

Fact sheet

Refrigerant constants

Antoine equation

ADAP-KOOL® Refrigeration control systems

$$T_e = \frac{A2}{(\ln P_e - A1)} - A3$$

Fact Sheet | Refrigerant constants, Antoine equation

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	9.421	-2069.6	249.5	0.0	9421	-2070	2495	0	1
R13	9.332	-1614.9	254.5	0.0	9332	-1615	2545	0	6
R13B1	10.170	-2274.5	282.9	0.0	10170	-2274	2829	0	7
R22	9.748	-2017.2	247.8	0.0	9748	-2017	2478	0	2
R23	9.904	-1687.6	252.5	0.0	9904	-1688	2525	0	8
R32	10.271	-2059.6	252.1	0.0	10271	-2060	2521	0	14
R114	9.954	-2655.3	263.8	0.0	9954	-2655	2638	0	11
R123	9.605	-2527.3	235.4	0.0	9605	-2527	2354	0	
R125	9.764	-1939.4	246.8	0.0	9764	-1939	2468	0	
R134a	9.936	-2147.9	242.3	0.0	9936	-2148	2423	0	3
R142b	9.600	-2258.8	244.4	0.0	9600	-2259	2444	0	12
R152a	9.919	-2209.3	246.8	0.0	9919	-2209	2468	0	
R170	9.353	-1608.3	260.5	0.0	9353	-1608	2605	0	24
R227ea	9.644	-2138.8	238.2	0.0	9644	-2139	2382	0	15
R236ea	10.119	-2532.6	244.3	0.0	10119	-2533	2443	0	
R236fa	9.718	-2250.5	233.2	0.0	9718	-2251	2332	0	
R245fa	9.938	-2457.0	232.3	0.0	9938	-2457	2323	0	
R290	9.400	-1990.7	253.9	0.0	9400	-1991	2539	0	25
R401A	9.863	-2124.3	242.5	5.1	9863	-2124	2425	5	16
R401B	9.786	-2076.2	241.1	4.9	9786	-2076	2411	5	
R402A	9.706	-1929.3	245.8	1.3	9706	-1929	2458	1	18
R402B	9.745	-1966.7	246.7	1.6	9745	-1967	2467	2	
R403B	9.925	-2066.6	254.7	0.9	9925	-2067	2547	1	
R404A	9.715	-1946.4	245.8	0.5	9715	-1946	2458	0	19
R406A	9.804	-2150.3	243.1	8.6	9804	-2150	2431	9	
R407A	10.060	-2037.4	241.1	5.3	10060	-2037	2411	5	21
R407B	9.875	-1950.9	239.8	3.4	9875	-1951	2398	3	22
R407C	10.072	-2059.7	241.1	5.9	10072	-2060	2411	6	20
R407D	10.097	-2119.0	242.4	5.7	10097	-2119	2424	6	
R407F	10.091	-2035.0	241.3	5.3	10091	-2035	2413	5	37
R407H	10.085	-2051.2	241.0	6.0	10085	-2051	2410	6	49
R408A	9.714	-1982.3	248.2	0.3	9714	-1982	2482	0	
R409A	9.864	-2131.9	242.0	7.7	9864	-2132	2420	8	
R409B	9.869	-2113.6	241.9	7.0	9869	-2114	2419	7	
R410A	10.086	-1990.0	248.7	0.1	10086	-1990	2487	0	23
R413A	9.867	-2089.8	240.0	3.7	9867	-2090	2400	4	32

Fact Sheet | Refrigerant constants, Antoine equation

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	9.824	-2131.1	241.7	7.3	9824	-2131	2417	7	
R416A	9.813	-2149.5	241.2	1.8	9813	-2149	2412	2	
R417A	9.807	-2004.0	238.5	3.8	9807	-2004	2385	4	30
R417C	9.902	-2094.2	240.7	2.8	9902	-2094	2407	3	
R420A	9.911	-2168.2	243.0	0.8	9911	-2168	2430	1	
R421A	9.908	-2025.9	239.9	4.1	9908	-2026	2399	4	
R422A	9.653	-1885.5	239.4	1.6	9653	-1885	2394	2	31
R422B	9.820	-1987.2	238.3	4.0	9820	-1987	2383	4	
R422C	9.658	-1886.6	238.2	2.1	9658	-1887	2382	2	
R422D	9.796	-1960.5	238.4	3.5	9796	-1960	2384	3	33
R424A	9.851	-2018.0	239.2	4.2	9851	-2018	2392	4	
R427A	9.989	-2039.3	240.4	5.6	9989	-2039	2404	6	34
R434A	9.641	-1896.3	239.0	1.9	9641	-1896	2390	2	
R438A	10.578	-2358.5	259.2	5.1	10578	-2359	2592	5	35
R442A	10.043	-2011.7	240.0	5.6	10043	-2012	2400	6	
R443A	9.374	-1932.7	248.3	2.6	9374	-1933	2483	3	
R444A	9.944	-2160.4	241.9	9.8	9944	-2160	2419	10	
R444B	10.039	-2058.0	240.4	8.9	10039	-2058	2404	9	
R445A	10.133	-2253.9	245.5	21.9	10133	-2254	2455	22	
R447A	9.857	-1891.5	236.7	4.2	9857	-1892	2367	4	
R448A	9.993	-2021.4	242.2	5.4	9993	-2021	2422	5	40
R449A	9.975	-2019.7	242.4	5.0	9975	-2020	2424	5	41
R449B	9.995	-2025.0	242.5	5.0	9995	-2025	2425	5	48
R449C	9.939	-2029.9	242.4	5.4	9939	-2030	2424	5	
R450A	9.831	-2153.5	241.9	0.6	9831	-2154	2419	1	43
R452A	9.922	-2023.5	247.1	3.7	9922	-2024	2471	4	42
R452B	10.068	-2001.9	248.6	1.1	10068	-2002	2486	1	44
R453A	11.457	-2909.2	290.9	5.8	11457	-2909	2909	6	
R454A	10.027	-2058.0	247.3	5.4	10027	-2058	2473	5	50
R454B	10.043	-1996.0	248.1	1.2	10043	-1996	2481	1	45
R454C	9.989	-2104.7	248.5	7.4	9989	-2105	2485	7	51
R455A	10.068	-2111.4	248.9	11.3	10068	-2111	2489	11	52
R463A	10.121	-1991.1	243.6	9.9	10121	-1991	2436	10	
R469A	10.714	-2057.9	253.5	13.4	10714	-2058	2535	13	54
R500	9.357	-1949.6	242.0	0.1	9357	-1950	2420	0	9
R502	9.459	-1894.1	245.4	0.1	9459	-1894	2454	0	4
R503	9.476	-1552.8	251.5	0.4	9476	-1553	2515	0	10
R507A	9.770	-1974.6	248.8	0.0	9770	-1975	2488	0	17
R508B	9.506	-1531.4	248.2	0.0	9506	-1531	2482	0	
R511A	9.352	-1957.8	251.4	0.0	9352	-1958	2514	0	
R513A	9.664	-2055.8	242.3	0.0	9664	-2056	2423	0	36
R516A	9.623	-2067.6	244.4	0.0	9623	-2068	2444	0	53
R600	9.443	-2328.3	247.1	0.0	9443	-2328	2471	0	26
R600a	9.322	-2203.9	248.2	0.0	9322	-2204	2482	0	27
R601	9.489	-2620.6	240.2	0.0	9489	-2621	2402	0	
R601a	9.471	-2575.2	244.0	0.0	9471	-2575	2440	0	
R717	10.760	-2307.3	247.9	0.0	10760	-2307	2479	0	5
R744	10.661	-1904.5	267.9	0.0	10661	-1904	2679	0	28
R744A	10.206	-1782.9	263.7	0.0	10206	-1783	2637	0	
R1150	9.352	-1477.3	261.7	0.0	9352	-1477	2617	0	
R1224yd(Z)	9.972	-2615.3	248.0	0.0	9972	-2615	2480	0	
R1233zdE	9.686	-2469.7	236.8	0.0	9686	-2470	2368	0	46
R1234yf	9.644	-2108.3	248.2	0.0	9644	-2108	2482	0	39
R1234zeE	9.775	-2179.7	242.0	0.0	9775	-2180	2420	0	38
R1234zeZ	10.118	-2633.2	250.6	0.0	10118	-2633	2506	0	47
R1270	9.430	-1942.1	253.5	0.0	9430	-1942	2535	0	29
R1336mzz(Z)	9.734	-2567.3	230.4	0.0	9734	-2567	2304	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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