

# Sail Controls

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# Not Many Sailors can Understand the Fundamental Forces of Sailing.

Apparent Wind

Aerodynamic Forces

Sail Geometry

Lift

Hydrodynamic Forces

Finite Element Modeling

Fluid Dynamics

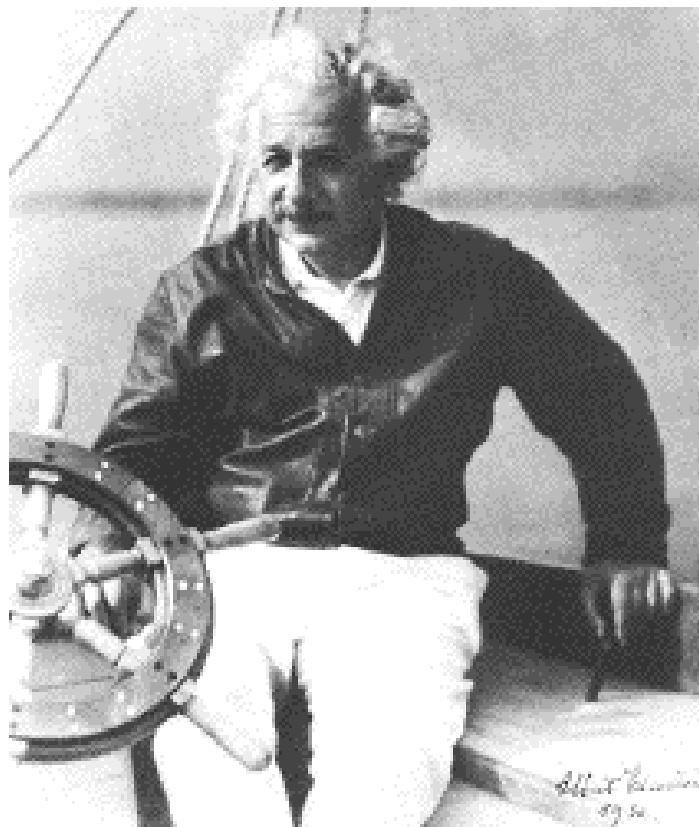
Turbulent Flow

Heeling Forces

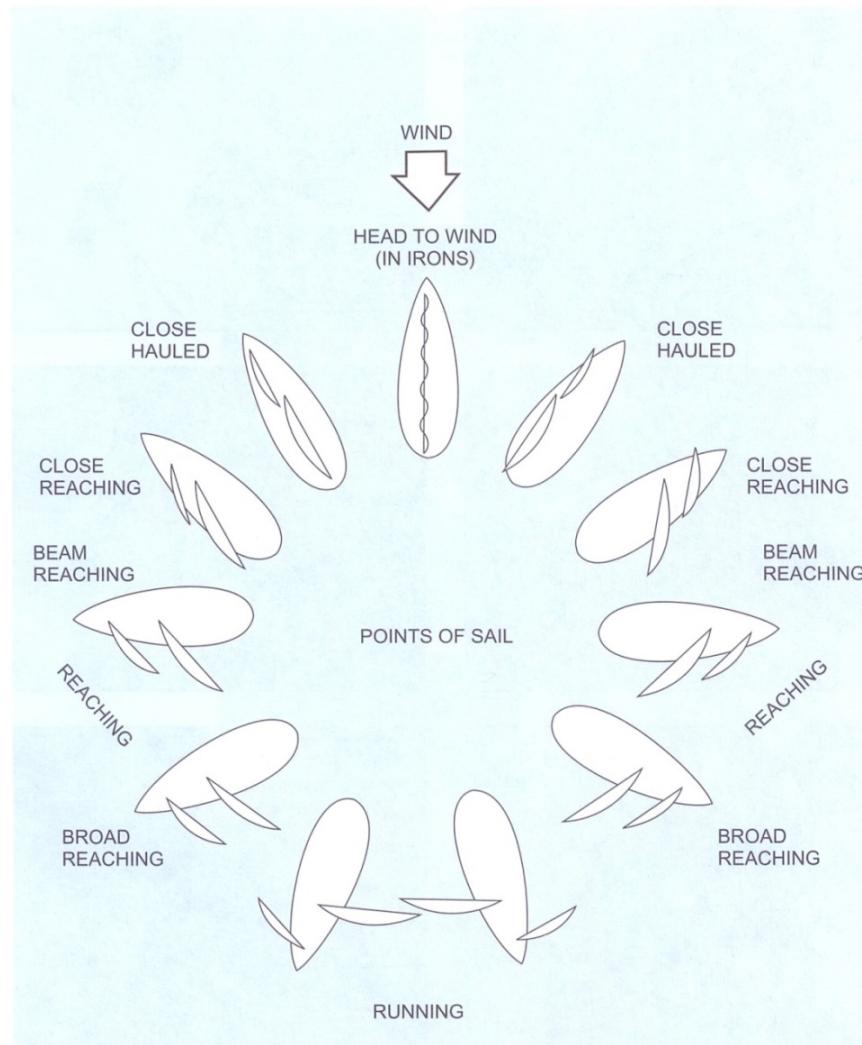
Laminar Flow

Drag

Bernoulli's Equation



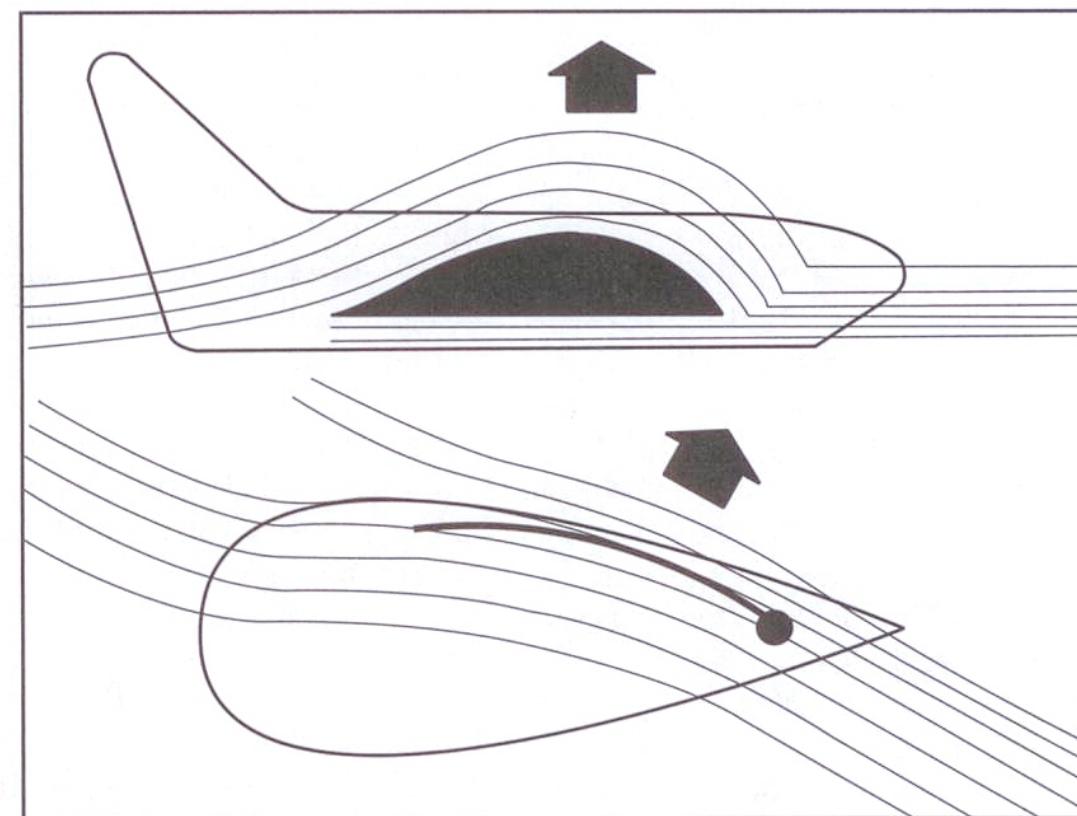
# Points of Sail and Proper Sail Trim



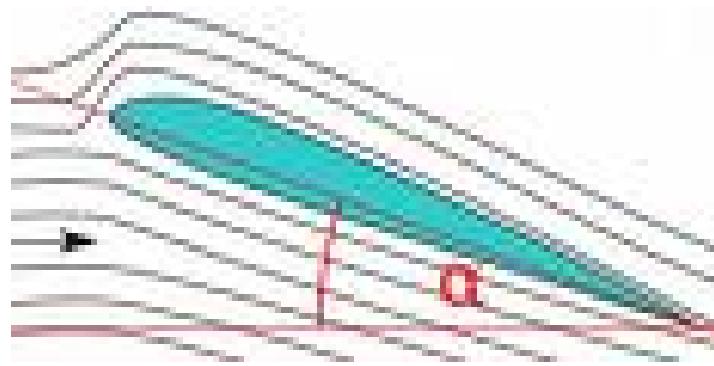
A Sailboat's directional heading with respect to the wind is her point of sail.

# What do Sail Controls Do?

- Allow you to change Angle of Attack
- Sail Shape
- Twist



# Angle of Attack



Angle of attack is the angle at which the wind hits the sail.

If sail is luffing, angle of attack is zero.

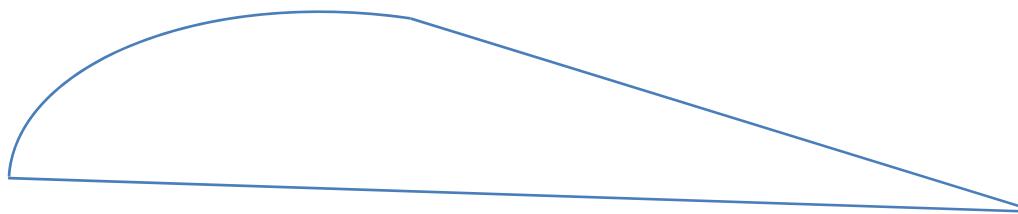
As we trim sail, angle of attack and power increases.

Increase angle of attack to increase power.

Decrease angle of attack to decrease power.

# Sail Shape has two main Components

- Control amount of depth in the sail.
  - Deepen your sails to increase power.
  - Flatten your sails to decrease power.
- Control where deepest draft is located in sail.
  - Put deepest draft about 40% of the way from luff to leech for both main and foresail.



# Twist



If the leech at the top of the sail is angled further out from the boat than at the foot, we say it has twist.

Note twist in genoa and main.

# Twist

- Use twist to depower the sail and eliminate twist to power up sail.
- Twist may be necessary because the wind speed may be greater at the top of the sail.
- Some twist may be necessary in light winds to keep sail from stalling.



Little twist to power up.



Lots of twist to depower.

# What are Sail Controls?



Main sheet



Back Stay Adjuster



Traveler



Boom Vang



Outhaul



Topping Lift



Leech Line



Genoa or Jib Sheet



Halyard



Cunningham

# Halyard



Decreasing halyard tension will deepen the sail.

Increasing halyard tension will flatten the sail.

Use main halyard to deepen or flatten mainsail.

Use genoa or jib halyard to deepen or flatten genoa or jib.

# Halyard



Leave couple wrinkles in light winds.

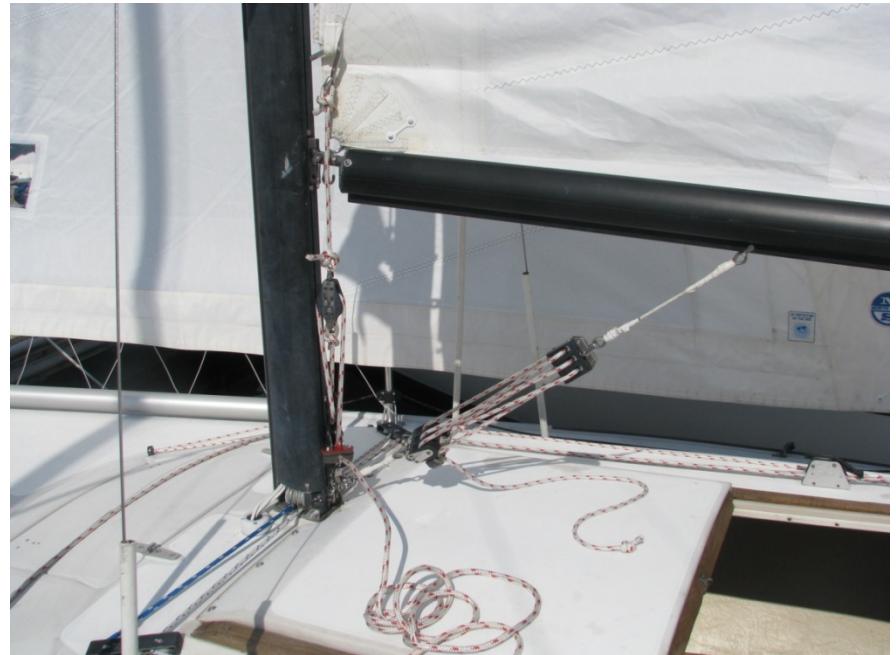


Take out most or all wrinkles in moderate or stronger winds.

# Cunningham or Downhaul



Loose Cunningham



Tightened Cunningham

The Cunningham or downhaul tightens the luff on the mainsail and moves draft forward. Tighten the halyard first and then tighten the Cunningham or downhaul to increase tension on the luff and move draft forward.

# Cunningham or Halyard?



Tightening the Cunningham or Downhaul will reduce wrinkles along the luff just like tightening the halyard. Use halyard first.

# Cunningham or Downhaul



Loose Cunningham



Tight Cunningham

Tightening the Cunningham will tighten the luff and move the camber forward.

# Cunningham or Downhaul

- Cunningham tightens the mainsail's luff.
- When close hauled can be used to flatten the mainsail in strong winds.
- Cunningham different than halyard because Cunningham in addition to tightening the luff can be used to change the fore and aft position of the point of deepest camber (draft or fullness).
- Used many times with backstay adjuster.
- Cunningham also used to tighten luff when leech fully extended and can't raise main any further because the leech is tight.

# Sail Controls Seminar

- Mainsheet- Controls twist and angle of attack of Mainsail. Control angle of attack by pulling in or letting out sheet. Put twist into mainsail by easing sheet or take twist out of mainsail by trimming the sheet.



# Sail Controls Seminar

- Traveler adjusts mainsail's angle of attack to the wind just like the mainsheet does. Pull car to windward of centerline narrows angle of attack. Letting it down to windward widens angle of attack. Once you achieve proper sail shape with mainsheet and other controls can use traveler to control angle of attack adjustments without changing sail shape and use mainsheet to pull down and flatten the sail.



# Traveler

Traveler controls angle of attack and twist on mainsail similar to mainsheet.

If you use traveler to control angle of attack and twist instead of mainsheet, then once sail is positioned with proper angle to the wind and twist you can use mainsheet to flatten the sail. Can use traveler to depower the sail in high winds similar to mainsheet only sail shape not affected as much.



See how boom is let out with traveler  
Centered and main sheet loosened.



See how boom is let out to same position  
By letting out traveler and keeping main  
Sheet tightened.

# Outhaul



Loose Outhaul

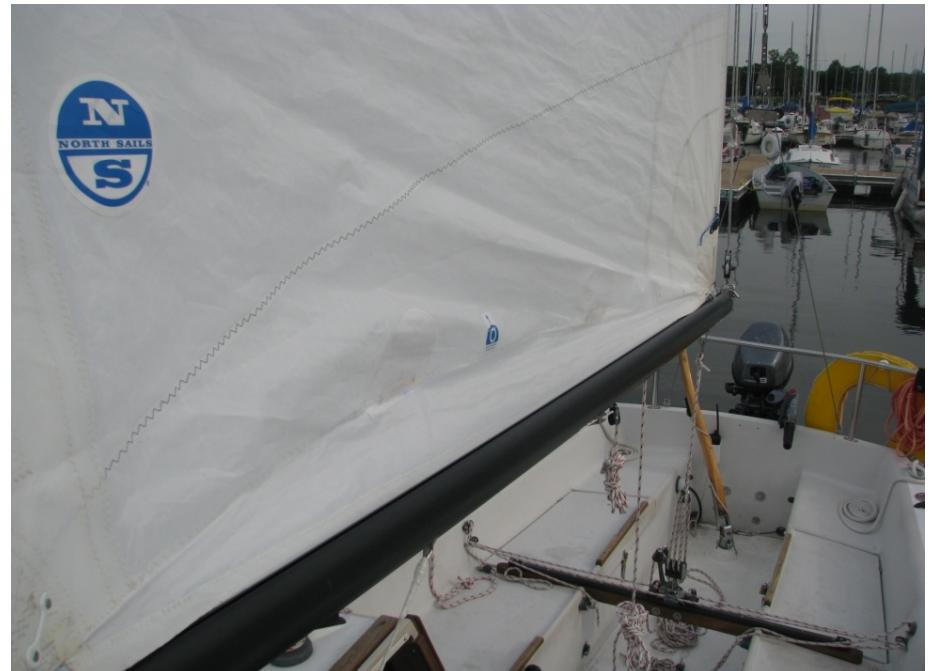


Tight Outhaul

# Outhaul



Loosen Outhaul to power up sail in light winds.



Tight Outhaul to depower sail in moderate to strong winds.

# Genoa Cars



Note angle of genoa sheet and indicator on genoa sail.

# Boom Vang

- When mainsail is fully out the mainsheet exerts little downward pressure on aft end of the boom. Boom Vang holds boom down and parallel and controls vertical rise and resultant mainsail twist.



# Boom Vang

Boom Vang- Used going downwind either running or reaching.



Loose Boom Vang



Tight Boom Vang

# Back Stay Adjuster



Tightened backstay adjuster.



Loose backstay adjuster.

# Back Stay Adjuster



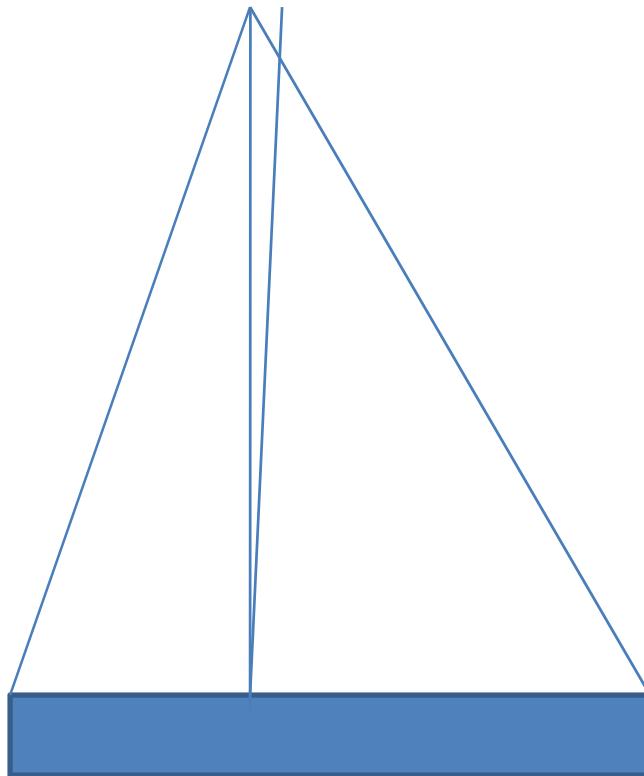
On masthead rigs main effect of tightening backstay is on forestay.  
Tightening backstay reduces forestay sag.  
Use in upwind courses to flatten genoa and depower. When running loosen backstay to pull mast forward so it fills better and is deeper.

# Backstay Adjuster

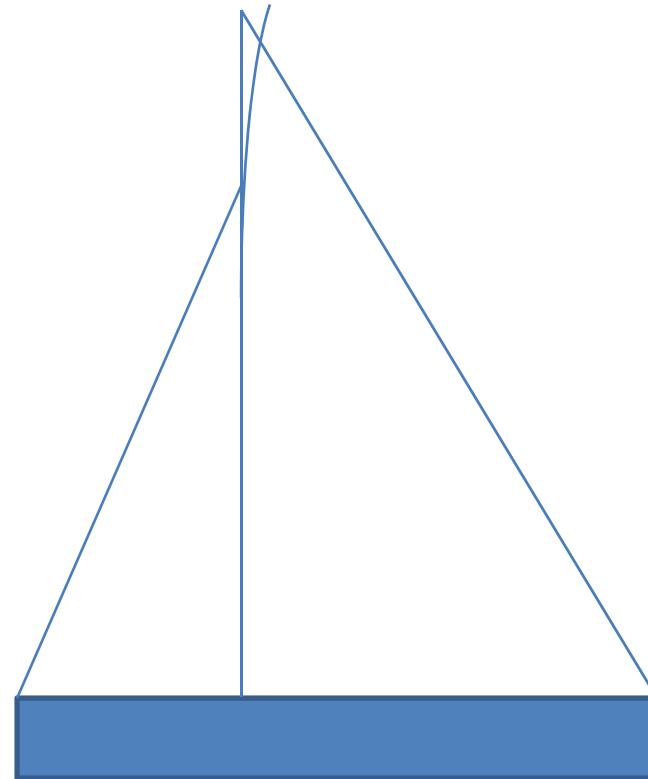


Back Stay Adjuster creates some mast bend in masthead rigs if there are tight forward lowers. Primary effect is on headstay sag.

# Backstay Adjustments and Effect on Mast for Masthead vs Fractional Rigs.

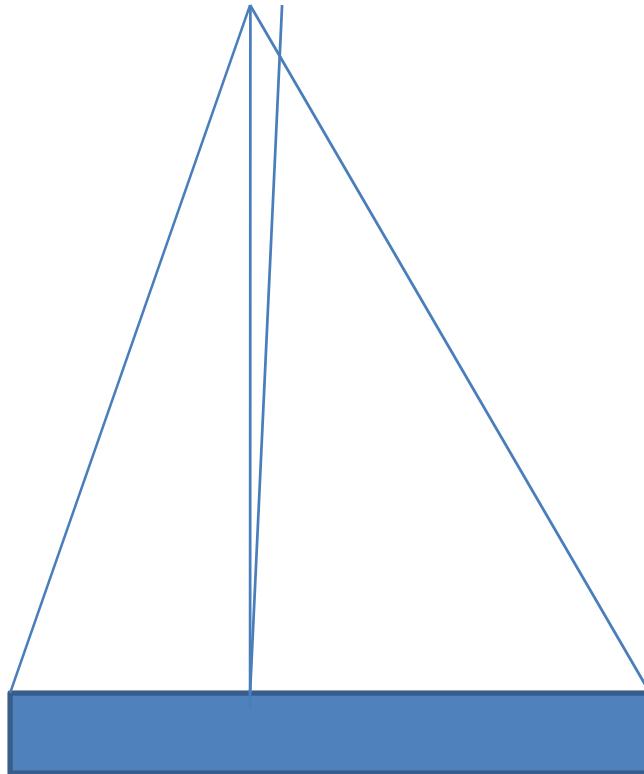


Mast head rig- Increasing backstay tension will tighten headstay.

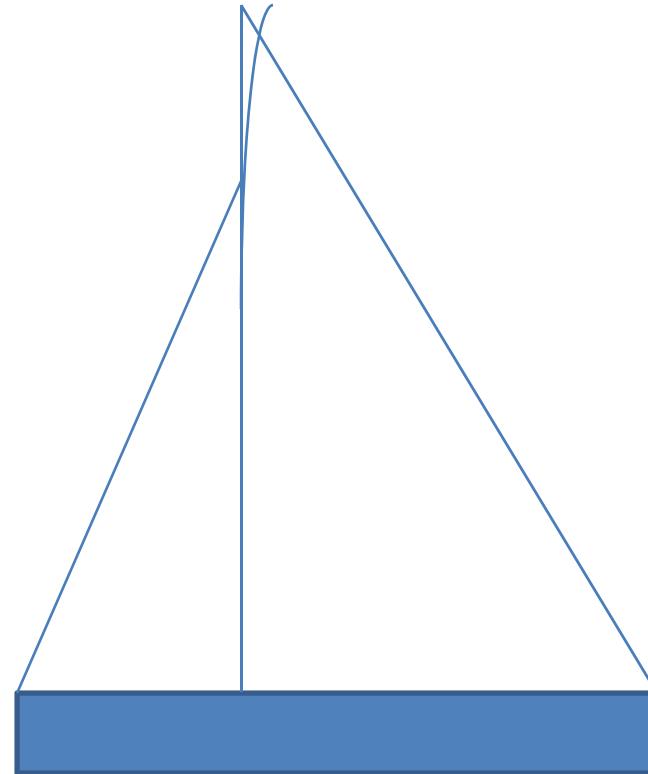


Fractional Rig- Increasing backstay tension will bend top portion of mast aft.

# Backstay Adjustments and Effect on Sails for Masthead vs Fractional Rigs



Mast head rig- Increasing backstay tension will flatten genoa. Use in strong winds to depower. Loosen backstay when running so mainsail fills better.



Fractional Rig- Increasing backstay tension will bend top portion of mast aft. This flattens top of mainsail and opens lower portion of leech. Little effect on headstay sag.

# Back Stay Adjuster

- Use Cunningham in conjunction with Backstay adjuster to control location of deepest draft on mainsail. Tightening backstay on mast head rig will deepen mainsail and move camber aft. Tightening backstay adjuster tightens luff and moves camber forward.

# Leech Lines

- Leech lines in mainsail and sometimes jib or genoa control tension on the leech. When the leech flutters tighten leech line and if the leech cups ease the leech line.



# Topping Lift



Loose topping lift.



Tightened topping lift.

# Topping Lift



Loosen topping lift in  
moderate to heavy winds.



Tightened topping lift in light winds to  
deepen sail and increase power. Also has  
benefit of raising boom for safer jibing.

# Topping Lift



With loose topping lift leech  
is very tight and sail is flat.



With tight topping lift sail leech opens at top  
of mainsail and is fuller at bottom of mainsail.

# Mainsail Controls Summary

- Twist can be controlled by outhaul, traveler, mainsheet, backstay adjuster, boom vang, topping lift.
- Angle of attack can be controlled by main sheet and traveler. See points of sail diagram.
- Sail shape is controlled by outhaul, traveler, mainsheet, backstay adjuster, boom vang, topping lift, and Cunningham.

# Generalizations

- Tighten controls in moderate to strong winds.
- Loosen controls in light winds.

# The End

