HURRICANE AWARENESS INFORMATION

www.corpuschristimarina.com (361) 826-3980

Hurricane Information, Checklist & Safety

HURRICANE CONDITIONS CITY OF CORPUS CHRISTI

CONDITION 4 (Green): This condition shall automatically go into effect upon such occurrences as the beginning of the hurricane season (June 1st of each year, remaining in effect until November 30th of each year); or other general conditions as determined by the City Manager.

CONDITION 3 (Yellow): This condition exists when the course of the hurricane is established, and the National Weather Service predicts the possibility of landfall within 36 hours and/or is within 100 miles of Corpus Christi.

CONDITION 2 (Orange): This condition shall be declared by the Mayor or the City Manager when the National Weather Service predicts hurricane landfall within 24 hours and is close enough to Corpus Christi to cause damaging winds, high tides and storm surge.

CONDITION 1 (Red): This condition shall be declared by the Mayor or City Manager when hurricane landfall is within 12 hours or less and damaging tides or hurricane force winds are imminent.

Information & Safety Tips

TERMS TO KNOW - By international agreement, tropical cyclone is the general term for all cyclonic circulations originating over tropical waters, classified by form and intensity as follows:

TROPICAL DISTURBANCE - Rotary circulation slight or absent at the surface, but sometimes better developed aloft, no closed isobars (lines of equal atmospheric pressure) and no strong winds, a common phenomenon in the tropics.

TROPICAL DEPRESSION - One or more closed isobars and some rotary circulation at surface, highest wind speed 39 miles per hour (34 knots).

TROPICAL STORM - Closed isobars, distinct rotary circulation, highest wind speed of 74 miles per hour (34-63 knots).

HURRICANE - Closed isobars, strong and very pronounced rotary circulation, wind speed of 74 miles per hour (64 knots) or more.

HURRICANE CHECKLIST

Hurricanes are an unfortunate fact of life in the Coastal Bend. Even if Corpus Christi does not get direct hit, high winds and tides will do severe damage, especially to boats. As a boater, you alone are responsible for securing your vessel before a storm.

This checklist will help you prepare for a hurricane. If followed, the suggested time schedule, safety equipment and precautions will reduce the possibility of damage to your boat, but cannot guarantee it. All storms are different and can not be predicted in terms of wind speeds and tide changes once they make landfall. Taking your boat out of the City Marina and securing it on land is the only sure way to reduce the potential for damage.

HURRICANE SEASON = JUNE 1ST - NOVEMBER 30TH

HURRICANE SAFETY RULES - Hurricane advisories will help save your life..... but you must help.

1) **ENTER EACH HURRICANE SEASON PREPARED**. Every June through November, recheck your supply of boards, tools, batteries, nonperishable foods, and the other equipment you will need if a hurricane strikes your town.

2) **WHEN YOU HEAR THE FIRST TROPICAL CYCLONE ADVISORY**, listen for future messages. This will prepare you for a hurricane emergency well in advance of the issuance of watches and warnings.

3) **WHEN YOUR AREA IS COVERED BY A HURRICANE WATCH**, continue normal activities, staying tuned to radio or television for all National Weather Service advisories. Remember, a hurricane watch means possible danger within 24 hours; if the danger materializes, a hurricane warning will be issued.

MEANWHILE, KEEP ALERT. IGNORE RUMORS.

4) **WHEN YOUR AREA RECEIVES A HURRICANE WARNING, PLAN YOUR TIME Before** the storm arrives and avoid the last-minute hurry which leaves you marooned or unprepared.

KEEP CALM until the emergency has ended.

LEAVE LOW-LYING AREAS that may be swept by high tides or storm waves.

LEAVE MOBILE HOMES for more substantial shelter. They are particularly vulnerable to damage during strong winds. Damage can be minimized by securing mobile homes with heavy cables anchored in concrete footing.

MOOR YOUR BOAT SECURELY before the storm arrives, or evacuate it to a designated safe area. When your boat is moored, leave it, and don't return once the wind and waves are up.

BOARD UP WINDOWS or protect them with storm shutters. Danger to small windows is mainly from wind-driven debris. Larger windows may be broken by wind pressure.

SECURE OUTDOOR OBJECTS that might be blown away or uprooted. Garbage cans, garden tools, toys, signs, porch furniture, and a number of other harmless items become missiles of destruction in hurricane winds. Anchor them or store them inside before the storm strikes.

STORE DRINKING WATER IN CLEAN BATHTUBS, JUGS, BOTTLES, AND COOKING UTENSILS; YOUR TOWN'S WATER SUPPLY MAY BE CONTAMINATED BY FLOODING OR DAMAGED BY HURRICANE FLOODS.

CHECK YOUR BATTERY-POWERED EQUIPMENT. Your radio may be your only link with the world outside the hurricane, and emergency cooking facilities, lights, and flashlights will be essential if utilities are interrupted.

KEEP YOUR CAR FUELED. Service stations may be inoperable for several days after the storm strikes, due to flooding or interrupted electrical power.

STAY AT HOME, if your home is sturdy and on high ground; if it is not, move to a designated shelter and stay there until the storm is over.

REMAIN INDOORS DURING THE HURRICANE. Travel is extremely dangerous when winds and tides are whipping through your area.

MONITOR THE STORM'S POSITION through National Weather Service advisories.

BEWARE OF THE EYE OF THE HURRICANE. If the calm storm center passes directly overhead, there will be a lull in the wind lasting from a few minutes to half an hour or more. Stay in a safe place UNLESS emergency repairs are absolutely necessary. But remember, at the OTHER SIDE OF THE EYE, the winds rise very rapidly to hurricane force, and come from the opposite direction.

5) WHEN THE HURRICANE HAS PASSED.

SEEK NECESSARY MEDICAL CARE AT RED CROSS disaster stations or hospitals.

STAY OUT OF DISASTER AREAS. Unless you are qualified to help, your presence might hamper first-aid and rescue work.

DRIVE CAREFULLY along debris-filled streets. Roads may be undermined and may collapse under the weight of a car. Slides along cliffs are also a hazard.

AVOID LOOSE OR DANGLING WIRES, and report them immediately to your power company or the nearest law enforcement officer.

REPORT BROKEN SEWER OR WATER MAINS to the water department.

PREVENT FIRES. Lower water pressure may make fire fighting difficult.

CHECK REFRIGERATED FOOD for spoilage if power has been off during the storm.

REMEMBER THAT HURRICANES MOVING INLAND CAN CAUSE SEVERE FLOODING. STAY AWAY FROM RIVER BANKS AND STREAMS.

NOTE: This program is not intended to be used to make life or death decisions. As you know, if you have studied past hurricanes, they seldom maintain constant course and speed. Please don't use this program to predict a storm's path. Instead, please follow the advice of your local authorities. It's always better to be safe than sorry.

THE SAFFIR/SIMPSON HURRICANE SCALE

The Saffir/Simpson Hurricane scale is an index which attempts to relate hurricane intensity to damage potential. This descriptive scale, which ranges over a scale of 1 to 5, is summarized below:

(From NOAA Technical Memorandum NWS NHC 22, "A Tropical Cyclone Data Tape for the North Atlantic Basin, 1886-1983: Contents, Limitations, and Uses", B. R. Jarvinen, C. J. Neumann, and M. A. S. Davis, March 84)

Category 1: Winds of 74 to 95 miles per hour. Damage primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. And/or: Storm surge 4 to 5 feet above normal. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.

Category 2: Winds of 96 to 110 miles per hour. Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. And/or: Storm surge 6 to 8 feet above normal. Coastal roads and low-lying escape routes inland cut by rising water 2 to 4 hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorage torn from moorings. Evacuation of some shoreline residences and low-lying island areas required.

Category 3: Winds of 111 to 130 miles per hour. Foliage torn from trees; large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. And/or: Storm surge 9 to 12 feet above normal. Serious flooding at coast and many smaller structures near coast destroyed; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Flat terrain 5 feet or less above sea level flooded inland 8 miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.

Category 4: Winds of 131 to 155 miles per hour. Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. And/or: Storm surge 13 to 18 feet above normal. Flat terrain 10 feet or less above sea level flooded as far as 6 miles. Major damage to lower floors of structures near shore due to flooding and battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Major erosion of beaches.

Massive evacuation of all residences within 500 yards of shore possibly required, and of single-story residences on low ground within 2 miles of shore.

Category 5: Winds greater than 155 miles per hour. Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. And/or: Storm surge greater than 18 feet above normal. Major damage to lower floors of all structures less than 15 feet above sea level within 500 yards of shore. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required.

SMALL-CRAFT ADVISORY: When a hurricane moves within a few hundred miles of the coast, advisories warn small-craft operators to take precautions and not to venture into the open ocean.

GALE WARNING: When winds of 38-55 miles per hour (33-48 knots) are expected, a gale warning is added to the advisory message.

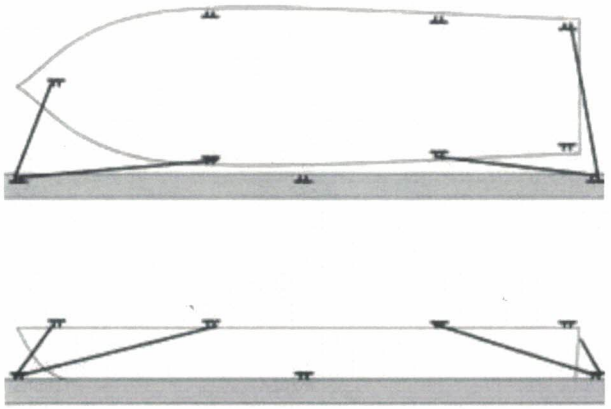
STORM WARNING: When winds of 55-74 miles per hour (48-64 knots) are expected, a storm warning is added to the advisory message. Gale and storm warnings indicate the coastal area to be affected by the warning, the time during which the warning will apply, and the expected intensity of the disturbance. When gale and storm warnings are part of a tropical cyclone advisory, they may change to a hurricane warning if the storm continues along the coast.

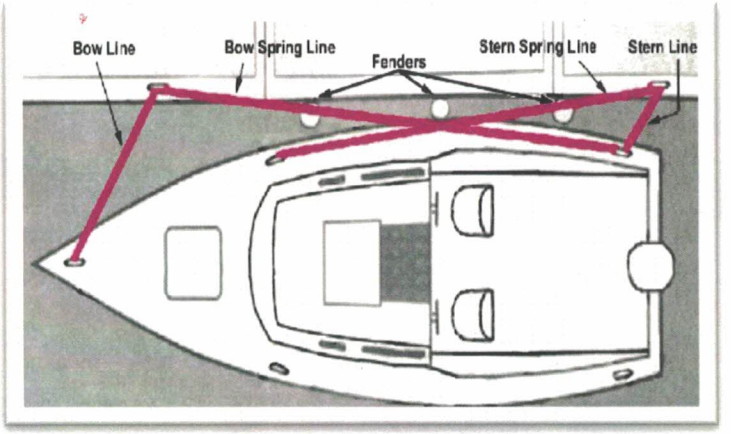
HURRICANE WATCH: If the hurricane continues its advance and threatens coastal and inland regions, a hurricane watch is added to the advisory, covering a specific area and duration. A hurricane watch means that hurricane conditions are a real possibility; it does not mean they are imminent. When a hurricane watch is issued, everyone in the area covered by the watch should listen for further advisories and be prepared to act quickly if hurricane warnings are issued.

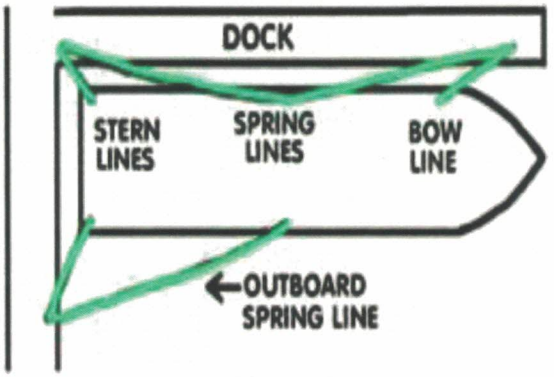
HURRICANE WARNING: When hurricane conditions are **expected within 24 hours**, a hurricane warning is added to the advisory. Hurricane warnings identify coastal areas in which winds of at least 74 miles per hour are expected to occur. A warning may also describe coastal areas in which dangerously high water or exceptionally high waves are forecast, even though winds may be less than hurricane force.

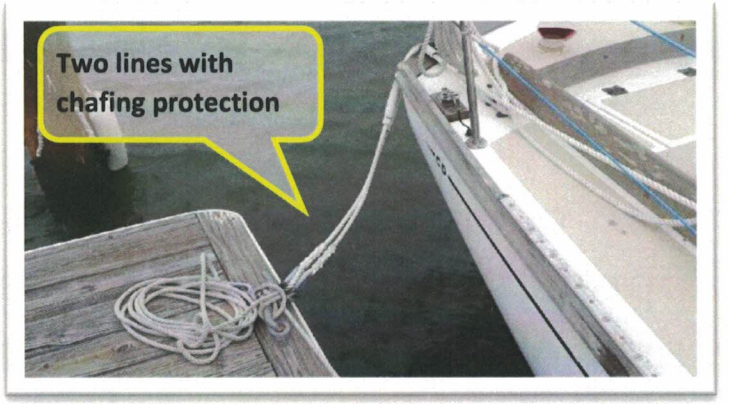
When a **HURRICANE WARNING** is issued, all precautions should be taken immediately. Hurricane warnings are seldom issued more than 24 hours in advance. If the hurricane's path is unusual or erratic, the warnings may be issued only a few hours before the beginning of hurricane conditions. Precautionary actions should begin as soon as a hurricane warning is announced.

FLOATING DOCK MOORING EXAMPLES

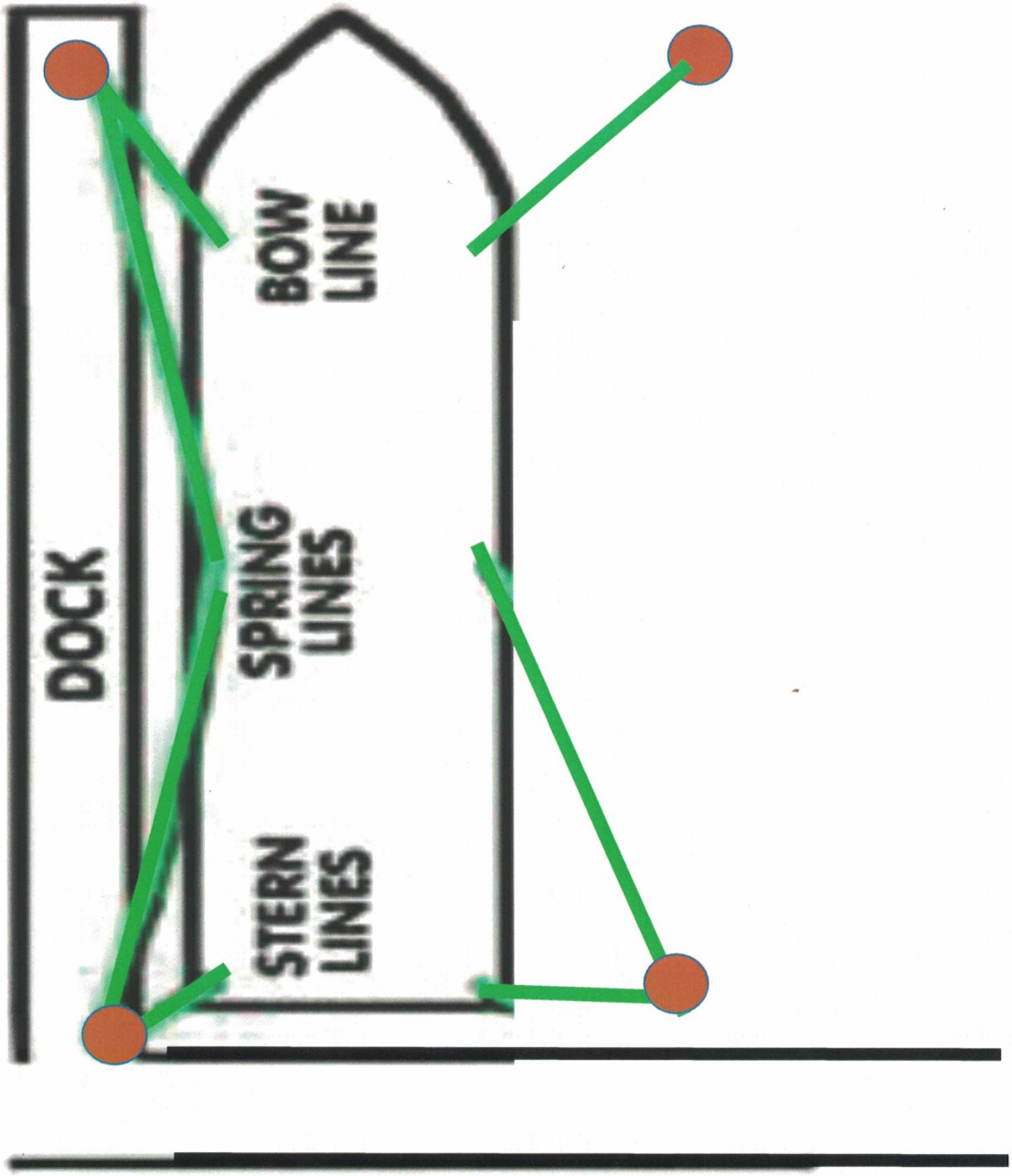








FIXED DOCK MOORING EXAMPLES



The use of multiple lines are suggested when preparing for approaching hurricane, lines size will depend on vessel size and cleat size. Be sure to use chafing protection at critical points. Chain and shackels around the wooden piling are allowed for storm purposes.

Preparing For A Hurricane

Wind, Rain And Surge

Tropical storms may be unpredictable, but one thing you can predict is that if one hits your marina, your boat is far more likely to survive if you have a preparation plan and follow it.

Long-range forecasters have learned that trying to predict the number and intensity of the next season's tropical storms is like herding cats. Weather patterns such as El Niño/La Niña, wind shear, and even Saharan desert dust affect the development of tropical storms, and these intertwined variables can confound the best prognosticators, even as the season is starting. As an example, the 2013 season was predicted to have more than average activity, yet it was (thankfully) a yawn. The 2012 season, on the other hand, had twice as many hurricanes as predicted (including Superstorm Sandy). Tropical storms, it seems, don't care about forecasts, and all it takes is one big storm that comes ashore to make seasonal predictions irrelevant. The lesson: Don't wait for the season's forecast before you develop your tropical-storm preparation plan, which is nothing more than knowing what, where, how, and when.

What To Expect

Tropical storms, including hurricanes, produce wind, rain, waves, and surge in proportions rarely experienced by boaters, and storm damage is usually due to a combination of these factors. A good preparation plan has to take all of these elements into consideration and the time to develop one is now, not when a storm is approaching.

How To Prepare For Wind

Removing the mast in smaller sailboats greatly reduces windage.

By definition, tropical storms have winds of at least 39 mph (which is when storms get a name) while hurricanes start at 74 mph and have been recorded at more than 150 mph. What's not always understood is that as the speed of the wind doubles, its force quadruples. In other words, the damage wind does increases much faster than its speed. This illustrates the importance of reducing your boat's windage — the area your boat presents to the wind — by removing as much rigging, canvas, and deck gear as possible. Whether your boat is stored ashore or stays in its slip, the less stuff the wind is able to push around, the safer your boat will be. Biminis are sure to get shredded in a strong storm, so take off the fabric and the frames. Strip off outriggers, antennas, running rigging, booms, life rings, and dinghies. Remove cowling ventilators and seal the openings. Furled headsails have a surprising amount of windage and are one of the first things damaged by wind, so they must be taken down. Not only can they shake your rig apart when they unfurl (and no matter how well you secure them, in a big storm they probably will), they can cause damage to your neighbor's boat as well. Mainsails are bulky and should be removed also.

How To Prepare For Rain

Rainfall of six to 12 inches in 24 hours is common during a hurricane, and as much as two feet can fall in a day. Cockpit scuppers can be overwhelmed by such torrents, and even boats stored ashore can suffer damage if rainwater overflows into the cabin. Boats stored in the water can be sunk when rainwater backs up in the cockpit and the weight forces deck drains underwater, causing them to backflow.

Make certain cockpit drains are free-running. If your boat is staying in the water, remove heavy items from the stern area, such as anchors, extra fuel tanks, and kicker motors, so that the cockpit scuppers are higher above the water. Close all but cockpit drain seacocks and plug the engine's exhaust port. Use masking or duct tape to seal around hatches, ports, and lockers to keep water from getting below. Seal

exposed electronics. Make sure the bilge pump and switch work, and that the battery is topped up; shore power is not likely to remain on throughout the storm. Keep in mind that the ability of the pump and battery to remove water is usually greatly overestimated. Small boats should be covered if possible.

How To Prepare For Waves

Tropical storms build up surprisingly large waves quickly, even in relatively small harbors, bays, and lakes. The longer the distance over which the wind can build up waves, the bigger the waves. Waves make boats bounce in their slips, displacing fenders and increasing strain on docklines.

Exposure to waves can pound a boat against the dock. Small boats should be trailered inland.

Double up on docklines and make sure all are well-protected from chafe. While fenders and fender boards won't compensate for poor docking arrangements, if the boat is well-secured, they may offer some additional protection, especially if they are heavy duty. Smaller boats can be overwhelmed, especially if they are stern-to to the waves. The bow is strongest and least likely to be overcome by water and should face into the waves.

How To Deal With Surge

Chandleries sell out of line, chafe guards, and fenders quickly, so buy what you need now.

Surge is rising water caused by a tropical storm, and it could very well be the highest an area has ever experienced. The strong wind from a storm causes water to pile up on top of any local tides. On a fixed dock, a boat will rise as much as 10 feet or more and it must be tied loosely enough to allow it to rise, but not so loose that it bangs against the dock. Long lines taken to an adjoining dock or piling and long spring lines will allow the boat to move up and down while still holding it in position. Floating

docks rise with the surge, but if it's high enough, the surge can float the docks right off the pilings. If the predicted surge is anywhere near as high as the pilings, the boat must be moved, preferably ashore. BoatUS claims data show that boats are nearly always safer when hauled out. But, as Superstorm Sandy showed, in an exceptionally high surge even hauled boats can be floated off their stands. On average, those boats fared better, though, than those in their slips, many of which were carried away with their docks.

How to secure your boat

No matter where you've decided to keep your boat -- in a marina, at a dock, in a canal, hurricane hole or on a mooring, there are several additional points to consider: chafe, cleats and chocks, and windage. Hurricane-force winds exert tremendous strains on boat's hardware.

Wind force, and the damage it causes, increases exponentially. A doubling of wind speed increases the force on your boat four times. For example, a 20-knot wind exerts a force of 1.3 pounds per square foot; doubling the speed to 40 knots quadruples the pressure to 5.2 pounds per square foot.

Chafe protectors are essential on all lines, wherever you keep your boat. Unprotected lines will chafe and sever within minutes under the rigorous conditions of a hurricane. Boats on a mooring are particularly vulnerable because the boat is usually held in place using only two pennants; the enormous forces generated are concentrated on only two lines.

Depending on your boat, wave surge may increase loading by 1.5 times the values shown. These same forces are transmitted to the mooring; make sure all eye splices have thimbles to reduce wear at the attachment point on the mooring.

Nylon line is well known for its ability to stretch under loads. Under severe loading, however, friction from stretching increases the internal temperature of the line to the point of meltdown. Heat from increased chafe accelerates the wearing process. Normal chafing gear is totally inadequate under hurricane conditions. Chafe protectors must be strong and longer. Remember, you'll be using longer lines, increasing the percentage of stretch over a given distance. You can make your own protectors using heavy canvas (rubber or neoprene hose may cause trapped heat to melt line). If your chocks will accommodate two layers, add a second layer over the first. Heavy-duty canvas can be purchased through industrial vendors. Check with your local fire department -- they sometimes discard used fire hose, which can be fabricated into high-quality, low-wearing chafe protectors.

Secure the chafe protectors to the docking lines. Canvas protectors can be sewn or tied to the line in a similar fashion.

Lines should also be larger in diameter to resist chafe and excessive stretching. Generally you should use 1/2-inch line on boats up to 25 feet, 5/8-inch line for boats 25 to 34 feet and 3/4 to one-inch line for larger boats. Double up on critical lines. Use chafe gear wherever the line comes in contact with anything such as chocks, pulpits, pilings or trees.

Longer, larger and more numerous lines will require larger cleats and chocks. In addition, the extra forces exerted during a hurricane will require stronger attachments of the cleats to the deck. Determine the size of lines you'll be using and, if necessary, add bigger cleats to accommodate them.

Beef up your dock cleats by adding backing plates if your boat doesn't already have them -- unbacked cleats may pull out of the deck under heavy loads. Use stainless steel plates. Make sure you use the largest size screws that will fit through the mounting holes in the cleats. Use cleats with four mounting holes for added strength. Don't overload a single cleat -- two lines per cleat should be the maximum. If your docking plan calls for more lines than there are cleats available, install additional cleats. Check windlass mounting points as well. The windlass should be mounted solidly with appropriately sized hardware and backing plates.

Boats with keel-stepped masts can also use the mast as a line termination point. Don't run a line attached to your mast through a deck chock -- the extra line length between the mast base and the chock will allow excessive stretch between the two points, increasing chafe at the chock.

Reducing windage

Remove everything to reduce wind resistance: Biminis, antennas, deck-stowed anchors, sails, running rigging, booms, life rings, dinghies and so on. Besides reducing windage, you eliminate the probability of these items being damaged or blown away.

Remove furling headsails. Even when furled, they offer a sizable amount of wind resistance and additional load on the headstay. And despite your best attempts to secure properly the furling line, the ravages of hurricane force winds most likely will unravel your efforts, allowing the sail to unfurl during the storm with disastrous consequences.

Arrange your halyards to reduce flogging and damage, both to the fittings on the halyard and to the objects in their path. One method to eliminate halyard slapping and windage is to tie all halyards off to a common messenger line and run the halyards to the top of the mast, reducing the number of lines exposed to the wind from as many as three or four to only one. Tie the messenger off on a rail.

Preventing water damage

Rain during a hurricane flies in every direction including up. Remove all cowl ventilators and replace with closure plates or tape off the vents using duct tape. Make sure Dorade box and cockpit drains are clear of debris. Close all seacocks except those used for drainage. Put bung plugs in unused thru-hulls and one in the exhaust to prevent water from flooding your engine. Deck drains and pump discharges located near the waterline can back flow when wind and waves put drains underwater.

Use duct tape and precut plywood panels to cover exposed instruments. Examine all hatches, ports, coaming compartments and sea lockers for leaks. Use duct tape to seal them off. Make sure that all papers (magazines, books, catalogs) are high enough in the boat to prevent them from getting wet if the cabin is flooded. Wet paper can turn into a pulpy mush, clogging bilge pumps. Prepare two lists: one listing all items to be removed from the boat prior to moving it to where it will ride out the hurricane and another listing all equipment needed to prepare your boat for the blow.

Electronics are particularly susceptible to water damage; if they can be removed from the boat quickly, add them to the list, along with clothing and other personal effects. Other items that should be removed include: outboard engines, portable fuel tanks, propane tanks, important ship's papers and personal papers, as well as any other essential personal effects.

What to bring aboard

The list of items to be taken aboard include everything you've assembled beforehand to prepare your boat. Many times, the extra "hurricane only" items will be stored ashore -- a well-organized list ensures nothing is missed when the hurricane package is taken aboard: extra lines, chafing gear, fenders, anchors, swivels, shackles, duct tape, bung plugs -- all the items identified during your planning session. Include a dinghy or some other method for getting ashore after you've secured your boat.

Make sure your batteries are fully charged. If needed, take additional batteries aboard to boost available capacity.

During your test run, make a diagram of how your mooring/docking lines will be arranged. Note any additional equipment you'll need to secure your boat and add it to the list.

Time is of the essence

Many of the above items will require a substantial amount of time to complete, considerably more than can be accomplished when a hurricane threatens your area. Chandleries will run out of gear quickly when a hurricane looms. After developing your survival plan, purchase and assemble the gear you need to implement it.

Finally, leave early! Waiting to take action until a storm's imminent arrival is inviting disaster. A hurricane warning is issued when sustained winds exceeding 64 knots are expected within 24 hours. Hurricane-proofing your house or evacuating the area will take precedence over boat safety. Winds may rise quickly. Securing a boat in 35-knot winds is extremely difficult; it's impossible in 45-knot winds.

A hurricane watch is issued when hurricane conditions pose a threat to a specific coastal area within 36 hours. Drawbridges may be locked down after a watch is issued. You may find your secluded hurricane hole or protected canal inaccessible or already filled with boats.

Start moving as soon as you feel a hurricane watch is probable. Don't rely on emergency services for assistance. Many harbor and marine patrols remove their vessels from the water or sequester them prior to the onset of storm and hurricane force winds.

After you've secured your boat, double-check everything. Turn off all electrical power except the bilge pumps. Test bilge pump switches and pump intakes for debris.

Don't stay on your boat! Fifty percent of all hurricane-related deaths occur from boat owners trying to secure their boats in deteriorating conditions. Develop a well-thought-out hurricane plan, be prepared to implement it in the shortest possible time and, when completed, leave the boat to its own survival. There is absolutely nothing you can do when hurricane force winds are screaming across the deck.

It's been decades since William Redfield's serendipitous discovery of the rotary motion of tropical storms. And the cirrus clouds first observed by Father Benito Viñes still race across a clear, blue, tropical sky ahead of an approaching hurricane. His early warning system has been replaced by weather satellites and advanced computer forecasting systems. Scientists can now predict, with reasonable accuracy, the approximate number of tropical storms and hurricanes that will form in a given season. Watchful electronic eyes constantly beam down updates of their wanderings as they relentlessly gnaw and churn across their expansive ocean feeding grounds.

But the best efforts to predict the path or the intensity of a storm at a given moment still escapes even the best scientists and the most advanced computers. Vilhelm Bjerknes, an eminent meteorologist, accurately describes the physicist's present attempts at hurricane forecasting: We are in a position of the physicist watching a pot of water coming to a boil. He knows intimately all the processes of energy transfer, molecular kinetics and thermodynamics involved. He can describe them, put them in the form of formulas and tell you a great deal about how much heat will boil how much water. Now ask him to predict precisely where the next bubble will form.

THE BOATER'S GUIDE TO

BoatU.S. MARINE INSURANCE

PREPARING BOATS & MARINAS FOR HURRICANES

Boat owners from Maine to Texas have reason to become edgy in the late summer and fall: Each year, on average, two hurricanes will come ashore somewhere along the Gulf or Atlantic coast, destroying homes, sinking boats, and turning people's lives topsy-turvy for weeks, or even months. This year, who knows? Florida is struck most often, but every coastal state is a potential target.

Experts predict that in the next 20 years there will be much more hurricane activity than has been seen in the past 20 years. Experts also fear that after a number of storm-free years, people in some of the vulnerable areas will be less wary of a storm's potential fury. But to residents of North Carolina and Virginia, crippled by Isabel in 2003, and people in Florida, ravaged from four giant storms in 2004, the hurricane threat won't soon be forgotten.

Developing a Plan

If you own a boat, the first step in developing a preparation plan is to review your dock contract for language that may require you to take certain steps or to leave the marina when a hurricane threatens. Ask the marina manager what hurricane plan the marina has in place.

Planning where your boat will best survive a storm, and what protective steps you need to take when a hurricane threatens, should begin *before* hurricane season. The BoatU.S. Marine Insurance claim files have shown that the probability of damage can be reduced considerably by choosing the most storm-worthy location possible and having your plan ready long before a hurricane warning is posted.

Knowing What to Expect

Preparing a Boat for a Hurricane Means Defending Against Wind, Rain, Waves, and High Water—All in Proportions Rarely Experienced by Boaters. Claim Files from Past Storms Show That Damage Is Usually Due to a Combination of These Factors.

SURGE

The damaging influence of high water, or storm surge, is often underestimated in preparing a boat for a storm. Storm surge raises the water level far above normal high tide, cutting off roads, forcing evacuation, and lifting boats above their docks and pilings. Surge accounts for major damage to boats because it puts docks and dockline arrangements underwater as the boat tries to float above.

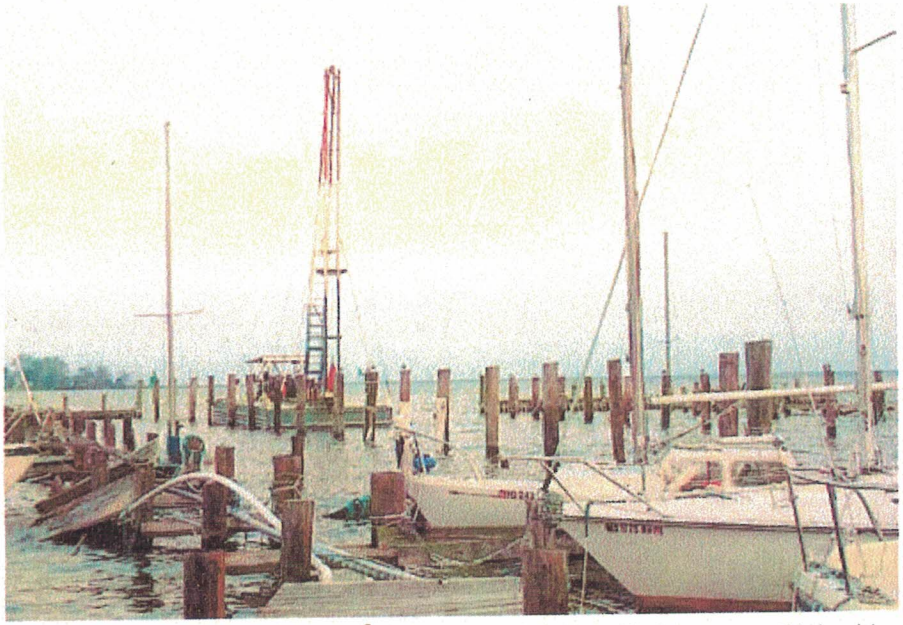
Surge is the result of several factors. Due to low barometric pressure, the ocean surface is drawn upward forming a mound about one foot higher than the surrounding ocean. Large swells generated by the storm reach land first, while storm winds drive water toward the coast. As the storm makes landfall, water levels 10 to 20 feet above normal high tide are possible. Surge is responsible for extensive flooding and much of the loss of life that accompanies a hurricane. Dangerous high tides can reach outward 20 to 50 miles from the storm's center. Surge makes extra length and positioning of docklines critical.

WIND

A hurricane, of course, brings high winds. Wind speeds of 70 to 130 mph are common, and winds over 200 mph have been recorded. What may be less understood is the force created by such winds. When wind speed doubles, the wind pressure quadruples. To put it in practical terms, when the wind speed increases, the damage it causes increases at a much greater rate. This illustrates the importance of reducing the boat's windage, which is the amount of area your boat presents to the wind, by removing as much rigging, canvas, and deck gear as possible, and facing the bow toward the greatest exposure.

WAVES

Waves in the ocean have tremendous energy and can reach mountainous heights. But even in relatively small harbors, bays, and lakes, waves can build to surprising heights.



A storm surge during Hurricane Isabel combined with normal high tides to overcome this low-lying breakwater. The protected harbor then became an open bay and many of the boats in the harbor either sank or were badly damaged.

In a hurricane, it is not unusual for steep, breaking waves three to six feet high to pound normally peaceful harbors. Seawalls, barrier beaches, and other structures that normally protect docks and moorings are submerged by the storm surge. This has the effect of greatly extending the "fetch," or distance, over which the wind can generate waves.

RAINFALL

Rainfall of six to 12 inches within 24 hours is normal during a hurricane, with extremes of 24 inches having been recorded. A hurricane that struck Puerto Rico in 1928 is estimated to have dumped over two-and-a-half billion tons of water on the island. Boats that are spared the worst high water and wind still can be sunk by the torrential rain. Cockpit decks are seldom 100% watertight, and the ability of a bilge pump and battery to handle rain accumulation is greatly overestimated. Deck drains and pump discharges located near the waterline can backflow when waves and rain put drains underwater.

TORNADOES

Tornadoes are sometimes spawned by hurricanes. Of the 46 people who died during Hurricane Carla in 1961, 11 were killed by tornadoes. Little can be done to protect a boat from a tornado. The possibility of a twister, however, is a strong reason for you, your family, and your boat, if it is trailerable, to be far from the coast when a hurricane makes landfall.

Recommended Reading:

Chapman: Piloting, Seamanship, & Small Boat Handling, by Elbert Maloney. 632 pages. Hearst Marine Books.

The Complete Book of Anchoring and Mooring, Second Edition, by Earl Hinz. 331 pages. Cornell Maritime Press.

Oceanography and Seamanship, by William Van Dorn. 463 pages. Dodd, Mead & Co.

Where to Keep Your Boat

Securing a Boat Ashore

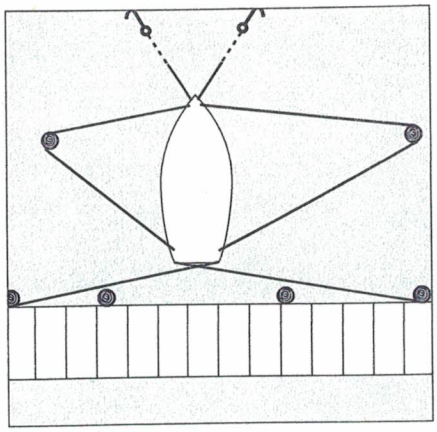
Going back as far as Hurricane Alicia in 1983, BoatU.S. Hurricane Catastrophe Team (CAT) members have spent thousands of hours working to identify and recover damaged boats. They have seen firsthand what works and what doesn't work when a boat is prepared for a hurricane. When asked where they would take their own boats if a hurricane warning were posted, most of said they would have it hauled ashore. For many boat owners and marinas, hauling boats is the foundation of their hurricane plan. Some farsighted marinas and yacht clubs have evacuation plans to pull as many boats out of the water as possible whenever a storm is approaching and secure the rest in the largest available slips.

There are some types of boats that must be pulled if they are to have any chance of surviving. Smaller, open boats and high-performance powerboats with low freeboard, to use two examples, will almost always be overcome by waves, spray, and rain. This is true even if the boats have self-bailing cockpits. Fortunately, most of these boats can be placed on trailers and transported inland.

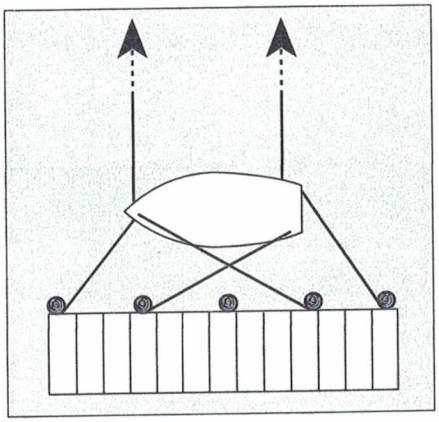
Boats ashore should be stored well above the anticipated storm surge, but even when boats are tipped off jack stands and cradles by rising water, the damage they sustain in a storm tends to be less severe than the damage to boats left in the water.

Windage is also a consideration. If nothing else, reduce windage as much as possible (see "Critical Points") and make sure your boat has extra jack stands, at least three or four on each side for boats under 30' and five or six for larger boats. The jack stands must be supported by plywood and chained together. To reduce windage, some ambitious boat owners on the Gulf Coast have dug holes for their sailboat keels so that they present less windage. Smaller sailboats are laid on their sides.

One technique that has proven to be very effective involves strapping boats down to eyes imbedded in concrete (see cover photo). At least two marinas in Florida and one in Puerto Rico have used straps with excellent results. One of the Florida marinas strapped the boats to eyes imbedded in its concrete storage lot. The other Florida marina and the one in Puerto Rico built heavy concrete runners (similar to long, narrow concrete deadweight moorings) beneath the boats to anchor the straps. Even when the wind has been on the beam and water has come into the storage area, the straps held and boats have stayed upright. An alternative tried at other marinas has been to use earth augers screwed into the ground to secure the straps. Results with the latter technique have been mixed; some have held while others have been pulled out. All things considered, any attempt to anchor a boat on shore is worth the effort.



A sample storm arrangement: note the spring lines, which were the longest lines, are now the shortest. Stern lines are extended one or two slips away. Additional bow lines lead across to the next dock or to storm anchors placed out from the slip.



On a face dock, position the boat farther (the farther, the better) than usual from the dock and add offshore lines to hold the boat away from the dock. Offshore lines can lead to distant pilings or trees, such as across a canal, or to anchors if the bottom provides adequate holding.

When to Take Action

"The time for taking all measures for a ship's safety is while still able to do so. Nothing is more dangerous than for a seaman to be grudging in taking precautions lest they turn out to have been unnecessary. Safety at sea for a thousand years has depended on exactly the opposite philosophy."

—Admiral Chester W. Nimitz

A hurricane "warning" advisory is posted when sustained winds of 74 mph or higher are expected within 24 hours or less—too late, in most situations, to head for the boat. Securing the house, gathering emergency provisions, and evacuating the family will need attention at this point.

A hurricane "watch" is posted when hurricane conditions pose a threat to a specified coastal area, usually within 36 hours. Some hurricane observers believe waiting for a watch to be posted also may be too late to head for the marina or to move the boat to a safer location.

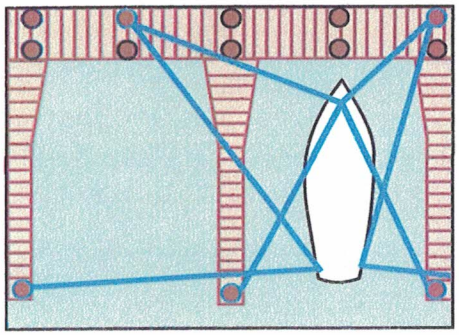
Even watching the barometer, which is helpful for some weather patterns, can't tell you when to prepare for a hurricane. The extreme low pressure associated with a hurricane occurs close to the eye of the storm—too late to predict landfall.

The best advice is to prepare or move your boat when a hurricane is a substantial possibility, even before a watch is issued. If you wait longer, and your plan includes relocating the boat, bridges may be locked down and the hurricane hole you choose may be inaccessible. Or, if you plan to have your boat weather the storm ashore, you may find the marina is too busy to haul your boat.

Securing a Boat in the Water

Two problems with the storm-worthiness of this marina: First, the boat is exposed to far too much open water. Second, the condition of the pilings is abysmal. In the event of a hurricane, this boat would have to be moved.

Several years ago, the 6′ pilings that anchored the floating docks at this Virginia marina were replaced with 18′ pilings. When Hurricane Isabel came up the Potomac in 2004, all of the boats survived the 14′ surge with no damage. Had the pilings not been replaced, damage at the marina would have been extensive.



The larger the slip, the better the chance that a boat will survive a hurricane. When a boat must be left at a dock, moving it to a larger slip (equally well protected) will be a decided advantage. Docklines (the more the better) should be arranged to minimize the chances of the boat coming in contact with the dock and pilings.

Any boat in the water should be secured in a snug harbor (don't even think about riding out the storm at sea unless you're the skipper of an aircraft carrier). The trick is deciding which harbors will still be snug if a hurricane comes ashore and which will be vulnerable. Storm surge—high water—is a major consideration. A storm surge of 10' or more is common in a hurricane, so a seawall or sandy spit that normally protects a harbor may not offer any protection in a hurricane.

Another consideration is rocks. Crowded, rock-strewn harbors are picturesque, but they are not a good place to keep your boat in a storm. Rocks are hard on boats, should yours break loose. If you plan to anchor, the best anchoring is usually in sand, followed by clay, hard mud, shells, broken shells, and soft mud. Also, water can sometimes be blown out of the harbor, leaving boats stranded briefly. If this happens, your boat would rather settle onto anything but rocks.

At a Dock

At a Fixed Dock. Members of the BoatU.S. CAT team estimate that as many as 50% of the boats damaged at fixed docks during hurricanes could have been saved by using better dock lines: lines that were longer, larger, arranged better, and/or protected against chafing. If you decide to leave your boat at a dock, you'll need to devise a docking plan that is liable to be far different than your normal docking arrangement. By the time preparations are completed, your boat should resemble a spider suspended in the center of a large web. This web will allow the boat to rise on the surge, be bounced around by the storm, and still remain in position.

Take a look at your boat slip and its relation to the rest of the harbor. For most boats, you'll want to arrange the bow toward open water or, lacking that, toward the least protected direction. This reduces windage. The exception is boats with swim platforms, especially swim platforms that are integral to the hull. These boats have been sunk when their platforms were bashed against a bulkhead. If your boat's swim platform can't be kept safely away from a bulkhead, secure the boat with its stern toward open water.

Next, look for trees, pilings, and dock cleats—anything sturdy—that could be used for securing dock lines. Not all pilings are sturdy. Old wood pilings that are badly deteriorated (rot, worms) should obviously not be relied on in a storm. The same is true of older concrete pilings, which seem to be more susceptible to snapping in two (and sometimes landing on boats) than their more pliant wood counterparts. Many of the boats that were wrecked in Hurricane Charley had been secured to concrete pilings that couldn't stand up to the lateral stress and twisting. And at least one marina in Pensacola had almost all its concrete pilings fail. All things being equal, wood is a better choice.

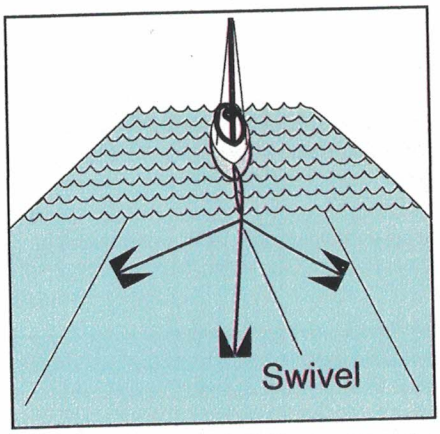
With most docking arrangements, lines will have to be fairly taut if the boat is going to be kept away from pilings. The key to your docking arrangement is to use long lines, the longer the better, to accommodate the surge. (A good rule of thumb: Storm dock lines should be at least as long as the boat itself.) You will probably want to use other boat owners' pilings (and vice versa), which calls for a great deal of planning and cooperation with slip neighbors and marina management.

Lines should also be a larger diameter to resist chafe and excessive stretching. On most boats, you should use 1/2" line for boats up to 25'; 5/8" line for boats 25' to 34'; and 3/4" to 1" lines for larger boats. Chafe protectors (see "Critical Points") must be on any portion of the line that could be chafed by chocks, pulpits, pilings, etc. To secure lines to hard-to-reach outer pilings, put the eye on the piling so that lines can be adjusted from the boat. For other lines, put the eye on the boat to allow for final adjustment from the dock.

At a Floating Dock. Because they rise with the surge, floating docks allow boats to be secured more readily than boats at fixed docks. There's no need to run lines to distant pilings because the boats and docks rise in tandem. Floating docks only offer protection from the surge, however, if—a HUGE if—the pilings are tall enough to accommodate the surge. In almost every major hurricane, there have been instances where the surge has lifted floating docks up and over pilings. When that happens, the docks and boats, still tied together, are usually washed ashore in battered clumps.

This sailboat was tied off in a canal in Gulf Breeze, Florida using three large anchors and 13 lines to shore. Despite considerable damage to other nearby boats and homes, the sailboat survived Hurricane Ivan without so much as a scratch.

Anchors used in tandem give you the advantage of 100% holding power of both anchors simultaneously. Use only chain to join the anchors before setting. Tandem rigs should be prepared well in advance of the hurricane season, as it is usually necessary to weld a pad eye to the trailering anchor.



Using three anchors set 120° apart allows the boat to swing and face the wind. This is an especially good technique if the boat must be moored in a crowded harbor because the boat will not swing in as wide an arc as a boat that is riding on only two anchors.

For more damage-avoidance articles to help prepare your boat for a hurricane, go to **BoatUS.com/hurricanes**. The site includes up-to-date information on active hurricanes, including tracking models and NOAA forecasts.

If you plan to leave your boat at a floating dock, it's critical that you measure the height of the pilings—will they remain above the predicted storm surge? Pilings that are only six or seven feet above the normal high tide probably won't be safe. When floating docks have been rebuilt after hurricanes, the new pilings have almost always been much taller, about 18' tall, and are far less likely to be overcome by surge than the six- to eight-foot pilings that they replaced. Taller pilings are much more "storm proof."

Hurricane Holes: Canals, Rivers, and Waterways

Whenever canals, rivers, or waterways are available, they serve as shelters—hurricane holes—and offer an attractive alternative to crowded harbors and marinas. Your mooring arrangement will depend on the nature of the hurricane hole.

In a narrow residential canal, a boat should be secured in the center with several sturdy lines ashore (the "spider web") to both sides of the canal. This technique was common to most of the boats in canals that survived recent hurricanes. Conversely, boats that were left at docks without the benefit of lines to both sides of the canal didn't fare any better than boats at marina docks.

The boat should be facing the canal's entrance and be as far back from open water as possible. Besides sheltering the boat, being away from the entrance should help with another consideration, which is the need to maintain a navigable waterway.

Securing boats in residential canals is possible only if you make arrangements with the homeowners whose trees and pilings you will be using to secure your boat. This can be difficult if your boat isn't normally moored in the canal. If your boat is already in the canal, getting other homeowners involved in planning for a hurricane increases the chances that your boat (and theirs) will survive. This is important. All it takes to wreak havoc in a narrow canal is one or two neglected boats coming loose.

In wider canals and waterways, boats should be secured using a combination of anchors and lines tied to trees ashore. More lines and anchors are always better. Try to find a spot that is well away from open water and that has tall banks, sturdy trees, and few homes. Moor your boat away from the main channel. Other considerations: A hurricane hole that ordinarily takes an hour to reach may take two hours to reach when winds and seas are building; bridges may not open as frequently once a hurricane warning has been posted; or the bridges may be locked-down to evacuate cars. Plan on moving your boat early.

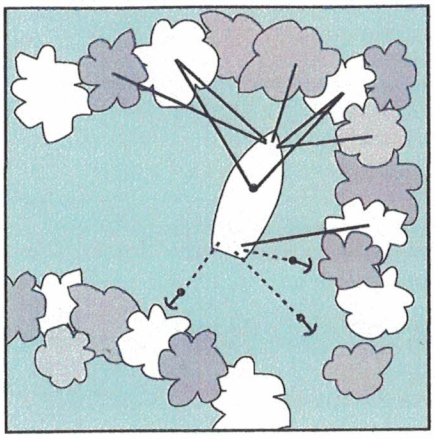
At a Mooring, at Anchor, or Both

Mooring in a sheltered location can also be a good alternative to exposed harbors and/or crowded marinas. A boat on a mooring can swing to face the wind, which reduces windage, and it can't be slammed into a dock unless the mooring or anchor drags.

The first question, then, is: Will your mooring hold? As a result of numerous moorings being dragged during recent hurricanes and northeasters, a search has been underway for a more secure mooring anchor. A study by the BoatU.S. Foundation, *Cruising World* magazine, and Massachusetts Institute of Technology (MIT) found that a 500-lb. mushroom buried in mud could be pulled out with 1,200 lbs. of pull (supplied by a 900-hp tug); an 8,000-lb. deadweight (concrete) anchor could be pulled out with 4,000 lbs. of pull. A helix morring, however, could not be pulled out by the tug and the strain gauge recorded 12,000 lbs. of pull—its maximum—before a shackle was burst apart by the strain. Scope in each case was slightly less than 3:1. (In another helix test, a strain gauge had registered 20,800 lbs. before the hawser snapped.)

The holding power of a mushroom or deadweight mooring anchor can be increased by extending the pennant's scope, which has as much to do with holding power of a mooring as the anchor itself. (Additional scope, while always advantageous, appears to be less critical with helix anchors.) Studies have found that when the angle of pull increases to 25°, a mooring's holding power begins to weaken precipitously. So in shallow harbors, where a scope of 3:1 can be had with, say, 20'- 30' of chain, the advantage of scope is all but eliminated in a storm by a combination of a large tidal surge and the high, pumping motion of waves. Note that in a crowded harbor, scope must be increased uniformly on all boats.

Finally, when was the last time your mooring's chain was inspected? Chain that is marginal in the spring will not be sufficiently strong at summer's end to stand up to a hurricane. A harbormaster should know how long your chain has been in use and whether its condition could be iffy.



One boat that survived Hurricane Andrew was secured in a mangrove channel with eight 5/8" lines to shore and three large anchors: a 60-lb. Danforth; a 37-lb. Fortress; and a 45-lb. Bruce. Each of the lines had 10′ of slack to allow for the tidal surge.

Most boats do well on trailers in a hurricane. The exception is deep-draft sailboats, which are vulnerable when the wind is on the beam. Whenever a sailboat with a deep keel is stored on a trailer, jack stands should be used to provide additional support.

A boat on davits is extremely vulnerable to storm surge. If possible, store the boat ashore.

If you have any doubts about your mooring, the chances of it failing can be reduced significantly by using one or two additional storm anchors to enhance its holding power and to decrease the room your boat will need to swing.

At Anchor

As with moorings, conventional storm anchors rely on scope—at least 10:1 if possible—to increase holding power. Heavy, oversize chain is also recommended; 50/50 is probably the optimum chain-to-line ratio. In theory, a riding weight, or sentinel, placed at the chain/line juncture will lower the angle of pull on the anchor and reduce jerking and strain on the boat. During a hurricane, however, its value will be diminished by the extreme pressure of wind and waves and a sentinel (and the weight of the chain) should never be relied on to compensate for lack of scope. To absorb shock, an all-chain rode must have a snubber (usually nylon line) that is 30% of the rode's length. Without the nylon line, the surging waves and intense gusts are much more likely to yank the anchor out of the bottom.

BoatU.S. CAT team members have consistently found boats that used single working anchors were much more likely to have been washed ashore. Conversely, more and larger anchors (suited for the type of bottom) increased a boat's chances of staying put. One CAT team member says he is impressed with the number of boats that ride out storms successfully using two large anchors with lines set 90° apart. With this technique, one rode should be slightly longer than the other so they won't become tangled should they drag. Even more staying power can be had using the tandem anchoring technique—backing each anchor with a second anchor. Using tandem anchors allows the first anchor to dig a furrow so that the second can dig in even deeper (see diagram, page 5). A study done by the U.S. Navy (Technical Note CEL N-1707, October 1984) found that the use of tandem anchors yields a 30% improvement over the sum of their individual holding powers.

One more important note: Chafe gear is essential on any line, but it is especially important on mooring and anchor lines. Recent storms have given dramatic evidence that a boat that is anchored or moored is especially vulnerable to chafing through its pennants (see "Critical Points"). Unlike a boat at a dock, which is usually more sheltered and secured with multiple lines, a boat on a mooring is more exposed to wind and wave and will typically be secured with only two lines. Lines on the latter will be under tremendous loads and will chafe through quickly if they aren't protected.

Trailerable Boats

A trailer is, or should be, a ticket to take your boat inland to a more sheltered location away from the tidal surge. But your boat won't get far on a neglected trailer that has two flat tires and rusted wheel bearings. Inspect your trailer regularly to make sure it will be operable when it's needed.

If you take your boat home, you may want to leave it, and not your car, in the garage. A boat is lighter and more vulnerable to high winds than a car. If this isn't practical, put the boat and trailer where they will get the best protection from wind, falling branches, etc.

Let some air out of the trailer tires and block the wheels. You can increase the weight of lighter outboard boats by leaving the drain plug in and using a garden hose to add water. (Rain will add a lot more water later.) This has the added advantage of giving you emergency water (non-drinking) if the main water supply gets knocked out by the hurricane. Place wood blocks between the trailer's frame and springs to support the added weight. On a boat with a stern drive, remove the drain plug so that the engine won't be damaged by flooding.

Secure the trailer to trees or with anchors or augers. Strip all loose gear, bimini tops, canvas covers, electronics, etc. and then lash the boat to the trailer.

Boats on Davits and Lifts

When asked, "Where wouldn't you want your boat to be in a hurricane?" just about all of the BoatU.S. CAT Team members consistently say they wouldn't want their boat to be on a hoist or lift. Damage to boats on lifts has been high and has included boats being blown off cradles; bunk boards breaking (and spilling the boats); boats grinding against lift motors and pilings; boats being overcome by the storm surge; and boats filling with

High-rise storage racks can be toppled by a storm's high winds. Especially if your boat is in an older building, consider putting it on a trailer and moving it further inland.

rainwater and collapsing lifts. Have any boats on lifts survived? In areas that have been hard hit, the answer is not many. The few that did survive were typically subjected to only a slight surge, and the lift had been secured so that the boat and its cradle couldn't be tossed around by the wind. Whenever possible, boats on lifts or davits should be stored ashore or moved to a safer location in the water (dock or anchorage).

If the boat must be left on its lift, remove the drain plug so the weight of accumulated rainwater will not collapse the lift. (If the tidal surge reaches the boat, it will be flooded, but to leave the plug in place is likely to result in more serious structural damage.) Tie the boat securely to its lifting machinery to prevent the boat from swinging or drifting away. Plug the engine's exhaust outlet and strip the boat. Make sure cockpit drains are free of debris.

Boats on High-Rise Storage Racks

In Hurricane Wilma alone, three large steel storage racks with thousands of boats were collapsed. Typically, older storage racks are more vulnerable than ones that were constructed in the past few years. On newer buildings, the supports will be free of rust and the "loosening" effect of previous storms. Newer ones are also more likely to have been built to a higher standard with more and heavier structural supports to withstand higher winds. (A marina owner should know how much wind a steel building was designed to withstand.) If not, or if there is any doubt about the structure's ability to stand up to an approaching storm, boats on storage racks should be placed on trailers and taken elsewhere.

Note to BoatU.S. insureds: **BoatU.S. Marine Insurance will pay up to $1,000 (half the cost) to haul and block a boat ashore or have it moved by a professional captain.**

Axiom: *Never Stay Aboard in a Hurricane!*

One of the most dangerous mistakes a skipper can make is to stay aboard his or her boat during a hurricane. Several accounts given in claim files indicate that there is little, if anything, a skipper can do to save a boat when winds are blowing over 100 mph, tides are surging, and visibility is only a few feet.

What can happen? Consider the case of a 68-year-old skipper in Charleston, who together with his grown nephew, took their trawler up the Wando River to ride out Hurricane Hugo in what they thought would be a "sheltered" hurricane hole. He reported that the boat seemed to be doing fairly well initially, but later that night the wind picked up to over 100 mph and 15' seas sent the boat crashing completely over.

The two men were trapped briefly in a pocket of air underwater when another wave rolled the boat back upright. They then scrambled onto the deck and were eventually rescued, but not before almost drowning and being overcome by exposure.

Another skipper who stayed aboard his motorsailer at a marina during Gloria had to jump overboard and swim through breaking waves, drifting boats, and debris after another boat broke free and rammed its mast (the boat was on its beam ends) through his boat's pilothouse window. Again, he was lucky to reach shore alive. Two Miami men who stayed aboard a Sportfisherman (not insured by BoatU.S.) during Andrew were not so lucky. They both drowned while trying to escape their battered and sinking boat.

When a hurricane is approaching, you should certainly do everything you can to protect your boat: Secure extra lines, set out anchors, add chafe protection, strip the boat above and below decks, etc. Do whatever it takes, and then head inland. Your boat can be replaced; you can't.

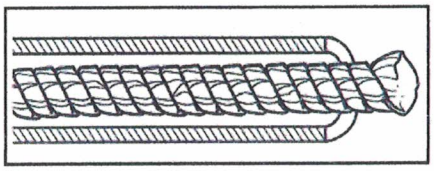
Critical Points

Chafe Gear!

Nylon stretches and absorbs shock, which is good, but this stretching under tremendous loads also works the line against chocks and other contact points. Chafe protectors are essential on all lines: at a dock, at a mooring, or at anchor. At a dock, lines are liable to abrade against chocks, pilings and the dock itself. If your chocks are large enough, fit a second, larger-diameter hose around another hose that fits snugly to the line. Drill holes in both hoses, and use cord to tie them securely to the line. In a pinch, you can use a single hose.

On moorings or at anchor, the line stretched over the edge of the rail can create sufficient heat to melt the line internally. Using hose to protect the line can encourage heat related failure by not allowing water to cool the nylon fibers. One solution is to mount the chocks directly at the rail so that the line won't be worked against a chock. Another is to use polyester (Dacron) line, which `has much less stretch, but is far more chafe resistant than nylon. By using a polyester line from the cleat through the chock and then joining it with a nylon line (use two eyes) to the piling or mooring, you can get the best of both types of line—the chafe resistance of polyester and the stretch of nylon. An alternative is to use polyester sleeves, which are available at chandleries and will protect the nylon lines from chafe while also allowing water to reach the heated fibers.

If you need chafe protection quickly, use duct tape (a lot) to secure several layers of heavy canvas to the lines. It isn't pretty, but works surprisingly well.

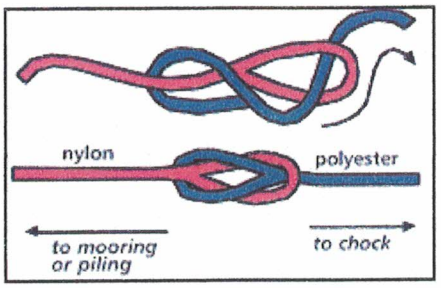


Super system for chafe: use neoprene garden hose at all potential cahfe points. Drill holes and use cord to secure it to the line.

Cleats and Chocks

Many boats have cleats and chocks that are woefully inadequate. This problem becomes critical when more and larger-diameter storm lines are used during a storm. If necessary, add more and larger cleats and chocks now; they'll make securing the boat easier all year.

Assess the ability of cleats to carry heavy loads. This means making sure all are backed properly with stainless steel or aluminum plates. Marine plywood is OK if it's healthy—free of rot and delamination. On sailboats, winches (if backed properly) and even keel-stepped masts can also be used to secure lines at a dock. (NOTE: Anchor lines should NOT be secured to the mast, as it creates that much more stretch on the line at the chock, which further increases the chances of chafe failure.)



Using a polyester line from the cleat through the chock, secured to an existing nylon line to the piling or mooring, gives you better protection from chafe, while also absorbing shock. Make eye splices in both lines with at least five tucks.

Don't put too many eggs in one basket by leading numerous lines to a single cleat, even if it is backed properly. Two lines per cleat is the maximum. Also, a cleat is not reliable when lines are led perpendicular to the base and the cleat can be wrenched out by the tremendous loads (see diagram).

Reduce Windage!

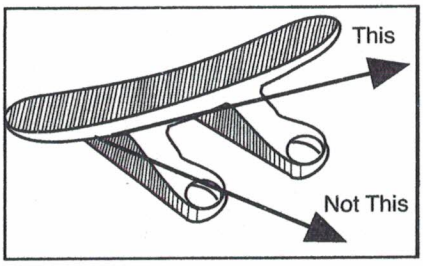
Strip all loose gear that creates windage: canvas covers, bimini tops, outriggers, antennas, anchors, running rigging, booms, life rings, dinghies, portable davits, etc. Remove cowling ventilators and seal the openings. Anything on deck that can't be taken off should be lashed securely.

Unstepping masts on sailboats is strongly advised. If this is impractical, sails—particularly roller furling headsails—must be removed. Roller furling headsails create a lot of windage, especially when they come unfurled, which is almost guaranteed to happen no matter how carefully they're secured. All halyards should be run to the masthead and secured with a single line led to the rail. This reduces windage and minimizes flogging damage to the mast. The line can be used to retrieve the halyards.

Fenders and Fender Boards

Fenders and fender boards won't compensate for a poor docking arrangement in a hurricane. However, when the boat has been well secured, they may offer some additional protection. When asked about fender boards, CAT Team members said they were effective at preventing "dock rash" but only if heavy boards were used with several large fenders. Using only two fenders at either end of a long board wasn't effective; the fenders were either bounced out or the boards broke in the middle.

One example of a system that worked: A member in Punta Gorda said he used several 12" x 32" fenders and a 2" x 10" x 16' fender board at his dock to keep his 50' Sea Ray from banging against a piling during Hurricane Charley. The member credits the fender board for helping to minimize damage to his boat.



Lines led perpendicular from a cleat can wrench the cleat out of the deck. Two-hole cleats are more vulnerable than four-hole cleats.

Preventing Theft

Electronics and other valuable gear should be taken home for safekeeping. Not only are electronics vulnerable when vandals comb through boatyards after the storm, they can also be wrecked by all of the water. Personal belongings and other loose gear (potential missiles) should be taken home and the cabinets and cabin doors secured. All ship's documents should be taken off the boat.

Preventing Water Damage

Remove cowl ventilators and seal the openings. Use duct tape to cover instrument gauges. Duct tape should also be used around hatches, ports, lockers, etc. to prevent water damage below. (Some types of duct tape leave less gummy residue than others.) Close all but the cockpit drain seacocks and shove a plug into the engine's exhaust ports. If the boat does take on water, it will sit lower, and water could back up into the cylinders. (Remember to remove the plug before starting the engine when the storm has passed.)

Boat Owner's Hurricane Worksheet

Use this worksheet, after reading the material in this guide, to adapt it to your own circumstances. Then be sure to distribute copies to your alternates as well as your marina owner/manager.

Boat's Name: _____ Length: ____ Model: ____

Your Name: _____

Address: _____

City: _____ State: ____ Zip: _____

Phone Day: _____ Night: _____

Alternates/Caretakers (if you are not available):

Name: _____

Address: _____

City: _____ State: ____ Zip: _____

Phone Day: _____ Night: _____

Has Boat Keys? _____ Access to Hurricane Equipment? _____

Name: _____

Address: _____

City: _____ State: ____ Zip: _____

Phone Day: _____ Night: _____

Has Boat Keys? _____ Access to Hurricane Equipment? _____

Boat's Current Location: Slip #: _____

Marina Name/Address: _____

_____

List All Equipment Needed Aboard to Prepare Boat:

Equipment	*Current Location*
1. Extra Lines	
2. Chafe Protectors	
3. Fenders	
4. Anchors	
5. Swivels	
6. Shackles	
7. Duct Tape	
8. Plugs (Exhaust Ports)	
9. _____	
10. _____	

List Equipment To Be Stripped from Boat:

Equipment	*Storage Location*
1. Electronics	
2. Dinghy	
3. Outboard/Fuel	
4. Sails	
5. Bimini	
6. Galley Fuel	
7. Ship's Papers	
8. Personal Effects	
9. _____	
10. _____	

Planned Location During Hurricane: _____

_____

If at a Dock: Slip #: _____

Marina Name/Address: _____

_____

Additional Lines #: _____ Length: _____ Size: _____

Chafe Gear: _____ Fenders: _____

If at a Hurricane Hole:

Travel Time by Water from Present Location: _____

Are There Any Bridges? _____

If Yes, Will They Open Prior to Hurricane? _____

Has Owner of Surrounding Land Been Contacted? _____

How Will the Skipper Get Ashore? _____

Type of Bottom: _____ Depth: _____

Additional Anchor Needed: #: _____ Size(s): _____

Type(s): _____

Additional Lines: #: _____ Length: _____ Size: _____

Additional Chain: #: _____ Length: _____ Size: _____

Chafe Gear: _____ Swivel: _____ Shackle(s): _____

If at a Mooring/Anchorage:

Has Mooring Been Inspected Within the Last Six Months? _____

How Will the Skipper Get Ashore? _____

Type of Bottom: _____ Depth: _____

Mooring Line Should Be Extended _____ to Increase Scope

Additional Anchors Needed: #: _____ Size: _____

Type(s): _____

Additional Lines: #: _____ Length: _____ Size: _____

Additional Chain: #: _____ Length: _____ Size: _____

Chafe Gear: _____ Swivel: _____ Shackle(s): _____

Diagram of Proposed Hurricane Docking/Mooring Arrangement:

If Stored Ashore:

Windage Reduced by Stripping Sails, Furling Gear, Bimini, Antennas?

_____

Blocking Adequate for Storm Conditions? _____

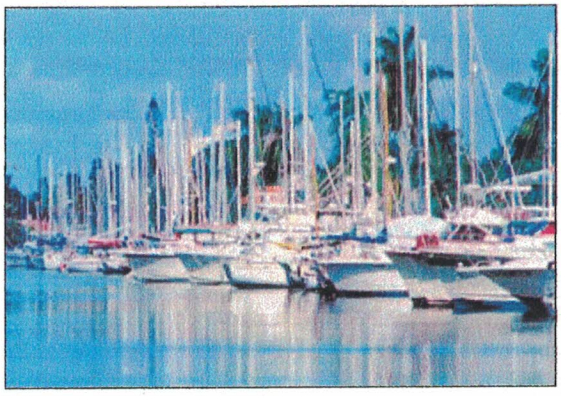
What Arrangements Have Been Made for Hauling? _____

Storage Location: _____

Contact Name (Marina/Property Owner): _____

Phone #: _____

Learning from Experience:
A Guide for Preparing Marinas for Hurricanes



Philip Hale says he sometimes stands in his boatyard and imagines it under four or five feet of water. Philip looks at all of the yard's valuable equipment and he looks at the boats. What could be done to secure all of those boats?

It's a scene that isn't difficult for Hale to imagine. His marina, Martha's Vineyard Shipyard, has been pounded on at least two occasions, by Hurricane Bob in 1991 and then by the big "No-Name" storm that swept up the coast in early 1992. Other marina owners in areas like Louisiana, Mississippi and Florida, who were hit hard by Katrina and Wilma, are plagued by the same sorts of questions. Hurricanes do that to people. What if it happens again?

Experience . . . the Teacher that Gives You the Test First and the Lesson Afterward

One mistake that any responsible marina owner would never make twice is to wait until a hurricane warning is posted to think about hurricane preparations. An extraordinary amount of work has to be done in a short time, perhaps only a few hours, and important decisions have to be made months in advance. Where will boats be stored? If boats are going to be stored ashore, which boats will be pulled first? What arrangements have been made with the owners?

Any hurricane plan ultimately involves people, and one of the first things Hale did after Bob was to put together a list of emergency employees, including many former employees and some local boat owners who are familiar with the boats and boatyard. This emergency staff is organized into teams, each having a specific assignment and leader, who can be called upon to join the regular staff whenever a large storm is approaching.

Most marinas don't have the personnel available to attend to all of the boats, and they depend on boat owners to strip their boats and add extra lines and chafe protection. James Frye, who runs a group of Westrec marinas in Florida, says that in addition to evaluating their own procedures, one of the biggest parts of their new hurricane plan is getting the name of a local alternate for each boat owner who will take care of hurricane preparations if the owner is out of town. There isn't enough time before a storm, Frye says, for marina personnel to take care of all of the boats and still have time left for their homes and families.

Time is critical. At Martha's Vineyard Shipyard, preparations start at the beginning of the boating season by requiring that all boats in the harbor use extra pennants and chafe gear. At other yards, like Burr Brothers in Marion, Massachusetts, a second, extra-heavy pennant is added to boats in the beginning of August, when the hurricane season gets started in earnest. Although boats would still have to be stripped, sails stowed, ports taped, etc., adding extra lines and chafe gear gives marinas and boat owners a valuable head start before a storm.

In the likely event that at least some owners won't be available to prepare their boats, many marinas will haul and/or prepare boats for a fee, but this should be arranged at the start of the season, not in the waning hours before a storm is due ashore. One marina in a particularly exposed Florida location has arranged to have several paid captains available to move boats to a more secure marina further inland. In this case, the agreement was written into the hurricane contract, but extra services usually require a separate agreement.

Hauling Boats

A study by MIT found that boats stored ashore were far less likely to have been wrecked than boats stored in the water, and for many marinas, hauling boats is the foundation of their hurricane plan. Toby Burr at Burr Brothers has a list of boat owners who have agreed to have their boats hauled by the marina whenever a hurricane threatens. The decision to haul boats is left to the marina, and Burr says it puts an extra burden on them to decide at what point a storm might pose a threat. The responsibility is more than offset, however, by the additional time it gives them to evacuate boats.

While almost all of the boats hauled by Burr Brothers for Hurricane Gloria escaped with relatively little damage, boats that were stored ashore during Hurricane Bob were not so fortunate. Unlike Gloria, which came ashore at low tide, Bob came ashore at high tide and many of the boats stored in the yard got knocked off their cradles by the surge. To prevent a recurrence of the damage done by the rising water, Burr Brothers has arranged to receive NOAA charts that predict when and where the surge is likely to be highest. If the surge predicted poses a threat to boats stored ashore, Burr Brothers has a contingency plan to unstep masts so that boats can be moved further inland to higher ground.

Ashley Marina in South Carolina doesn't have the facilities to haul boats, and even if it did, Ed Rhodes at Ashley says the grounds are too close to sea level to offer even minimal protection from tidal surge. Rhodes recommends boat owners take boats to nearby Ross Marina, which has a travel lift and a storage area that is a much safer 15' above sea level. David Browder at Ross acknowledges that many of his regular customers have already made arrangements to have their boats hauled and stored at his yard whenever a storm threatens.

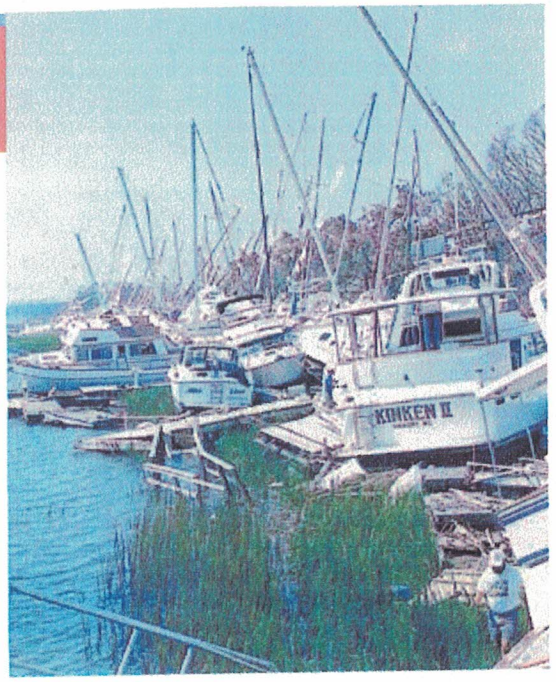
A Model Plan: The Houston Yacht Club

Probably the best known and most comprehensive hurricane plan for a facility was devised by the Houston Yacht Club after Hurricane Alicia wrecked the club's docks and 141 of its members' boats in 1983. The plan, now used as a model for many other marinas and yacht clubs, is anchored by the individual efforts of all its members, each of whom is required to submit a hurricane plan with their harbor rental agreement. Each plan must include details on where the boat will be kept, what equipment is available, and the name of a "boat buddy" who will take care of the boat if the member is sick

Continued on page 11

After the Storm

Some Guidelines to Help Get You Back on the Water Sooner



After a storm has passed and authorities are allowing travel, get to your boat quickly. It is a boat owner's responsibility to protect the boat from further damage, and its equipment from theft, regardless of its condition. If there is severe damage at the marina, you will be needed to help arrange moving the boat. An important task is calling your insurance company. They need to know the exact location and condition of the boat, and will assist you in what steps to take. The BoatU.S. Emergency Dispatch phones are manned 24 hours a day, and will be heavily staffed after a storm to assist BoatU.S. insureds.

Don't take chances. A marina can be a hostile environment after a storm. Leave children and sightseers at home. Be cautious of exposed electrical lines, leaking fuel, sewage backups, missing dock boards, and other dangers. And don't mind if you are challenged to show proof of ownership or asked to keep out of damaged areas. Marina management and authorities should restrict access to damaged and undamaged boats.

Some things to take to the boat include duct tape to secure broken rigging or railings and seal cracks or holes; pencil and paper to inventory damage; and lots of cleaning gear and anti-corrosion spray. Removing salt, mud, and moisture should begin as soon as it can be done safely. Take trash bags to remove leaking cans and debris that could clog bilges and pumps. Don't forget bug spray, boots, and gloves.

If the boat appears undamaged or has only minor scrapes, inspect for chafed lines and broken ports or hatches where rain can enter. Monitor water level in the bilge in the event there is underwater damage. Make sure the galley and main engine fuel systems are undamaged and the bilge pump is working. Report damage to the insurance company.

If the boat is sunk, beached, or otherwise in need of salvage, contact your insurance representative on how to proceed. While you have the right to salvage your boat, contracting with salvors can be tricky business and is best left to insurance professionals. Inexperienced, poorly equipped, or overpriced crews can cause delays and additional damage that may keep you ashore longer than necessary. If the marina wants to act as a contractor, it should have your permission and the agreement of your insurance company before moving or salvaging your boat.

Boat owners insured with BoatU.S. should call the 24-hour Emergency Dispatch Center, 1-800-937-1937, before contracting for salvage or removal work. If communications are impaired, look for BoatU.S. Catastrophe Team field people who will be in the area immediately after a major hurricane.

Whoever raises a sunken boat should begin cleaning the boat and "pickling" and preserving the engine and machinery immediately. Flush everything with fresh water, remove cushions and clothing to dry, and dry out the interior. Your yacht policy should cover the reasonable cost of any steps you take to reduce further damage.

Your policy should also reimburse any costs incurred for security you may hire if the boat is exposed. After past storms, boats thrown onto beaches or parking lots fell victim to looters. In one sad case, a classic yawl cast onto a New England beach by a storm was dismembered by souvenir hunters with chain saws. After Wilma, boats stranded in marshes were stripped clean before salvors could reach them. After Andrew, someone painted a claim on a large yacht, mistakenly thinking that an "abandoned" boat was up for grabs. Police will be occupied with higher priorities and it is up to you to protect your damaged boat and its equipment.

HOUSTON YACHT CLUB, *from page 10*

or out of town. The plan must be approved by the club's Hurricane Committee.

Individual plans must conform to the overall guidelines set by the club. For example, boats in the outer harbor have to be evacuated, and arrangements must be made to move them to hurricane holes and alternative dock sites further inland. During hurricane season, owners of boats in the outer harbor are required to keep fuel tanks topped off and extra mooring gear aboard.

In the event of a storm, boat owners report to one of the 14 dock captains, who coordinate the preparation efforts at each of the club's docks. There are other captains and teams to haul and secure boats in the club's one-design fleets and strip them of masts and sails. Each captain has a backup.

In addition to the dock and fleet captains, there are also crew chiefs who are responsible for the crane operations, harbor operations, and securing the clubhouse and grounds. The crew chief for the grounds, for example, is responsible for seeing that volunteers board windows, store outdoor furniture, shut off electricity, store emergency water, and provide sources of electricity.

The captains and chiefs report to the hurricane operations group at the clubhouse, and the entire effort is coordinated by the club's Commodore and Vice Commodore. Preparations are implemented in carefully planned phases, beginning 72 hours before the hurricane's ETA.

Perhaps the most notable accomplishment of the Houston Yacht Club is that their plan wasn't written and then left on a shelf to gather dust. Although it has been over a decade since the club was devastated by Alicia, the plan continues to be examined and revised. Members must still submit individual plans whenever they bring a boat into the facility. And every year at the start of hurricane season, the entire membership gathers together to rehearse the plan.

HURRICANE TRACKING CHART

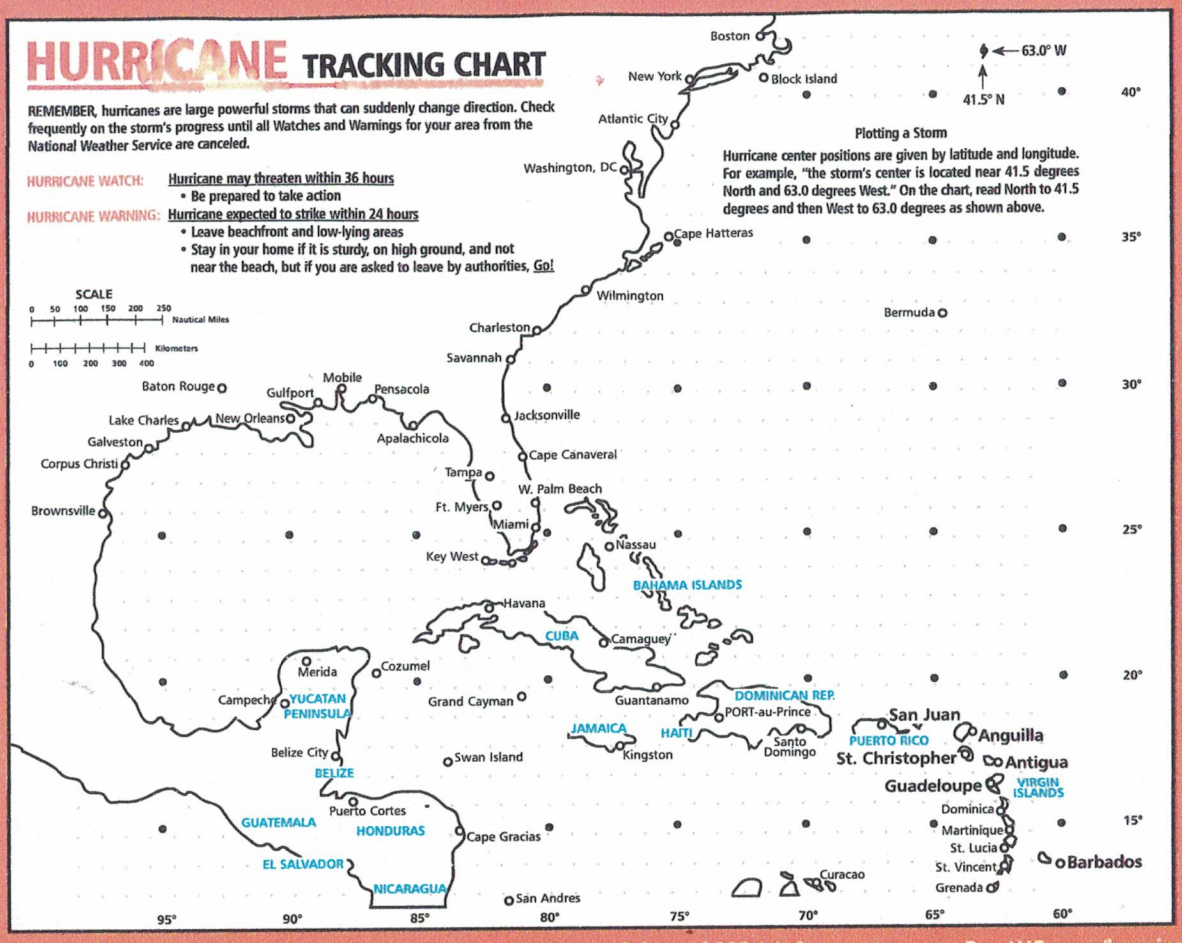
REMEMBER, hurricanes are large powerful storms that can suddenly change direction. Check frequently on the storm's progress until all Watches and Warnings for your area from the National Weather Service are canceled.

HURRICANE WATCH: Hurricane may threaten within 36 hours
- Be prepared to take action

HURRICANE WARNING: Hurricane expected to strike within 24 hours
- Leave beachfront and low-lying areas
- Stay in your home if it is sturdy, on high ground, and not near the beach, but if you are asked to leave by authorities, Go!

Plotting a Storm

Hurricane center positions are given by latitude and longitude. For example, "the storm's center is located near 41.5 degrees North and 63.0 degrees West." On the chart, read North to 41.5 degrees and then West to 63.0 degrees as shown above.



For up-to-date hurricane information, including tracking models and NOAA forecasts, go to **BoatUS.com/hurricanes.**