

Tornado Safety

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Introduction

Tornadoes are mobile, destructive vortexes of violently rotating winds which have the appearance of a funnel-shaped cloud and advance beneath a large storm system (see Figure 1). They may appear nearly transparent until dust and debris are picked up or a cloud forms within the funnel, making them deadly. Good warning systems allow citizens to be alerted before a tornado is visible, making safe survival more likely. Therefore, during bad weather, we must be alert and tune in for warnings. If a tornado should strike, well-made plans for emergency shelter can overcome this disaster and bring you, your family and your community through without personal injury. This fact sheet highlights the frequency of tornadoes in Arkansas and the importance of following the safety tips if a tornado watch or warning is issued.



Figure 1. Tornadoes often have a classic funnel-shaped cloud associated with the whirling updraft.

Tornado watches and warnings are issued as soon as the conditions are identified. Use the available time, once you note a warning, to prepare for one of nature's most destructive storms. Stay informed about the approaching storm.

What Is the Difference Between a TORNADO WATCH and a TORNADO WARNING?

TORNADO WATCH: Tornado watches are issued by the Storm Prediction Center in Norman, Oklahoma, when tornadoes are possible in the area and the conditions or the weather is right for a tornado to occur. A watch encompasses a broad area (sometimes several states) and lasts for several hours. Stay tuned to the radio or television news.

TORNADO WARNING: Tornado warnings are issued by local National Weather Service Forecast Offices, such as the one in Little Rock, Arkansas, when a tornado is either on the ground or has been detected by Doppler radar. A warning is for a small area (one or more counties) and usually lasts for 30 minutes to an hour. Seek shelter immediately.

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Tornado Severity

In the past, tornado severity used to be estimated using the Fujita Scale (F-scale). The F-scale was decided mostly by visual evidence and the degree of damage to an object such as a house. In 2007, the F-scale method was used to determine a newer scale called the Enhanced Fujita Scale (EF-scale). The EF-scale is based on damage to structures and also takes into account the quality of construction. While a mangled home is rated high on the F-scale, the EF-scale results might be lower given a poorly built structure. Table 1 shows the Enhanced Fujita Scale for tornadoes. It depicts the six levels of tornadoes (0-5) along with the extent of the damage that may be associated. Figure 2 shows tornado damage in Damascus, Arkansas, on May 2, 2008.

Table 1. Enhanced Fujita Scale for Tornadoes

EF Number	Intensity	Three-Second Gust (mph)	Damage
0	Gale	65-85	Some damage to roofs, siding and tree branches.
1	Weak	86-110	Roofs stripped, mobile homes overturned and exterior home damage.
2	Strong	111-135	Torn off roofs, mobile homes destroyed, large trees uprooted.
3	Severe	136-165	Entire stories of homes and buildings destroyed, trains overturned, cars lifted off the ground.
4	Devastating	166-200	Steady buildings leveled, cars thrown around.
5	Incredible	> 200	Destruction of all infrastructure.

Note: The Enhanced F-scale is a set of wind estimates (not measurements) based on damage.



Figure 2. Tornado damage in Damascus, Arkansas, on May 2, 2008.

Arkansas Statistics

- Tornadoes occur at any time of the year and any time of the day in many parts of the world. Almost 75 percent of the world's tornadoes occur in the United States. They have occurred in almost every state; however, they are most frequent east of the Rocky Mountains during spring and summer months. Arkansas is located in the lower Mississippi Valley where warm, moist air flowing northward from the Gulf of Mexico interacts with cool, dry air spreading southward and eastward from the Great Plains along tornado alley.
- Tornadoes are frequent during late afternoon to late evening, according to National Weather Service records. In Arkansas, five in the afternoon is the time of the maximum tornado incidence. The greater tornado frequency in the afternoons and evenings is due to increased instability in the atmosphere. This air instability results from a buildup of heat near the earth's surface on warm afternoons. After sunset, the layer of heated air near the earth's surface begins to cool. This usually restores more atmospheric stability and reduces the threat of tornadoes.
- During the last 66 years (January 1, 1950, through December 31, 2016), about 2,073 tornadoes have struck in Arkansas. The yearly average number of tornadoes in Arkansas is 33, based on the period from 1981 to 2010. Since 1950, counties with 35 or more tornadoes are mostly clustered along Interstate 30 and U.S. Highway 67/167. This includes areas from Clark County to Pulaski County and Craighead County. Tornado deaths are highest in this part of the state as well. Therefore, it represents a tornado alley in Arkansas.
- As mentioned earlier, tornadoes can strike in any month. For instance, in January 1999, a total of 68 tornadoes occurred. This set a national record for the greatest number of tornadoes in this month. During this year, a total of 107 tornadoes were sighted, setting a new record for Arkansas. In second place was 2008 with 81 tornadoes. Lately, in 2016, a total of 28 tornadoes struck in Arkansas. Table 2 shows the actual number of tornadoes, deaths and injuries in each county in Arkansas from 1950-2016 (adopted from National Weather Service records).
- Tornadoes killed a total of 390 and injured 5,356 in Arkansas from January 1, 1950 through December 31, 2016 (<https://www.ncdc.noaa.gov>). A "killer" tornado is one that causes the death of at least one person. The worst killer storms in the state's history occurred on March 21, 1952. That day, 111 people were killed and 772 were injured by three tornadoes. Recent statistics indicate that an average of four Arkansans are killed by tornadoes annually.
- Destructive/deadly tornadoes in Arkansas are rare. From 2000 through 2016, there were 669 tornadoes and 72 tornado-related fatalities across the state. The vast majority of tornadoes,

83 percent (553), were weak (rated F1/EF1 or less) and responsible for 4 percent (3) of the deaths. Tornadoes rated F3/EF3 or higher (27) occurred only 4 percent of the time but accounted for 76 percent of the deaths (55). Two F4 tornadoes struck Arkansas on March 1, 1997, and killed 25 citizens. Both tornadoes were spawned by the same parent storm. On February 5, 2008, an EF4 tornado with the longest track in

Arkansas (122 miles) struck seven counties in northern and western sections of the state. The only F5 tornado documented in Arkansas was on April 10, 1929, in northern Jackson County. It was known as the “Sneed Tornado.” The most damaging and most costly tornado, with the associated costs around \$300 million, occurred on April 21, 1996, from Fort Smith to Rudy. It killed 2 and injured 89 citizens.

Table 2. Total Number of Tornadoes, Deaths and Injuries in Each County in Arkansas From 1950-2016 (adopted from National Weather Service records)

County	Number of Events	Number of Deaths	Number of Injuries	County	Number of Events	Number of Deaths	Number of Injuries
Arkansas	42	0	30	Lee	13	0	28
Ashley	32	6	50	Lincoln	19	5	24
Baxter	18	4	70	Little River	20	2	11
Benton	51	0	28	Logan	23	1	12
Boone	13	1	66	Lonoke	79	18	115
Bradley	21	7	59	Madison	20	2	7
Calhoun	19	0	1	Marion	19	6	41
Carroll	12	0	16	Miller	27	0	9
Chicot	35	1	45	Mississippi	43	5	149
Clark	32	6	121	Monroe	21	0	6
Clay	18	1	1	Montgomery	14	0	2
Cleburne	26	4	35	Nevada	17	0	5
Cleveland	11	0	2	Newton	12	0	2
Columbia	32	3	19	Ouachita	22	0	24
Conway	37	8	52	Perry	17	0	0
Craighead	35	37	616	Phillips	26	0	7
Crawford	25	0	84	Pike	22	0	2
Crittenden	17	6	126	Poinsett	34	8	98
Cross	20	5	24	Polk	35	4	65
Dallas	25	1	6	Pope	24	7	41
Desha	24	0	33	Prairie	27	6	40
Drew	18	1	4	Pulaski	88	9	421
Faulkner	55	27	522	Randolph	13	0	6
Franklin	25	3	26	Saline	50	12	116
Fulton	20	4	28	Scott	8	0	2
Garland	36	1	56	Searcy	13	0	2
Grant	25	1	3	Sebastian	28	16	334
Greene	26	2	62	Sevier	18	0	15
Hempstead	31	5	13	Sharp	19	0	27
Hot Spring	35	0	62	St. Francis	20	6	139
Howard	33	12	51	Stone	21	6	18
Independence	42	8	54	Union	36	3	30
Izard	23	4	55	Van Buren	35	8	128
Jackson	50	5	105	Washington	32	5	67
Jefferson	31	1	15	White	37	60	431
Johnson	33	4	150	Woodruff	32	32	219
Lafayette	10	0	0	Yell	29	0	8
Lawrence	22	1	15				

Some Observations Related to Tornadoes

- Tornadoes come from any direction, although 64 percent of the tornadoes in Arkansas move from the southwest to the northeast.
- Tornadoes are either gale, weak, strong, devastating or incredible.
- Average speed of advance for tornadoes is 30 mph; nonetheless, a few move as fast as 70 mph.
- Most tornado damage is probably caused by winds of 125 mph or less; however, maximum wind speeds may exceed 200 mph.
- Some tornadoes may stop their forward movement, turn and loop back across their path.
- Debris from tornadoes causes most deaths and injuries.

Tornado Identification

- Violent storms associated with low barometric pressure can spawn a tornado. Strong winds in the lower few thousand feet of the atmosphere may be noted by cloud movements. The storm cells develop from an elevation of 20,000 to 40,000 feet. Rotation of air (cloud movement) usually starts with a circulation near 20,000 feet and builds up and down.
- Tornadoes often form near a thunderstorm's updraft. Often surface winds of 25 to 35 miles per hour are noted near a developing tornado. Small clouds will rise quickly into the larger cloud layer. Near a tornado, the barometric pressure drops rapidly. The characteristic funnel may drop down, loop and appear to dissipate at times.
- Tornadoes can reach you within a few minutes. Other funnels can spawn directly overhead.
- Tornadoes may "mature" in a classic fashion. However, violent storm cells can cause two or more circulations.
- Tornadoes occur all over Arkansas.

Doppler Radar

Doppler radar measures wind speeds and the direction of air currents within storms. Doppler radar units can detect tornadoes that are forming. This capability really enhances identification because a tornado is simply a violently rotating column of air, a pendant from a cumulonimbus (thunderstorm) cloud. Doppler radar units are located at National Weather Service offices in Little Rock and Fort Smith, Arkansas; Memphis, Tennessee; Tulsa, Oklahoma; Jackson, Mississippi; Shreveport, Louisiana; and Springfield, Missouri.

Disaster Plans

Follow these basic steps to develop a family tornado disaster plan:

- Find out if your community has tornado-warning sirens. Learn your community's warning signals and evacuation plans. Locate the safest areas in

your home. To be better prepared for a tornado, contact your local National Weather Service office, local Office of Emergency Management, American Red Cross chapter or county Cooperative Extension office to determine what they can provide.

- Meet with your family to create a plan. Discuss the tornado warning measures available to you. Point out the safest areas in your home to ensure that everyone knows where to go for shelter. A storm cellar or safe room offers the best protection. Funds to assist in the construction of safe rooms may be available from the Arkansas Department of Emergency Management (www.adem.arkansas.gov).
- Practice emergency drills and maintain your plan. Assemble in the assigned tornado shelter. Remind family members to use the telephone only if there is no immediate danger and then only to notify other family members of the violent weather or of a tornado watch. Post emergency phone numbers and safety rules by the telephone. Teach children how and when to call 911 or the local emergency medical service number.
- Improve your plan.
 - (a) Review the emergency phone numbers posted by the telephones.
 - (b) Install fire extinguishers and make other safety improvements to your house.
 - (c) Teach your family how to use a fire extinguisher and how and when to turn off water, gas and electricity.
 - (d) Review basic safety measures and/or enroll in CPR and first aid classes.
 - (e) Maintain supplies in your home to meet emergency needs for at least three days.
 - (f) Have a disaster supply kit ready.
- Protect valuable records for tax or federal disaster declarations and insurance compensation. Maintain a safety deposit box for family and business papers that cannot be replaced. Review specific wind and flood damage protection provided by your insurance policy.
- Test and recharge (as needed) your fire extinguishers according to the manufacturer's instructions.
- Replace stored water every six months.

Sometimes tornadoes develop so rapidly that advance warning is not possible. Remain alert for signs of an approaching tornado.

What You Can Do Before the Storm

- Recognize conditions that may develop into tornadic winds. It is the first major step in avoiding cruel disaster.
- Develop an emergency storm plan for all family members whether at home, work, school or outdoors.
- Teach children their county and neighboring counties because storm alerts are given

by counties. Keep highway maps in several convenient locations to follow storm movements given by weather bulletins.

- Conduct frequent storm drills.
- Have a NOAA Weather Radio All Hazards with a battery backup and warning alarm to receive warnings.
- Listen to the TV or radio for weather updates.
- If your activity is outdoors, listen to the latest forecasts and take necessary precautions (possibly delaying activities until the danger is past) during threatening weather.
- Be prepared to find suitable protection.
- Charge all your cell phones.

During actual tornado warnings or tornado drills, remember to **DUCK!**

D – (Downstairs). Go down to the lowest level, stay away from windows.

U – (Underneath Something). Get under something (a basement staircase or heavy table or desk).

C – (Center Part of the House). Cover your head.

K – (Keep Away From Windows). Keep in shelter until the storm has passed.

If a Tornado Warning Is Issued or Threatening Weather Approaches

- If a funnel is sighted, take shelter immediately.
 - Get indoors and stay there.
 - Move to a previously designated safe area, preferably a basement.
 - If an underground shelter or “safe room” is not available, move to an interior room or hallway on the lowest floor. Crouching under a sturdy desk or rugged furniture is advisable if it is located near a central wall. Place pillows or blankets over your head and upper body for extra protection.
 - Stay away from doors and windows.
 - Do not try to outrun a tornado in your vehicle. Instead, leave it immediately.
 - If caught in a vehicle, your best option is to buckle your seat belt and try to drive to the closest sturdy shelter.
 - Watch out for flying debris.
 - Avoid taking shelter under highway overpasses. It is very dangerous.
 - If you see flying debris while you are driving, pull over and park.
 - The following options should be used only as a last resort, taking into account your specific circumstances:
 - Stay in your vehicle with the seat belt on; put your head down below the windows, covering with your hands and a blanket if possible.
 - If you can safely get noticeably lower than the level of the roadway, get out of the car and lay in a ditch or depression, covering your head with your hands.
 - During a tornado, watch out for fallen power lines to avoid accidental electrical shock.
- Be alert; refrain from driving to locate family and friends.
 - Make phone calls to notify those who may have missed the tornado warning broadcast, but keep an alert eye on the sky.

School Disaster Plans (Hospitals, nursing homes and other institutions should develop similar plans.)

- Develop a severe weather action plan and have frequent drills.
- Assign responsibility for activating the severe weather plan. This includes assuring severe weather is continually monitored with NOAA Weather Radio All Hazards and local TV/radio.
- Make sure several leaders know how to turn off electricity and gas in the event the school is damaged.
- Each school structure should be inspected and tornado shelter areas designated by a registered engineer or architect. Schools without safe rooms or basements should use interior rooms and hallways on the lowest floor and away from windows.
- If the primary power for the school’s alarm is electricity, provide a charged-battery backup or have a compressed air horn or megaphone to activate the alarm during power outages.
- Have provisions for disabled students and those in portable classrooms.
- Move students quickly into interior rooms or hallways on the lowest floor. Have them assume the tornado protection position with their heads against the wall.
- Lunches, classes or assemblies in large, free-span cafeterias or auditoriums should be delayed if severe weather is anticipated.
- Keep children at school beyond regular hours if threatening weather is expected. Children are safer at school than in a bus or car. Students should not be sent home early if severe weather is approaching. Students should learn about the tornado protection position as shown in Figure 3.

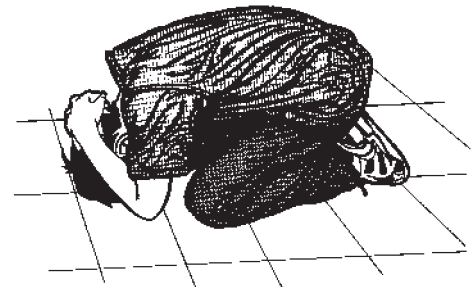


Figure 3. Tornado protection position

- Do not remain in auditoriums, cafeterias, gymnasiums or other structures with wide, free span roofs because they offer no protection from tornado-strength winds.

Community Preparedness

- A warning coordination meteorologist (WCM) is located at the National Weather Service office in Little Rock. The WCM assists officials at all levels of state and local government as well as private individuals.
- The WCM provides severe storm spotter training to local Office of Emergency Management personnel, HAM radio operators and local groups. The WCM also presents severe weather preparedness programs at school assemblies and civic meetings.
- To contact the WCM, write to the National Weather Service Forecast Office, 8400 Remount Road, North Little Rock, Arkansas 72118; 501-834-0308.
- Arkansas Department of Emergency Management personnel help prepare for and recover from disasters, including tornadoes. Contact your local Emergency Management coordinator or the Arkansas Department of Emergency Management (501-683-6700) to obtain information.
- The University of Arkansas System Division of Agriculture Cooperative Extension Service offers educational programs on tornado safety through 4-H, Extension Homemaker clubs or programs for the general public. If you would like an educational program on tornado safety, contact your county Extension office.

Tornado Safety Locations

Homes With Basements

Seek refuge near a basement wall in the most sheltered and deepest part of the basement below ground.

Homes Without Basements

Take cover in the smallest room with stout walls under heavy furniture or a tipped-over, sturdy, upholstered couch or chair near the center of the house. The first floor is safer than the second or third. Don't take time to open or close windows; get away from them and go to a safe area immediately. Construction of a storm cellar is particularly advisable for those in homes without basements.

Mobile Homes and Modular Buildings

Abandon mobile homes. Arrange for use of a convenient safe area in advance should violent weather occur. Consider basements, a storm cellar

or safe room, the ground floor of a sturdy structure or a nearby culvert or deep ditch.

Factories, Auditoriums and Other Large Buildings With Wide, Free-Span Roofs

These buildings are particularly vulnerable to tornadic wind damage due to the large roof expanse upon which wind forces act and the distance between roof-supporting walls. Basements of these buildings offer reasonably good protection. Smaller interior rooms at ground level or nearby sturdy buildings are options, depending on their construction and the urgency for shelter. Preselect and mark designated safe areas. Hold tornado safety drills. Train building employees to direct occupants to designated safe areas. Trained spotters should assume their posts as soon as conditions become threatening.

Office Buildings

The basement or an interior hallway on a lower floor of an office building is safest. Upper stories are unsafe. If there is not time to reach one of the lower floors, a small room with stout walls (closet or bathroom) or an inside hallway provides some protection against flying debris. Otherwise, getting under heavy furniture must do. Select and mark designated safe areas in office buildings. Train employees to direct occupants to designated areas.

If a tornado strikes, watch out for fallen power lines. Stay out of damaged areas until power is disconnected to avoid accidental electrical shock.

NOAA Weather Radio

- Weather information can be received 24 hours a day from NOAA Weather Radio All Hazards. In Arkansas, this is a joint effort between the National Weather Service and the state. The latest weather information is broadcast all day and all night, including severe weather details.
- Special radio receivers are available at radio shops, electronics stores, department stores and discount stores. Many multiband radios and scanners can also receive these frequencies.
- Some radio receivers have a "warning alarm" feature for severe weather watches or warnings that allows the National Weather Service to automatically turn on the radio, day or night. This warning alarm is tested each Wednesday between 11 a.m. and noon. If bad weather is occurring or is forecast, the test is postponed until the next good weather day.

Other Sources of Information

Tornado Safety. Learn how to stay safe during a tornado, and how to improve your home's ability to withstand tornadoes. American Red Cross. <http://www.redcross.org/get-help/prepare-for-emergencies/types-of-emergencies/tornado#About> (Accessed on 4/18/2017)
Tornado Safety. Roger Edwards. <http://www.spc.noaa.gov/faq/tornado/safety.html> (Accessed on 4/18/2017)
Tornadoes. Prepare, Plan and Stay Informed. <https://www.ready.gov/tornadoes> (Accessed on 4/18/2017)

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