

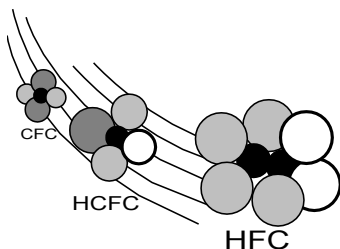
# Refrigerant Changeover Guidelines R-502 to R-402A/R-408A

Leading the Industry with Environmentally  
Responsible Refrigerant Solutions



**EMERSON**<sup>™</sup>  
Climate Technologies





Emerson Climate Technologies, Inc. does not advocate the wholesale changeover of CFC refrigerants to HCFCs or HFCs. If a system is not leaking

refrigerant to the atmosphere, and is operating properly, there is no technical reason to replace the CFC refrigerant. In fact, changing the refrigerant may void the UL listing of the unit; however, once the decision has been made to make the change from R-502 to the interim R-402A or R-408A, the following guidelines are recommended.

## CONSIDERATIONS

1. Retrofitting systems that employ compressors manufactured prior to 1973 is not recommended. This is due to the different materials used in motor insulation that have not been evaluated for compatibility with the new refrigerants and lubricants. Failure to heed this advice will violate UL Standard for Field Conversion/Retrofit of Alternate Refrigerants in Refrigeration and Air Conditioning Equipment (UL 2170).

2. The lubricant that Emerson Climate Technologies, Inc. recommends for use with R-402A/R-408A is a mixture of 50% mineral oil and 50% alkyl benzene. Emerson Climate Technologies, Inc. approved Polyol Ester lubricants can also be used with R-402A/R-408A, if the system is expected to be changed in the near future to an HFC refrigerant such as R-404A. This will eliminate the need of having to flush the system again when making the R-404A retrofit.

For a list of other lubricants approved for use with R-402A/R-408A, refer to item 12 in this section. For a complete list of all lubricants approved by Emerson Climate Technologies, Inc. refer to Form 93-11.

3. R-402A/R-408A should be used only in systems that currently use R-502. It should not be mixed with R-502 or any other refrigerant nor should it be used to replace CFC-12 or HCFC-22.

4. The capacity of the existing R-502 thermal expansion valve (TEV) will be approximately the same when using

R-402A/R-408A; however, the superheat setting must be checked and may have to be readjusted after the system is put back into operation.

Consult with the TEV manufacturer for correct sizing and superheat settings.

5. Filter driers must be changed at the time of conversion. This is proper air conditioning/refrigeration practice.

a. Solid core driers, such as Emerson Climate Technologies ADK, are compatible with either R-502 or R-402A/R-408A.

b. Compacted bead type driers can use an XH6 or XH9 molecular sieve material, such as found in the Emerson Climate Technologies EK or EKH series.

c. If a loose fill type drier is to be used, an XH9 molecular sieve is required.

6. Because of glide, pressure regulators such as EPR valves may have to be reset. Contact the EPR manufacturer for the correct settings.

7. R-402A/R-408A exhibits higher pressures than R-502 at normal condensing temperatures. This may require the high pressure safety controls be reset in order to operate as intended.

8. The higher pressure characteristics exhibited by R-402A will in some cases exceed the industry accepted safety factors on the compressor crankcase (low side). This will require the addition of a pressure relief valve on the compressor crankcase, set at a maximum of 375 psig to adequately protect the compressor from the possibility of excessive pressure. **Semi-hermetic compressors that require this additional valve are:**

- Copeland Discus™ 3D and 4D
- All other semi-hermetic (non-Discus models)

**WARNING: IT IS POSSIBLE THAT EXCESS PRESSURE BUILD-UP ON MODELS INDICATED COULD RESULT IN THE COMPRESSOR'S EXPLODING, UNLESS THE PRESSURE RELIEF VALVE SPECIFIED HAS BEEN PROPERLY INSTALLED ON THE ORIGINALLY BUILT COPELAND™ COMPRESSOR.**

**WARNING: Use only Emerson Climate Technologies, Inc. approved refrigerants and lubricants in the manner prescribed by Emerson Climate Technologies, Inc. In some circumstances, other refrigerants and lubricants may be dangerous and could cause fires, explosions or electrical shorting. Contact Emerson Climate Technologies, Inc., Sidney, Ohio for more information.**

Pressure relief valves can be purchased from your Authorized Copeland™ Wholesaler as part number 998-0051-02.

Note: Due to the lower pressure of R-408A, pressure relief valves are not required when retrofitting to this refrigerant.

9. Systems that use a low pressure controller to maintain space temperature may need to have the cut in and cut out points changed. With R-402A, the pressure settings must reflect an average temperature of the refrigerant in the evaporator. Because of refrigerant glide, the refrigerant entering the evaporator for a specific suction pressure will be approximately 2°F colder than the refrigerant vapor at the outlet of the evaporator (not considering superheat). Therefore, the average refrigerant temperature will be at a midpoint pressure/temperature equivalent.

Example: A -10°F refrigerated space usually requires that the refrigerant temperature in the evaporator be approximately -20°F. Using R-402A, the liquid entering the evaporator may be as cold as -21°F and the vapor temperature before superheat may be -19°F. Taking the saturated vapor pressure at -19°F gives us the exit pressure at the evaporator of 19.1 psig. Considering a 2 psig pressure drop in the suction line, the pressure control cut out should be set at 17.1 psig.

10. Due to refrigerant glide, it is important that when measuring and/or adjusting TEV superheat, the pressure and saturated vapor tables be used. Example: The pressure measured at the TEV bulb is 18 psig. The Pressure/Temperature (P/T) chart shows that the saturated vapor temperature of R-402A for 18 psig is -20.7°F. If the actual refrigerant temperature is -15.7°F, the superheat is 5°F.

Note: The glide with R-408A is so small as to be negligible. Use saturated vapor tables to set pressure controls.

To measure subcooling at the condenser outlet or at the TEV inlet to verify that a solid column of liquid is present, measure the pressure and the temperature at the location that the subcooling information is needed. Compare it to the saturated liquid tables. Example: A pressure of 250 psig is measured at the condenser outlet. From the R-402A P/T chart, 250 psig is 99°F saturated liquid temperature. If the actual refrigerant temperature is 89°F, the liquid is sub-cooled 10°F.

11. Systems using R-402A/R-408A may have a lower system pressure drop than when using R-502. Check with the manufacturer of any pressure regulators and

pilot-operated solenoid valves used in the system to be sure that they will operate properly. These controls may have to be downsized.

12. Mineral oil lubricant only, such as 3GS, cannot be used as the compressor lubricant. Emerson Climate Technologies, Inc. recommends the following lubricant choices :

- a. A mixture of 3GS Mineral Oil (MO) and Shrieve Zerol 200 TD, Soltex AB200A, Crompton Suniso AKB200A or Fuchs Reniso SP46 Alkyl Benzene (AB) with a minimum of 50% AB
- b. Shell 22-12 or Fuchs Reniso Triton MS 46
- c. A mixture of 3G5 Mineral Oil (MO) and Polyol Ester (POE), i.e., Copeland™ Ultra 22 CC, Mobil EAL Arctic 22 CC, Uniqema Emkarate RL32CF, Copeland™ Ultra 32CC or Uniqema RL32-3MAF with a minimum of 50% POE
- d. 100% Copeland™ Ultra 22 CC, Mobil EAL Arctic 22 CC, Uniqema Emkarate RL32CF, Copeland™ Ultra 32CC or Uniqema RL32-3MAF

Before starting the changeover, it is suggested that at least the following items be ready:

1. Safety glasses
2. Gloves
3. Refrigerant service gauges
4. Electronic thermometer
5. Vacuum pump capable of pulling 250 microns
6. Thermocouple micron gauge
7. Leak detector
8. Refrigerant recovery unit, including refrigerant cylinder
9. Proper container for removed lubricant
10. New liquid control device
11. Replacement liquid line filter drier(s)
12. New lubricant
13. R-402A/R-408A pressure temperature chart
14. R-402A/R-408A refrigerant

## CHANGEOVER PROCEDURE

1. The system should be thoroughly leak tested with the R-502 still in the system. All leaks should be repaired before the R-402A/R-408A refrigerant is added.

2. It is advisable that the system operating conditions be recorded with the R-502 still in the system. This will provide the base data for comparison when the system is put back into operation with the R-402A/R-408A.

3. The system should be shut off electrically and the refrigerant properly removed from the system. Measure the quantity of refrigerant removed. This will provide a guide for recharging the system with R-402A/R-408A (see item 9 this section).

4. The mineral oil must be removed from the compressor crankcase. Hermetic compressors will have to be removed from the piping and the lubricant drained out through the suction stub. It is advisable to do an acid test on the lubricant removed.

5. Measure the amount of lubricant removed. It should be within 4 to 6 ounces of the compressor's factory oil charge. The lubricant charge is indicated on the name plate of the compressors. If the lubricant charge is unknown, an Authorized Copeland™ Wholesaler can provide the technician with the information.

If the amount of lubricant removed is less than 50% of the factory charge, it will be necessary to clean the excess lubricant from the system.

Those systems that have oil separators, oil reservoirs, oil floats and suction line accumulators must have the oil drained from them. If the liquid control device is going to be replaced, it is advisable that the suction line, liquid line and evaporator coil be blown clean using properly regulated dry nitrogen.

**NOTE: Properly dispose of the lubricant.**

6. Before the new lubricant is installed into the compressor, be sure all leaks are repaired and liquid control devices and any other system components are changed. Also ensure that a pressure relief valve has been added if required. Install the correct liquid line filter drier. Driers must be compatible with the refrigerant and lubricant.

7. Be advised that POEs are very hygroscopic. They will very quickly absorb moisture from the air once the container is opened. Once the lubricant is added to the compressor, the compressor should be quickly installed. Like an open container, an open compressor with POE will absorb moisture. Add the correct amount of lubricant to the compressor. It is important that the system contain a minimum of 50% AB or POE. On systems using enhanced surfaces in the heat exchanger, excessive mineral oil can adversely effect the heat transfer due

to logging. Therefore, it is desirable to have no more than 20% mineral oil in systems employing these types of surfaces.

8. Once the compressor is installed and the system is closed, the system must be evacuated to 250 microns or lower.

9. REFRIGERANT CHARGING WITH "NEAR AZEOTROPES". R-402A/R-408A are near azeotropic mixtures. It is important that during initial charging or "topping off" a system that the refrigerant be removed from the charging cylinder in the liquid phase. Many of the cylinders for the newer refrigerants use a dip tube so that in the upright position liquid is drawn from the cylinder. DO NOT vapor charge out of a cylinder unless the entire cylinder is to be charged into the system. Refer to charging instructions provided by the refrigerant manufacturer.

With the system in a 250 micron or lower vacuum, liquid can be charged into the system "high side." The initial charge should be approximately 80% of the amount of refrigerant removed from the system.

10. Start the system and observe its operation. Additional refrigerant may have to be added to obtain optimum performance.

When adding refrigerant to an operating system, it may be necessary to add the refrigerant through the compressor suction service valve. Because the refrigerant leaving the refrigerant cylinder must be in liquid phase, care must be exercised to avoid damage to the compressor. It is suggested that a sight glass be connected between the charging hose and the compressor suction service valve. This will permit you to adjust the cylinder hand valve so that liquid can leave the cylinder while allowing vapor to enter the compressor.

11. Operate the system and record the operating conditions. Compare this data to the data taken in item 2 this section. Check and adjust the TEV superheat setting if necessary. Make adjustments to other controls as needed.

12. Properly label the components. Tag the compressor with the refrigerant used (R-402A/R-408A) and the lubricant used. The proper color code for R-402A is Light Brown PMS (Paint Matching System) 461. The color for R-408A is Medium Purple PMS 248.


13. Clean up and properly dispose of the removed lubricant. Check local and state laws regarding the disposal of refrigerant lubricants. Recycle or reclaim the removed refrigerant.

**CAUTION:** *These guidelines are intended for use with R-402A/R-408A only, not for refrigerants which are similar to R-402A/R-408A. Other refrigerants may not be compatible with the materials used in our compressors or the lubricants recommended in this bulletin; their use may result in unacceptable reliability and durability of the compressor.*

*Note: Videos on retrofitting are available from your Authorized Copeland™ Wholesaler. Ask for VT-025.*

## **ADDENDUM**

The contents of this publication are presented for informational purposes only and are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. Emerson Climate Technologies, Inc. and/or its affiliates (collectively “Emerson”), as applicable, reserve the right to modify the design or specifications of such products at any time without notice. Emerson does not assume responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use and maintenance of any Emerson product remains solely with the purchaser or end user.

 **CAUTION** POE must be handled carefully and the proper protective equipment (gloves, eye protection, etc.) must be used when handling POE lubricant. POE must not come into contact with any surface or material that might be harmed by POE, including without limitation, certain polymers (e.g. PVC/CPVC and polycarbonate).

## R-402A Saturated Vapor/Liquid Temperature/Pressure Chart

Temp. °F	Vapor Press. PSIG	Liquid Press. PSIG	Temp. °F	Vapor Press. PSIG	Liquid Press. PSIG	Temp. °F	Vapor Press. PSIG	Liquid Press. PSIG	Temp. °F	Vapor Press. PSIG	Liquid Press. PSIG
-40	5.8	7.6	10	47.1	50.2	60	132.7	137.3	110	285.7	290.9
-39	6.4	8.1	11	48.3	51.5	61	135.0	139.6	111	289.6	294.9
-38	6.9	8.7	12	49.5	52.7	62	137.4	142.0	112	293.6	298.8
-37	7.4	9.2	13	50.8	54.0	63	139.7	144.4	113	297.6	302.8
-36	8.0	9.8	14	52.0	55.3	64	142.1	146.8	114	301.6	306.9
-35	8.5	10.4	15	53.3	56.6	65	144.6	149.2	115	305.7	311.0
-34	9.1	11.0	16	54.6	57.9	66	147.0	151.7	116	309.8	315.1
-33	9.7	11.6	17	55.9	59.3	67	149.5	154.2	117	314.0	319.2
-32	10.3	12.2	18	57.2	60.6	68	152.0	156.7	118	318.2	323.4
-31	10.9	12.9	19	58.6	62.0	69	154.6	159.3	119	322.4	327.6
-30	11.5	13.5	20	60.0	63.4	70	157.1	161.9	120	326.7	331.9
-29	12.1	14.2	21	61.4	64.8	71	159.7	164.5	121	331.0	336.2
-28	12.8	14.8	22	62.8	66.3	72	162.2	167.1	122	335.3	340.5
-27	13.4	15.5	23	64.2	67.8	73	165.0	169.8	123	339.8	344.9
-26	14.1	16.2	24	65.7	69.2	74	167.7	172.5	124	344.2	349.3
-25	14.8	16.9	25	67.2	70.7	75	170.4	175.3	125	348.7	353.8
-24	15.4	17.6	26	68.6	72.3	76	173.1	178.0	126	353.2	358.3
-23	16.2	18.3	27	70.2	73.8	77	175.9	181.0	127	357.8	365.9
-22	16.9	19.1	28	71.7	75.4	78	178.7	183.6	128	362.4	367.4
-21	17.6	19.8	29	73.2	77.0	79	181.5	186.6	129	367.1	372.1
-20	18.3	20.6	30	74.8	78.6	80	184.4	189.6	130	371.7	376.7
-19	19.1	21.4	31	76.4	80.2	81	187.3	192.4			
-18	19.8	22.1	32	78.0	81.8	82	190.2	195.2			
-17	20.6	23.0	33	79.7	83.5	83	193.2	198.2			
-16	21.4	23.8	34	81.3	85.2	84	196.2	201.2			
-15	22.2	24.6	35	83.0	86.9	85	199.2	204.2			
-14	23.0	25.4	36	84.7	88.6	86	202.2	207.3			
-13	23.8	26.3	37	86.5	90.4	87	205.3	210.4			
-12	24.7	27.2	38	88.2	92.2	88	208.4	213.5			
-11	25.6	28.1	39	90.0	94.0	89	211.6	216.7			
-10	24.4	29.0	40	91.8	95.8	90	214.7	219.9			
-9	27.3	29.9	41	93.6	97.6	91	218.0	223.1			
-8	28.2	30.8	42	95.4	99.5	92	221.2	226.4			
-7	29.1	31.8	43	97.3	101.4	93	224.5	229.7			
-6	30.0	32.7	44	99.2	103.3	94	227.8	233.0			
-5	31.0	33.7	45	101.1	105.2	95	231.2	236.4			
-4	32.0	34.7	46	103.0	107.2	96	234.6	239.8			
-3	33.0	35.7	47	105.0	109.2	97	238.0	243.2			
-2	33.9	36.7	48	107.0	111.2	98	241.4	246.6			
-1	34.9	37.8	49	109.0	113.2	99	244.9	250.2			
0	36.0	38.8	50	111.0	115.3	100	248.4	253.7			
1	37.0	39.9	51	113.1	117.4	101	252.0	257.3			
2	38.0	41.0	52	115.1	119.5	102	255.6	260.8			
3	39.1	42.0	53	117.3	121.6	103	259.2	264.5			
4	40.2	43.2	54	119.4	123.8	104	262.9	268.1			
5	41.3	44.3	55	121.5	126.0	105	266.6	271.9			
6	42.4	45.5	56	123.7	128.2	106	270.4	275.6			
7	43.6	46.6	57	125.9	130.4	107	274.2	279.4			
8	44.7	47.8	58	128.2	132.7	108	277.9	283.2			
9	45.9	49.0	59	130.4	135.0	109	281.8	287.1			

The information contained herein is based on technical data and tests which we believe to be reliable and is intended for use by persons having technical skill, at their own discretion and risk. Since conditions of use are beyond the control of Emerson Climate Technologies, Inc., we can assume no liability for results obtained or damages incurred through the application of the data presented.

## R-402A Saturated Vapor/Liquid Pressure/Temperature Chart

Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F
5	-41.6	-45.0	55	16.2	13.6	105	47.0	44.9	335	121.9	120.7
6	-39.8	-42.9	56	16.9	14.3	106	47.5	45.4	340	123.0	121.9
7	-37.9	-41.1	57	17.6	15.2	107	48.0	45.9	345	124.2	123.0
8	-36.0	-39.6	58	18.3	16.0	108	48.5	46.2	350	125.3	124.1
9	-34.6	-37.7	59	19.1	16.7	109	49.0	46.9	355	126.4	125.3
10	-33.2	-35.8	60	20.0	17.4	110	49.5	47.4	360	127.5	126.3
11	-31.4	-34.0	61	20.7	18.1	115	51.9	49.9	365	128.6	127.5
12	-29.8	-32.7	62	21.4	18.9	129	54.1	52.1	370	129.6	128.5
13	-27.8	-31.4	63	22.0	19.5	125	56.6	54.6	375	130.7	129.6
14	-26.6	-29.6	64	22.8	20.2	130	58.8	56.8	380	131.7	130.7
15	-25.3	-27.9	65	23.4	20.9	135	61.0	59.0	385	132.8	131.7
16	-23.6	-26.6	66	24.1	21.6	140	63.1	61.2	390	133.8	132.8
17	-21.9	-25.4	67	24.8	22.2	145	65.2	63.3	395	134.8	133.8
18	-20.7	-23.7	68	25.5	22.9	150	67.2	65.3	400	135.8	134.9
19	-19.6	-22.6	69	26.1	23.6	155	69.2	67.3			
20	-17.9	-21.4	70	26.8	24.3	160	71.1	69.3			
21	-16.8	-19.7	71	27.4	24.9	165	73.0	71.2			
22	-15.6	-18.6	72	28.1	25.6	170	74.9	73.1			
23	-14.5	-17.5	73	28.8	26.2	175	76.7	74.9			
24	-13.4	-15.9	74	29.4	26.9	180	78.5	76.7			
25	-11.8	-14.8	75	30.0	27.5	185	80.2	78.5			
26	-10.8	-13.7	76	30.7	28.2	190	81.9	80.1			
27	-9.7	-12.6	77	31.4	28.8	195	83.6	81.9			
28	-8.6	-11.5	78	32.0	29.5	200	85.3	83.6			
29	-7.6	-10.0	79	32.3	30.1	205	86.9	85.2			
30	-6.5	-8.9	80	33.2	30.8	210	88.5	86.9			
31	-5.5	-7.9	81	33.8	31.4	215	90.0	88.5			
32	-4.0	-6.9	82	34.2	32.1	220	91.6	90.0			
33	-3.0	-5.9	83	35.9	32.7	225	93.1	91.6			
34	-2.0	-4.6	84	35.6	33.3	230	94.6	93.1			
35	-1.0	-3.8	85	36.1	33.9	235	96.1	94.6			
36	0.0	-2.8	86	36.7	34.2	240	97.6	96.1			
37	0.8	-1.9	87	37.3	35.1	245	99.0	97.6			
38	1.5	-0.9	88	37.9	35.6	250	100.4	99.0			
39	2.2	0.1	89	38.2	36.1	255	101.8	100.4			
40	3.2	1.1	90	39.0	36.8	260	103.2	101.8			
41	4.2	2.0	91	39.6	37.3	265	104.6	103.1			
42	5.2	2.8	92	40.1	37.9	270	105.9	104.5			
43	6.2	3.5	93	40.7	38.5	275	107.2	105.8			
44	7.1	4.4	94	41.2	39.0	280	108.5	107.2			
45	8.1	5.3	95	41.8	39.6	285	109.8	108.5			
46	8.9	6.2	96	42.2	40.1	290	111.1	109.8			
47	9.6	7.2	97	42.8	40.7	295	112.4	111.0			
48	10.4	8.1	98	43.4	41.2	300	113.6	112.3			
49	10.4	8.1	98	43.4	41.2	300	113.6	112.3			
49	11.3	8.8	99	43.9	41.7	305	114.8	113.5			
50	12.2	9.6	100	44.2	42.1	310	116.0	114.8			
51	12.9	10.3	101	45.0	42.8	315	117.2	116.0			
52	13.6	11.2	102	45.7	43.3	320	118.4	117.2			
53	14.4	12.1	103	46.0	43.8	325	119.6	118.4			
54	15.3	12.8	104	46.3	44.2	330	120.8	119.6			

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## R-408A Saturated Vapor/Liquid Temperature/Pressure Chart

Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F	Press. PSIG	Vapor Temp. °F	Liquid Temp. °F
-40	2.7	2.3	10	39.1	38.2	60	116.2	114.7	110	255.7	253.6
-39	3.1	2.7	11	40.2	39.3	61	118.4	116.9	111	259.3	257.3
-38	3.6	3.2	12	41.3	40.4	62	120.5	119.0	112	262.9	260.9
-37	4.1	3.6	13	42.4	41.5	63	122.7	121.2	113	266.6	264.6
-36	4.5	4.1	14	43.5	42.5	64	124.9	123.4	114	270.2	268.3
-35	5.0	4.5	15	44.6	43.6	65	127.1	125.5	115	273.8	272.0
-34	5.5	5.1	16	45.8	44.8	66	129.3	127.8	116	277.7	275.9
-33	6.1	5.6	17	47.0	46.0	67	131.6	130.0	117	281.7	279.7
-32	6.6	6.1	18	48.2	47.2	68	133.9	132.3	118	285.6	283.6
-31	7.2	6.6	19	49.4	48.4	69	136.1	134.5	119	289.5	287.5
-30	7.7	7.2	20	50.6	49.6	70	138.4	136.7	120	293.4	291.4
-29	8.2	7.7	21	51.9	50.8	71	140.8	139.1	121	297.5	295.5
-28	8.8	8.2	22	53.1	52.1	72	143.3	141.6	122	301.6	299.5
-27	9.3	8.8	23	54.4	53.3	73	145.7	144.0	123	305.6	303.6
-26	9.9	9.3	24	57.0	55.8	74	148.1	146.4	124	309.7	307.7
-25	10.4	9.9	25	58.4	57.2	75	150.6	148.8	125	313.8	311.7
-24	11.1	10.4	26	59.8	58.6	76	153.1	151.4	126	317.8	315.8
-23	11.7	11.0	27	61.1	60.0	77	155.6	153.9	127	321.9	319.9
-22	12.3	11.5	28	62.5	61.4	78	158.2	156.5	128	326.0	323.9
-21	13.0	12.1	29	63.9	62.7	79	160.7	159.1	129	330.0	328.0
-20	13.6	12.7	30	63.9	62.7	80	163.3	161.6	130	334.1	332.1
-19	14.3	13.3	31	65.3	64.2	81	165.9	164.3			
-18	15.0	14.0	32	66.8	65.6	82	168.6	167.0			
-17	15.6	14.6	33	68.3	67.1	83	171.3	169.7			
-16	16.3	15.3	34	69.8	68.6	84	174.0	172.4			
-15	17.0	15.9	35	71.2	70.0	85	176.7	175.0			
-14	17.7	16.6	36	72.8	71.6	86	179.6	177.9			
-13	18.5	17.3	37	74.4	73.2	87	182.4	180.7			
-12	19.2	18.0	38	76.0	74.7	88	185.3	183.5			
-11	20.0	18.7	39	77.6	76.3	89	188.2	186.3			
-10	20.7	19.4	40	79.2	77.9	90	191.0	189.1			
-9	21.5	20.2	41	80.9	79.5	91	194.0	192.1			
-8	22.3	20.9	42	82.6	81.2	92	197.0	195.1			
-7	23.1	21.7	43	84.2	82.9	93	200.0	198.1			
-6	23.9	22.5	44	85.9	84.5	94	202.9	201.1			
-5	24.7	23.2	45	87.6	86.2	95	205.9	204.1			
-4	25.6	24.3	46	89.4	88.0	96	209.1	207.2			
-3	26.5	25.3	47	91.2	89.8	97	212.3	210.4			
-2	27.4	26.3	48	93.0	91.6	98	215.4	213.5			
-1	28.3	27.3	49	94.8	93.3	99	218.6	216.7			
0	29.1	28.3	50	96.6	95.1	100	221.8	219.8			
1	30.1	29.3	51	98.5	97.0	101	225.1	223.1			
2	31.1	30.2	52	100.4	99.0	102	228.4	226.4			
3	32.0	31.2	53	102.3	100.9	103	231.7	229.7			
4	33.0	32.1	54	104.2	102.8	104	235.0	233.0			
5	33.9	33.0	55	106.1	104.7	105	238.3	236.3			
6	35.0	34.1	56	108.1	106.7	106	241.8	239.8			
7	36.0	35.1	57	110.1	108.7	107	245.2	243.2			
8	37.0	36.1	58	112.1	110.7	108	248.7	246.7			
9	38.0	37.2	59	114.2	112.7	109	252.2	250.1			

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