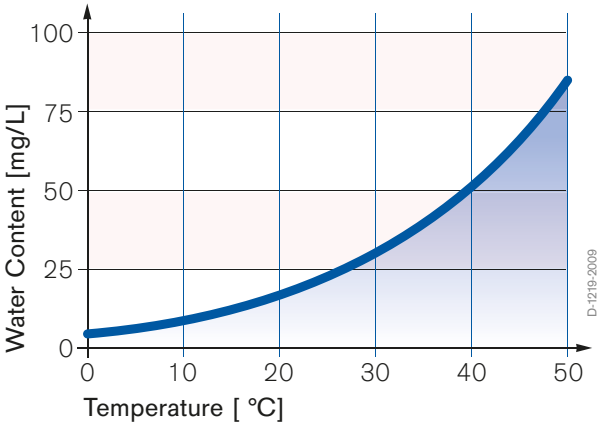
1.3 Water Vapor and Humidity

Water vapor 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 vapor as a metabolic product with each breath that is exhaled.



The maximum water vapor content of the air depends on temperature, i. e. the figures of relative humidity are always to be considered in reference to temperature. To convert relative humidity into absolute humidity as a function of temperature, the above diagram or the following formula can be used. Using a pocket calculator a conversion can be done:

$$Y = 3.84 \cdot 10^{-6} \cdot \vartheta^4 + 2.93 \cdot 10^{-5} \cdot \vartheta^3 + 0.014 \cdot \vartheta^2 + 0.29 \cdot \vartheta + 4.98$$

With y = maximum absolute humidity in mg H_2O / L and ϑ = temperature in °C. This formula is valid for the temperature range of 0 to 100 °C.

Example: The absolute humidity at t = 25 °C is needed. Using the formula the result is y = 22.94 mg H_2O / L. The result indicates that at 25 °C the maximum absolute humidity is 22.94 mg/L; that corresponds to a relative humidity of 100 % at the same temperature.

Similarly, every other absolute humidity at this temperature can be calculated, e. g. 50 % relative humidity at 25 °C equals 11.47 mg H_2O / L etc. If the relative humidity and the corresponding temperature are known, the absolute humidity can be calculated using the above formula.

A general statement about the effect of humidity on detector tube indications cannot be made. Some tubes, like hydrogen sulfide, need only a minimum amount of water vapor since the indicating reaction of this tube is an ion reaction. Also, because of the extraordinarily low solubility of metal sulfides, 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 instructions for use and in this handbook. When in doubt, measure the humidity using a water vapor Dräger-Tube.

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

Absolute and relative humiditiy at different temperatures