

APPENDIX D CLIMATIC CONDITIONS

D-1. EXPLANATION OF CLIMATIC TERMS

a. Climatic Zones. The four climatic zones considered in AFCS facility designs.

- (1) Temperate Zone.
- (2) Tropical Zone.
- (3) Frigid Zone.
- (4) Desert Zone.

b. Climatic Categories. Eight broad classes¹ of climate differentiated on the basis of temperature and/or humidity extremes. Climatic conditions of each climatic zone are detailed in paragraphs D-2 through D-5 and are summarized in table D-1. Interrelationships of climatic zones and climatic categories for the purposes of AFCS designs are:

- (1) *Temperate Zone.*
 - (a) Category 5: Intermediate Hot-Dry.
 - (b) Category 6: Intermediate Cold.
- (2) *Tropical Zone.*
 - (a) Category 1: Wet-Warm.
 - (b) Category 2: Wet-Hot.
- (3) *Frigid Zone.* Category 7: Cold.
- (4) *Desert Zone.*
 - (a) Category 3: Humid-Hot Coastal Desert.
 - (b) Category 4: Hot-Dry.

c. Operational and Storage and Transit Conditions. The distinction made between operational temperature and humidity conditions and storage and transit temperature and humidity conditions.

(1) *Operational Conditions.* The climatic conditions to which military materiel might be subjected during operations or standby for operations. Determined in accordance with the 1-percent risk policy,² operational conditions are stated in terms of ambient temperature and

humidity measured under standard conditions of ventilation and radiation shielding in a meteorological shelter 4 to 6 feet above the ground. Solar radiation and wind values that might be experienced concurrently with the temperature and humidity also are set forth for many of the categories. Temperature of the materiel itself may vary considerably from the operational air temperature because of the effects of incoming and outgoing radiation, internal sources of heat, thermal mass, and heat transfer characteristics of the materiel.

(2) *Storage and Transit Conditions.* Air temperature and humidity conditions to which materiel might be subjected in storage and transit situations. Examples are the inside of an ISO container or unventilated field storage shelter, under a tarpaulin, in a tent, or in a railway box-car. Storage and transit air temperature and humidity may differ from operational temperature and humidity because of induced effects of heat gain or air loss in confined spaces.

D-2. TEMPERATE ZONE: INTERMEDIATE HOT-DRY AND INTERMEDIATE COLD

a. Category 5: Intermediate Hot-Dry.

(1) *Location.* Intermediate hot-dry conditions are found throughout the world, extending outward from the areas of hot-dry conditions in the United States, Mexico, Africa, Asia, and Australia. Intermediate hot-dry conditions are also found in southern Africa, South America, southern Spain, and Southeast Asia during the dry seasons.

(2) *Operational Conditions.*

(a) Four hours with an ambient air temperature above 105 °F, with an extreme temperature of 110 °F for not more than 1 hour.

(b) A maximum ground surface temperature of 130 °F.

1. Category 8, Extreme Cold, is not used for AFCS design criteria.

2. AFCS designs are developed to withstand the most extreme climatic conditions only 1-percent of the time (hours) in the most extreme month in the most extreme parts of the climatic area. The 1-percent risk policy is used in order to avoid the cost and complexity of designing for absolute conditions.

Table D-1. Summary of temperature, solar radiation, and relative humidity extremes

	Desert Zone		Frigid Zone	Temperate Zone		Tropical Zone	
	Category 3 Hot-Humid Coastal Desert	Category 4 Hot-Dry	Category 7 Cold	Category 5 Intermediate Hot-Dry	Category 6 Intermediate Cold	Category 1 Wet-Warm	Category 2 Wet-Hot
Operational Conditions							
Ambient Air Temperature °F	85 to 110	90 to 160	-35 to 50	70 to 110	-5 to -25	75	78 to 95
Reverse Season Air Temperature °F	32	25	95	NA	NA	40	40
Solar Radiation Btu/ft ² /hr	0 to 360	0 to 360	Negligible	0 to 360	Negligible	Negligible	0 to 360
Ambient Relative Humidity %	63 to 90	5 to 20	Tending toward saturation	20 to 85	Tending toward saturation	95 to 100	74 to 100
Storage & Transit Conditions							
Induced Air Temperature °F	90 to 160	90 to 160	-35 to -50	20 to 145	-10 to -35	80	90 to 160
Induced Relative Humidity %	10 to 85	2 to 50	Tending toward saturation	5 to 50	Tending toward saturation	95 to 100	10 to 85

(c) Solar radiation (horizontal surface) at a rate of 360 Btu/ft²/hr for not more than 4 hours.

(d) A wind velocity between 5 and 10 knots when temperatures are above 105 °F.

(3) *Storage and Transit Conditions.* Four continuous hours occur with an induced air temperature above 140 °F and relative humidity less than 10 percent; an air temperature extreme of 145 °F occurs for not more than 1 hour without benefit of solar radiation and with negligible wind.

(4) *Rain.* A 12-hour rainfall of 9.5 inches occurs with a maximum intensity of 0.45 inches per minute and an intermittent wind velocity of 35 knots.

(5) *Snow.* Snow occurs in part of the area designated intermediate, but not during periods of high temperature.

(6) *Icing.* Icing occurs in parts of the area designated intermediate, but not during periods of high temperature.

(7) *Sea-Salt Fallout.* The distribution of sea-salt fallout is uneven over land areas with maximum amounts on exposed coasts and minimum amounts in dry inland areas. For inland deserts, sea salts may be supplemented by local alkali suspensions. Fallout can be locally intense, although most dry inland areas experience less than 5 lb/acre/yr. Even in the dry interior of North America and Eurasia a few areas experience salt fallout of less than 0.5 lb/acre/yr.

(8) *Winds.* AFCS designs with a life expectancy of 5 years or more may be subject to winds of 55 knots (with gusts to 85 knots) for a 5-minute period, except at exposed coastal and mountain locations where sustained 5-minute winds of 70 knots with gusts to 105 knots may be experienced. Designs with a life expectancy of less than 5 years, may be subject to winds of 45 knots (with gusts to 65 knots) for a 5-minute period. All wind velocities were determined for a height of 10 feet above the ground.

(9) *Blowing Sand.* Blowing sand is considered when winds are greater than 30 knots. Windblown particles are 0.01 to 1.00 mm in diameter, with predominant diameters between 0.15 and 0.3 mm found close to the surface and approximately half the particles below 0.4 mm and a few particles above 4 mm. Sand stirred up by aircraft or vehicles may produce heavier concentrations at higher levels.

(10) *Blowing Dust.* Windblown dust concentrations are 6×10^{-9} gm/cm³ with a 0.0001 to 0.01 mm diameter and blow at 35 knots at a 5-foot height. Dust stirred up by aircraft or vehicles may produce heavier concentrations.

(11) *Atmospheric Pressure.*

(a) Sea Level Maximum: 1,050 millibars (31.0 inches of mercury).

(b) Sea Level Minimum: 990 millibars (29.2 inches of mercury).

b. *Category 6: Intermediate Cold.*

(1) *Location.* Intermediate cold conditions are found only in the Northern Hemisphere in midlatitudes south of the coldest areas and on high-latitude coasts (such as the southern coast of Alaska) where maritime effects prevent very low temperatures.

(2) *Operational Conditions.*

(a) Six continuous hours with an ambient air temperature of -25 °F.

(b) A minimum ground surface temperature of -35 °F.

(c) Wind velocity less than 10 knots.

(d) Negligible solar radiation (horizontal surface).

(e) Humidity tending toward saturation.

(f) Wind velocities infrequently greater than 10 knots with temperatures of -25 °F.

(3) *Storage and Transit Conditions.* Six continuous hours occur with an induced air temperature of -30 °F and no wind or solar radiation; humidity tends toward saturation.

(4) *Rain.* Not applicable during periods of low temperature extremes.

(5) *Snow Load.* 30 lb/ft².

(6) *Icing.* Deposits of hoarfrost, rime, and glaze may be several inches thick.

(7) *Sea-Salt Fallout.* Near windward coasts (i.e., southern coast of Alaska), sea-salt fallout of 25 lb/acre/yr or more may occur. In the continental interiors, sea-salt fallout is normally between 3 and 5 lb/acre/yr.

(8) *Winds.* See category 5, intermediate hot-dry.

(9) *Blowing Sand.* See category 5, intermediate hot-dry.

(10) *Blowing Dust.* See category 5, intermediate hot-dry.

(11) *Atmospheric Pressure.*

(a) Sea Level Maximum: 1,055 millibars (31.2 inches of mercury).

(b) Sea Level Minimum: 960 millibars (28.3 inches of mercury).

D-3. TROPICAL ZONE: WET-WARM AND WET-HOT

a. *Category 1: Wet-Warm.*

(1) *Location.* Wet-warm conditions are found under the canopy of heavily forested tropical areas. In part of the area, wet-warm conditions may occur on several days during any month of the year (nonseasonal); however, in the rest of the area, wet-warm conditions may occur seasonally, but on several days in at least 4 months of the year.

(2) *Operational Conditions.* Persistence of relative humidity above 95 percent with nearly constant temperatures of 75 °F for periods of a day or more.

(3) *Storage and Transit Conditions.* Persistence of relative humidity above 95 percent with temperatures of nearly 80 °F for periods of a day or more.

(4) *Rain.* Rainfall is intercepted by the forest canopy and reaches the forest floor as drip and tree runoff.

(5) *Sea-Salt Fallout.* Negligible.

(6) *Winds.* Wind beneath the forest canopy is light, seldom exceeding 5 knots.

(7) *Atmospheric Pressure.*

(a) Sea Level Maximum: 1,030 millibars (30.4 inches of mercury).

(b) Sea Level Minimum: 945 millibars (27.9 inches of mercury).

(9) *Reverse Season Temperature.* The reverse season minimum temperature expectancy is 40 °F. That temperature is in accordance with the 1-percent risk policy.

b. *Category 2: Wet-Hot.*

(1) *Location.* Wet-hot conditions, characterized by high temperatures accompanied by high humidity and intense solar radiation, are found in open, tropical areas. Those are the same general areas where category 1 (wet-

warm conditions) are found, but in the open rather than under the forest canopy. In part of the area, wet-hot conditions may be experienced during any month of the year, while in the rest of the area wet-hot conditions occur seasonally at least 4 months per year.

(2) *Operational Conditions.*

(a) Four continuous hours with an ambient temperature of 95 °F.

(b) Maximum ground surface temperature of 130 °F.

(c) Maximum solar radiation (horizontal surface) at a rate of 360 Btu/ft²/hr for not more than 4 hours.

(d) A wind velocity less than 5 knots, concurrent with the high temperatures.

(e) Relative humidity of 74 percent, concurrent with the high temperatures.

(3) *Storage and Transit Conditions.*

(a) Four continuous hours with an induced air temperature above 155 °F.

(b) Relative humidity between 10 and 20 percent.

(c) An air temperature extreme of 160 °F for not more than 1 hour without benefit of solar radiation and negligible wind.

(4) *Rain.* See category 5, intermediate hot-dry.

(5) *Sea-Salt Fallout.* Salt fallout will vary from a maximum of over 25 lb/acre/yr on exposed coasts to a minimum between 3 and 5 lb/acre/yr at inland locations.

(6) *Winds.* See category 5, intermediate hot-dry.

(7) *Blowing Sand.* Not applicable during wet periods that characterize the wet-hot category; however, blowing sand may be a problem during the dry seasons and even during dry spells in the wet season. See category 5, intermediate hot-dry.

(8) *Atmospheric Pressure.*

(a) Sea Level Maximum: 1,030 millibars (30.4 inches of mercury).

(b) Sea Level Minimum: 945 millibars (27.9 inches of mercury).

(9) *Reverse Season Temperature.* The reverse season minimum temperature expectancy is 40 °F. That temperature is in accordance with the 1-percent risk policy.

D-4. FRIGID ZONE: COLD

a. Location. Cold conditions (category 7) are found only in the Northern Hemisphere in Canada, Alaska, Greenland, northern Scandinavia, northern Asia, Tibet, and Russia.

b. Operational Conditions.

(1) Six continuous hours with a minimum ambient air temperature of -50 °F.

(2) A minimum ground or snow surface temperature of -50 °F.

(3) Wind velocity of less than 10 knots.

(4) Negligible solar radiation (horizontal surface).

(5) Humidity tending toward saturation.

c. Reverse Season Temperature. The reverse season maximum temperature expectancy is 95 °F. That temperature is in accordance with the 1-percent risk policy.

d. Storage and Transit Conditions. Same as operational conditions.

e. Rain. Not applicable during periods of low temperature extremes.

f. Snow Load. 60 lb/ft².

g. Icing.

(1) *Hoarfrost.* Hoarfrost can occur only under cold conditions. Deposits may be several inches thick.

(2) *Ice Fog.* Suspended ice crystals average 5 to 20 microns in diameter. In areas where there is a source of water vapor, ice fog occurs mainly at temperatures below -20 °F; when temperatures are below -35 °F, ice fog may be very dense, limiting visibility to a few feet.

h. Sea-Salt Fallout. Generally, less than 3 lb/acre/yr because of the low salinity of northern waters and the interior location of most areas where cold conditions occur.

i. Wind. See category 5, intermediate hot-dry.

j. Blowing Sand. See category 5, intermediate hot-dry.

k. Blowing Dust. See category 5, intermediate hot-dry.

l. Atmospheric Pressure.

(1) Sea Level Maximum: 1,060 millibars (31.3 inches of mercury).

(2) Sea Level Minimum: 970 millibars (28.6 inches of mercury).

D-5. DESERT ZONE: HUMID-HOT COASTAL DESERT AND HOT-DRY

a. Category 3: Humid-Hot Coastal Desert.

(1) *Locations.* Humid-hot coastal desert conditions are limited to the immediate coast of bodies of water having a high surface temperature, such as the Persian Gulf and the Red Sea. Those coastal areas have the highest water vapor associated with air near the ground.

(2) *Operational Conditions.*

(a) Not more than 4 continuous hours with an ambient air temperature of 100 °F. Temperatures higher than 100 °F can occur in humid-hot coastal desert.

(b) Relative humidity 64 percent, corresponding to a wet bulb temperature of 89 °F and a dew point temperature of 86 °F.

(c) Maximum ground temperature of 130 °F.

(d) Maximum solar radiation (horizontal surface) at a rate of 360 Btu/ft²/hour for not more than 4 hours.

(e) Wind velocities between 5 and 10 knots.

(3) *Storage and Transit Conditions.* Not more than 4 continuous hours with an induced air temperature above 155 °F and relative humidity less than 5 percent; an air temperature extreme of 160 °F for not more than 1 hour without benefit of solar radiation and with negligible wind.

(4) *Reverse Season Temperature.* The reverse season minimum temperature expectancy is 32 °F. That temperature is in accordance with the 1-percent risk policy.

(5) *Rain.* A 1-hour rainfall of 4.00 inches, with a maximum intensity of 0.45 inches per minute and an intermittent wind velocity of 35 knots. The total annual inches and frequency of rainfall are much less in the humid-hot and hot-dry climates than in the wet-warm, wet-hot, and intermediate climates; nevertheless, heavy rainfall may fall occasionally in parts of the humid-hot areas. Temperatures during heavy rainfall are lower than 80 °F.

(6) *Sea-Salt Fallout.* Salt fallout is no more than 25 lb/acre/yr.

(7) *Winds.* See category 5, intermediate hot-dry.

(8) *Blowing Sand.* See category 5, intermediate hot-dry.

(9) *Blowing Dust*. See category 5, intermediate hot-dry.

(10) *Atmospheric Pressure*.

(a) Sea Level Maximum: 1,030 millibars (30.4 inches of mercury).

(b) Sea Level Minimum: 990 millibars (29.2 inches of mercury).

b. *Category 4: Hot-Dry*.

(1) *Location*. Hot-dry conditions are found in the deserts of northern Africa, the Middle East, West Pakistan, India, southwestern United States, and northern Mexico and Australia.

(2) *Operational Conditions*.

(a) Four continuous hours with an ambient temperature above 120 °F. An extreme temperature of 125 °F for not more than 1 hour. A maximum ground surface temperature of 145 °F.

(b) Solar radiation (horizontal surface) at a rate of 350 Btu/ft²/hr concurrent with a temperature above 120 °F.

(c) Wind velocities between 5 and 10 knots during the period with temperatures above 120 °F.

(d) A relative humidity of approximately 5 percent concurrent with the high temperature.

(3) *Storage and Transit Conditions*. Not more than 4 continuous hours with an induced air temperature above 155 °F and relative humidity less than 5 percent; an air temperature extreme of 160 °F for not more than 1 hour without benefit of solar radiation and with negligible wind.

(4) *Reverse Season Temperature*. The reverse season minimum temperature expectancy is 25 °F. That temperature is in accordance with the 1-percent risk policy.

(5) *Rain*. See category 5, intermediate hot-dry.

(6) *Sea-Salt Fallout*. See category 5, intermediate hot-dry.

(7) *Winds*. See category 5, intermediate hot-dry.

(8) *Blowing Sand*. See category 5, intermediate hot-dry.

(9) *Blowing Dust*. See category 5, intermediate hot-dry.

(10) *Atmospheric Pressure*.

(a) Sea Level Maximum: 1,040 millibars (30.7 inches of mercury).

(b) Sea Level Minimum: 985 millibars (29.1 inches of mercury).