlet for the sample air is located at the front of the analyzer and is protected from dust and other impurities. When the integrated mechanics have established an air-tight connection between the entire gas conduction system and the open capillary of the chip, a special pump system pulls a constant mass-flow of air through the capillary.

The pump system consists of a mass-flow-controller, a processor, and a small electric membrane pump. The processor regulates the pump performance to ensure the necessary mass-flow. This combination ensures an accurate mass-flow and compensates for fluctuations in the ambient air pressure, within certain limits. No correction of the measurement result is necessary, regardless of whether the measurement is to be carried out at the Dead Sea or in the mountain air of Mexico City.

In the CMS, miniaturization has resulted in a reduction in the sample volume necessary for a measurement. For a typical measurement, only 30 mL of air is needed for a measuring time of approximately two minutes and a mass-flow of 15 mL / min. For shorter measuring times correspondingly less air is needed. This results in a more accurate measurement value which may otherwise be affected by fluctuating concentrations over a longer measurement period.



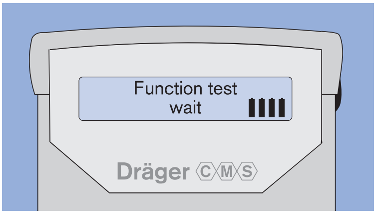
Flow Chart of the Measuring Principle

The capillaries are filled with chemical reagents and filter layers. These ensure a reliable and reproducible response when the corresponding hazardous substance is present, which is one of the main reasons for the high degree of accuracy of the measuring system.

Optoelectronic detectors within the analyzer evaluate the reaction effects in the chip capillary. This has various advantages: small changes in the reaction products can be reliably identified, and measurements can be performed even under conditions of complete darkness, since the measuring signal is electrically processed and indicated in an illuminated display.

The power supply needed for the analyzer to operate is provided by four AA batteries, which have a longer service life than rechargeable batteries on account of their lower self-discharge current.

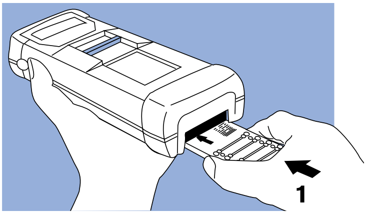
4.2.3. The Measurement



Functions-Test

The handling of the Dräger CMS is always constant, no matter what gas or vapor is measured. This is provided by simple menu driven commands given by the display as well as the one button/switch operation. The Dräger CMS can be implemented with a minimum of training costs.

The analyzer's most important operating feature is the slide switch positioned symmetrically in the middle. It is symmetrical in order to allow both left and right-handed people to use it with equal ease. The whole measurement is performed using only four switch positions.

Switch Position	Function of the Analyzer
0	Device switched off
1	Switch on analyzer - analyzer immediately performs a complete self-test, followed by the message „function test ok“, displayed for three seconds. Then the message „insert chip“prompts the user to push the chip selected for the measurement through the rear inlet flap into the analyzer. During this process the analyzer receives information, in the form of a bar code printed on the chip, which is relevant to the measurement: gas type, measuring range, flow and data for the calibration curve. The optical system calculates the number of measurements still available on the chip being used, and displays this together with the gas type and the measuring range. Five seconds later the user is instructed to set the switch to position 2  Inserting the chip
2	In this switch position the CMS automatically checks the air-tight integrity of the entire gas conduction system, right up to the chip itself, in order to exclude the occurrence of false measurements due to possible leakages. When the leak test is complete, the switch can be moved to position 3 in order to start the actual measurement process.
3	Start measurement, both ends of the capillary are open, the pump system pulls ambient air through the measuring capillary of the chips. A bar indicator in the display shows that the measurement is active, until the result of the measurement appears in the display.

In order to take another test with the same chip, the switch can be moved to position 2 and a new leak test will be conducted for analyzer version after 11/00 only.

In order to replace the chip the switch is returned to position 0, the outlet flap opens, the chip is ejected automatically, and the chip can be easily removed.

The Special Feature of Dynamic Dose Measurement

The measurement principle of the CMS is based on a dynamic dose measurement which is dependent on concentration. The basis of this principle is chemical kinetics, whereby the speed of the chemical reaction in the capillary depends on the concentration of the sample. Therefore, the measuring time is not constant, but is directly related to the concentration, i.e. the higher the concentration, the shorter the measuring time. The positioning of the optical unit allows a direct determination of the speed of the chemical reaction within the capillary. Since concentration and reaction speed are directly proportional, the analyzer terminates the measurement very quickly when high concentrations are present.

The safety advantage of the CMS which this provides is of course immediately obvious, as a reduced measuring time at higher concentrations also means a very quick display of the measurement result, thereby providing information about possible gas dangers more quickly. For example, for nitrogen dioxide at a concentration of 5 ppm in accordance with the TLV value, there is a standard measuring time of 30 to 35 seconds, whereas for a five-fold TLV value this drops to around 10 to 12 seconds.

4.2.4. The DataRecorder

The analyzer is equipped with an integrated DataRecorder and a real-time clock. In keeping with the CMS ease-of-use-philosophy, storing measurement results with the DataRecorder is a simple, menu-driven process. Up to 50 measurement results can be stored with the name of the measured substance, the concentration, date and time of the measurement, and a code letter to help identify the measurement location.

4.3. Characterization of Dräger CMS-Chips

4.3.1. Overview

Chip	Measuring Range [1)	Order Code
Acetic Acid	2 - 50 ppm	64 06 330
Acetone	40 - 600 ppm	64 06 470
Ammonia	0,2 - 5 ppm	64 06 550
Ammonia	2 - 50 ppm	64 06 130
Ammonia	10 - 150 ppm	64 06 020
Ammonia	100 - 2000 ppm	64 06 570
Benzene	0,2 - 10 ppm	64 06 030
Benzene	0,5 - 10 ppm	64 06 160
Benzene	10 - 250 ppm	64 06 280
Butadiene	1 - 25 ppm	64 06 460
Carbon Dioxide	200- 3000 ppm	64 06 190
Carbon Dioxide	1000 - 25000 ppm	64 06 070
Carbon Dioxide	1 - 20 Vol.-%	64 06 210
Carbon Monoxide	5 - 150 ppm	64 06 080
Chlorine	0,2 - 10 ppm	64 06 010
Ethanol	100 - 2500 ppm	64 06 370
Ethylene Oxide	0,4 - 5 ppm	64 06 580
Formaldehyde	0,2 - 5 ppm	64 06 540
Gasodor S-Free™	5 - 30 mg/m³	64 06 590
Hydrochloric Acid	1 - 25 ppm	64 06 090
Hydrochloric Acid	20 - 500 ppm	64 06 140
Hydrocyanic Acid	2- 50 ppm	64 06 100
Hydronen Peroxide	0,2 - 2 ppm	64 06 440
Hydroqen Sulphide	0,2 - 5 ppm	64 06 520
Hydrogen Sulphide	2 - 50 ppm	64 06 050
Hydrogen Sulphide	20 - 500 ppm	64 06 150
Hydrogen Sulphide	100 - 2500 ppm	64 06 220
Mercaptan	0,25 - 6 ppm	64 06 360
Methanol	20 - 500 ppm	64 06 380
Methylene Chloride	10 - 200 ppm	64 06 510
MTBE	10 - 200 ppm	64 06 530

Chip	Measuring Range [1]	Order Code
Nitrogen Dioxide	0,5 - 25 ppm	64 06 120
Nitrous Fumes	0,5 - 15 ppm	64 06 060
Nitrous Fumes	10 - 200 ppm	64 06 240
Oxygen	1 - 30 Vol.-%	64 06 490
Ozone	25 - 1000 ppb	64 06 430
Perchloroethylene	5 - 150 ppm	64 06 040
Petrolium Hydrocarbons	20 - 500 ppm	64 06 200
Petrolium Hydrocarbons	100 - 3000 ppm	64 06 270
Phosgene	0,05 - 2 ppm	64 06 340
Phosphine	0,1 - 2,5 ppm	64 06 400
Phosphine	1 - 25 ppm	64 06 410
Phosphine	20 - 500 ppm	64 06 420
Phosphine	200 - 5000 ppm	64 06 500
Propane	100 - 2000 ppm	64 06 310
i-Propanol	40 - 1000 ppm	64 06 390
Styrene	2 - 40 ppm	64 06 560
Sulphur Dioxide	0,4 - 10 ppm	64 06 110
Sulphur Dioxide	5 - 150 ppm	64 06 180
Toluene	10 - 300 ppm	64 06 250
Trichlorethylene	5 - 100 ppm	64 06 320
Vinyl Chloride	0,3 - 10 ppm	64 06 170
Vinyl Chloride	10 - 250 ppm	64 06 230
Water Vapour	0,4 - 10 mg/L	64 06 450
o-Xylene	10 - 300 ppm	64 06 260
Training Chip	Simulation	64 06 290

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1) Technical data are subject to modifications

4.3.2. Explanation of the Data Given in the Chip Descriptions

The instructions for use may not always correspond to the data given in this book. For the use of the Dräger Chip-Measurement- System (Analyzer, Chips, Remote System, and Accessories) only the instructions for use enclosed with the product shall apply. Technical data are subject to modifications.

Measuring Range
The chip is calibrated at standard conditions 20 °C and 50 % r.h. In case of influences by temperature or humidity, correction factors are stated. In general chips can be stored up to two years.

Measuring Time
The typical measuring time for selected concentrations is given in minutes or seconds.

The speed of the measurement depends on the concentration to be measured. Therefore, the measuring time is not constant, e. g. the higher the concentration, the shorter the measuring time.

Ambient Operating Conditions
The measuring range of a chip is influenced by the ambient temperature and humidity. The recommended temperature range is given in °C and the absolute humidity limits are given in mg H_2O/L.

In cases, where influences caused by temperature or humidity occur, correction factors are stated in % of the measured value per °C or in % of the measured value per mg H_2O/L.

The Chip-Measurement-System can be used in the range of 700 to 1100 hPa air pressure. A correction within this range is not necessary.

Accuracy
The accuracy describes the deviation of the measured concentration to the true concentration and is given in % of the measured value [3,4]. A measurement result of 10 ppm and an accuracy of ± 4 % means:

the true concentrations lies in the range of 10 ppm ±4 %
or in the range of $9.6 < 10 < 10.4$ ppm.

The given accuracy is valid for the total measuring range, e. g.:

A measuring range of 2 to 50 ppm and an accuracy of ± 4 % means:

± 0.08 ppm at 2 ppm (=80 ppb at 2 ppm)

± 1 ppm at 25 ppm
± 2 ppm at 50 ppm

Reproducibility

The reproducibility is a measure of the incidental deviations of the indicated values from their mean value
(= standard deviation) and describes the closeness of a series of measured concentrations to each other [3,4]. The reproducibility is given in % and is valid for the total measuring range.

A measurement result of 10 ppm and a reproducibility of ± 7 % means:

the individual measuring results lie in the range ± 7 %
around the mean value of a series of measurement values.

Cross Sensitivity

The chips are calibrated for a specific contaminant, but under other than ideal conditions, other interfering contaminants may also be present. Other contaminants that influence the measurement are described as being cross sensitive.

The information given under the cross sensitivity section indicates which contaminants can influence the measurement and which contaminants would not influence the measurement. However, this information does not adress all possibilities.

Measurement with Remote System

Please always refer to the Instructions for Use of the Remote System. Before each measurement, the extension hose must be flushed with the air sample to be measured. The flushing phase is necessary to minimize or elimiate effects associated with the use of an extension hose (e.g. memory effects, dead volume). The duration of the flushing phase depends on factors such as:

– type and concentration of the substance to be measured,
– material, length, diameter, and age of the extension hose.

There is no standard flushing time that can be stated that would be valid for all cases. All possible factors affecting the measurement must be considered. The flushing times given in the Instructions for Use have been determined for the specified gas concentrations only. The values refer to the extension hose supplied with the remote System (length: 3 m, inside diameter: 1.5 m, new, dry, clean).

4.3.3. Description of Dräger Chips

Acetic Acid 2 - 50 ppm

Order Code
64 06 330

Measuring Range:	2 to 50 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 40 to 300 s
Rel. Standard deviation:	± 17%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 5 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Formic acid is indicated with the same sensitivity.

Acetone 40 - 600

Order Code
64 06 470

Measuring Range:	40 to 600 ppm (20°C, 50% r.h.)
Measuring Time:	approx. 60 to 600s
Rel. Standard deviation:	± 16%
Ambient Operating Conditions	
Temperature:	5 to 40 °C
Humidity:	0 to 30 mg/L (corresp. 0 to 100% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Substance	Display of Analyzer indicates
200 ppm Methylethylketon	approx. 370 ppm
100 ppm Methylisobutylketon	approx. 240 ppm
100 ppm Methanol	approx. 200 ppm
500 ppm Ethanol	approx. 500 ppm
250 ppm i-Propanol	approx. 290 ppm

Order Code
64 06 550

Ammonia 0.2 - 0.5 ppm

Measuring Range:	0.2 to 5 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 100 to 600 s
Rel. Standard deviation:	± 14%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Acid gases can cause minus errors. Other basic substances such as organic amines are indicated with differing sensitivity.

Order Code
64 06 020

Ammonia 2 - 50 ppm

Measuring Range:	2 to 50 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 15 to 140 s
Rel. Standard deviation:	± 12%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

No influence at 10 ppm NH_3 by

≤ 200 ppm hydrogen sulphide

≤ 200 ppm sulphur dioxide

Other basic substances such as organic amines are indicated with differing sensitivity.

Ammonia 10 - 150 ppm

Order Code
64 06 020

Measuring Range:	10 to 150 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 15 to 50 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

No influence at 25 ppm NH_3 by

≤ 200 ppm hydrogen sulphide
≤ 200 ppm sulphur dioxide

Other basic substances such as organic amines are indicated with differing sensitivity.

Ammonia 100 - 2000 ppm

Order Code
64 06 570

Measuring Range:	100 to 2000 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 15 to 120 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Acid gases can cause minus errors, basic substances such as organic amines are indicated with differing sensitivity. There is no indication due to 200 ppm SO_2 or 200 ppm H_2S, cause however in presence of NH_3 substantial minus errors.

Order Code
64 06 030

Benzene 0.2 - 10 ppm

Measuring Range:	0.2 to 10 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 35 to 300 s
Rel. Standard deviation:	± 25%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 0.2 ppm benzene by	
	≤ 50 ppm toluene
	≤ 50 ppm xylene
	≤ 800 ppm n-octane

Order Code
64 06 160

Benzene 0.5 - 10 ppm

Measuring Range:	0.5 to 10 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 35 to 225 s
Rel. Standard deviation:	± 25%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 0.5 ppm benzene by	
	≤ 50 ppm toluene
	≤ 50 ppm xylene
	≤ 1000 ppm n-octane

Benzene 10 - 250 ppm

Order Code
64 06 280

Measuring Range:	10 to 250 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 40 to 275s
Rel. Standard deviation:	± 18%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

No influence at 10 ppm benzene by

≤ 50 ppm toluene
≤ 50 ppm xylene
≤ 1000 ppm n-octane

Butadiene 1 - 25 ppm

Order Code
64 06 460

Measuring Range:	1 to 25 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 90 to 550 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	5 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Substance	Display of Analyzer indicates
20 ppm styrene	approx. 6 ppm
5 ppm 1-butene	approx. 1 ppm
5 ppm chloroprene	approx. 10 ppm
5 ppm propene	approx. 2 ppm

Order Code
64 06 190

Carbon Dioxide 200 - 3000 ppm

Measuring Range:	200 to 3000 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 60 to 260 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 200 ppm CO_2 by	
	≤ 1 ppm hydrogen sulphide ≤ 0.2 ppm sulphur dioxide

Order Code
64 06 070

Carbon Dioxide 1000 - 25000 ppm

Measuring Range:	1000 to 25000 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 25 to 100 s
Rel. Standard deviation:	± 7%
Ambient Operating Conditions	
Temperature:	0 to 30 °C
Humidity:	1 to 30 mg/L (corresp. 3 to 98% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 5000 ppm CO_2 by	
	≤ 10 ppm hydrogen sulphide ≤ 2 ppm sulphur dioxide

Carbon Dioxide 1 - 20 Vol%

Order Code
64 06 210

Measuring Range:	1 to 20 Vol% (20 °C, 50% r.h.)
Measuring Time:	approx. 12 to 120 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 1 Vol% CO_2 by	
	≤ 100 ppm hydrogen sulphide
	≤ 100 ppm sulphur dioxide

Carbon Monoxide 5 - 150 ppm

Order Code
64 06 080

Measuring Range:	5 to 150 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 80 to 300 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 50 mg/L (corresp. 2 to 98% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 25 ppm CO by	
≤ 1000 ppm butane	≤ 300 ppm hydrogen sulphide
≤ 1000 ppm propane	≤ 100 ppm sulphur dioxide
≤ 500 ppm n-octane	≤ 15 ppm nitrogen dioxide

Order Code
64 06 010

Chlorine 0.2 - 10 ppm

Measuring Range:	0.2 to 10 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 30 to 400 s
Rel. Standard deviation:	± 12%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	5 to 12 mg/L (corresp. 30 to 70% r.h. at 20 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 0.5 ppm chlorine by	
	≤ 10 ppm hydrochloric acid

Order Code
64 06 370

Ethanol 100 - 2500 ppm

Measuring Range:	100 to 2500 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 60 to 340 s
Rel. Standard deviation:	± 14%
Ambient Operating Conditions	
Temperature:	10 to 30 °C
Humidity:	5 to 25 mg/L (corresp. 16 to 82% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Substance	Display of Analyzer indicates
250 ppm methanol	approx. 225 ppm
500 ppm methanol	approx. 450 ppm
200 ppm n-butanol	approx. 150 ppm
100 ppm i-propanol	approx. 100 ppm

Ethylene Oxide 0.4 - 5 ppm

Order Code
64 06 580

Measuring Range:	0.4 to 5 ppm (20°C, 50% r.h.)
Measuring Time:	approx. 160 to 600s
Rel. Standard deviation:	± 25%
Ambient Operating Conditions	
Temperature:	10 to 30 °C
Humidity:	3 to 25 mg/L (corresp. 10 to 83% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Other organic substances are likewise indicated, however, with differing sensitivity.

Gasodor S-Free™ in natural gas 5-30 mg/m³

Order Code
64 06 590

Measuring Range:	5 to 30 mg/m³ in natural gas (20 °C, < 1 mg/L)
Measuring Time:	approx. 180 to 600s
Rel. Standard deviation:	± 16%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	< 1 mg/L
Air Pressure:	700 to 1100hPa

Cross Sensivity

No notification for:	
	15 mg/m³ hydrogen sulphide
	25 mg/m³ methylmercaptane
	25 mg/m³ ethylmercaptane

Order Code
64 06 540

Formaldehyde 0.2 - 5 ppm

Measuring Range:	0.2 to 5 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 100 to 600 s
Rel. Standard deviation:	± 25% (0.2 to 0.9 ppm) ± 15% (1.0 to 5.0 ppm)
Ambient Operating Conditions	
Temperature:	10 to 30 °C
Humidity:	2 to 12 mg/L (corresp. 10 to 70% r.h. at 20 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No intiuence by	≤ 5 ppm NO_2
(at 1 ppm HCHO)	≤ 5 ppm HCl

Following substances are not indicated: 0.5 ppm acrolein, 500 ppm octane, 20 ppm styrene, 10 ppm vinyl acetate. Acetaldehyde is indicated with approx. the factor 8 less than fomaldehyde.

Order Code
64 06 090

Hydrochloric Acid 1 - 25 ppm

Measuring Range:	1 to 25 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 15 to 110 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 10 mg/L (corresp. 5 to 60% r.h. at 20 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 5 ppm HCl by	
	≤ 10 ppm hydrogen sulphide ≤ 2 ppm sulphur dioxide

Hydrochloric Acid 20 - 500 ppm

Order Code
64 06 140

Measuring Range:	20 to 500 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 6 to 80 s
Rel. Standard deviation:	± 8%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 10 mg/L (corresp. 5 to 60% r.h. at 20 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 20 ppm HCl by	
	≤ 100 ppm hydrogen sulphide
	≤ 20 ppm sulphur dioxide

Hydrocyanic Acid 2 - 50 ppm

Order Code
64 06 100

Measuring Range:	2 to 50 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 30 to 260 s
Rel. Standard deviation:	± 16%
Ambient Operating Conditions	
Temperature:	0 to 30 °C
Humidity:	1 to 20 mg/L (corresp. 3 to 65% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 10 ppm HCN by	
	≤ 80 ppm hydrogen sulphide
	≤ 200 ppm ammonia
	≤ 50 ppm sulphur dioxide
	≤ 200 ppm hydrochloric acid

Order Code
64 06 440

Hydrogen Peroxide 0.2 - 2 ppm

Measuring Range:	0.2 to 2 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 180 to 600 s
Rel. Standard deviation:	± 30%
Ambient Operating Conditions	
Temperature:	10 to 30 °C
Humidity:	1 to 20 mg/L (corresp. 3 to 65% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Substances	Display of Anlayzer indicates
0.1 ppm ozone	approx. 0.3 ppm
0.5 ppm ozone	approx. 2 ppm
0.5 ppm chlorine	approx. > 2 ppm

Order Code
64 06 520

Hydrogen Sulphide 0.2 - 5 ppm

Measuring Range:	0.2 to 5 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 40 to 450 s
Rel. Standard deviation:	± 15%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 10 ppm H2S by	
	≤ 50 ppm nitrogen dioxide
	≤ 2 ppm sulphur dioxide

Mercaptan is also indicated, but with different sensitivity.

Hydrogen Sulphide 2 - 50 ppm

Order Code
64 06 050

Measuring Range:	2 to 50 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 20 to 200 s
Rel. Standard deviation:	± 7%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L
	(corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 10 ppm H2S by	
	≤ 50 ppm nitrogen dioxide
	≤ 20 ppm sulphur dioxide
	≤ 200 ppm mercaptan

Hydrogen Sulphide 20 - 500 ppm

Order Code
64 06 150

Measuring Range:	20 to 500 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 4 to 60 s
Rel. Standard deviation:	± 13%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L
	(corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 100 ppm H_2S by	
	≤ 50 ppm nitrogen dioxide
	≤ 20 ppm sulphur dioxide
	≤ 200 ppm mercaptan

Order Code
64 06 220

Hydrogen Sulphide 100 - 2500 ppm

Measuring Range:	100 to 2500 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 10 to 70 s
Rel. Standard deviation:	± 9%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 100 ppm H_2S by	
	≤ 10 ppm nitrogen dioxide
	≤ 25 ppm sulphur dioxide
	≤ 300 ppm mercaptan

Order Code
64 06 360

Mercaptan 0.25 - 6 ppm

Measuring Range:	0.25 to 6 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 70 to 480 s
Rel. Standard deviation:	± 15%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 1 ppm mercaptan by	
	≤ 10 ppm hydrogen sulphide

Methanol 20 - 500 ppm

Order Code 64 06 380

Measuring Range:	20 to 500 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 200 to 600 s
Rel. Standard deviation:	± 19%
Ambient Operating Conditions	
Temperature:	15 to 30 °C
Humidity:	5 to 25 mg/L (corresp. 16 to 82% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Substance	Display of Analyzer indicates
250 ppm i-propanol	approx. 350 ppm
250 ppm ethanol	approx. 380 ppm
100 ppm n-butanol	approx. 75 ppm

Methylene Chloride 20 - 400 ppm

Order Code 64 06 510

Measuring Range:	20 to 400 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 180 to 600 s
Rel. Standard deviation:	± 25%
Ambient Operating Conditions	
Temperature:	10 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence by (at 10 ppm CH_2Cl_2)	$\leq$ 5 ppm HCl $\leq$ 0,1 ppm Cl_2 $\leq$ 1 Vol% CO_2

Order Code
64 06 530

MTBE (tert butyl methyl ether) 10 - 200 ppm

Measuring Range:	10 to 200 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 90 to 450 s
Rel. Standard deviation:	± 15%
Ambient Operating Conditions	
Temperature:	10 to 30 °C
Humidity:	1 to 30 mg/L (corresp. 3 to 98% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Aromatics and petroleum hydrocarbons are also indicated, however, with different sensitivities.

Order Code
64 06 120

Nitrogen Dioxide 0.5 - 25 ppm

Measuring Range:	0.5 to 25 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 20 to 330 s
Rel. Standard deviation:	± 8%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 3 to 98% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

No influence at 3 ppm NO_2 by

$\leq$ 0.1 ppm ozone
$\leq$ 50 ppm sulphur dioxide

Chlorine is indicated with differing sensitivity. Nitrogen monoxide is not indicated.

Nitrous Fumes 0.5 - 15 ppm

Order Code
64 06 060

Measuring Range:	0.5 to 15 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 40 to 350 s
Rel. Standard deviation:	± 11%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 3 ppm NO_x by	
	≤ 0.1 ppm ozone
	≤ 50 ppm sulphur dioxide
Chlorine is indicated with differing sensitivity.	

Nitrous Fumes 10 - 200 ppm

Order Code
64 06 240

Measuring Range:	10 to 200 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 20 to 100 s
Rel. Standard deviation:	± 14%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 20 ppm NO_x by	
	≤ 0.2 ppm ozone
	≤ 50 ppm sulphur dioxide
Chlorine is indicated with differing sensitivity.	

Order Code
64 06 490

Oxygen 1 - 30 Vol%

Measuring Range:	1 to 30 Vol% (20 °C, 50% r.h.)
Measuring Time:	approx. 100 to 600 s
Rel. Standard deviation:	± 18%
Ambient Operating Conditions	
Temperature:	1 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 1 Vol% O_2 by	
	< 60 ppm CO
	< 0.5 Vol% CO_2
	< 200 ppm xylene
	< 100 ppm tri- and perchloroethylene
	< 1000 ppm acetone
	< 850 ppm ethyl acetate

Order Code
64 06 430

Ozone 25 - 1000 ppb

Measuring Range:	25 to 1000 ppb (20 °C, 50% r.h.)
Measuring Time:	approx. 100 to 600 s
Rel. Standard deviation:	± 20%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 25 mg/L (corresp. 2 to 50% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Substance	Display of Analyzer indicates
0.2 ppm hydrogen peroxide	approx. 50 ppb
1.0 ppm hydrogen peroxide	approx. 250 ppb
0.5 ppm chlorine	approx. 500 ppb
2.5 ppm chlorine	> 1000 ppb

Perchloroethylene 5 - 150 ppm

Order Code
64 06 040

Measuring Range:	5 to 150 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 40 to 200 s
Rel. Standard deviation:	± 12%
Ambient Operating Conditions	
Temperature:	15 to 40 °C
Humidity:	5 to 30 mg/L (corresp. 10 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 5 ppm perchloroethylene by	
	≤ 10 ppm n-octane

Petroleum Hydrocarbons 20 - 500 ppm

Order Code
64 06 200

Measuring Range:	20 to 500 ppm n-octane (20 °C, 50% r.h.)
Measuring Time:	approx. 50 to 330 s
Rel. Standard deviation:	± 15%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Substance	Display of Analyzer indicates
250 ppm n-hexane	approx. 330 ppm
250 ppm n-heptane	approx. 280 ppm
250 ppm n-nonane	approx. 150 ppm
200 ppm toluene	approx. 80 ppm
50 ppm o-xylene	< 20 ppm

Order Code
64 06 270

Petroleum Hydrocarbons 100 - 3000 ppm

Measuring Range:	100 to 3000 ppm n-octane (20 °C, 50% r.h.)
Measuring Time:	approx. 30 to 110 s
Rel. Standard deviation:	± 13%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Substance	Display of Analyzer indicates
250 ppm n-hexane	approx. 330 ppm
250 ppm n-heptane	approx. 280 ppm
250 ppm n-nonane	approx. 150 ppm
200 ppm toluene	< 100 ppm
200 ppm o-xylene	< 100 ppm

Order Code
64 06 340

Phosgene 0.05 - 2 ppm

Measuring Range:	0.05 to 2 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 90 to 420 s
Rel. Standard deviation:	± 12%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 0.05 ppm $COCl_2$ by	
	≤ 100 ppm methyl chloride
	≤ 10 ppm hydrochloric acid
	≤ 100 ppm carbon monoxide

Phosphine 0.1 - 2.5 ppm

Order Code
64 06 400

Measuring Range:	0.1 to 2.5 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 30 to 400 s
Rel. Standard deviation:	± 14%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 1 ppm PH_3 by	
	≤ 10 ppm methyl bromide

Phosphine 1 - 25 ppm

Order Code
64 06 410

Measuring Range:	1 to 25 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 50 to 600 s
Rel. Standard deviation:	± 14%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 1 ppm PH_3 by	
	≤10 ppm methyl bromide

Order Code
64 06 420

Phosphine 20 - 500 ppm

Measuring Range:	20 to 500 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 25 to 220 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 20 ppm PH3 by	
	≤ 50 ppm methyl bromide.

Order Code
64 06 500

Phosphine 200 - 5000 ppm

Measuring Range:	200 to 5000 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 20 to 200 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No infuence at 200 ppm PH_3 by	
	< 50 ppm methyl bromide

Propane 100 - 2000 ppm

Order Code
64 06 310

Measuring Range:	100 to 2000 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 60 to 360 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

No influence at 100 ppm propane by

≤ 2000 ppm methane
≤ 2000 ppm ethane

Other aliphatic hydrocarbons are also indicated, however, with differing sensitivity.

i-Propanol 40 - 1000 ppm

Order Code
64 06 390

Measuring Range:	40 to 1000 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 100 to 550 s
Rel. Standard deviation:	± 16%
Ambient Operating Conditions	
Temperature:	10 to 30 °C
Humidity:	5 to 25 mg/L (corresp. 16 to 82% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Substance	Display of Analyzer indicate
250 ppm ethanol	approx. 275 ppm
100 ppm methanol	approx. 120 ppm
100 ppm n-butanol	approx. 80 ppm

Order Code
64 06 560

Styrene 2 - 40 ppm

Measuring Range:	2 to 40 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 100 to 550 s
Rel. Standard deviation:	± 19%

Ambient Operating Conditions

Temperature:	5 to 40 °C
Humidity:	5 to 30 mg/L (corresp. 10 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

100 ppm n-octane, 50 ppm toluene, 50 ppm o-xylene, 50 ppm methanol and 50 ppm ethyl acetate are not indicated.

Order Code
64 06 110

Sulphur Dioxide 0.4 - 10 ppm

Measuring Range:	0.4 to 10 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 50 to 500 s
Rel. Standard deviation:	± 18%

Ambient Operating Conditions

Temperature:	5 to 30 °C
Humidity:	5 to 20 mg/L (corresp. 15 to 65% r.h. at 30 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

No influence at 0.4 ppm SO_2 by

	≤ 150 ppm hydrogen sulphide
	≤ 10 ppm hydrochloric acid

Sulphur Dioxide 5 - 150 ppm

Order Code
64 06 180

Measuring Range:	5 to 150 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 15 to 200 s
Rel. Standard deviation:	± 12%
Ambient Operating Conditions	
Temperature:	5 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 2 to 80% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 5 ppm SO_2 by	
	≤ 150 ppm hydrogen sulphide
	≤ 10 ppm hydrochloric acid

Toluene 10 - 300 ppm

Order Code
64 06 250

Measuring Range:	10 to 300 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 15 to 180 s
Rel. Standard deviation:	± 19%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa

Cross Sensivity

Substance	Display of Analyzer indicates
300 ppm n-octane	< 10 ppm
10 ppm o-xylene	< 10 ppm
100 ppm o-xylene	approx. 70 ppm
100 ppm benzene	approx. ≥ 120 ppm

Order Code
64 06 320

Trichloroethylene 5 - 100 ppm

Measuring Range:	5 to 100 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 40 to 300 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Substance	Display of Analyzer indicates
No influence at 5 ppm trichloroethylene by	
	≤ 10 ppm n-octane
	≤ 2 ppm hydrochloric acid
Chlorine is indicated with identical sensitivity.	

Order Code
64 06 170

Vinyl chloride 0.3 - 10 ppm

Measuring Range:	0.3 to 10 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 30 to 420 s
Rel. Standard deviation:	± 18%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 0.3 ppm vinyl chloride by	
	≤ 20 ppm hydrochloric acid
	≤ 5 ppm chlorine
	≤ 0.5 ppm trichloroethylene

Vinyl chloride 10 - 250 ppm

Order Code
64 06 230

Measuring Range:	10 to 250 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 45 to 100 s
Rel. Standard deviation:	± 12%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
No influence at 10 ppm vinyl chloride by	
	≤ 50 ppm hydrochloric acid ≤ 25 ppm chlorine ≤ 2 ppm trichloroethylene

Water Vapour 0.4 - 10 mg/L

Order Code
64 06 020

Measuring Range:	0.4 to 10 mg/L (20 °C, 50% r.h.)
Measuring Time:	approx. 20 to 120 s
Rel. Standard deviation:	± 10%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Acid and basic gases cause plus errors.	

Order Code
64 06 260

o-Xylene 10 - 300 ppm

Measuring Range:	10 to 300 ppm (20 °C, 50% r.h.)
Measuring Time:	approx. 75 to 400 s
Rel. Standard deviation:	± 19%
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 30 mg/L (corresp. 2 to 60% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	
Substance	Display of Analyzer indicates
300 ppm n-octane	< 10 ppm
100 ppm m-xylene	approx. 120 ppm
100 ppm p-xylene	approx. 140 ppm
10 ppm toluene	approx. 130 ppm
100 ppm benzene	approx. 150 ppm

Order Code
64 06 290

Trainings Chip

Measuring Range:	not applicable (20 °C, 50% r.h.)
Measuring Time:	approx. 30 s
Rel. Standard deviation:	not applicable
Ambient Operating Conditions	
Temperature:	0 to 40 °C
Humidity:	1 to 40 mg/L (corresp. 5 to 100% r.h. at 40 °C)
Air Pressure:	700 to 1100hPa
Cross Sensivity	not applicable

4.4. Appendix

4.4.1. Performance Data of the Dräger CMS

Measuring Range	depends on the chip type
Typical Measuring Time	30 seconds to 3 minutes (depends on the chip type and the concentration of hazardous gas to be measured) 20 seconds to10 minutes with special hazardous gas
Calibration	by manufacturer
Temperature (operation)	0 to 40 °C (32 to 104 °F)
Temperature (storage)	- 20 to 60 °C (- 4 to 140 °F) (Analyzer) < 25 °C (< 75 °F) (Chips)
Atmospheric Pressure	700 to 1100 hPa
Relative Humidity	0 to 95 %, not condensing
System Diagnosis	automatic self-diagnosis, microprocessor controlled for all components of the system
Display	LCD, alphanumerical digits, backlight
Menu Languages	English, German, French, Spanish
Operational Time	approx. 450 minutes of measurements (per battery pack)
Power Supply	4 x 1.5-V-batteries, only use the following types: Varta LR 6 4006** Ralsten (Energizer) LR 6 E 91* ** Duracell LR 6 MN 1500* Panasonic LR 6 MN 1500**
Weight	730 g (1.6 lbs., analyzer with batteries)
Dimensions	215 x 105 x 65 mm; 8.5" x 4.1" x 2.5" (L x W x H)

4.4.2. Approvals

Approvals / Certifications for Analyzer Set (Order code 64 05 300):

Approvals

ATEX
II 2G EEx ib IIC T4, -20 ≤ Ta ≤ +40 °C

UL, cUL
Class 1, Div 1, Group A, B, C, D,
Temp. Code T4

CSA
Class 1, Div 1, Group A, B, C, D,
Ex ia, Temp. Code T4

CE-mark
electromagnetic compatibility
(directive 89/336/EEC)

Approvals / Certifications for Analyzer Set Australia (Order code 64 05 210):

WorkCover Australia,
Class Ex ia I / II B T4 AUS Ex 3404X

4.4.3. Validation by Third Parties

Performance data of each measuring system can be found in the instructions for use. Usually the technical data will be checked by independent institutions. The results will be described from the test organization in a validation report. To date, the Chip-Measurement-System has been tested by the following independent institutions or laboratories:

- Authority for Civil Defence, Germany, Bonn-Bad Godesberg, 1998 [5]
- Institute of Firedepartment Sachsen Anhalt, Germany, Heyrothsberge, 1997[6]
- Clayton Laboratory Services, USA, Detroit, 1998 [7]
- Austrian Workplace Safety Testing Institute of the Employee's Liability Insurance
- Association, Austria, Vienna, 1998 [8]

Authority for Civil Defence, Germany

The operation and function of the Dräger CMS were tested. Using the Remote System, measurements against different test gas concentrations were performed. Ten chip-types were checked:

- Ammonia	2 - 50 ppm
- Ammonia	10 - 150 ppm
- Carbon Monoxide	5 - 150 ppm
- Chlorine	0.2 - 10 ppm
- Hydrochloric Acid	1 - 25 ppm
- Hydrochloric Acid	20 - 500 ppm
- Hydrocyanic Acid	2 - 50 ppm
- Hydrogen Sulfide	2 - 50 ppm
- Hydrogen Sulfide	20 - 500 ppm
- Nitrogen Dioxide	0.5 - 25 ppm

The measurement results comply with the performance specifications shown in the instructions for use. The study recommends the Dräger CMS as a robust and easy to use instrument.

Institute of Firedepartment Sachsen Anhalt, Germany

During this study measurements of fires were made in the laboratory and under actual fire-fighting conditions. Based on the results of this study, the institute recommends the Chip-Measurement-System for the measurement of hazardous gases and vapors.

Clayton Laboratory Services, USA

The Dräger CMS was tested using benzene at two concentrations (1 ppm and 4 ppm). The accuracy and reproducubility of the measuring system was within the values given in the instructions for use.

Measuring results	Clayton Laboratory		Dräger Laboratory		Instructions for use
Concentration	1 ppm	4 ppm	1 ppm	4 ppm	0.2 - 10 ppm
Accuracy	± 4.4%	± 7.3%	– 1 %	5 %	± 18 %
Reproducibility	± 9.9%	± 8.2%	15 %	11 %	± 25 %

Chip: Benzene 0.2-10 ppm
Order-Code: 64 06 030
Batch-No.: ARLM-0611

Austrian Workplace Safety Testing Institute of the Employee's Liability Insurance Association, Austria The intention of the study was a practice-oriented test of the Dräger CMS in varying conditions of temperature, humidity, and concentration. The measuring results of the Dräger CMS measurements were compared with reference methods.

Different chip-types were checked in a brewery and a thermal spring / bath:

- Carbon Dioxide	1000	to	25000	ppm
- Carbon Dioxide	1	to	20	Vol.-%
- Hydrogen Sulfide	2	to	50	ppm

The basis of this validation was the Austrian standard EN 482:

"Workplace Atmospheres –
General Requirements for Methods of Measuring Chemical Agents".

The institute confirms:

- The measuring results of the Dräger CMS correspond with the results of the reference methods.
- The accuracy of the Dräger CMS is far higher than the required accuracy of the standard EN 482.
- The Dräger CMS is a suitable measurement system.

Key to the Table of Physical, Chemical and Toxicological Data

The table lists physical, chemical and toxicological data for many of the airborne contaminants that can be measured using direct reading Dräger detector tubes. This table is intended to serve as a convenient reference source. The information was compiled from relevant technical publications, however, Dräger is not responsible for any use or misuse of the information. The TLV-values are current as of the 2001 Threshold Limit Values from the American Conference of Governmental Industrial Hygienists (ACGIH) and the other exposure values are current as of 2001.

Chemical Name

The common names are given in alphabetical order. Various other frequently used names are given in Section 3.8 Directory of synonyms.

Chemical Formula

The format is molecular, showing the actual number and kind of atoms.

Molecular Weight

The molecular weight listed in the table is given as Kg/Kmol.

Limit Values

The limit values listed for the gases, vapours and aerosols in the table are given in units of ml/m3 (ppm) or mg/m3. The ml/m3 units are given independent of temperature and pressure, but the mg/m3 values are based on 20 °C and 1013 hPa (mbar).

MAK-Values (Germany)

In addition to the established **MAK-values** listed in the table, the safety professional should consult paragraph III of the TRGS 900 standard regarding the carcinogenic potential of a substance. The potential to be a carcinogen must be considered apart from the 8-hour average during a 40-hour workweek.

MAK Peak Exposure Limitation Categories

The Peak Limit corresponding to the TRGS 900 standard must be calculated by a factor multiplied with the MAK-values. This Peak Limit is the average concentration for 15 minutes. The total time of exposition should not be longer than 1 hour of an 8-hour workday.

TRK-Values (Germany)

The TRK-values are given as shift mean values for an 8-hour workday, 40-hour workweek, according to TRGS 900. Manuftr. is used as an abbreviation for manufacturer (consult TRGS 900).

TLV-Values

According to the American Conference of Governmental Industrial Hygienists (ACGIH) the Threshold Limit Values (TLVs) refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. [2] The three categories of Threshold Limit Values (TLVs) and two categories of carcinogens are described as follows:

Threshold Limit Value - Time Weighted Average (TLV-TWA)

The time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Threshold Limit Value - Short-Term Exposure Limit (TLV-STEL)

The concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. The STEL should not exceed 15 minutes and should not occur more than four times per day, with at least 60 minutes between successive exposures.

Threshold Limit Value - Ceiling (TLV-C)

The concentration that should not be exceeded during any part of the working exposure.

A 1: confirmed human carcinogen
A 2: suspected human carcinogen

Occupational Exposure Limit Values

The Occupational Exposure Limit values pertain to Great Britain. There are two types of limit values, the Occupational Exposure Standard (OES) and the Maximum Exposure Limit (MEL). Both types usually have a longtherm Time Weighted Average (TWA) and also a Short-Therm Exposure Limit (STEL). The OES time-weighted average values and short-term exposure limit values are very similar to the ACGIH Threshold Limit Values (TLVs).The MEL is specified, together with the appropiate reference period, in schedule 1 of the regulations.

Conversion Factors

These factors provide for quick conversion from ml/m3 (ppm) to mg/m3 and mg/m3 to ml/m3.

Vapour Pressure

The pressure at any given temperature of a vapour in equilibrium with its liquid or solid state. The data in the table relates to 20 °C and is given in hPa (mbar).

Relative Vapour Density

The relative vapour density is the relationship of the weight of the vapour to air (air=1).

Melting Point

The melting point is given in °C at 1013 hPa (mbar).

Boiling Point

The boiling point is given in °C at 1013 hPa (mbar). If the substance sublimes, the abbreviation "subl." is given. If the substance decomposes, the abbreviation "decom." is given.

UN-Number

This is a four digit international identification number assigned to a substance or substance group by the United Nations for the transportation of dangerous goods.

CAS-Number

The CAS-Number is an identification number of the Chemical Abstract Service (CAS).

Group and Hazard Class (VbF)

The groups and hazard classes are in accordance with the "Verordnung über brennbare Fluessigkeiten-VbF (Regulations on flammable liquids).

1. Group A:
   Liquids which have a flash point which do not exceed 100 °C and which do not have the properties of Group B with regard to water solubility.

   Hazard Class I:
   Liquids with a flash point below 21 °C.

   Hazard Class II:
   Liquids with a flash point between 21 °C and 55 °C.

   Hazard Class III:
   Liquids with a flash point between 55 °C and 100 °C.

2. Group B:
   Liquids with a flash point below 21 °C, which dissolve in water in any arbitrary ratio at 15 °C or the flammable liquid components of which dissolve in water in any ratio at 15 °C.

Ignition Temperature

The ignition temperature is the lowest temperature at which a flammable gas/air or vapour/air mixture will just ignite. The temperature is given in °C at 1013 hPa (mbar).

Lower Ignition Limit and Upper Ignition Limit

Flammable gases or vapours, mixed with air, are explosive within a given concentration range. In this table, the concentration range is given in percent by volume of the gas or vapour, mixed with air, in which ignition by an external ignition source is possible. The values are given at 20 °C and 1013 hPa (mbar).

Smelling Point

The smelling point concentration is given from informations out of different litherature and deviates sometimes. The concentrations in this table should be for orientation only.

Note

A dash signifies the information is not known or unavailable, it does not denote a zero.

5.

Table of Physical, Chemial and Toxicological Data for selected Substances

		Acetaldehyde	Acetic Acid	Acetone	Acetylene
CAS – Number		[75-07-0]	[64-19-7]	[67-64-1]	[74-86-2]
Chemical Formula		$H_3C\text{-}CHO$	$H_3C\text{–}COOH$	$H_3C\text{-}CO\text{-}CH_3$	C_2H_2
Molecular Weight [Kg/Kmol]		44.05	60.05	58.08	26.04
MAK-/TRK-Value	ppm = [mL/m^3]	50, III B	10	500	–
	[mg/m^3]	91, III B	25	1200	–
Peak Limit		= 1 =	= 1 =	4	–
TLV-Value					
TWA	ppm = [mL/m^3]	–	10	500	–
	[mg/m^3]	–	25	1205	–
STEL	ppm = [mL/m^3]	C 25	15	750	–
	[mg/m^3]	C 46	37	1780	–
OES-Value					
TWA	ppm = [mL/m^3]	100	10	750	–
	[mg/m^3]	180	25	1780	–
STEL	ppm = [mL/m^3]	150	15	1500	–
	[mg/m^3]	270	37	3560	–
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.83	2.5	2.41	1.08
[1 mg/m^3] = ppm = mL/m^3		0.55	0.40	0.41	0.92
Vapour Pressure at 20°C	[h Pa]	1007	15.7	247	43000
Relative Vapour Density		1.52	2.07	2.01	0.91
Melting Point	[°C]	-123.4	16.8	-95.4	-81.8
Boiling Point	[°C]	20.8	118.1	56.2	-83.8 subl.
UN – Number		1089	2789	1090	1001
Group & Hazard Class		B	–	B	–
Ignition Temperature	[°C]	140	485	540	305
Lower Ignition Limit	[Vol%]	4	4	2.5	2.3
Upper Ignition Limit	[Vol%]	57	17	13	83
Odour threshold (approx.) ppm		0.2	1	100	670 mg/m^3

	Acrolein	Acrylonitrile	Alcohol (Ethanol)	Ammonia
CAS – Number	[107-02-8]	[107-13-1]	[64-17-5]	[7664-41-7]
Chemical Formula	$H_2C=CH-CHO$	$H_2C=CH-CN$	H_3C-CH_2OH	NH_3
Molecular Weight [Kg/Kmol]	56.06	53.06	46.07	17.03
MAK-/TRK-Value ppm = [mL/m^3]	0.1	3	1000	50
[mg/m^3]	0.25	7	1900	35
Peak Limit	= 1 =	4	4	= 1 =
TLV-Value				
TWA ppm = [mL/m^3]	–	2, A3	1000	25
[mg/m^3]	–	4.3 A3	1880	17
STEL ppm = [mL/m^3]	C 0.1	–	–	35
[mg/m^3]	C 0.23	–	–	24
OES-Value				
TWA ppm = [mL/m^3]	0.1	2	1000	25
[mg/m^3]	0.25	4	1900	18
STEL ppm = [mL/m^3]	0.3	–	–	35
[mg/m^3]	0.8	–	–	27
Conversion Factors				
1 ppm = 1 mL/m^3 = [mg/m^3]	2.33	2.21	1.92	0.71
[1 mg/m^3] = ppm = mL/m^3	0.43	0.45	0.52	1.41
Vapour Pressure at 20°C [h Pa]	287	124	59	8572
Relative Vapour Density	1.94	1.83	1.59	0.6
Melting Point [°C]	-87.0	-83.6	-114.2	-77.7
Boiling Point [°C]	52.7	77.3	78.3	-33.4
UN – Number	1092	1093	1170	1005
Group & Hazard Class	A I	A I	B	–
Ignition Temperature [°C]	278	480	425	630
Lower Ignition Limit [Vol%]	2.8	2.8	3.5	15.4
Upper Ignition Limit [Vol%]	31	28	15	30.2
Odour threshold (approx.) ppm	0.1	20	10	5

		Aniline	Arsenic trioxide	Arsine	Benzene
CAS – Number		[62-53-3]	[1327-53-3]	[7784-42-1]	[71-43-2]
Chemical Formula		C_6H_5-NH_2	As_2O_3	AsH_3	C_6H_6
Molecular Weight [Kg/Kmol]		93.13	197.84	77.95	78.11
MAK-/TRK-Value	ppm = $[mL/m^3]$	2	–, III A1	0.05	1
	$[mg/m^3]$	7.7	0.1 G, III A1	0.2	3.2
Peak Limit		4	4	4	4
TLV-Value					
TWA	ppm = $[mL/m^3]$	2	–	0.05	0.5
	$[mg/m^3]$	7.6	0.01 (As)	0.16	1.6
STEL	ppm = $[mL/m^3]$	–	–	–	2.5
	$[mg/m^3]$	–	–	–	8.1
OES-Value					
TWA	ppm = $[mL/m^3]$	2	–	0.05	5
	$[mg/m^3]$	10	0.1 (As)	0.2	15
STEL	ppm = $[mL/m^3]$	5	–	–	–
	$[mg/m^3]$	20	–	–	–
Conversion Factors					
1 ppm = 1 mL/m^3 = $[mg/m^3]$		3.87	8.22	3.24	3.25
$[1\ mg/m^3]$ = ppm = mL/m^3		0.26	0.12	0.31	0.31
Vapour Pressure at 20°C	[h Pa]	0.821	0	16000	99.7
Relative Vapour Density		3.22	6.83	2.69	2.7
Melting Point	[°C]	-6.0	312.3	-116.3	5.5
Boiling Point	[°C]	184.4	subl. >370	-55	80.1
UN – Number		1547	1561	2188	1114
Group & Hazard Class		A III	–	–	A I
Ignition Temperature	[°C]	530	–	–	555
Lower Ignition Limit	[Vol%]	1.2	–	4.5	1.2
Upper Ignition Limit	[Vol%]	11	–	100	8
Odour threshold (approx.) ppm		0.5	–	0.2	5

		Bromine	Bromotrifluoromethane	1.3-Butadiene	Butane
CAS – Number		[7726-95-6]	[75-63-8]	[106-99-0]	[106-97-8]
Chemical Formula		Br_2	CF_3Br	$H_2C=CH-CH=CH_2$	$H_3C-CH_2-CH_2-CH_3$
Molecular Weight [Kg/Kmol]		159.82	148.91	54.09	58.1
MAK-/TRK-Value	ppm = [mL/m³]	0.1	1000	15 / 5	1000
	[mg/m³]	0.66	6200	34 / 11	2400
Peak Limit		= 1 =	4	4	4
TLV-Value					
TWA	ppm = [mL/m³]	0.1	1000	2	800
	[mg/m³]	0.66	6090	4.5	1900
STEL	ppm = [mL/m³]	0.2	–	–	–
	[mg/m³]	1.33	–	–	–
OES-Value					
TWA	ppm = [mL/m³]	0.1	1000	10	600
	[mg/m³]	0.7	6100	22	1430
STEL	ppm = [mL/m³]	0.3	1200	–	750
	[mg/m³]	2.0	7300	–	1780
Conversion Factors					
1 ppm = 1 mL/m³ = [mg/m³]		6.62	6.19	2.25	2.42
[1 mg/m³] = ppm = mL/m³		0.15	0.16	0.44	0.41
Vapour Pressure at 20°C	[h Pa]	230	14270	2450	2100
Relative Vapour Density		5.52	5.24	1.87	2.05
Melting Point	[°C]	-7.2	-168.0	-108.9	-135
Boiling Point	[°C]	58.8	-57.8	-4.8	-0.5
UN – Number		1744	1009	1010	1011
Group & Hazard Class		–	–	–	–
Ignition Temperature	[°C]	–	–	415	365
Lower Ignition Limit	[Vol%]	–	–	1.1	1.4
Upper Ignition Limit	[Vol%]	–	–	12.5	8.5
Odour threshold (approx.) ppm		< 0.01	–	–	1.5

		n-Butanol	Butene	Carbon dioxide	Carbon disulphide
CAS – Number		[71-36-3]	[106-98-7]	[124-38-9]	[7446-09-5]
Chemical Formula		$H_3C\text{-}(CH_2)_2\text{-}CH_2OH$	$H_2C\text{=}CH\text{-}CH_2\text{-}CH_3$	CO_2	CS_2
Molecular Weight [Kg/Kmol]		74.12	56.1	44.01	76.14
MAK-/TRK-Value	ppm = [mL/m³]	100	–	5000	10
	[mg/m³]	310	–	9100	30
Peak Limit		4	–	4	4
TLV-Value					
TWA	ppm = [mL/m³]	20	–	5000	10
	[mg/m³]	62	–	9000	31
STEL	ppm = [mL/m³]	–	–	30000	–
	[mg/m³]	–	–	54000	–
OES-Value					
TWA	ppm = [mL/m³]	–	–	5000	10
	[mg/m³]	–	–	9000	30
STEL	ppm = [mL/m³]	50	–	15000	–
	[mg/m³]	150	–	27000	–
Conversion Factors					
1 ppm = 1 mL/m³ = [mg/m³]		3.08	2.33	1.83	3.16
[1 mg/m³] = ppm = mL/m³		0.33	0.43	0.55	0.32
Vapour Pressure at 20°C	[h Pa]	7.6	2500	57330	397
Relative Vapour Density		2.56	1.94	1.53	2.63
Melting Point	[°C]	-89	-186	–	-111.6
Boiling Point	[°C]	117.5	-6.3	-78.5 subl.	46.3
UN – Number		1120	1012	1013	1131
Group & Hazard Class		A II	–	–	A I
Ignition Temperature	[°C]	340	445	–	95
Lower Ignition Limit	[Vol%]	1.4	1.6	–	1
Upper Ignition Limit	[Vol%]	11.3	9.3	–	60
Odour threshold (approx.) ppm		25	–	odourless	< 1

		Carbon monoxide	Carbon tetrachloride	Chlorine	Chlorine dioxide
CAS – Number		[630-08-0]	[56-23-5]	[7782-50-5]	[10049-04-4]
Chemical Formula		CO	CCl_4	Cl_2	ClO_2
Molecular Weight [Kg/Kmol]		28.01	153.82	70.91	67.45
MAK-/TRK-Value	ppm = [mL/m^3]	30	10	0.5	0.1
	[mg/m^3]	35	64	1.5	0.28
Peak Limit		2	4	= 1 =	= 1 =
TLV-Value					
TWA	ppm = [mL/m^3]	25	5, A2	0.5	0.1
	[mg/m^3]	29	31, A2	1.5	0.28
STEL	ppm = [mL/m^3]	–	10	1	0.3
	[mg/m^3]	–	62	2.9	0.84
OES-Value					
TWA	ppm = [mL/m^3]	50	2	0.5	0.1
	[mg/m^3]	55	12.6	1.5	0.3
STEL	ppm = [mL/m^3]	300	–	1	0.3
	[mg/m^3]	330	–	3	0.9
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.16	6.39	2.95	2.80
[1 mg/m^3] = ppm = mL/m^3		0.86	0.16	0.34	0.36
Vapour Pressure at 20°C	[h Pa]	–	119.4	6731	1400
Relative Vapour Density		0.97	5.31	2.49	2.4
Melting Point	[°C]	-199	-23.0	-101.0	-59.5
Boiling Point	[°C]	-191.5	76.5	-34.1	11
UN – Number		1016	1846	1017	–
Group & Hazard Class		–	–	–	–
Ignition Temperature	[°C]	605	>982	–	–
Lower Ignition Limit	[Vol%]	10.9	–	–	–
Upper Ignition Limit	[Vol%]	74	–	–	–
Odour threshold (approx.) ppm		odourless	70	0.02	–

		Chlorobenene	Chlorodifluorobromo-methane	Chlorodifluoro-methane	Chloroform
CAS – Number		[108-90-7]	[353-59-3]	[75-45-6]	[67-66-3]
Chemical Formula		C_6H_5Cl	CF_2ClBr	CHF_2Cl	$CHCl_3$
Molecular Weight [Kg/Kmol]		112.56	165.36	86.47	119.38
MAK-/TRK-Value ppm =	[mL/m^3]	10	–	500	10
	[mg/m^3]	47	–	3600	50
Peak Limit		4	–	4	4
TLV-Value					
TWA ppm =	[mL/m^3]	10	–	1000	10, A3
	[mg/m^3]	46	–	3540	49, A3
STEL ppm =	[mL/m^3]	–	–	–	–
	[mg/m^3]	–	–	–	–
OES-Value					
TWA ppm =	[mL/m^3]	50	–	1000	10
	[mg/m^3]	230	–	3500	50
STEL ppm =	[mL/m^3]	–	–	–	50
	[mg/m^3]	–	–	–	225
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		4.68	6.87	3.59	4.962
[1 mg/m^3] = ppm = mL/m^3		0.21	0.15	0.28	0.202
Vapour Pressure at 20°C	[h Pa]	11.7	2294	9169	213
Relative Vapour Density		3.89	5.82	2.99	4.12
Melting Point	[°C]	-45.1	-160.5	-160.0	-63.2
Boiling Point	[°C]	132.2	-3.9	-40.8	61.3
UN – Number		1134	1974	1018	1888
Group & Hazard Class		A II	–	–	–
Ignition Temperature	[°C]	590	–	–	982
Lower Ignition Limit	[Vol%]	1.3	–	–	–
Upper Ignition Limit	[Vol%]	11	–	–	–
Odour threshold (approx.) ppm		0.2	–	–	200

	Chloroprene	Chlorpikrine	Chromic acid	Cyanide (as CN)
CAS – Number	[126-99-8]	[76-06-2]	[1333-82-0]	[151-50-8; 143-33-9]
Chemical Formula	$H_2C=CCl-CH=CH_2$	CCl_3NO_2	CrO_3	–
Molecular Weight [Kg/Kmol]	88.54	164.38	99.90	–
MAK-/TRK-Value ppm = [mL/m^3]	5	–	–	–
[mg/m^3]	18	–	0.1 G	5 G
Peak Limit	4	–	4	4
TLV-Value				
TWA ppm = [mL/m^3]	10	0.1	–	–
[mg/m^3]	36	0.68	0.05 (Cr), A1	–
STEL ppm = [mL/m^3]	–	–	–	–
[mg/m^3]	–	–	–	C 5
OES-Value				
TWA ppm = [mL/m^3]	10	0.1	–	–
[mg/m^3]	36	0.7	0.05 (Cr)	5
STEL ppm = [mL/m^3]	–	0.3	–	–
[mg/m^3]	–	2.0	–	–
Conversion Factors				
1 ppm = 1 mL/m^3 = [mg/m^3]	3.68	6.82	–	–
[1 mg/m^3] = ppm = mL/m^3	0.27	0.15	–	–
Vapour Pressure at 20°C [h Pa]	239	25	0	–
Relative Vapour Density	3.06	–	–	–
Melting Point [°C]	-130	-64	198	–
Boiling Point [°C]	59.4	112	>230 decom.	–
UN – Number	1991	1580	1463	1588
Group & Hazard Class	–	–	–	–
Ignition Temperature [°C]	–	–	–	–
Lower Ignition Limit [Vol%]	2.5	–	–	–
Upper Ignition Limit [Vol%]	12	–	–	–
Odour threshold (approx.) ppm	15	–	–	–

		Cyanogen chloride (as CN)	Cyclohexane	Cyclohexylamine	Diborane
CAS – Number		[506-77-4]	[110-82-7]	[108-91-8]	[19287-45-7]
Chemical Formula		ClCN	C_6H_{12}	$C_6H_{11}NH_2$	B_2H_6
Molecular Weight [Kg/Kmol]		61.47	84.16	99.18	27.67
MAK-/TRK-Value	ppm = [mL/m³]	–	200	10	0.1
	[mg/m³]	0.75	700	41	0.1
Peak Limit		–	4	= 1 =	= 1 =
TLV-Value					
TWA	ppm = [mL/m³]	C 0.3	100	10	0.1
	[mg/m³]	C 0.75	352	41	0.11
STEL	ppm = [mL/m³]	–	–	–	–
	[mg/m³]	–	–	–	–
OES-Value					
TWA	ppm = [mL/m³]	2	100	10	0.1
	[mg/m³]	9.8	340	40	0.1
STEL	ppm = [mL/m³]	–	300	–	–
	[mg/m³]	–	1030	–	–
Conversion Factors					
1 ppm = 1 mL/m³ = [mg/m³]		2.55	3.52	4.12	1.15
[1 mg/m³] = ppm = mL/m³		0.39	0.28	0.24	0.87
Vapour Pressure at 20°C	[h Pa]	1400	104	14.26	–
Relative Vapour Density		2.16	2.91	3.43	0.96
Melting Point	[°C]	-6.9	6.5	-17.8	-164.8
Boiling Point	[°C]	13.0	80.8	134.5	-92.5
UN – Number		1589	1145	2357	1911
Group & Hazard Class		–	A I	–	–
Ignition Temperature	[°C]	–	260	290	40...50
Lower Ignition Limit	[Vol%]	–	1.2	1.6	0.8
Upper Ignition Limit	[Vol%]	–	8.3	9.4	98
Odour threshold (approx.) ppm		1	0.4	–	2

		o-Dichlorobenzne	p-Dichlorobenzene	Dichlorodifluoro-methane	Dichlorotetrafluoro-ethane
CAS – Number		[95-50-1]	[106-46-7]	[75-71-8]	[76-14-2]
Chemical Formula		$C_6H_4Cl_2$	$C_6H_4Cl_2$	CF_2Cl_2	$F_2ClC\text{-}CF_2Cl$
Molecular Weight [Kg/Kmol]		147.00	147.00	120.91	170.92
MAK-/TRK-Value	ppm = [mL/m^3]	50	50	1000	1000
	[mg/m^3]	300	300	5000	7100
Peak Limit		4	4	4	4
TLV-Value					
TWA	ppm = [mL/m^3]	25	10	1000	1000
	[mg/m^3]	150	61	4950	6990
STEL	ppm = [mL/m^3]	50	–	–	–
	[mg/m^3]	301	–	–	–
OES-Value					
TWA	ppm = [mL/m^3]	–	25	1000	1000
	[mg/m^3]	–	150	4950	7000
STEL	ppm = [mL/m^3]	50	50	1250	1250
	[mg/m^3]	300	300	6200	8750
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		6.11	6.11	5.03	7.1
[1 mg/m^3] = ppm = mL/m^3		0.16	0.16	0.20	0.14
Vapour Pressure at 20°C	[h Pa]	1.3	1.7	5669	1836
Relative Vapour Density		5.08	5.08	4.18	6.02
Melting Point	[°C]	-17.0	53.08	-155.0	-94.0
Boiling Point	[°C]	180.5	173.9	-24.9	3.8
UN – Number		1591	1592	1028	1958
Group & Hazard Class		A III	A III	–	–
Ignition Temperature	[°C]	640	>500	–	–
Lower Ignition Limit	[Vol%]	2.2	ca. 18	–	–
Upper Ignition Limit	[Vol%]	12	–	–	–
Odour threshold (approx.) ppm		2	15	–	–

	Dichlorvos	Diethyl ether	Dimethyl acetamide	Dimethylformamide
CAS – Number	[62-73-7]	[60-29-7]	[127-19-5]	[68-12-2]
Chemical Formula	$Cl_2C=CH\text{-}O\text{-}PO(OCH_3)_2$	$H_3C\text{-}CH_2\text{-}O\text{-}CH_2\text{-}CH_3$	$H_3C\text{-}CO\text{-}N(CH_3)_2$	$HCO\text{-}N(CH_3)_2$
Molecular Weight [Kg/Kmol]	220.98	74.12	87.12	73.09
MAK-/TRK-Value ppm = [mL/m^3]	0.11	400	10	10
[mg/m^3]	1	1200	36	30
Peak Limit	4	4	4	4
TLV-Value				
TWA ppm = [mL/m^3]	0.1	400	10	10
[mg/m^3]	0.9	1210	36	30
STEL ppm = [mL/m^3]	–	500	–	–
[mg/m^3]	–	1520	–	–
OES-Value				
TWA ppm = [mL/m^3]	0.1	400	10	10
[mg/m^3]	1	1200	35	30
STEL ppm = [mL/m^3]	0.3	500	15	20
[mg/m^3]	3	1500	50	60
Conversion Factors				
1 ppm = 1 mL/m^3 = [mg/m^3]	9.81	3.08	3.62	3.04
[1 mg/m^3] = ppm = mL/m^3	0.11	0.33	0.28	0.33
Vapour Pressure at 20°C [h Pa]	0.016	562.8	3.3	3.5
Relative Vapour Density	7.63	2.56	3.01	2.52
Melting Point [°C]	liq.	-116.4	-20	-60.4
Boiling Point [°C]	74	34.6	166.1	153
UN – Number	2783	1155	–	2265
Group & Hazard Class	–	A I	–	–
Ignition Temperature [°C]	–	180	400	440
Lower Ignition Limit [Vol%]	–	1.7	1.7	2.2
Upper Ignition Limit [Vol%]	–	36	11.8	16
Odour threshold (approx.) ppm	–	100	50	100

		Dimethyl sulphate	Dimethyl sulphide	Diphenylmethane diisocyanate	Epichlorohydrin
CAS – Number		[77-78-1]	[75-18-3]	[101-68-8]	[106-89-9]
Chemical Formula		$(H_3CO)_2SO_2$	$(CH_3)_2S$	$(OCN\text{-}C_6H_4)_2CH_2$	$H_2C\text{-}O\text{-}CH\text{-}CH_2Cl$
Molecular Weight [Kg/Kmol]		126.13	62.14	250.26	92.53
MAK-/TRK-Value	ppm = [mL/m^3]	Manuftr. / User	–	0.05, IIIB	3
	[mg/m^3]	0.02 / 0.04 / 0.1 / 0.2	–	4, IIIB	12
Peak Limit		4	–	= 1 =	4
TLV-Value					
TWA	ppm = [mL/m^3]	0.1. A3	–	0.005	0.5
	[mg/m^3]	0.52. A3	–	0.051	1.9
STEL	ppm = [mL/m^3]	–	–	–	–
	[mg/m^3]	–	–	–	–
OES-Value					
TWA	ppm = [mL/m^3]	0.1	–	–	2
	[mg/m^3]	0.5	–	0.02 (NCO)	8
STEL	ppm = [mL/m^3]	0.1	–	–	5
	[mg/m^3]	0.5	–	0.07 (NCO)	20
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		5.24	2.58	10.40	3.85
[1 mg/m^3] = ppm = mL/m^3		0.19	0.39	0.096	0.26
Vapour Pressure at 20°C	[h Pa]	0.6	560	4 x 10–6	16
Relative Vapour Density		4.36	2.15	8.64	3.2
Melting Point	[°C]	-31	-98.3	39.5	-25.6
Boiling Point	[°C]	188.5 decom.	37.3	190	116.6
UN – Number		1595	1164	2489	2023
Group & Hazard Class		A III	A I		A II
Ignition Temperature	[°C]	470	215	–	385
Lower Ignition Limit	[Vol%]	3.6	2.2	>500	2.3
Upper Ignition Limit	[Vol%]	23.2	19.7	–	34.4
Odour threshold (approx.) ppm		–	0.001	–	10

	Ethyl acetate	Ethylacrylat	Ethyl benzene	Ethyl chloroformate
CAS – Number	[141-78-6]	[140-88-5]	[100-41-4]	[541-41-3]
Chemical Formula	$H_3C\text{-}COOCH_2\text{-}CH_3$	$CH_2\text{-}CHCOOC_2H_5$	$C_6H_5\text{-}CH_2\text{-}CH_3$	$Cl\text{-}CO\text{-}O\text{-}CH_2\text{-}CH_3$
Molecular Weight [Kg/Kmol]	88.11	100.12	106.17	108.5
MAK-/TRK-Value ppm = $[mL/m^3]$	400	5	100	–
$[mg/m^3]$	1500	21	440	–
Peak Limit	= 1 =	= 1 =	= 1 =	–
TLV-Value				
TWA ppm = $[mL/m^3]$	400	5	100	–
$[mg/m^3]$	1440	21	434	–
STEL ppm = $[mL/m^3]$	–	15	125	–
$[mg/m^3]$	–	62	543	–
OES-Value				
TWA ppm = $[mL/m^3]$	400	5	100	1
$[mg/m^3]$	1400	20	435	4.4
STEL ppm = $[mL/m^3]$	–	15	125	–
$[mg/m^3]$	–	60	545	–
Conversion Factors				
1 ppm = 1 mL/m^3 = $[mg/m^3]$	3.66	4.15	4.41	4.52
[1 mg/m^3] = ppm = mL/m^3	0.27	0.24	0.23	0.22
Vapour Pressure at 20°C [h Pa]	96.8	39	9.3	54.6
Relative Vapour Density	3.04	–	3.67	3.74
Melting Point [°C]	-82.4	-71.2	-95.0	-81
Boiling Point [°C]	77.1	99.7	136.2	95
UN – Number	1173	1917	1175	1182
Group & Hazard Class	A I	A I	A I	500
Ignition Temperature [°C]	460	355	430	–
Lower Ignition Limit [Vol%]	2.1	1.7	1	–
Upper Ignition Limit [Vol%]	11.5	13	7.8	
Odour threshold (approx.) ppm	50	–	25	–

		Ethylene	Ethylene dibromide	Ethylene glycol	Ethylene oxide
CAS – Number		[74-85-1]	[106-93-4]	[107-21-1]	[75-21-8]
Chemical Formula		$H_2C\text{-}CH_2$	C_2HyBr_2	H_2COHCH_2OH	$H_2C\text{-}O\text{-}CH_2$
Molecular Weight [Kg/Kmol]		28.05	187.86	67.07	44.05
MAK-/TRK-Value	ppm = [mL/m^3]	–	–	10	1
	[mg/m^3]	–	–	26	2
Peak Limit		–	–	= 1 =	4
TLV-Value					
TWA	ppm = [mL/m^3]	–	–	–	1, A2
	[mg/m^3]	–	–	–	1.8, A2
STEL	ppm = [mL/m^3]	–	–	–	–
	[mg/m^3]	–	–	C 100	–
OES-Value		–	–		
TWA	ppm = [mL/m^3]	–	–	–	5
	[mg/m^3]	–	–	60	10
STEL	ppm = [mL/m^3]	–	–	–	–
	[mg/m^3]	–	–	125	–
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.17	7.80	2.58	1.83
[1 mg/m^3] = ppm = mL/m^3		0.86	0.13	0.39	0.55
Vapour Pressure at 20°C	[h Pa]	–	11.3	0.053	1440
Relative Vapour Density		0.97	–	2.14	1.52
Melting Point	[°C]	-169.2	9.97	-13	-112.5
Boiling Point	[°C]	-103.7	131.6	197.6	10.7
UN – Number		1962	1605	–	1040
Group & Hazard Class		–	–	–	–
Ignition Temperature	[°C]	425	–	410	440
Lower Ignition Limit	[Vol%]	2.3	–	3.2	2.6
Upper Ignition Limit	[Vol%]	34	–	53	100
Odour threshold (approx.) ppm		–	–	10	–

		Ethyl glycol acetate	Ethyl mercaptan	Fluorine	Formaldehyde
CAS – Number		[111-15-9]	[75-08-1]	[7782-41-4]	[50-00-0]
Chemical Formula		$C_2H_5OC_2H_4OCOCH_3$	$H_3C\text{-}CH_2SH$	F_2	HCHO
Molecular Weight [Kg/Kmol]		132.16	62.1	37.99	30.03
MAK-/TRK-Value	ppm = [mL/m^3]	5	0.5	0.1	0.5
	[mg/m^3]	27	1.0	0.16	0.62
Peak Limit		4	= 1 =	= 1 =	= 1 =
TLV-Value					
TWA	ppm = [mL/m^3]	5	0.5	1	–
	[mg/m^3]	27	1.3	1.6	C 0.37, A2
STEL	ppm = [mL/m^3]	–	–	2	C 0.3, A2
	[mg/m^3]	–	–	3.1	–
OES-Value					
TWA	ppm = [mL/m^3]	10	0.5	–	2
	[mg/m^3]	54	1	–	2.5
STEL	ppm = [mL/m^3]	–	2	1	2
	[mg/m^3]	–	3	1.5	2.5
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		5.49	2.59	1.58	1.25
[1 mg/m^3] = ppm = mL/m^3		0.18	0.39	0.63	0.80
Vapour Pressure at 20°C	[h Pa]	1.6	585	–	–
Relative Vapour Density		4.57	2.1	1.3	1.04
Melting Point	[°C]	-61.7	-147	-219.6	-92
Boiling Point	[°C]	156.7	35	-188.1	-21
UN – Number		1172	2363	1045	–
Group & Hazard Class		A II	A I	–	–
Ignition Temperature	[°C]	380	295	–	300
Lower Ignition Limit	[Vol%]	1.7	2.8	–	7
Upper Ignition Limit	[Vol%]	12.7	18	–	73
Odour threshold (approx.) ppm		–	0.001	–	< 1

		Formic Acid	n-Hexane	Hexamethylene diisocyanate	Hydrazine
CAS – Number		[64-18-6]	[110-54-3]	[822-06-0]	[302-01-2]
Chemical Formula		HCOOH	$H_3C\text{-}(CH_2)_4\text{-}CH_3$	$OCN\text{-}(CH_2)_6\text{-}NCO$	$H_2N\text{-}NH_2$
Molecular Weight [Kg/Kmol]		46.03	86.18	168.20	32.05
MAK-/TRK-Value	ppm = [mL/m^3]	5	50	0.005	0.1
	[mg/m^3]	9.5	180	0.035	0.13
Peak Limit		= 1 =	4	= 1 =	4
TLV-Value					
TWA	ppm = [mL/m^3]	5	50	0.005	0.01, A3
	[mg/m^3]	9.4	176	0.034	0.013, A3
STEL	ppm = [mL/m^3]	10	–	–	–
	[mg/m^3]	19	–	–	–
OES-Value					
TWA	ppm = [mL/m^3]	5	20	–	0.1
	[mg/m^3]	9	70	0.02 (NCO)	0.1
STEL	ppm = [mL/m^3]	–	–	–	–
	[mg/m^3]	–	–	0.07 (NCO)	–
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.91	3.58	6.99	1.33
[1 mg/m^3] = ppm = mL/m^3		0.52	0.28	0.14	0.75
Vapour Pressure at 20°C	[h Pa]	43.3	160	0.014	21
Relative Vapour Density		1.59	2.98	5.81	1.11
Melting Point	[°C]	8.4	-95.3	-67	1.5
Boiling Point	[°C]	100.8	68.7	255	113.5
UN – Number		1779	1208	2281	2029
Group & Hazard Class		–	A I	–	–
Ignition Temperature	[°C]	520	240	454	270
Lower Ignition Limit	[Vol%]	10	1.0	0.9	4.7
Upper Ignition Limit	[Vol%]	45.5	7.4	9.5	100
Odour threshold (approx.)	ppm	20	–	–	3

		Hydrochloric acid	Hydrocyanic Acid	Hydrogen	Hydrogen fluoride
CAS – Number		[7647-01-0]	[74-90-8]	[1333-74-0]	[7664-39-3]
Chemical Formula		HCl	HCN	H_2	HF
Molecular Weight [Kg/Kmol]		36.46	27.03	2.02	20.01
MAK-/TRK-Value	ppm = [mL/m^3]	–	10	–	3
	[mg/m^3]	8	11	–	2.5
Peak Limit		= 1 =	4	–	= 1 =
TLV-Value					
TWA	ppm = [mL/m^3]	–	–	–	–
	[mg/m^3]	–	–	–	C 2.6 (F)
STEL	ppm = [mL/m^3]	C 2	C 4.7	–	C 3 (F)
	[mg/m^3]	C 3	C 5.3	–	–
OES-Value					
TWA	ppm = [mL/m^3]	–	–	–	–
	[mg/m^3]	–	–	–	–
STEL	ppm = [mL/m^3]	5	10	–	3
	[mg/m^3]	7	10	–	2.5
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.52	1.12	0.084	0.83
[1 mg/m^3] = ppm = mL/m^3		0.66	0.89	11.90	1.20
Vapour Pressure at 20°C	[h Pa]	42600	830	–	1000
Relative Vapour Density		1.27	0.95	0.07	0.69
Melting Point	[°C]	-114.2	-13.3	-259.1	-83.6
Boiling Point	[°C]	-85.1	25.7	-252.8	19.5
UN – Number		1050	1051	1049	1052
Group & Hazard Class		–	–	–	–
Ignition Temperature	[°C]	–	535	560	–
Lower Ignition Limit	[Vol%]	–	5.4	4	4.75
Upper Ignition Limit	[Vol%]	–	46.6	75.6	–
Odour threshold (approx.) ppm		–	2	odourless	–

		Hydrogen peroxide	Hydrogen sulphide	Mercury vapour	Methacrylonitrile
CAS – Number		[7722-84-1]	[7783-06-4]	[7439-97-6]	[126-98-7]
Chemical Formula		H_2O_2	H_2S	Hg	$H_2C=C(CH_3)CN$
Molecular Weight [Kg/Kmol]		34.01	34.08	200.59	67.09
MAK-/TRK-Value	ppm = [mL/m^3]	1	10	0.01	–
	[mg/m^3]	1.4	14	0.1	–
Peak Limit		= 1 =	= 1 =	4	–
TLV-Value					
TWA	ppm = [mL/m^3]	1	10	–	1
	[mg/m^3]	1.4	14	0.025	2.7
STEL	ppm = [mL/m^3]	–	15	–	–
	[mg/m^3]	–	21	–	–
OES-Value					
TWA	ppm = [mL/m^3]	1	10	–	1
	[mg/m^3]	1.5	14	0.05	3
STEL	ppm = [mL/m^3]	2	15	–	–
	[mg/m^3]	3	21	0.15	–
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.41	1.42	8.34	2.79
[1 mg/m^3] = ppm = mL/m^3		0.71	0.71	0.12	0.36
Vapour Pressure at 20°C	[h Pa]	1.9	18100	1.63×10^{-3}	86
Relative Vapour Density		1.17	1.19	6.93	2.32
Melting Point	[°C]	-0.4	-85.6	-38.8	-35.8
Boiling Point	[°C]	150.2	-60.2	356.6	91.3
UN – Number		2015	1053	2809	1992
Group & Hazard Class		–	–	–	A I
Ignition Temperature	[°C]	–	270	–	–
Lower Ignition Limit	[Vol%]	–	4.3	–	–
Upper Ignition Limit	[Vol%]	–	45.5	–	–
Odour threshold (approx.) ppm		–	< 0.1	odourless	–

		Methane	Methanol	Methyl acrylate	Methyl bromide
CAS – Number		[74-82-8]	[67-56-1]	[96-33-3]	[74-83-9]
Chemical Formula		CH_4	H_3COH	$H_2C{=}CH\text{-}COOCH_3$	CH_3Br
Molecular Weight [Kg/Kmol]		16.04	32.04	86.09	94.94
MAK-/TRK-Value	ppm = [mL/m^3]	–	200	5	–, III B
	[mg/m^3]	–	270	18	–, III B
Peak Limit		–	4	= 1 =	–
TLV-Value					
TWA	ppm = [mL/m^3]	–	200	2	1
	[mg/m^3]	–	262	35	4
STEL	ppm = [mL/m^3]	–	250	–	–
	[mg/m^3]	–	328	–	–
OES-Value					
TWA	ppm = [mL/m^3]	–	200	10	5
	[mg/m^3]	–	260	35	20
STEL	ppm = [mL/m^3]	–	250	–	15
	[mg/m^3]	–	310	–	60
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		0.67	1.33	3.58	3.95
[1 mg/m^3] = ppm = mL/m^3		1.50	0.75	0.28	0.25
Vapour Pressure at 20°C	[h Pa]	–	128.6	89.2	1890
Relative Vapour Density		0.55	1.11	2.97	3.28
Melting Point	[°C]	-182	-97.9	-76.5	-93.7
Boiling Point	[°C]	-161	64.5	80.5	3.6
UN – Number		1971/1972	1230	1919	1062
Group & Hazard Class		–	B	A I	–
Ignition Temperature	[°C]	595	455	415	535
Lower Ignition Limit	[Vol%]	4.4	5.5	2.4	8.6
Upper Ignition Limit	[Vol%]	15	44	18.6	20
Odour threshold (approx.)	ppm	–	5	0.1	odourless

		Methyl chloroformate	Methylene chloride	Methyl ethyl ketone	Methyl isobutyl ketone
CAS – Number		[79-22-1]	[75-09-2]	[78-93-3]	[108-10-1]
Chemical Formula		$Cl\text{-}CO\text{-}O\text{-}CH_3$	CH_2Cl_2	$CH_3\text{-}CH_2\text{-}CO\text{-}CH_3$	$(H_3C)_2C_2H_3\text{-}CO\text{-}CH_3$
Molecular Weight [Kg/Kmol]		94.45	84.93	72.2	100.16
MAK-/TRK-Value ppm =	[mL/m^3]	–	100	200	20
	[mg/m^3]	–	350	600	83
Peak Limit		–	4	= 1 =	= 1 =
TLV-Value					
TWA ppm =	[mL/m^3]	–	50, A3	200	50
	[mg/m^3]	–	174, A3	590	205
STEL ppm =	[mL/m^3]	–	–	300	75
	[mg/m^3]	–	–	885	307
OES-Value					
TWA ppm =	[mL/m^3]	–	100	200	50
	[mg/m^3]	–	350	590	205
STEL ppm =	[mL/m^3]	–	250	300	75
	[mg/m^3]	–	870	885	300
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		3.93	5.53	3.0	4.16
[1 mg/m^3] = ppm = mL/m^3		0.26	0.28	0.33	0.24
Vapour Pressure at 20°C	[h Pa]	127	461	105	20.2
Relative Vapour Density		3.26	2.93	2.48	3.46
Melting Point	[°C]	-61	-93.7	-86	-84.7
Boiling Point	[°C]	71.4	40.7	79.6	115.9
UN – Number		1238	1593	1193	1245
Group & Hazard Class		–	–	A I	A I
Ignition Temperature	[°C]	504	605	505	475
Lower Ignition Limit	[Vol%]	10.6	13	1.8	1.2
Upper Ignition Limit	[Vol%]	–	22	11.5	8
Odour threshold (approx.) ppm		–	180	< 25	0.5

		Methyl mercaptan	Methyl methacrylate	MTBE	Nickel
CAS – Number		[74-93-1]	[80-62-6]	[1634-04-4]	[7440-02-0]
Chemical Formula		H_3CSH	$H_2C{=}C(CH_3)COOCH_3$	$C_5H_{12}O$	Ni
Molecular Weight [Kg/Kmol]		48.1	100.12	88.15	58.69
MAK-/TRK-Value	ppm = $[\mathrm{mL/m^3}]$	0.5	50	–	–
	$[\mathrm{mg/m^3}]$	1	210	–	0.5 G
Peak Limit		= 1 =	= 1 =	–	4
TLV-Value					
TWA	ppm = $[\mathrm{mL/m^3}]$	0.5	50	50	–
	$[\mathrm{mg/m^3}]$	0.98	205	183	1
STEL	ppm = $[\mathrm{mL/m^3}]$	–	100	–	–
	$[\mathrm{mg/m^3}]$	–	410	–	–
OES-Value					
TWA	ppm = $[\mathrm{mL/m^3}]$	0.5	100	–	–
	$[\mathrm{mg/m^3}]$	1	410	–	0.5
STEL	ppm = $[\mathrm{mL/m^3}]$	–	125	–	–
	$[\mathrm{mg/m^3}]$	–	510	–	–
Conversion Factors					
1 ppm = 1 $\mathrm{mL/m^3}$ = $[\mathrm{mg/m^3}]$		2.0	4.16	3.66	–
$[1\ \mathrm{mg/m^3}]$ = ppm = $\mathrm{mL/m^3}$		0.5	0.24	0.27	–
Vapour Pressure at 20°C	[h Pa]	1700	38.7	268	0
Relative Vapour Density		1.7	3.46	–	–
Melting Point	[°C]	-121	-48.2	-108.6	1453
Boiling Point	[°C]	6	100.6	55.05	2732
UN – Number		1064	1247	2398	–
Group & Hazard Class		–	A I	–	–
Ignition Temperature	[°C]	–	430	460	–
Lower Ignition Limit	[Vol%]	4.1	2.1	1.6	–
Upper Ignition Limit	[Vol%]	21	12.5	8.4	–
Odour threshold (approx.) ppm		0.002	20	–	–

		Nickel tetracarbonyl	Nitric acid	Nitrogen dioxide	Nitroglycol
CAS – Number		[13463-39-3]	[7697-37-2]	[10102-44-0]	[628-96-6]
Chemical Formula		$Ni(CO)_4$	HNO_3	NO_2	$O_2N\text{-}O\text{-}(CH_2)_2\text{-}O\text{-}NO_2$
Molecular Weight [Kg/Kmol]		170.73	63.01	46.01	152.06
MAK-/TRK-Value	ppm = [mL/m^3]	–	2	5	–
	[mg/m^3]	–	5.2	9.5	–
Peak Limit		–	= 1 =	= 1 =	–
TLV-Value					
TWA	ppm = [mL/m^3]	0.05 (Ni)	2	3	0.05
	[mg/m^3]	0.12 (Ni)	5.2	5.6	0.31
STEL	ppm = [mL/m^3]	–	4	5	–
	[mg/m^3]	–	10	9.4	–
OES-Value					
TWA	ppm = [mL/m^3]	–	2	3	0.2
	[mg/m^3]	–	5	5	1.2
STEL	ppm = [mL/m^3]	0.1 (Ni)	4	5	0.2
	[mg/m^3]	0.24 (Ni)	10	9	1.2
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		7.10	2.62	1.91	6.32
[1 mg/m^3] = ppm = mL/m^3		0.14	0.38	0.52	0.16
Vapour Pressure at 20°C	[h Pa]	428	60	960	0.065
Relative Vapour Density		5.9	2.18	1.59	5.25
Melting Point	[°C]	-17.2	-41.6	-11.3	-22.3
Boiling Point	[°C]	42.4	83 decom.	21.2	197.5
UN – Number		1259	2031	1067	–
Group & Hazard Class		A I	–	–	–
Ignition Temperature	[°C]	35	–	–	–
Lower Ignition Limit	[Vol%]	0.9	–	–	–
Upper Ignition Limit	[Vol%]	64	–	–	–
Odour threshold (approx.) ppm		0.2	–	0.5	–

		n-Octane	Oil mist	Oxygen	Ozone
CAS – Number		[111-65-9]	–	[7782-44-7]	[10028-15-6]
Chemical Formula		C_8H_{18}	varies	O_2	O_3
Molecular Weight [Kg/Kmol]		114.23	–	32.00	48.00
MAK-/TRK-Value ppm =	[mL/m^3]	500	–	–	0.1
	[mg/m^3]	2400	–	–	0.2
Peak Limit		4	–	–	= 1 =
TLV-Value					
TWA ppm =	[mL/m^3]	300	–	–	0.05 (0.1)
	[mg/m^3]	1400	5	–	0.1 (0.2)
STEL ppm =	[mL/m^3]	–	–	–	–
	[mg/m^3]	–	10	–	–
OES-Value					
TWA ppm =	[mL/m^3]	300	–	–	0.1
	[mg/m^3]	1450	5	–	0.2
STEL ppm =	[mL/m^3]	375	–	–	0.3
	[mg/m^3]	1800	10	–	0.6
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		4.75	–	1.33	2.00
[1 mg/m^3] = ppm = mL/m^3		0.21	–	0.75	0.50
Vapour Pressure at 20°C	[h Pa]	14	–	–	–
Relative Vapour Density		3.95	–	1.10	1.66
Melting Point	[°C]	-56.8	liq.	-218.4	-192.7
Boiling Point	[°C]	125.8	–	-183.0	-111.9
UN – Number		1262	–	1072	–
Group & Hazard Class		A I	–	–	–
Ignition Temperature	[°C]	210	–	–	–
Lower Ignition Limit	[Vol%]	0.8	–	–	–
Upper Ignition Limit	[Vol%]	6.5	–	–	–
Odour threshold (approx.) ppm		–	–	odourless	0.015

		n-Pentane	Perchloroethylene	Phenol	Phosgene
CAS – Number		[109-66-0]	[127-18-4]	[108-95-2]	[75-44-5]
Chemical Formula		$H_3C\text{-}(CH_2)_3\text{-}CH_3$	$Cl_2C{=}CCl_2$	C_6H_5OH	$COCl_2$
Molecular Weight [Kg/Kmol]		72.15	165.83	94.11	98.92
MAK-/TRK-Value	ppm = $[mL/m^3]$	1000	50	5	0.02
	$[mg/m^3]$	3000	345	19	0.082
Peak Limit		4	4	= 1 =	= 1 =
TLV-Value					
TWA	ppm = $[mL/m^3]$	600	25	5	0.1
	$[mg/m^3]$	1770	172	19	0.4
STEL	ppm = $[mL/m^3]$	–	100	–	–
	$[mg/m^3]$	–	689	–	–
OES-Value					
TWA	ppm = $[mL/m^3]$	600	50	5	0.1
	$[mg/m^3]$	1800	335	19	0.4
STEL	ppm = $[mL/m^3]$	750	150	10	–
	$[mg/m^3]$	2250	1000	38	–
Conversion Factors					
1 ppm = 1 mL/m^3 = $[mg/m^3]$		3.00	6.89	3.91	4.11
[1 mg/m^3] = ppm = mL/m^3		0.33	0.15	0.26	0.24
Vapour Pressure at 20°C	[h Pa]	566	18.9	0.2	1564
Relative Vapour Density		2.49	5.73	3.25	3.5
Melting Point	[°C]	-129.7	-22.4	40.9	-127.8
Boiling Point	[°C]	36.1	121.2	181.8	7.6
UN – Number		1265	1897	1671	1076
Group & Hazard Class		A I	–	A III	–
Ignition Temperature	[°C]	285	–	595	–
Lower Ignition Limit	[Vol%]	1.4	–	1.3	–
Upper Ignition Limit	[Vol%]	7.8	–	9.5	–
Odour threshold (approx.) ppm		–	20	0.05	0.5

		Phosphine	Potassium cyanide	Propane	iso-Propanol
CAS – Number		[7803-51-2]	[151-50-8]	[74-98-6]	[67-63-0]
Chemical Formula		PH_3	KCN	$H_3C\text{-}CH_2\text{-}CH_3$	$(H_3C)_2\text{-}CHOH$
Molecular Weight [Kg/Kmol]		34.00	65.12	44.1	60.1
MAK-/TRK-Value	ppm = [mL/m^3]	0.1	–	1000	200
	[mg/m^3]	0.14	5 G	1800	500
Peak Limit		= 1 =	4	4	4
TLV-Value					
TWA	ppm = [mL/m^3]	0.3	–	–	200
	[mg/m^3]	0.42	–	–	500
STEL	ppm = [mL/m^3]	1	–	–	400
	[mg/m^3]	1.4	C 5	–	1000
OES-Value					
TWA	ppm = [mL/m^3]	–	–	–	400
	[mg/m^3]	–	5	–	980
STEL	ppm = [mL/m^3]	0.3	–	–	500
	[mg/m^3]	0.4	–	–	1225
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.41	–	1.83	2.5
[1 mg/m^3] = ppm = mL/m^3		0.71	–	0.55	0.4
Vapour Pressure at 20°C	[h Pa]	34600	–	8300	40
Relative Vapour Density		1.18	–	1.6	2.08
Melting Point	[°C]	-133.8	635	-190	-89.5
Boiling Point	[°C]	-87.8	900	-42	82.4
UN – Number		2199	1680	1978	1219
Group & Hazard Class		–	–	–	–
Ignition Temperature	[°C]	100	–	470	425
Lower Ignition Limit	[Vol%]	1	–	1.7	2
Upper Ignition Limit	[Vol%]	–	–	9.3	12
Odour threshold (approx.) ppm		0.02	–	–	1000

		Propylene	Pyridine	Sodium cyanide	Sulphur dioxide
CAS – Number		[115-07-1]	[110-86-1]	[143-33-9]	[7446-09-5]
Chemical Formula		$H_2C{=}CH\text{-}CH_3$	C_5H_5N	NaCN	SO_2
Molecular Weight [Kg/Kmol]		42.1	70.10	49.0	64.06
MAK-/TRK-Value	ppm = [mL/m^3]	–	5	–	0.5 (1.0)
	[mg/m^3]	–	16	5 G	1.3 (2.5)
Peak Limit		–	4	4	= 1 =
TLV-Value					
TWA	ppm = [mL/m^3]	–	5	–	2
	[mg/m^3]	–	16	–	5.2
STEL	ppm = [mL/m^3]	–	–	–	5
	[mg/m^3]	–	–	C 5	13
OES-Value					
TWA	ppm = [mL/m^3]	–	5	–	2
	[mg/m^3]	–	15	5	5
STEL	ppm = [mL/m^3]	–	10	–	5
	[mg/m^3]	–	30	–	13
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		1.76	3.29	–	2.66
[1 mg/m^3] = ppm = mL/m^3		0.57	0.31	–	0.37
Vapour Pressure at 20°C	[h Pa]	10200	20	–	3305
Relative Vapour Density		1.45	2.73	–	2.26
Melting Point	[°C]	-185.3	-41.8	562	-75.5
Boiling Point	[°C]	-48	115.3	1497	-10.1
UN – Number		1077	1282	1689	1079
Group & Hazard Class		–	B	–	–
Ignition Temperature	[°C]	460	550	–	–
Lower Ignition Limit	[Vol%]	2.0	1.7	–	–
Upper Ignition Limit	[Vol%]	11.1	10.6	–	–
Odour threshold (approx.) ppm		–	above 30 ppm intolerable	–	0.5

		Sulphuric acid	Sulphurylfluorid	Styrene	1.1.1.2-Tetrafluoroethan
CAS – Number		[7664-93-9]	[2699-79-8]	[100-42-5]	[811-97-2]
Chemical Formula		H_2SO_4	SO_2F_2	CH_5-$CH=CH_2$	$F_3C–CH_2F$
Molecular Weight [Kg/Kmol]		98.08	102.06	104.15	102.03
MAK-/TRK-Value	ppm = [mL/m³]	–	–	20	–
	[mg/m³]	0.1 E (0.5 E)	21	86	–
Peak Limit		= 1 =	–	4	–
TLV-Value					
TWA	ppm = [mL/m³]	–	5	20	–
	[mg/m³]	1	21	87	–
STEL	ppm = [mL/m³]	–	10	40	–
	[mg/m³]	3	42	173	–
OES-Value					
TWA	ppm = [mL/m³]	–	5	100	–
	[mg/m³]	1	20	420	–
STEL	ppm = [mL/m³]	–	10	250	–
	[mg/m³]	–	40	1050	–
Conversion Factors					
1 ppm = 1 mL/m³ = [mg/m³]		–	4.23	4.33	4.25
[1 mg/m³] = ppm = mL/m³		–	0.24	0.23	0.33
Vapour Pressure at 20°C	[h Pa]	<0.001	15980	6.24	6620
Relative Vapour Density		–	4.3 g/L	3.6	3.53
Melting Point	[°C]	10.4	-135.8	-30.6	–
Boiling Point	[°C]	279.6	-55.4	145.1	-26.5
UN – Number		1830	2191	2055	1078
Group & Hazard Class		–	–	A II	–
Ignition Temperature	[°C]	–	–	490	–
Lower Ignition Limit	[Vol%]	–	–	1.1	–
Upper Ignition Limit	[Vol%]	–	–	8	–
Odour threshold (approx.) ppm		–	–	0.1	–

		Tetrahydrothiophene	Tet.-Butyl-mercaptan	Toluene	2.4-Toluene diisocyanate
CAS – Number		[110-01-0]	[75-66-1]	[108-88-3]	[584-84-9]
Chemical Formula		$CH_2–C_3H_6–S$	$C_4H_{10}S$	C_6H_5-CH_3	H_3C-$C_6H_3(NCO)_2$
Molecular Weight [Kg/Kmol]		88.17	90.19	92.14	174.16
MAK-/TRK-Value	ppm = [mL/m^3]	–	–	50	0.005
	[mg/m^3]	–	–	190	0.035
Peak Limit		–	–	4	4
TLV-Value					
TWA	ppm = [mL/m^3]	–	–	50	0.005
	[mg/m^3]	–	–	188	0.036
STEL	ppm = [mL/m^3]	–	–	–	0.02
	[mg/m^3]	–	–	–	0.14
OES-Value					
TWA	ppm = [mL/m^3]	–	–	50	–
	[mg/m^3]	–	–	188	0.02 (NCO)
STEL	ppm = [mL/m^3]	–	–	150	–
	[mg/m^3]	–	–	560	0.07 (NCO)
Conversion Factors					
1 ppm = 1 mL/m^3 = [mg/m^3]		3.66	3.74	3.83	7.24
[1 mg/m^3] = ppm = mL/m^3		0.27	0.27	0.26	0.14
Vapour Pressure at 20°C	[h Pa]	19.3	–	27.8	0.013
Relative Vapour Density		3.05	–	3.18	6.02
Melting Point	[°C]	-96.2	1.1	-95.0	21.8
Boiling Point	[°C]	121.1	64.2	110.6	247
UN – Number		2412	1228	1294	2078
Group & Hazard Class		A I	–	A I	–
Ignition Temperature	[°C]	–	–	535	620
Lower Ignition Limit	[Vol%]	–	–	1.2	0.9
Upper Ignition Limit	[Vol%]	–	–	7	9.5
Odour threshold (approx.)	ppm	–	–	< 5	–

		2.6-Toluene diisocyanate	o-Toluidine	1.1.1-Trichlorethane	1.1.2-Trichlorethane
CAS – Number		[91-08-7]	[95-53-4]	[71-55-6]	[79-00-5]
Chemical Formula		$H_3C\text{-}C_6H_3(NCO)_2$	$H_3C\text{-}C_6H_4\text{-}NH_2$	$H_3C\text{-}CCl_3$	$ClCH_2\text{-}CHCl_2$
Molecular Weight [Kg/Kmol]		174.16	107.16	133.40	133.4
MAK-/TRK-Value	ppm = $[mL/m^3]$	0.005	–	200	10, III B
	$[mg/m^3]$	0.035	0.5	1100	55, III B
Peak Limit		4	4	4	4
TLV-Value					
TWA	ppm = $[mL/m^3]$	–	2, A3	350	10
	$[mg/m^3]$	–	8.8, A3	1910	55
STEL	ppm = $[mL/m^3]$	–	–	450	–
	$[mg/m^3]$	–	–	2460	–
OES-Value					
TWA	ppm = $[mL/m^3]$	–	2	350	10
	$[mg/m^3]$	0.02 (NCO)	9	1900	45
STEL	ppm = $[mL/m^3]$	–	5	450	20
	$[mg/m^3]$	0.07 (NCO)	22	2450	90
Conversion Factors					
1 ppm = 1 mL/m^3 = $[mg/m^3]$		7.24	4.45	5.54	5.54
$[1\ mg/m^3]$ = ppm = mL/m^3		0.14	0.23	0.18	0.18
Vapour Pressure at 20°C	[h Pa]	0.02	0.18	133	29
Relative Vapour Density		6.02	3.7	4.61	4.61
Melting Point	[°C]	8.5	-14.7	-32.6	-36.7
Boiling Point	[°C]	120	200.2	73.7	113.7
UN – Number		2078	1708	2831	–
Group & Hazard Class		–	A III	–	–
Ignition Temperature	[°C]	–	480	537	460
Lower Ignition Limit	[Vol%]	–	–	8	–
Upper Ignition Limit	[Vol%]	–	–	10.5	–
Odour threshold (approx.) ppm		–	0.5	< 100	–

	Trichlorethylene	Triethylamine	Trichlorotrifluoroethane	Trichlorofluoromethane
CAS – Number	[79-01-6]	[121-44-8]	[76-13-1]	[75-69-4]
Chemical Formula	$ClHC=CCl_2$	$(H_3C\text{-}CH_2)_3N$	$F_2ClC\text{-}CFCl_2$	$CFCl_3$
Molecular Weight [Kg/Kmol]	131.39	101.19	187.38	137.37
MAK-/TRK-Value ppm = [mL/m^3]	50	1	500	1000
[mg/m^3]	270	4.2	3900	5700
Peak Limit	4	= 1 =	4	4
TLV-Value				
TWA ppm = [mL/m^3]	50	1	1000	–
[mg/m^3]	269	4.2	7670	C 5620
STEL ppm = [mL/m^3]	100	3	1250	–
[mg/m^3]	546	12.6	9590	C 1000
OES-Value				
TWA ppm = [mL/m^3]	100	10	1000	1000
[mg/m^3]	535	40	7600	5600
STEL ppm = [mL/m^3]	150	15	1250	1250
[mg/m^3]	802	60	9500	7000
Conversion Factors				
1 ppm = 1 mL/m^3 = [mg/m^3]	5.46	4.21	7.79	5.71
[1 mg/m^3] = ppm = mL/m^3	0.18	0.24	0.13	0.18
Vapour Pressure at 20°C [h Pa]	77.3	71	364	886.5
Relative Vapour Density	4.54	3.5	6.74	4.75
Melting Point [°C]	-73	-114.7	-33.0	-110.5
Boiling Point [°C]	87	89.3	47.6	23.8
UN – Number	1710	1296	–	–
Group & Hazard Class	–	B	–	–
Ignition Temperature [°C]	410	230	–	–
Lower Ignition Limit [Vol%]	7.3	1.2	–	–
Upper Ignition Limit [Vol%]	–	8.0	–	–
Odour threshold (approx.) ppm	20	–	–	–

		Vinyl chloride	Water vapour	Xylene
CAS – Number		[75-01-4]	[7732-18-5]	[1330-20-7]
Chemical Formula		$H_2C{=}CHCl$	H_2O	$C_6H_4(CH_3)_2$
Molecular Weight [Kg/Kmol]		62.50	18.02	106.17
MAK-/TRK-Value	ppm = [mL/m³]	Manuftr. / User 3 / 2	–	100
	[mg/m³]	Manuftr. / User 8 / 5	–	440
Peak Limit		4	–	4
TLV-Value				
TWA	ppm = [mL/m³]	5, A4	–	100
	[mg/m³]	13, A4	–	434
STEL	ppm = [mL/m³]	–	–	150
	[mg/m³]	–	–	651
OES-Value				
TWA	ppm = [mL/m³]	10	–	100
	[mg/m³]	40	–	435
STEL	ppm = [mL/m³]	–	–	150
	[mg/m³]	–	–	650
Conversion Factors				
1 ppm = 1 mL/m³ = [mg/m³]		2.6	0.75	4.41
[1 mg/m³] = ppm = mL/m³		0.38	1.33	0.23
Vapour Pressure at 20°C	[h Pa]	3406	23.3	–
Relative Vapour Density		2.16	0.59	3.67
Melting Point	[°C]	-153.7	0	-48...13
Boiling Point	[°C]	-13.7	100	138...144
UN – Number		1086	–	1307
Group & Hazard Class		–	–	A II
Ignition Temperature	[°C]	415	–	465...525
Lower Ignition Limit	[Vol%]	3.8	–	1.0...1.1
Upper Ignition Limit	[Vol%]	31	–	7.0...7.6
Odour threshold (approx.) ppm		–	–	4

6. Measurement of Contaminants in Liquids

Order Code
67 22 101

Acetic Acid 0.5 to 20 g/L

ST-40-01

Application Range

Determination of acetic acid in water/waste water

Dräger-Tube:	Acetic Acid 5/a
Measuring range:	0.5 to 20 g/L
Number of Strokes (n):	10
Typical Stroke Time:	10 to 30 s
Measurement Time:	approx. 200 s
Sample Volume:	200 mL
Colour Change:	blue violet –> yellow
Temperature Range:	10 to 30 °C
pH-Measurement:	necessary

Information of Measurement

Using sulfuric acid, the pH-value has to be adjusted to the value of 1.3

System Parameters (valid for pH 1.3)

Measurement Range [g/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.5 to 20	25	10 to 30	0.339	1.368

Evaluation of Measurement

Calculate acetic acid concentration:

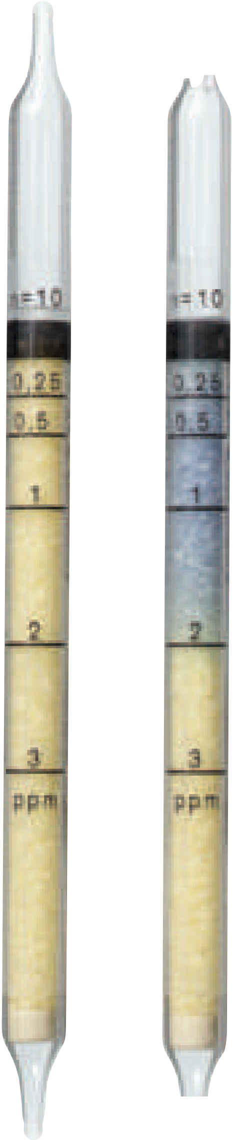
$$Y_{[g/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Formic acid is indicated with lower and propionic acid with higher sensitivity.

Ammonia 1.5 to 10 mg/L

Order Code
81 01 711



Application Range

Determination of ammonia in water/waste water

Dräger-Tube:	Ammonia 0,25/a
Measuring range:	1.5 to 10 mg/L
Number of Strokes (n):	10
Typical Stroke Time:	10 to 30 s
Measurement Time:	approx. 200 s
Sample Volume:	200 mL
Color Change:	yellow –> blue
Temperature Range:	4 to 30 °C
pH-Measurement:	necessary

Information of Measurement

Using acetic acid or sodium hydroxide solution,
the pH-value has to be adjusted to the value of 10.2 - 10.3.

System Parameters (valid for pH 10.2 - 10.3)

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	Parameters C
1.5 to 10	30	4 to 7	3.427	1.409
		8 to 12	2.926	0.815
		13 to 17	2.578	0.918
		18 to 24	1.895	0.989
		25 to 30	1.397	0.774

Evaluation of Measurement

Calculate ammonia concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Other basic substances are also indicated.

Order Code
81 01 711

Ammonia 10 to 100 mg/L

Application Range

Determination of ammonia in water/waste water

Dräger-Tube:	Ammonia 0.25/a
Measuring range:	10 to 100 mg/L
Number of Strokes (n):	1
Typical Stroke Time:	10 to 30 s
Measurement Time:	approx. 20 s
Sample Volume:	200 mL
Color Change:	yellow –> blue
Temperature Range:	4 to 30 °C
pH-Measurement:	necessary

Information of Measurement

Using acetic acid or sodium hydroxide solution,
the pH-value has to be adjusted to the value of 10.2 - 10.3.

System Parameters (valid for pH 10.2 - 10.3)

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	Parameters C
10 to 100	30	4 to 7	61.34	0.826
		8 to 12	40.46	0.310
		13 to 17	29.37	0.943
		18 to 24	27.59	0.463
		25 to 30	18.11	-0.123

Evaluation of Measurement

Calculate ammonia concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Other basic substances are also indicated.

Benzene 0.5 to 5 mg/L

Order Code
81 01 231

ST-184-01

Application Range

Determination of benzene in water/waste water

Dräger-Tube:	Benzene 2/a
Measuring range:	0.5 to 5 mg/L
Number of Strokes (n):	5
Typical Stroke Time:	40 to 60 s
Measurement Time:	approx. 250 s
Sample Volume:	200 mL
Color Change:	white –> brown grey
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.5 to 5	30	5 to 30	0.119	0

Evaluation of Measurement

Calculate benzene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

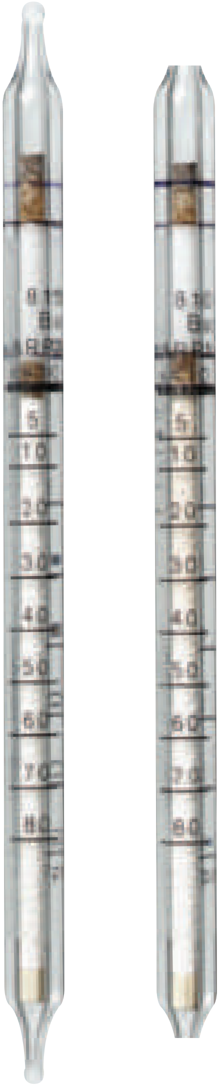
Cross Sensivity

Ethyl acetate, perchloroethylene, phenol, styrene, toluene and m-xylene are not indicated.

Petroleum hydrocarbons are indicated with lower sensitivity.

Order Code
81 01 661

Benzene 0.2 to 5 mg/L



Application Range

Bestimmung von Ameisensäure in Wasser/Abwasser

Dräger-Tube:	Toluene 5/b
Measuring range:	0.2 to 5 mg/L
Number of Strokes (n):	6
Typical Stroke Time:	60 to 90 s
Measurement Time:	approx. 450 s
Sample Volume:	200 mL
Color Change:	white –> yellow green
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.2 to 5	40	5 to 30	0.057	0

Evaluation of Measurement

Calculate benzene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

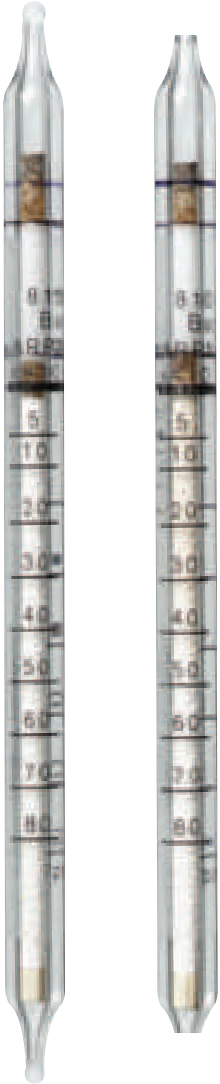
Toluene, xylene (all isomere), ethylbenzene and styrene are indicated with different sensitivity.

Acetone, ethanol and n-octane do not interfere with the reading.

Phenol does not interfere with the reading up to a concentration of 100 mg/L

BTX-Aromatics 0.2 to 5 mg/L

Order Code
81 01 661



ST-151-01

Application Range

Determination of sum parameter benzene, toluene and xylene in water/waste water

Dräger-Tube:	Toluene 5/b
Measuring range:	0.2 to 5 mg/L
Number of Strokes (n):	6
Typical Stroke Time:	60 to 90 s
Measurement Time:	approx. 450 s
Sample Volume:	200 mL
Color Change:	white –> brown violet to yellow
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.2 to 5	40	5 to 30	0.057	0

Evaluation of Measurement

Calculate BTX concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Ethylbenzene and styrene are also indicated, however, with different sensitivity.

Acetone, ethanol und n-octane are not indicated.

Phenol does not interfere with the reading up to a concentration of 100 mg/L.

Order Code
81 01 661

BTX-Aromatics qualitative in oil

Application Range

Determination of sum parameter benzene, toluene and xylene in oil sludges/oil emulsions

Dräger-Tube:	Toluene 5/b
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	60 to 80 s
Measurement Time:	approx. 75 to 750 s
Sample Volume:	approx. 0.5 g
Color Change:	white –> brown violet to yellow-green
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

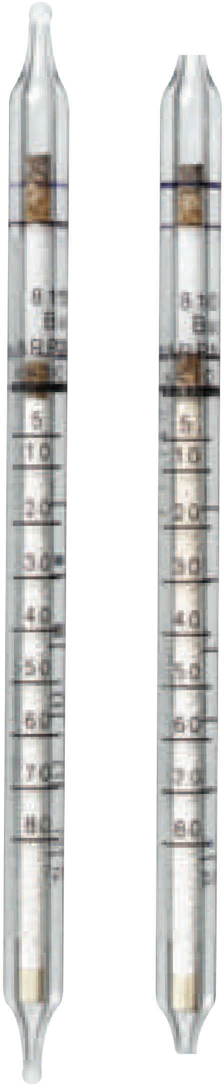
- Approx. 0.5 g oil sample has to be shaken intensively with 1 L de-ionized water for 2 minutes in a laboratory bottle.
- The solution must be filtered through an analysis funnel with a round filter (black ribbon) directly into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

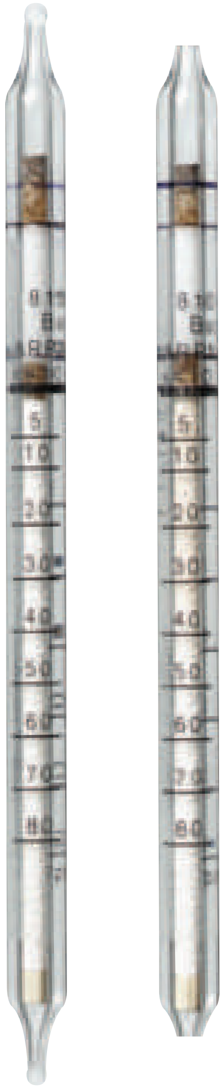
Benzene, xylene (all isomere), ethylbenzene and toluene are indicated. Acetone, ethanol, phenol and n-octane are not indicated.



ST-151-01

BTX Aromatics in soil 2 to 50 mg/kg

Order Code
81 01 661



ST-151-01

Application Range

Determination of sum parameter benzene, toluene and xylene in soil

Dräger-Tube:	Toluene 5/b
Measuring range:	2 to 50 mg/kg dry substance
Number of Strokes (n):	6
Typical Stroke Time:	60 to 90 s
Measurement Time:	approx. 450 s
Sample Volume:	20 g soil
Color Change:	white –> brown violet to yellowgreen
Temperature Range:	15 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- 20 g soil is suspended completely with 100 mL de-ionized water and 1 mL surfactant solutions (2 mass % Extran AP 13, Merck).
- The precipitate must rest for approx. 1 minute, until the particles have settled to the bottom; the liquid above the particles has to be filled into the wash bottle
- The remaining precipitate has to be shaken two times with 50 mL de-ionized water and the liquid above the particles has to be filled into the wash bottle
- The gas wash bottle is filled up with de-ionized water up to 200 mL mark.

System Parameters

Measurement Range [mg/kg]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
2 to 50	40	15 to 25	0.057	0

Evaluation of Measurement

Calculate BTX concentration:

$$Y_{soil[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Ethylbenzene and styrene are indicated with different sensitivity. Acetone, ethanol and n-octane do not interfere with the reading. Phenol does not interfere with the reading up to a concentration of 100 mg/L

Order Code
CH 27 401

Carbon Tetrachloride 0.2 to 4 mg/L

Application Range

Determination of carbon tetrachloride in water/waste water

Dräger-Tube:	Carbon Tetrachloride 5/c + Activation Tube (81 01 141)
Measuring range:	0.2 to 4 mg/L
Number of Strokes (n):	5
Typical Stroke Time:	50 to 130 s
Measurement Time:	approx. 450 s
Sample Volume:	200 mL
Color Change:	yellow –> blue green
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters	
			B	C
0.2 bis 4	30	5 bis 30	0.025	0
			for readings of 5 to < 30 ppm	
			0.115	-22
			for readings of 30 to < 50 ppm	

Evaluation of Measurement

Calculate carbon tetrachloride concentration:

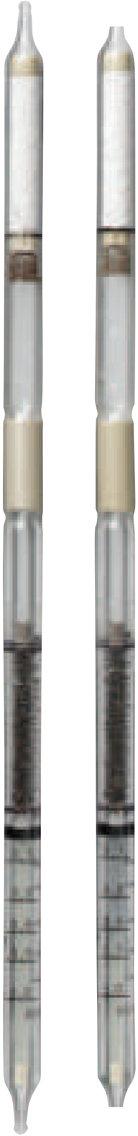
$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Benzene, dichloroethane, perchloroethylene, 1,1,1-trichloroethane and trichloroethylene are indicated with lower sensitivity.

Chlorinated Hydrocarbons qualitative in oil

Order Code
81 01 551



ST-193-01

Application Range

Determination of volatile chlorinated hydrocarbons in oil sludges/oil emulsions

Dräger-Tube:	Perchloroethylene 0.1/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	2 to 3 minutes
Measurement Time:	approx. 2 to 20 minutes
Sample Volume:	approx. 0.5 g
Color Change:	yellow white –> grey blue
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- Approx. 0.5 g oil sample has to be shaken intensively with 1 L de-ionized water for 2 minutes in a laboratory bottle.
- The solution must be filtered through an analysis funnel with a round filter (black ribbon) directly into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, perchloroethylene, trichloroethylene and trichloromethane are indicated. Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.

Order Code
81 01 551

Chlorinated Hydrocarbons qualitative in multiple phase

Application Range

Determination of volatile chlorinated hydrocarbons in multiple phase

Dräger-Tube:	Perchloroethylene 0.1/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	2 to 3 minutes
Measurement Time:	approx. 2 to 20 minutes
Sample Volume:	200 mL
Color Change:	yellow white –> grey blue
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

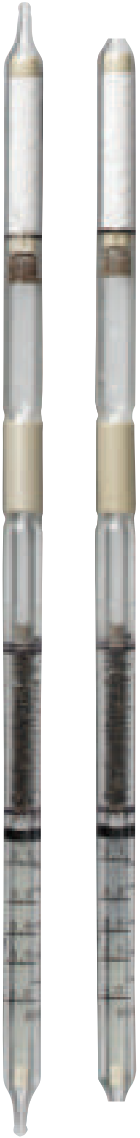
- Mix a multiple phase sample which consists of e.g. 250 g water, 10 g fixed phase and 10 g oil part (about 300 mL) is mixed with approx. 5 g activated coal. It must rest for 3 minutes and then be shaken for 1 min.
- 0.2 g hydrophobated peat is added and the it must be shaken for 1 minute.
- The liquid is filled into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

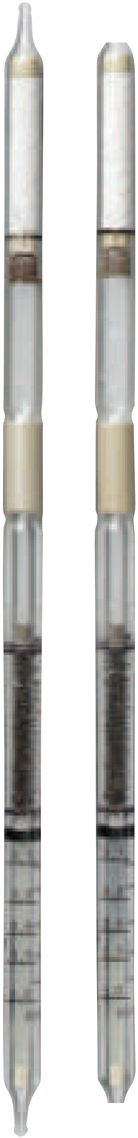
Chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, perchloroethylene, trichloroethylene and trichloromethane are indicated. Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.



ST-193-01

Chlorinated Hydrocarbons qualitative in soil

Order Code
81 01 551


ST-193-01

Application Range

Determination of volatile chlorinated hydrocarbons in soil

Dräger-Tube:	Perchloroethylene 0.1/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	2 to 3 minutes
Measurement Time:	approx. 2 to 20 minutes
Sample Volume:	20 g
Color Change:	yellow white –> grey blue
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- 20 g soil is suspended completely with 100 mL de-ionized water and 1 mL surfactant solutions (2 mass % Extran AP 13, Merck).
- The precipitate must rest for approx. 1 minute, until the particles have settled to the bottom; the liquid above the particles has to be filled into the wash bottle
- The remaining precipitate has to be shaken two times with 50 mL de-ionized water and the liquid above the particles has to be filled into the wash bottle
- The gas wash bottle is filled up with de-ionized water up to 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, perchloroethylene, trichloroethylene and trichloromethane are indicated. Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.

Order Code
81 01 501

Chlorinated Hydrocarbons qualitative in soil

Application Range

Determination of volatile chlorinated hydrocarbons in soil

Dräger-Tube:	Perchloroethylene 2/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	45 to 65 s
Measurement Time:	approx. 55 to 550 s
Sample Volume:	20 g
Color Change:	yellow white –> grey blue
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- 20 g soil is suspended completely with 100 mL de-ionized water and 1 mL surfactant solutions (2 mass % Extran AP 13, Merck).
- The precipitate must rest for approx. 1 minute, until the particles have settled to the bottom; the liquid above the particles has to be filled into the was bottle
- The remaining precipitate has to be shaken two times with 50 mL de-ionized water and the liquid above the particles has to be filled into the was bottle
- The gas wash bottle is filled up with de-ionized water up to 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, perchloroethylene, trichloroethylene and trichloromethane are indicated. Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.

ST-90-01

Chlorinated Hydrocarbons qualitative in oil

Order Code
81 01 501

Application Range

Determination of volatile chlorinated hydrocarbons in oil sludges/oil emulsions

Dräger-Tube:	Perchloroethylene 2/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	45 to 65 s
Measurement Time:	approx. 55 to 550 s
Sample Volume:	approx. 0.5 g
Color Change:	yellow white –> grey blue
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- Approx. 0.5 g oil sample has to be shaken intensively with 1 L de-ionized water for 2 minutes in a laboratory bottle.
- The solution must be filtered through an analysis funnel with a round filter (black ribbon) directly into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, perchloroethylene, trichloroethylene and trichloromethane are indicated. Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.

Order Code
81 01 501

Chlorinated Hydrocarbons qualitative in multiple phase

Application Range

Determination of volatile chlorinated hydrocarbons in multiple phase

Dräger-Tube:	Perchloroethylene 2/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	45 to 65 s
Measurement Time:	approx. 55 to 550 s
Sample Volume:	200 mL
Color Change:	yellow white –> grey blue
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- Mix a multiple phase sample which consists of e.g. 250 g water, 10 g fixed phase and 10 g oil part (about 300 mL) is mixed with approx. 5 g activated coal. It must rest for 3 minutes and then be shaken for 1 min.
- 0.2 g hydrophobated peat is added and the it must be shaken for 1 minute.
- The liquid is filled into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, perchloroethylene, trichloroethylene and trichloromethane are indicated. Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.

Chlorinated Hydrocarbons qualitative in oil

Order Code
CH 21 101

Application Range

Determination of volatile chlorinated hydrocarbons in oil sludges/oil emulsions

Dräger-Tube:	Trichloroethane 50/a
Measuring range:	qualitative
Number of Strokes (n):	6 + 3 desorption strokes in clean air
Typical Stroke Time:	40 to 70 s + 30 s
Measurement Time:	approx. 660 s + 90 s
Sample Volume:	approx. 0.5 g
Color Change:	grey –> brown red
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- Approx. 0.5 g oil sample has to be shaken intensively with 1 L de-ionized water for 2 minutes in a laboratory bottle.
- The solution must be filtered through an analysis funnel with a round filter (black ribbon) directly into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Dichloromethane, Perchloroethylene, Carbon tetrachlroide, 1,1,1-Trichloroethane and Trichloroethylene are indicated. Petroleum hydrocarbons are not indicated.

Order Code CH 21 101

Chlorinated Hydrocarbons qualitative in multiple phase

Application Range

Determination of volatile chlorinated hydrocarbons in multiple phase

Dräger-Tube:	Trichloroethane 50/a
Measuring range:	qualitative
Number of Strokes (n):	6 + 3 desorption strokes in clean air
Typical Stroke Time:	40 to 70 s + 30 s
Measurement Time:	approx. 660 s + 90 s
Sample Volume:	200 mL
Color Change:	grey –> brown red
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- Mix a multiple phase sample which consists of e.g. 250 g water, 10 g fixed phase and 10 g oil part (about 300 mL) is mixed with approx. 5 g activated coal. It must rest for 3 minutes and then be shaken for 1 min.
- 0.2 g hydrophobated peat is added and the it must be shaken for 1 minute.
- The liquid is filled into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

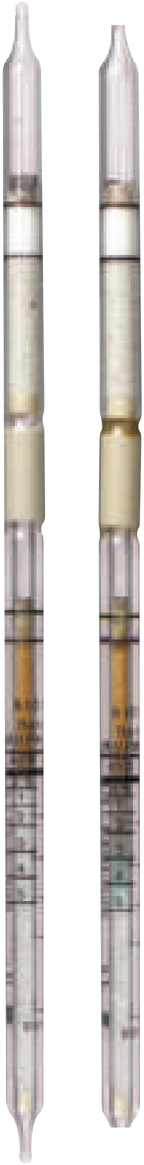
The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Dichloromethane, perchloroethylene, carbon tetrachloride, 1,1,1-trichloroethane and trichloroethylene are indicated. Petroleum hydrocarbons are not indicated.

Chlorinated Hydrocarbons qualitative in oil

Order Code
81 01 671



ST-201-01

Application Range

Determination of volatile chlorinated hydrocarbons in oil sludges/oil emulsions

Dräger-Tube:	Methylbromide 0.5/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	60 to 70 s
Measurement Time:	approx. 65 to 650 s
Sample Volume:	approx. 0.5 g
Color Change:	white grey –> blue green
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- Approx. 0.5 g oil sample has to be shaken intensively with 1 L de-ionized water for 2 minutes in a laboratory bottle.
- The solution must be filtered through an analysis funnel with a round filter (black ribbon) directly into the gas wash bottle up to the 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Chloroform, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, methylbromide, perchlorethylene, 1,1,1-trichloroethane and trichloroethylene are indicated.

1,4-dichlorobutane and carbon tetrachloride is not indicated.

Order Code
81 01 671

Chlorinated Hydrocarbons qualitative in multiple phase

Application Range

Determination of volatile chlorinated hydrocarbons in multiple phase

Dräger-Tube:	Methylbromide 0.5/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	60 to 70 s
Measurement Time:	approx. 65 to 650 s
Sample Volume:	200 mL
Color Change:	white grey –> blue green
Temperature Range:	10 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- Mix a multiple phase sample which consists of e.g. 250 g water, 10 g fixed phase and 10 g oil part (about 300 mL) is mixed with approx. 5 g activated coal. It must rest for 3 minutes and then be shaken for 1 min.
- 0.2 g hydrophobated peat is added and the it must be shaken for 1 minute.
- The liquid is filled into the gas wash bottle up to the 200 mL mark.

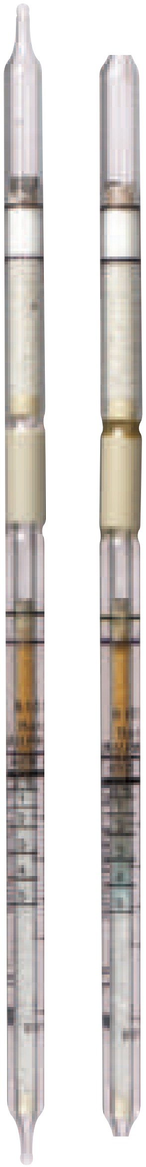
Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

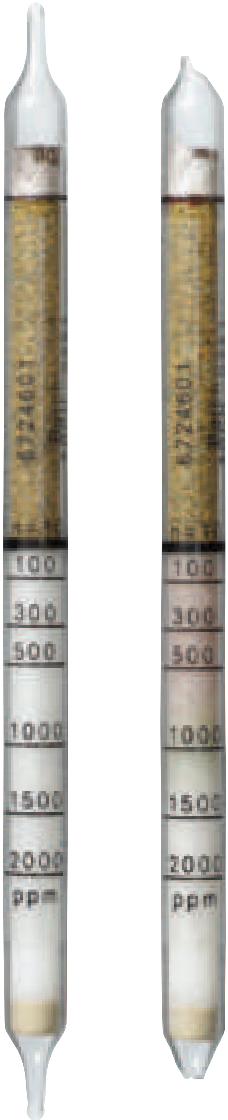
Chloroform, 1,1-dichloroethane, 1,2-dichloroethane, dichloromethane, methylbromide, perchlorethylene, 1,1,1-trichloroethane and trichloroethylene are indicated.

1,4-dichlorobutane and carbon tetrachloride is not indicated.



Dichloromethane 5 to 100 mg/L

Order Code
67 24 601



ST-76-01

Application Range

Determination of dichloromethane in water/waste water

Dräger-Tube:	Methylene Chloride 100/a
Measuring range:	5 to 100 mg/L
Number of Strokes (n):	8
Typical Stroke Time:	60 to 120 s
Measurement Time:	approx. 720 s
Sample Volume:	200 mL
Color Change:	white –> brown green
Temperature Range:	5 to 33 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters	
			B	C
5 to 100	30	5 to 10	0.050	0
		11 to 15	0.041	0
		16 to 25	0.036	0
		26 to 33	0.030	0

Evaluation of Measurement

Calculate dichloromethane concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Petroleum hydrocarbons, benzene, chlorobenzene, toluene, dichloromethane, 1,1,1-trichloroethane, trichloroethylene and trichloromethane are indicated with different sensitivity.

Perchloroethylene, carbon tetrachloride and o-xylene are not indicated.

Order Code
81 01 691

Diesel Fuels 0.5 to 5 mg/L

Application Range

Determination of diesel fuels in water/waste water

Dräger-Tube: Petroleum hydrocarbons 10/a
Measuring range: 0.5 to 5 mg/L
Number of Strokes (n): 8
Typical Stroke Time: 30 to 60 s
Measurement Time: approx. 360 s
Sample Volume: 200 mL
Color Change: white –> brown green
Temperature Range: 5 to 25 °C
pH-Measurement: not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters	
			B	C
0.5 to 5	30	5 to 25	0.089	0

Readings > 50 ppm give qualitative results, only.

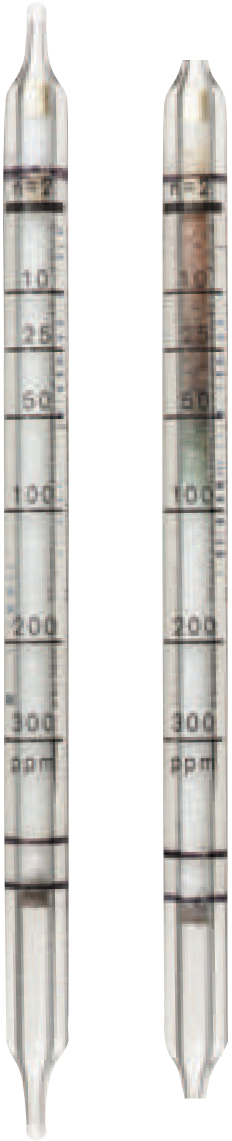
Evaluation of Measurement

Calculate diesel fuel concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

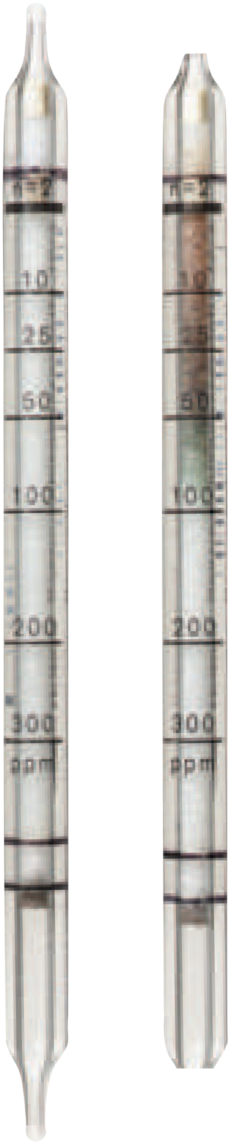
Ethyl acetate, diesel oil, hydrogen sulphide and toluene are indicated with lower sensitivity.
Perchloroethylene is indicated with higher sensitivity.



ST-19-01

Diesel Fuels qualitative in soil

Order Code
81 01 691



Application Range

Determination of diesel fuels in soil

Dräger-Tube:	Petroleum Hydrocarbons 10/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	30 to 60 s
Measurement Time:	approx. 45 to 450 s
Sample Volume:	20 g
Color Change:	white –> brown green
Temperature Range:	5 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- 20 g soil is suspended completely with 100 mL de-ionized water.
- The precipitate must rest for approx. 1 minute, until the particles have settled to the bottom; the liquid above the particles has to be filled into the was bottle
- The remaining precipitate has to be shaken two times with 50 mL de-ionized water and the liquid above the particles has to be filled into the was bottle
- The gas wash bottle is filled up with de-ionized water up to 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Diesel oil, ethyl acetate, perchloroethylene, hydrogen sulphide and toluene are also indicated.

Order Code
81 01 661

Ethylbenzene 0.2 to 5 mg/L

Application Range

Determination of ethylbenzene in water/waste water

Dräger-Tube:	Toluene 5/b
Measuring range:	0.2 to 5 mg/L
Number of Strokes (n):	6
Typical Stroke Time:	60 to 90 s
Measurement Time:	approx. 450 s
Sample Volume:	200 mL
Color Change:	white –> yellow green
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters	
			B	C
0.2 to 5	40	5 to 30	0.057	0

Evaluation of Measurement

Calculate ethylbenzene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Benzene, toluene, xylene (all isomere) and styrene are indicated with different sensitivity.
Acetone, ethanol and n-octane do not interfere with the reading.
Phenol does not interfere with the reading up to a concentration of 100 mg/L

Formic Acid 1 to 20 g/L

Order Code
67 22 101

ST-40-01

Application Range

Determination of formic acid in water/waste water

Dräger-Tube:	Acetic Acid 5/a
Measuring range:	1 to 20 g/L
Number of Strokes (n):	10
Typical Stroke Time:	10 to 30 s
Measurement Time:	approx. 200 s
Sample Volume:	200 mL
Color Change:	blue violet –> yellow
Temperature Range:	5 to 25 °C
pH-Measurement:	necessary

Information of Measurement

Using sulfuric acid, the pH-value has to be adjusted to the value of 1.3.

System Parameters (valid for pH 1.3)

Measurement Range [g/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
1 to 20	25	5 to 25	0.487	1.607

Evaluation of Measurement

Calculate formic acid concentration:

$$Y_{[g/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Acetic acid and propionic acid are indicated with higher sensitivity.

Order Code
81 01 691

Gasoline qualitative in soil

Application Range

Determination of gasoline in soil

Dräger-Tube:	Petroleum Hydrocarbons 10/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	30 to 60 s
Measurement Time:	approx. 45 to 450 s
Sample Volume:	20 g
Color Change:	white –> brown green
Temperature Range:	5 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

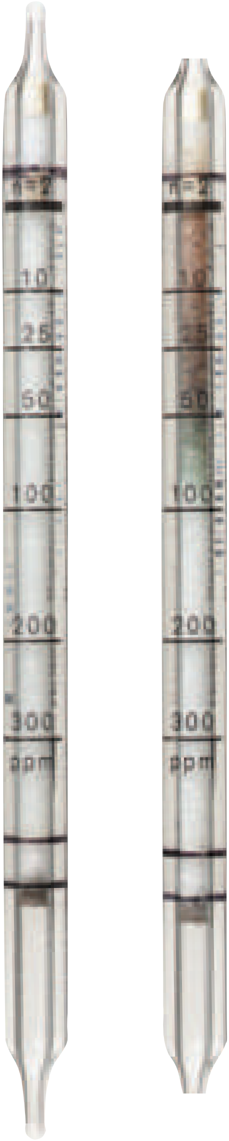
- 20 g soil is suspended completely with 100 mL de-ionized water.
- The precipitate must rest for approx. 1 minute, until the particles have settled to the bottom; the liquid above the particles has to be filled into the was bottle
- The remaining precipitate has to be shaken two times with 50 mL de-ionized water and the liquid above the particles has to be filled into the was bottle
- The gas wash bottle is filled up with de-ionized water up to 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

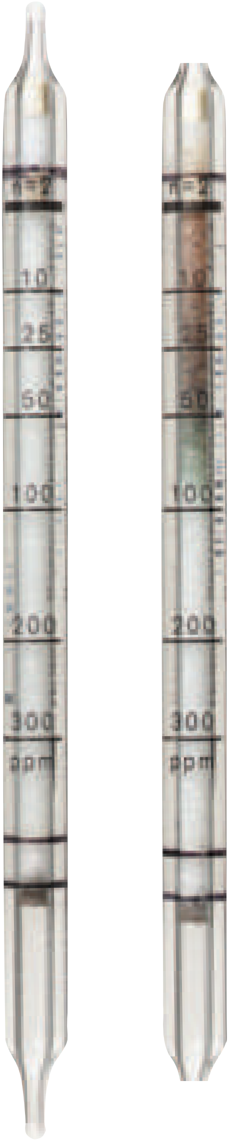
Cross Sensivity

Diesel oil, ethyl acetate, perchloroethylene, hydrogen sulphide and toluene are also indicated.



Gasoline 0.1 to 2 mg/L

Order Code
81 01 691



ST-19-01

Application Range

Determination of gasoline in water/waste water

Dräger-Tube:	Petroleum Hydrocarbons 10/a
Measuring range:	0.1 to 2 mg/L for n-octan
Number of Strokes (n):	2
Typical Stroke Time:	30 to 60 s
Measurement Time:	approx. 90 s
Sample Volume:	200 mL
Color Change:	white –> brow green
Temperature Range:	5 to 25 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters	
			B	C
0.1 to 2	30	5 to 25	0.010	0

Evaluation of Measurement

Calculate gasoline concentration:

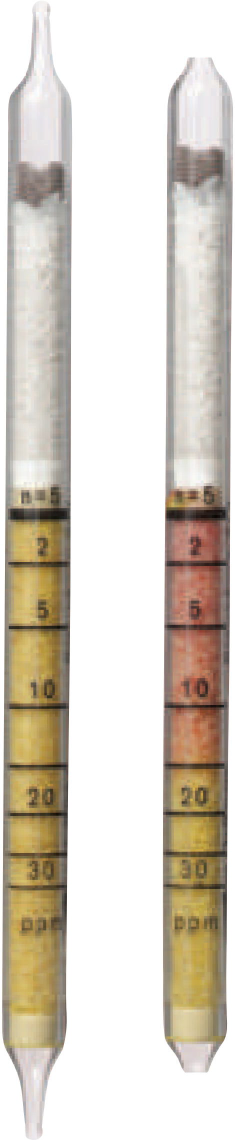
$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Ethyl acetate, diesel oil, hydrogen sulphide and toluene are indicated with lower sensitivity.

Perchloroethylene is indicated with higher sensitivity.

Order Code CH 25 701 Hydrocyanic Acid (Cyanide) 0.5 to 10 mg/L



ST-25-01

Application Range

Determination of hydrocyanic acid in water/waste water

Dräger-Tube:	Hydrocyanic acid 2/a
Measuring range:	0.5 to 10 g/L
Number of Strokes (n):	8
Typical Stroke Time:	15 to 30 s
Measurement Time:	approx. 180 s
Sample Volume:	200 mL
Color Change:	yellow orange –> red
Temperature Range:	5 to 34 °C
pH-Measurement:	necessary

Information of Measurement

Using acetic acid or sodium hydroxide solution, the pH-value has to be adjusted to the value of 1 - 8.

System Parameters (valid for pH 1 - 8)

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	Parameters C
1.5 to 10	30	5 to 15	0.350	0
		16 to 25	0.285	0
		26 to 34	0.248	0

Evaluation of Measurement

Calculate hydrocyanic acid concentration:

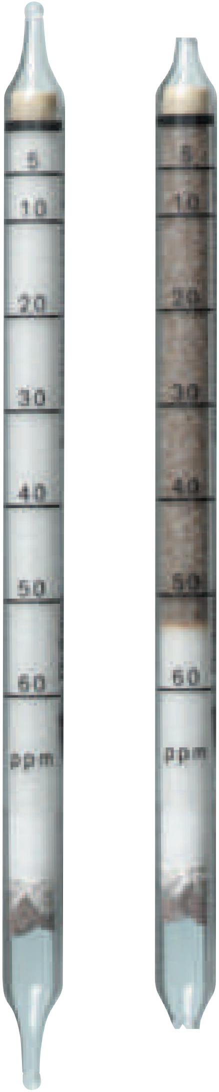
$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Hydrochloric acid in concentrations > 5 % may also give a color indication and there may, therefore, appear to be a higher concentration of free hydrocyanic acid (cyanides) than there actually is.

Hydrogen Sulphide 50 to 500 µg/L

Order Code
81 01 461



ST-125-01

Application Range

Determination of hydrogen sulphide (sum of sulphide) in water/waste water

Dräger-Tube:	Hydrogen Sulphide 0.2/a
Measuring range:	50 to 500 mg/L
Number of Strokes (n):	5
Typical Stroke Time:	50 to 80 s
Measurement Time:	approx. 325 s
Sample Volume:	200 mL
Color Change:	white –> pale brown
Temperature Range:	3 to 30 °C
pH-Measurement:	necessary

Information of Measurement

Using acetic acid or sodium hydroxide solution,
the pH-value has to be adjusted to the value of 7.3 - 7.4 (K=1)

System Parameters (valid for pH 7.3 - 7.4)

Measurement Range [µg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
50 to 500	30	3 to 7	72	0.2
		8 to 13	63	0.2
		14 to 30	57	0.2

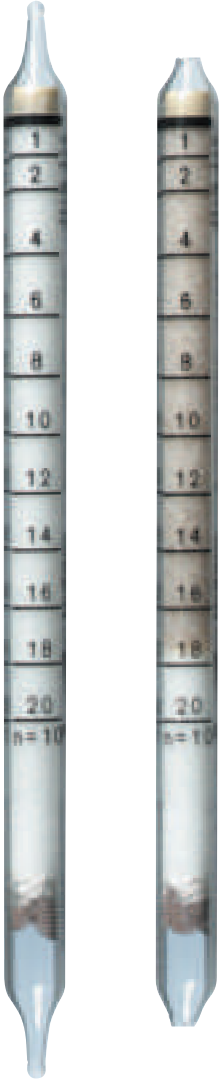
Evaluation of Measurement

Calculate hydrogen sulphide concentration:

$$Y_{[\mu g/L]} = A \bullet B \bullet (K \bullet X_{[ppm]} + C)$$

Order Code
67 19 001

Hydrogen Sulphide 0.2 to 1 mg/L



Application Range

Determination of hydrogen sulphide (sum of sulphide) in water/waste water

Dräger-Tube:	Hydrogen Sulphide 1/c
Measuring range:	0.2 to 1 mg/L
Number of Strokes (n):	5
Typical Stroke Time:	50 to 100 s
Measurement Time:	approx. 375 s
Sample Volume:	200 mL
Color Change:	white –> pale brown
Temperature Range:	3 to 30 °C
pH-Measurement:	necessary

Information of Measurement

Using acetic acid or sodium hydroxide solution,
the pH-value has to be adjusted to the value of 7.3 - 7.4 (K=1).

System Parameters (valid for pH 7.3 - 7.4)

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.5 to 10	30	3 to 7	0.051	0
		8 to 13	0.045	0
		14 to 30	0.040	0

Evaluation of Measurement

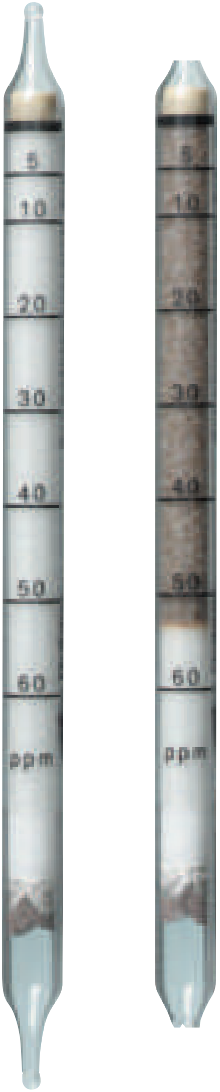
Calculate hydrogen sulphide concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (K \bullet X_{[ppm]} + C)$$

ST-130-01

Hydrogen Sulphide 0.5 to 10 mg/L

Order Code
CH 29 801



ST-125-01

Application Range

Determination of hydrogen sulphide (sum of sulphide) in water/waste water

Dräger-Tube:	Hydrogen Sulphide 5/b
Measuring range:	0.5 to 10 g/L
Number of Strokes (n):	2
Typical Stroke Time:	50 to 80 s
Measurement Time:	approx. 130 s
Sample Volume:	200 mL
Color Change:	white –> brown
Temperature Range:	3 to 30 °C
pH-Measurement:	necessary

Information of Measurement

Using acetic acid or sodium hydroxide solution,
the pH-value has to be adjusted to the value of 7.3 - 7.4 (K=1).

System Parameters (valid for pH 7.3 - 7.4)

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	Parameters C
0.5 to 10	30	3 to 7	0.131	0
		8 to 13	0.122	0
		14 to 30	0.127	0

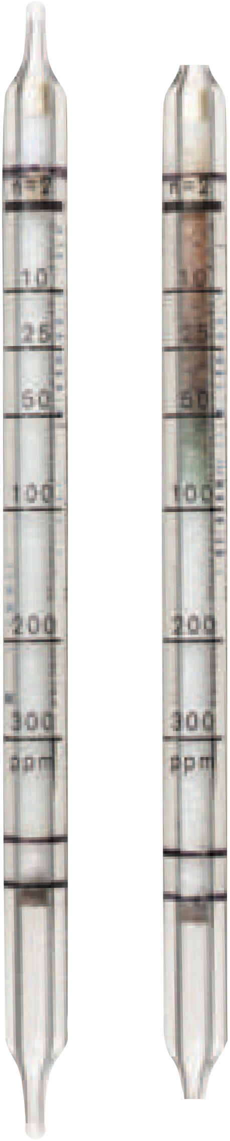
Evaluation of Measurement

Calculate hydrogen sulphide concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (K \bullet X_{[ppm]} + C)$$

Order Code
81 01 691

Jet Fuels (Kerosene) 0.5 to 5 mg/L



Application Range

Determination of jet fuels in water/waste water

Dräger-Tube:	Petroleum hydrocarbons 10/a
Measuring range:	0.5 to 5 mg/L
Number of Strokes (n):	4
Typical Stroke Time:	30 to 60 s
Measurement Time:	approx. 180 s
Sample Volume:	200 mL
Color Change:	white –> brown green
Temperature Range:	5 to 25 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.5 to 5	25	5 to 25	0.062	0

Evaluation of Measurement

Calculate jet fuel concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

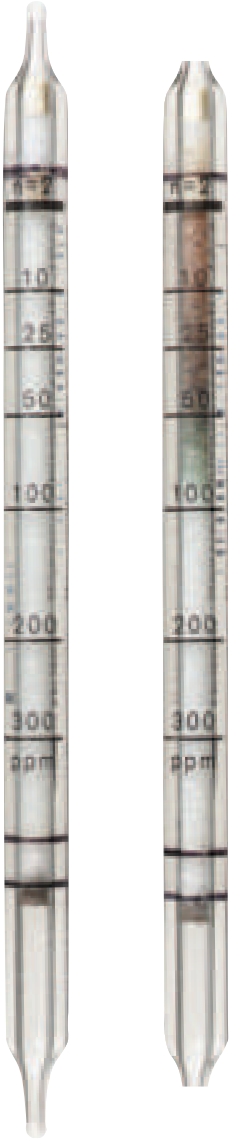
Cross Sensivity

Ethyl acetate, diesel oil, hydrogen sulphide and toluene are indicated with lower sensitivity.

Perchloroethylene is indicated with higher sensitivity.

Jet Fuels (Kerosene) qualitative in soil

Order Code 81 01 691



Application Range

Determination of jet fuels in soil

Dräger-Tube:	Petroleum Hydrocarbons 10/a
Measuring range:	qualitative
Number of Strokes (n):	maximum 10
Typical Stroke Time:	30 to 60 s
Measurement Time:	approx. 45 to 450 s
Sample Volume:	20 g
Color Change:	white –> brown green
Temperature Range:	5 to 25 °C
pH-Measurement:	not necessary

Information of Measurement

- 20 g soil is suspended completely with 100 mL de-ionized water.
- The precipitate must rest for approx. 1 minute, until the particles have settled to the bottom; the liquid above the particles has to be filled into the was bottle
- The remaining precipitate has to be shaken two times with 50 mL de-ionized water and the liquid above the particles has to be filled into the was bottle
- The gas wash bottle is filled up with de-ionized water up to 200 mL mark.

Evaluation of Measurement

The measurement evaluation is qualitative (yes or no)

Cross Sensivity

Diesel oil, ethyl acetate, perchloroethylene, hydrogen sulphide and toluene are also indicated.

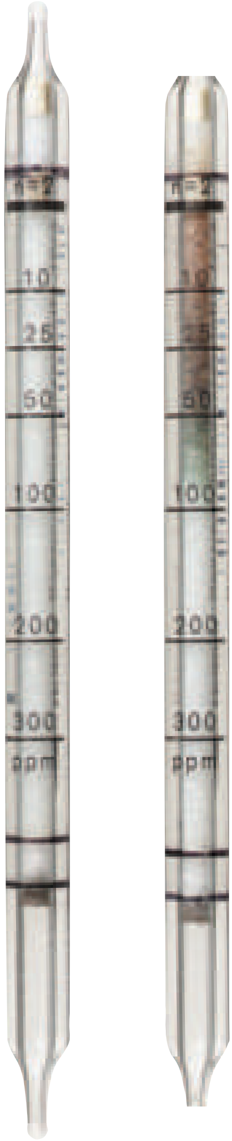
Order Code
81 01 691

n-Octane 0.1 to 2 mg/L

Application Range

Determination of n-octane in water/waste water

Dräger-Tube:	Petroleum Hydrocarbons 10/a
Measuring range:	0.1 to 2 mg/L
Number of Strokes (n):	2
Typical Stroke Time:	30 to 60 s
Measurement Time:	approx. 90 s
Sample Volume:	200 mL
Color Change:	white –> brown green
Temperature Range:	5 to 25 °C
pH-Measurement:	not necessary



ST-19-01

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.1 to 2	30	5 to 25	0.010	0

Evaluation of Measurement

Calculate n-octane concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Ethyl acetate, diesel oil, hydrogen sulphide and toluene are indicated with lower sensitivity.

Perchloroethylene is indicated with higher sensitivity.

n-Octane 2 to 25 mg/L

Order Code
67 30 201

Application Range

Determination of n-octane in water/waste water

Dräger-Tube:	Petroleum Hydrocarbons 100/a
Measuring range:	2 to 25 mg/L
Number of Strokes (n):	2
Typical Stroke Time:	30 to 45 s
Measurement Time:	approx. 75 s
Sample Volume:	200 mL
Color Change:	white –> brown green
Temperature Range:	5 to 25 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
2 to 25	30	5 to 25	0.010	0

Evaluation of Measurement

Calculate n-octane concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

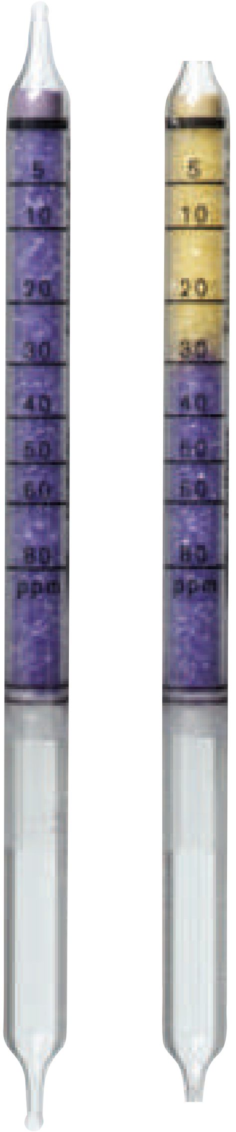
Ethyl acetate and hydrogen sulphide are indicated with lower sensitivity.

Perchloroethylene is indicated with higher sensitivity.

Toluene is indicated with different sensitivity

Order Code
67 22 101

Organic Acids 0.5 to 10 g/L



Application Range

Determination of sum parameter acetic acid, formic acid and propionic acid in water/waste water

Dräger-Tube:	Acetic Acid 5/a
Measuring range:	0.3 to 15 g/L
Number of Strokes (n):	10
Typical Stroke Time:	10 to 30 s
Measurement Time:	approx. 200 s
Sample Volume:	200 mL
Color Change:	blue violet –> yellow
Temperature Range:	10 to 25 °C
pH-Measurement:	necessary

Information of Measurement

Using sulfuric acid, the pH-value has to be adjusted to the value of 1.3.

System Parameters (valid for pH 1.3)

Measurement Range [g/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.5 to 15	25	10 to 25	0.241	1.157

Evaluation of Measurement

Calculate acid concentration:

$$Y_{[g/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Perchloroethylene 10 to 80 µg/L

Order Code
81 01 551


ST-193-01

Application Range

Determination of perchloroethylene in water/waste water

Dräger-Tube:	Perchloroethylene 0.1/a
Measuring range:	10 to 80 µg/L
Number of Strokes (n):	8
Typical Stroke Time:	2 to 3 minutes
Measurement Time:	approx. 20 minutes
Sample Volume:	200 mL
Color Change:	yellow white –> grey blue
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [µg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
10 to 80	30	5 to 30	70	- 0.1

Evaluation of Measurement

Calculate perchloroethylene concentration:

$$Y_{[[\mu g/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Dichloromethane, chlorobenzene, chloroform, 1,1-dichloroethane and 1,2-dichloroethane are indicated with lower sensitivity.

Trichloroethylene is indicated with nearly the same sensitivity.

Petroleum hydrocarbons, benzene, carbon tetrachloride, toluene, 1,1,1-trichloroethane and xylene are not indicated.

Order Code
81 01 501

Perchloroethylene 0.1 to 2 mg/L

Application Range

Determination of perchloroethylene in water/waste water

Dräger-Tube:	Perchloroethylene 2/a
Measuring range:	0.1 to 1 mg/L / 0.5 to 2 mg/L
Number of Strokes (n):	8 / 4
Typical Stroke Time:	45 to 65 s
Measurement Time:	approx. 440 s / ca. 220 s
Sample Volume:	200 mL
Color Change:	yellow white –> grey blue
Temperature Range:	8 to 37 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters	
			B	C
0.1 to 1 number of strokes n=8	25	8 to 12	0.035	0
	20	13 to 17	0.031	0
	20	18 to 22	0.028	0
	20	23 to 27	0.026	0
	20	28 to 32	0.025	0
	25	33 to 37	0.023	0
0.5 to 2 number of strokes n=4	25	8 to 12	0.075	0
	20	13 to 17	0.071	0
	20	18 to 22	0.065	0
	20	23 to 27	0.057	0
	25	28 to 32	0.056	0
	30	33 to 37	0.047	0

Evaluation of Measurement

Calculate perchloroethylene concentration:

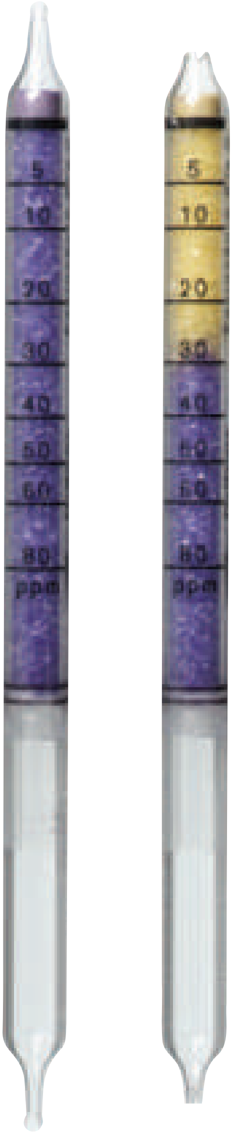
$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Dichloromethane and chloroform are indicated with lower sensitivity.
Trichloroethylene is indicated with nearly the same sensitivity.
Petroleum hydrocarbons, benzene, carbon tetrachloride, toluene, 1,1,1-trichloroethane and xylene are not indicated.

Propionic Acid 0.3 to 10 g/L

Order Code
67 22 101



Application Range

Determination of propionic acid in water/waste water

Dräger-Tube:	Acetic Acid 5/a
Measuring range:	0.3 to 10 g/L
Number of Strokes (n):	10
Typical Stroke Time:	10 to 30 s
Measurement Time:	approx. 200 s
Sample Volume:	200 mL
Color Change:	blue violet –> yellow
Temperature Range:	10 to 30 °C
pH-Measurement:	necessary

Information of Measurement

Using sulfuric acid, the pH-value has to be adjusted to the value of 1.3.

System Parameters (valid for pH 1.3)

Measurement Range [g/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	Parameters C
0.3 to 10	25	10 to 30	0.153	0.687

Evaluation of Measurement

Calculate propionic acid concentration:

$$Y_{[g/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Acetic acid and formic acid are indicated with lower sensitivity.

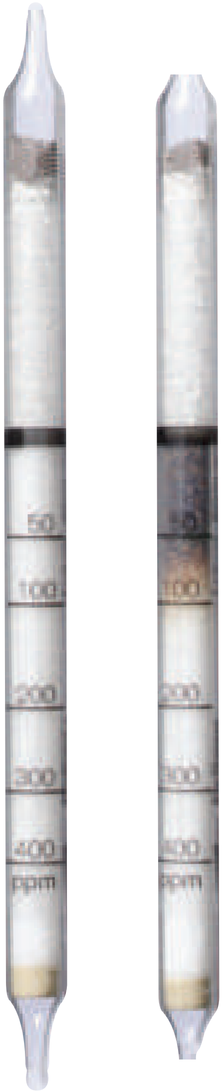
Order Code
81 01 701

Toluene 1 to 10 mg/L

Application Range

Determination of toluene in water/waste water

Dräger-Tube:	Toluene 50/a
Measuring range:	1 to 10 mg/L
Number of Strokes (n):	5
Typical Stroke Time:	20 to 40 s
Measurement Time:	approx. 150 s
Sample Volume:	200 mL
Color Change:	white –> brown
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary



System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters	
			B	C
1 bis 10	25	5 bis 30	0.037	-20
			for X ≥ 50	
			0.011	0
			for X ≥ 50	

Evaluation of Measurement

Calculate toluene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

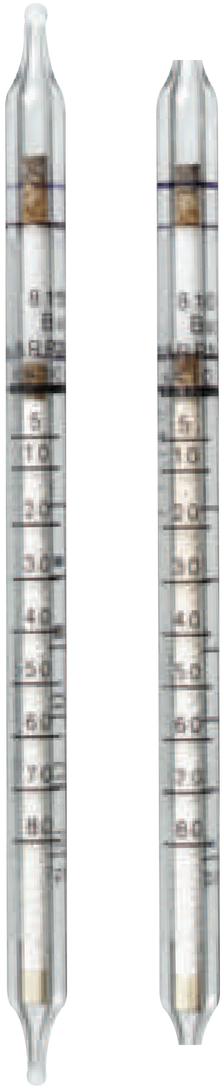
Benzene leads to a weak diffuse reading.

Petroleum hydrocarbons, styrene and o-xylene are indicated with lower sensitivity.

Phenol is not indicated.

Toluene 0.2 to 5 mg/L

Order Code
81 01 661



Application Range

Determination of toluene in water/waste water

Dräger-Tube:	Toluene 5/b
Measuring range:	0.2 to 5 mg/L
Number of Strokes (n):	6
Typical Stroke Time:	60 to 90 s
Measurement Time:	approx. 450 s
Sample Volume:	200 mL
Color Change:	white –> yellow green
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.2 to 5	40	5 to 30	0.057	0

Evaluation of Measurement

Calculate toluene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Benzene, xylene (all isomere), ethylbenzene and styrene are indicated with different sensitivity.

Acetone, ethanol and n-octane do not interfere with the reading.

Phenol does not interfere with the reading up to a concentration of 100 mg/L.

Order Code
CH 21 101

1,1,1-Trichloroethane 0.5 to 5 mg/L

Application Range

Determination of 1,1,1-trichloroethane in water/waste water

Dräger-Tube:	Trichloroethane 50/d
Measuring range:	0.5 to 5 mg/L
Number of Strokes (n):	5 + 3 desorption strokes at clean air
Typical Stroke Time:	40 to 70 s + 20 to 40 s
Measurement Time:	approx. 550 s + 90 s
Sample Volume:	200 mL
Color Change:	grey –> brown red
Temperature Range:	5 to 35 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.5 to 5	25	5 to 12	0.0059	-50
	25	13 to 25	0.0059	-100
	30	26 to 33	0.0054	-200

Evaluation of Measurement

Calculate 1,1,1-trichloroethane concentration:

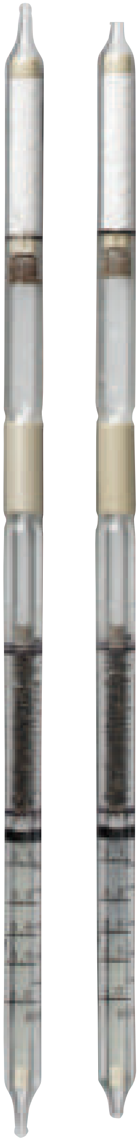
$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Perchloroethylene, carbon tetrachloride, dichloromethane and trichloroethylene are indicated with lower sensitivity.
Petroleum hydrocarbons are not indicated.

Trichloroethylene 10 to 100 µg/L

Order Code
81 01 551



Application Range

Determination of trichloroethylene in water/waste water

Dräger-Tube:	Perchloroethylene 0.1/a
Measuring range:	10 to 100 µg/L
Number of Strokes (n):	4
Typical Stroke Time:	2 to 3 minutes
Measurement Time:	approx. 10 minutes
Sample Volume:	200 mL
Color Change:	yellow white –> grey blue
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [µg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
10 to 100	30	5 to 10	134	0
		11 to 20	120	-0.01
		21 to 30	90	0

Evaluation of Measurement

Calculate trichloroethylene concentration:

$$Y_{[\mu g/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Dichloromethane, chlorobenzene, chloroform, 1,1-dichloroethane and 1,2-dichloroethane are indicated with lower sensitivity. Perchloroethylene is indicated with nearly the same sensitivity. Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.

Order Code
81 01 501

Trichloroethylene 0.1 to 1 mg/L

Application Range

Determination of trichloroethylene in water/waste water

Dräger-Tube:	Perchloroethylene 2/a
Measuring range:	0.1 to 1 mg/L
Number of Strokes (n):	8
Typical Stroke Time:	45 to 65 s
Measurement Time:	approx. 440 s
Sample Volume:	200 mL
Color Change:	yellow white –> grey blue
Temperature Range:	5 to 33 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.1 to 1	30	5 to 10	0.033	0
		11 to 15	0.030	0
		16 to 22	0.024	0
		23 to 28	0.020	0
		29 to 33	0.018	0

Evaluation of Measurement

Calculate trichloroethylene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

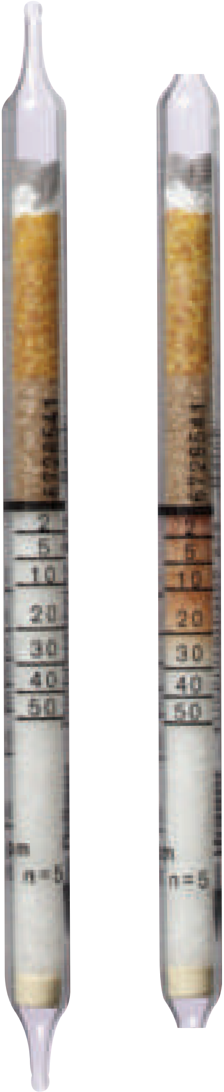
Dichloromethane, chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane and chloroform are indicated with lower sensitivity.

Perchloroethylene is indicated with nearly the same sensitivity.

Carbon tetrachloride and 1,1,1-trichloroethane are not indicated.

Trichloroethylene 0.2 to 3 mg/L

Order Code
67 28 541



Application Range

Determination of trirchloroethylene in water/waste water

Dräger-Tube:	Trichloroethylene 2/a
Measuring range:	0.2 to 1 mg/L / 0.3 to 3 mg/L
Number of Strokes (n):	8 / 4
Typical Stroke Time:	40 to 80 s
Measurement Time:	approx. 480 s / approx. 240 s
Sample Volume:	200 mL
Color Change:	pale grey –> orange
Temperature Range:	4 to 30 °C
pH-Measurement:	not necessary

System Parameters

Number of Stokes	Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
n=8	0.2 to 1	25	4 to 10	0.028	3
			11 to 19	0.025	3
			20 to 30	0.021	3
n=4	0.3 to 3	25	4 to 18	0.049	1
			19 to 30	0.044	1

Evaluation of Measurement

Calculate trichloroethylene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Dichloromethane, n-hexane, perchloroethylene and chloroform are indicated with lower sensitivity.

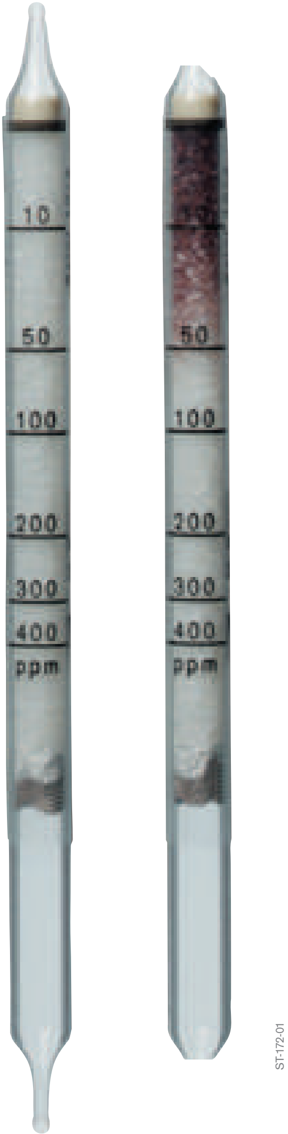
Order Code
67 33 161

Xylene (o, m, p) 0.3 to 10 mg/L

Application Range

Determination of xylene in water/waste water

Dräger-Tube:	Xylene10/a
Measuring range:	0.3 to 10 mg/L
Number of Strokes (n):	8
Typical Stroke Time:	10 to 25 s
Measurement Time:	approx. 140 s
Sample Volume:	200 mL
Color Change:	white –> red brown
Temperature Range:	5 to 35 °C
pH-Measurement:	not necessary



System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
o-Xylene 0.3 to 10	30	5 to 15	0.048	-7
		16 to 35	0.042	-10
m-Xylene 0.3 to 10	30	5 to 10	0.041	-10
		11 to 20	0.034	-10
		21 to 35	0.028	-10
p-Xylene 0.3 to 10	30	5 to 10	0.029	0
		11 to 35	0.031	-10

Evaluation of Measurement

Calculate xylene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Benzene, styrene and toluene are indicated with different sensitivity. Petroleum hydrocarbons and perchloroethylene do not interfere with the reading.

Xylene (o, m, p) 0.2 to 5 mg/L

Order Code
81 01 661

Application Range

Determination of xylene in water/waste water

Dräger-Tube:	Toluene 5/b
Measuring range:	0.2 to 5 mg/L
Number of Strokes (n):	6
Typical Stroke Time:	60 to 90 s
Measurement Time:	approx. 450 s
Sample Volume:	200 mL
Color Change:	white –> brown violet
Temperature Range:	5 to 30 °C
pH-Measurement:	not necessary

System Parameters

Measurement Range [mg/L]	Standard Deviation [%]	Temperature [°C]	Parameters B	C
0.2 to 5	40	5 to 30	0.057	0

Evaluation of Measurement

- Calculate xylene concentration:

$$Y_{[mg/L]} = A \bullet B \bullet (X_{[ppm]} + C)$$

Cross Sensivity

Benzene, toluene, ethylbenzene and styrene are indicated with different sensitivity.

Acetone, ethanol and n-octane do not interfere with the reading.

Phenol does not interfere with the reading up to a concentration of 100 mg/L

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