



AEROSPACE STANDARD

AS210™

Issued 2014-02
Reaffirmed 2023-11

Superseding ARP210

Definition of Commonly Used Day Types (Atmospheric Ambient Temperature Characteristics Versus Pressure Altitude)

RATIONALE

Due to the stability of this document and prompted by industry request, this document is to become an Aerospace Standard.

“Hot Day”, “Tropical Day”, “Standard Day”, “Polar Day”, and “Cold Day” are part of the lexicon of the aircraft industry. These terms are generally understood to refer to specific, generally accepted characteristics of atmospheric temperature versus pressure altitude. There are also other, less well-known days, defined by their frequency of occurrence, such as “1% Hot Day”, “10% Cold Day”, or “Highest Recorded Day”. These temperature characteristics have their origins in multiple sources, including U.S. military specifications which are no longer in force.

These day types find their most frequent application in aircraft and propulsion system computer simulations. They do not impose any requirements on system design, but rather form a common frame of reference for defining the conditions under which various types of analyses are to be performed. Day types provide both a convenient mechanism for setting up computer program input and a convenient shorthand for discussing operational environment.

This document is intended to preserve the commonly used day types in an accessible form for future use, make recommendations for their consistent usage, and collect the data in a single format.

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TABLE OF CONTENTS

1.	SCOPE.....	3
1.1	Purpose.....	3
1.2	Field of Application.....	3
2.	REFERENCES.....	3
2.1	Applicable Documents.....	3
2.2	Applicable References.....	3
3.	DEFINITIONS.....	4
4.	SOURCES AND ANALYSIS.....	4
4.1	History.....	4
4.2	Accuracy, Precision, and Round-off.....	5
4.3	Days Derived from MIL-STD-210A.....	5
4.3.1	Cold Day.....	6
4.3.2	Hot Day.....	6
4.3.3	Polar Day.....	6
4.3.4	Tropical Day.....	6
4.4	Days Derived from MIL-STD-210C, MIL-HDBK-310.....	7
4.4.1	Highest Recorded Day.....	7
4.4.2	Lowest Recorded Day.....	7
4.4.3	1% Hot Day.....	7
4.4.4	1% Cold Day.....	7
4.4.5	5% Hot Day, 10% Hot Day, 20% Hot Day.....	7
4.4.6	5% Cold Day, 10% Cold Day, 20% Cold Day.....	7
4.5	Standard Day.....	8
5.	RECOMMENDATIONS.....	8
5.1	Days Derived from MIL-STD-210A.....	9
5.2	Days Derived from MIL-STD-210C / MIL-HDBK-310.....	13
6.	NOTES.....	18
APPENDIX A	DATA EXTRACTED FROM SOURCE DOCUMENTS (WITH ALTERATIONS AS NOTED).....	19
APPENDIX B	PLOTS OF ALL DAY TYPES.....	56
APPENDIX C	THE FLAVORS OF ALTITUDE.....	62
TABLE 1	ABBREVIATED COLD DAY BASED ON MIL-STD-210A TABLE II.....	10
TABLE 2	ABBREVIATED HOT DAY BASED ON MIL-STD-210A TABLE III.....	11
TABLE 3	ABBREVIATED POLAR DAY BASED ON MIL-STD-210A TABLE IV.....	12
TABLE 4	ABBREVIATED TROPICAL DAY BASED ON MIL-STD-210A, CHANGE NOTICE 1, TABLE V.....	12
TABLE 5	HIGHEST RECORDED DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.1.1.....	13
TABLE 6	LOWEST RECORDED DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.2.1.....	14
TABLE 7	1% HOT DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.1.2.....	14
TABLE 8	1% COLD DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.2.2.....	15
TABLE 9	5% HOT DAY BASED ON MIL-HDBK-310 TABLE XIX.....	15
TABLE 10	10% HOT DAY BASED ON MIL-HDBK-310 TABLE XIX.....	16
TABLE 11	20% HOT DAY BASED ON MIL-HDBK-310 TABLE XIX.....	16
TABLE 12	5% COLD DAY BASED ON MIL-HDBK-310 TABLE XX.....	17
TABLE 13	10% COLD DAY BASED ON MIL-HDBK-310 TABLE XX.....	17
TABLE 14	20% COLD DAY BASED ON MIL-HDBK-310 TABLE XX.....	18

1. SCOPE

“Hot Day”, “Tropical Day”, “Standard Day”, “Polar Day”, and “Cold Day” are part of the lexicon of the aircraft industry. These terms are generally understood to refer to specific, generally accepted characteristics of atmospheric temperature versus pressure altitude. There are also other, less well-known days, defined by their frequency of occurrence, such as “1% Hot Day”, “10% Cold Day”, or “Highest Recorded Day”. These temperature characteristics have their origins in multiple sources, including U.S. military specifications which are no longer in force.

1.1 Purpose

This document is intended to preserve the commonly used day types in an accessible form for future use, make recommendations for their consistent usage, and collect the data in a single format.

1.2 Field of Application

These day types find their most frequent application in aircraft and propulsion system computer simulations. They do not impose any requirements on system design, but rather form a common frame of reference for defining the conditions under which various types of analyses are to be performed. Day types provide both a convenient mechanism for setting up computer program input and a convenient shorthand for discussing operational environment. For example, an airframe company might request engine data on a Hot Day to determine hot-day aircraft payload or range capability.

Except for Standard Day, the source data for this document covers a pressure altitude range from sea level to either 100000 feet (30.48 km) or 30 km (98425 feet), depending on the source. All tables in Section 5 have been extended to -2000 feet. (The ambient pressure at -2000 feet is higher than the highest barometer reading ever recorded at sea level.) The tables in Appendix A have not been extended.

2. REFERENCES

2.1 Applicable Documents

There are no other publications which form a part of this document. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.2 Applicable References

The following documents contain material relevant to the subject area of this document, but do not form a part of this document. While some of the military specifications listed are no longer in force, they are still available from various document services.

	U.S. Standard Atmosphere, 1976
MIL-STD-210	Climatic Extremes for Military Equipment, 1 June, 1953
MIL-STD-210A	Climatic Extremes for Military Equipment, 2 August, 1957
MIL-STD-210A	Change Notice 1, Climatic Extremes for Military Equipment, 30 November, 1958
MIL-STD-210B	Climatic Extremes for Military Equipment, 15 December, 1973
MIL-STD-210C	Climatic Information to Determine Design and Test Requirements for Military Systems and Equipment, 9 January, 1987
MIL-HDBK-310	Global Climatic Data for Developing Military Products, 23 June, 1997
MIL-STD-3013	Glossary of Definitions, Ground Rules, and Mission Profiles to Define Air Vehicle Performance Capability, 14 February, 2003

3. DEFINITIONS

Day type	A named characteristic of ambient air temperature as a function of pressure altitude
Standard Day	The day type derived from U.S. Standard Atmosphere, 1976
Cold Day	The day type derived from MIL-STD-210A "Cold Atmosphere"
Hot Day	The day type derived from MIL-STD-210A "Hot Atmosphere"
Polar Day	The day type derived from MIL-STD-210A "Polar Atmosphere"
Tropical Day	The day type derived from MIL-STD-210A "Tropical Atmosphere"
1% Hot (Cold) Day	The day types derived from MIL-STD-210C / MIL-HDBK-310 "Frequency of Occurrence. Temperatures (1-percent values)"
5% Hot (Cold) Day	The day types derived from MIL-STD-210C / MIL-HDBK-310 "Frequency of Occurrence. Temperatures (5-percent values)"
10% Hot (Cold) Day	The day types derived from MIL-STD-210C / MIL-HDBK-310 "Frequency of Occurrence. Temperatures (10-percent values)"
20% Hot (Cold) Day	The day types derived from MIL-STD-210C / MIL-HDBK-310 "Frequency of Occurrence. Temperatures (20-percent values)"
Highest Recorded Day	The day type derived from MIL-STD-210C / MIL-HDBK-310 "Highest Recorded"
Lowest Recorded Day	The day type derived from MIL-STD-210C / MIL-HDBK-310 "Lowest Recorded"
Geopotential altitude	The equivalent height of an object if gravity were constant at the mean-sea-level, 45-degree-north-latitude, value (see Appendix C).
Pressure altitude	There is a unique relationship between pressure and geopotential altitude on a standard day. The standard day temperature profile is implicit in the relationship. If the standard day pressure-altitude relationship is used to infer altitude from pressure, the result is called pressure altitude. On a standard day, geopotential altitude and pressure altitude are identical. On a non-standard day, pressure altitude is the standard-day geopotential altitude which corresponds to the local ambient pressure (see Appendix C).

4. SOURCES AND ANALYSIS

4.1 History

In the altitude range of interest, the standard atmosphere has been unchanged since the publication of the "U.S. Standard Atmosphere, 1976".

MIL-STD-210 introduced the concept of climatic extremes in 1953. It established an operational ambient temperature range requirement of -65 to 125 °F.

In 1957, MIL-STD-210A introduced Cold, Hot, Polar, and Tropical Day tables of temperature versus altitude. Tropical Day was revised in MIL-STD-210A Change Notice 1. The Polar and Tropical Day tables are hydrodynamically consistent. That is, the pressure at a given altitude is the result of integrating with respect to geopotential altitude while accounting for the density variation with temperature at all lower altitudes (see Appendix C). The Cold and Hot Day tables are not hydrodynamically consistent.

Tables of Highest (Lowest) Recorded temperatures and 1%, 5%, 10%, and 20% risk temperatures first appeared in MIL-STD-210B in 1973. There were two sets of tables, one for “Naval Air Environment” and one for “World-wide Air Environment”. Cold, Hot, Polar, and Tropical Day definitions did not appear in MIL-STD-210B.

MIL-STD-210C, issued in 1987, eliminated the separate “Naval Air Environment” tables, and revised and extended all the other tables to at least 30 km pressure altitude.

MIL-HDBK-310 replaced MIL-STD-210C in 1997. The climatic temperature data in MIL-HDBK-310 is the same as that in MIL-STD-210C.

MIL-STD-3013, published in 2003, provides a table of Standard Day conditions to 150000 feet altitude, and re-publishes Polar and Tropical Day tables with more significant digits than the MIL-STD-210A versions. Tropical Day in MIL-STD-3013 reverts to the original MIL-STD-210A table; not to Change Notice 1.

4.2 Accuracy, Precision, and Round-off

Computers make very precise calculations, carrying a large number of significant digits through all calculations. This is absolutely necessary for repeatability. However, the results may well only be accurate to 2 or 3 significant digits. The results of calculations are generally rounded off in documentation; sometimes rigorously to the number of significant digits justified by the accuracy of the underlying data, but more often to an arbitrary fixed number of places after the decimal point. And in the era before the advent of calculators, digital computers, and spreadsheets, human errors crept into the published tabulations.

The source materials for this document exhibit all these issues in the columns of data that are rendered in different units. There are obvious errors; small, unexplained discrepancies; unjustified significant digits; and imprecise conversions among units. A computer program which enters the tables with altitude in meters and reads temperature in °C is going to produce slightly different results from one which enters the tables with altitude in feet and reads temperature in °F, for example.

There are two sets of tables in this document. Those in the appendices repeat the data as given in the source documents, but with the correction of apparent typographical errors. All such corrections are footnoted. The tables in Section 5, on the other hand, are modified to improve their repeatability. This typically involves adding significant digits that are not mathematically justified. Section 5 also provides recommendations for using the tables in computer programs.

In analyzing the tables to identify typographical errors and inaccuracies, a number of attempts were made to “reverse engineer” the tables. For example, one can assume temperatures in °C are exact, convert to °F and °R, and compare to the values in the source tables. One may then assume °F is exact, and repeat the process. No combination of assumptions, conversions, and round-off was found to exactly reproduce the tables. The approaches described in 4.3 and 4.4 produced the fewest discrepancies between calculated results and the source tables.

4.3 Days Derived from MIL-STD-210A

The MIL-STD-210A source tables have columns for pressure altitude in feet, geopotential altitude in feet, and temperature in °F, °R, and °C. (As well as other parameters that are not relevant to the purpose of this document.) Due to roundoff, the temperature conversions are not exact. With some exceptions, the temperatures in the tables can be reproduced by assuming °F is exact and applying the conversions

$$^{\circ}\text{R} = ^{\circ}\text{F} + 459.7 \text{ (Inexact; the exact conversion is 459.67)}$$

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) / 1.8 \text{ (Exact)}$$

and rounding to the nearest tenth of a degree. Some of the exceptions are typographical errors, and are noted below. Many of the exceptions are discrepancies of ± 0.1 °C, and are unexplained.

The temperature characteristics are piece-wise linear with respect to geopotential altitude. The end points of the various linear regimes will be referred to as altitude break points in the following discussion. It is important to note that the temperature characteristics are not piecewise linear with respect to pressure altitude. Thus one may use linear interpolation between the altitude break points with respect to geopotential altitude and match the table values with good accuracy (± 0.2 °F), but linear interpolation between the altitude break points with respect to pressure altitude introduces errors of up to 3.9 °F. (Where error is defined as the difference between the results of linear interpolation and the temperatures tabulated in the original source documents.)

In the tables in this document, a column has been added for pressure altitude in meters.

4.3.1 Cold Day

Appendix A1, Cold Day, is derived from Table II, "Cold Atmosphere", of MIL-STD-210A. Two of the temperatures in the table are apparent typographical errors, and are corrected and footnoted in Appendix A.1.

The Cold Day temperature characteristic has altitude break points at geopotential altitudes of 0, 3000, 10 000, 28 000, 42 000, 52 000, 62 000, 71 000, and 94 900 feet. These correspond to pressure altitudes of 0, 3311, 10 744, 30 715, 42 377, 50 583, 61 087, 73 055, and 100 000 feet, respectively. Using linear interpolation between the altitude break points with respect to pressure altitude introduces errors of up to 2.4 °F.

4.3.2 Hot Day

Appendix A.2, Hot Day, is derived from Table III, "Hot Atmosphere", of MIL-STD-210A. Two of the temperatures in the table are apparent typographical errors, and are corrected and footnoted in Appendix A2.

The Hot Day temperature characteristic has altitude break points at geopotential altitudes of 0, 40 000, 51 000, 68 000, and 105 000 feet. These correspond to pressure altitudes of 0, 39 400, 50 400, 66 400, and 100 000 feet, respectively. Using linear interpolation between the altitude break points with respect to pressure altitude introduces errors of up to 2.9 °F.

4.3.3 Polar Day

Appendix A.3, Polar Day, is derived from Table IV, "Polar Atmosphere", of MIL-STD-210A. There are no apparent typographical errors.

The Polar Day temperature characteristic has altitude break points at geopotential altitudes of 0, 3112, 9173, 28 225, 83 363, and 96 249 feet. These correspond to pressure altitudes of -319, 3243, 9882, 30 065, 86 092, and 100 000 feet, respectively. Note that the temperature characteristic is very nearly piecewise linear with respect to pressure altitude. Using linear interpolation between the altitude break points with respect to pressure altitude introduces errors of only up to 0.3 °F.

4.3.4 Tropical Day

Appendix A.4, Tropical Day, is derived from Table V, "Tropical Atmosphere", of MIL-STD-210A as revised by Change Notice 1. One of the temperatures in the table is an apparent typographical error, and is corrected and footnoted in Appendix A.4.

The Tropical Day temperature characteristic has altitude break points at geopotential altitudes of 0, 55 000, 70 000, and 100 745 feet. These correspond to pressure altitudes of 0, 53 595, 69 620, and 100 000 feet, respectively. The revision of Change Notice 1 changed the temperatures and geopotential altitudes above 69 620 feet pressure altitude. Using linear interpolation between the altitude break points with respect to pressure altitude introduces errors of up to 3.9 °F.

4.4 Days Derived from MIL-STD-210C, MIL-HDBK-310

The MIL-STD-210C and MIL-HDBK-310 source tables have columns for pressure altitude in meters, pressure altitude in feet, and temperature in °C and °F. (As well as other parameters that are not relevant to the purpose of this document.) All temperatures are rounded to the nearest whole degree. Altitude in feet is rounded to three significant digits. With three exceptions, the temperatures in the tables can be reproduced by assuming °C is exact and applying the conversions

$$^{\circ}\text{F} = 1.8(^{\circ}\text{C}) + 32. \text{ (Exact)}$$

$$^{\circ}\text{R} = 1.8(^{\circ}\text{C} + 273.15) \text{ (Exact)}$$

and rounding to the nearest degree.

The source tables are much shorter than those of MIL-STD-210A, eliminating much of the concern about method of interpolation – there is little incentive to abbreviate the tables. The degree of roundoff in altitude expressed in feet does imply, however, that one will no doubt get slightly different temperatures out of the tables, depending on whether they are entered with altitude in feet or in meters.

In the tables in this document, a column has been added for temperature in °R.

4.4.1 Highest Recorded Day

Appendix A.5, Highest Recorded Day, is derived from 5.3.1.1.1, “Highest Recorded”, of MIL-HDBK-310. One of the temperatures in the table is an apparent typographical error, and is corrected and footnoted in Appendix A.5.

4.4.2 Lowest Recorded Day

Appendix A.6, Lowest Recorded Day, is derived from 5.3.1.2.1, “Lowest Recorded”, of MIL-HDBK-310.

4.4.3 1% Hot Day

Appendix A.7, 1% Hot Day, is derived from 5.3.1.1.2, “Frequency of Occurrence. Temperatures (1-percent values)”, of MIL-HDBK-310.

4.4.4 1% Cold Day

Appendix A.8, 1% Cold Day, is derived from 5.3.1.2.2, “Frequency of Occurrence. Temperatures (1-percent values)”, of MIL-HDBK-310.

4.4.5 5% Hot Day, 10% Hot Day, 20% Hot Day

Appendices A.9, 5% Hot Day, A.10, 10% Hot Day, and A.11, 20% Hot Day are derived from Table XIX, “Supplementary High Temperature Values for the Worldwide Air Environment”, of MIL-HDBK-310. There is one discrepancy between the 5% Hot days in MIL-HDBK-310 and MIL-STD-210C. There appears to be a typographical error in MIL-STD-210C, but the “correction” of the error in MIL-HDBK-310 appears to be erroneous. The errors are corrected and footnoted in Appendix A.9.

Note that there is no entry at 0 altitude for 20% Hot Day in MIL-HDBK-310.

4.4.6 5% Cold Day, 10% Cold Day, 20% Cold Day

Appendices A.12, 5% Cold Day, A.13, 10% Cold Day, and A.14, 20% Cold Day are derived from Table XX, “Supplementary Low Temperature Values for the Worldwide Air Environment”, of MIL-HDBK-310. There is one possible typographical error; the temperatures given at sea level for the 5% Cold Day may be inconsistent. Due to conversion and round-off issues, it is impossible to be certain.

4.5 Standard Day

U.S. Standard Atmosphere, 1976 is the most common source for all information pertaining to a Standard Day. Standard Day temperatures and pressures from -2000 to 100 000 feet geopotential altitude are reproduced here for convenient reference.

Appendix A.15, Standard Day, presents Standard Day temperatures and pressures versus pressure altitude (which is the same as geopotential altitude on a Standard Day). Standard Day temperature (T) is piecewise linear with respect to pressure altitude (H), and may be calculated with the following equations:

Up to 36 089 feet	$T = 288.15 * (1. - 6.87558E-6 * H) \text{ K}$ $T = 518.67 * (1. - 6.87558E-6 * H) \text{ °R}$
36 089 to 65 617 feet	$T = 216.65 \text{ K}$ $T = 389.97 \text{ °R}$
65 617 to 104 987 feet	$T = 216.65 * (1. + 1.40688E-6 * (H - 65616.8)) \text{ K}$ $T = 389.97 * (1. + 1.40688E-6 * (H - 65616.8)) \text{ °R}$
104 987 to 150 000 feet	$T = 228.65 * (1. + 3.73252E-6 * (H - 104986.88)) \text{ K}$ $T = 411.57 * (1. + 3.73252E-6 * (H - 104986.88)) \text{ °R}$

The temperatures in °R in Appendix A.15 are calculated via these equations and rounded to the nearest hundredth of a degree. Temperature conversions are as follows:

$$°F = °R - 459.67 \text{ (Exact)}$$

$$°C = °R / 1.8 - 273.15 \text{ (Exact)}$$

with the results rounded to the nearest hundredth of a degree.

Standard Day pressure may be calculated with the following equations:

Up to 36 089 feet	$P = 14.696 * (1. - 6.87558E-6 * H)^{5.25591} \text{ lbf/in}^2$ $P = 101.325 * (1. - 6.87558E-6 * H)^{5.25591} \text{ kN/m}^2$
36 089 to 65 617 feet	$P = 14.696 * 0.22336 * \text{EXP}(-4.80637E-5 * (H - 36089.24)) \text{ lbf/in}^2$ $P = 101.325 * 0.22336 * \text{EXP}(-4.80637E-5 * (H - 36089.24)) \text{ kN/m}^2$
65 617 to 104 987 feet	$P = 14.696 * 0.0540322 * (1. + 1.40688E-6 * (H - 65616.8))^{-34.1634} \text{ lbf/in}^2$ $P = 101.325 * 0.0540322 * (1. + 1.40688E-6 * (H - 65616.8))^{-34.1634} \text{ kN/m}^2$
104 987 to 150 000 feet	$P = 14.696 * 0.00856649 * (1 + 3.73252E-6 * (H - 104986.88))^{-12.2012} \text{ lbf/in}^2$ $P = 101.325 * 0.00856649 * (1 + 3.73252E-6 * (H - 104986.88))^{-12.2012} \text{ kN/m}^2$

A column has been added to Appendix A.15 for pressure altitude in meters, rounded to the nearest meter.

5. RECOMMENDATIONS

For the purposes of this document, it is less important that these day types be used with high precision than that they be used in a consistent manner by all parties. The source materials themselves are not particularly precise or consistent: altitudes converted from meters to feet are rounded to three significant digits; a conversion constant from Fahrenheit to Rankine of 459.7 is apparently used, rather than the exact value of 459.67; temperatures are rounded to the nearest 10th of a degree in some tables, nearest degree in others; some sources tabulate data for 500 feet altitude increments, some for 2 km altitude increments. The tables in this section have been modified to make them more consistent with one another, and more consistent with the results a computer program would obtain using exact unit conversions.

The general recommendations for all users are

- a. For Standard Day, use the equations of 4.5 in computer programs
- b. For all other days, adopt the tables in this section for use in computer programs
- c. Use linear interpolation with respect to pressure altitude
- d. Take altitude in feet and temperature in °F as exact; use exact conversions within computer programs to obtain other units if required

Plots of ambient temperature versus altitude for the various days are provided for reference in Appendix B.

5.1 Days Derived from MIL-STD-210A

Tables 1 through 4 present Cold Day, Hot Day, Polar Day, and Tropical Day in abbreviated form. Data is given at a sufficient number of altitudes to allow linear interpolation with respect to pressure altitude with an error of no greater than ± 0.2 °F. (Where error is defined as the difference between the results of linear interpolation and the temperatures tabulated in the original source documents.) Temperature in °F is taken as exact in the source tables. The other temperatures are obtained by applying the conversions

$$^{\circ}\text{R} = ^{\circ}\text{F} + 459.7$$

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) / 1.8$$

and rounding to the nearest tenth of a degree. With two exceptions, footnoted in the tables, these conversions result in the same temperatures given in the source tables at these pressure altitudes. Pressure altitude in feet is taken as exact and pressure altitude in meters is rounded to the nearest meter. The tables have been extended to -2000 feet pressure altitude, assuming the same temperature values as at 0 altitude for Cold, Hot, and Tropical Day, and the same value as at -319.2 feet pressure altitude for Polar Day.

TABLE 1 - ABBREVIATED COLD DAY BASED ON MIL-STD-210A TABLE II

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	-60.0	399.7	-51.1
0	0	-60.0	399.7	-51.1
3311	1009	-15.0	444.7	-26.1
10 744	3275	-15.0	444.7	-26.1
15 000	4572	-29.1	430.6	-33.9
20 000	6096	-46.1	413.6	-43.4
25 000	7620	-63.9	395.8	-53.3
30 715	9362	-85.0	374.7	-65.0
42 377	12 917	-85.0	374.7	-65.0
45 000	13 716	-98.6	361.1	-72.6
48 500	14 783	-117.2	342.5	-82.9
50 000	15 240	-122.9	336.8	-86.1
50 583	15 418	-125.0	334.7	-87.2
61 087	18 619	-125.0	334.7	-87.2
65 000	19 812	-113.2	346.5	-80.7
67 500	20 574	-106.5	353.2	-76.9
70 000	21 336	-100.5	359.2	-73.6
73 055	22 267	-94.0	365.7	-70.0
75 000	22 860	-94.5	365.2	-70.3
80 000	24 384	-95.9	363.8	-71.1
85 000	25 908	-97.8	361.9	-72.1
90 000	27 432	-99.7	360.0	-73.2
95 000	28 956	-101.7	358.0	-74.3
100 000	30 480	-103.9	355.8	-75.5

TABLE 2 - ABBREVIATED HOT DAY BASED ON MIL-STD-210A TABLE III

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C	Notes
-2000	-610	103.0	562.7	39.4	
0	0	103.0	562.7	39.4	
5000	1524	83.7	543.4	28.7	
10 000	3048	63.9	523.6	17.7	
15 000	4572	44.9	504.6	7.2	
20 000	6096	25.5	485.2	-3.6	
25 000	7620	6.7	466.4	-14.0	
30 000	9144	-12.3	447.4	-24.6	
32 500	9906	-21.3	438.4	-29.6	
35 000	10 668	-30.1	429.6	-34.5	
39 400	12 009	-45.0	414.7	-42.8	
45 000	13 716	-42.6	417.1	-41.5	
47 500	14 478	-41.4	418.3	-40.8	
48 500	14 783	-40.9	418.8	-40.5	
50 000	15 240	-40.2	419.5	-40.1	
50 400	15 362	-40.0	419.7	-40.0	
65 000	19 812	-37.2	422.5	-38.4	1
66 400	20 239	-37.0	422.7	-38.3	
70 000	21 336	-34.7	425.0	-37.1	
75 000	22 860	-31.2	428.5	-35.1	
80 000	24 384	-27.7	432.0	-33.1	
85 000	25 908	-23.8	435.9	-31.0	
90 000	27 432	-19.8	439.9	-28.8	
95 000	28 956	-15.9	443.8	-26.6	
100 000	30 480	-11.6	448.1	-24.2	

NOTE: 1 Temperature in °C is -38.5 in the source table

TABLE 3 - ABBREVIATED POLAR DAY BASED ON MIL-STD-210A TABLE IV

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	-16.6	443.1	-27.0
-319.2	-97	-16.6	443.1	-27.0
0	0	-15.7	444.0	-26.5
3243	988	-5.8	453.9	-21.0
9882	3012	-9.4	450.3	-23.0
20 000	6096	-38.0	421.7	-38.9
30 065	9164	-67.0	392.7	-55.0
86 092	26 241	-81.4	378.3	-63.0
100 000	30 480	-81.4	378.3	-63.0

TABLE 4 - ABBREVIATED TROPICAL DAY BASED ON MIL-STD-210A, CHANGE NOTICE 1, TABLE V

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C	Notes
-2000	-610	89.8	549.5	32.1	
0	0	89.8	549.5	32.1	
20 000	6096	12.3	472.0	-10.9	1
35 000	10 668	-45.6	414.1	-43.1	
40 000	12 192	-64.6	395.1	-53.7	
45 000	13 716	-82.8	376.9	-63.8	
50 000	15 240	-100.1	359.6	-73.4	
53 595	16 336	-112.0	347.7	-80.0	
60 000	18 288	-98.0	361.7	-72.2	
69 620	21 220	-76.0	383.7	-60.0	
100 000	30 480	-35.4	424.3	-37.5	

NOTE: 1 Temperature in °C is -11.0 in the source table

5.2 Days Derived from MIL-STD-210C / MIL-HDBK-310

Tables 5 and 6 provide Highest and Lowest Recorded Day; Tables 7 and 8 present 1% Hot and 1% Cold Day; Tables 9 through 11 give 5%, 10%, and 20% Hot Day; and Tables 12 through 14 show 5%, 10%, and 20% Cold Day. These tables are virtually identical to the source tables given in the appendices. The only modifications are:

- Table 11 has been linearly extrapolated to 0 altitude.
- Temperatures in °C have been assumed to be exact, and temperatures in °F and °R were obtained by conversion. Altitudes in m have been assumed to be exact, and altitudes in feet were obtained by conversion.
- All tables have been extended to -2000 feet, assuming the same temperature values as at 0 altitude.
- Altitudes in feet are rounded to the nearest foot; temperatures in °F and °R are rounded to the nearest 10th of a degree. While the addition of significant digits is not justified mathematically, it is more consistent with the results a computer program would obtain using exact unit conversions.

TABLE 5 - HIGHEST RECORDED DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.1.1

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	136.4	596.1	58
0	0	136.4	596.1	58
3281	1000	104.0	563.7	40
6562	2000	87.8	547.5	31
13 123	4000	66.2	525.9	19
19 685	6000	42.8	502.5	6
26 247	8000	24.8	484.5	-4
32 808	10 000	-0.4	459.3	-18
39 370	12 000	-16.6	443.1	-27
45 932	14 000	-29.2	430.5	-34
52 493	16 000	-31.0	428.7	-35
59 055	18 000	-29.2	430.5	-34
65 617	20 000	-23.8	435.9	-31
72 178	22 000	-23.8	435.9	-31
78 740	24 000	-23.8	435.9	-31
85 302	26 000	-16.6	443.1	-27
91 864	28 000	-7.6	452.1	-22
98 425	30 000	1.4	461.1	-17

TABLE 6 - LOWEST RECORDED DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.2.1

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	-90.4	369.3	-68
0	0	-90.4	369.3	-68
3281	1000	-68.8	390.9	-56
6562	2000	-52.6	407.1	-47
13 123	4000	-59.8	399.9	-51
19 685	6000	-76.0	383.7	-60
26 247	8000	-83.2	376.5	-64
32 808	10 000	-99.4	360.3	-73
39 370	12 000	-106.6	353.1	-77
45 932	14 000	-108.4	351.3	-78
52 493	16 000	-124.6	335.1	-87
59 055	18 000	-121.0	338.7	-85
65 617	20 000	-117.4	342.3	-83
72 178	22 000	-121.0	338.7	-85
78 740	24 000	-121.0	338.7	-85
85 302	26 000	-121.0	338.7	-85
91 864	28 000	-121.0	338.7	-85
98 425	30 000	-121.0	338.7	-85

TABLE 7 - 1% HOT DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.1.2

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	120.2	579.9	49
0	0	120.2	579.9	49
3281	1000	102.2	561.9	39
6562	2000	84.2	543.9	29
13 123	4000	60.8	520.5	16
19 685	6000	39.2	498.9	4
26 247	8000	19.4	479.1	-7
32 808	10 000	-0.4	459.3	-18
39 370	12 000	-16.6	443.1	-27
45 932	14 000	-29.2	430.5	-34
52 493	16 000	-34.6	425.1	-37
59 055	18 000	-36.4	423.3	-38
65 617	20 000	-34.6	425.1	-37
72 178	22 000	-34.6	425.1	-37
78 740	24 000	-32.8	426.9	-36
85 302	26 000	-29.2	430.5	-34
91 864	28 000	-22.0	437.7	-30
98 425	30 000	-22.0	437.7	-30

TABLE 8 - 1% COLD DAY BASED ON MIL-HDBK-310 PARAGRAPH 5.3.1.2.2

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	-77.8	381.9	-61
0	0	-77.8	381.9	-61
3281	1000	-67.0	392.7	-55
6562	2000	-43.6	416.1	-42
13 123	4000	-50.8	408.9	-46
19 685	6000	-67.0	392.7	-55
26 247	8000	-83.2	376.5	-64
32 808	10 000	-95.8	363.9	-71
39 370	12 000	-97.6	362.1	-72
45 932	14 000	-106.6	353.1	-77
52 493	16 000	-122.8	336.9	-86
59 055	18 000	-121.0	338.7	-85
65 617	20 000	-117.4	342.3	-83
72 178	22 000	-121.0	338.7	-85
78 740	24 000	-121.0	338.7	-85
85 302	26 000	-121.0	338.7	-85
91 864	28 000	-121.0	338.7	-85
98 425	30 000	-119.2	340.5	-84

TABLE 9 - 5% HOT DAY BASED ON MIL-HDBK-310 TABLE XIX

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	114.8	574.5	46
0	0	114.8	574.5	46
3281	1000	100.4	560.1	38
6562	2000	80.6	540.3	27
13 123	4000	55.4	515.1	13
19 685	6000	33.8	493.5	1
26 247	8000	12.2	471.9	-11
32 808	10 000	-9.4	450.3	-23
39 370	12 000	-25.6	434.1	-32
45 932	14 000	-34.6	425.1	-37
52 493	16 000	-38.2	421.5	-39
59 055	18 000	-38.2	421.5	-39
65 617	20 000	-38.2	421.5	-39
72 178	22 000	-36.4	423.3	-38
78 740	24 000	-36.4	423.3	-38
85 302	26 000	-32.8	426.9	-36
91 864	28 000	-29.2	430.5	-34
98 425	30 000	-22.0	437.7	-30

TABLE 10 - 10% HOT DAY BASED ON MIL-HDBK-310 TABLE XIX

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	113.0	572.7	45
0	0	113.0	572.7	45
3281	1000	98.6	558.3	37
6562	2000	78.8	538.5	26
13 123	4000	51.8	511.5	11
19 685	6000	30.2	489.9	-1
26 247	8000	8.6	468.3	-13
32 808	10 000	-13.0	446.7	-25
39 370	12 000	-27.4	432.3	-33
45 932	14 000	-36.4	423.3	-38
52 493	16 000	-38.2	421.5	-39
59 055	18 000	-38.2	421.5	-39
65 617	20 000	-38.2	421.5	-39
72 178	22 000	-38.2	421.5	-39
78 740	24 000	-36.4	423.3	-38
85 302	26 000	-34.6	425.1	-37
91 864	28 000	-29.2	430.5	-34
98 425	30 000	-23.8	435.9	-31

TABLE 11 - 20% HOT DAY BASED ON MIL-HDBK-310 TABLE XIX

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	109.4	569.1	43
0	0	109.4	569.1	43
3281	1000	93.2	552.9	34
6562	2000	77.0	536.7	25
13 123	4000	50.0	509.7	10
19 685	6000	28.4	488.1	-2
26 247	8000	6.8	466.5	-14
32 808	10 000	-14.8	444.9	-26
39 370	12 000	-34.6	425.1	-37
45 932	14 000	-40.0	419.7	-40
52 493	16 000	-40.0	419.7	-40
59 055	18 000	-40.0	419.7	-40
65 617	20 000	-40.0	419.7	-40
72 178	22 000	-40.0	419.7	-40
78 740	24 000	-38.2	421.5	-39
85 302	26 000	-34.6	425.1	-37
91 864	28 000	-31.0	428.7	-35
98 425	30 000	-25.6	434.1	-32

TABLE 12 - 5% COLD DAY BASED ON MIL-HDBK-310 TABLE XX

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	-70.6	389.1	-57
0	0	-70.6	389.1	-57
3281	1000	-65.2	394.5	-54
6562	2000	-36.4	423.3	-38
13 123	4000	-45.4	414.3	-43
19 685	6000	-61.6	398.1	-52
26 247	8000	-77.8	381.9	-61
32 808	10 000	-92.2	367.5	-69
39 370	12 000	-94.0	365.7	-70
45 932	14 000	-104.8	354.9	-76
52 493	16 000	-121.0	338.7	-85
59 055	18 000	-115.6	344.1	-82
65 617	20 000	-115.6	344.1	-82
72 178	22 000	-119.2	340.5	-84
78 740	24 000	-119.2	340.5	-84
85 302	26 000	-119.2	340.5	-84
91 864	28 000	-117.4	342.3	-83
98 425	30 000	-117.4	342.3	-83

TABLE 13 - 10% COLD DAY BASED ON MIL-HDBK-310 TABLE XX

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	-65.2	394.5	-54
0	0	-65.2	394.5	-54
3281	1000	-63.4	396.3	-53
6562	2000	-32.8	426.9	-36
13 123	4000	-38.2	421.5	-39
19 685	6000	-59.8	399.9	-51
26 247	8000	-77.8	381.9	-61
32 808	10 000	-86.8	372.9	-66
39 370	12 000	-88.6	371.1	-67
45 932	14 000	-103.0	356.7	-75
52 493	16 000	-119.2	340.5	-84
59 055	18 000	-112.0	347.7	-80
65 617	20 000	-113.8	345.9	-81
72 178	22 000	-117.4	342.3	-83
78 740	24 000	-117.4	342.3	-83
85 302	26 000	-117.4	342.3	-83
91 864	28 000	-115.6	344.1	-82
98 425	30 000	-113.8	345.9	-81

TABLE 14 - 20% COLD DAY BASED ON MIL-HDBK-310 TABLE XX

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C
-2000	-610	-59.8	399.9	-51
0	0	-59.8	399.9	-51
3281	1000	-61.6	398.1	-52
6562	2000	-27.4	432.3	-33
13 123	4000	-34.6	425.1	-37
19 685	6000	-54.4	405.3	-48
26 247	8000	-74.2	385.5	-59
32 808	10 000	-83.2	376.5	-64
39 370	12 000	-85.0	374.7	-65
45 932	14 000	-99.4	360.3	-73
52 493	16 000	-117.4	342.3	-83
59 055	18 000	-110.2	349.5	-79
65 617	20 000	-106.6	353.1	-77
72 178	22 000	-110.2	349.5	-79
78 740	24 000	-115.6	344.1	-82
85 302	26 000	-115.6	344.1	-82
91 864	28 000	-113.8	345.9	-81
98 425	30 000	-110.2	349.5	-79

6. NOTES

- 6.1 A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE COMMITTEE S-15, GAS TURBINE PERFORMANCE
SIMULATION NOMENCLATURE AND INTERFACES

APPENDIX A - DATA EXTRACTED FROM SOURCE DOCUMENTS (WITH ALTERATIONS AS NOTED)

A.1 COLD DAY

Table A1 provides Cold Day temperature versus pressure altitude based on Table II – Cold Atmosphere of MIL-STD-210A. Two apparent typographical errors in the source table have been corrected, as noted below.

TABLE A1 - COLD DAY TEMPERATURES VERSUS PRESSURE ALTITUDE

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C	Notes
0	0	-60.0	399.7	-51.1	
500	152	-53.3	406.4	-47.4	
1000	305	-46.5	413.2	-43.6	
1500	457	-39.8	419.9	-39.9	
2000	610	-33.0	426.7	-36.1	
2500	762	-26.1	433.6	-32.3	
3000	914	-19.3	440.4	-28.5	
3311	1009	-15.0	444.7	-26.1	
3500	1067	-15.0	444.7	-26.1	
4000	1219	-15.0	444.7	-26.1	
4500	1372	-15.0	444.7	-26.1	
5000	1524	-15.0	444.7	-26.1	
5500	1676	-15.0	444.7	-26.1	
6000	1829	-15.0	444.7	-26.1	
6500	1981	-15.0	444.7	-26.1	
7000	2134	-15.0	444.7	-26.1	
7500	2286	-15.0	444.7	-26.1	
8000	2438	-15.0	444.7	-26.1	
8500	2591	-15.0	444.7	-26.1	
9000	2743	-15.0	444.7	-26.1	
9500	2896	-15.0	444.7	-26.1	
10 000	3048	-15.0	444.7	-26.1	
10 500	3200	-15.0	444.7	-26.1	
10 744	3275	-15.0	444.7	-26.1	
11 000	3353	-15.8	443.9	-26.6	
11 500	3505	-17.5	442.2	-27.5	
12 000	3658	-19.1	440.6	-28.4	
12 500	3810	-20.8	438.9	-29.3	
13 000	3962	-22.4	437.3	-30.2	
13 500	4115	-24.1	435.6	-31.2	
14 000	4267	-25.7	434.0	-32.1	
14 500	4420	-27.3	432.4	-32.9	
15 000	4572	-29.1	430.6	-33.9	
15 500	4724	-30.8	428.9	-34.9	
16 000	4877	-32.4	427.3	-35.8	

TABLE A1 - COLD DAY TEMPERATURES VERSUS PRESSURE ALTITUDE

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C	Notes
16 500	5029	-34.1	425.6	-36.7	
17 000	5182	-35.8	423.9	-37.7	
17 500	5334	-37.5	422.2	-38.6	
18 000	5486	-39.2	420.5	-39.6	
18 500	5639	-41.0	418.7	-40.6	
19 000	5791	-42.7	417.0	-41.5	
19 500	5944	-44.4	415.3	-42.4	
20 000	6096	-46.1	413.6	-43.4	
20 500	6248	-47.9	411.8	-44.4	
21 000	6401	-49.6	410.1	-45.3	
21 500	6553	-51.4	408.3	-46.3	
22 000	6706	-53.2	406.5	-47.3	
22 500	6858	-54.9	404.8	-48.3	
23 000	7010	-56.7	403.0	-49.3	
23 500	7163	-58.5	401.2	-50.3	
24 000	7315	-60.3	399.4	-51.3	
24 500	7468	-62.1	397.6	-52.3	
25 000	7620	-63.9	395.8	-53.3	
25 500	7772	-65.7	394.0	-54.3	
26 000	7925	-67.5	392.2	-55.3	
26 500	8077	-69.3	390.4	-56.3	
27 000	8230	-71.1	388.6	-57.3	
27 500	8382	-73.0	386.7	-58.3	
28 000	8534	-74.8	384.9	-59.3	
28 500	8687	-76.7	383.0	-60.4	
29 000	8839	-78.6	381.1	-61.4	
29 500	8992	-80.4	379.3	-62.4	
30 000	9144	-82.3	377.4	-63.5	
30 500	9296	-84.2	375.5	-64.6	
30 715	9362	-85.0	374.7	-65.0	
31 000	9449	-85.0	374.7	-65.0	
31 500	9601	-85.0	374.7	-65.0	
32 000	9754	-85.0	374.7	-65.0	
32 500	9906	-85.0	374.7	-65.0	
33 000	10 058	-85.0	374.7	-65.0	
33 500	10 211	-85.0	374.7	-65.0	
34 000	10 363	-85.0	374.7	-65.0	
34 500	10 516	-85.0	374.7	-65.0	
35 000	10 668	-85.0	374.7	-65.0	
35 500	10 820	-85.0	374.7	-65.0	

TABLE A1 - COLD DAY TEMPERATURES VERSUS PRESSURE ALTITUDE

Pressure Altitude feet	Pressure Altitude m	Temperature °F	Temperature °R	Temperature °C	Notes
36 000	10 973	-85.0	374.7	-65.0	
36 500	11 125	-85.0	374.7	-65.0	
37 000	11 278	-85.0	374.7	-65.0	
37 500	11 430	-85.0	374.7	-65.0	
38 000	11 582	-85.0	374.7	-65.0	
38 500	11 735	-85.0	374.7	-65.0	
39 000	11 887	-85.0	374.7	-65.0	
39 500	12 040	-85.0	374.7	-65.0	
40 000	12 192	-85.0	374.7	-65.0	
40 500	12 344	-85.0	374.7	-65.0	
41 000	12 497	-85.0	374.7	-65.0	
41 500	12 649	-85.0	374.7	-65.0	
42 000	12 802	-85.0	374.7	-65.0	
42 377	12 917	-85.0	374.7	-65.0	
42 500	12 954	-85.6	374.1	-65.3	
43 000	13 106	-88.2	371.5	-66.8	1
43 500	13 259	-90.7	369.0	-68.2	
44 000	13 411	-93.3	366.4	-69.6	
44 500	13 564	-96.0	363.7	-71.1	
45 000	13 716	-98.6	361.1	-72.6	
45 500	13 868	-101.2	358.5	-74.0	2
46 000	14 021	-103.9	355.8	-75.5	
46 500	14 173	-106.6	353.1	-77.0	
47 000	14 326	-109.3	350.4	-78.5	
47 500	14 478	-112.0	347.7	-80.0	
48 000	14 630	-114.7	345.0	-81.5	
48 500	14 783	-117.2	342.5	-82.9	
49 000	14 935	-119.2	340.5	-84.0	
49 500	15 088	-121.0	338.7	-85.0	
50 000	15 240	-122.9	336.8	-86.1	
50 500	15 392	-124.7	335.0	-87.1	
50 583	15 418	-125.0	334.7	-87.2	
51 000	15 545	-125.0	334.7	-87.2	
51 500	15 697	-125.0	334.7	-87.2	
52 000	15 850	-125.0	334.7	-87.2	
52 500	16 002	-125.0	334.7	-87.2	
53 000	16 154	-125.0	334.7	-87.2	
53 500	16 307	-125.0	334.7	-87.2	
54 000	16 459	-125.0	334.7	-87.2	
54 500	16 612	-125.0	334.7	-87.2	