APPENDIX K

WEATHER ELEMENTS AND SUPPORT

A working knowledge of weather elements is essential to provide your commander with a complete picture of potential adverse weather effects on the battlefield.

INTERACTION OF BATTLEFIELD ENVIRONMENT ELEMENTS

Weather conditions, terrain, BIC, illumination, and background signatures are some primary conditions found in a battlefield environment (Figure K-1).

A weather element is an atmospheric variable that is measured in a weather observation. A weather parameter is derived from one or more weather elements. Example: Density altitude is a weather parameter derived from the element's barometric pressure and temperature.

Weather conditions such as wind, precipitation, and clouds can impact or can be influenced by the other conditions of the battlefield. All of these conditions are interdependent, to a certain degree, and must be considered as a whole (Figure K-2).

WEATHER EFFECTS AND TERRAIN

Terrain features affect weather elements such as visibility, temperature, humidity, precipitation, winds, clouds. The most common example of terrain affecting weather is that on the windward side of high terrain, such as mountains, the rainfall rate will be greater than on the leeward (opposite) side.

Weather conditions have a definite effect on the terrain and can enhance or limit military operations such as trafficability, water crossing (fording), and the first-round accuracy of supporting FA fires. The responsibility for determining mobility and counter-mobility is given to the terrain team at division.

ATMOSPHERIC PRESSURE: Atmospheric pressure is the pressure exerted by the atmosphere at a given point and measured by a barometer in inches of mercury (Hg) or in millibars (Mb).

Pressure Altitude: This is indicated in an altimeter when 29.92 is set in the barometric scale window. High pressure altitude is critical to the lift capability of fixed wing aircraft.

Density Altitude: This is a place in the atmosphere corresponding to a particular value of air density. High pressure is critical to helicopter operations.

CLOUDS: The amount of sky covered by clouds is usually described in eighths: Overcast (8/8ths), broken (5 to 7/8ths), or scattered (1 to 4/8ths). Cloud conditions are described by the amount of cloud cover and the height of the base of the cloud AGL. A cloud ceiling is the height of the lowest broken or overcast layer, and is expressed in feet. A higher layer of several scattered layers of clouds is designated as a cloud ceiling when the sum of the coverage of the lower layers exceeds 4/8ths.

DEW POINT TEMPERATURE: Dew point is the temperature to which the air must be cooled for the air to become saturated and allow dew, and probably fog, to form.

HUMIDITY: This is the state of the atmosphere with respect to water vapor content. It is usually expressed as:

Relative Humidity: The ratio between the air's water content and the water content of saturated air.

Absolute Humidity: The measure of the total water content in the air. It is high in the tropical ocean areas and low in the arctic.

PRECIPITATION: Precipitation is any moisture falling from a cloud in frozen or liquid form. Rain, snow, hail, drizzle, sleet, and freezing rain are common types. The intensity of precipitation is described as light, moderate, and heavy.

Light Rain: Drops are easily seen, very little spray, and puddles form slowly, and accumulation is a trace to 0.10 in/h.

Figure K-1. Common weather elements.

Moderate Rain:	Drops are not easily seen, spray noticeable, puddles form rapidly, and accumulation rates are 0.11 to 0.30 in/h.
Heavy Rain:	Drops are not seen, rain comes in sheets with heavy spray, puddles form quickly, and the rate is more than 0.30 in/h.
Light Snow:	Visibility is equal to or greater than 5/8 miles, or 1,000 meters in falling snow; and a trace to 1 in/hr accumulates.
Moderate Snow:	Visibility is 5/16 to ½ statute miles, or 500 through 900 meters in falling snow with 1 to 3 in/hr accumulation.
Heavy Snow:	In heavy snow, visibility is cut to less than 1/4 statute miles, or 400 meters, with more than accumulation of 3 in/h.

TEMPERATURE: Temperature is the value of heat or cold recorded by a thermometer normally at 6 feet AGL at the observation site. Temperatures are normally given in both Fahrenheit and Celsius values. It is sometimes referred to as the ambient air temperature.

VISIBILITY: A measurement of the horizontal distance at the surface or aloft that the unaided human eye can discern a large object or terrain feature. Visibility is reported in meters or fractions of a mile, and is reported as a prevailing value of the visibility in all directions. Thus, a visibility report of 1,600 meters may not reveal that fog is diminishing visibility to 400 meters in the northwest if the observer has good visibility in other directions. However, such an event would typically be carried in the weather observation's remarks section.

WIND SPEED AND DIRECTION: These two measure the rate of movement of the air past a given point and the direction from which the wind is blowing. A gust is a rapid fluctuation in wind speed with a variation of 10 knots or more between peak and lull. Gust spread is the instantaneous difference between a peak and a lull and is important for helicopter operations.

Figure K-1. Common weather elements (continued).

WEATHER ELEMENTS	THRESHOLD VALUES	IMPACTED SYSTEMS
VISIBILITY	1.0 km 3.0 km	•DRAGON, Machine guns. •Main gun, TOW, CAS, thermal viewers.
CLOUDS	500 ft 1,000 ft 1,500 ft 5,000 ft	•NOE operations, airborne, helicopter TA. •CAS. •COPPERHEAD engagements. •Visual reconnaissance, ADA TA.
SURFACE WIND	6 kn 13 kn 18 kn 30 kn	•Chemical. •Airborne-round parachute. •Military free fall-ram air parachutes, artillery smoke loses its effectiveness, artillery fire accuracy. •Helicopter maneuver.
TEMPERATURE	>32^{C}C < 0^{C}C	•Helicopter lift capabilities. •NVG (PVS-5).
WINDCHILL	<10^{C}C	Personnel survival.
PRECIPITATION	Moderate Freezing	•Ground maneuver, chemical, laser systems, GSR. •Ground maneuver.

Figure K-2. IPB weather overlay criteria.

BATTLEFIELD-INDUCED CONTAMINANTS

During combat operations, visibility can become severely reduced by BIC. These contaminants are either induced directly by combatants or occur as by-products from battlefield operations.

Two significant sources of battlefield contaminants are dust produced by HE artillery or mortar rounds and deliberately employed smoke. HE rounds used in a pre-attack barrage not only may kill enemy forces but also may restrict the visibility of your own troops by dust caused by the HE if you do not consider the direction of the wind. Smoke produced by smoke generators, vehicle exhaust emission

systems, smoke pots, indirect fire, and smoke rounds also produce battlefield contaminants.

Wind speed and direction are critical to maintaining an effective smoke screen. Rain can remove BIC quickly. Weather inversions over valley areas can sustain airborne contaminants for long periods.

Other sources of BIC that will lower visibility in the AO are clouds of dust from vehicle traffic or smoke from fires. These types of contaminants not only blind you but also may help your adversary in detecting troop movements and pinpointing your location.

A unique BIC affecting visibility occurs in conditions when temperatures are in the range of -30EC or -22EF or colder. When a source of moisture or water vapor is released into the cold air by internal combustion engines, artillery fires, or launched self-propelled munitions, visibility can be reduced to zero when the moisture freezes instantly and changes into ice fog.

Ice fog may restrict visibility across a whole valley and can linger for hours. Ice fog crystals permit ground objects to be seen from above while severely restricting visibility on the ground—an advantage for aerial reconnaissance.

On airfields an ice fog created by fixed-wing aircraft may cover an entire runway. Visibility can be reduced so that other aircraft cannot take off or land if the wind is calm. The ice fog also draws attention to the airfield location.

Launching missiles such as the TOW in very cold air can create an ice fog. As the TOW moves to the target, the exhaust blast exits into the air where it condenses and creates the ice fog. If the wind is calm, this fog follows the trajectory of the missile and reduces launch point visibility to such an extent that the operator loses sight of the target. Also, the launch point can be identified by threat forces from the condensation trail of the missile.

ILLUMINATION

Natural light is critical in planning operations where NVD are used or in operations timed to use only available light. Natural light values vary as a function of the position of the sun, moon, stars, and clouds. Light data are available from your SWO for any time period and place. These data are particularly important for determining first and last light, moonrise, and moonset, and are most effective for planning use of NVD.

Variables such as altitude, cloud cover, terrain-produced shadows, visibility, and direction of vehicle or aircraft movement in relation to the sun or the moon can also affect light level availability.

Artificial light is intended to increase visibility but, under certain weather conditions, this does not always occur. Example: Low cloud ceilings will limit the area covered and effective time of flares. Rain, snow, or fog can reduce flare effectiveness. However, under the right conditions, cloud cover can enhance the effects of artificial light due to cloud base reflection. Snow- or sand-covered terrain also reflect both natural and artificial light.

BACKGROUND SIGNATURES

Temperature, wind, and precipitation have a major influence on your ability to pick out a target from the background in the infrared spectrum. They also affect seismic (sound and acoustic) signatures. Detection of objects in the infrared spectrum depends on a temperature contrast between the object and its surrounding environment. This difference is known as the background signature.

Snow, rain, and wind influence the background signature because they can change the surface temperature of objects. These elements lower object temperatures and thus reduce the differential between a target and its background.

A heavy layer of snow produces a washout during any part of the day since it causes both the object and the background to exhibit the same temperature.

Precipitation also degrades seismic sensors through the introduction of background noise (rain), while a snow-covered surface will dampen sound and the movement of troops.

SEVERE OR HAZARDOUS WEATHER

In addition to a continuous need for forecast updates, you need non-forecasted or unanticipated severe or hazardous weather warnings. WETMs normally issue severe weather warnings and advisories. Check for the values at which each weather element becomes known as severe. You will be concerned with conditions such as—

- Tornadoes.
- Thunderstorms producing winds in excess of 45 knots and hail greater than 3/4 of an inch.
- Hurricanes and typhoons.
- Precipitation (rain or snow) when X inches fall in Y hours.
- Surface winds in excess of X knots.
- Maximum and minimum temperatures; when a forecast value misses the actual temperature by X degrees.

You want to know that an earlier forecast for light snow was amended to a forecast of a 16-inch accumulation within the next 12 hours. We cannot over emphasize that you need to work with your next higher HQ S2/G2 and the SWO so that your needs are realistically stated and can be supported. All of your weather support needs should be reviewed every 6 months in garrison and as required in the field.

LIGHT DATA

Another weather-related element that your commander needs is light data. NVD and NVG have made many night operations feasible. Your SWO provides official times for sunrise and sunset, BMCT and EECT, BMNT and EENT, length of absolute darkness, moonrise, moonset, lunar phase in percent, and time periods for using NVD and NVG. Light data to support NVD is needed because there are times when there is not enough moon or starlight to use them.

Civil twilight is sufficient for conduct of combat operations while nautical twilight permits most ground movements without difficulty. Nautical twilight allows a general visibility of up to 400 meters (1,320 ft) and lets you distinguish silhouettes from the background.

The actual duration of light varies with latitude and time of year. For example, in the vicinity of 35 to 40 degrees north latitude, civil twilight generally occurs 30 to 45 minutes before sunrise and after sunset. In the tropics, twilight is shorter.

Once light requirements are determined, relay them to your next higher S2 and SWO. This information is important for your commander because he needs to know not only when he can begin friendly military operations (day or night) but also when threat operations could begin.

OTHER CONSIDERATIONS

Although HF radio wave propagation forecasts are not normally available to the SWO, he can make arrangements before he deploys to receive these forecasts. When available, they should be given to every signal and intelligence organization. The SIGO should know that when HF is not effective, it may be because of solar activity rather than enemy jamming.

The USAF Global Weather Central can routinely provide solar forecast products to the SWO even in the field. Other data, such as tidal information and sea state conditions, can be obtained from the SWO but are normally provided only to specific Army units upon request.

RECEIPT OF FORECASTS

Every tactical echelon should receive the weather forecast prepared and briefed to the commander at the next higher echelon. With no SWO at a maneuver brigade, you receive both the forecast briefed at division covering the division AO and the forecast made by the division SWO specifically for your brigade. Each forecast message received should be worked by you to discover the direct weather impacts on your unit.

A commander wants the weather forecast. He also needs the effects and impacts of the forecasted weather interpreted for his specific operations, systems, and personnel. Schedule your forecasts so they arrive in time for you to prepare your commander's briefing.

HOW G2 OR S2 RECEIVE WEATHER SUPPORT

It is your responsibility to provide weather and weather effects information to your commander and supported or subordinate units. Methods may vary among units and echelons. At higher echelons, the SWO has primary responsibility for providing weather support. There, the G2 simply contacts the SWO, states requirements, and receives the needed weather support.

If you have no SWO, you must pass the request up the chain of command to a level where one is assigned. Once your requirements have been validated, weather support products flow back over the same path. In addition to weather forecast products, the SWO can provide specialized weather effects products. You must provide the threshold values used in developing these products.

You alert your commander and staff about the adverse impact of the forecasted weather. You prepare two simple charts to use during your commander's stand-up briefing. You can post these charts in the CP for reference.

Update the charts when a new forecast is issued by the WETM. Methods used in briefing your commander during the morning and evening briefings may vary greatly among commands. The formats below are a guide and should be modified to suit your situation.

The first chart (Figure K-3) illustrates how the weather elements and parameters contained in the forecast might be displayed on the board. Blown up to poster size and covered with acetate, this chart can be updated easily.

WEATHER FORECAST
VALID FOR 121200Z to 131200Z

LOCATION: PUNGSAN

24-HOUR FORECAST:

SKIES:	CLEAR MORNING AND NIGHT, PARTLY CLOUDY IN THE AFTERNOON, BASES 3,000 FEET.
VISIBILITY:	UNLIMITED, OCCASIONALLY 1 TO 2 MILES IN BLOWING SNOW DURING AFTERNOON.
WINDS:	NORTH TO NORTHWEST, 10 TO 15 KNOTS, OCCASIONAL GUSTS TO 25 KNOTS IN AFTERNOON.
TEMPERATURES:	MAX: 10EF MIN: -20EF

72-HOUR OUTLOOK:

CLOUDY SKIES, SNOW FLURRIES DURING AFTERNOON HOURS LOWERING VISIBILITY TO 2 TO 4 MILES.

TEMPERATURES: MAX: 20EF MIN: -5EF

LIGHT DATA:

BMNT: 1247Z MOONRISE: 1924Z
BMCT: 2221Z MOONSET: 0819Z
SUNRISE: 2251Z
SUNSET: 0820Z NVG USE:
EECT: 0851Z

Figure K-3. Example of a weather forecast chart.

Figure K-4 shows color codes as one way to display potential weather impacts on operations, systems, and personnel in your unit. Another way would be to write the words "moderate" and "severe" in those blocks affected. Do not list all the equipment or systems, but have the list available to answer questions posed by the commander or staff. Stress those critical systems during the verbal portion of your briefing.

If the weather conditions change significantly during the period covered by the SWO's forecast, then an updated impact chart will have to be prepared. Because a brigade or battalion's AI is small, the SWO's forecast is likely to be uniform across the AI.

WEATHER IMPACT CHART
PERIOD 121200Z to 131200Z

IMPACTED ITEMS	CLOUDS	PRECIPI-TATION	WIND	VISIBILITY	TEMPER-ATURE
NBC DEFENSE	GREEN	GREEN	GREEN	GREEN	RED
NIGHT VISION DEVICES	GREEN	GREEN	GREEN	AMBER EXCEPT 07 /0 05Z	AMBER
CSS	GREEN	AMBER	AMBER	AMBER	AMBER
TOW/DRAGON	GREEN	GREEN	AMBER	GREEN	RED
M-1/M-2	GREEN	GREEN	GREEN	GREEN	AMBER
SMOKE/ CHEMICAL	GREEN	GREEN	AMBER	GREEN	GREEN
GROUND RADAR	GREEN	GREEN	AMBER	GREEN	GREEN
PERSONNEL	GREEN	GREEN	RED	GREEN	RED
THREAT	GREEN	GREEN	GREEN	AMBER	GREEN

GREEN No impact
AMBER Moderate impact (Normal effectiveness reduced 25 to 75%)
RED Severe impact (Normal effectiveness reduced to 0 to 25%)

Figure K-4. Example of a weather impacts display chart.

CRITICAL WEATHER FACTORS

Figure K-5 shows major critical weather factors that can enhance or degrade combat operations, systems, and personnel.

LOW VISIBILITY:	Low visibility (less than 3 km). • Can be beneficial to threat and friendly forces. • Conceals the center of gravity and maneuver of offensive forces. • Increases possibility of achieving surprise. • Disadvantages. –Hinders $C^{2.}$ –Reduces effectiveness of R&S and TA, especially during the defense.
SURFACE WINDS:	• Strong winds can reduce effectiveness of downwind forces by blowing dust, smoke, sand, rain, or snow on them. • Upwind force generally has better visibility and can advance faster and easier. • Strong winds limit airborne and aviation (primarily helicopters) operations. • Winds in excess of 35 knots can— –Cause personal injury. –Damage materiel and structures. –Create false radar returns. –Reduce visibility because of blowing sand, dust, and other battlefield debris.
PRECIPITATION:	• Affects trafficability, visibility, personnel effectiveness, and a wide variety of tracked and wheeled military equipment. • Heavy rains can make some unsurfaced, low-lying, and off-road areas impassable.

Figure K-5. Critical weather factors.

	• Both rain and snow can drastically reduce personnel effectiveness by limiting visibility, causing discomfort, increasing fatigue, and creating other physical and psychological problems.
CLOUD COVER:	• The type and amount of cloud cover and the altitude of cloud bases and tops influence aviation operations. • CAS employing fixed-wing aircraft would like a ceiling of at least 2,500 feet (762 m), but can be employed with ceilings as low as 500 feet. • Threat CAS rotary-wing aircraft and aerial resupply missions require a minimum ceiling of 300 feet (100 m). • Affects ground operations by reducing illumination and visibility or by enhancing effects of artificial light.
TEMPERATURE AND HUMIDITY:	• Have a direct impact on personnel and vehicle performance. • Excessively high temperatures cause heat-related injuries to personnel and vehicle engine wear that leads to equipment failure. • Very low temperatures increase cold weather injuries, cause damage to vehicle cooling systems and engines, decrease the effectiveness of vehicle lubrication, and create excessive logistics requirements.

Figure K-5. Critical weather factors (continued).

WEATHER EFFECTS ON THREAT SYSTEMS

MILITARY ASPECTS OF WEATHER:

US Forces must be prepared to fight in a variety of climatic conditions on short notice. Key to accomplishing our missions under any circumstances is

understanding how weather affects both friendly and threat forces and their operations, systems, and personnel.

Current weather conditions and weather forecasts for the AO and AI are analyzed to determine the effects on friendly and enemy operations. This is significant when threat forces have the capability to employ NBC weapon systems.

THREAT EQUIPMENT:

Some of the major arms merchants today are the former Soviet Union, Sweden, Brazil, Britain, Germany, France, Italy, and the United States. However, the major arms purchasers continue to be the underdeveloped or Third-World countries in the Middle East, Latin America, and Asia.

The types of threat equipment we may encounter on future battlefields will vary from artillery and mortars produced during World War II to the Austrian-produced GHN-45, a 155-mm towed gun with a range of 39,600 meters (using ERFB-BB technology). Almost all the Third-World countries have bought or made their own versions of Soviet-produced tanks, APCs, artillery, AAA, and assorted SAM and SSM systems. Tables K-1, K-2, and K-3 list the weather effects from cloud ceilings, reduced visibility, and precipitation, respectively.

Table K-1. Weather effects from cloud ceilings.

WEATHER VALUE (FEET)	SEVERE DEGRADATION		MODERATE DEGRADATION	
	SYSTEM/ EVENT	REMARKS	SYSTEM/ EVENT	REMARKS
LT 1,000			SA-9 SAM SA-14 SAM	
LT 2,500			ZU-23 ZSU-23-4 SA-13 (Contrast mode) SA-16 SA-19	

Table K-2. Weather effects from reduced visibility.

WEATHER VALUE (METERS)	SEVERE DEGRADATION		MODERATE DEGRADATION	
	SYSTEM/ EVENT	REMARKS	SYSTEM/ EVENT	REMARKS
LT 200			RPG-18 (RL) AKM/AKMS (7.62-mm) TKN-1T infrared periscope	ATW Rifle E-O device
LT 500	SA-14 GREMLIN SAM SA-13 SAM SA-16 SAM SA-19 (FSU) SAM		OU-3GK White infrared search light RPG-7 (GL) PT-76 (5.45-mm) AK-74	E-O device ATW AG/LT Rifle
LT 600			ERYX	
LT 750	SA-9 GASKIN SAM			
LT 800	AT-2 SWATTER AT-3 SAGGER AT-6 SPIRAL	ATGM ATGM ATGM	ASU-85 BMD (73-mm) BMP (73-mm) Sniper rifle, SVD RPK-74, squad AGS-17, GL RPG-16, GL	AG/LT LAV LAV Rifle MG

Table K-2. Weather effects from reduced visibility (continued).

WEATHER VALUE (FEET)	SEVERE DEGRADATION		MODERATE DEGRADATION	
	SYSTEM/ EVENT	REMARKS	SYSTEM/ EVENT	REMARKS
LT 1,000	All Types	ATGM	SPG-9 (73 mm recoilless rifle) SD-44 (85-mm) 14.5-mm KPU hvy MG 7.62-mm PKT MG DShK NSV/NSVT PK Series MT-LB 7.62-mm coaxial machine gun for all tanks	ATW ATW AA AA MG MG LAV MT
LT 1,500			7.62-mm 15.5-mm heavy BTR-50,-60,-70 (14.5-mm) KPVT ACRV M1974 DShK NSV/NSVT T-54, T-55, T-62 (main gun)	MG MG AA/LAV AA LAV MG MG MT
LT 2,000			T-12, MT-12 (100-mm) KPVT BRDM-2 (14.5-mm) T-80, T-72, T-64 (main gun) MATHOGO MILAN 2 RBS-56 SPIGOT	ATW MG LAV MT

Table K-2. Weather effects from reduced visibility (continued).

WEATHER VALUE (METERS)	SEVERE DEGRADATION		MODERATE DEGRADATION	
	SYSTEM/ EVENT	REMARKS	SYSTEM/ EVENT	REMARKS
LT 2,500			SA-7 GRAIL ZU-23 ZSU-23-4	FSU SAM AA AA
LT 3,000			RED ARROW 73 RED ARROW 8 SUSONGP'O AT-3 SAGGER	
LT 4,000			SA-9 GASKIN HOT 2 SWINGFIRE AT-2 SWATTER AT-5 SPANDREL AT-8 SONGSTER AT-10 STABBER SA-13 (contrast mode)	 FSU SAM FSU SAM
LT 4,500			MAPATS	
LT 5,000			NIMROD AT-6 SPIRAL AT-11 SNIPER SWIFT (SF)	ATGM
LT 6,000			120-mm, M-1943 S-60 (57-mm)	MO AA
LT 8,000			160-mm, M-160	MO

Table K-3. Weather effects from precipitation.

WEATHER CONDITION	SEVERE DEGRADATION		MODERATE DEGRADATION	
	SYSTEM/EVENT	REMARKS	SYSTEM/ EVENT	REMARKS
Light rain			LOW BLOW (fire control) STRAIGHT FLUSH (12gHz) (tracking) THIN SKIN (height finder)	SAM radar SAM radar SAM radar
Moderate rain			STRAIGHT FLUSH (acquisition)	SAM radar
Heavy rain			LOW BLOW (fire control) THIN SKIN (height finder)	SAM radar SAM radar
	NOTE: The list of AD radars on this page should be considered as a sample of the various other types of threat radars associated with EW operations and tactical and strategic SAM systems. Not listed are a large variety of threat combat equipment (wheeled and tracked) affected by moderate or heavy rain and snow.			

WEATHER AND ENVIRONMENTAL ELEMENTS AND PARAMETERS IMPACTING ARMY SYSTEMS AND OPERATIONS:

Table K-4 is compiled from a study conducted by the US Army Intelligence School as part of the IEWMAA. Each TRADOC branch was asked to survey the impact of weather and environmental elements on their operations, systems, and personnel and rate them as either **essential (E)** or **desired (D)**. Also included are other Army agencies' requirements.

- **E**—Some positive action had to be taken by the user based on severe current or forecasted weather conditions.

- **D**—Some impact, but the degree of impact is uncertain or not mission-threatening.

For each element or parameter listed, at least one responder identified it as essential for one or more of their operations, systems, or personnel.

Some data elements and parameters are known to have an impact, but exact critical thresholds have not been determined. Others cannot be measured or sensed with present technology. But identifying these data elements or parameters now allows for further research in how to collect the raw data (where applicable), determine the frequency of collection, establish data accuracy, and learn other supporting information.

As users and planners continue to learn more about weather and environmental impacts, the misconception that there is a hypothetical Army "all-weather" system or operation fades.

Table K-5 shows windchill factors.

Table K-4. Weather and environmental data elements impacting Army systems and operations.

WEATHER AND ENVIRONMENTAL DATA ELEMENTS IMPACTING ARMY SYSTEMS/OPERATIONS

A = AIR DEFENSE
B = ADJUTANT GENERAL
C = ARMOR
D = AVIATION
E = CHAPLAIN
F = DEFENSE AMMUNITION CENTER
G = ENGINEER
H = FIELD ARTILLERY
I = FINANCE
J = HEALTH SERVICES
K = INTELLIGENCE
L = INFANTRY
M = JUDGE ADVOCATE
N = MILITARY POLICE
O = CHEMICAL
P = ORDNANCE
Q = ORDNANCE M&M
R = PUBLIC AFFAIRS
S = QUARTERMASTER
T = SIGNAL
U = SPECIAL FORCES
V = SOLDIER SUPPORT
W = TRANSPORTATION
X = JOINT READINESS TRNG CENTER

REQUIREMENT DESIGNATORS: E = ESSENTIAL SUPPORT NEEDS D = DESIRABLE SUPPORT NEEDS

SPECIAL GROUP CATEGORIES: (GS) = GROUND STATE (SS) = SEA STATE (SW) = SEVERE WEATHER CRITERIA

DATA ELEMENT	CATEGORY	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1. ALTIMETER SETTING					E						E	E										E			
2. ATMOSPHERIC CONTAMINANTS				E	D	D	E	D			E	E							D			D			
3. ATMOSPHERIC DENSITY								E				E										E			
4. ATMOS. TRANSMISSION COEFFICIENT								E																	
5. BAROMETRIC PRESSURE		D		E	E			E			E	E										E			E
6. CLOUD COVER AMOUNT		D		E	E		E	E	E		E	E	E		D	E			D			D	E	E	E
7. CLOUD BASE HEIGHT		E			E		E	E	E		E	E	E	D		E						E		E	E
8. CLOUD TOP HEIGHT					E						E	E										D			
9. DAMAGING WINDS	[SW]	E	E	E	E	E	D	E	E	E	E	E	E	E	E	E	E	D	E	E	E	E	E	E	E
10. DENSITY ALTITUDE					E						E	E										E			E
11. EXTINCTION COEFFICIENT									E			E										D			
12. EXTREME HEAT/COLD	[SW]	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
13. FLOODING, RIVER STAGE	[GS]	E	E	E	E	E		E	D	E	E	E	E	E	E	E	D	E	E	E	E	E	E	E	E
14. FREEZE/THAW DEPTH	[GS]	D		E	E			E	D		E	E	E		E	D	E	E		E	E	D			E
15. FREEZING PRECIPITATION	[SW]	E	E	E	E	E		E	E	E	E	E	E	E	E	E	D	E	E	E	E	E	E	E	E
16. HEAVY RAIN/SNOW	[SW]	E	E	E	E	E	D	E	E	E	E	E	E	E	E	E	E	D	E	E	E	E	E	E	E
17. HUMIDITY, ABSOLUTE		D			E			E			E	E				E						E			E
18. HUMIDITY, ABSOLUTE, PROFILE		D			E			E			E	E				E						E			E
19. HUMIDITY, RELATIVE							E	E	D		E	E				E				E		D	E	E	E
20. HUMIDITY, RELATIVE, PROFILE									E													D			
21. HURRICANES/TYPHOONS	[SW]	E	E	E	E	E		E	E	E	E	E	E	E	E	E	D	E	E	E	E	E	E	E	E
22. ICE/SNOW DEPTH/COVER	[GS]	D		E	E			E	D		E	E	E		E	D	D	E		E	E	D			E
23. ICING, FLIGHT	[SW]				E						E	E	E									E			E
24. ILLUMINATION		E		E	E			E	E		E	E	E		E		D			D		E	E	E	E
25. IR TARGET/BACKGROUND CONTRAST				E	E				D		E	D										E			E
26. IR THERMAL CONTRAST X-OVER TIME				E	E				D		E	E										E			E
27. IONOSPHERIC DISTURBANCES					D						D	E									E	E			
28. LIGHT DATA		E		E	E		D	E	D		E	E	E		D	D				D	D	E		D	D
29. LIGHTNING/THUNDERSTORMS	[SW]				D		E	E	E		D	E								E		E			E
30. LITTORAL CURRENT	[SS]				D		D	E			D	D	E									E			
31. PRECIPITATION, ACCUMULATION			D	E	E	D	D	E	D	D	E	E	E		E	D	E		D	E	E	E	E	E	D

Table K-4. Weather and environmental data elements impacting Army systems and operations (continued).

DATA ELEMENT	CATEGORY	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
32. PRECIPITATION, RATE		E	D		E	D		E	E	D	E	E	E	D	E	E	D		D	E	E	E	E	E	E
33. PRECIPITATION, HAIL SIZE		E			E			E	D		E	E			E		E			E		D			
34. PRECIPITATION, TYPE		E	D	E	E	D		E	E	D	E	E	E	D	E	E	D		D	E	E	E	E	E	E
35. PRESSURE ALTITUDE					E						E	E	E									E			E
36. REFRACTIVE INDEX		E		E	E				D		E	E			D										
37. RESTRICTION TO VISIBILITY					E			E	D		D	E			E	E				E	E	E			E
38. SEEABILITY (MILLIMETER WAVE, INFRARED, ULTRAVIOLET)		E		E	E			E	E		E	E	E		E	D						E		E	D
39. SEVERE WEATHER CONDITIONS	[SW]	E	E	E	E	E		E	E	E	E	E	E	E	E	E	D	E	E	E	E	E	E	E	E
40. SNOW STATE CONDITION	[GS]	D		E	E			E	E		E	E	E		E	D	D	E		E	E	D			E
41. SNOW DRIFT DEPTH	[GS]	D			D			E	D		D	E	E		E		E			D	E	E			E
42. SOIL/GROUND MOISTURE	[GS]	D		E	E		D	E	D		E	E	E		E	D	D	E		D	E	D			E
43. SOIL/GROUND TEMPERATURE	[GS]	D		E	E		D	E	D		E	E	E		E		E		D	D		E	E	E	E
44. SOLAR RADIATION							E				D	D										E			
45. STABILITY INDEX							E					E				E									E
46. STANDING WATER/POOLING	[GS]	D		E	E	D		E	D		E	E	E		E	D	D	E	D	E	E	D			E
47. STATIC ELECTRICITY POTENTIAL					E						E	E													
48. SURF HEIGHT	[SS]				D			E			D	D	E									E		E	
49. SWELL DIRECTION/HEIGHT	[SS]				D						D	D	E									E		E	
50. TEMPERATURE, AIR, SURFACE		E	E	E	E	E	E	E	E	E	E	E	E		E	E	D	E		D	E	E	E	E	E
51. TEMPERATURE, AIR, PROFILE					E		E		E		E	E										D			
52. TEMPERATURE, AIR, UPPER AIR					E				E		E	E										D			E
53. TEMPERATURE, DEWPOINT				E	E				D		E	E										E			E
54. TEMPERATURE, DEWPOINT, PROFILE					E				E		E	E										D			
55. TEMPERATURE, WINDCHILL FACTOR			D		D	D		E	D	D	E	E	E	D	E		E		D	E		E	E	E	
56. TEMPERATURE, INVERSION LEVEL(S)					E		E		E		E	E				E						D			E
57. TEMPERATURE, SEA SURFACE	[SS]				D			E			D	D	E									E		E	
58. TEMPERATURE, WATER, INLAND	[GS]				D			E			D	E	E									E		E	
59. TEMPERATURE, WBGT					D			E	D		E	E			E	E	E			E		E			E
60. TORNADO	[SW]	E	E	E	E	E		E	E	E	E	E		E	E	E	D	E	E	E	E	E	E	E	E
61. TURBULENCE, FLIGHT					E						E	E										E			
62. TURBULENCE, OPTICAL				E	E			E	E		E	D										E			
63. VISIBILITY, VISIBLE SPECTRUM, ALOFT					E				E														E		E
64. VISIBILITY, VISIBLE SPECTRUM, SFC		E			E			E	E		E	E	E		E	E	D			E		E	E		E
65. WAVE PERIODICITY	[SS]				D						D	D	E									E		E	
66. WAVE DIRECTION/HEIGHT	[SS]				D						D	D	E									E		E	
67. WIND, PROFILE					E				E		E	E										E			
68. WIND, PROFILE, TARGET, AGL - 3KM					E				E							E						E			
69. WIND, SHEAR					E						E	E										E			E
70. WIND, SURFACE, SPEED/DIRECTION		E		E	E		E	E	E		E	E	E		E	E	D	E	D	D	E	E	E	D	E
71. WIND, SURFACE, GUST SPEED				E			D	E	E		E	E	E		D						E	E			E
72. WIND, SURFACE, GUST SPREAD					E				E		E	E										E			E
73. WIND, UPPER AIR, SPEED/DIRECTION		E			E				E		E	E				E						E			E

Table K-5. Windchill chart.

WIND SPEED (KNOTS)	WIND SPEED (MPH)	LOCAL TEMPERATURE (EF)										
		32	23	14	5	-4	-13	-22	-31	-40	-49	-58
		EQUIVALENT TEMPERATURE (EF)										
	CALM	32	23	14	5	-4	-13	-22	-31	-40	-49	-58
4	5	29	20	10	1	-9	-18	-28	-37	-47	-56	-65
9	10	18	7	-4	-15	-26	-37	-48	-59	-70	-81	-91
13	15	13	-1	-13	-25	-37	-49	-61	-73	-85	-97	-109
17	20	7	-6	-19	-32	-44	-57	-70	-83	-96	-109	-121
21	25	3	-10	-24	-37	-50	-64	-77	-90	-104	-117	-127
26	30	1	-13	-27	-41	-54	-68	-82	-97	-109	-123	-137
30	35	-1	-15	-29	-43	-57	-71	-85	-99	-113	-127	-142
35	40	-3	-17	-31	-45	-59	-74	-87	-102	-116	-131	-145
39	45	-3	-17	-31	-45	-59	-74	-87	-102	-116	-131	-145
43	50	-4	-18	-33	-47	-62	-76	-91	-105	-120	-134	-148
		LITTLE DANGER FOR PROPERLY CLOTHED PERSONS		**CONSIDERABLE DANGER**			**VERY GREAT DANGER**					
DANGER FROM FREEZING OF EXPOSED FLESH												

HOT WEATHER ENVIRONMENT:

In hot weather, important factors are temperature and relative humidity. Primary concerns are physical exhaustion and dehydration. You must consider both because a common work task will take longer and additional water may have to be transported during hot weather. The following are specific concerns:

Water Adequacy. Water supplies and the enforcement of its intake before, during, and after physical activity is critical for survival.

Workload Correlation. Adapt workload or training activities to environmental heat stress conditions.

Rest Periods. Provide adequate break time for physically active personnel in a hot environment.

Chilled Drinking Water. Soldiers will often reject warm drinking water even when they are significantly dehydrated.

Physical Activity. Soldiers' introduction to physical exertion in a hot climate upon arriving from a temperate climate should be as gradual as circumstances allow. They will need 1 to 2 weeks' time to physiologically adjust to the new climate. Lighten physical activity during this period to ensure optimum performance.

Salt. Sodium intake must be maintained in hot weather. Two good meals a day normally provide enough salt for most soldiers.

Humidity. A low WBGT index (e.g., in the morning) may not be a totally safe indicator if the humidity is high. High humidity retards cooling by evaporation of sweat and decreases the urge to drink sufficient water.

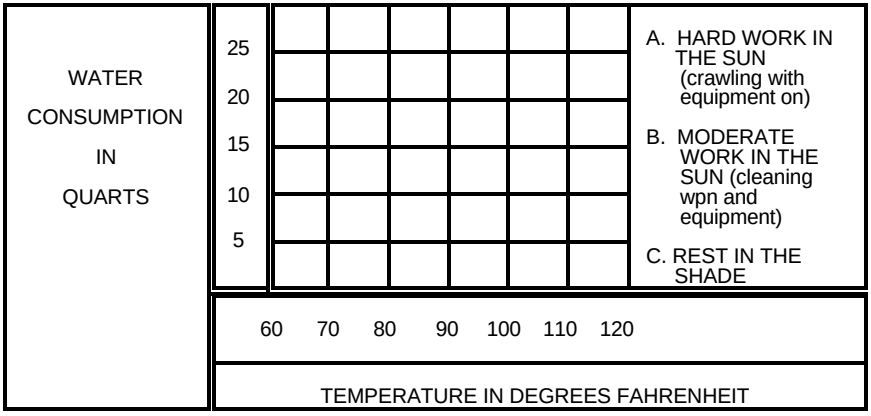
Water Spray. A water mist will cool a person. But it should never be substituted for adequate consumption of water before, during, and after strenuous activities in the heat.

The SWO can provide temperature measurement, forecast, and relative humidity forecasts from the following tables. If you need air temperature values measured at your particular location, use the thermometer included in the FALOP BWK.

HOT WEATHER WATER REQUIREMENTS:

Table K-6 shows the water needs for soldiers at 3 activity levels over an 8-hour work period. To determine soldiers' average water needs, you have to know the air temperature and decide the level of activity the troops will be doing. Example: If a soldier is doing 8 hours of hard work in the sun (curve C) when the average temperature for the day is 100EF, his water requirements for the day will be around 15 quarts. This amount of water can be converted into extra weight the soldier must carry. One quart is equal to 2 pounds, so the 15 quarts of water would weigh 30 pounds.

Table K-6. Daily water consumption requirement s **for three levels of activity.**



HOT WEATHER WORK TIME LIMITS:

Table K-7 shows the time limits during which work can be performed safely in hot weather. In computing the time limits, consider both air temperature and relative humidity. The values are based on a sitting soldier in BDUs doing light work. Do not consider these tables as absolute limits—especially since light, moderate, or heavy work are difficult to quantify. Table K-8 indicates work time in hot weather based on the WBGT index. Table K-9 shows conversion factors.

Table K-7. Work time in hot weather operations.

TEMPERATURE		RELATIVE HUMIDITY (%)					
(EC)	(EF)	10	30	50	70	90	100
60	140	1 HR	.25 HR				
54	130	2 HR	.5 HR	.25 HR	NO WORK RECOMMENDED		
49	120	4 HR	2 HR	.5 HR	.25 HR		
43	110	12 HR	4 HR	2 HR	.5 HR	.25 HR	
38	100	NO LIMIT	12 HR	4 HR	2 HR	1 HR	.5 HR
32	90	WITH PRECAUTIONS			12 HR	6 HR	4 HR

Table K-8. WBGT index (light work).

HEAT CONDITION/ CATEGORY *	WBGT(^{o}F)	WATER INTAKE QUARTS/HOUR	WORK/REST CYCLE (MINUTES)
1	78.0 to 81.9	AT LEAST ½	CONTINUOUS
2	82.0 to 84.9	AT LEAST 1.2	50/10
3	85.0 to 87.9	AT LEAST 1	45/15
4	88.0 to 89.9	AT LEAST 1-½	30/30
5 **	90.0 and ABOVE	MORE THAN 2	20/40

* MOPP gear or body armor adds at least 10 ^{o}F to the WBGT index.
** Suspend PT and strenuous activity. If operational (non-training) mission requires strenuous activity, enforce water intake to minimize expected heat injuries.

Table K-9. Conversion factors.

TO CONVERT:	TO:	USE:
	TEMPERATURE	
Degrees F	Degrees C	$^0C = 5/9\ ^0F - 32)$
Degrees C	Degrees F	$^0F = (9/5\ ^0C) + 32$
	DISTANCE	
Kilometers	Miles	0.62
Kilometers	Nautical Miles	0.54
Kilometers	Feet	3,280.80
Miles	Kilometers	1.61
Miles	Nautical Miles	0.87
Miles	Yards	1,760.00
Miles	Feet	5,280.00
Nautical Miles	Kilometers	1.85
Nautical Miles	Miles	1.15
Meters	Feet	3.28
Yards	Feet	3.00
	SPEED	
Kilometers/Hour	Miles/Hour	0.62
Kilometers/Hour	Knots (Nautical Miles/Hour)	0.54
Miles/Hour	Kilometers/Hour	1.61
Miles/Hour	Knots	0.87
Miles/Hour	Feet/Second	1.467
Knots	Kilometers/Hour	1.85
Knots	Miles/Hour	1.15
Meters/Second	Feet/Second	3.281
Meters/Second	Miles/Hour	2.237
	PRESSURE	
Inches of Mercury (Hg)	Millibar	33.86395
Millibar (Mb)	Inches of Mercury	0.295299
	LENGTH	
Feet Meters	0.3048	
Feet Centimeters	30.48	
Inches	Meters	0.0254
Inches	Centimeters	2.54
Meters	Yards	1.094
Yards	Meters	0.9144