FRERS 33 TUNING GUIDE (2010)

Photo courtesy Wavelength Photography

Frers 33 Wolverine at the weather mark New York Race Week 2008

1. Introduction

This Frers 33 Tuning Guide has been compiled by a group of Frers 33 owners during 2009: Dave Nauber, Francis Albert, Art Kelley coordinated by a new Frers 33 owner Rod Stright. This Tuning Guide should be very much considered a work in progress and Frers 33 owners with additional input are invited to contribute to the guide by contacting Rod at StrightR@eastlink.ca.

2. The Frers 33

Designed by German Frers to optimize the then new International Measurement System (IMS) rating rule, the Frers 33 was built from 1986 to 1992 and marketed by its builder, Carroll Marine Ltd. of Bristol, RI, as a racer/cruiser. What you choose to call this boat may be more a function of how you choose to use it than any other criteria. If you plan to race more than cruise, then you have a racer/cruiser and vice versa.

This German Frers's design shows ideal proportions for contemporary yacht design. The rake of the bow and stern, coupled with an extremely pleasing sheerline and the look of the Frers trademark transom, results in a nicely balanced very handsome yacht.

For these reasons, as well as her consistent performance on the race course, the Frers 33 is revered by her owners and competitors alike.

3. Rig Tuning

a) Headstay Length

Prior to stepping the Mast: This length is measured from the center of the pins at the hounds and the stem fitting and should equal 46' 00". Maximum headstay length needs to be reduced in heavier air as much as 1 – 2" by tightening the headstay thereby reducing rake and weather helm.

b) Setting up the Spar

To create maximum rake the mast step butt location should be in the maximum forward location. To reduce rake move the mast butt location aft.

A starting point: To date it has been reported that most Frers 33s have the step located in the aft position with the aft end of the mast step plate within an inch of the max aft location. Rake the mast aft with the headstay length such that a weight suspended from the main halyard intersects the boom 12" aft of the mast. Minimal backstay pressure, less than 500 lbs. Block the mast forward with a one inch block behind the mast at the partners. This should result in a mast pre bend of approximately 1 ½" – 2". The amount of pre-bend required will depend upon the amount of luff curve that is actually built into your main. Input also indicates that maximum racing backstay pressure is 2700 lbs. Some use more some use less.

c) Pre-bend

Pre-bend is dependent upon how your main is built. It is believed that maximum optimal bend for the Frers 33 is about 4" and the pre-bend is only about an inch or two on most sails with about 500 lbs. of tension on the backstay. If in doubt measure the amount of luff curve built into the mainsail and adjust the rig accordingly.

With this you can reduce bend to zero easily with hand tight runner for downwind and light air upwind. Then in like 20 apparent, with Heavy #1 and max backstay you can now "limit" your mast bend to 4" with use of the checkstay.

d) Tuning the Mast

Step 1

With slack shrouds and minimum backstay pressure centre the rig by using the main halyard to measure to identical reference points on each sheerline until the measurement is identical on both sides. An alternate method of centering the rig, using a bucket at least ½ full of water with a lanyard tied on the handle, attach the main halyard to the end of the lanyard and suspend the bucket off the side of the boat at the chainplate area. With a marker, hold the marker flat on the deck near the chainplates and place a mark on the lanyard. Transfer the bucket to the other side of the boat and repeat to see if the mast is centered. Make sure the lanyard intersects the sheerline at excatally the same location on each side. If the mast is centered, the marks will line up, if not adjust the rig until you have matching marks. This method insures even tension on the jib halyard from side to side. Tighten the uppers equally (a few turns past hand tight) and sight up the mast slot to ensure the mast is perfectly strait. (Sample readings are contained in Section 11 Sample Rig Measurements)

Figure 1 Centering the Rig

Step 2

Now that the mast is in centered and the upper shrouds are tensioned, it is time to tune the intermediate shrouds. Tighten the intermediates so the slack is taken out and they are hand tight plus 1.5 to 2 turns. Now tighten the lowers to hand tight. Final tuning of the intermediates and lowers needs to be done on the water going to windward, but this should get you in the ball park.

Step 3

Check the rig for overall straightness both at the dock and again while sailing by sighting up the mainsail track. Adjust the shrouds appropriately to get the mast straight. Secure the turnbuckles with the Velcro wrap pins or cotter pins. Note: This is a starting point for the lowers and intermediates; you must go sailing to fine tune the set up on the lowers and Intermediates.

The above settings will be the initial starting point for light air.

e) Another take on shroud tension

"We sail with the lowers (inners) almost slack in light wind venues, taking up ½ to 1 turn in breezy situations. The mids are a bit tighter, and the uppers are good and tight, so there is only a little slack in the leeward uppers when heeled 20 degrees under sail. This was the recommendation of my sail maker, and it seems to work." Art Kelley Brilliant

4. Boat Preparation

a) The boat should be as light as legally possible. That means everything that you don't need to have on the boat to race is either in your garage or left on the dock as long as you meet the one design or PHRF rules as appropriate.

b) Bottom: must be race ready. This means an ULTRA smooth bottom (spraying is recommended). The bottom of the boat should be as shiny as the freshly waxed hull and the keel has to be just about perfect. Recommend starting with 400 after spraying bottom paint, then finish with 600 or 800 grit for wet-sanding the bottom. 800 is good for mid-season touch-ups. Pay special attention to the trailing edge of the keel which can be damaged by cavitation and get rough and the keel bottom which can be damaged over time by poor blocking. Depending upon the type of bottom paint it may to be cleaned by a diver periodically, if this is still permitted in your area.

c) Crewing: To race the Frers 33 well you need about 7 people, 8 is better. One design class limit is 9. PHRF crew weight limits may vary from area to area. Basic roles are Helm, Main trimmer, Headsail trimmers (2), Pit, Mast and Foredeck. Ideally, the eighth position is a dedicated Tactician and the ninth serves as additional weight on the rail and an extra set of hands and eyes.

5. Frers 33 Racing Considerations (Tips and Tricks)

a) Replace the wire check stays with Spectra or Vectran line and run forward to the secondary winches for adjustment and release by the Main trimmer. Also make sure the check stays are led back to the center of the boat near the base of the stern chain plate rather than having it run to the corners of the transom as originally supplied. (Centerline attachment, while desirable, works only with tiller boats)

b) Make the traveler line continuous (depending upon configuration) so that it can be released from the high side or use a windward sheeting car.

c) Generally keep weight low and near the base of the mast. Consider placing a cooler with drinks here instead of loading up the boat's starboard side fixed cooler.

d) Replace all halyards with Spectra or Kevlar core to reduce speed robbing stretch and weight.

e) Tape all turnbuckles to avoid chafe. Place a sail roller on the lifelines to help in pulling the foot of the sail over the lifelines after a tack.

f) Consider leading vang to swivel cam cleats on both sides of the cabin top so they can be reached from the weather rail and pit/cockpit area.

g) Consider removing the spinnaker pole topping lift entirely (just a messenger line in its place) and use the center line halyard as the topping lift. This allows the bowman to quickly get the foredeck clear for a tack out of the leeward mark. Run the centerline topper through a shackle or Velcro strap at the base of the mast to keep it out of the way going upwind.

h) Consider re-organizing how the halyards exit the mast, both port and starboard wing halyards, as well as, the center line topping lift should exit the mast on the starboard side. The main (and the spinnaker polr topping lift messenger) should exit on the port side. Use the port wing halyard as the primary spinnaker halyard and starboard wing halyard for the headsail. With this setup, with port roundings, your bowman can get the pole set from the high side (and usually) without going forward. The pit crew can pull the slack out of the topper without leaving the rail and the mastman can start jumping the spin halyard from the high side as you're rounding the mark.

i) Consider rigging the spinnaker for end-for-end rather than dip-pole jibes. You'll keep the bowman off the foredeck, make fast smooth jibes and it's easy to do with lazy sheets and guys.

j) Consider using tapered sheets and guys with a single shackle to save weight. This also allows you to use your standard gear in lighter air before having to switch to a light air sheet.

k) Carry a snatch-block that can be easily attached to the rail for barber-hauling the genoa clew outboard when close reaching. If the short sheet used to barberhaul has a shackle, it can be quickly attached or removed. Keep it within reach of the cockpit (i.e. tied to the steering pedestal) to quickly assist in relieving the load on the clew if you get an override that can't easily be undone.

l) For boats with wheels, consider tying a "turkshead" or other decorative knot on the wheel to indicate where the rudder is centered. This helps remind you how much helm you are using and lets you quickly center the wheel by feel without having to look at it. A piece of red tape on the spoke to the port of centre and green on the spoke to starboard also lets the main trimmer see how much helm is on without saying a word.

m) Always set the prop before the race. Use a bright paint on the shaft to indicate where it's in good vertical alignment. Or purchase a geared propeller which will close in any position.

6. Checkstays (By Art Kelley)

We frequently refer to the checkstays as "runners" or running backstays but since they supplement a fixed backstay I believe "checkstay" is the accurate name. However, we will use the terms interchangeably here.

Some of the fleet prefers to use a block and tackle arrangement for adjustment, foregoing winches as the helmsman can handle it himself and it can be set up more quickly. Some helmsmen become annoyed with "all that line" hanging in their faces and feel that it is more difficult to release and stow for the run (use a snap shackle at the lower end for starters).

Many prefer using the secondary winches with some owners adding a rope clutch between the transom turning block and the winch to allow the winch to be freed when setting up for the spinnaker set. In my opinion and from what I've heard from other owners, the block and tackle arrangement seems to be favoured by short-handed crews, and tiller boats where it is difficult to get an extra man back by the secondary's when going upwind. On wheel boats with 8 or 9 crew, the checkstay is often handled by the tactician, seated next to the helmsman although often I find my main trimmer tweaking it.

Without a doubt, you should replace the wire rope stays with high-tech line for weight savings and reduced chafing of sails for starters. Mine are stripped core Technora (I think) and have held up well for at least 8 years so far. Various methods such as shock cord have been employed to pull them up over the helmsman's head when slack. I'm not satisfied with my arrangement yet.

There has been discussion about whether the deck attachment should be as close to centerline as possible, or off on the quarters. The purists (my sail maker among them) say keeping them on centerline eliminates the tendency of the runner to pull the mast out of column laterally. Others, who have spent hours steering a wheel boat, move them out to the quarter because they can be damned annoying, and that arrangement wins races too. Mine are on movable cars on a track on the transom. I leave them on centerline most of the time, but when they become annoying, mostly in light wind, they get moved. I should note that an early line drawing of the sail plan has the runners coming directly down to the secondary winches – something I have never seen done.

When I started in the Frers my only experience with check stays was on a C&C 40 where we only used them in heavy weather to prevent the mast from pumping and possibly inverting, resulting in a collapsed mast. The owner was paranoid about that because he had seen it happen to others. I have not heard that concern in this fleet, but caution is advised. As a result, for the first 3 years we barely used them except over about 20 kts. While your crew is still developing, simplifying manoeuvres by eliminating the use of the runners probably costs you less than you lose when a foul up is caused by the added distraction of trying to manage them.

A few years ago, main trimmer to main trimmer, we learned more about the importance of the runners from one of the class champ crews. As a result we now use them almost all the time when our "A" crew is on board.

The purpose of the permanent backstay is two-fold. Sure, we all know it creates mast bend to flatten the main in heavy winds, but we often forget that it also serves to control headstay sag. The problem is that there are conditions where you want less headstay sag for a finer entry, but want a powerful main as well. This is where the check stays really come to fore. Use the backstay to get the jib shape right, then crank on a little runner to add power back into your main.

I tend to use a little bit of backstay in light wind to stabilize the rig, then add runner to tweak the main for optimum shape. As the wind builds, we may ease the backstay to power up the jib and release the runners. As the breeze comes up over about 10 or so, they go back on as the backstay comes on to control jib shape again.

Going back to basics, jib halyard and headstay sag control the camber of the jib, while main halyard, mast bend, Cunningham and outhaul all affect the shape of the main (not to forget the sheet, traveler, and vang of course). Isn't sailing simple??

7. Suggested Sail Inventory

Sails do make a big difference so the best you can afford will likely be the fastest as well. One design class limit is 5 headsails and 3 spinnakers. Actual sails selected will of course depend upon wind and sea conditions as well as crew aboard etc.

The recommended racing sail inventory for the Frers 33 is:

Mainsail	**All conditions unless you happen to have a light air main**
Light # 1	**0-11 knots**
Medium #1	**6-15 kts**
Heavy # 1	**13-18 kts (with lots of crew)**
#2 (135-145%)	**13-18 kts**
Blade or #3	**15 kts depending upon crew size/weight**
Runner Spinnaker .5 or .6 oz	**0 – 15 kts (windward leeward)**
AP .75 oz spinnaker	**15 kts + or reaching courses.**

8. Tuning in different wind conditions (Dave Nauber, Frank Albert and Rod Stright)

The Frers 33 is in reality a fairly beamy boat for its length on deck but its relatively narrow at waterline resulting in poor initially stability but once heeled it has excellent ultimate stability.

UPWIND

a) Jib Sheet - Three things control the jib shape: sheet tension, car placement, and halyard tension. The sheet tension has the most obvious effect as it controls the leech twist and how far the sail is pulled in. If you look at the overall sail as it relates to the sheet it does two things: hauls the sail in and pulls the leech down. As you pull in the sheet, first the angle of the sail changes, then as the last few inches are tensioned the leech gets tighter. It is important to try to match the genoa leech shape to the shape of the lee side of the main. You will need to look at the shape from forward and aft then place marks on the sheet to duplicate settings if necessary.

Note the parallel shape of the leech of the genoa and the shape of the main nearest the leech of the genoa.

Marks are a good idea for the mainsheet, jib sheet, backstay, jib leads and jib halyard. These make sure you can duplicate fast settings.

One rule of thumb for jib luff tension is just pull the wrinkles out in all conditions, except flat water, and 4 to 9 knots where a slightly softer jib entry is OK for better pointing.

b) Light Air - 3-6 knots

The head stay should be at the max aft rake position. Set the light #1 hand snug on the halyard (in winds less than 5 knots tighten it so you can just see horizontal wrinkles in the luff (at 6 and above remove the wrinkles). The sheet lead can be played with, moving it forward to power up, and inching it back as the boat comes up to speed. When accelerating, the leech should be at least 6" from the tip of the spreader, then slowly bringing into about 4" off the top spreader and about the same off the base as the boat accelerates. The backstay will be off with just enough tension to remove the slop in the backstay.

The main will be hoisted to the black line, but little to no Cunningham will be used. Remember in these conditions, some wrinkles are fast! The outhaul should be about 2" from the black line, and the vang off. The boom should be on the centerline. Use the crew weight to leeward to heel the boat 10-12 degrees. Keep the boat powered up and keep the number of tacks to a minimum.

In 0 to 4 knots trim the sail to about 4 inches off the lower spreader (and not touching the upper spreader) and set the leads so it's the same off the side stays on the deck.

c) Medium Air - 7-12 knots

The head stay should be moved ahead an inch further than the light air position. Set the light #1 just to remove all the wrinkles and increase the halyard tension as the wind build to the upper end of this wind range. The sheet lead can move back slightly so that the foot of the sail is about 1"-2" from the base of the shrouds. When accelerating, the leech should be about 5" from the top spreader, coming into to about 1"- 2" away when at speed. The backstay will be pulled into about 800-1200 lbs. As the wind increases it may be necessary to open up the slot (depending upon the cut of your sails) to have the leech of the genoa about 6" off the lower spreader and the lead moved further aft.

The main should be hoisted to the black line, and the wrinkles removed with the Cunningham. The outhaul should about 1" from the black line, vang snug. The boom can be played on the centerline to 2"-3" above the centerline.

Use the crew weight to keep the boat flat (5-10 degrees max heel).

The helm should at all times feel quite soft with the main trimmer lowering the traveler slightly every time the helm loads up slightly. Good co-ordination between helmsman and main trimmer is essential in these conditions.

d) Medium Air - 13-16 knots

The head stay will be set all the way forward to reduce rake. There is a decision required here in the Frers 33 class. Most will switch from the light # 1 to a heavy #1 while others will opt for a #2 especially in the upper end of this wind range. This may relate to crew size and sea conditions. If you need the power and have the crew (9) the heavy # 1 will be the way to go and is no doubt faster although a number two with less crew may have you pointing slightly higher and tracking better and could possibly be faster in smooth water. Experience will dictate.

Set the heavy #1 just to remove the wrinkles. Make sure when you are testing up wind before the start that the draft is at 40-45% aft. The sheet lead will move forward slightly from the light #1 setting, but again it should be set up so that all the tell tails are breaking at the same time. The base of the sail will be touching the shroud base, and the top of the sail can be touching the spreader in the lower part of this range to 10" off at the higher range. The backstay will be set between 2000 lbs to 3000 lbs. The main sail will have all wrinkles removed and the outhaul will be used to pull the foot of the main all the way to the black line. The boom will be played from center to 6" below center. It is vitally important that the traveler is dropped if the helm loads up. Use the crew to keep the boat on its feet, with maximum heel at 15-18 degrees.

e) Heavy Air - 19+ knots

Headstay max forward, minimum rake. Set the #3 and make sure the draft is at 40-45% aft. The sheet lead will go inside the shrouds and run through the forward cars. Upwind, the foot will be quite flat, with the leech 3"-4" inside the upper spreaders. The backstay will be set max at about 3,000 lbs the mainsail will be made very flat with max outhaul, Cunningham and vang. The boom will be played from 6" below to all the way down, again depending on helm. Again try to keep the boat on its feet, with no more than 20 degrees of heel.

f) Upwind Sail Settings for Frers 33

MAINSAIL				
TRUE WIND SPEED	**0-6 knots**	**7-12 knots**	**13-19 knots**	**20+knots**
Backstay	snug	800-1200 lbs	2000-3000 lbs	3000 lbs
Outhaul	back 1.5"	back 1"	to black band	to black band
Boom	centerline +3"	to center	center to -4”	-6” or more
Cunningham	none	50% on/or no wrinkles	no wrinkles	on tight
Vang	none	snug	50%	on tight
Checkstay	off	off to snug	50% on	on tight
Heel Angle (ideal)	10-12	5-10	15-18	18-20
Crew Weight	Low	Centered	hike hard	hike harder
HEADSAIL				
Headstay	46’ ’02”	46’ 01”	46’	46’
Halyard	hand tight	hand tight firm	very firm	firm tight
Sail Choice	Light #1	Light #1	H #1 or #2	#3
From Spreader	4”-6"	2"-5"	0"-10"+ to bleed off excess power in the top of the sail	inside 4"
From Base	6"	2"	0"	inside

Once the correct sail selection is made, it is important to "go up wind" before the start to check the following.

- ✓ Car position
- ✓ Tell tails break evenly
- ✓ Outhaul
- ✓ Cunningham
- ✓ Halyard tension

The Frers 33 goes fastest with a very neutral helm. If the helm is heavy, this is slow, and adjustments need to be made.

DOWNWIND (SPINNAKER)

a) Light Air Trim - Downwind

Light air is a real exercise in concentration. As soon as the boat slows down, head up 2-3 degrees to get closer to the wind. As the boat begins to gain speed, ease it back down again slowly.

The helmsman must constantly search for wind and good wind angles. In these conditions, it is better to sail a little high instead of a little low. A runner will excel in these light conditions allowing you to sail lower and faster than with a conventional all purpose chute. It is important that the trimmer and helmsman communicate about the pressure and the guy trimmer pays attention to the angle that the boat is sailing to the wind. The crew weight should be kept well forward. Sailing by the lee in these conditions can be very fast and you can sail well below dead down wind. Move all the weight to the pole side of the boat and the spinnaker will rotate out into clean air. You now have the full spinnaker on one side and the main sail on the other. Heel the boat about 10 degrees to windward and go. (This tactic often works in light air and smooth water but sea conditions may compromise its effectiveness, largely a trial and error process, when it works it works very well).

b) Heavy Air Trim - Downwind

To maximize speed, you need to maximize exposed area, and reduce rudder drag. A Maxi Runner excels in down wind conditions. The boat should sail from +5 degrees to by the lee 5 degrees. By the lee with the boat heeled slightly to weather is fast.

The leeward twing should be pulled about half way on to allow maximum projected area. The pole can be at 90 degrees to the boat. If the boat suddenly roles to windward, the pole should be let forward until the boat comes under control.

On the set, it is critical to get the head sail down quickly. When using a blade, it is not so important, and in many cases can be left up if it is not interfering with the spinnaker.

As a large mast head rig with and underbody that has a wide beam and very narrow stern in heavy winds and heavy seas the boat will roll down waves and also the large spinnaker will roll the boat. There are a number of things that can be done to maintain control.

Heavy Wind (16 to 28 knots) Spinnaker sailing in the Frers is challenging and exciting. EVERYONE must understand what to do if the boat should broach and what their job is when (note the word when and not if) the boat starts to death roll.

1. The helmsman must work to keep the boat under the spinnaker which will be rolling from side to side in front of the boat.

2. The pole should be forward of square to the wind to help reduce the overall size of the spinnaker to the wind. This will reduce speed slightly but in 20 to 25 knot winds you're already going 8 to 10 knots so it becomes more important to control the boat.

3. Vang should be off as it tends to over-power the main sail in heavy winds causing the rolling motion to worsen.

4. Set the twings as far forward and attached to the spinnaker sheets to pull the clew of the spinnaker down and bleed off excess wind. This will help with the overwhelming effect the spinnaker will be having on the boat.

5. If the boat should broach release the mainsail sheet and ease the spinnaker sheet as quickly as possible. NEVER EVER ease the spinnaker guy. The boat will recover within a few seconds

although it will feel like a lot longer. Once the boat begins sailing again and begins to respond to the rudder fall off and start trimming the sails once again.

c) Reaching

Depending on the wind use either the .6 A.P or the .75 A.P. Keep the spinnaker pole relatively low, (but keep the clews as even as possible) and always off the forestay. Make sure the leeward tweaker is right off, to allow the foot of the 'chute to flatten out. If the helm loads up quickly release control lines from the rear to the bow i.e. mainsheet, main vang, spinnaker sheet. With practice, you will feel the boat load up and can react with the helm before you wipe out! Remember steer down in the puffs, and up in the lulls.

Spinnaker Notes: - When reaching the spinnaker trimmer MUST be ready to ease in the puffs. If they ease aggressively and the helmsman steers down a bit the boat will accelerate dramatically and you will gain a lot. If the spinnaker trimmer is a little lax and the helmsman is as well, you'll round up and loose ground so make sure everyone understands what they are supposed to do.

Position folks on the rail so you have no more than 20 to 25 degrees of heel which will be hard in the bigger winds but do the best you can.

If the angle is too tight or too windy, set the genoa, but remember to move the cars forward and pull outboard if possible.

9. Tips to Remember

1. **Keep the boat relatively flat**
2. **In heavy winds try to keep the rail out of the water if over powered pinch up in the puffs.**
3. **Keep the boat moving**
4. **Power up after the tacks**
5. **keep the bottom and foils very clean and smooth**
6. **Keep the crew weight between the back of the cabin top and the shrouds**
7. **Keep folks OUT of the cockpit as much as possible, don't drag the stern.**
8. **Keep all gear stowed low and with in two feet of the mast.**
9. **Let the keel do what it's designed to do. Don't try and out point other boats sail the Frers at max speed and you will go upwind faster.**
10. **Have fun**

10. Frers 33 Target Speeds

The following tables provide you with an idea of how your boat should be performing on various points of sail in the wind conditions indicated.

Optimum Upwind

TWS	TWA	AWS	AWA	TBS	VMG	HEEL
6.0	46.0	9.72	25.4	4.80	3.33	5.1
8.0	44.0	12.23	25.7	5.50	3.97	11.8
10.0	42.2	14.37	26.6	5.83	4.32	15.1
12.0	40.7	16.43	27.0	6.00	4.53	17.3
14.0	40.4	18.35	27.9	6.10	4.66	19.2
16.0	39.8	20.29	28.4	6.16	4.74	20.5
20.0	40.1	23.87	30.4	6.23	4.77	21.9

Optimum Downwind

TWS	TWA	AWS	AWA	TBS	VMG	HEEL
6.0	141.8	3.67	93.3	4.42	3.47	1.1
8.0	145.6	4.56	104.6	5.33	4.41	1.2
10.0	153.9	5.27	124.9	5.79	5.20	1.1
12.0	164.9	6.08	149.6	6.13	5.91	0.9
14.0	171.5	7.35	163.9	6.54	6.47	0.8
16.0	173.8	8.87	169.2	6.92	6.88	0.8
20.0	174.0	12.09	170.2	7.64	7.60	1.0

11. Sample Rig Measurements

The following table has been prepared with the input of those boats indicated to provide some sample rig measurements for comparative purposes. Local sailing conditions may affect how the rig is tuned so adjustments will vary depending upon actual racing conditions.

ITEM	*TUNING GUIDE*	*WOLVERINE*	*EQUINOX (Original)*	*EQUINOX 2010 (Modified)*	*OUT OF REACH*	*ECLIPSE*	*REMARKS*
HEAD STAY	46’	46’ 1 7/8”	45’ 8 1/2”	45’ 11”	45’ 11”	45’ 9”	
RAKE		18”	11 1/2”	15”			AT BOOM BEHIND MAST 500 LBS BACKSTAY
MAST BUTT LOCATION	ALL THE WAY AFT	.75” FWD OF MAX AFT POSITION	.75” FWD OF MAX AFT POSITION	.75” FWD OF MAX AFT POSITION			
MAST AT PARTNERS		1” BLOCK BEHIND MAST	1” BLOCK BEHIND MAST	1” BLOCK BEHIND MAST			
UPPERS D3			45	48	58	65	65 seems very high
INT D2			23	25	20	16	
LOWERS D1			45	35	20	27	
MAX BACKSTAY	3000	3500	2200	2700			
BACKSTAY LENGTH			48’ pin to pin		47’ 8”	48’ 0.5”	
Pre Bend				1 ¾”			

Notes:

1. Hall Spars - Mast Rake Formula: 50 cm (19.7”) of rake for every 15 meters (49.2’) of mast height (1:30) roughly 20” of rake for a 50’ mast. Using the formula at the boom (39’ from the mast head) there should be 15.5” of rake at the boom. Of course specific tuning adjustments are necessary for individual types of boats based on keel configuration, Centre of Effort etc.

2. Hall Spars – moving the mast butt back ½” on a mast with a bury of 6’ with a mast height of 45’ above the cabin top is the equivalent of lengthening the headstay 1 ¼”. So on the Frers 1 inch of mast butt movement is equivalent to 2 ½” of headstay length.

NOTES: