



BSR ES1.7 - 202x, Event Safety Requirements - Weather Preparedness

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The Event Safety Working Group, which authored this (set of) Standards, consists of a cross section of entertainment industry professionals representing a diversity of interests related to event production, insurance and legal matters, rigging and stage machinery for theatrical events. ESTA is committed to developing consensus-based standards and recommended practices in an open setting. Future Event Safety Working Group projects will include updating this publication as changes in technology and experience warrant, as well as developing new standards and recommended practices for the benefit of the entertainment industry.

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Foreword

The Event Safety Guide was first published by the Event Safety Alliance in 2014, as a guideline for discourse regarding the many aspects of special event safety. It originated in the UK Health and Safety Executive's HSG195 "The event safety guide (Second edition) A guide to health, safety and welfare at music and similar events." where its purple cover subsequently led to its reference as, simply, "The Purple Guide". In 2016 the Event Safety Working Group was established within ESTA's Technical Standards Program for the purpose of converting the Event Safety Guide chapters into formally recognized, consensus-based standards that could be universally referenced across special events organizers, producers, enforcement agencies and user-groups. This document is part of a compilation of many such chapters, intended to be used in conjunction with each other, as a collection of standards, which are used to establish a reasonable standards for care and public safety for special events. Because event technology and requirements constantly evolve, so too will this collection of standards change and evolve to accommodate industry needs.

It has been assumed in the drafting of this standard that the execution of any design provision is entrusted to appropriately qualified and experienced people, and that any fabrication and use provision is carried out by qualified and suitably experienced people and organizations.

This standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment within its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees.

Compliance with this standard does not of itself confer immunity from legal obligations.

This document uses annex notes to provide additional reference information about certain specific section requirements, concepts, or intent. Subject matter with a corresponding annex note reference is identified by the asterisk (*) symbol, and the associated reference text is found in Appendix A, Commentary, identified with the referring text section number – e.g. an annex note to section 3.2 will be identified in Appendix A, Commentary as A.3.2. The annex notes are informational only, and do not add or subtract from the mandatory requirements of this standard.

Introduction

All events are impacted in some way by weather. Managing the hazards associated with weather are critically important, and can only be effectively addressed with appropriate planning and execution of mitigation actions. At their web page on *Weather Safety at Venues and Public Gatherings*¹, the American Meteorological Society stresses the importance of venue operators and event organizers being situationally aware of every weather risk that can occur, and of proactively planning to mitigate those risks.

Using technologies readily available to the consumer, general weather forecasts across large areas can be predicted with a reasonably high degree of accuracy. As the overall area of effect decreases, so too does the accuracy and reliability of these consumer technologies. Broad areas of coverage – over square miles, for example – can be captured within the scope of multiple radar or other monitoring systems. When considering that an outdoor event may encompass an area of only a few thousand square feet, it should be apparent that the accuracy necessary to pinpoint potential conditions over such a small area is quite challenging, but not impossible. However, demanding predictions within such a small area may be an unreasonable expectation, when reliance on such a thing may inherently place event participant in a reactive mode. Usually, it is prudent to monitor weather activities over a larger area, so that the time required to perform actions necessary for mitigation does not force a reactive response.

While rain, snow and lightning each represent unique hazards, the single largest hazard for outdoor events and temporary structures has proven to be wind. Due to its dynamically fluid nature, wind is also a difficult hazard to precisely predict, especially within a small area of effect.

This standard gives guidance on how to plan for and mitigate against weather-related hazards associated with special events.

1 Scope, purpose and application

The scope of this standard covers the consideration, development and use of event planning strategies that mitigate weather-related risks associated with live events, and with their associated temporary special event structures. Its scope includes both indoor and outdoor events, because each have considerations for the event participants. Its scope includes only public-access events, and private events where jurisdictional permits are required.

1.1 Purpose

The purpose of this document is to provide guidance on identifying weather-related hazards, monitoring technologies, and the basic requirements necessary to develop and implement risk mitigation actions associated with weather.

1.2 Intent

This document is intended for use by event producers, and by enforcement officials, in order to help establish and maintain reasonable standards for care and safety for special events.

1.3 Application

This document is one part of a larger collection of standards relating to special event safety. The requirements of the complete collection shall be considered in relation to the application of this standard, where necessary to coordinate and correlate all related requirements into the scope of a special event. Where an approved standard does not exist, the current edition of the *Event Safety Guide* shall be used as a reference for guidance. Other resources may be used, based on the relevance of the subject matter.

1.4 Normative references

The following documents contain requirements relating to the scope of this standard. They are provided for guidance only, unless otherwise referenced specifically elsewhere within this standard. Where a specific version is not given, the version applicable to the event jurisdiction shall be used.

International Fire Code
International Building Code

1 <https://www.ametsoc.org/index.cfm/ams/about-ams/ams-statements/statements-of-the-ams-in-force/weather-safety-at-venues-and-public-gatherings/>

NFPA 101 *Life Safety Code, 2015 edition*

ANSI E1.21, (current edition), *Entertainment Technology - Temporary Structures Used for Technical Production of Outdoor Entertainment Events*

National Oceanic and Atmospheric Administration (NOAA), *Lightning Safety Toolkit for Outdoor Venues Event Safety Guide (ESG)**, © 2014 *Event Safety Alliance of USA, Inc*, specifically these chapters:

ESG Chapter 2, Planning and Management (ref from section 3)

ESG Chapter 5, Medical, Ambulance and First-aid Management (ref from section 9)

ESG Chapter 6, Communication (ref from section 5)

ESG Chapter 7, Weather Preparedness (ref from Annex B)

ESG Chapter 8, Venue and Site Design (ref from section 3)

2 Definitions

2.1 Forecast. The gathering, evaluation, assessment, and use of weather-related data for prediction purposes.

2.2 Forecast, extended. A forecast of weather conditions for a period extending beyond three or more days from the day of issuance.*

2.3 forecasting, short-range. A weather forecast made for a time period up to 48 hours.*

2.4 Nowcast. A short-term weather forecast, generally for the next few hours.*

2.5 On-site monitoring. The gathering of weather-related data using equipment located on the event site, or using remote technologies for the purpose of monitoring and predicting weather hazards at or near the event site.

2.6 shall: denotes a mandatory requirement.

2.7 should: denotes a recommendation.

3 Advance planning and site selection*

Event planners shall determine if a formal weather preparedness plan is necessary for the event. Event size, location, number and demographic of anticipated attendees, availability of infrastructure shall all be considered in this determination. When formal weather preparedness plans are deemed necessary, they shall meet the requirements of this standard. Where they are not deemed necessary, this standard shall be used as a guideline, with all reasonable effort taken to meet the requirements herein.

Site selection shall be done in accordance with Chapter 2, Planning and management, and Chapter 8, Venue and site design of the *Event Safety Guide*. Site locations shall be evaluated on the basis of any localized or unique weather conditions reasonably foreseeable or known to occur due to geographic location, terrain, presence of surrounding structures and other local conditions.

3.1 Site location

Sites shall be evaluated based on location, size and availability of egress and evacuation pathways, where weather conditions may require evacuation of the site or structure(s), or where the operations management plan requires actions to be taken based on weather conditions.

3.2 Site climate profile.

Weather planning shall consider acquiring and documenting a site climatological profile, comprised of what weather conditions can be expected for a specific location and time of year. History of winds, temperatures, precipitation, and lightning within an event radius of not less than 8 miles shall be gathered as part of the site climate profile evaluation.

3.3 Determination of services required.

The need for remote monitoring, professional meteorologists or other forecasting services shall be identified and evaluated in the event planning phase. A professional meteorologist should be included in the evaluation process.

3.3.1. Basic requirements for services shall include a weather information source, or service, with the ability to provide long-range forecasting, short-range forecasting and nowcasting information for weather events, such as temperatures, winds, lightning, thunderstorms, rain, and snow.

3.3.2. The use of multiple technologies for public announcements is recommended. Such technologies may include mobile apps, SMS alerts and visual displays.

3.4 Operations management plan requirements for weather

Requirements for mitigating weather-related risks shall be included in the event's management plan.

3.4.1 Weather preparedness plan required. A written weather preparedness plan shall be developed as part of the event planning processes. The weather preparedness plan shall be specific to the event, relative to the event site and the site's specific weather patterns. The plan shall include the site climate profile information, if required by section 3.2.

3.4.2 Coordination with remote forecasting services. If remote forecasting services are deemed necessary to achieve the intended weather preparedness goals, such services shall provide forecasting products capable of meeting the event's specific weather preparedness plan requirements and triggering action thresholds. The weather preparedness plan shall be coordinated with the remote forecasting services.

3.4.3 Coordination with other hazard management systems. Where weather hazards present human comfort-related risks, the operations management plan shall include those risks, and associated response actions.

3.5 Event-specific weather risk assessment*

Weather planning shall include an event-specific evaluation and assessment of the minimum time required to execute any mitigation action, and shall determine the maximum permissible time to complete any such action.

3.5.1 The weather risk assessment shall consider the total amount of time required to complete any sequence of mitigation actions, up to and including show-stop and site evacuation.

3.5.2 The weather risk assessment shall consider what circumstances will permit a change in mitigation sequence, up to and including an escalation of the sequence to a show-stop and site evacuation.

3.5.3 The weather risk assessment shall consider site-specific criteria, such as infrastructure, terrain, and prevailing weather patterns.

3.5.4* The weather risk assessment shall determine the radius boundaries from the event site center, to be used for monitoring, alerting, and triggering of weather-related hazard mitigation actions. Multiple boundaries shall be permitted, where a single boundary conflicts with the risk assessment of multiple hazards. Radius boundaries shall be coordinated and used in conjunction with time-dependent thresholds, based on the time required to perform actual mitigation actions.

4 Organizational structure.*

Life safety is the highest priority of this standard. Live event producers shall establish a clearly defined organizational decision-making process for all actions relating to life safety.

4.1 Designated person required.

The organizational structure for life-safety decisions shall clearly identify the individual(s) responsible for weather hazard response decisions, and shall clearly identify their roles and responsibilities within the organizational decision making process.

4.2 Multiple designated persons permitted.

Multiple onsite designated persons shall be permitted if all of them are in direct communication with each other, and can jointly effect immediate response to imminent weather threats.

4.2.1 If the weather preparedness plan includes remote (off-site) forecasting and alerting, primary points-of-contact shall be designated for each remote service.

4.2.2 Multiple remote points of contact shall communicate with the same onsite designated person, who receives forecasts and alerting communications as determined by the requirements of section 4.1. If a weather threat becomes imminent, on-site or remote consulting meteorologists shall communicate in accordance with the planned communication structure.

4.2.3 Direct communication line required. Real-time communication methods shall be used to notify designated persons of potential and imminent weather threats.

5 Communication*

Live event producers shall define communications systems, protocols and sequences in accordance with Chapter 6 of the Event Safety Guide.

5.1 Emergency communication systems required.

Live event producers shall identify all methods of communication required for use as part of the weather preparedness plan, by and between those individuals identified by the administrative requirements of section 7.

5.2 Communication redundancy required.

Communication systems shall be designed and installed with redundancy to ensure that failure of one communication element does not disable the remaining emergency communication system elements.

5.2.1 Exceptions.

Communication redundancy is not required where all event participants are within earshot, and emergency communications can be quickly and reliably delivered to all event participants using unaided voice communication.

5.3 Extent of communication system coverage.

Communication systems used for weather hazard plan activation and response shall extend to include all personnel and attendees of the event.

5.4 Communication sequence.

The sequence of communication shall be established in accordance with section 4, Organizational structure, but shall not be restricted by a sequence that delays public communication of weather hazards. Security and crowd management personnel shall be notified prior to public notification.

5.5 Testing and verification.

Communication systems used for weather hazard plan activation and response shall be tested and verified prior to the event site being opened to public access.

5.6 Public address system requirements.

The communication system shall clearly define the method of communication, and individuals responsible for public address announcements, of any weather hazard mitigation procedure requiring attendee action.

5.6.1 Announcements. Public announcements regarding weather hazard plan actions required shall be accurate and unambiguous.

5.6.2 Announcement duration. Public announcements regarding severe weather actions required shall continue throughout the implementation of any such action. All weather information must be consistent through all communication channels.

5.7 Trained personnel.

Personnel shall be trained to use the communication equipment, and shall be trained to execute the plans and processes within their assigned roles and responsibilities.

6 Forecasting and monitoring requirements

Weather forecasting and on-site monitoring of actual conditions shall be required. Monitoring data used for forecasting purposes shall only be assessed by professional meteorologists.

6.1 General forecasting requirements.

Weather forecasting shall meet the requirements of this section. Nowcasting and on-site monitoring shall be synchronized to provide interactive and comparative reports.

6.1.1 Extended forecasting. Extended forecasting should be used during the event planning process, as part of the event's management plan regarding delay or cancellation of the event due to weather-related circumstances.

6.1.2 Short-range forecasting. Short-range forecasting shall be used in the event planning process, as part of the event's management plan regarding risk mitigation, event delay or cancellation due to weather-related hazards.

6.1.3 Nowcasting. Nowcasting should include interactive weather maps.

6.2 Monitoring requirements.

6.2.1* On-site monitoring. Onsite weather monitoring shall be required.

6.2.1.1* Lightning. Weather monitoring shall include high-precision lightning monitoring, reported for the radius boundaries as designated in the weather preparedness plan.

6.2.1.2 Wind. Anemometers shall be located in accordance with ANSI E1.21 (current edition). Where the event has no production structures, the anemometer shall be located in accordance with the manufacturer's instructions, or as directed by a qualified person.

6.2.2 Off-site monitoring

Off-site monitoring shall require direct and real-time communication with on-site monitoring personnel.

7 Administrative requirements*

The requirements of this standard shall be fully coordinated with the event's management plan, and with the event's emergency response procedures.

7.1 Organizational structure.

Event producers shall establish an organizational hierarchy for management, communication, and execution of weather preparedness activities.

7.1.1 The organizational hierarchy shall identify specific person(s) in responsible charge, their respective capacities and responsibilities within the weather preparedness plan administration.

7.1.2 The administrative requirements shall include a risk assessment of reasonably foreseeable weather hazards, and the actions required in response to each hazard.

7.1.3 The administrative requirements shall include an assessment of the time required to perform mitigation actions, relative to any triggering thresholds that may be established.

8 Interruption of show

Weather-related conditions that will result in day-of-show delay or cancellation, or show-stop during an event, shall be coordinated with the event's management plan, and with the event's emergency response plan. show-stop conditions shall require coordination with the event crowd management plan.

8.1 Show stop with delay.

Temporary weather-related show stops, made with intent to resume normal show operations, shall only be considered in circumstances where weather conditions are continuously monitored and assessed by a professional meteorologist, during the show stop period.

8.2 Resuming normal show operations.

When a show stop due to weather-related risks occurs, normal show operations shall only commence with approval from the professional meteorologist actively monitoring the current weather conditions.

8.2.1 Delays due to wind. When a show stop occurs as a result of wind conditions, normal show operations shall not resume until wind speeds have reduced below the wind speed triggering thresholds for not less than thirty minutes, or upon approval from a professional meteorologist.

8.2.2 Delays due to lightning. When a show stop occurs as a result of lightning, normal show operations shall not resume until after 30 minutes have passed with no new strikes within the alert radius, or upon approval by a professional meteorologist using guidance for resuming the event from NOAA's *Lighting Safety Toolkit for Outdoor Venues*.*

9 Other Weather Hazards

Other weather-related hazards shall be identified and evaluated in accordance with section 3.5.

9.1 Heatstroke.

Heatstroke hazards shall be evaluated using the WBGT hazard table in Annex C.

9.2 Dehydration

Dehydration risks shall be evaluated using the WBGT hazard table in Annex C

Annex A – Explanatory information

A1.4 Normative references. This standard currently references chapters from the *Event Safety Guide*, but intends to update those references to their corresponding ANSI ES1 standards once approved.

A2.2 Extended forecast. The U.S. National Weather Service issues extended forecasts for the three- to five-day period ahead.

A2.3 Short-range forecast. The U.S. National Weather Service issues short-range forecasts by part of the day, for example, today, tonight, etc.

A2.4 Nowcast. The U.S. National Weather Service specifies zero to three hours, though up to six hours may be used by some.

A3 Advance planning and site selection. The nature and complexity of the plan will be unique for each event. The weather preparedness plan should incorporate event size, event location, the number and demographic of anticipated attendees, the vulnerability of permanent and/or temporary structures (e.g. stages, inflatables, tents, seating areas, etc.), availability and proximity of infrastructure for refuge, availability and proximity of transportation, etc.)

A3.5 Event-specific weather risk assessment. In the context of this standard, “assessment of risk” implies risk evaluation and reduction. It is important to fully assess the amount of time required to execute weather hazard mitigation actions, relative to the available time allowed by their respective forecasting, monitoring, and triggering thresholds. Evacuation time will be dependent on crowd size, crowd demographic and mobility, and distance to refuge. Likewise, the speed of the weather hazard as it moves toward the venue must be taken into account. The weather preparedness plan should be flexible so as to set a safe radius which will serve as a trigger for the weather evacuation decision. Weather forecasting and monitoring should then be aligned with the specific safe radius as determined by the weather preparedness plan for the event. Refer to ANSI E1.21 and the Event Safety Guide for additional information.

A3.5.4

A7.1.3 The time needed to execute the mitigation actions is generally constant, but the radius is variable based on factors such as lightning strike count, or the speed and direction of high winds along the approaching gust front. Storm speed should be monitored and the radius distance adjusted accordingly. Alternatively, an assessment or forecast of the arrival time of the hazard at a fixed radius (i.e. 8 miles or more) should be obtained.

Multiple boundaries can be very useful if the outermost boundary is used as a mitigation action triggering threshold based on distance, with innermost boundaries demarcating the boundary for when mitigation actions must be complete, based on rate of travel between the outermost boundary to the innermost boundary.

Time needed to execute the mitigation actions must also consider crowd demographics and event site layout, including the distance to refuge areas, if applicable.

A4 Organizational structure. The individual responsible for making decisions in response to a weather threat must be designated, and must be clearly understood by all parties relevant to execution of weather-related actions. The authority of this individual should be final.

Having good communication channels is key and must be arranged before any event. In the event of weather hazards, a primary point of contact must be available to contact a designated weather organization or professional meteorologist.

A5 Communication. During severe or adverse weather conditions, communication by and between venue staff needs to be efficient, accurate and targeted. The communication response must be correlated to appropriate trigger criteria and actions defined in the weather preparedness plan. As time is of the essence during a weather hazard situation, all communication should, as much as possible, be rehearsed during training and exercises.

The sequence of communication needs to be considered, allowing technical departments, security and event staff and food and beverage/merchandising to make preparations before the audience is advised.

Performers can be of great value in calmly asking guests to take action, assuming that they are willing and able to relay this important information. They should not be solely relied upon to communicate this important information, but should be asked to do so if their special connection with audience members could make the process smoother.

A6.2.1 Onsite monitoring. Onsite monitoring is useless without proper interpretation of data. Onsite monitoring of wind speeds can result in a reactive mode response if no plan exists, if an existing plan is ignored, or if triggering thresholds are unrealistic given the time it may take to perform mitigation actions. This is also a communication and risk assessment topic.

A6.2.1.1 Many lightning monitoring services and applications are available, and should be used.

A7 Administrative requirements. Refer to ANSI E1.21, current edition for additional resources for Operations Management Plan examples.

A8.2.2 This reference can be found online here: <https://www.weather.gov/safety/lightning-toolkits>

Annex B - Example Weather Action Matrix

This table is an example only, and is not intended to be all-inclusive. It is intended to give the reader a better understanding of how a risk matrix might be formatted. The actual risk matrix must consider all circumstances identified in the event-specific weather risk assessment (Section 3.5). This example uses a stadium event as a model. The matrix headings for equipment, systems, and areas may – likely will – differ for each venue or location. A different and more extensive example can be found in the *Event Safety Guide*, Chapter 7.

THREAT	ALERT METHOD	FIELD (STAGE)	PARKING	MARKETPLACE	SPECTATOR SEATING	VIDEO PRODUCTION	TICKETING
TORNADO ACTIVITY	1 long air horn blast + staff radio communication with PA announcement	IMMEDIATE RETREAT TO NEAREST DESIGNATED SHELTER AREA					
SURFACE WINDS IN EXCESS OF 40 MPH OR TORNADO WARNING	1 long air horn blast + staff radio communication with PA announcement	ORGANIZED EVACUATION IN ACCORDANCE WITH EVENT EVACUATION PLAN					
WINDS 30 MPH OR GREATER	Text, radio, PA	Move under stadium	Return to bus	Move under stadium	Move under stadium or return to vehicles	Add bracing cables or prepare to lower to floor/ground	Stay in box office
LIGHTNING PER ASSESSMENT CRITERIA	Text, radio, PA	Move under stadium	Return to bus	Move under stadium	Move under stadium or return to vehicles	N/A	Stay in box office
WINDS 26-30 MPH	Text, radio	Move under stadium	Return to bus	Move under stadium	Move under stadium or return to vehicles	Check rigging	Stay in box office
WINDS 20-25 MPH	Text	Move under stadium	Return to bus	Move under stadium	Move under stadium or return to vehicles	Check rigging	Stay in box office
STORM/LIGHTNING TRACKING TOWARDS SITE (WITHIN 20 MILES)	Text	Monitor	Monitor	Monitor	Monitor	Check rigging	Monitor
RAIN EVENT TRACKING TOWARDS SITE (WITHIN 20 MILES)	Text	Monitor	Monitor	Monitor	Monitor	N/A	Monitor
ALL CLEAR	Text, radio, PA	WEATHER IS ALL CLEAR, RESUME NORMAL SHOW ACTIVITIES					

Table note: Refer to A3.5.4 for guidance on coordinating the hazard threshold triggers with time-based limits.

Annex C – Wet bulb globe temperature risk table**Wet Bulb Globe Temperature Category Work/Rest and Water Intake**

08/07/15

Unacclimated and Acclimated Work/Rest and Water Intake Chart

Heat Risk Category		Wet Bulb Globe Temp	Light Work		Moderate Work		Heavy Work	
			Work/Rest	Water Intake (quart/hr)	Work/Rest	Water Intake (quart/hr)	Work/Rest	Water Intake (quart/hr)
No Risk	Unacclimated	78 – 79.9	50/10 min	½	40/20 min	¾	30/30 min	¾
	Acclimated	78 – 79.9	continuous	½	continuous	¾	50/10 min	¾
Low	Unacclimated	80 – 84.9	40/20 min	½	30/30 min	¾	20/40 min	1
	Acclimated	80 – 84.9	continuous	½	50/10 min	¾	40/20 min	1
Moderate	Unacclimated	85 – 87.9	30/30 min	¾	20/40 min	¾	10/50 min	1
	Acclimated	85 – 87.9	continuous	¾	40/20 min	¾	30/30 min	1
High	Unacclimated	88 – 90	20/40 min	¾	10/50 min	¾	avoid	1
	Acclimated	88 – 90	continuous	¾	30/30 min	¾	20/40 min	1
Extreme	Unacclimated	> 90	10/50 min	1	avoid	1	avoid	1
	Acclimated	> 90	50/10 min	1	20/40 min	1	10/50 min	1

Adapted from: 1) USGS Survey Manual, Management of Occupational Heat Stress, Chapter 45, Appendix A. 2) Manual of Naval Preventive Medicine, Chapter 3: Prevention of Heat and Cold Stress Injuries. 3) OSHA Technical Manual Section III: Chapter 4 Heat Stress. 4) National Weather Service Tulsa Forecast Office, Wet Bulb Globe Temperature.