ENGINEERING TOMORROW

Fact sheet

Refrigerant constants
Antoine equation

ADAP-KOOL® Refrigeration control systems

$$Te = \frac{A2}{(LnPe - A1)} - A3$$

Purpose

This document is for controllers that require a refrigerant setting. This setting is performed with three constants A1 , A2 , A3 and for some controllers a "Glide" value.
In most controllers, these values are put in from factory. Either as a number or as refrigerant name.
If the controller is to regulate with a refrigerant that can not be selected with a number or a name, set the three constants and for some controllers a "Glide" value. The values refer to the table.

Note:
Case controllers will not be able to run the *Adaptive defrost function* or *Flash gas detection*, when a user defined refrigerant is selected.
Pack controllers will not be able to run the *Dirt detection*, when a user defined refrigerant is selected. The Antoine constants are based on data generated by RefProp 10.0 software delivered by NIST.

ASHRAE Refrigerant number	EKE / AK-CC / AK-PC Constants				AKC / EKC / AK-CC / AK-PC Constants				Controller setting
	A1	A2	A3	Glide	A1	A2	A3	Glide	
R12	9.33297	-2043.28	248.945	0	9332	-2044	0	0	1
R13	10.2229	-2056.28	283.975	0	10222	-2057	0	0	6
R13B1	10.1698	-2274.47	282.865	0	10169	-2275	0	0	7
R22	9.76408	-2038.07	249.796	0	9764	-2039	0	0	2
R23	10.6499	-2042.14	274.808	0	10649	-2043	0	0	8
R32	10.4452	-2163.51	259.107	0	10445	-2164	0	0	14
R114	9.28854	-2260.62	240.146	0	9288	-2261	0	0	11
R123	9.36944	-2411.3	229.88	0	9369	-2412	0	0	
R125	9.99167	-2055.9	254.15	0	9991	-2056	0	0	
R134a	9.80044	-2095.32	240.112	0	9800	-2096	0	0	3
R142b	9.33327	-2141.24	238.852	0	9333	-2142	0	0	12
R152a	9.77691	-2153.76	244.567	0	9776	-2154	0	0	
R170	10.2076	-2038.27	289.812	0	10207	-2039	0	0	24
R227ea	9.49769	-2080.25	235.631	0	9497	-2081	0	0	15
R236ea	9.51804	-2217.01	227.065	0	9518	-2218	0	0	
R236fa	9.46784	-2144.22	228.265	0	9467	-2145	0	0	
R245fa	9.74671	-2365.52	227.961	0	9746	-2366	0	0	
R290	9.43154	-2022.19	256.795	0	9431	-2023	0	0	25
R401A	9.70007	-2067.86	240.601	5.14523	9700	-2068	51	5	16
R401B	9.71057	-2056.55	240.995	4.93742	9710	-2057	49	4	
R402A	9.90027	-2032.78	252.612	1.28509	9900	-2033	12	1	18
R402B	9.84692	-2029.02	251.153	1.60187	9846	-2030	16	1	
R403B	9.61307	-1929.54	247.76	0.936324	9613	-1930	9	0	
R404A	9.91997	-2058.12	253.211	0.494245	9919	-2059	4	0	19
R406A	9.62634	-2084.25	240.604	8.66649	9626	-2085	86	8	
R407A	10.1253	-2084.77	244.7	5.36477	10125	-2085	53	5	21
R407B	10.0407	-2040.47	245.697	3.364	10040	-2041	33	3	22
R407C	10.1278	-2101.03	244.286	5.97219	10127	-2102	59	5	20
R407D	10.0338	-2106.1	242.725	5.74087	10033	-2107	57	5	
R407F	10.1853	-2097.27	245.786	5.36401	10185	-2098	53	5	37
R407H	10.1744	-2109.24	245.092	5.98708	10174	-2110	59	5	49
R408A	9.83437	-2054.93	253.342	0.341386	9834	-2055	3	0	
R409A	9.68334	-2067.23	239.674	7.81426	9683	-2068	78	7	
R409B	9.68935	-2051.57	239.824	7.04815	9689	-2052	70	7	
R410A	10.3407	-2127.41	257.427	0.102696	10340	-2128	1	0	23
R413A	9.78602	-2061.36	238.942	3.73744	9786	-2062	37	3	32

ASHRAE Refrigerant number	EKE / AK-CC / AK-PC Constants				AKC / EKC / AK-CC / AK-PC Constants				Controller setting
	A1	A2	A3	Glide	A1	A2	A3	Glide	
R414B	9.62958	-2058.93	238.955	7.35294	9629	-2059	73	7	
R416A	9.6917	-2104.34	239.444	1.826	9691	-2105	18	1	
R417A	9.80846	-2015.76	239.8	3.86004	9808	-2016	38	3	30
R417C	9.81966	-2066.8	239.821	2.77909	9819	-2067	27	2	
R420A	9.77348	-2114.59	240.784	0.853895	9773	-2115	8	0	
R421A	9.89544	-2031.98	240.918	4.12757	9895	-2032	41	4	
R422A	9.83964	-1986.15	246.13	1.6385	9839	-1987	16	1	31
R422B	9.81705	-1998.13	239.634	4.00701	9817	-1999	40	4	
R422C	9.82921	-1978.83	244.412	2.06833	9829	-1979	20	2	
R422D	9.79949	-1977.1	240.31	3.47479	9799	-1978	34	3	33
R424A	9.8558	-2032.14	240.738	4.23557	9855	-2033	42	4	
R427A	10.0394	-2077.78	243.369	5.60844	10039	-2078	56	5	34
R434A	9.82201	-1993.15	245.421	1.89821	9822	-1994	18	1	
R438A	9.98498	-2063.24	242.979	5.16347	9984	-2064	51	5	35
R442A	10.1978	-2104.26	246.276	5.66811	10197	-2105	56	5	
R443A	9.47483	-1999.68	253.4	2.63373	9474	-2000	26	2	
R444A	9.82475	-2121.36	240.754	9.85992	9824	-2122	98	9	
R444B	10.0728	-2095.9	243.713	8.96538	10072	-2096	89	8	
R445A	9.93216	-2177.79	242.661	22.158	9932	-2178	221	22	
R447A	10.1964	-2074.05	248.563	4.19	10196	-2075	41	4	
R448A	10.1305	-2106.22	248.068	5.46317	10130	-2107	54	5	40
R449A	10.1249	-2110.69	248.681	5.06654	10124	-2111	50	5	41
R449B	10.1274	-2107.52	248.295	5.07845	10127	-2108	50	5	48
R449C	10.0728	-2111.86	248.051	5.42271	10072	-2112	54	5	
R450A	9.70452	-2105.87	239.989	0.62633	9704	-2106	6	0	43
R452A	10.1626	-2154.29	255.369	3.72931	10162	-2155	37	3	42
R452B	10.3759	-2176.2	259.854	1.0839	10375	-2177	10	1	44
R453A	10.6633	-2427.79	263.607	5.85208	10663	-2428	58	5	
R454A	10.2189	-2173.64	255.1	5.45108	10218	-2174	54	5	50
R454B	10.3717	-2180.17	260.006	1.24417	10371	-2181	12	1	45
R454C	10.1339	-2194.63	254.531	7.48083	10133	-2195	74	7	51
R455A	10.2276	-2210.32	255.505	11.3538	10227	-2211	113	11	52
R463A	10.4788	-2181.65	255.371	9.93397	10478	-2182	99	9	55
R469A	11.3359	-2382.08	272.316	13.3356	11335	-2383	133	13	54
R500	9.51804	-2051.95	249.43	0.0624113	9518	-2052	0	0	9
R502	9.64088	-1997.51	252.545	0.0563537	9640	-1998	0	0	4
R503	10.8373	-2215.82	294.076	0.369029	10837	-2216	3	0	10
R507A	9.96457	-2082.26	255.992	0.021549	9964	-2083	0	0	17
R508B	10.655	-2069.33	282.996	0.00189622	10655	-2070	0	0	
R511A	9.43458	-2018.43	256.2	0.00374966	9434	-2019	0	0	
R513A	9.65798	-2065.84	243.607	0.0338831	9657	-2066	0	0	36
R516A	9.63795	-2090.5	246.531	0.0215054	9637	-2091	0	0	53
R600	9.18221	-2210.54	241.571	0	9182	-2211	0	0	26
R600a	9.10397	-2108.85	243.702	0	9103	-2109	0	0	27
R601	9.25176	-2498.22	234.345	0	9251	-2499	0	0	
R601a	9.14048	-2408.14	236.005	0	9140	-2409	0	0	
R717	10.6312	-2247.46	244.966	0	10631	-2248	0	0	5
R744	10.7776	-1962.3	271.613	0	10777	-1963	0	0	28
R744A	10.4711	-1919.52	273.12	0	10471	-1920	0	0	
R1150	10.5268	-2056.95	301.93	0	10526	-2057	0	0	
R1224yd(Z)	9.4246	-2307.13	230.521	0	9424	-2308	0	0	
R1233zd(E)	9.40277	-2333.29	230.225	0	9402	-2334	0	0	46
R1234yf	9.59621	-2096.27	248.18	0	9596	-2097	0	0	39
R1234ze(E)	9.59169	-2106.12	238.807	0	9591	-2107	0	0	38
R1234ze(Z)	9.65638	-2385.03	237.596	0	9656	-2386	0	0	47
R1270	9.51747	-2003.81	258.464	0	9517	-2004	0	0	29
R1336mzz(Z)	9.50294	-2455.09	225.241	0	9502	-2456	0	0	

How to insert refrigerant (Antoine) constants for "User defined" refrigerant?

The refrigerant (Antoine) constants cannot be typed into the controllers directly but there are two indirect ways to do it:

- Using Service Tool AK-ST 500 directly or through a System Manager or
- Copy the complete controller settings including user defined refrigerant constants to a controller using the copy key EKA 183A (084B8582)

This is the procedure using Service Tool for AK2 type controllers

1. Find Refrigerant constants A1, A2, A3 and glide in the table on the **left**-hand side of the table
2. Set Main Switch in controller to "OFF"
3. Set Configuration to "Unlocked"
4. Select Refrigerant "User defined"
5. Insert the three constants A1, A2, A3 and glide in Refrigerant factor K1, K2, K3 and glide respectively
6. Set all other necessary settings
7. Set Main Switch to "ON" enabling the controller to start running.

This is the procedure using Service Tool for EKC type controllers

1. Find Refrigerant constants A1, A2 and A3 in the table on the **right**-hand side of the table
2. Set Main Switch in controller (r12) to "0"
3. Select Refrigerant (o30) to "13"
4. In Danfoss Only set the three constants for A1, A2 and A3
5. Set all other necessary settings
6. Set Main Switch to "1" enabling the controller to start running.

The refrigerant (Antoine) constants can be typed in directly on these controllers

This is the procedure using the display

1. Find Refrigerant constants A1, A2, A3 and glide in the table on the **right**-hand side of the table.
2. Activate the display by pushing a button
3. Push and hold "Enter"
4. Insert Password to access the Main menu
5. Go to "Start / Stop" and set main switch OFF
6. Go back to Main menu with "Escape" button
7. Go to Plant type
8. Go to Refrigerant type and select "User defined"
9. Four lines will emerge
10. Type the four values
11. Set all other necessary settings
12. Set main switch to ON enabling the controller to start running.

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