

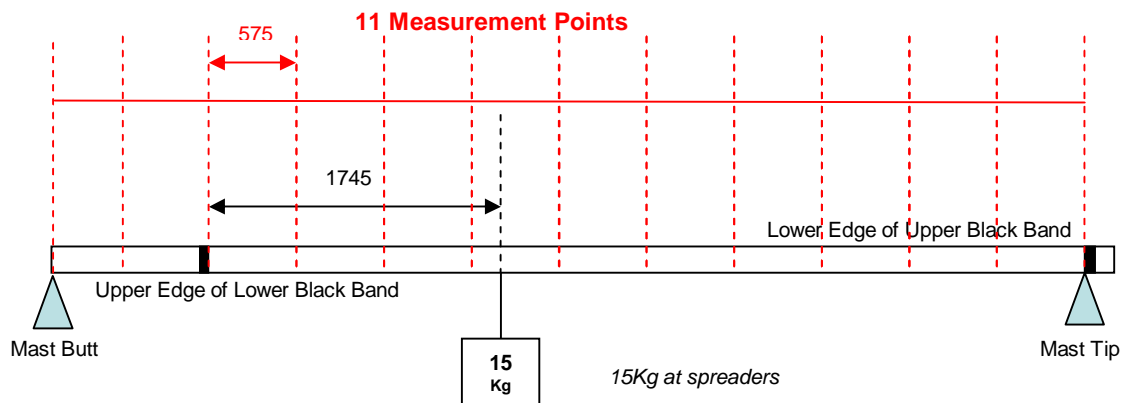


### Overview

There are multiple methods for deflecting a given mast. At North Sails One Design, we believe the following procedure will best indicate the bend properties of your masts (stiff or soft; where is the bend concentrated, etc.). Mast deflection procedures often vary from sailor to sailor. It is important to dedicate the time and tools needed for a proper mast deflection. Otherwise, the data may be compromised. It is also critical to follow the steps in order and deflect each of your masts with the same exact procedure. As you continue to deflect masts, your ability to run through the procedure will become more efficient; however, skipping or rushing steps will affect your data. Keep in mind that the data requires concentration to the millimeter, so improper procedure can nullify your data set.

### Components/Tools

- 1) Reliable, easy-to-see string. We recommend using Marlow 4oz Whipping Twine or a similar product. Most sailors have whipping twine in their toolbox, so it is often easy to secure. The line is easy to see and does not break under load.
- 2) A 0.5Kg weight (or weight in similar range. 1lbs will do)
- 3) 15Kg weight (33.07lbs)
- 4) Short piece of line to attach the 15Kg weight to the mast. This can include a hook to make the procedure easier. Please subtract the weight of the line and hook from the 15Kg max.
- 5) 2x sawhorses, or stable platform with similar height.
- 6) 2x angled edges (such as a piece of angled aluminum extrusion or piece of wood).
- 7) 2x large C-clamps (to secure the mast butt to the saw horse, if need be)
- 8) Metric ruler (30cm).

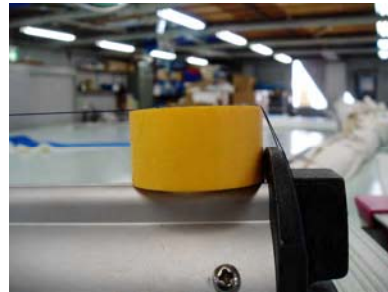


### Procedure

- 1) Secure an indoor space of adequate length. 470 masts are about 23' 6¼" (7.17m) in length. Calm outdoor locations can be used, but are not recommended.
- 2) If you have multiple masts distinguish each with a name or mark that will correspond to the individual data you collect. It is easy to mistakenly swap data when doing multiple mast deflections.
- 3) Clear the mast of spreaders, shrouds, trap wires, and luff wire. All three halyards and the topping lift should be "skied." Make certain that all three halyards and the topper are slack in tension. This is best accomplished by exiting all lines through the bottom of the mast and leaving them untied/un-cleated.



- 4) With the track facing up, lay the mast horizontally such that the tip and butt rest on the saw horses (or other mounts of equal height). Total height needs to be in the meter-plus range so that the deflection weights do not touch the ground when loaded on the mast. Drop the excess halyards to the ground.
- 5) Beginning with top edge of the lower black band (measurement band) mark the mast with marker every 575mm. The top edge of the lower band is the "0". If done correctly, the bottom edge of the upper black band should intersect one of the 575mm increments at exactly 5750mm. Continue below the "0" another 575mm and make a final mark. At this point, the mast should be divided into 12 segments (11 equal segments of 575mm and one 480mm segment).
- 6) Place one angled aluminum (or similar piece) under the mast tip such that the point is focused on the lower edge of the black band. Place the second piece under the mast butt such that the point is focused as close to the mast butt as possible, but not on the actual mast butt key (the part that fits into the mast step). Make note of this location with a permanent marker or piece of tape. Some mast butts, such as those with *SuperSpars*, include odd angles and make positioning the angled aluminum difficult. Use the large C-clamp to secure the whole system.
- 7) Secure the measurement string to the mast tip as closely to the mast track as possible.
- 8) Run the string the length of the mast and drape over the end of the mast butt. Tie the 0.5Kg weight to the end of the string so that the weight is suspended above the ground.
- 9) Once tension is applied to the string via the hanging weight, rest a roll of tape (or other object) on the mast track and under the string at the lower edge of the upper black band (see Diagrams 1 and 2). This will bend the string directly above the focus point made by the angled aluminum. Do the same at the mast butt focus point. Make certain to use the same width tape/object. The objective is to raise the string above the hardware of the mast so that the string runs clear tip to butt. Different masts will require different set-up attention.



Diagrams 1 & 2: Use a roll of tape to support tensioned string at measurement points

- 10) With the entire system secured, use a metric ruler to measure the distance from each marked segment (Step #5) perpendicular to the taught string above. It is important to ensure the ruler is exactly perpendicular to the line (not the mast). A second set of eyes can make this job easier. Also, a good trick is to cut off the bottom of the ruler at exactly 0mm. You can just barely rest the bottom edge of the ruler on the mast, but it is easy to accidentally add too much downward pressure and skew the measurement. Also, the mast can bounce easily. You must dampen any and all movement before each measurement. Record the data in the following table under **Fore-Aft Bend (Initial)**. Feel free to record to the 0.5mm if the string lies between two mm points. Also, do not hesitate to measure each station twice (or have someone else measure) to allow for human error.



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## 470 Mast Deflection Procedure

- 11) Secure a 15Kg weight to the spreaders. A good trick is to tie a loop that spans over the top of one spreader bracket and under the opposite spreader bracket. The goal is that the focus of the weight is centered in the middle of the brackets. Use of a hook to quickly fashion the weight to the loop is handy, just make sure to subtract the weight of the hook and line from the overall 15Kg weight. If using Imperial weights, two 15lbs, one 3lbs, and a spare block is about equal to 15Kg. Of course, weight the system with a scale first.
- 12) Measure each station as done in Step #10. Record under **Fore-Aft Bend (Measured)**.
- 13) Take off the weight and rotate mast and systems such that the mast is secured on its side with the Starboard side facing up. Remove the objects that held up the string as described in Step #9. Some masts are difficult to position on the sides, particularly when weight is attached. Make certain your clamping system fixes the butt of the mast perpendicular to the ground.
- 14) At this point, the string should still be taught with the 0.5 Kg weight. Tape over the string at the top black band and at the mast butt in order to secure both end points. If any mast gear (gooseneck) still interferes with the string, you will need to raise the strip above the mast track, but not away from the mast track (as that will complicate measurements).
- 15) Measure each station as done in Step #10. Record as **Side Bend S (Initial)**.
- 16) Affix the 15Kg weight and repeat measurements. Again, make certain that the mast does not twist from perpendicular. Record as **Side Bend S (Measured)**.
- 17) Rotate mast and systems so that the Port side is facing up. Repeat Steps #14-16. Record under **Side Bend P (Initial)** and **Side Bend P (Measured)**.
- 18) Subtract all "Initial" measurements from "Measured" measurements to complete the data set for **Fore-Aft Bend (Corrected)**, **Side Bend S (Measured)**, and **Side Bend P (Measured)**. Please refer to the *Mast Deflection Form*.

### Additional Tips

- 1) Different mast manufacturers use different components. Some ingenuity may be needed when securing the systems. It is best, of course, to use the same tools with each deflection (saw horses, etc.).
- 2) Use of a mast deflection jig can be useful. The jig essentially holds the mast top and butt in place and allows for a riser for the string to set on. The jigs are then clamped to the saw horses. Use of a jig can also limit the torque from the mast when measuring the side-to-side deflection.
- 3) If need be, you may choose to only measure one side deflection.

### Data Review & Additional Information

Use the North Sails One Design Mast Deflection Form to collect your data. Please note that "Initial" refers the measurements when the mast is at rest (with no weight at the spreaders) and "Measured" refers to when the 15Kg weight is applied. The "Corrected" data is the delta of the two, as stated in Step #18. It is the "Corrected" data that will be used to determine the overall characteristics of your mast; however, the "Initial" data can be used for further analysis of the mast column.

North Sails One Design is happy to review and plot the collected data. We will review the accuracy of the test and graph the bend characteristics of your mast. Your data will not be shared. Please contact Dave Hughes at 619-226-1415 and [dave@od.northsails.com](mailto:dave@od.northsails.com) – or any North Sails One Design representative – for more information.



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**470 Mast Deflection Form**

<b>Owner</b>	
<b>Date of Deflection</b>	
<b>Location of Deflection</b>	
<b>Mast Type</b>	
<b>Mast Model</b>	
<b>Mast Date/Age</b>	
<b>Mast Name Reference</b>	
<b>Notes</b>	



Distance from Lower Black Band	Fore-Aft Bend (Initial)	Fore-Aft Bend (Measured)	Fore-Aft Bend (Corrected)
-1055	0	0	0
-575			
0			
575			
1150			
1725			
2300			
2875			
3450			
4025			
4600			
5175			
5750	0	0	0

Distance from Lower Black Band	Side Bend S (Initial)	Side Bend S (Measured)	Side Bend S (Corrected)	Side Bend P (Initial)	Side Bend P (Measured)	Side Bend P (Corrected)
-1055	0	0	0	0	0	0
-575						
0						
575						
1150						
1725						
2300						
2875						
3450						
4025						
4600						
5175						
5750	0	0	0	0	0	0