Buccaneer Tuning Guide

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A Few Words from Dick Gibbs, who with Rod McAlpine-Downey designed the Buccaneer and who continues to be the Guardian of the Design and Patron Saint of the Class.

Many top sailors are reluctant to improve their competitor's performance by sharing their go fast knowledge. Some "Experts" produce meaningful information but in general terms. How fortunate the Buccaneer Class is to have available this Tuning Guide from those who have "been there and done that" in a Buccaneer. This excellent work should do much to level the playing field.

Dick Gibbs, August, 2003

Introduction and Purpose

BACKGROUND: Going fast in a sailboat is fun. Going as fast or faster than other sailboats is the main goal of the racing sailor. Going fast in a Buccaneer came easy for me. After watching Harry Sindle sail his new boat #5201 to 2nd place in the 1997 Championship Regatta at Nyack, New York – with Bill Bartel the winner, I decided to arrange to purchase Harry's boat as he was in a position to build another new one for himself. These two were in a class of their own as far as their boat speed was concerned. Whatever wisdom I have since achieved regarding tuning my Bucc was directly influenced by Harry and the boat he sold me. The boat came with Gleason sails. Bill used North's. I purchased new North's from Greg Fisher and added a little more rake to allow for a higher pointing mode made possible by the nice mylar jib. I then felt that the boat's rig was optimized for speed.

I named the boat ELUSIVE and in the ensuing years we proceeded to terrorize the Portsmouth and Bucc fleets all over Colorado and Nebraska. As fun as sailing my 1983 Starwind was, this was, well… more fun. ELUSIVE sailed in the 1998, 2000, 2001 and 2002 Buccaneer Championship Regattas – finishing 5th, 3rd, 1st and 2nd.

At Indianapolis in 2000 I finally met Greg Fisher in person and he conducted an on-the-water clinic where he video taped my son Dan and I sailing the boat in the practice race. He confirmed what we already knew…ELUSIVE was fast and its sails looked "right" on the rig.

At the beginning of 2002 when Greg Twombly was trying to decide whether to purchase an older bucc or order a new one we had many discussions and the availability of used Cardinals was nil so Greg ordered a new one from Harry. Greg asks a lot of questions. When the boat arrived it was clear that the boat was set up differently from mine. Well, since Harry had not used it … it was not set up at all. We endeavored to match up the tuning of his boat to mine and we documented the tuning process of the modern Buccaneer, giving rise to the information in this guide.

At the same time in 2002 I became involved in discussions – sometimes quite lively ones – regarding the Buccaneer Racing Rules relating to the positioning of the main sail plan. For a non-technical sailor this proved somewhat challenging to me. My initial reaction was to defend the status quo. But as the true story emerged I became interested in the valid questions being raised about the evolution of the Buccaneer sail plan and the options for managing it fairly for all the owners and competitors. Many times Greg and I were down at the boat yard with the tape measure trying to get the measurements needed to understand the basics specs of the boat and to share this information with other sailors.

Meanwhile, Greg is learning to race and continuing to refine his boat and duplicate the settings of ELUSIVE. When Greg purchased a 1980 Buccaneer to be the fleet guest boat we were challenged to determine the boat's rake because the length of the mast was different. This is the case with most vintage Buccaneers as there are two mast step positions and several different heights for the mast etc. I asked Greg to help figure out a way for us to describe the mast rake angle that could be used by anyone with a Buccaneer that wants to sail fast. As a result – this tuning guide features four different ways to do it – and the tables to calculate the rake angle regardless of your mast length.

The belief among one design racers is that given a stiff hull that can be adequately faired, good racing sails (preferably as new as possible), and a tuning guide proven to unlock the potential of those sails – one can go out and race that boat with NO EXCUSES!

TUNING PHILOSOPHY: I believe that at this stage in developing the tuning guide for the Buccaneer, we are concerned about "benchmarking" the set up that we know works. This means that while you may still need to make small adjustments to get the exact feel that you want, sailing the boat with slightly different settings might give you some feedback as to what to look out for. These variations should be made in small increments. Don't change too many things at once after your initial setting and make sure that you pay attention to all of the following before and while sailing the boat upwind:

Magic Box set tight
Centerboard lowered as far as possible
Rudder straight up and down and secured properly
Jib leads and main outhaul set correctly

I recommend that you acquire a tuning partner who is using the same sails and will be sailing in the same races as you or has time to go out and do speed testing. Having Greg Twombly as a tuning partner has been beneficial in this process insofar he is very skilled in the technical aspects allowing a thorough understanding of the geometry and the measurement methods that can be used for duplicating the exact settings that work. My contribution is to describe how having a fast boat can help win races…and how to use the boat once it is set up correctly. I believe what we have here is a starting point. Buccaneer sailors and their sailmakers may experiment with other ideas like adding more rake or shifting the sailplan within the 3" range that will be class legal or cutting the sails differently. But experimentation is not the point of this guide. Getting your boat set up to be the fastest and duplicating those settings on other boats is what we are after.

This has been a fun project and it has facilitated building our fleet and getting more sailors interested in racing their own Buccaneer. It is most gratifying to see Greg go from a complete novice racer to someone who can now say - "I know what I did right that time…and it wasn't a boat speed problem." The sailors in other fleets are taking notice!

In his book <u>No Excuse to Lose</u>, Dennis Conner explains how important it is to start your racing career in any given one design class by setting your boat up – using the same equipment and rig tuning as – the "fast guys". This is essentially the idea behind this guide. Start by writing down your boat settings. All you need to do is figure out how to make the adjustments you want in the mast, forestay tension and centerboard placement to duplicate the fast numbers we believe make the Bucc live up to its reputation. Once you have done this, you can go out racing with a new attitude. When you have used all your sailing skills to win the start of a race, you will have the confidence that your boat has the speed that you need in order to get in front of the competition and stay in front.

David Spira, May 2003

The sail plan of the Buccaneer is very simple. Lack of spreaders, backstay, or other devices for bending the mast means tuning the Buccaneer is simpler, with fewer options, than classes with controls for bending the mast and actively adjusting the standing rigging while sailing. Boat tuning in the Buccaneer is finding the optimum location for the centerboard, then adjusting mast rake to produce balanced steering. More involved tuning comes in fairing the rudder, centerboard and hull; reducing weight where possible, finding the optimum line sizes, and a hundred other insignificant things that might add up to a few feet ahead by the end of a race.

Tuning involves a series of decisions and trade offs. Do you want less weather helm to make the boat handle better, but a little slower in low wind? Do you want more weather helm, slightly slower in high wind, but better pointing in low wind? Do you want a faster thin trailing edge on your foils or a thicker, durable edge?

I thought I had a reasonable handle on the tuning process until I sailed with Randy Smyth at the 2004 Buccaneer North American Championships in Ft. Walton Beach, Florida. Randy taught me a practical lesson in the logic and process of boat tuning. Randy and I wrote an article about the tuning process and specifics, which I have added to Chapter 5 of this guide, along with North Sails Tuning Guide for the Buccaneer written at Greg Fisher's request by Spira and me.

Greg Twombly
2004

1980 Buccaneer Logo

SUMMARY-Gloucester, Cardinal and Nickels Buccaneers

In this tuning guide we explain the goal of tuning and present a technical outline of why tuning works. We present tables comparing measurements of Buccaneers of different ages and manufacturers, with special attention to Dave Spira's winning boat, Elusive, sail number 5201. We propose a systematic method for tuning the Buccaneer to match Elusive as a starting point for fine tuning. We present 3 methods for measuring mast rake and many other aspects of tuning the Buccaneer.

Table 1. Summary of Fast Settings from 5201 Elusive

Mast Rake	4.5 degrees aft = 24'7" masthead to stern
Centerboard location	7.5 inches from bulkhead
Rig Tension	350-380 lbs or 27-28 on Loos Guage
Boom Height	17" above deck

The most effective tuning procedure is to a.) measure the location of the centerboard from the bulkhead; b.) measure the mast rake; c.) adjust centerboard location; d.) adjust mast rake; e.) test sail the boat to determine the helm response. Repeat the cycle of moving the shrouds down one hole at a time and test sailing until the boat starts to have too much weather helm, then go back to the previous hole on the shroud adjuster. Take notes as you test so you can get back to the same settings in the future. When the boat is set up to your liking, measure and record all the settings you can, especially the mast rake and CB Location.

Now you are ready to fine tune the boat by fairing and wet sanding the rudder blade, fairing and wet sanding the centerboard, fairing and wet sanding the hull, modifying and reassembling the rudder head, removing any extra weight from the mast, changing the sheets to light weight line, changing the halyards, shimming the pintles, and on and on without end.

This tuning guide focuses narrowly on tuning the Buccaneer for racing. We strongly recommend you buy Harry Sindle's "Rigging and Tuning Guide for Buccaneers & Mutineers", a much more comprehensive guide to setting up and sailing the Buccaneer.

SUMMARY-Low step Chrysler Buccaneers

DISCLAIMER: Our experience with low step Chryslers is very limited, but tells us the tuning differences between low step Chryslers and later boats are significant. This needs work and advice from someone more experienced with low step Chryslers than us. This is only meant as a rough starting point for tuning.

In this tuning guide we explain the goal of tuning and present a technical outline of why tuning works. We present tables comparing measurements of Buccaneers of different ages and manufacturers, with special attention to Dave Spira's winning boat, Elusive, sail number 5201. We propose a systematic method for tuning the Buccaneer. We present 3 methods for measuring mast rake and many other aspects of tuning the Buccaneer.

There are many differences between the low step Buccaneers and later designs. For tuning purposes the most important differences are: The mast is longer, stepped 10" lower and is more flexible; the CB is supported below, the boom is smaller diameter and more flexible; the shrouds are attached to the mast at the same point as the jib forestay; the shroud chain plates are inboard of the hull-deck flange; and the forestay chain plate is further forward. The longer mast places the center of effort further aft, for the same rake angle, than the newer short masted boats. The shorter distance across the boat to the shroud chain plates means the shrouds carry a higher vertical component of the rig loads than the newer boats, which, together with the softer hull, means the rig tensions cannot be as high as on the newer boats. This is somewhat offset by the better distribution of loads allowed by the low mast step. The position of the center board is more difficult to adjust with the bottom mounted bracket, so it is more effective to leave it in the original position and change the mast rake to tune the boat.

Table 1. Summary of Initial Settings for Low Step Buccaneers

Mast Rake	2.0 degrees aft = 300" masthead to stern
Centerboard location	6.5 inches from bulkhead
Rig Tension	180 to 250 lbs on Loos Guage
Boom Height	17" above deck

The most effective tuning procedure is to a.) measure the location of the centerboard from the bulkhead; b.) measure the mast rake; c.) adjust mast rake; d.) test sail the boat to determine the helm response. Repeat the cycle of moving the shrouds down one hole at a time and test sailing until the boat starts to have too much weather helm, then go back to the previous hole on the shroud adjuster. Take notes as you test so you can get back to the same settings in the future. When the boat is set up to your liking, measure and record all the settings you can, especially the mast rake and CB Location.

There is merit to simple modifications to the boat to match the configuration of the newer Gloucester, Cardinal, and Nickels boats. These modifications include 1.) change the centerboard hangers from bottom to top for greater adjustability; 2.) change the shrouds and mast tangs so the shrouds are attached to the mast 6-9" above the jib block to prevent mast inversion; 3.) cut down the mast and raise the step to current boom height and mast head elevations.

Now you are ready to fine tune the boat by fairing and wet sanding the rudder blade, fairing and wet sanding the centerboard, fairing and wet sanding the hull, modifying and reassembling the rudder head, removing any extra weight from the mast, changing the sheets to light weight line, changing the halyards, shimming the pintles, and on and on without end.

This tuning guide focuses narrowly on tuning the Buccaneer for racing. We strongly recommend you buy Harry Sindle's "Rigging and Tuning Guide for Buccaneers & Mutineers", a much more comprehensive guide to setting up and sailing the Buccaneer.

SUMMARY-High step Chrysler Buccaneers

DISCLAIMER: Our experience with high step Chryslers and Starwinds is llimited, but tells us the tuning differences between these and later boats are significant. This needs work and advice from someone more experienced with these boats than us. This is only meant as a rough starting point for tuning.

In this tuning guide we explain the goal of tuning and present a technical outline of why tuning works. We present tables comparing measurements of Buccaneers of different ages and manufacturers, with special attention to Dave Spira’s winning boat, Elusive, sail number 5201. We propose a systematic method for tuning the Buccaneer. We present 3 methods for measuring mast rake and many other aspects of tuning the Buccaneer.

There are many differences between the high step Buccaneers and earlier and later designs. For tuning purposes the most important differences are: The mast is shorter and more flexible; the CB is supported below, the boom is smaller diameter and more flexible; the shrouds are attached to the mast at the same point as the jib forestay; the shroud chain plates are inboard of the hull-deck flange; and the forestay chainplate is further aft. The shorter distance across the boat to the shroud chain plates means the shrouds carry a higher vertical component of the rig loads than the newer boats, which, together with the softer hull, means the rig tensions cannot be as high as on the newer boats. The position of the center board is more difficult to adjust with the bottom mounted bracket, so it is more effective to leave it in the original position and change the mast rake to tune the boat.

Table 1. Summary of Initial Settings for High Step Chryslers

Mast Rake	2.0 to 4.0 degrees aft = 297” to 293” masthead to stern
Centerboard location	6.5 inches aft from bulkhead
Rig Tension	150-230 lbs on Loos Guage
Boom Height	17” above deck

The most effective tuning procedure is to a.) measure the location of the centerboard from the bulkhead; b.) measure the mast rake; c.) adjust mast rake; d.) test sail the boat to determine the helm response. Repeat the cycle of moving the shrouds down one hole at a time and test sailing until the boat starts to have too much weather helm, then go back to the previous hole on the shroud adjuster. Take notes as you test so you can get back to the same settings in the future. When the boat is set up to your liking, measure and record all the settings you can, especially the mast rake and CB Location.

There is merit to simple modifications to the boat to match the configuration of the newer Gloucester, Cardinal, and Nickels boats. These modifications include 1.) change the centerboard hangers from bottom to top for greater adjustability; 2.) change the shrouds and mast tangs so the shrouds are attached to the mast 6-9” above the jib block to prevent mast inversion; 3.) shim the mast to current boom height and mast head elevations.

Now you are ready to fine tune the boat by fairing and wet sanding the rudder blade, fairing and wet sanding the centerboard, fairing and wet sanding the hull, modifying and reassembling the rudder head, removing any extra weight from the mast, changing the sheets to light weight line, changing the halyards, shimming the pintles, and on and on without end.

This tuning guide focuses narrowly on tuning the Buccaneer for racing. We strongly recommend you buy Harry Sindle's "Rigging and Tuning Guide for Buccaneers & Mutineers", a much more comprehensive guide to setting up and sailing the Buccaneer.

SUMMARY-Starwind Buccaneers

DISCLAIMER: Our experience with high step Chryslers and Starwinds is llimited, but tells us the tuning differences between these and later boats are significant. This needs work and advice from someone more experienced with these boats than us. This is only meant as a rough starting point for tuning.

In this tuning guide we explain the goal of tuning and present a technical outline of why tuning works. We present tables comparing measurements of Buccaneers of different ages and manufacturers, with special attention to Dave Spira's winning boat, Elusive, sail number 5201. We propose a systematic method for tuning the Buccaneer. We present 3 methods for measuring mast rake and many other aspects of tuning the Buccaneer.

There are many differences between the Starwind Buccaneers and earlier and later designs. For tuning purposes the most important differences are: The mast is more flexible; the CB is supported below, the boom is large section and considerably stiffer; the shrouds are attached to the mast at the same point as the jib forestay; the shroud chain plates are outboard of the hull-deck flange; and the forestay chain plate is further aft.

The primary functional difference between the Starwind and other Buccaneers is the mast. The Kenyon mast is considerably more flexible than other Buccaneers. The top half of the mast easily inverts to forward rake in gusty winds. It is therefore desirable to increase the rake so the mast never inverts to forward of vertical, consistent with good boat handling, and use the boom vang to control mast shape. It is important that the mast is stepped on it's forward edge to avoid inverting the mast when the rig is tensioned.

The position of the center board is more difficult to adjust with the bottom mounted bracket, so it is more effective to leave it in the original position and change the mast rake to tune the boat. If the CB hanger is replaced with the more adjustable top hanger, tuning becomes similar to more recent boats.

Table 1. Summary of Initial Settings for Starwinds

Mast Rake	2.0 to 4.0 degrees aft = 300" to 296" masthead to stern
Centerboard location	6.5 inches aft from bulkhead
Rig Tension	200-300 lbs on Loos Guage
Boom Height	17" above deck

The most effective tuning procedure is to a.) measure the location of the centerboard from the bulkhead; b.) measure the mast rake; c.) adjust centerboard location; d.) adjust mast rake; e.) test sail the boat to determine the helm response. Repeat the cycle of moving the shrouds down one hole at a time and test sailing until the boat starts to have too much weather helm, then go back to the previous hole on the shroud adjuster. Take notes as you test so you can get back to the same settings in the future. When the boat is set up to your liking, measure and record all the settings you can, especially the mast rake and CB Location.

There is merit to simple modifications to the boat to match the configuration of the newer Gloucester, Cardinal, and Nickels boats. These modifications include 1.) change the centerboard hangers from bottom to top for greater adjustability; 2.) change the shrouds and mast tangs so the shrouds are attached to the mast 6-9” above the jib block to prevent mast inversion; 3.) shim the mast to current boom height and mast head elevations.

Now you are ready to fine tune the boat by fairing and wet sanding the rudder blade, fairing and wet sanding the centerboard, fairing and wet sanding the hull, modifying and reassembling the rudder head, removing any extra weight from the mast, changing the sheets to light weight line, changing the halyards, shimming the pintles, and on and on without end.

This tuning guide focuses narrowly on tuning the Buccaneer for racing. We strongly recommend you buy Harry Sindle’s “Rigging and Tuning Guide for Buccaneers & Mutineers”, a much more comprehensive guide to setting up and sailing the Buccaneer.

CHAPTER 1
BUCCANEER 18 PRODUCTION HISTORY

BACKGROUND

Dick Gibbs formed Gibbs Boat Company in 1950 when he was 21 years old. Dick built wooden and later fiberglass boats in his plant in LaSalle, MI. The Gibbs Boat Company had produced some 6,000 sailboats by 1972 when he sold the business to MFG in Union City, PA. The principal boats built during this time period were Y-Flyers, the Rhodes Bantam, the Shark, Phoenix, Dingo catamarans and the Thai MK 4 catamaran designed by Rod Macalpine – Downie.

Rod Macalpine – Downie was a brilliant King's Scholar at Eaton College who had no formal training in yacht design. Rod had seen the Shearwater catamaran, which was the latest rage in the UK, and felt that he could do a better job. The Thai MK 1 class B catamaran was the first boat Rod designed. Rod handily won the UK One of a Kind Regatta with 'straight bullets' in 1961. Shortly after, Rod Licensed Dick to build the Thai MK 4 for the U.S. market. Dick had built about 100 Thai MK 4's by the time they first met in person.

In 1962 Dick and Rod finally met at the First International Catamaran Challenge at Sea Cliff, Long Island, NY, where Rod raced his Hellcat class C design to yet another victory. It was during this time that they agreed to corroborate on the Shark Catamaran Project. They were to campaign the Shark prototype throughout the United States. This barnstorming adventure would begin in Montreal in 1962, travel as far west as El Paso, TX, back to the America's Cup at Newport in September, down to win the President's Cup in D.C. and on to Yachting's One of a Kind Regatta in Miami in February of 1963. While in New Orleans during this adventure they formed a boat design partnership, which began with a handshake and continued until Rod's death in 1986. During that time Rod and Dick designed some 80 sailboats with a combined production in excess of 150,000 units for builders in the U.S., UK, Germany, Italy and Japan.

Their business relationship was a simple one, begun with a handshake and based on a steadfast trust in and respect for each other's talents. Both men were competent designers. Rod's strength was in hull form and Dick's in production engineering. While both participated fully in all deliberations of design, they agreed early on that in areas of disagreement Rod had the final word in hull form and Dick in production engineering. Dick fully appreciated that it was Rod's genius in hull form design that made the Buccaneer (Mutineer) the fine boat that she is.

Chrysler had purchased in 1964 or 5 the Lone Star Boat Co. in Plano, TX and in addition to the Lone Star 13' and 16' they had added a Gus Linell design; the 'Barracuda', a 13' dagger board, cat rigged scow. There had been a major surge of sailboat production during that decade and demand for Chrysler's sailboats was dwindling. In (1968) the Marketing Director of Chrysler Marine, who had recently moved over from MFG, employed Rod Macalpine-Downie and Dick Gibbs to submit designs for sailboats that would help bolster Chrysler Marine's position in the sailboat market.

Prior to associating with Chrysler; Downie-Gibbs had designed the 16'6" 'Upstart' for Bud Sanxter of Starcraft in Goshen, IN and the 15'5" 'Sidewinder' for Art Hansen of MFG in Union City, PA. along with several other designs for the UK and German market. In 1968 the prototype of the Man-o-War, originally designed for Starcraft, had recently been completed. When Bangor Punta bought Starcraft he decided to get out of the sailboat business and backed out of Starcrafts' contract to build the boat. The Man-o-War was then made available to Chrysler to become the first design by Downie-Gibbs to be produced by Chrysler. The next in line was the Buccaneer 18' followed by the Mutineer 15', the Musketeer, a 16' catamaran, the Pirateer 13' and the Dagger 14'6", an updated version of the Man-o-War.

PRODUCTION

Design of the Buccaneer 18' began in (1968). Because the Buccaneer was to be a production boat; read a wider range of built weights was to be expected, the design displacement was established at 785 lb. The boat weight was to be 500 lb. with a crew allowance of 285 lb. She was designed with long waterlines and with adequate beam and a modest aspect ratio sail plan to reduce the heeling moment. The waterlines were retrimmed to produce as nearly a symmetrical heeled waterline as possible, minimizing weather helm due to heeling. She has a long easy entry to reduce bow wave and easily greases onto a plane. The Buccaneer is a boat that suffers little if sailed with three persons, e.g., 165 lb. over the design displacement. A renowned builder of patternmaker prototypes constructed the original cold-molded wooden Buccaneer 18 prototype in England. This overweight, 3/8' thick, glass covered tooling plug, was first sailed/raced on Lake Michigan near Chicago. The event was Yachting Magazine's One of a Kind Regatta which took place in late summer of (1968). The Buccaneer 18 placed second to the Thistle in a fleet of twenty plus boats.

It took Chrysler most of 1969 to set up their marketing, distribution, sales and tooling to manufacture the Buccaneer 18. In August of 1969 Chrysler held a press preview to introduce the Buccaneer 18 at Honey Harbor, Ontario, Canada. The Buccaneer 18 debuted for the boat dealers at the Playboy Club, Lake Geneva, WI in September 1969.

During 1969 when Chrysler was gearing up to manufacture the Buccaneer 18 there were only a handful of production builders of dinghy sailboats; Alcort - Sunfish, George O'Day – O'Day day sailor and the 505, and the Ray Green Co. - Nipper and Rebel to name a few. Chrysler had the unique ability to produce an unlimited number of boats. They were able to warehouse unsold inventory in 5 regional facilities and had a national marketing and distribution organization. Their dealer organization built three sailing simulators to train salesmen and dealers to sail and sell sailboats. It was this well founded infrastructure and commitment that allowed Chrysler to convert sailboat manufacture from, 'order one-build one' to 'what color would you like.....Is delivery on next Tuesday OK?'

It is uncertain how many Buccaneers made it into the hands of individual owners in 1969. In the sailboat industry the model year begins in September; thus any boats manufactured in late 1969 would have been considered 1970 models. By 1970 production was in full swing. During Chrysler's ten-year tenure in the sailboat business they built about (4,000 Buccaneers), (8,000 Mutineers) and total of 22,000 plus dinghies. To compare, it took forty years of Flying Scot production to reach 4,000 units.

All of the first generation Buccaneer 18's were built by Chrysler Corporation's wholly owned subsidiary; **Chrysler Boat Corporation** at the Plano, Texas plant on 1700 Nautical Way. (**Total production is estimated to be 4,050 units).** The production figures by year have not been identified. On January 31, 1980 the Chrysler Boat Corporation was sold to the next builder, Texas Marine International, Inc.

NOTES

Please note that this is to be a work in progress. The production records for Chrysler, TMI and Starwind have not been recovered as of this date. The records for Gloucester and Cardinal are available from Harry Sindle. I have received some yearly/overall production estimates from Dick Gibbs based on his recall of Royalty payments. Because TMI and Wellcraft failed to pay Royalty payments when they were experiencing financial hardship even these estimates are not very accurate.

I have reviewed all of the documents on hand. I hope those to be only about one third of the material that I will eventually collect as the BCA Archivist.

In the absence of production records I am attempting to reconstruct production numbers from sail numbers. TMI and Starwind both produced an unknown number of boats with no sail numbers. TMI, Starwind and Cardinal all at one time or another during their production used some non sequential numbering systems for their sail numbers with the result that at times the same sail numbers were used by two different builders. I have discovered that some Dealers used inflated sail numbers, i.e., 8000, 8008 and 8888 perhaps to provide the illusion that production was greater than it actually was. Owners over the years have selected clever or individualized sail numbers on there own without regard to their hull number. Many owners bought boats without sails and kept their original numbers for the new boat. There were also lapses in production due to legal issues with Bayliner and Wellcraft and delays in transfer of the tooling from one builder to another.

So you see it is quite a mess and will be very difficult, if not impossible, to ever determine the actual overall production numbers. I suspect, at this time, that the numbers that I had published earlier were inflated a bit. The Buccaneer production was inflated less than the Mutineer was. I will continue working on solving the mystery and will add to the Buccaneer Production History Document as I recover additional reliable information. I have uncovered much interesting information about the various builders, the dates of their production and the terms of the transfers. These details will be included as the document is completed.

As a counterpart to the Buccaneer Production History I plan to develop a timeline of which developments/improvements/modifications were made and when. I will also eventually produce a chronological listing of features, equipment and colors available for each model year. My research to date indicates that Chrysler made boats until December of 1979 or January 1980. The model year is from Sept until the next August. So both Chrysler and TMI built 1980 Buccaneers under the Chrysler trade mark. For the 1981 model year, from September 1980 until about March of 1981, when TMI went out of business, TMI made Buccaneers under their own Trade Name. Wellcraft purchased the legal rights to build Buccaneers from TMI in the spring of 1981 and so also built and marketed 1981 Buccaneers under the Starwind trade name. During 1981, Bayliner of Seattle, Washington also built Buccaneer 18's, some of these boats could have been considered 1981 and some 1982 models. Likewise, both Starwind and Gloucester built Buccaneer models in 1984, and both Gloucester and Cardinal built Buccaneer models in 1987.

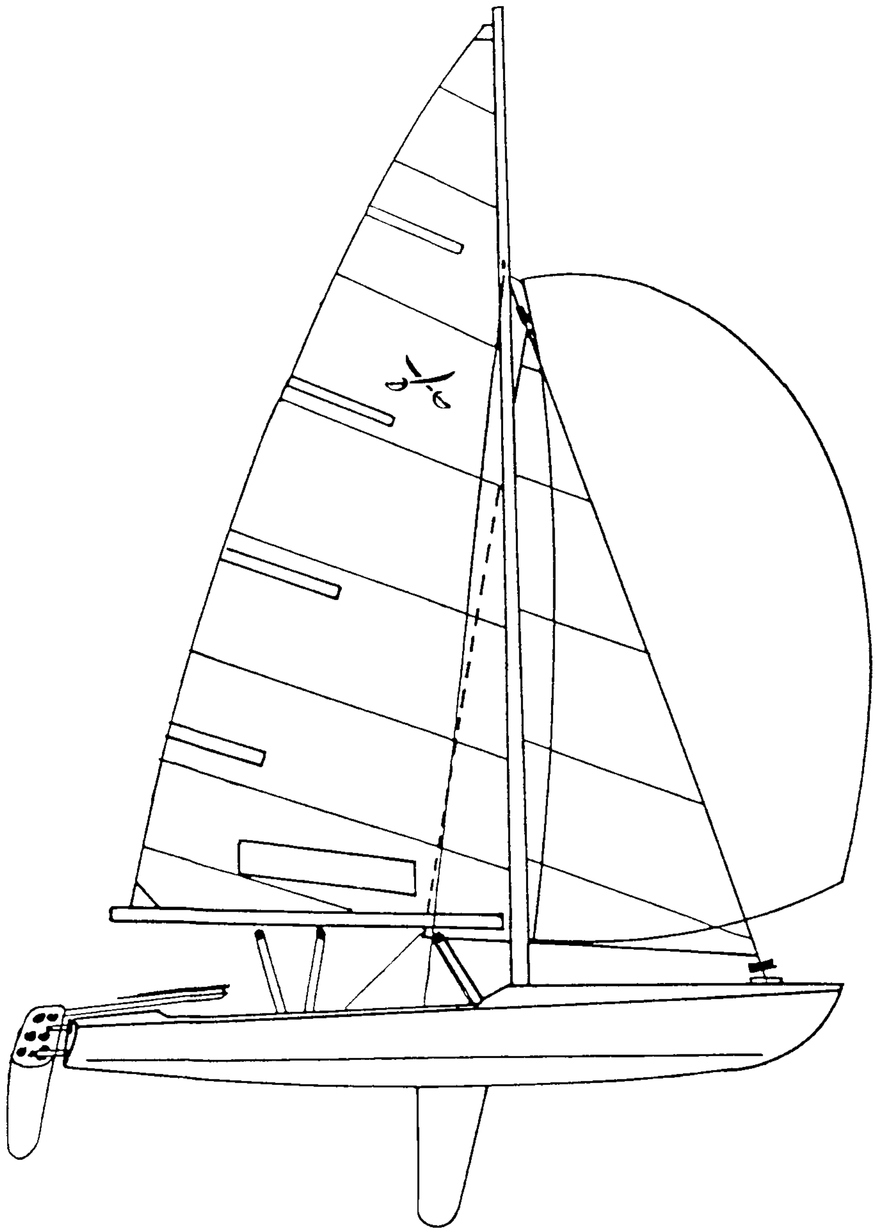
During the severe weather of the October, 1977 Championship of Champions several Buccaneers were dismasted, capsized and swamped. Following this 'bad press' so to speak several design changes were made by Chrysler to make the boat better and safer. My boat is sail number 2332 and is a 1978 boat. Most of the boats sailed in the C of C had sail numbers in the 2816 - 2836 range and would also have been considered 1978 models. None of these boats had the later improvements.

It is my best guess that in mid 1978 and for sure for the 1979 model year, i.e., Sept. 1978, Chrysler had redesigned the boat. These improvements included redesigned the inner hull to prevent water from entering the spaces under the deck and seats, at this time the jib changed to the luff wire replacing the tube-luff furling system. Since the forestay no longer had to be lead below deck the spinnaker launcher was enlarged and improved. The mast step was raised to clear the centerboard when stepping and a hinged step was provided. Jibsheet tracks were relocated to the inside edge of the seats, eliminating the need for jib in-hauls, and Harken cleats added to the windward side for cross sheet cleating. At this time the bow eye moved from the top of the deck to the stem of the hull and Large Elvstrom bailers replaced the older round style cockpit drains. This had been a major redesign of the Buccaneer at considerable expense to Chrysler. All of these new redesigned Chrysler Buccaneers were known as the Champion Edition.

To answer your questions, the higher mast step came earlier that you thought, mid 1978 or by Sept. 1978 for the 1979 model. Starwind announced for the 'new 1983 models' (this would have been in the late summer of 1982) that the hull joint would be lapped, (flanged as you call it). This is also when the cockpit got lengthened and brought them into a squabble with Dick Gibbs. These boats interestingly enough were not called Buccaneers but Starwind 18's. The outboard shroud chainplates were related to the lapped deck hull joint. There was no mixing or matching of this design feature that I am aware. Gloucester in 1984 made the change to topside centerboard hangers. The spinnaker launcher being molded as part of the deck mold was introduced in the Gloucester 1985 (Sept. 1984) model year. After this time one could not purchase a Buccaneer without a spinnaker launcher. You have a much better handle on the various mast lengths used. (I will be asking you for your data on masts when I get to that point in the History Piece). I am still recovering documents to help sort out by sail number when specific design changes were made. I am sorry not to be of much help to you on that issue at this time

Michael Connolly BCA Archivist/Historian June, 2004

Buccaneer Diagram



LOA:	18’
LWL:	16’8”
Beam:	6’
Draft- board up	7”
Draft – board down	3’10”
Sail Area	175 sq ft
Spinnaker Area	178 sq ft
Weight	500 lbs
Design Crew Weight	285 lbs

There is a significant difference over this time in the spars and other equipment used, and some differences in dimensions. The first step in tuning is to take a few key measurements to verify the dimensions, and therefore the initial state of tune. Table 1 shows dimensions taken from 3 boats made in 1980, 1996, and 2002. This is a work in progress. Data on other boats, especially early Chryslers with long masts and the low mast step, and Starwinds, will be added as the data is available.

Table 2. Comparison of Boat Dimensions

Measurement	Chrysler Boat	Cardinal Boat	Cardinal Boat		Maximum Variation
Sail Number	3590	5201	5215		
Year built	1980	1998	2002		
pre-ballast weight	518	475	450		13%
Race weight	518	505	505		3%
rudder blade weight	4.9		5.75	4.5	22%
CB weight	12.76				
stern to aft CB slot	73		72.5		1%
stern to forward CB slot	121		120.5		0%
length of CB slot	48		48		0%
stern to mast base	126.75		126.5		0%
stern to bulkhead	125.75		125.5		0%
bow to mast base	86		86		0%
bow to jib chainplate eye	20	18.25	18		10%
jib chainplate eye to mast base	66.5		68		-2%
jib chainplate eye to shroud		95			
shroud to mast CL	36.5	39	40		9%
shroud to shroud width	66	70.5	70.25		6%
shroud-shroud to mast base	18	18	18.5		3%
beam at deck	69	71.5	71.5		3%
Btm deck well to top deck	6	6	6		0%
rudder stand off	1	2	1		0%
bulkhead to front CB hanger hole	4.75	5.25	5	3	43%
CB hanger width-hole to hole	4.375	4.5	5.75	4.25	26%
bulkhead to CB pivot	6.9375	7.5	7.875	5.125	35%
mast height-original	278.25	283	283		2%
mast height-current	280	281	281		0%
mast head base to sheave CL	2	2	2		0%
mase base to boom	17.5	17.5	17.5		0%
mast base to shroud tang hole	206	209	209		1%
mast base to topping lift sheave					
mast base to jib sheave (top)	208	201.5	201.5		-3%
mast base to spinnaker sheave	214.75	215.5	216		1%
shroud length	204	207	207		1%
shroud adjusters hole to hole	0.3750		0.3125		-20%
deck to working hole			3.5		
mast head to transom top center			294		

mast head to projected stern			296
mase base to transom top center			123
mast base to projected stern	128		127
width-mast section			2.25
depth-mast section			2.625
boom length			
spinnaker pole length			
spinnaker mast eye-height from deck	30 to 54	41	42
distance, mast to main block on boom		50	50
distance, bulkhead to main block		45.75	46.5
jib track, CL from front of seat	0.5	1.5	1.5
jib track forward end	35	29	29
normal jib block position, from bulkhead	39	34	34

Table 3. Line lengths and weights

Main Sheet	3/8” to 7/16”	24 feet depending on configuration
Jib Sheet	1/4” to 3/4”	32 feet – can be tapered
Spinnaker Sheet	1/8” to ¼”	70 feet - can be tapered
Spinnaker halyard/dousing	1/8” to ¼”	60 feet
Boom Vang 6:1	¼”	15 ft depending on configuration
Cunningham	1/8” to ¼”	4 ft depending on configuration
Jib messenger	1/8” to 3/16”	22’ with wire luff jib
Main messenger	1/8” to 3/16”	22’ with wire halyard
Topping lift	1/8” to ¼”	24’
Outhaul 4:1	1/8” to 3/16”	6’ depending on configuration
Rudder blade line	1/8” to 3/16”	6’

Remember: Lighter is better except in main and jib sheets. Change lines often

CHAPTER 2.
STEERING BALANCE

The goal of tuning is to make the boat fast while handling well. Certainly these are closely related goals, as the skipper must like the way a boat handles to sail at his or her best, but what is fast? And how do we determine whether a boat is handling well, aside from her “feel”? We will start by explaining a few terms and factors that give a boat ‘s helm it’s “feel” and show a simple method for quantifying what “feel” is at the tiller.

So what is fast? The water line length limited hull speed of the Buccaneer is roughly 5.5 knots sailed upright in full displacement mode, determined by the formula:

Boat Speed V=1.34sqrt(LWL)=5.5 knots=6.3 mph=554 fpm=9.2 fps

Two modes of sailing can increase this speed considerably; planning and surfing down swells. The Buccaneer planes and surfs well, so these are important techniques to sailing competitively, but ABSOLUTE speed in a sailboat is not fast, or particularly important in a sailboat. In a sailboat, fast is going faster than your competitors. This can only be determined by sailing one-on-one or in races against other tough competitors. Fast is observing whether, on a beat or a run with no tacks or gibes, you are consistently pulling away from your competitors or they are pulling away from you. If they are pulling away from you, you need to figure out why and fix it. The fastest and best way is to figure it out is to measure the fastest boat in the fleet, Dave Spira’s boat Elusive, sail number 5201, and copy the settings on your boat as well as you can. Using this as the starting point, you can fine-tune your boat. This method is the basis for this tuning guide.

So what is good handling? Starting by defining terms, weather helm is the tendency of the boat to turn upwind. Lee helm is the tendency to turn downwind. We can agree that too much weather helm or lee helm makes a boat unmanageable in higher winds, and unmanageable is slow. But this is still too broad a range of handling to be useful. Generally, the best handling and fastest boats handle neutrally, with a slight amount of weather helm when pointing as high as possible in 10 knot winds with the hull sailed flat (as little heel as possible). But the preference of the skipper is the most important factor to determining <u>exactly</u> how much weather helm is desirable.

The tendency to weather or lee helm is caused by a torque between the center of lateral resistance CLR (the Centerboard and rudder) and the center of effort CE (the sails), as is shown on the following illustration from Ross Garrett’s “Symmetry of Sailing”. This torque can be changed by moving the centerboard or by moving the mast. Moving the centerboard forward or aft moves the center of lateral resistance. Changing the mast rake moves the center of effort forward (less rake) or aft (more rake). A more detailed and very useful discussion of boat balance from “Symmetry of Sailing” is reproduced in Appendix A.

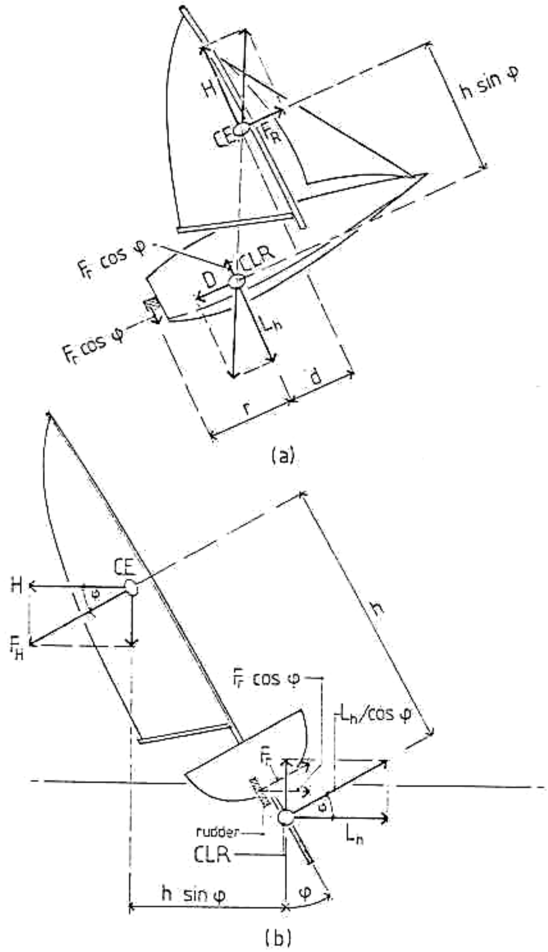
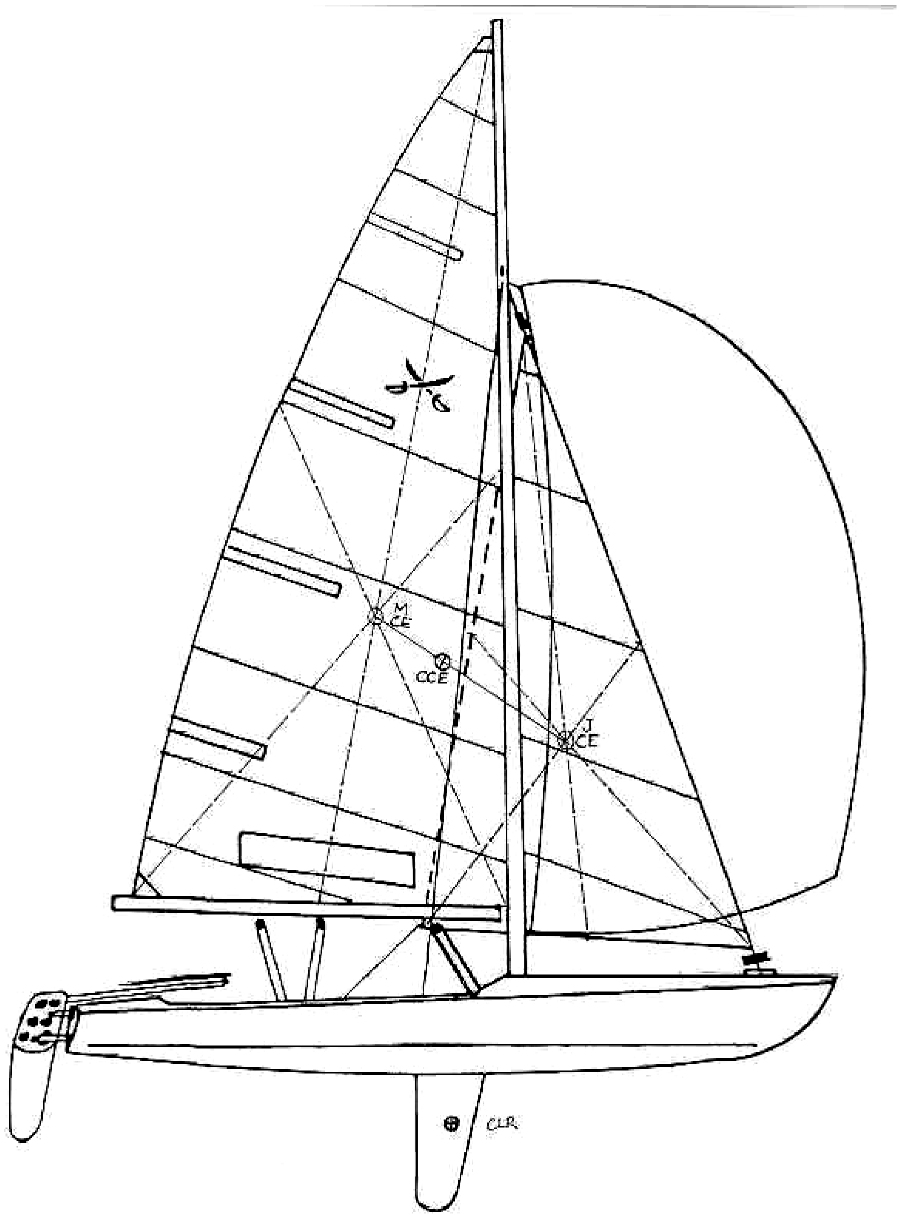


Fig. 6.4 (a) shows the forces in a horizontal plane acting on a yacht. There are three pairs of equal and opposite forces which do not act along the same straight line. Such pairs form torques or yawing moments tending to turn the yacht. These torques are: the rudder force with a moment arm r, the heeling force with a moment arm d (both tend to make the boat pay off from the wind), and the driving force with an arm hsin φ. This latter torque tends to make the boat round up into the wind. It is because this torque increases greatly with angle of heel that all boats exhibit weather helm when heeled. This large aerodynamic effect swamps the smaller hydrodynamic effects on balance which are due to idiosyncracies of hull shape.

I have graphically determined the center of effort for the jib and main (CEM and CEJ), the combined center of effort for the sail plan (CCE) and the center of lateral resistance (CLR) on the Buccaneer diagram below. Note I have used an estimate of the hydrodynamic center of lateral resistance rather than the traditional graphical centroid method. The traditional method places the CLR too far aft for useful discussion, and a “lead” from the CLR to the CCE must be introduced to compensate for the error in the estimation or CLR. A number of things are immediately apparent. The main sail center of effort is well aft of the combined center of effort and the center of lateral resistance, so furling the jib to sail in higher winds is not effective. The wide separation between the jib and main centers of effort means that the balance of the boat shifts aft (toward CEM) if the jib is inefficiently sheeted. Most importantly for boat tuning, the CCE is very close to the CLR, so the range available to boat tuning is very limited.



Because of rudder drag, sailing with the helm over to counteract excessive weather helm slows the boat, however it has been well established that a little weather helm is faster than none. Dick Gibbs points out that if a boat is COMPLETELY neutral, the lack of weather helm makes the angle of attack on the CB too low to generate sufficient lift, allowing to boat to make too much lee way rather than point efficiently. From the graph below you can see that in light air, weather helm up to 4 degrees improves VMG by improving pointing ability and upwind speed. This effect is greatest at lowest wind speeds and is almost entirely gone in winds 13 knots and higher.

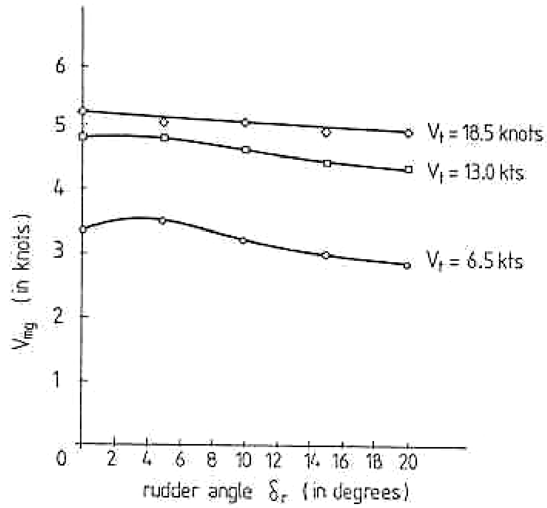


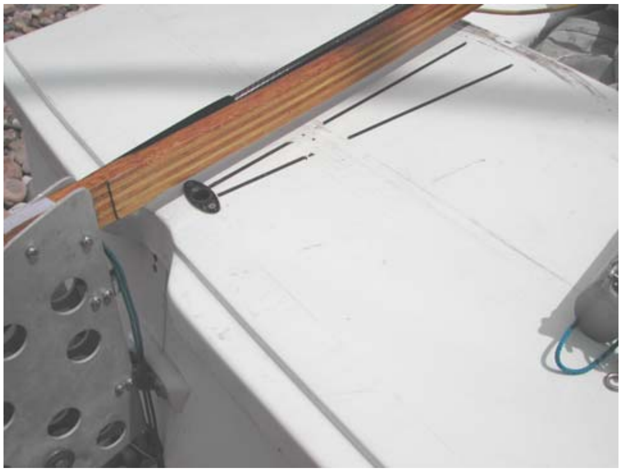
Fig. 5.33 Extensive tests on *Standfast* showed that a small amount of weather helm was advantageous when sailing to windward in winds up to 13 knots. There is good reason to believe this to be qualitatively true of most designs.

(from reference 4)

Clearly there is a lot of room for personal preference within the workable limits of handling. Randy Smyth points out (Chapter 5 of this Guide) that boat tuning cannot be effectively determined by handling, which can be deceptive and subjective, but by sailing one-on-one against other competitive boats to determine which changes improve VMG.

Bill Gladstone in North Sails' "Performance Racing Trim" (reference 3) indicates that weather helm should be no more than 4 degrees in a steady 10-15 knot wind. This agrees with the results in the graph above. Practically I have found it difficult to judge differences in weather helm "feel" when the weather helm is less than roughly 6 degrees. Anything less than 6 degrees feels more or less neutral depending on the conditions. I found I needed a better way than "feel" to fine tune the amount of weather helm as closely to the desirable 4 degrees as possible.

Marking lines on the stern of the Buccaneer makes it easier to evaluate the effect of tuning changes on boat handling. The rear deck of the Buccaneer is 24" wide and the rudder axis of rotation is between 1 and 4 inches aft of the rear deck, depending on the pintle arrangement. Buccaneers have been manufactured with pintle standoffs from 1" to 4" (for use with a transom mounted outboard motor). The outside of the 4 degree bands would be located on either side of the centerline of the boat.



4 degree helm reference lines

The table reproduced below shows the location of the 4 degree reference lines for different pintle standoffs:

Table 4. Four degree markers on stern deck.

Stern Deck Width	Pintle Stand Off	Total length	degrees	(1) CL to side	(2) Side to Side
24	0	24	4	1.67	3.35
24	1	25	4	1.74	3.49
24	2	26	4	1.81	3.63
24	3	27	4	1.88	3.77
24	4	28	4	1.95	3.91

(1) Forward edge of aft deck-from center line to either side
(2) Forward edge of aft deck-from port to starboard mark

The amount of weather helm can be produced by factors other than boat tuning, such as inefficient jib sheeting or excessive heel. Because it is harder to sheet efficiently and steer to keep the boat flat in strong gusty winds, weather helm will appear more pronounced in these conditions. Strong gusty winds are therefore not the best conditions to test boat handling or rig tune. Too little weather helm will make the boat feel mushy and unresponsive, or worse, can produce lee helm.

CHAPTER 3
Rig Tuning

"Tuning is probably shrouded in more mystery and misconception than any other word in the yachtsman's vocabulary. Yachtsmen tend to overcomplicate and surround their tuning problems with highly technical and confusing discussion that has no bearing on the immediate issue. Tuning means looking for more speed" Mike Fletcher (1)

Tuning the standing rigging is usually regarded as the heart of sailboat tuning. While it is important, it is not the complicated endeavor in the Buccaneer that it is in classes with more elaborate rigging and the ability to actively bend the mast.

Mast rake is important because increasing rake decreases aerodynamic drag and orients sail forces in more useful, more horizontal, directions (How do Sails Work by Paul Bogataj, North Sails; and Computational Methods for Investigating Sail Forces by Patrick Couser). In addition, adjusting mast rake is the most straightforward way to change the center of effort of the entire sail plan. Increasing the rake moves the center of effort aft. As a consequence, rake can't be increased too much, or the boat's handling will become seriously unbalanced. As shown in the section on steering balance, the amount of desirable mast rake and the weather helm it produces are a tradeoff between low wind VMG and high wind drag and boat handling.

Assuming the rigging has been set to the few dimensions referred to in the class constitution, and the mast is set up properly and is centered on the boat, two primary adjustments are to mast rake and rig tension. I will cover these in reverse order, as the rig must be properly tensioned for the rake measurements to have meaning.

Checking the Rig

But first the rig must be centered on the boat. Looking at the boat from the bow or stern, tension the rig and look for any sign the mast is not centered or straight. If you suspect it is not centered, you can use either a measuring tape or a plumb bob to check it.

To use the measuring tape, attach the tape to the main halyard, pull it to the top of the mast and carefully measure to the deck by the shrouds on either side of the boat. The side to side measurements should be as close as possible. NOTE: Measuring to the deck is required because the chain plates are not necessarily in the same location side to side, and the chain plate and shroud adjusters are not necessarily the same height.

Alternatively you can use a plumb bob to check that the mast is centered. First level the boat side-to-side by putting the level across the seats, floor, and mast well. Scootch the boat in the trailer until it is level side to side, and level fore and aft. It is best to check it as many places as you can to avoid a false level. Attach the plumb bob string to the main halyard and hoist it to the mast head. The plumb bob will hang aft of the mast at a distance determined by the rake (more on that later). It should be perfectly centered. NOTE: If there is *ANY* wind, the plumb bob might not show true plumb.

If you find that the mast is not centered, check the locations of the shroud chainplates by measuring from the bow to each side, and check the lengths of the shrouds and positions of the shroud tangs on the mast. To set the mast back on center you must either find and correct the problem that creates the condition, or set the port and starboard shroud adjusters at different positions to adjust for the off-center. Once this has been checked and corrected, you can move on to tensioning the rig and measuring the rake.

Rig Tension

Rig tension is most commonly set using a Harken Magic Box, though some older boats use Hyfield levers. The general consensus is that the Buccaneer rig should be set very tight. Harry Sindle (reference 6) recommends enough tension to keep leeward shroud from going slack sailing upwind in a 10-15 knot wind. I put as much tension on the jib forestay with the Magic Box as I can, often using my foot to increase the tension. At my usual rig tension the Loos Guage measures 27 to 28 on the shrouds, equal to a tension of 350 to 380 pounds. When the rig has been properly tensioned the mast rake can be measured and adjusted. Lower rig tension will let the rig move aft slightly (as much as 2 degrees with very low forestay tension). In theory, this setting should be better for light wind, as moving the entire center of effort aft will improve pointing ability and speed, and therefore VMG. In practice, I set the rig as tight as I can and don’t adjust it while sailing.

Mast rake can be set by moving the shroud position up or down the shroud adjusters. Both rig geometry and hole spacing in the shroud adjusters varies, so the change in rake expected by moving one hole up or down varies.

Mast Rake

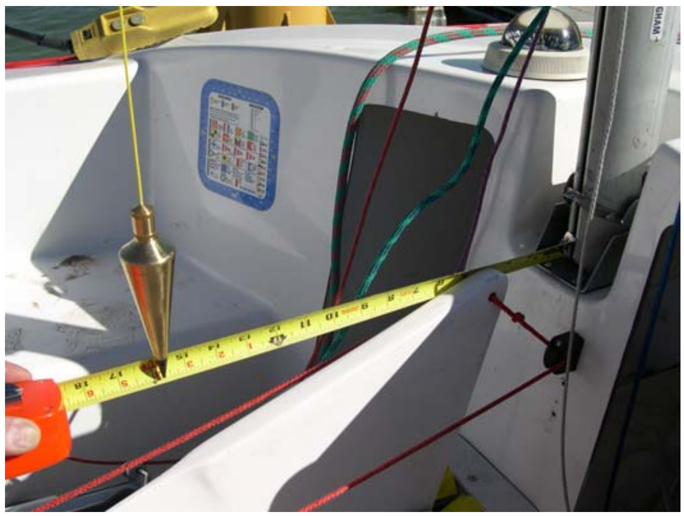
There are several methods of measuring mast rake at our disposal. I will present four methods here; 1. direct measurement with a digital level; 2. measurement with a plumb bob 3. measurement from mast head to stern with a measuring tape attached to the main halyard; and 4. measurement from spinnaker halyard sheave to bow.

Digital Level Method
Measuring the rake directly with a digital level is the simplest method, but requires specialized equipment and is inherently less accurate. In this method we assume the deck directly in front of the mast is a horizontal reference. Checking the Buccaneer diagram at the front of this tuning guide shows the deck was drawn parallel to the water line in the original design, so the assumption seems to agree with the designer’s intent. Because the deck is a curved surface it can’t be parallel to a planar water line, so this method is approximate only. To take the measurement you can place the level on the deck in front of the mast with it’s ends pointing at the mast and the jib roller furler. Using the trailer wheel, level the deck. Move the digital level up to the base of the mast, take the measurement and record the result. It isn’t necessary to measure the deck, as the readings can be taken and the deck measurement subtracted from the mast measurement, however leveling the deck will minimize the chance for error. Using this method boat 5201, our proven winning standard, measures a rake of 85.5 degrees, or 4.5 degrees aft. The decks of 6 Buccaneers tested vary from each other, and level, by about 1 degree. Leveling the boat on it’s waterline as described in Appendix A will compensate for any

inconsistency in deck measurement and provide a more accurate, albeit more difficult, measurement.

Plumb BobMethod

The other methods presented here do not rely on any specialized equipment. The second method requires a plumb bob, a framer's square, a bubble level, and a clamp. The plumb bob cord will be attached to the main halyard, and the distance from the bob to the mast base measured. This is done most easily by clamping the framer's square to the base of the mast, using the scale on the square to measure the plumb bob location. Next, the boat must be leveled. A quick method is by placing the bubble level on the foredeck close to the mast, raising or lowering the trailer nose wheel until the bubble indicates level. A more exact method is described in Appendix A.



The chart below shows the mast rake from 1 to 10 degrees determined from plumb bob for different mast lengths:

Table 5. Mast Rake determined by plumb bob offset for different mast lengths.

Boats	**1**	**2**	**3**	**4**	**5**
Mast Height	288	278	281	283	281
Rake	Offset-In	Offset-In	Offset-In	Offset-In	Offset-In
0	0.0	0.0	0.0	0.0	0.0
1	5.0	4.9	4.9	4.9	4.9
1.25	6.3	6.1	6.1	6.2	6.1
1.5	7.5	7.3	7.4	7.4	7.4
1.75	8.8	8.5	8.6	8.6	8.6
2	10.1	9.7	9.8	9.9	9.8
2.25	11.3	10.9	11.0	11.1	11.0
2.5	12.6	12.1	12.3	12.3	12.3
2.75	13.8	13.3	13.5	13.6	13.5
3	15.1	14.5	14.7	14.8	14.7
3.25	16.3	15.8	15.9	16.0	15.9
3.5	17.6	17.0	17.2	17.3	17.2
3.75	18.8	18.2	18.4	18.5	18.4
4	20.1	19.4	19.6	19.7	19.6
4.25	21.3	20.6	20.8	21.0	20.8
4.5	22.6	21.8	22.0	22.2	22.0
4.75	23.8	23.0	23.3	23.4	23.3
5	25.1	24.2	24.5	24.7	24.5
5.25	26.4	25.4	25.7	25.9	25.7
5.5	27.6	26.6	26.9	27.1	26.9
5.75	28.9	27.9	28.2	28.4	28.2
6	30.1	29.1	29.4	29.6	29.4
7	35.1	33.9	34.2	34.5	34.2
8	40.1	38.7	39.1	39.4	39.1
9	45.1	43.5	44.0	44.3	44.0
10	50.0	48.3	48.8	49.1	48.8

1 Chrysler low mast step, boats made before 1979
2 Chrysler high mast step, boats made 1978-80
3 Starwind and Gloucester
4 Cardinal
5 Nickels

Main Triangle Method
The third method uses a measuring tape to measure the diagonal distance from the mast head to the stern of the boat. This method is the most popular among other classes such as Lightning, MC Scow, and Thistle, to name only a few.

There was considerable manufacturing variation in deck arrangements at the stern of Buccaneers, shown on the next three photos for boats made in 1980, 1997, and 2002. A point at the aft side of the stern deck, on the centerline, at the corner of the raised area above the hull deck flange seems to be the same on boats of all ages (within ½”), so we will measure to this point.

1980 Chrysler

1996 Cardinal

2002 Cardinal

Attach a 35 ft (or longer) measuring tape to the main halyard with the shackle you use for the main sail. Raise the tape to the mast head and pull it tight. Take a measurement to the aft most point of the rear deck above the hull deck flange.

The chart below shows the mast rake from 1 to 10 degrees determined from the diagonal measurement for a number of different mast heights. This method is better in winds, but requires a lot of tension on the tape to counteract sag. This amount of tension can bend the mast and stretch the tape, but the distance being measured is long and errors comparatively small. In addition, the measurement cannot be taken with the main sail in place, so any difference in rig position from the mainsail weight cannot be determined from this method:

Table 6. Mast Rake determined from measurement from mast head to
stern (main triangle), for different mast
lengths.

Boats	**1**	**2**	**3**	**4**	**5**
Mast	288	278	281	283	281
MB to T	125	123	123	123	123
Rake		MH to T	MH to T	MH to T	MH to T
0.00	304.1	301.3	304.1	305.9	304.1
0.25	303.6	300.8	303.6	305.4	303.6
0.50	303.1	300.3	303.1	304.9	303.1
0.75	302.6	299.8	302.6	304.4	302.6
1.00	302.0	299.3	302.1	303.9	302.1
1.25	301.5	298.8	301.6	303.4	301.6
1.50	301.0	298.3	301.1	302.9	301.1
1.75	300.5	297.9	300.6	302.4	300.6
2.00	300.0	297.3	300.1	301.9	300.1
2.25	299.4	296.8	299.6	301.4	299.6
2.50	298.9	296.3	299.1	300.9	299.1
2.75	298.4	295.8	298.6	300.4	298.6
3.00	297.9	295.3	298.1	299.9	298.1
3.25	297.4	294.8	297.6	299.4	297.6
3.50	296.8	294.3	297.1	298.9	297.1
3.75	296.3	293.8	296.6	298.4	296.6
4.00	295.8	293.3	296.0	297.9	296.0
4.25	295.3	292.8	295.5	297.4	295.5
4.50	294.7	292.3	295.0	296.9	295.0
4.75	294.2	291.8	294.5	296.3	294.5
5.00	293.7	291.3	294.0	295.8	294.0
6.00	291.6	289.2	292.0	293.8	292.0
7.00	289.5	287.2	289.9	291.7	289.9
8.00	287.3	285.1	287.9	289.7	287.9
9.00	285.2	283.1	285.8	287.6	285.8
10.00	283.0	281.0	283.7	285.5	283.7

1 Chrysler low mast step, boats made before 1979
2 Chrysler high mast step, boats made 1978-80
3 Starwind and Gloucester boats
4 Cardinal Boats
5 Nickels Boats

Spinnaker Halyard Method
The last method, probably the best for our purposes, is to use the spinnaker halyard to measure the diagonal distance from the spinnaker halyard sheave to the bow. This measurement can be taken with the boat fully rigged including mainsail. There are 2 problems that are easily solved to make this method work. The first is to choose a point on the bow to measure to that is common to all Buccaneers, and the second is to correct for the downward curve of the deck to the bow. I have chosen the point of the bow just aft of the hull flange, but other points can be chosen, and the measurement from mast base to that point entered in the spreadsheet. To compensate for the downward curve of the bow I have added a correction factor, in degrees, to the table to adjust for the 1 degree slope to the deck. With this correction the table agrees well with the other measurement methods. I have calculated the diagonal distances for 4 of the most common sheave heights in the table. The table below can be used to convert the diagonal distance to mast rake:

Table 7. Determine Mast Rake from Spinnaker Halyard Measurement.

Distance from point of bow aft of flange at raised deck 86 inches

Mast		215.00	216.00	218.00	222.00	sheave height
Rake,	Correction	6.00	6.00	6.00	6.00	deck height
Degrees	Degrees	209.00	210.00	212.00	216.00	deck to sheave
0.00	1.00	227.39	228.31	230.17	233.88	
0.50	1.00	228.07	229.00	230.86	234.57	
1.00	1.00	228.76	229.69	231.54	235.26	
1.50	1.00	229.45	230.37	232.23	235.95	
2.00	1.00	230.13	231.05	232.91	236.64	
2.50	1.00	230.81	231.73	233.59	237.32	
3.00	1.00	231.48	232.41	234.27	238.00	
3.50	1.00	232.16	233.09	234.95	238.68	
4.00	1.00	232.83	233.76	235.62	239.35	
4.50	1.00	233.50	234.43	236.29	240.03	
5.00	1.00	234.17	235.10	236.96	240.70	
5.50	1.00	234.83	235.76	237.63	241.37	
6.00	1.00	235.50	236.43	238.29	242.03	
6.50	1.00	236.15	237.09	238.96	242.70	
7.00	1.00	236.81	237.75	239.61	243.36	
7.50	1.00	237.47	238.40	240.27	244.02	
8.00	1.00	238.12	239.05	240.92	244.67	
8.50	1.00	238.77	239.70	241.57	245.32	
9.00	1.00	239.41	240.35	242.22	245.97	
9.50	1.00	240.06	240.99	242.87	246.62	
10.00	1.00	240.70	241.64	243.51	247.27	

The procedure is to attach the end of the measuring tape to the spinnaker halyard, measure the distance from the knot (which will stop against the sheave) and the end of the measuring tape, raise the tape end with the spinnaker halyard, and measure the distance to the bow. I have used 86 inches from mast base to the point of the bow <u>behind</u> the hull flange. The point of the bow seems to drop from the plane of the deck, so I have included a 1 degree correction factor to accommodate this drop. After you have taken the measurement and added the distance from tape end to knot, look up that number in the table for the appropriate spinnaker sheave height, and read the mast rake from the left column. Note that spinnaker sheave height is measured from the mast base to the top of the spinnaker sheave. The 6” deck height in the table is subtracted from that to calculate the angle using the Law of Cosines.

Chapter 4.
HULL, CENTERBOARD AND RUDDER

Tuning the hull, centerboard and rudder are simple in concept but very time consuming in execution.

Hull

Tuning the hull means making it as smooth and clean as possible. Water should flow over it as smoothly as possible. It is clear from many technical studies that an adhered boundary layer of water (a “water wet” surface) has lower drag. There is some technical disagreement over what sandpaper grit to use in final wet sanding to get the best surface. I have heard numbers from 320 grit to 1,200 grit, but the consensus seems to be 400 or 600 grit. Finer than 600 grit results in a polished surface that water does not completely adhere to. There are also many wax products that produce a high gloss buffed surface that many dinghy sailors swear is the fastest, however testing has shown the boundary layer flow to be lower drag. My opinion is that merely paying attention to the hull will make the boat much faster than not, and that difference is greater than the difference between boundary layer flow and waxed hull.

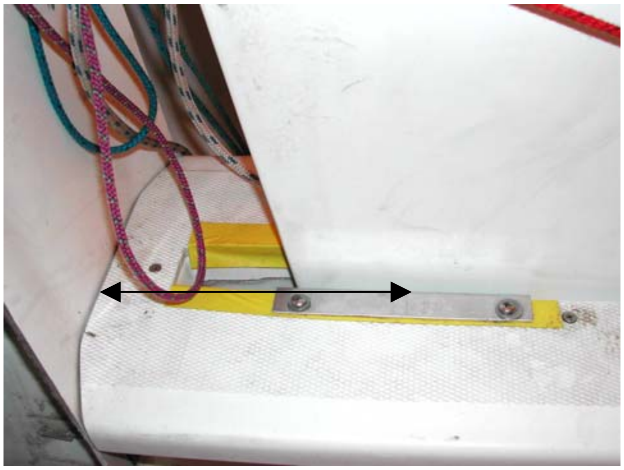
A discussion of the details of fairing and bottom coatings is too complex and beyond the scope of this tuning guide.

Centerboard.

Tuning the centerboard means setting the location of the hangers, putting together a workable system for adjusting the board while underway, making the board as smooth and fair as possible, and adjusting the centerboard position appropriately while sailing.

Location

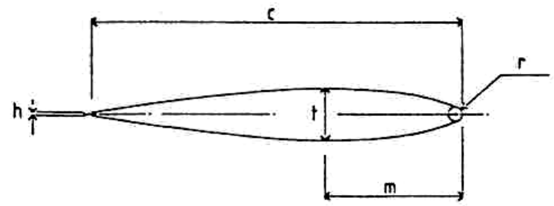
The location of the mast base and the forward cockpit bulkhead have been consistent among the boats measured, so measuring from the bulkhead to determine the centerboard location seems practical and accurate. There is a wide variation in the width of the centerboard hangers (see Table 1), so measuring the forward edge of the centerboard hangers is not an accurate measure of the location of the centerboard pin. Therefore it is best to mark the centerboard hangers at the midpoint on the top flange. This accurately locates the position of the centerboard pin. The distance from the bulkhead to the centerboard pin is 7.5 inches in Dave Spira’s boat, 5201, a proven winner. Greg Twombly’s boat, 5215 was set up with the same distance and handled very well until a new set of hangers set the pin location an additional half inch aft, which made the helm loose it’s feel. The exact centerboard pin location seems to be important. 5215 came originally with a distance of 5.125 inches, which created an almost unmanageable amount of weather helm.



Older boats use a centerboard pin attached to the bottom of the centerboard trunk behind the centerboard gasket. For the bottom mounting bracket, locating the midpoint of the mounting bracket 120 inches from the stern is equivalent in position to 7.0 inches aft of the bulkhead for the top bracket. Changing older boats to the top bracket allows easier fine-tuning of the centerboard position.

Control lines to set and retract the centerboard can be rigged many different ways using rope, bungie cord, continuous loops, separate lines for setting and retracting, and many variations using all sorts of cleat arrangements. The details are not particularly important as long as the system allows easy setting and retracting while under way to change the board position for different upwind, downwind, light air, or high wind conditions. Harry Sindle’s book (reference 6) explains the use and settings of the centerboard . Particular attention should be paid to making sure the centerboard is fully deployed when sailing upwind. The control line hole in the upper aft end of the centerboard should be at, or slightly below the top of the centerboard trunk cap. Because the center of effort of the centerboard changes as the board is set, the position of the board is very important to boat handling in general, and particularly important to sailing upwind.

The general comments on hull fairing (above) apply equally to centerboard and rudder, however there are additional constraints to keep in mind while fairing rudder or centerboard foils. Clearly foil shape and trailing edge thickness are equal in importance to a smooth surface. General foil shape considerations are presented in the table below from “Symmetry of Sailing”.



(a)

parameter	increasing	decreasing
thickness ratio t/c	increases stall angle increases form drag increases volume for ballast	reduces stall angle reduces drag at zero angle of attack
position of maximum thickness	0.5c reduces drag at zero angle of attack	0.3c increases lift-drag ratio moves ballast forward
leading edge radius	increases lift-drag ratio	reduces drag at zero angle of attack decreases stall angle
trailing edge thickness	increases lift decreases lift-drag ratio h = 0.10t absolute maximum	minimum ('knife edge') best

Fig. 5.23 (a) shows the parameters describing section shape: c is the chord length; h is the trailing edge thickness; m is the position of maximum thickness, usually specified as m/c; r is the leading edge radius; t is the section maximum thickness, usually specified as the ratio t/c. (b) shows the principal effects of varying the section shape. Except for special applications foils with a maximum thickness at 0.3c are best for keels and rudders. More details on the effect of trailing edge thickness are given in fig. 7.3.

The trailing edge and blade tips deserve special attention. Harry Sindle recommends keeping the trailing edge squared off and about 1/16” thick as a compromise between a fast shape and a durable edge, however a thinner trailing edge is faster. I think constant attention to the shape of centerboard and rudder condition is part of racing maintenance, and the occasional dinged edge a small price to pay for the additional speed.

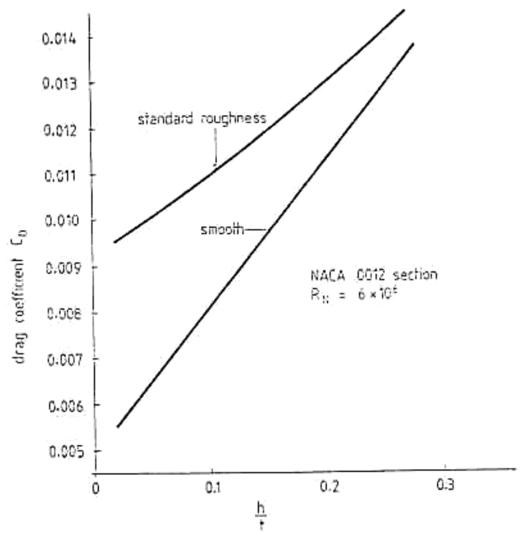


Fig. 7.3 Increase in drag resulting from removing the trailing edge of a foil section; h is the thickness of the trailing edge and t the maximum foil thickness. The graph shows, for instance, that a 10% increase in drag can be expected for a hydrodynamically smooth section if the thickness of the trailing edge is 3.6% of the maximum thickness. Although these results are for the ‘ideal’ two-dimensional situation they give us a clue as to the importance of the trailing edge even though the effect is likely to be less marked in the real three-dimensional world.

Rudder

Tuning the rudder means assembling the rudder to make it operate smoothly, making the blade as smooth and fair as possible, and setting it properly when you begin sailing. The design of the Buccaneer rudder assembly is marginal for the forces involved and requires constant maintenance. Two particular problems regularly encountered are failures of the ¼” bolt the blade rotates on, and bending of the cheek plates. Both these problems can be prevented by drilling the center hole in the rudder blade out to a larger size. Many active racers use a larger size bolt, either 5/16” or 3/8”, a large diameter stainless steel fender washer, and a Teflon sleeve for the bolt. The larger bolt and the fender washers distribute the turning forces better and prevent the aluminum cheek plates from bending. Another common problem is wear of the soft aluminum gudgeon blocks on the hard stainless steel pintle. The wear allows excessive rudder play within a short time, often in 6 months of active sailing. These blocks are available from Harry Sindle at Cardinal Yachts. A better solution is to have bushings fabricated from a bearing grade plastic such as Molybdenum Sulfate filled Nylon 6 (Nylatron) or Delrin AF PTFE filled according to the drawings included in this chapter. I have been using bushings fabricated from both Delrin and Nylatron with very good results. They fit the pintles much more closely than even a new set of aluminum bushings. They must be changed more often but are cheaper and stop the rudder from working back and forth in swells in light air. The second drawing is for thicker bushings. These 1” thick bushings have more surface by 33% over the stock ¾” bushings and last longer. These bushing fit so tightly on the pintles that pintle misalignment can become a problem. I leave the bushings loose on the rudder head until I have fit the bushings over the pintles, then tighten the bushing bolts on the rudder head. This accommodates minor pintle misalignment. If the pintles have greater misalignment the pintle bolts must be loosened, then retightened using the rudder head as an alignment jig.

Fairing the rudder blade was covered in the section on centerboards.

A number of Buccaneers were made with the rudder axis of rotation off center. A procedure to verify the rudder pintles are well centered is contained in Harry Sindle’s book (reference 6).

Buccaneers have been made with many different pintle and gudgeon arrangements, including a wide variation in the distance the pintles stand off from the boat. These seem to have been made with from one to four inches of standoff, the latter for use with outboard motor mounts. The resulting variation in the location of the axis of rotation also allows considerable latitude in how the blade is deployed. The consensus among competitive Buccaneers, and confirmed by theoretical studies, is that the rudder blade leading edge should be set as close to vertical as possible. This is especially important to sailing upwind. Setting the blade forward of vertical should be avoided as it will make the blade vibrate at speed and increases drag greatly. Sweeping the blade aft by an angle greater than the transom angle is equally undesirable, as the increased leverage of the swept blade creates a feel very much like excessive weather helm.

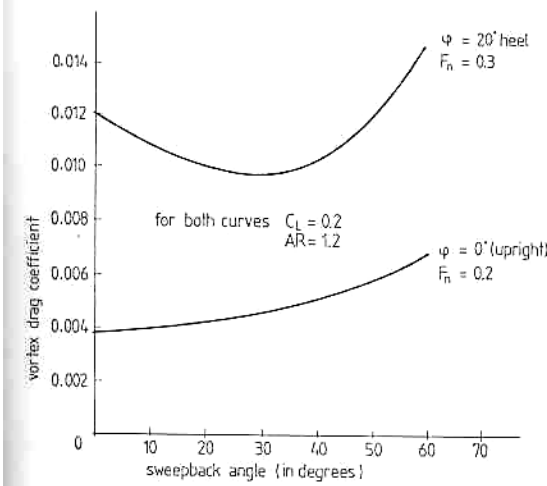


Fig. 5.26 The effect of sweep angle on vortex drag when water surface effects are taken into account. The lift produced by leeway is the same in both cases. For small boats which are sailed upright, zero sweepback is best. When heeled some sweep is beneficial. The optimum amount of sweep decreases with increasing aspect ratio and draft.

“Most of our trimming and fine tuning effort is directed at improving the mix of useful and useless forces. Even a slight improvement in the mix can make a big difference in performance. Every little bit counts *a lot*.” Bill Gladstone (3)

Chapter 5.
SAIL TUNING

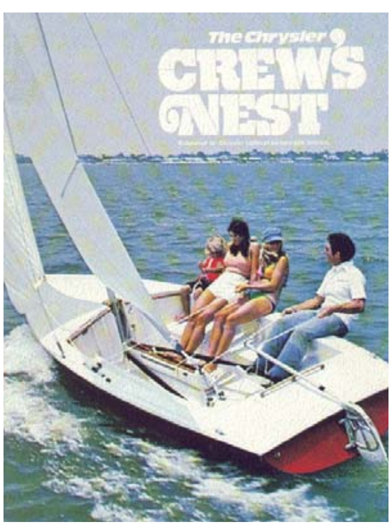
Sail tuning is by itself the subject of many lengthy books. I have reproduced here the North Sails Tuning Guide to cover the basics of Buccaneer sail tuning and trim. A few measurements and adjustments that come under the heading of boat tuning are necessary to use the advice given in the North Sails Tuning Guide. These measurements and adjustments are rig tension (already discussed), mast rake (already discussed), forestay position, jib track position, jib block position, main sheet configuration and mast bend.

Forestay Position

Buccaneers have been made with a wide variation in jib forestay configuration. Early boats had tube luff jibs with luff tension set by a lever located below deck. This evolved into the current roller furler system with a wire luff tensioned by Magic Box. In this configuration sail luff tension is set by a luff line cleated at the sail's tack, as described in the North Sails Tuning Guide. Over this manufacturing history the position of both the jib tack chain plate and the halyard sheave have varied significantly. The jib halyard sheave in early boats was positioned at the same level on the mast as the shroud attachments. In later boats the halyard sheave is up to 9 inches below the shroud attachments. The cumulative effect of these variations is to change the jib forestay angle significantly, and in conjunction with the Magic Box, to change the amount of mast preload.

Older boats can have much steeper forestay, and therefore luff, as a result of less mast rake, jib sheave higher on the mast, and jib tack chain plate further aft. In addition, high rig loads that can be achieved with the Magic Box create a mast preload that has both a mast parallel (vertical) component and a horizontal component. This mast preload can allow the mast to bend earlier, and more, with mainsheet and vang. The locations of the jib halyard sheave and the shrouds can be changed, but it requires purchasing new shrouds, relocating the Magic Box or other tensioning device or lengthening the halyard, and making modifications to the mast. It is also not clear these changes would make the boat faster, but will make it easier to tune.

Jib track position



The position of the jib blocks controls the angle the jib sheet pulls on the jib, and therefore the shape of the jib, as more fully described in the North Sails Tuning Guide. The position of the jib block is set by the position of the jib track. Early Buccaneers were made with the jib track above the seats on the gunwale of the boat, as shown in this early advertising photo, but this prevented efficient pointing upwind, so many early boats were modified to put the track on the bench seat. Later boats have all been made with the jib track on the seat. The position of the jib track is therefore very important. The jib track in 5201, our performance standard, is 29 inches aft of the bulkhead as measured along the front of the seat, and 1 1/2 inches inboard from the vertical plane of the front of the seat. The position 29 inches aft of the bulkhead provides room to move the jib block fore and aft enough to accommodate a wide range of wind conditions.With the track in that position, Dave Spira has the jib block set in the center of the track for sailing in moderate wind conditions (34 inches aft of the bulkhead), moves it forward no more than 2 inches in light air and no more than 2 inches aft in higher winds (32 and 36 inches from the bulkhead respectively).

Main Sheet Configuration

Buccaneers have been made with at least three mainsheet configurations. Early boats had 2 blocks on the boom running to a main sheet block and cleat (shown in the Buccaneer diagram on page 6) on the aft end of the centerboard trunk. This arrangement was presumably to reduce loading on the boom, which was light and has a tendency to bend. Starwind boats used a larger square section boom with adjustable position on the upper block. Later boats had booms lighter than the Starwind boom but heavier than Chrysler booms. Starwinds, Gloucesters, and Cardinals use a double block on the boom and a double block with cleat and Becket on the aft end of the centerboard trunk. In this arrangement, the position of the boom block relative to the main block and cleat on the CB trunk is very important to mast bend. Placing the block on the boom exactly lined up with the main block produces no additional mast bending force other than that transmitted by sail tension. Moving the boom block forward of the main block will reduce mast bend and is not helpful. Moving the boom block aft of the main block will increase mast bend. If the boom block is aft of the main block when the mainsheet is tightened, there is a component of the mainsheet tension pushing the boom forward into the mast, increasing mast bend. While the differences in configuration are small from boat to boat, the difference in mast bending force from these small differences can be significant. The one inch difference in main sheet block offsets between our standard for speed, Dave Spira's boat 5201 and Greg Twombly's boat 5215 results in Dave's boat having twice the mast bending force from the main sheet.

Tension on the boom vang will increase this effect for the same reason, but more effectively because of the higher angle the boom vang makes with the boom increases the horizontal force component.

Nickels Buccaneers are currently produced with 3 separate blocks on the boom and 2 blocks on the CB trunk. The arrangement of the blocks and the 6:1 mechanical advantage produces a large amount of mast bend with little effort.

Mast Bend

Mast bend can be important in controlling main sail shape, especially in high winds when leech twist is used to spill air from the main or reduce lee side trailing edge turbulence. As we have said, mast bend in Buccaneer can not be changed as easily or precisely as it can in boats with running backstays, active shroud tensioners, mast rams, or other devices designed to bend the mast. Mast bend in a Buccaneer can only be changed indirectly, and then by the cumulative effects described in the previous sections of this guide. This picture of Bill Bartel at the BNAC shows the bend that can be achieved. The main controls are main sheet tension and vang tension, but the amount of mast bend and when it occurs (ie, under lower wind speeds and main sail loadings) can be changed by rig tension (with the Magic Box), rig configuration and main sheet configuration. Adding together the forces referred to above, Dave Spira's boat with the rig

fully tensioned would have 12 pounds more preload on the mast than Greg Twombly's boat before the vang is set. This mast preload means Dave's mast will bend earlier under wind load than Greg's. From this example you can see that even small differences can be important.

NORTH SAILS BUCCANEER TUNING GUIDE, UPDATED MAY 2004. The following measurements are those we've found to be the fastest for your new North sails. After experimenting you may find slightly different settings which may mean even better boatspeed for you and your style of sailing. We have found that neutral helm is a good goal of the tuning process. If you have any questions or problems, please don't hesitate to call. We are anxious to help you go faster and win more races!

Information provided by: Greg Fisher, Greg Twombly and David Spira

Onshore Adjustments

Mast Rake: The Nickels Buccaneers are set up to sail with neutral helm at 4.5 degrees of rake. To set up the mast with the proper rake the simplest method is to run a tape measure from the main halyard shackle pulled to the sheave at the top of the mast to the transom. With the "standard" mast length of 23'5" (281") the distance to the outside edge of the transom will be 24'7" (295"). As a rule of thumb, 2" represents 1 degree of rake. **This must be done with the jib on and the rig fully tensioned**. **You increase rake by moving the pins on the shroud adjuster down.**

Some Cardinals and Gloucesters have a mast that is 2" longer (283") – use 297" to 299" to determine rake. Chrysler masts are 3" shorter so use 293" to 295" to set the rake OR add blocking to raise the mast higher). If this causes too much weather helm – rake the mast forward until the helm is neutral. On older Buccaneers, less of rake is needed to sail without lee helm. If the rake is increased as much as suggested above, the centerboard may need to be moved aft (see below). It is best to set up the mast rake on your older Buccaneer so that with the correct amount of rig tension the mast will be 1/4" to 3/8" away from the forward edge of the deck partner (on boats where the mast is stepped below deck level). This is important as it will allow the mast to bend adequately in heavy air with the boomvang tension on tight. For boats where the mast is stepped 6'' below deck (all boats since 1980) and as a final check on boats where the mast goes through the deck, the boom should be drooped slightly below parallel to the horizon at the outboard end when trimmed in and sailing upwind in a 10-15 mph breeze. In winds below that (8-10 mph) the boom should just be level with the horizon.

Other methods to determine rake, using a plumb bob and a carpenter's level, are very simple as well. First level the boat at the foredeck near the mast with a bubble or digital level. Drop a weight (needle nose pliers) from the main halyard shackle and note the distance from the inside edge of the mast along the boom. 10 inches back results from about 2 degrees of rake, 15 inches is 3 degrees, 22 inches is 4.5 degrees. If you have a digital level you can run it along the mast vertically to get the rake – 85.5 degree reading shows 4.5 degree rake aft.

Rudder position: The rudder must be capable of being set to vertical so that the leading edge is approximately perpendicular to the waterline. Any significant rake aft will lead to a tug on the helm and cause excess drag.

Centerboard Location: Newer Buccaneers are equipped with pivot hangers mounted on the centerboard cap. **The ideal location is 7.5" from the center of the hangers (pivot point) to the bulkhead.** This is the placement on the Nickels boats. Many older Buccaneers have come from the factory with the centerboard over 1" forward of where it is located on the newer boats. To take advantage of the full 4.5 degrees of rake you may consider relocating the centerboard further aft or the additional rake will simply cause excessive weather helm. The stopper can also be removed from the tip of the centerboard so it can be used in its full down position while going upwind effectively moving the board forward, while the pivot has been moved aft.

Rig Tension: We have found that the Buccaneer performs better with the rig set up very tight. Measured using a Loos gauge, a minimum of 250 lbs will barely keep the lee shroud from sagging in light air. **We recommend 350 lbs for most conditions.** This will keep the jib stay tension so that the leeward shroud does not go slack when sailing upwind until it is blowing 10-12 mph. This rig tension can be tuned in with the jib halyard through the use of a 16:1 cascade, magic box, a lever, or a series of balls on your halyard hooked to a plate assembly. Up to 400 lbs can be used, if necessary in higher winds. More tension than that can damage the boat so be careful.

To set up this amount of rig tension without a magic box or lever, ease off your spinnaker halyard enough so that a person can stand at least 10' in front of the boat and hold onto the spinnaker halyard. Then, recleat the halyard and pull on it hard enough so that the correct amount of rig tension can be "tuned in" with your jib halyard.

Jib Lead Position: Your jib lead angle should be 8 - 10 degrees off the centerline. This corresponds to locating the jib track near the inside edge of the seat – about 1.5". Unfortunately there are several different jib lead positions on the different model Buccaneer boats built. We suggest measuring out 10 degrees and try to set your lead accordingly side to side to meet the adjustment.

As for fore and aft trim, set your jib leads so that the jib luff breaks evenly from top to bottom in light to medium winds. In winds above 10-12 mph it is best to move the leads back 2". In winds above 20-25 mph it is best to move the lead back another 2".

With the rake at 4.5 degrees we have found that the median jib lead position is 34" aft of the bulkhead. With less rake, this position moves further aft.

Sailing Adjustments

Main and Jib Cunningham: For both the main and the jib, never pull tighter than to just remove the wrinkles. It is best to leave just a hint of horizontal wrinkles from the luff of your main and jib to be sure that you don't have it pulled too tight.

Your North Buccaneer jib is fitted with a small plastic clam cleat so you can easily adjust the cloth tension on your luff wire. As on the main, it is a good idea to set the cloth tension so there is just a hint of wrinkles coming off the luff of the jib. It is better to err toward the loose side than the tight side of luff tension on your North Buccaneer sails.

Outhaul: Your North Buccaneer main is fitted with a shelf foot which, when eased, will give the main incredible power. We suggest pulling the outhaul tight enough to close the shelf (so that the top seam is parallel with the boom) when sailing upwind in all conditions except very light winds with extreme chop. In these conditions it is advantageous to ease the outhaul 1-2" to open the shelf up approximately 2-3" at the center of the boom. When sailing downwind or on a reach it is a good idea to ease the outhaul off so that the shelf is completely open and the sail is very deep down low. However, never are vertical wrinkles in the foot advantageous. Never ease the outhaul off to this point.

Jib Sheet Trim: An easy guide for jib sheet trim on the Buccaneer is to trim until the foot of the jib is even with the line where the spinnaker sheets, pulled tight, lay on the deck. Basically, we are looking for a parallel slot between the exit of the jib and the entry of the main. The guide that has been used with success is that of imagining a batten in the jib at mid-leech. This "batten" is usually set parallel to the centerline of the boat which makes the upper leech of the jib twist outboard slightly and the lower leech of the jib twist inboard slightly. It seems that 90% of the boat speed problems on the Buccaneer are due to faulty jib sheet trim.

Mainsheet Trim: The mainsheet should be pulled tight enough so that the last 18" of the upper compression batten on the main is set parallel with the boom. This is sighted from underneath the boom and lining the batten and the boom parallel on a horizontal plane. In light winds it is sometimes impossible to keep the upper batten from hooking slightly to weather because of the weight of the boom hanging on the leech of the sail. In these conditions and in choppy water we suggest easing the sheet out approximately 6" so that the upper batten will then become more or less aligned with the centerline of the boat. In choppy conditions ease the mainsheet approximately 6" to open the upper batten slightly to or past parallel to the boom. This is a "power" gear which will allow the mast to straighten slightly and the main become fuller. Picture the mainsheet as your accelerator. As your boat picks up speed, pull the main tighter and tighter until the upper batten is parallel to the boom. In light winds or when the boat is hit with a wave and is slow downwind, ease the mainsheet so that the upper batten is angled outboard slightly inducing "twist" into the sail.

Use the Cunningham as the wind increases to keep the draft from moving to far aft. In light air put on enough Cunningham so that there are some wrinkles near the luff on the bottom half of the sail. In heavy air pull it tight so the wrinkles are gone. Make certain that the main halyard is up as far as possible and mark this position on the halyard so this setting can be repeated easily. The halyard should be made from wire or no-stretch line such as Spectra.

Upper Compression Batten: Your North Buccaneer main is fitted with a full-length upper batten that fits into plastic protectors along the luff of the sail. The velcro adjustment allows you to change the tension on this batten as the conditions change. However, 90% of the time we set the upper batten in the pocket just tight enough to barely remove the vertical wrinkles along the pocket. To overcompress the batten will induce more fullness into the sail than it is designed for and will tend to hook the leech to windward in all but the heaviest conditions. It is best to slide the batten into the pocket, putting very little tension on the batten and pocket before setting it in the velcro.

Boomvang: Downwind the vang should be trimmed tight enough to keep the boom down and the leech set on the mainsail so that the upper batten is parallel to the boom. Basically we are looking for the main to set as it does when sailing upwind in a medium breeze. Upwind in medium to heavy winds the vang is set just tight enough to keep the tail end of the upper batten parallel to the boom. In heavy breezes this may require a great deal of boomvang tension as this will also help bend the mast and flatten the sail. In light winds (below 8 mph) never use any boomvang tension upwind.

Spinnaker Trim: Sail your North spinnaker with a 6-12" curl in the luff. Careful concentration is needed. Use short, smooth ins and outs on the sheet to keep the spinnaker trimmed correctly. Try to keep from jerking the sheet when the spinnaker begins to collapse. Keep the clews even at all time through the adjustments on your topping (pole) lift. In some conditions it is difficult to see the leeward clew behind the mainsheet so you can use another guide of adjusting the pole height so that the center vertical seam in the spinnaker is parallel to the mast. The pole position to the wind should be set so that the pole is nearly perpendicular to the wind.

We wish you good luck and fast sailing. If you have any further questions, please feel free to give us a call.

For tuning help, contact the North Buccaneer experts.

Randy Smyth's Buccaneer Tuning Session
Randy Smyth and Greg Twombly

Sailing with Randy Smyth at the 2004 BNAC in Ft Walton Beach, Florida was a great experience and was a practical lesson in the logic and process of boat tuning (among many other lessons in helming, sail trim, and teamwork). The starting settings for my new Nickels Buccaneer 5218 Duck Soup were those David Spira and I determined from Elusive, David Spira's 2 time BNAC winner, for the Buccaneer Tuning Guide; 4.5 degrees of mast rake (set at 3.5 on the Sta-Masters) 350 lbs shroud tension, centerboard pivot 7.5 inches aft of the bulkhead, and jib blocks 34" aft of the bulkhead. These settings have proven very competitive in setting up other fast boats and are the basis for the initial tuning of the new Nickels Buccaneers, so I presumed these settings were the last word in tuning. Then Randy went to work. Starting the day before the regatta began, Randy went through the full range of sail trim with pretty much all possible combinations of sheeting, outhaul, vang, Cunningham and jib luff tension. In two hours of sailing in gusty thunderstorm winds Randy figured out more about sail control than I have learned in 2 years sailing Buccaneers. During the first two days sailing Randy spent a fair amount of time looking up the mast at the shape of the jib and main seams and back along the centerline of the boat at the helm before observing that the helm was not balanced, but was neutral to slightly lee, and that the top of the jib slot was closed off, back-winding the middle part of the main sail. To resolve these problems Randy moved the Sta-Masters to the lowest setting he could get by hand, about 1, to increase the mast rake and open up the top of the jib-main slot. Even with the new amount of rake the slot was still narrow at the top, so Randy set the jib blocks aft to the end of the track (37 to 39 inches aft of the bulkhead) to flatten the foot and open up the head of the jib in windy conditions. With the jib very tightly sheeted the slot was then fairly even from top to bottom. In lighter air Randy moved the track forward by about 3 inches, still aft of my previous center position. As the wind slackened this caused the foot of the jib to be too flat, so Randy pulled the lazy sheet to add draft to the bottom of the sail without closing off the top of the slot. This proved to be very effective, but we did not sail in really light conditions (less than 5 knot winds). With these tuning settings we were improving with every race. We were pointing as high and were at least as fast as the fastest boats in the fleet, David Spira's Encore (5216) and Ryan Flack and Jenn Armbruster's 5225, winner of the 2004 BNAC. The price of these changes was that the jib had to be sheeted much closer than I was accustomed in order to keep the sail plan balanced, and I had to steer a much narrower and more consistent angle to the wind, both things I should have been doing anyway.

Randy adds:
MAINSAIL TUNING:
While I don't contend that this is a definitive end game for Mainsail tuning, Greg and I found this approach worked well for us. After experimenting with several combinations not worth listing here I discovered that the Mainsail could be adjusted through a wide range of wind conditions as follows:

In light air from 5 to 7 knots when we were underpowered upwind we set the Cunningham for moderate luff wrinkles, the outhaul just smooth, and the vang loose. Our Mainsheet was adjusted much tighter than Greg had been previously accustomed to. Both of the upper leech tell tales were fully stalled all of the time which produced maximum power and very good pointing ability. However as Greg mentioned this set up required Greg's full attention to steering ‘within this narrow road’. In this underpowered condition steering attention was focused on the lower Jib tell tales keeping the leeward one always straight back and the windward one ‘dancing’ without the jib ever getting soft on the luff.

In the mid range of 8 to 11 knots, which we seemed to have quite a lot of during the Fort Walton Beach North American’s we found the Mainsail required plenty of changing adjustments. Steering in this condition required Greg to graduate from tell tale steering to a much more challenging technique of keeping the heel angle constant. To do this properly Greg strived to learn to anticipate the effect of puffs and lulls. By the fourth day of racing I can say that Greg mastered this technique most of the time.

We did get a chance to race in over 12 knots a few times when thunderheads passed close by. While other competitors seemed content with noisy, high drag mainsails when they flogged in the puffs, I looked for a faster, quieter solution. First we pulled the outhaul tight enough to form a horizontal wrinkle along the boom. This greatly reduced back-winding in the lower 1/3 of the Main. Next we ‘maxed out the Cunningham’ well beyond removing the wrinkles along the luff. This added enough compression load on the mast to add sufficient mast bend to flatten the Main in the middle and top even when the Mainsheet was eased in the puffs. Our first temptation was to bend the mast primarily with vang tension but this proved to be slower. Using excessive vang tension to bend the mast caused the leech to be too tight even when the mainsheet was eased which resulted in both poor pointing ability and excessive heel angle unless the mainsheet was eased until the mainsail was highly back-winded or flogging in the puffs.

After setting up the boat “fairly close”, in Randy’s words, to the optimum settings we discussed the differences in tuning philosophy. Randy pointed out that “feel” is an unreliable way to tune sailboats, and boat speed is a deceptive goal. One-on-one sessions with other competitive boats, continually making changes and evaluating the results, not on speed but on VMG, is the only way to improve tuning. In addition, my ‘engineering’ based approach, changing one thing through it’s range until hitting an undesirable result, is not effective on a sailboat as each change requires other things to be changed to maintain balance and efficiency. In retrospect these observations seem obvious, like any good idea should.

REFERENCES

(1) “Tuning a Racing Yacht” by Mike Fletcher and Bob Ross, 1972; WW Norton and Co., Pub.

(2) “Sailboat Racing with Greg Fisher” by Tom Hubbell, 2000; Hathaway ones Publishing

(3) “Performance Racing Trim” by Bill Gladstone, 1983; North Sails

(4) "Symmetry of Sailing-The Physics of Sailing for Yachtsment" by Ross Garrett 1987 Sheridan House, Publishers

(5) “Buccaneer Tuning Guide” no date or author; North Sails One Design Tuning Guides

(6) “Rigging and Handling Guide for Buccaneers and Mutineers” by Harry R. Sindle

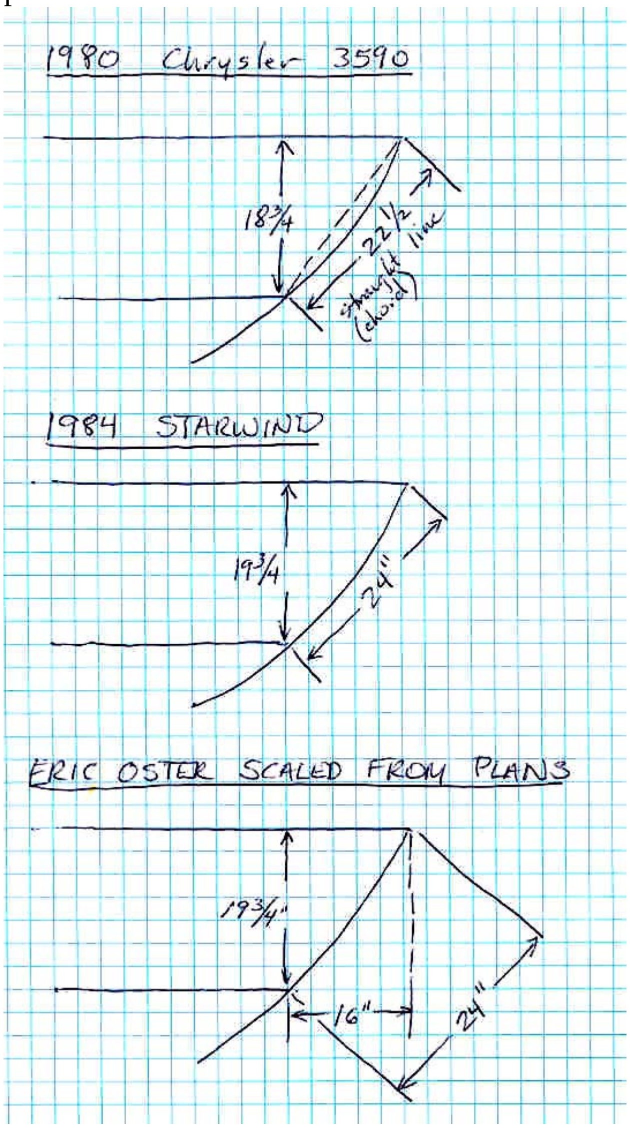
(7) “How do Sails Work” by Paul Bogataj; North Sails

(8) “Computational Methods for Investigating Sail Forces – A Case Study” by Patrick Couser; presented at Yacht Vision, 1998 Auckland, New Zealand

APPENDIX A. Leveling the boat

With thanks to Chuck Lentz for his memo on the leveling method.

But before we start measuring the rake, it would be a good idea to know what relationship the various elements on the boat, mast, decks, seats, CB cap, floor, etc. bear to a *fixed reference plane*, and therefore the relationship between the 4 measurement methods. The fixed reference plane is the intersection of the waterline with the hull. Most Buccaneer models originally had a waterline intersects the bow from boat to boat, so it is a good idea to mark a "standard" waterline on the bow of your boat as a measuring reference point. More recent Cardinal hulls do not have a molded waterline, so one must be determined. After many measurements and head scratching and help from other Buccaneers, in particular Eric Oster, Richard West, David Spira, Marcel Wolf, Chuck Lentz and many others, the following SEEMS to be the best consensus waterline: The waterline comes to a point at the stern at the intersection of the keel line with the plane of the transom on the bottom of the hull, in other words the furthest aft point on the bottom of the hull. On the bow the intersection of the waterline plane with the keel line (the "cutwater") on the bow is a point 16" aft of a vertical line from the tip of the bow (measured inside the bow flange where the flange meets the bow). This is also about 19 ¾" to 20" below the deck flange measured on the outside of the hull. I made a jig of foam core to find this point. The position and measurements are shown on the picture.



In order to level the hull for measurements, a 20 ft. length of ¼" diameter clear plastic hose filled with water can be used as a level. Tape the hose to the bow and stern of the boat with the level of the water in the hose roughly at the waterline. Raise and lower the bow of the boat (I use the nose wheel on my trailer), and adjust the location of the hose until the water level in the hose is at the waterline on both the bow and stern. A four foot framer's level can be used to level the boat side to side. Once the boat is carefully leveled the plumb bob can be used to determine mast rake.

The hulls of a 1980 Chrysler, a 1984 Starwind, and a 2002 Cardinal were all leveled using a clear plastic hose filled with water and a laser level. With the waterline leveled carefully, we made measurements of the angles of the seats, decks, floor, CB Cap, and mast using a digital level, then measured the mast rake using the 4 methods presented here.