

**BY ORDER OF THE COMMANDER
EDWARDS AIR FORCE BASE**

**EDWARDS AIR FORCE BASE
INSTRUCTION 48-107**



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Aerospace Medicine

**PREVENTION OF
HEAT STRESS ILLNESS**

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This instruction implements Air Force Policy Directive (AFPD) 48-1, Aerospace Medicine Enterprise, and Department of the Air Force Instruction (DAFI) 48-151, Thermal Stress Program. It establishes Edwards Air Force Base (EAFB) responsibilities and procedures to prevent the adverse health effects of heat stress. This instruction applies to all personnel who are assigned to EAFB with the exception of contractor personnel. The provisions of this instruction (i.e., work/rest cycles) apply to workers exposed to hot environments. This publication may be supplemented at any level, but all direct supplements must be routed to the Office of Primary Responsibility (OPR) of this publication for coordination prior to certification and approval. During mission essential, contingency, or emergency operations, commanders may waive the provisions of this instruction; however, in that event, they must ensure all supervisors exercise caution, make certain all subordinate personnel are aware of heat injury symptoms and take the necessary actions to protect the health of their personnel. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with (IAW) Air Force Instruction (AFI) 33-322, Records Management and Information Governance Program, and disposed of IAW Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS). Refer recommended changes and questions about this publication to the OPR using the AF Form 847, Recommendation for Change of Publication; route AF Form 847s from the field through the appropriate functional' s chain of command. This instruction requires the collection and/or maintenance of information protected by the Privacy Act of 1974 authorized by 10 United States Code (USC) § 9013, Secretary of the Air Force, and Department of Defense Instruction (DoDI) 5400.11, DoD Privacy and Civil Liberties Program. The applicable System of Record Notice (SORN), OPM/GOVT-1 (77 FR 79694), General Personnel Records, is available at <https://dpcl.d.defense.gov/Privacy/SORNs/>.

SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. Major changes include. Updates to 412 OMRS/SGXB Bioenvironmental Engineering Flight responsibilities, Unit Commander, and Supervisor responsibilities, Unit Fitness Program Manager responsibilities, Fighter Index of Thermal Stress (FITS) Table, EAFB Automated Forecasted Wet Bulb Globe Temperature (WBGT) and FITS values, symptoms and first-aid treatments for heat illness, references, and attachments. Inclusion of acclimatization guideline, WBGT modification guideline for Personal Protective Equipment (PPE), heat stress workload task multiplier for Mission Oriented Protective Posture (MOPP) 3 and 4 conditions. Additionally, the term thermal injury and disorder was replaced with thermal illness to align with Title 29, Code of Federal Regulations (CFR) 1904.46 and Department of the Air Force Manual (DAFMAN) 91-224, Ground Safety Investigation and Hazard Reporting definitions. Lastly, the title changed from the Prevention of Heat Stress Disorder to Prevention of Heat Stress Illness.

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1. Roles and Responsibilities.

1.1. 412 OMRS/SGXB Bioenvironmental Engineer Flight will:

- 1.1.1. Be the OPR concerning the thermal stress program for the installation.
- 1.1.2. During duty hours, use the Wet Bulb Globe Temperature (WBGT) to determine thermal stress potential and flag conditions throughout the summer months. Issue Heat Stress Advisory when applicable.
- 1.1.3. Upon request, during non-routine activities (i.e., change of command ceremonies, parades, and readiness exercises) monitor localized WBGT at site of non-routine activities and determine the heat stress condition/ flag condition.
- 1.1.4. Ensure current heat stress readings, guidance, and the most current WBGT index are published on Defense Occupational and Environmental Health Readiness System (DOEHRS).
- 1.1.5. During duty hours, call the 412 TW/CP (Command Post) at 7-3040 with the current WBGT reading and heat stress condition so they can prepare and forward advisory messages to the entire base.
- 1.1.6. Ensure all work centers that are exposed to heat stress include training in their job safety training outline.
- 1.1.7. Investigate and document all heat stress illnesses via Occupational Illness/Injury Report (AF IMT 190).
- 1.1.8. Develop an office operating instruction detailing procedures for determining WBGT measurements and stress conditions.
- 1.1.9. During normal duty hours, all related questions/concerns will be directed to 412 OMRS/SGXB. After duty hours, emergency heat stress items will be directed to the 412 OMRS/SGXB technician on-call at 661-810-6928.

1.2. 412 OMRS/SGXM Public Health Flight will:

- 1.2.1. Assist in investigating and reporting heat illness accidents.
- 1.2.2. Coordinate with Edwards AFB staff personnel on discrepancies disclosed during an investigation of heat stress illness incidents or other pertinent findings.

1.3. 412 TW/CP Test Wing Command Post will:

- 1.3.1. Disseminate Flag Color condition to the base.
- 1.3.2. Disseminate Heat Stress Advisories to 412th Maintenance Operations Squadron Maintenance Operations Center (412 MOS/MXOO) and 412th Test Wing Civil Engineering (412 TW/CE).

1.4. 412 OSS/OSW Weather Flight will:

- 1.4.1. Assesses and informs flight test squadrons of the FITS condition IAW Section 5.1 of this instruction.

1.5. Organizational and Unit Commanders will:

- 1.5.1. Enforce activity levels for personnel in day-to-day operations and training status.

1.5.2. Ensure workers and trainees are properly acclimatized to heat exposures.

1.5.3. Brief supervisors and workers annually on the health hazards of heat stress, the WBGT index, notification procedures, flag colors, and appropriate preventive measures. This training will be documented on AF Form 55 or equivalent, Employee Safety and Health Record. Ensure training is documented in an appropriate manner for individual organizations (i.e., CAMS for maintenance personnel). Supervisors must ensure the AF 55 is marked FOUO IAW DoD 5200.1-R if it has a SSN on it. Further, if the forms with a SSN are maintained in a binder, they need to be properly safeguarded IAW DoD 5200.1-R.

1.5.4. Where applicable, ensure flying personnel are annually informed on how heat stress affects aircrew performance, FITS temperature and zones, and appropriate preventive measures.

1.5.5. During training exercises when personnel wear the ground crew chemical defense ensemble, ensure supervisors and workers are counseled concerning the early signs of heat stress and methods to be used to minimize the effects of heat stress.

1.5.6. Plan and implement work/rest cycles for personnel exposed to hot environments.

1.5.7. Disseminate the WBGT index to workers and trainees. Ensure exposed workers and trainees increase their fluid intake as stated in [Table 5](#). Be aware that feelings of weakness and/or fatigue may be symptoms of hyponatremia (low blood sodium level, which may be caused by overconsumption of water).

1.6. Unit Fitness Program Manager will:

1.6.1. Ensure Physical Training Leaders are aware of Air Quality Index (AQI) level, WBGT level, and flag condition during Physical Fitness Assessment (PFA).

1.6.2. Ensure PFAs are postpone when Edwards AFB is notified of Green Flag heat stress condition or higher.

1.6.3. See [Attachment 4](#) for more information.

2. Heat Stress Monitor.

2.1. 412 OMRS/SGXB.

2.1.1. Monitor the WBGT Index and heat stress advisory (flag condition) daily during the summer months. Depending on seasonal variation, monitoring will begin after Memorial Day or when the peak ambient temperature reaches 95°F for three consecutive days. Monitoring will end after Labor Day or when the peak ambient temperature falls below 95°F for three consecutive days.

2.1.1.1. 412 OMRS/SGXB will perform WBGT index monitoring every two hours during normal duty hours from 0800 until 1600L.

2.1.1.2. When the WBGT index reaches 82°F (Green Flag), 412 OMRS/SGXB will initiate monitoring hourly during normal duty hours.

2.1.1.3. If WBGT index reached 90°F at any time, Stage 5 (Black Flag) heat stress advisory level will be sustained until the ambient temperature drops below 95°F.

- 2.1.1.4. If WBGT index is above 82°F at the end of the duty day, Stage 3 (Yellow Flag) heat stress advisory conditions will be sustained until the ambient temperature drops below 95°F.
- 2.1.2. Issues Heat Stress Advisories to 412 TW/CP at 7-3040 as soon as the WBGT Index reaches the first flag condition (Green Flag) IAW **Table 1**, when a flag condition is upgraded, downgraded, or if heat stress advisory need to be sustained.
- 2.1.3. Publish the most current WBGT Index and heat stress condition on DOEHRS.

Table 1. WBGT Temperature Ranges and Flag Colors¹.

Stage	WBGT Temperature Range (°F) ²	Flag Color
1	78.0 – 81.9	(No Flag)
2	82.0 – 84.9	Green
3	85.0 – 87.9	Yellow
4	88.0 – 89.9	Red
5	90 and above	Black

Note:

1.Values referenced from DAFI 48-151.

2.WBGT (Wet Bulb Globe Temperature) combines 4 thermal components: ambient air temperatures, relative humidity, air velocity, and radiant heat.

2.2. 412 TW/CP:

- 2.2.1. Within 30 minutes of notification from 412 OMRS/SGXB, contact 412 MOS/MXOO and 412 TW/CE to inform them of Heat Stress Advisory and Heat Stress Condition Stage changes.
- 2.2.2. Within 30 minutes of notification from 412 OMRS/SGXB of heat stress condition changes, send pop-up alert notifications to the entire base of the equivalent Flag Color condition IAW **Table 1**.

2.3. Unit Commanders and Supervisor:

- 2.3.1. Work center upon receiving notification from Flag Color condition will implement work/rest cycle IAW Tables **3 and 7**.
- 2.3.2. During weekends, holidays and after duty hours, shop supervisors will use heat stress condition posted on Edwards Automated Heat Stress Forecast to implement work/rest cycle. Forecasted WBGT values can be found on the NASA AFRC weather homepage (<https://weather.dfrc.nasa.gov>), under Edwards Automated Heat Stress Forecast link.

3. Heat Acclimatization. Heat Acclimatization is a series of physiological adjustments that occur when an individual is exposed to a hot climate. A period of acclimatization is required for all personnel regardless of physical condition. Acclimatization is achieved by progressively exposing individuals to increasing levels of heat and physical exertion over 1-2 weeks. Generally, fitter individuals may acclimatize quicker.

- 3.1. The following personnel requires acclimatization:

3.1.1. Individuals who are routinely and occupationally exposed to strenuous work in hot environments. This may occur as outside temperatures increase during the spring and summer.

3.1.2. Newly assigned personnel arriving from a cooler climate or have not been previously exposed to extreme heat.

3.1.3. Personnel returning to work after four or more days of illness or was absent for more than one week.

3.2. Acclimatization guideline

3.2.1. Ensure that workers are aware of the signs and symptoms of thermal illness layout in **Table 9**. Encourage workers to stay hydrated, see **Table 5** for minimum water intake, depending on the heat stress advisory condition.

3.2.2. A sample schedule for acclimatization is provided in **Table 2**. Note that most workers should be able to handle a full workload by day five of exposure, but acclimatization may take up to two weeks. Exercise caution within this period. When discomfort and heat stress symptoms occur, workers should self-pace their activities to perform below their maximum physical capacity by adjusting their work speed and taking brief, unscheduled, in-place breaks.

3.2.3. Previously acclimated personnel returning to work after 4 or more days should undergo an abbreviated acclimatization schedule in **Table 2**.

3.2.4. Eating regular and healthy meals to help replace lost electrolytes when sweating.

3.2.5. Acclimatization requires at least two hours per day of exposure to heat and physical exertion. Perform the most strenuous tasks early in the morning or late in the evening to conform to ambient temperature. As workers become acclimatized, work schedules can be shifted back to normal routines.

3.2.6. When non-acclimatized workers are exposed to heat, they may experience some discomfort and signs of heat strain, such as high body temperatures, increased heart rates, and fatigue. As acclimatization progresses, the ability to perform at the same level of heat stress improves and symptoms of discomfort and strain diminish.

Table 2. Heat Acclimatization Sample Schedule.

	Full Schedule	Abbreviated Schedule
Day 1	20% usual workload	40% usual workload
Day 2	40% usual workload	60% usual workload
Day 3	60% usual workload	80% usual workload
Day 4	80% usual workload	100% usual workload
Day 5	100% usual workload	100% usual workload
Note: Referenced from NIOSH Occupational Exposure to Heat and Hot Environments, CDC 2016.		

4. Guidelines For Occupational Heat Exposure.

4.1. General.

4.1.1. Personnel who routinely perform their jobs in hot environments (such as aircraft maintenance, grounds maintenance, and repair work in steam pits and tunnels) are considered occupationally exposed.

4.1.2. Supervisors of occupationally exposed personnel should use Tables **3, 4, and 5** to plan work/rest cycles for individuals under their control. When the WBGT index reaches the temperatures shown in the table, supervisors will initiate the appropriate work/rest cycle.

4.1.3. Exposures above 90°F (Black Flag) WBGT should be allowed only when performing mission essential duties, and then only with caution.

4.1.4. When necessary to accomplish the task, two or more details should be arranged to work in sequence to ensure each crew adheres to the proper work/rest cycle.

4.1.5. Heat Stress Conditions provide guide to workplace supervisors to reduce thermal illness.

4.1.6. The WBGT Index should not be used directly for operations requiring heavy PPE or hot indoor operations. Use correction factors for PPE and Mission Oriented Protective Posture (MOPP) Great from Tables **6 and 7**.

4.2. Personnel Wearing the Ground Crew Chemical Defense Ensemble:

4.2.1. Personnel performing ground crew operations and training while wearing the charcoal-impregnated over-garment and associated protective equipment of the chemical defense ensemble are at increased risk of injury from heat stress. Maximum work times tolerated by personnel while they are wearing the protective ensemble are affected by multiple individual factors, such as an individual's physical condition, state of thermal acclimatization, degree of hydration, the workload associated with a given task, and environmental factors, including air velocity, radiant heat (sunlight), air temperature, and humidity. WBGT criteria include many of these variables.

4.2.2. During exercises where MOPP gear is utilized, 412 OMRS/SGXB will notify the Deployment Control Center and Command Post (CP) of the current work/rest ratios and the CP will then relay that information to the Installation Control Center. 412 OMRS/SGXB personnel will monitor the heat stress until two consecutive WBGT Index readings fall below 74.9 °F.

4.2.3. Guidelines for increases in task performance times and maximum and safe work times while personnel are wearing MOPP 3 and 4 equipment are detailed in **Table 6** below. Commanders and supervisors should use this information when planning and conducting exercises to avoid thermal illness in their personnel.

4.3. Personnel Working Under Aircraft Shelters:

4.3.1. When working under aircraft shelter, follow the WBGT work-rest cycle one level lower than posted, unless during Black Flag.

4.3.2. See **Attachment 3** for more information.

Table 3. Work/Rest Times & Fluid Replacement Guidelines for Acclimatized Individuals.

WBGT ¹ Index (°F)	Light (Easy) Work		Moderate Work		Hard (Heavy) Work	
	Work/ Rest ²	Water Intake ³ (Qt/Hour)	Work/ Rest ²	Water Intake ³ (Qt/Hour)	Work/ Rest ²	Water Intake ³ (Qt/Hour)
78 - 81.9	NL ⁴	1/2	NL	3/4	40/20 min	3/4
82 - 84.9	NL	1/2	50/10 min	3/4	30/30 min	1
85 - 87.9	NL	3/4	40/20 min	3/4	30/30 min	1
88 - 89.9	NL	3/4	30/30 min	3/4	20/40 min	1
>90	50/10 min	1	20/40 min	1	10/50 min	1

Notes:

1. If wearing any MOPP gear or PPE, adjust the WBGT IAW Table 7
 2. Rest means minimal physical activity (sitting or standing), accomplished in shade, if possible.
 3. Fluid needs can vary based on individual differences and sun exposure conditions (+/- 0.25 qt/hr).
- Caution:* Daily fluid intake should not exceed 12 quarts. Hourly fluid intake should not exceed 1 quart. The work/rest time and fluid replacement volumes will sustain performance and hydration for at least 4 hours of work in the specified work category.

Table 4. Work Intensity Guideline.

Easy Work	Moderate Work	Hard Work
Walking on hard surface @ 2.5 mph with < 30 lb load Guard duty Drill and Ceremony	Walking on hard surface @ 3.5 mph with < 40 lb load Walking on loose sand @ 2.5 mph with no load Light maintenance work Construction equipment operation	Walking on hard surface @ 3.5 mph with > 40 lb load Walking on loose sand @ 2.5 mph with load Loading and unloading pallets Dragging hoses or lines

Table 5. Guideline for Unacclimatized Individuals.

Flag Color	WBGT (°F)	Easy Work		Moderate Work		Hard Work	
		Work/Rest Cycle	Water Intake (Qt/hr)	Work/Rest Cycle	Water Intake (Qt/hr)	Work/Rest Cycle	Water Intake (Qt/hr)
No Flag	78 - 81.9	No Limit	0.5	50/10 min	0.75	30/30 min	0.75
Green	82 – 84.9	No Limit	0.5	40/20 min	0.75	30/30 min	1.0
Yellow	85 – 87.9	No Limit	0.75	30/30 min	0.75	20/40 min	1.0
Red	88 – 89.9	50/10 min	0.75	20/40 min	0.75	10/50 min	1.0
Black	> 90	40/20 min	1.0	10/50 min	1.0	Not Allowed	N/A

Table 6. Heat Stress Workload Task Multiplier for MOPP 3 and 4 Conditions.

		AMBIENT TEMPERATURE		
WORK RATE	ACTIVITY EXAMPLES	20 to 49 °F -7 to -9 °C	50 to 84 °F 10 to 28 °C	85 to 100 °F 29 to 38 °C
LIGHT	Tower Operators Operations Officers Pilot Ground Activities Command Post Activities	1.2	1.4	1.5
MODERATE	Refueling Avionics Shop Aircraft Maintenance NBC Recon Team	1.3	1.4	3.0
HEAVY	Armament Crew Rapid Runway Repair Heavy Aircraft Repair	1.7	2.1	5.0

NOTE: Referenced from AFMAN 32-4005, Attachment 8

To estimate how much time it will take to perform a task or operation while in MOPPs 3 and 4:

1. Determine the appropriate column for the outside temperature.
2. Find the work rate using the activity examples as a guide (e.g. light, moderate, and heavy).
3. Find the task time multiplier: read across the work rate line and down the temperature column.

Example: A rapid runway repair team is working while the outside temperature is 60 °F. The task normally takes 2.5 hours to complete. By using the chart, rapid runway repair is listed as a heavy work rate under the activity examples. Also, by using the outside temperature (60 °F) for that work rate (heavy), find the task time multiplier. In this case, the task time multiplier is 2.1. Take the task time multiplier and multiply it by the time it normally takes to do the job (2.1 x 2.5 hours = 5.25 hours). Therefore, the time it takes to do the job in MOPP 3 or 4 is 5.25 hours.

Table 7. WBGT Modification for Body Armor and PPE Base on Workload.

	Addition to WBGT (°F)		
	Easy Work	Moderate Work	Hard Work
Normal Duty-Type Uniforms (OCP/ABU, Overalls or Long-Sleeved Work Clothes)	0	0	0
Body Armor	5	5	5
Second Layer of Clothing or MOPP Gear	10	20	20
Total Maximum Addition to WBGT Based Upon Work-Rate and PPE	15	25	25

Note: Extracted from DAFI 48-151.

5. Fighter Index of Thermal Stress for Flying Personnel.

5.1. FITS: The FITS chart in **Table 8** determine Normal, Caution, and Danger Zones IAW DAFI 48-151. Forecasted FITS values can be found on the NASA AFRC weather homepage (<https://weather.dfrc.nasa.gov>), under the Range Forecast and/or Edwards Automated Heat Stress Forecast links. 412 OSS/OSW will forecast the FITS values for the day and include it in the Range Mission Execution Forecast. The 412 OSS/OSW will determine the current FITS Zone on an hourly basis during normal duty hours during flying operations conducted in a heat stress environment. If the Caution or Danger Zones are entered, they will disseminate a FITS Weather Advisory over the Joint Environmental Toolkit and notify the Supervisor of Flying, who will ensure it is included on the Automated Terminal Information System. Unit Operations Desks will clearly post the FITS Zone. 412 OG/CC Operation Group Command is the waiver authority for this guidance.

5.2. Hot Weather Precautions for all Aircrew

5.2.1. All aircrew will allow time for acclimatization to hot weather and should avoid extreme efforts on the first several days of exposure.

5.2.2. When exposed to hot weather, aircrew will drink more water than thirst dictates; at a minimum, the amounts recommended in **Table 5**. This will ensure proper hydration as the body increases sweat secretion to defend against heat. Aircrew should either carry water or have it readily available in the aircraft.

5.2.3. Flying squadron commanders will ensure their pilots understand the FITS measurement system and the appropriate preventive procedure below.

5.3. Fighter/Trainer Aircrew Procedures. This section applies to aircrew flying high-G aircraft (i.e., capable of G-loading in excess of 4.0 G).

5.3.1. Caution Zone Procedures: Limit ground operations outside of an air conditioned environment to 90 minutes maximum. If ground operations exceed 90 minutes (i.e., no flight), the aircrew must spend 60 minutes in an air-conditioned environment and re-hydrate before re-attempting flight. Once a flight is completed, the aircrew must spend at least 60 minutes in an air-conditioned environment and re-hydrate before flying again.

5.3.2. Danger Zone (DZ) Procedures: Cancel all flights planned to remain below 3,000 feet AGL (low-level/pattern-only sorties). Limit ground operations outside of an air-conditioned environment to 45 minutes maximum. T-38s are considered non-air-conditioned aircraft while on the ground and must take off within the 45-minute limit. If ground operations exceed 45 minutes (i.e., no flight), the aircrew must spend 60 minutes in an air-conditioned environment and re-hydrate before attempting to fly. Once a flight is completed, the aircrew must spend at least 60 minutes in an air-conditioned environment and re-hydrate before flying again. Do not fly with chemical defense, immersion, or arctic flight equipment while in the DZ.

5.3.3. Cancellation: Cancel all non-essential flights when the FITS value exceeds 115°F.

5.4. Multiengine Jet, Reciprocating, Turboprop, and Helicopter Aircrew Procedures. Aircrew flying non-fighter/trainer aircraft will observe the following precautions when Edwards AFB is in the FITS Caution or Danger Zones.

5.4.1. If available, use cooling air during ground operations.

5.4.2. Limit ground operations outside of an air-conditioned environment to no more than three hours. If the 3-hr limit is exceeded, aircrew must spend 30 minutes in an air-conditioned environment and re-hydrate before flying. The aircraft commander may waive the 3-hr limit based on mission requirements.

5.5. For more information, see [attachment 2](#) for extracted guidelines from DAFI 48-151.

Table 8. Fighter Index of Thermal Stress (FITS).

T _{db} (°F)	T _{pwb} (°F)																										
	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	
60	75	77	78	80	82	83	85	87	88	90	92	93	95	97	98	100	102	103	105	106	108	110	111	113	115	116	
62	76	77	79	81	82	84	86	87	89	91	92	94	96	97	99	101	102	104	106	107	109	111	112	114	115	117	
64	76	78	80	81	83	85	86	88	90	91	93	95	96	98	100	101	103	105	106	108	110	111	113	115	116	118	
66	77	79	80	82	84	85	87	89	90	92	94	95	97	99	100	102	104	105	107	109	110	112	114	115	117	119	
68	78	79	81	83	84	86	88	89	91	93	94	96	98	99	101	103	104	106	108	109	111	113	114	116	118	119	
70	78	80	82	83	85	87	88	90	92	93	95	97	98	100	102	103	105	107	108	110	112	113	115	117	118	120	
72	79	81	82	84	86	87	89	91	92	94	96	97	99	101	102	104	106	107	109	111	112	114	116	117	119	121	
74	80	82	83	85	86	88	90	91	93	95	96	98	100	101	103	105	106	108	110	111	113	115	116	118	120	121	
76	81	82	84	86	87	89	91	92	94	95	97	99	100	102	104	105	107	109	110	112	114	115	117	119	120	122	
78	81	83	85	86	88	90	91	93	95	96	98	100	101	103	104	106	108	109	111	113	114	116	118	119	121	123	
80	82	84	85	87	89	90	92	94	95	97	99	100	102	104	105	107	109	110	112	113	115	117	118	120	122	123	
82	83	84	86	88	89	91	93	94	96	98	99	101	103	104	106	108	109	111	113	114	116	118	119	121	122	124	
84	83	85	87	88	90	92	93	95	97	98	100	102	103	105	107	108	110	112	113	115	117	118	120	122	123	125	
86	84	86	87	89	91	92	94	96	97	99	101	102	104	106	107	109	111	112	114	116	117	119	121	122	124	126	
88	85	86	88	90	91	93	95	96	98	100	101	103	105	106	108	110	111	113	115	116	118	120	121	123	125	126	
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92	86	88	89	91	93	94	96	98	99	101	103	104	106	108	109	111	113	114	116	118	119	121	123	124	126	128	
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110	92	94	96	97	99	101	102	104	106	107	109	111	112	114	116	117	119	121	122	124	126	127	129	131	132	134	
112	93	95	96	98	100	101	103	105	106	108	110	111	113	115	116	118	120	121	123	125	126	128	130	131	133	135	
114	94	96	97	99	100	102	104	105	107	109	110	112	114	115	117	119	120	122	124	125	127	129	130	132	134	135	
116	95	96	98	100	101	103	105	106	108	109	111	113	114	116	118	119	121	123	124	126	128	129	131	133	134	136	
118	95	97	99	100	102	104	105	107	109	110	112	114	115	117	118	120	122	123	125	127	128	130	132	133	135	137	
120	96	98	99	101	103	104	106	108	109	111	113	114	116	118	119	121	123	124	126	127	129	131	132	134	136	137	
FITS Normal Zone				FITS Caution Zone				FITS Danger Zone				DANGER ZONE*															
DANGER ZONE* : Consider limiting or cancelling non-essential flight operations.																											

Note: This table used the Celsius equation where $FITS = 0.83T_{pwb} + 0.35T_{db} + 5.08^{\circ}C$. These values are converted to Fahrenheit to be more user-friendly. Where T_{db}^{\square} = Dry Bulb Temperature and T_{pwb}^{\square} = Psychometric Wet Bulb Temperature.

6. Prevention Of Heat Stress Illness. The following subjects discuss actions to help prevent heat stress illness.

6.1. Water. Drink large quantities of cool water to make up for water lost through sweating. It is better to drink small amounts of water frequently to replace water than to drink large amounts less frequently.

6.1.1. Milk and coffee do not effectively replace water loss. Consumption of these fluids should be kept to a minimum.

6.1.2. Carbonated beverages, while containing water, are not as effective as water in keeping the body hydrated because of the tendency to delay gastric emptying.

6.2. Salt. Some salt is lost in sweat. Because the typical North American diet contains so much salt, an individual should season food to taste but should not make any additional attempts to add excessive salt to the diet. Salt tablets will not be used except when ordered by a competent medical authority.

6.3. Acclimatization. Personnel must be acclimated to heat exposures. See Section 3.

6.4. Work Schedules. Modify work schedules to perform the heaviest work during the coolest parts of the day. When working in hot environments, establish work and rest cycles as outlined in Table 3 and 4. Take rest breaks in cool, shaded areas.

6.5. Food. Avoid eating greasy, fatty, or heavy foods if possible.

6.6. Medical Treatment. Seek medical treatment for any heat stress-related problems, including rashes.

6.7. Medications. Any individual who works outdoors or in hot environments should inform their doctor when receiving medications. Many prescription drugs have diuretic effects or may reduce the body's ability to sweat. These reactions can have severe effects when working outdoors and may speed the heat-stress process significantly.

6.8. Use Table 9 as a guide in recognizing the common heat stress illness and as a quick reference for first aid.

Table 9. Symptoms and First-Aid Treatment for Thermal Illness.

Illness	Symptoms	First Aid
Heat Rash/ Prickly Heat (Less Severe)	-Red clusters of pimples or small blisters in areas where clothing is restrictive, usually on neck, upper chest, groin, and elbow creases. -Extensive areas of skin that do not sweat on heat exposure, but present gooseflesh appearance.	-Move to a cooler, less humid work environment -Keep rash area dry -Powder can be applied to increase comfort -Do not use ointments or cream, as they may impair cooling—warm, moist skin can make the rash worse
Heat Cramps (Less Severe)	-Muscle cramps, pain, or spasms in the abdomen, arms, or legs	-Drink fluids every 15 to 20 minutes and eat a snack or sports drink -Avoid salt tablets -Get medical help if the worker has heart problems, is on a low sodium diet, or if cramps do not subside within 1 hour
Heat Syncope/ Fainting (Severe)	-Fainting, dizziness, or lightheadedness after standing or suddenly rising from a sitting/lying position	-Sit or lie down in a cool place when beginning to feel faint or dizzy -Slowly drink water or clear juice
Heat Exhaustion (More Severe)	-Headache -Nausea -Dizziness, weakness -Irritability -Elevated body temperature	-Call for medical help or take worker to a healthy facility for evaluation and treatment -Stay with worker until help arrives -Remove worker from hot area and give liquids to drink

	<ul style="list-style-type: none"> -Decreased urine output 	<ul style="list-style-type: none"> -Remove unnecessary clothing, including shoes and socks -Cool worker with water, cold compressed, ice bath, or fans -Encourage frequent sips of cool water
<p>Heat Stroke (MEDICAL EMERGENCY)</p>	<ul style="list-style-type: none"> -Confusion, altered mental state, slurred speech, loss of consciousness -Hot, dry skin or profuse sweating -Seizures -Very high body temperatures -Fatal if treatment delayed 	<p>This is an emergency! Call for emergency care immediately!</p> <ul style="list-style-type: none"> -Move worker to a cool area and remove outer clothing -Cool worker with water, cold compresses, an ice bath, or fans -Circulate air around worker to speed cooling -Place cold, wet clothes or ice on head, neck, armpits, and groin -Stay with worker until emergency medical services arrive
<p>NOTE: Referenced from NIOSH Occupational Exposure to Heat and Hot Environments, CDC 2016.</p>		

DOUGLAS P. WICKERT, Colonel, USAF
 Commander, 412th Test Wing

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

AFMAN 10-100, *Airman's Manual*, 1 March 2009

AFPD 48-1, *Aerospace & Operational Medicine Enterprise*, 1 June 2019

CDC, *NIOSH Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments*, August 2016

DAFI 48-151, *Thermal Stress Program*, 2 May 2022

DAFMAN 91-224, *Ground Safety Investigation and Hazard Reporting*, 21 Jan 2022

SAM TR-78-6, *USAFSAM/VNT, Fighter Index of Thermal Stress: Development of Interim Guidance for Hot Weather USAF Operations*, February 1978

Adopted Forms

AF Form 55, *Employee Safety and Health Record*

AF Form 847, *Recommendation for Change of Publication*

AF IMT 190, *Occupational Illness/Injury Report*

Abbreviations and Acronyms

AFMAN—Air Force Manual

AFPD—Air Force Policy Directive

AQI—Air Quality Index

CFR—Code of Federal Regulations

DOEHRS—Defense Occupational and Environmental Health Readiness System

DZ—Danger Zone

EAFB—Edwards Air Force Base

FITS—Fighter Index of Thermal Stress

IAW—In Accordance With

MOPP—Mission Oriented Protective Posture

OPR—Office of Primary Responsibility

PFA—Physical Fitness Assessment

PPE—Personal Protective Equipment

WBGT—Wet Bulb Globe Temperature

412 MOS/MXOO—412th Maintenance Operations Squadron Maintenance Operations Center

412 OMRS/SGXB—412th Aerospace Medical Squadron/Bioenvironmental Engineering

412 OMRS/SGXM—412th Aerospace Medical Squadron Public Health

412 OSS/OSW—412th Operation Support Squadron Weather Flight

412 TW/CP—Test Wing Command Post

Terms

Acclimatization—A period of adjustment an individual's body requires to become accustomed to working in hot environments. Full acclimatization occurs through progressive degrees of heat exposure and physical exertion. Personnel may need two weeks of increasing exposures to become substantially acclimated and may retain most of their adaptation for about one week after leaving a hot climate. Workers in good physical condition acclimatize more quickly.

Air-Conditioned Environment—1) Any air-conditioned building or vehicle; 2) The air-conditioned cockpit or cabin area of an aircraft, with cooling air supplied either externally or internally.

Curtailement vs. Suspension of Activities—Curtailement means reducing the level of exertion, reducing the pace of the activity and increasing the number and length of the rest periods. Suspension means to stop all strenuous activities temporarily until favorable environmental conditions return.

Diuretic—Diuretic compounds cause your body to lose excess water through saliva, urination, or excessive sweating. Examples of diuretics are caffeine-containing drinks such as coffee and sodas, alcohol, and water loss pills. Some prescription medications contain diuretic compounds.

Heat Stress—Heat stress is the combination of environmental and physical work factors that constitute the total heat load imposed on the body. The environmental heat stress factors are air temperature, radiant heat exchange (example, sunlight), air movement, and relative humidity. Physical work contributes to total heat stress through the body's production of heat (metabolic heat) as it burns energy to sustain the work. This production of metabolic heat depends on the intensity of the physical effort that is affected, in turn, by body size, muscular development, physical fitness, and age.

Fighter Index of Thermal Stress (FITS)—A guideline to predict cockpit environmental conditions during low-level missions which may jeopardize aircrew performance. FITS is based on the dry air and the dew point temperatures.

Heat Stress Illness—Heat stress illness are general terms used to indicate any type of adverse health problem related to heat. Heat syncope, cramps, exhaustion, and strokes are all forms of heat stress illness. Heat stress illness may be recognized by one or more of the following symptoms: nausea, vomiting, fever, dizziness, headache, faintness, abdominal or leg cramps, abnormal sweating, lack of coordination, mental confusion, and convulsions. The personnel most likely to be affected by the heat are those who have just arrived from cooler regions of the country, are obese, or are in poor condition.

Heat Rash—The most common heat rash is prickly heat (miliaria rubra), which appears as red papules, usually in areas where clothing is restrictive, and gives rise to a prickling sensation, particularly as sweating increases. It occurs in skin that is persistently wetted by unevaporated sweat, apparently because the keratinous layers of the skin absorb water, swell, and mechanically obstruct the sweat ducts

Heat Syncope—Heat syncope (unconsciousness), fainting while standing erect and immobile in heat is caused by pooling of the blood in dilated vessels and lower extremities brought on by prolonged periods of immobile activity or standing. Selecting acclimated personnel to participate in parades and ceremonies, having them drink water for several hours prior to the event, and directing them to discreetly move arms and legs to assist the return of blood to the heart may prevent heat syncope.

Heat Cramps—Painful intermittent spasms of the muscles used during work (arms, legs, or abdominal) which may occur during or after work hours. Cramps may result from exposure to high temperature for a relatively long time, particularly if accompanied by hard physical work. Cramps usually occur in unacclimated personnel after heavy sweating and are the result of excessive loss of salt from the body. Even if the moisture is replaced by drinking water, the loss of salt by sweating may provoke heat cramps.

Heat Exhaustion—The signs of heat exhaustion are profuse sweating, weakness, rapid pulse, dizziness, nausea, and headache. The skin is cool and sometimes pale and clammy with sweat; however, the body temperature rises rapidly.

Heat Stroke—Increased body temperature, if uncontrolled, may lead to delirium, convulsions, coma, and even death. Heat stroke is a much more serious condition than either heat cramps or heat exhaustion.

Hyponatremia—Low sodium level in the blood, a condition caused by the over consumption of water. Symptoms include feeling weak and fatigued, which may progressively get worse as the sodium level declines. In severe cases, patients may experience seizures and loss of consciousness.

Rest—Minimal physical activity, and should be accomplished in the shade, if possible. Any activity requiring only minimal physical activity can be performed during “rest.” Examples are classroom type training, paperwork, minor maintenance on vehicles or weapons, and personal hygiene activities.

Sortie—One sortie equates to stepping from Ops, going to the jet, flying, and returning to Ops (Ops-jet-fly-Ops).

Timing—Begins when exiting air-conditioned environment (ops, life support, step van with air-conditioning). Time is cumulative on the flight line while outside air-conditioned aircraft.

Wet Bulb Globe Temperature (WBGT) Index—The WBGT index is a combination of temperature measurements which considers dry air temperature, relative humidity, and radiant heating. The equation for the WBGT index uses dry bulb, natural wet bulb, and black globe temperatures.

Mandatory—Preferred, and Acceptable Requirements

May—Indicates an acceptable or satisfactory method of accomplishment.

Should—Indicates a preferred method of accomplishment.

Will—Indicates a mandatory requirement and is also used to express a declaration of intent, probability, or determination.

Attachment 2

FIGHTER STRESS INDEX FOR THERMAL STRESS (FITS) TAKEN FROM DAFI 48-151

A2.1. The FITS was developed in 1979 (SAM TR-78-6) to provide a measure of the thermal stress experienced by aircrew in fast jet aircraft with canopies and environmental control systems, engaged in combat sorties at low altitudes, direct sunlight or light overcast, and high outside temperatures. The FITS was derived from the WBGT using in-flight data on cockpit environments and assuming a fixed contribution from solar heating. The FITS table uses ground dry bulb temperature and wet bulb temperatures to yield an estimate of cockpit thermal stress.

A2.2. Assessing FITS Reference Values. In hot environments, the FITS provides a measure of thermal strain required which can be used to determine risk of aircrew heat stress and injury. The calculated values assume an Aircrew Equipment Assembly (AEA) thermal insulation of 1.5-2.0 clo, roughly equivalent to light, summer AEA; therefore, the index is not appropriate for cold weather, immersion suit or other types of individual protective equipment.

A2.2.1. The FITS equation utilizes T_{pwb} and T_{db} , the ground psychometric wet bulb and dry bulb temperatures, respectively.

A2.2.1.1. In Celsius, the equation is: $FITS = 0.83 + 0.35 + 5.08^{\circ}C$.

A2.3. FITS Actions. FITS reference values and their associated zones are not exact demarcations but represent the temperatures and humidities at which aircrews begin to experience heat-stress-related effects. These effects may vary with the individual, the particulars of the ground and flight aspects of the mission, the particular clothing worn, and so forth. The following FITS Action, therefore, are guides, rather than directives.

A2.3.1. FITS Normal Zone. The Normal Zone is subjectively hot, but normally safe, and generally covers FITS Reference Values under 90 °F (32 °C) The following procedures should be implemented:

A2.3.1.1. Be alert for symptoms of heat stress.

A2.3.1.2. Ensure adequate fluid intake.

A2.3.2. FITS Caution Zone. The Caution Zone includes conditions that are tolerable if adequate precautions are taken, and generally covers FITS Reference Values between 91 °F and 101 °F (33 °C and 37 °C) The following procedures should be implemented:

A2.3.2.1. Be alert for symptoms of heat stress.

A2.3.2.2. Drink plenty of non-caffeinated fluids.

A2.3.2.3. Avoid exercise 4 hours prior to take off.

A2.3.2.4. Limit ground operations time outside an air-conditioned environment to 90 minutes.

A2.3.3. FITS Danger Zone. The Danger Zone represents conditions that induce progressive heat storage and dehydration sufficient to affect crew performance during normal low-level missions and comprise FITS Reference Values over 102 °F (38 °C). When the FITS Reference Value is over 115 °F (42 °C), consider limiting or cancelling non-essential flight operations, as the thermal stress constitutes a serious drain on physiological reserves. The following procedures should be implemented:

A2.3.3.1. Minimum recovery time is two hours (landing time to next take off.)

A2.3.3.2. Limit ground operations time outside air-conditioned environment to 45 minutes.

A2.3.3.3. If possible, wait in a cool shaded area if the aircraft is not ready to fly. A3.3.3.4. Complete a maximum of two aircraft inspections, two exterior inspections on initial sorties, and one exterior inspection on subsequent sorties for fighters and trainers. A3.3.3.5. Undergraduate Flying Training solo students should be limited to one exterior aircraft inspection per sortie.

A2.4. FITS Chart in Celsius. This chart was created from the FITS equation and used to generate the Fahrenheit chart.

Figure A2.1. FITS Chart in Celsius.

Tdb (°C)	Tpwb (°C)																																												
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	
15	23	24	24	25	26	27	28	29	29	30	31	32	33	34	34	35	36	37	38	39	40	41	41	42	43	44	44	45	46	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
16	23	24	25	26	26	27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	41	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
17	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	
18	24	25	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	
19	24	25	26	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	
20	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	
21	25	26	27	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	
22	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66		
23	26	26	27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	
24	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	
25	26	27	28	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	
26	27	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	
27	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	
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35	30	31	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70		
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38	31	32	32	33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70			
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41	32	33	34	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70					
42	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70					
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44	33	34	35	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70						
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49	35	36	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70								
50	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70									
FITS Normal Zone																	FITS Caution Zone																	FITS Danger Zone							DANGER ZONE*				


DANGER ZONE* : Consider limiting or cancelling non-essential flight operations.

Attachment 3

HEAT STRESS INDEX FOR AIRCRAFT SHELTERS ON FLIGHT LINE

Figure A3.1. Recommended Heat Stress Index for AC Shelters on Flight Line.

Current and Correct
14 October 2016



**DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 412TH TEST WING (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA**

23 August 11

MEMORANDUM FOR RECORD

SUBJECT: Recommended Heat Stress Index for AC Shelters on Flight Line

FROM: 412 AMDS/SGPB
55 N. Wolfe Ave.
Edwards AFB, CA 93524-1132

- Bioenvironmental Engineering Flight (BEF; 412 AMDS/SGPB) conducted a three-day WBGT (wet-bulb globe temperature) heat stress survey under the AC shelters on Ramp 7 (between Bldg. 1630 and Bldg. 1635) in July 2007. The results obtained from the assessments on 12, 17, and 26 July 2007 indicate that significant relief is provided by the shelters. The WBGT under the shade of the shelters is between 2-8°F lower than the WBGT in the sun and usually between 4-5°F.
- BEF recommends that Commanders and supervisors follow the WBGT Level (Flag Stage) that is one level lower than the level posted on the Edwards Heat Stress Update Sharepoint until we reach Stage 5 (Black Flag), during which BEF recommends all outdoor work be limited to critical missions only. A reminder of the Levels and Flags is in the below table.

Stage	WBGT Index (°F)	Flag	Work/Rest Cycle
1	78-81.9	None (White)	NL
2	82-84.9	Green	50/10 min
3	85-87.9	Yellow	40/20 min
4	88-89.9	Red	30/30 min
5	>90	Black	20/40 min

- If you have any questions, please contact me at 277-3272 or anh.pham@edwards.af.mil.

//SIGNED ORIGINAL ON FILE//

ANH PHAM, 2d Lt, USAF, BSC
Chief, Environmental Health Element
Bioenvironmental Engineering

Attachment 4

AQI AND FLAG CONDITION FOR HALTING PHYSICAL FITNESS ASSESSMENT

Figure A4.1. MFR From Bioenvironmental Engineering.



DEPARTMENT OF THE AIR FORCE
412TH TEST WING
EDWARDS AIR FORCE BASE, CALIFORNIA

15 June 2022

MEMORANDUM FOR 412 FSS/FSVS

FROM: 412 OMRS/SGXB

SUBJECT: Air Quality Index (AQI) and Flag Condition for Halting Physical Fitness Assessment (PFA)

1. Due to extreme effort exerted during a PFA, and to ensure the safety of Edwards Air Force Base (EAFB) members, Bioenvironmental Engineering (BE) recommends all PFAs to be postpone when the AQI reaches 101 and when EAFB reaches Green Flag heat stress condition or greater.
2. BE supports and advises following the National Oceanic and Atmospheric Administration (NOAA) for AQI standards at EAFB. According to the NOAA, an AQI of 101 is categorized as Unhealthy for Sensitive individuals; vigorously exercising individuals fall under this category. An AQI at 101 or higher could impact the performance and health of all involved.
3. In accordance with DAFI 48-151, Green Flag condition or greater means when the Wet Bulb Globe Temperature (WBGT) exceeds 82°F. BE advises Green Flag to be the cut-off point for PFA due to the nature of EAFB's dry climate and high temperature in the summer.
4. Individual members are still responsible for scheduling and completing their PFA before it is due. BE will not be responsible for members failing to meet their requirements if they have to reschedule due to weather condition. To avoid this, BE recommends that members have back up plans and schedule their PFA early in the morning or later in the afternoon when the weather condition is more suitable.
5. If you have any questions or concerns, please contact BE at 661-277-3272.

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