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SPEED AND SmartsTM

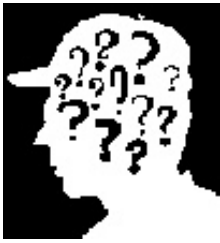


The monthly newsletter of how-to information for racing sailors *Number 12*

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Performance File

OK, this isn't exactly a Quick Quiz - it's really a Longer Exercise for you to do in your spare time this month. We all realize how important it is to know your boat. Here are some inquiring questions about your boat's performance in various windspeeds. Try answering these at home first; then test each one on the water. There are no right and wrong answers - the object is simply to get more familiar with the info you need to sail faster.

1) How long does it take you to go from luffing in place to full speed on a closehauled course?

in 5 knots of wind _____

10 knots _____

15 knots _____

2) How much distance do you lose every time you tack?

in 5 knots _____

10 knots _____

15 knots _____

3) Sailing upwind at full speed, how long does it take you to sail one boatlength?

in 5 knots _____

10 knots _____

15 knots _____

4) What are your boat's approximate tacking and jibing angles?

in 5 knots _____

10 knots _____

15 knots _____

5) If you have a knotmeter, what are your boat's upwind and downwind target speeds?

in 5 knots _____

10 knots _____

15 knots _____

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How to describe wind and waves

Explaining the relationship between wind and waves definitely requires some unique terminology, and this is essential for optimizing sailtrim and other speed-related variables. Here are the descriptive phrases I use:

More wind than waves.

"this situation exists when the water is flatter than" you'd expect for the existing wind. It occurs during a building or offshore breeze, and it's perfect for shifting into point mode.

Equal wind and waves.

"most of the time the wind and waves are roughly" matched in the strength and height you'd expect.

"more waves than wind."

This happens when the waves are bigger than what you'd expect for the existing wind. It occurs in a dying breeze and when you have lots of motorboat slop. It requires full, powerful sails and much patience.

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HOW TO CALL WINDSHIFTS



One of the most important jobs on your boat may belong to the crewmember who is in charge of tracking windshifts. That's because playing the shifts correctly will often do more to improve your finish position than any other single factor.

I usually organize my crew so one person is in charge of watching the compass (or the true wind direction readout if we have one). This crewmember's job is to keep track of what the wind is doing and call out windshifts in a loud voice for the rest of the crew to hear.

In my opinion, the most effective way to communicate about windshifts is to describe your boat's compass heading in relation to the median heading for that tack. In other words, your wind calls will sound like "up 5 . . . up 8" . . . Up 3 . . . Median . . . Down 4 . . . Down 10 . . ." and so on. This makes it very easy for the rest of the people in your crew to know if you are lifted or headed (since "up" means you're lifted and "down" means you're headed relative to the median).

Calling shifts relative to your median heading is the key. Don't just yell out "235 . . . 227 . . . 222 . . . 230" since it will be difficult for others to keep track of what these numbers mean. Also, if you are lifted 10 degrees on port tack and then the wind heads you 5 degrees, you are not "down 5." You should say "up 5" because you are still 5 degrees higher than median on that tack.

Here are a few related suggestions:

- * Convince your helmsperson to give you plenty of time to collect data before the start. What you want to get is a wide range of port and starboard closehauled headings, since this is what you'll be seeing during the race. Write these in pencil on your deck.
- * Since your wind calls are always made relative to the median, make sure you 1) always have a median in mind; and 2) adjust the median as necessary. If you do change the median, tell your skipper.
- * Unless you have responsibility as a tactician, it's probably better to report the facts and leave out the editorial. For example, say "we're down" 10" rather than "We should tack on this big header." however, if you're concerned about your afterguard's strategic sense, you might say something like "we're down 10. should we tack here?"

Just as you should assign one crew-member to call windshifts from the compass, you should designate another person to look for puffs, lulls and shifts around the race course. That person really needs to keep his or her head "out of the boat." Do this by getting as high as possible above the water. On a bigger boat you can climb up on the boom at the gooseneck (or even go up the mast). On a smaller boat, sit on the windward rail and stand up every so often to take a quick look around. When you see something, make sure you communicate this in a clear, concise way to everyone on the boat who needs to know, particularly the helmsperson and sail trimmers.

Click on image for full page JPEG.



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Understanding the Wind



America 3 navigator By Baldrige shares his secrets about how to decipher and profit from wind shifts.

By Baldrige is one of the most respected and sought-after navigators in the world. A resident of Seabrook, Texas, he was an integral part of the America3 afterguard that won the America's Cup in 1992. By navigated Kialoa to a Maxi world championship in 1984 and did the same on Matador2 in 1991. With his sharp tactical mind, good numbers sense and extensive racing experience, he is extremely qualified to talk about wind, weather and sailing fast.

DAVID: What information about the wind do you gather before heading out to the race course?

BY: It's important to know what the weather has been doing over the last few days, especially if you're sailing away from home. You can always call 1-900-WEATHER to find out what's happening. The other thing is to pump the "locals" for info on typical wind patterns and local effects. If you act non-threatening, you can learn quite a bit. When you're sailing in an area with a dominant thermal breeze, try to find out what I call the "happy" direction for that breeze. In Newport, RI, for example, the happy number is around 230°. In other words, on most days (except those influenced by a frontal situation) the seabreeze will tend to shift toward 230°. Once it gets there it will usually settle in and oscillate around that number until the power (i.e. heat) which is fueling that wind starts to die off for the day.

Once you arrive at the race area, what information do you collect about the wind and weather?

On the way out to the course I like to steer the boat and watch the wind and water, just to keep my head up and out of the boat. Since races are generally won or lost on the first leg, it's important to get into the flow of the day mentally so you can be on top of what's going to happen early in the race. When we hoist sails, the first thing I do is check my instruments, hopefully in conjunction with another boat, to see if there is any wind sheer or gradient. The clouds will also give you good clues about this. If the low clouds are moving a different direction than the wind you feel, for example, there's a good chance you will have sheer. I look for sheer early in the day because this will give you clues about what the wind may do later on. Of course, I keep track of wind direction before the start to see trends. If I have instruments and I trust their calibration, I will use the true wind direction readout. But on any boat I rely primarily on the compass heading for each tack. Before the start, I like to check the heading on each tack at least every 5 or 10 minutes.

When the wind is oscillating, do you try to figure out both the range of oscillation and the timing of shifts?

The range of oscillation is very important, but I very rarely trust the timing of the shifts. In fact, I can't think of any regatta I've sailed where I could tell you what the period of oscillation was. However, I do try to get a handle on the timing of oscillations before the start. That way I can predict where the wind will be at the start or just afterward, which is obviously important for picking the favored end and hitting the first shift.

Do you record your wind observations during a race?

I usually write down the numbers in pencil on the deck. The most important things to me are the farthest left and farthest right numbers that I see for any leg. I basically treat each leg separately as a new situation. Every time I go around a mark I re-evaluate the wind and pick a new median direction if necessary.

During a race, what are you watching to gauge the wind?

I look at two things: the clouds and the water surface. The lower layer of clouds, such as cumulus that may be filling in across the course, can have a big effect on wind velocity and direction. One thing I look for is the shape of the bottom of each cloud. If the underside of the cloud looks linear and chopped-off, there will probably be more breeze under it. But if the bottom of the cloud is very puffy and wispy, there will be less breeze under it. In either case, there is likely to be a change in wind direction around the edges of the clouds. And, more often than not, that change will be consistent from cloud to cloud on any given day. The other thing I look at for wind is the water surface. In general, more breeze appears darker because the wind ripples break up the surface of the water, allowing more light to go into the water rather than be reflected to your eye.

Can you tell whether a puff is a lift or a header before it gets to you?

Reading the wind on the water depends on subtle reflective differences. It's a lot like reading the grain on a putting green. Sometimes I look at a puff and know instantly whether it's a lift or header. Other times I'm much less sure. I think it depends on the angle of the sun. The key for me is noticing the subtle differences in a puff, experiencing what that puff brings and then expecting the same result the next time I see those subtle effects. Whenever you're not steering the boat, you have a lot of time to watch the water and play some wind games. Look at each puff and try to guess whether it will be a lift or a header. Then see what happens. The next time you notice a similar puff, see if the same thing happens.



Pictured at left: In the 1992 America's Cup, By (center) kept Buddy Melges (left) and I on track (and laughing). As navigator, he functioned as the nerve center of our boat, and was in charge of everything from weather information to laylines to the onboard computer and instruments. **Click on image for full page JPEG.**

When the wind seems irregular, how do you know whether to play it as oscillating or persistent?

First of all, I think it's important to make the distinction between oscillating and persistent because this changes your whole philosophy on how you're going to sail that leg. The wind pattern depends on the time of day and what you think the wind will do. In most places, I don't look for an oscillating breeze until later in the day. Earlier on, the breeze is still settling in and is more likely to make bigger jumps in one direction. If I expect the wind to shift 40° to the right, I don't really call it oscillating, even if it shifts in jumps. I don't consider a breeze to be oscillating unless it always comes back to the same average direction. When I'm in doubt about the wind on any particular leg, I'll play the odds by favoring the side that usually pays off in that area. Here in Galveston Bay, for example, I'd go right. In the ocean off San Diego, a lot of times I'd go left.

In an oscillating breeze, how do you know exactly when to tack?

In a smaller boat, if you have very quick oscillations, you should tack right away. When the oscillating period is longer, you may want to sail into the shift a little just so you don't sail out of it when you tack. This is also a

function of how much breeze you have. When it's lighter, you should probably sail a little further into the new wind. That's because your boatspeed is greater relative to the wind, which increases the chances you will sail out of the new wind after tacking. Also, your wider tacking angles take you further away from the wind.

How much of a header do you need before you're willing to tack?

It's all relative to the situation. If my competition is going the same direction I am, it will have to be a pretty good-sized shift - say 5 or 10 degrees. If I'm not happy with my position or if my boatspeed isn't great, I'll go on a smaller shift. The larger your boat, the bigger the shift must be before you are willing to tack. And the lighter the wind, the bigger the shift you need since you will lose more by tacking.

When sailing upwind, is it more important to go for good windshifts or for increases in velocity?

That's a great question. It mostly depends on the wind velocity you're racing in. In light air, I'd go for better pressure almost every time. That's because in light air, an extra knot or two of wind will produce a relatively large increase in your boatspeed. In 6 knots of wind, for example, an AC boat will go upwind at 7 knots. If the wind increases to 7, your speed will jump to 8.5 knots and you'll point 5 degrees higher. That extra knot of breeze is worth more than a 5; or 10; shift. On the other hand, if you're sailing in moderate or heavy air, I'd tend to go for the shift, since an extra knot or two of wind will no longer add much to your VMG. If the wind increases from 11 to 12, for example, an AC boat might gain one tenth of a knot and one degree of pointing. Even a 5; shift at 11 knots would be better. Basically this choice depends on knowing your boat's performance. If you're close to hull speed you should go for the shift. If you're downspeed, go for velocity.

Any final wind comments?

I'm very much an observer on the race course. What I try to do is compile a history, even if it's very short, to help my decision-making in real time. However, I'm much more interested in "what" happens than "why" it happens. Too much analysis slows down your decision-making. That's why, to a certain extent, you have to shoot from the hip. Be a good observer, look for patterns and stick to the most basic information you know. That will help you win races much more than coming up with fancy theories.

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Windshifts -- How to calculate gain and loss upwind

If there's one generalization we can make about the wind, it's that it is always shifting, even when it seems steady. And whenever the wind shifts, some boats gain and others lose.

For upwind legs, there are three basic rules of thumb:

- 1) The boat that's closer to the new wind direction will gain in a shift
- 2) The amount of gain is roughly proportional to the size of the shift
- 3) The amount of gain is proportional to the distance between boats

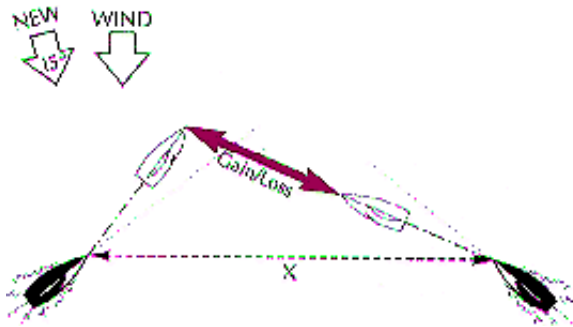
Once you understand these principles, we can move on to calculate more precise gains or losses for any windshift. This calculation depends on the magnitude of the windshift, the tacking angles of the boats, and the relative positions of the boats.

It is easiest to consider what happens when two boats are on the same ladder rung and the wind shifts (see Situation I below). However, two boats are seldom in this position. As you can see from the chart and Situations II, III and IV, the amount of gain and loss varies according to whether the boats are abeam, in front of or upwind of each other.

If the number of variables seems overwhelming, let me offer one simple guideline that works in most situations: **For every 5 degrees of windshift, you will gain or lose approximately 10 percent of the distance between you and other boats.**

In future issues we'll talk about the tactical implications of separation, or "leverage."

I. BOATS EVEN



In a 15-degree back, the boat on the left gains 37% of the lateral separation (x) between the 2 boats (see chart below). If the boats started out 6 boatlengths apart, then the left boat would gain just over 2 lengths in the shift.

GAIN AND LOSS CHART

The numbers below show the rough amount of sailing distance that is lost or gained in windshifts, expressed as a percentage of the separation (x) between two boats. All tacking angles are assumed to be 90 degrees, except for the second example listed

under I, which is 80 degrees. Situations II, III and IV are diagrammed below.

SHIFT	5	10	15	20	25
-------	---	----	----	----	----

I. BOATS EVEN

Tack angle 90	12%	25%	37%	49%	60%
Tack angle 80	11%	23%	34%	45%	55%

II. ABEAM

Lift/A Gains	8%	16%	22%	28%	33%
Header/B Gains	9%	19%	29%	40%	52%

III. BOW TO STERN

How to play Oscillating Shifts



Want to know the best way to lower your elapsed time around the race course? It's not sanding your bottom, buying new sails or practicing with your crew. No, the best way to increase your VMG is to play the windshifts better. And best of all, the wind is free! By nature, the wind is usually oscillating, or shifting back and forth, around an average wind direction. This shiftiness can be caused by vertically unstable air, thermal effects or offshore wind patterns. Sometimes the oscillations are very obvious and regular; other times they're subtle and confusing. In any case, the fastest sailors are those who are able to correctly identify and take advantage of the shifts. Here are some questions to ask yourself:

Are the windshifts primarily oscillating or persistent?

This may be the most fundamental and crucial decision of your entire race. Before you play any shift as oscillating, make sure it's not really persistent. This requires good historical tracking of the wind pattern, both before and during the race.

What is the median wind direction?

Once you've identified an oscillating breeze, you need to find the "median." A phasing breeze will swing back and forth between extreme right and left shifts. You can generally get the median by averaging these two limits. (Don't worry so much about the timing of shifts, since this is erratic and difficult to track under even the best conditions.) You'll then use this number to make critical decisions about which tack to stay on during the race. Make sure you always have a median in mind during the race. You may need to revise it as you go, but don't forget it.

In what phase is the wind right now?

By having a median in mind, you will always know whether the wind is in a left or right-hand phase. At any moment in a race you should be able to identify the wind phase, since this will have a large impact on your strategy and tactics. If you lose track of the median or phase, a nearly foolproof fallback is to sail the tack on which your bow is pointed closer to the next mark.

Follow this basic strategy

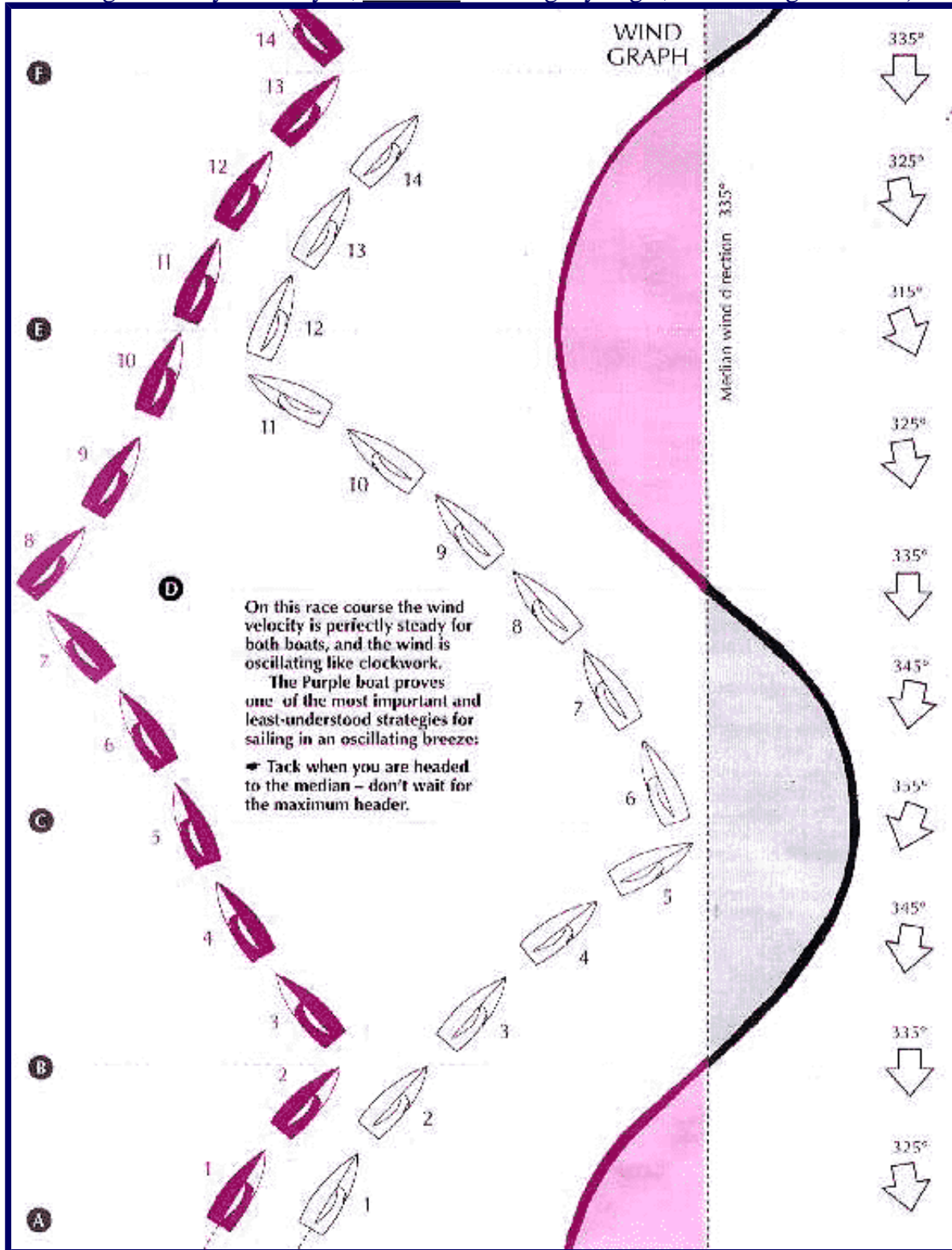
When sailing upwind in an oscillating breeze, your goal is to sail on the lifts. By staying on the lifted tack as much as possible, you will sail the shortest distance toward the next mark. In general, stay near the middle of the other boats and the course. Once you get close to the laylines, or to the fringes of the fleet, you lose your ability to play each shift to the fullest.

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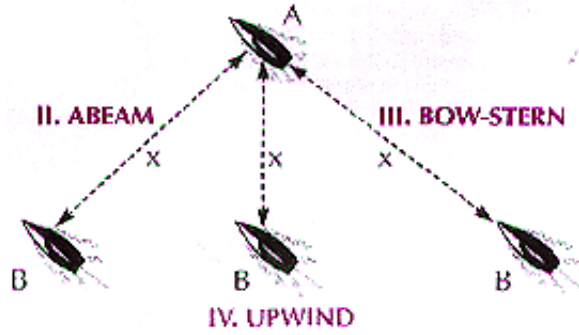
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Lift/B Gains 9%19%29%40%52%
 Header/A Gains 8%16%22%28%33%

IV. UPWIND

B Gains 1% 2% 4% 6% 10%



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The Secret to Windshift Success

Please expand your web browser screen to it's maximum width.

One of the best questions to ask about oscillating winds is when you should tack. We've all heard about "tacking on the headers," but what does this really mean? Should you go as soon as you start to get headed, wait until you've sailed into the maximum header, or tack somewhere in between?

To find the answer, let's go to our secret laboratory (right) where wind velocity is perfectly steady, and the wind oscillates as predictably as a pendulum. We start off with two boats sailing upwind bow to bow. One of them (the purple boat) will tack each time it gets headed to the median wind direction. The other (black) will continue until it reaches the maximum header and then tack. Which will come out ahead? Here's how it goes: (please refer to image below)

A - Both boats start off on port tack, sailing in a port-tack lift.

B - The wind trends slowly to the right until it reaches its median direction (335 degrees). At this point Purple tacks to starboard and Black keeps going.

C - As the wind continues phasing to the right, Purple is more lifted on starboard tack, while Black is headed more on port. Finally the wind reaches its farthest right oscillation (355), and Black tacks.

D - Now the wind starts shifting back toward the left. When it reaches the median (335) again, Purple tacks from starboard to port. Black remains on starboard tack and is slowly getting headed as she sails toward Purple.

E - As the wind continues phasing toward its far-left oscillation, Purple is maximum lifted and crosses Black by over a boatlength. When the wind hits 315, Black tacks onto port.

F - Now the wind starts going right again (this predictable stuff is boring!). When it hits the median, Purple tacks again to starboard and Black continues almost two boatlengths behind.

What did we learn? **It's better to tack at the median than it is to wait until you reach the maximum header.** Why is this true? One quick glance at the courses of the two boats shows that Purple has sailed a more direct course to windward. This is the goal when racing in an oscillating breeze - to take a shortcut by sailing the closer tack to the next mark. In fact, one thing you can see about Purple is that whenever the wind is to the left of median (purple shading in wind graph), she is on port tack. When it's to the right of median (grey shading), she's on starboard tack. That's the fastest way to go upwind in shifts.

Note: If you're NOT using Netscape or a browser that supports background colors and transparent GIFs (ie,

How to Measure Wind Strength

When you're racing sailboats, you must be able to describe wind speed accurately. This is important for a variety of reasons, including which sail you should use, the size of the next puff, and the target speed you are aiming for.

Around the world there are several conventions for measuring wind strength. The most common of these is knots, or nautical miles per hour. One nautical mile is 6,076 feet, which is about 15 percent longer than a statute mile (5,280 feet). If you hear the TV weatherman predict a wind speed of 25 miles per hour, for example, that's just under 22 knots.

Another way of measuring wind speed, used in some European countries, is meters/second. If you ever see this, remember that one knot is roughly the same as .5 meters/second. Or, a wind speed of 5 meters/second is roughly the same as 10 knots.

A third popular system, used a lot in England, is the Beaufort Scale. Named after Sir Francis Beaufort, who developed it, this scale indicates wind strength using a series of numbers from 0 to 17. It offers a rough method for judging how hard it's blowing by looking at the activity of the trees on land or the surface of the water at sea (see chart below).

The book *Fastnet Force 10* was written about the storm that raked the fleet in the 1979 Fastnet Race. As you can see from the chart, Force 10 is a whole gale with 48-55 knot winds, huge waves and white spray. Not exactly my idea of a nice sail!



THE BEAUFORT SCALE

Note: done in Netscape table format. If not properly formatted for your web browser, [click here](#) for different version.

Beaufort Number	Wind (knots)	Descriptive term	Land observations	Sea observations
0	<1	Calm	Calm, smoke rises vertically	Water calm, mirrorlike
1	1-3	Light air	Wind direction shown by smoke but not by windvanes	Ripples with the appearance of scales
2	4-6	Light breeze	Leaves rustle; wind felt on face; windvanes moved by wind	Small wavelets on water; crests have a glassy appearance and do not break
3	7-10	Gentle breeze	Leaves and twigs in constant motion; wind extends light flag	Large wavelets; crests begin to break; maybe scattered whitecaps
4	11-16	Moderate breeze	Wind raises dust and loose paper; small branches move	Moderate waves; fairly frequent whitecaps
5	17-21	Fresh breeze	Small leafed trees begin to sway	Moderate, longer waves; many whitecaps; chance of spray
6	22-27	Strong breeze	Large branches in motion; phone lines whistle	Large waves form; white foam crests everywhere; probable spray
7	28-33	Moderate gale	Whole trees in motion; difficult to walk against wind	Sea heaps up; white foam starts to blow in streaks
8	34-40	Fresh gale	Wind breaks twigs off trees; walking impeded	Moderately high waves with crests beginning to break into foam that's blown in white streaks
9	41-47	Strong gale	Slight damage to buildings occurs; shingles torn off roofs	High waves; rolling seas; dense streaks of foam; wave crests begin to topple, tumble and fall over
10	48-55	Whole gale	Trees uprooted; considerable structural damage to buildings	High waves with overhanging crests; sea is white
11-17	56+	Storm, Hurricane	Widespread damage	Huge waves; air filled with spray; little visibility

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Be A Wind Detective



The ability to predict what the wind will do is one of the biggest keys to success in sailboat racing. To be successful at this, you must search out clues from a variety of sources. Then you must use your analytical skills and piece the clues together to form an accurate picture of what's really happening on the race course.

Unfortunately, this is not always so easy. But, luckily, there are many clues to help you forecast the immediate and longer term wind trends. If you consistently use many of the ideas listed below, you should be able to get a good grasp of wind shifts more often than not.

1 Monitor recent wind readings.

The best way to predict what the wind will do in the near future is to understand what it's done in the recent past. Try to decipher trends and extrapolate into the future.

2 Keep an eye on wind sheer.

When the wind is blowing a different direction at the top of your mast than it is at water level, this often indicates a windshift to come.

3 Listen to weather radio forecasts.

Keep in mind, though, that this is very "big-picture" stuff. Call your local airport for better information.

4 Watch the wind on the water to windward.

Assign one crewmember to do this all the time. Get as high as possible by standing on deck or on the boom. Be sure to do this during the critical 10 minutes before your start.

5 Look at boats to windward.

Racing boats are great wind indicators. Cruisers show lifts well, but don't use them for headers since they are usually sailing below your normal closehaunched angle.

6 Watch "telltale" to windward

Smoke from smokestacks, flags on shore, flags on stake or committee boats, the swing of anchored boats, and so on. See if you can discern any pattern between the action of these telltales and subsequent changes in the wind.

7 Note where the race committee sets (or moves) the windward mark.

If it is not directly into your sailing wind, they may have information (e.g. wind readings from a mark boat or a weather report) that the wind will shift.

8 Watch the other boats in your fleet

They're often the best telltales, especially when they split to opposite sides of the course right after the start. Any time you cross near another boat, keep an eye on them the next time you come together to see if you have gained or lost. If another fleet started ahead of you, they'll provide great wind information.

9 Keep a log of wind data and observations every time you go sailing.

This is the best way to learn about, and therefore predict, changes in the wind due to local geographic effects.

10 Feel the waves.

Sometimes an impending windshift will show up first in the form of waves coming from a new direction.

11 Keep an eye on the clouds.

Movement and formation of the clouds is often your best giveaway of what the wind will be doing.

One good clue for wind direction up the course are the **flags** on stake boats and committee boats. Before you predict an upcoming shift, however, make sure the boat you're looking at is anchored or stationary. Otherwise, what you see is its apparent wind.



The small **ripples** on the water are my favorite clue for judging wind direction and strength. To gauge direction, I turn my head until I'm looking perpendicular to the ripples. This is where the wind is blowing from.

The key to anticipating the **strength** of wind coming toward you is differences in the appearance of the wind ripples. You will often see lulls as light-colored spots and puffs as darker blotches moving across the water. That's because when the ripples are close together, they reflect less of the sky's brightness.

Don't forget to correct for **sun glare**. If you're looking toward the sun, the sparkles will make it look as if there's more wind than if you're looking away from the sun.

Also, the breeze appears stronger when you're looking upwind than when you look downwind. That's because the back sides of the ripples are less steep and reflect more of the light-colored sky.

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