



Wind and Tide

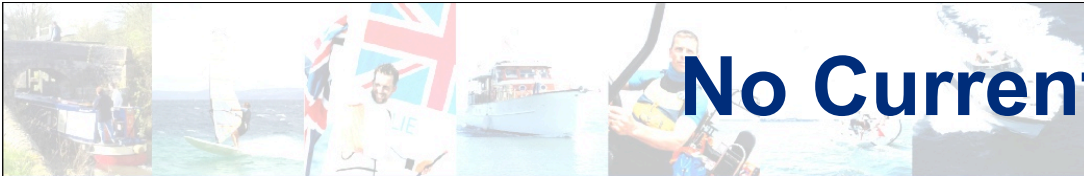
Rob Lamb
and
Chris Hadden



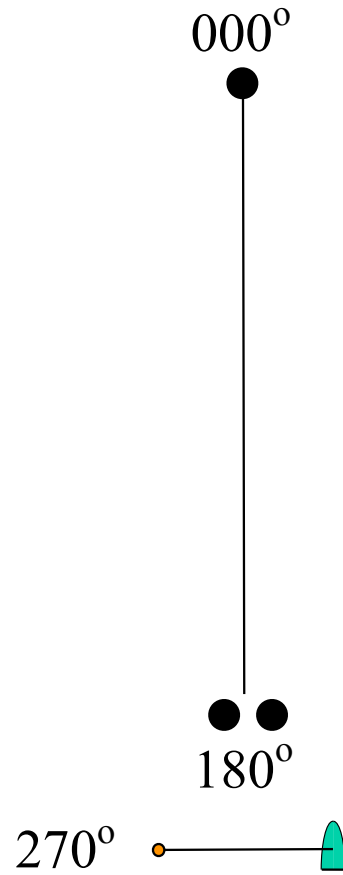
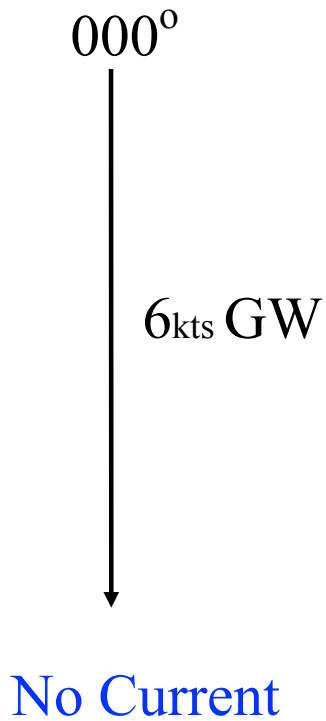
Race Officials' National Conference

Wind and Tide

Outline Theory



No Current

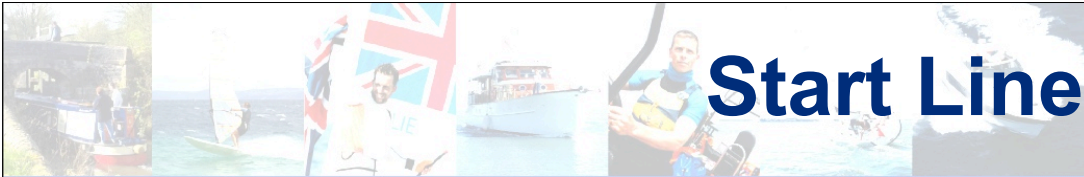


Working in Current

How do we set the start line?

Where do we put the windward mark?

Where do we put the leeward mark?



STARBOARD BIAS

Boats sail the same angles to the wind on each tack

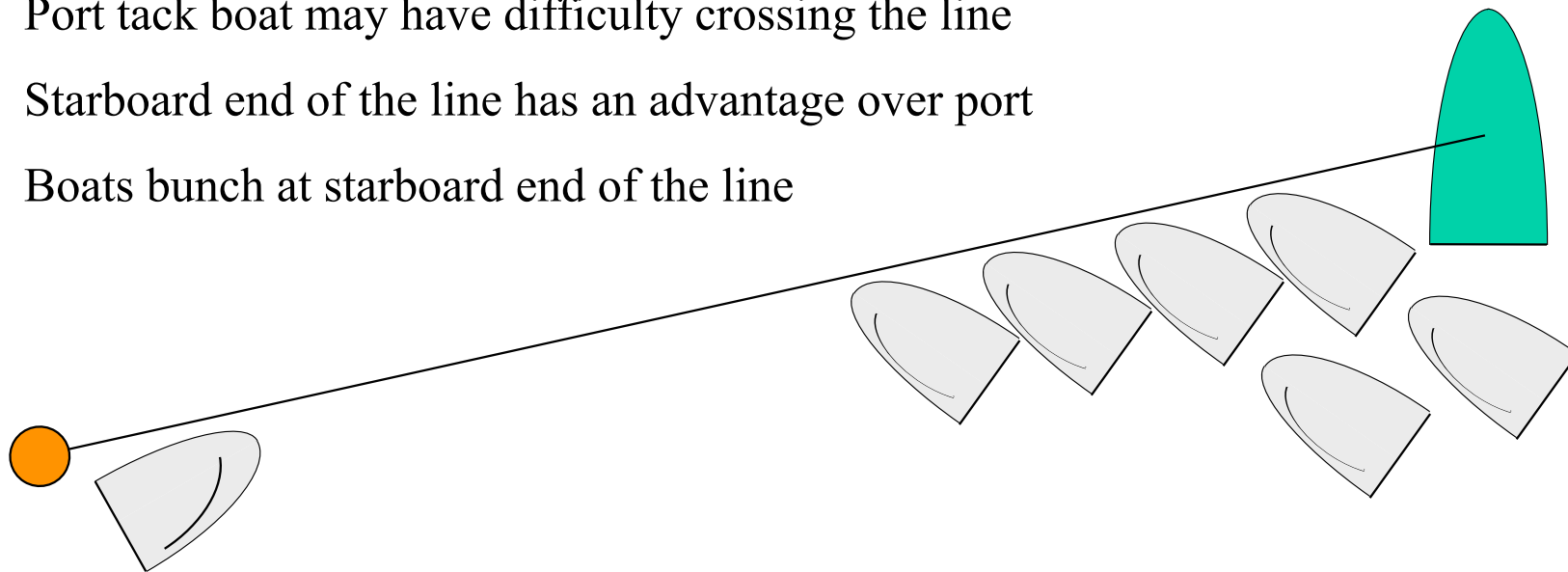
The distance to the first mark is less at the starboard end

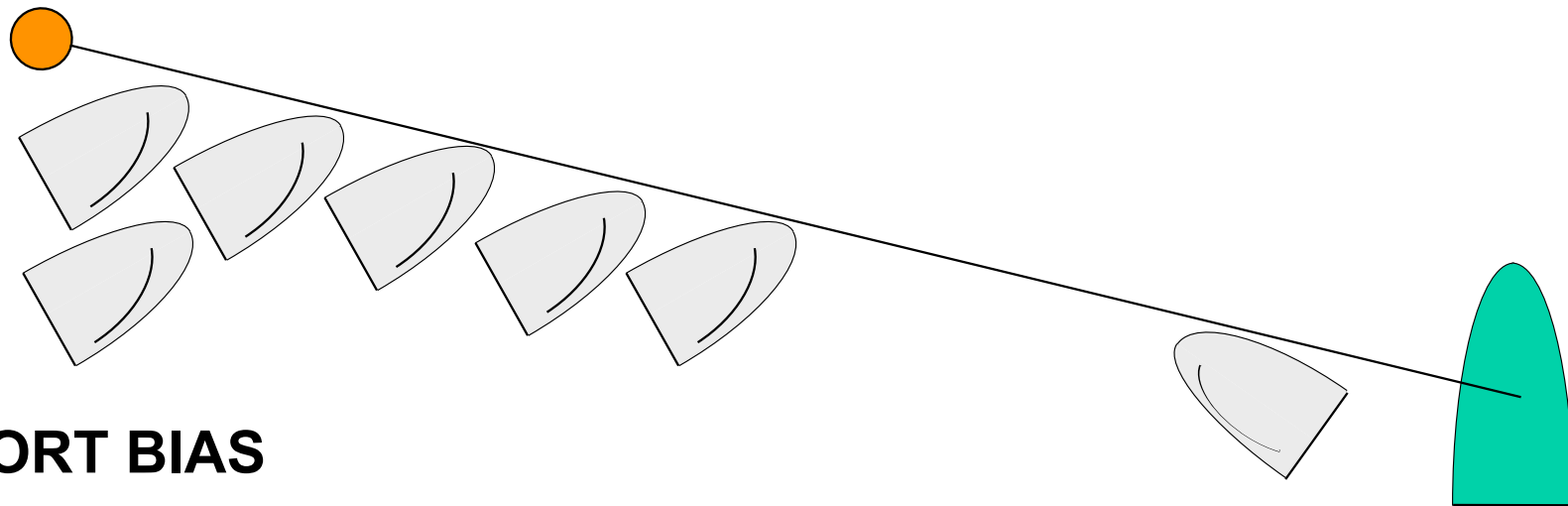
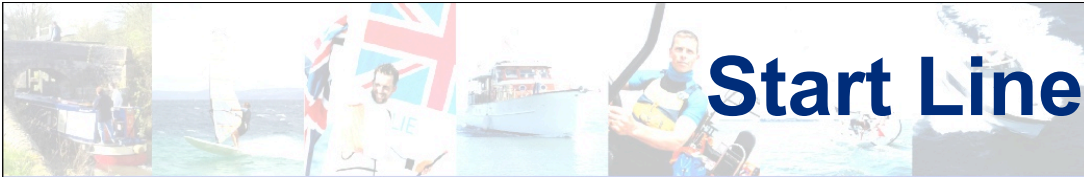
Starboard is the making tack

Port tack boat may have difficulty crossing the line

Starboard end of the line has an advantage over port

Boats bunch at starboard end of the line





PORT BIAS

Boats sail the same angles to the wind on each tack

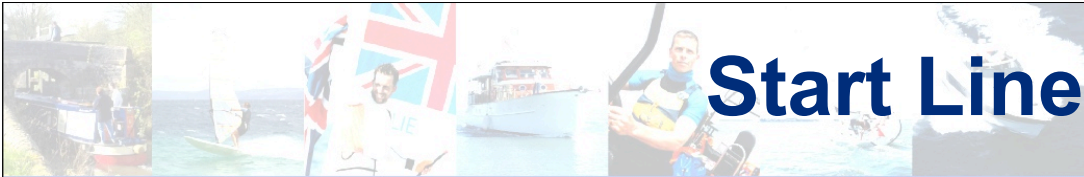
The distance to the first mark is less at the port end

Port is the making tack

Starboard tack boat may have difficulty crossing the line

Port end of the line has an advantage over starboard

Boats bunch at port end of the line



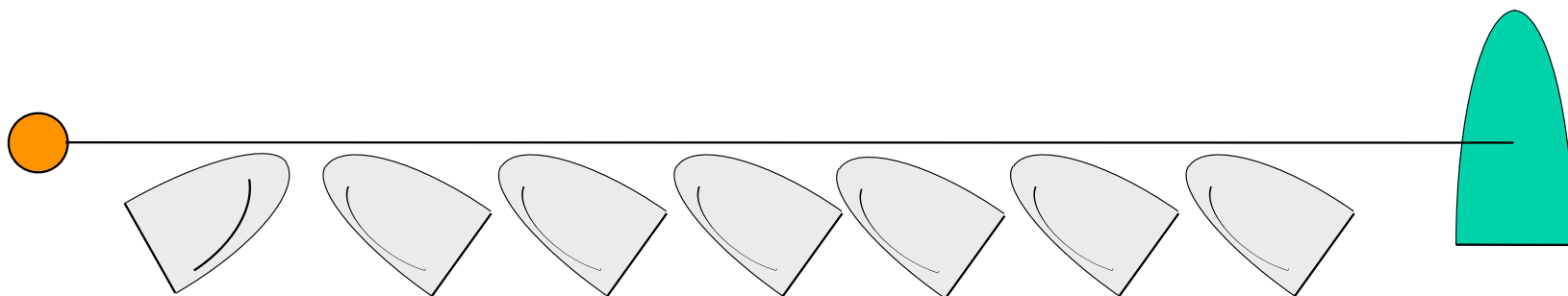
AIMS

Neither end of the line has an advantage over the other

The distance to the first mark is the same at either end

There is no 'making' or optimum tack at either end of the line

The line should be square to the wind boats are sailing in



AIMS

Windward mark

Boats spend the same amount of time on each tack

- beating to the windward mark from the start line
- beating to the windward mark from the leeward mark

Leeward Mark

Boats spend the same amount of time on each gybe

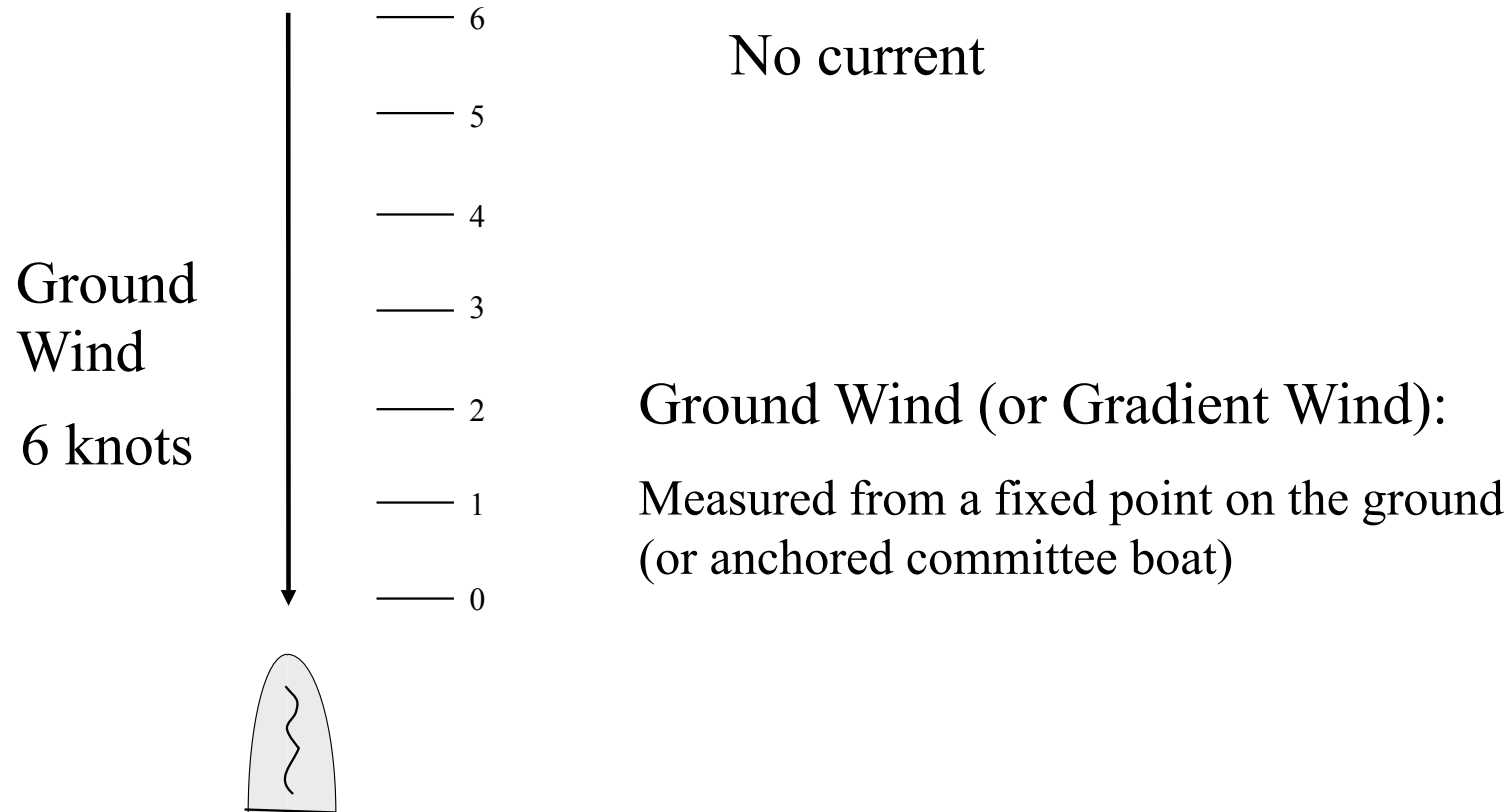
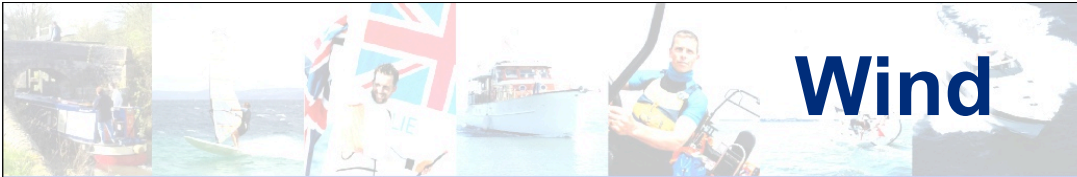
- running from the windward mark to the leeward mark

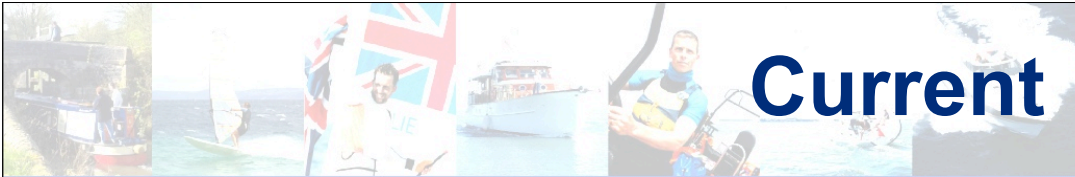
Vectors

Line length = speed (of wind, current, boat etc)

Angle = direction (of wind, boat, current etc)

Draw the lines to touch at the ends - we can 'add' the vectors

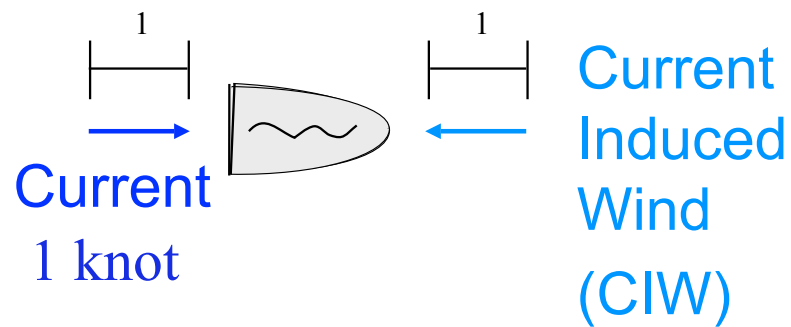




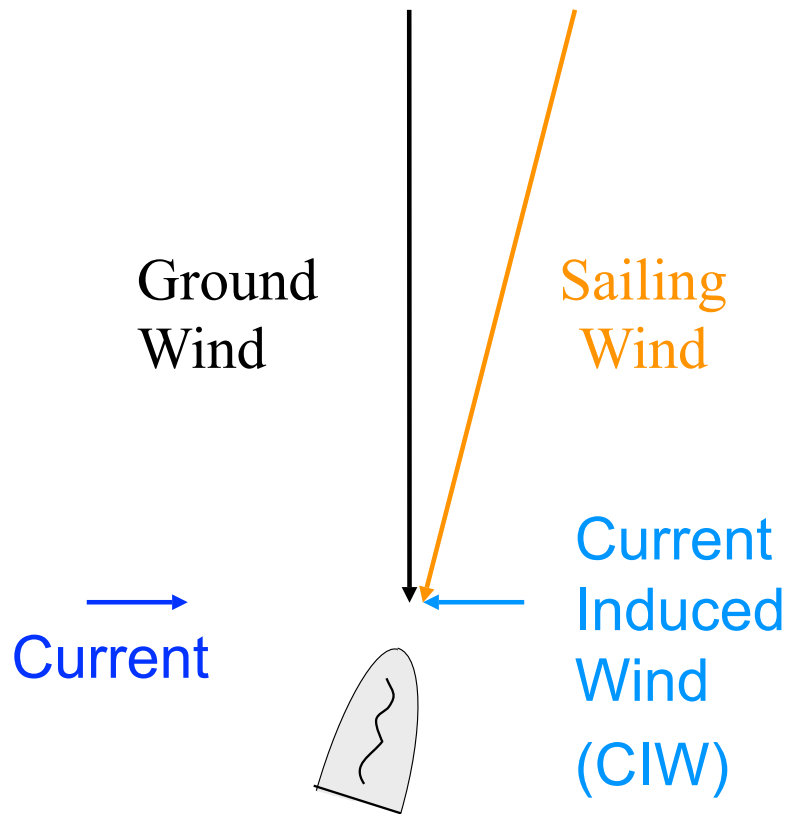
No gradient wind at all!

A still sunny day

But there is current



Wind and Current

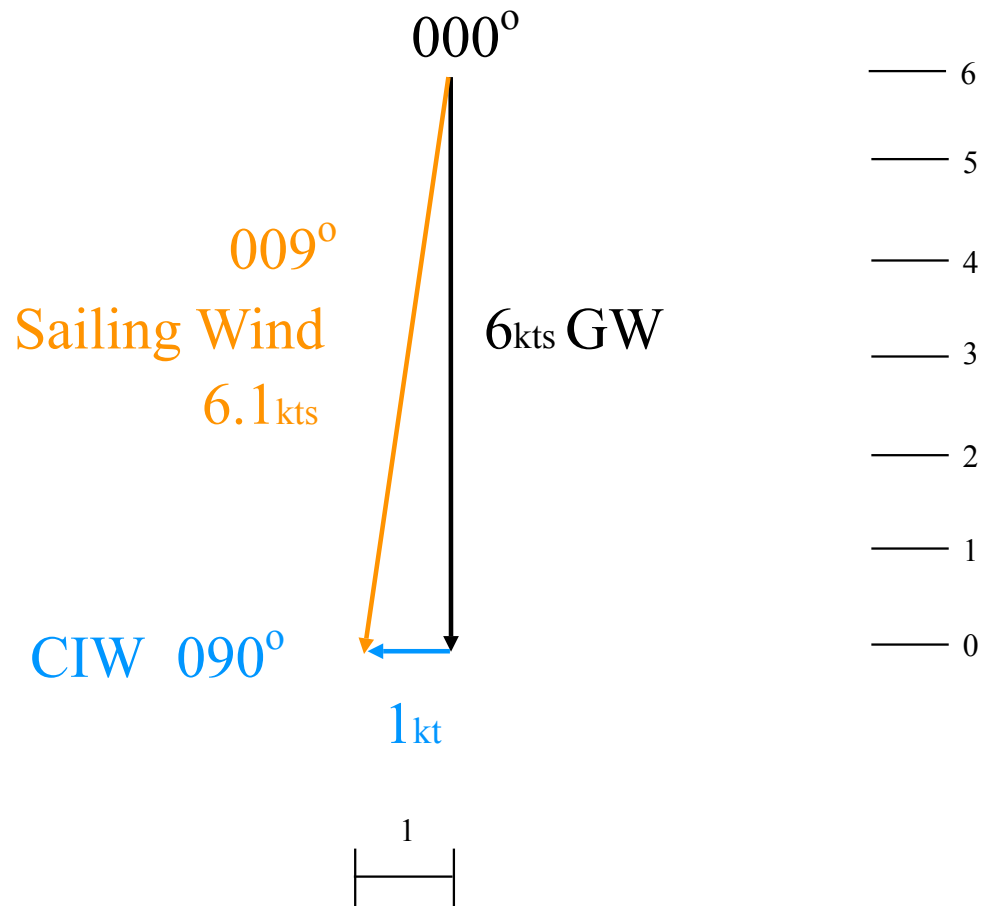


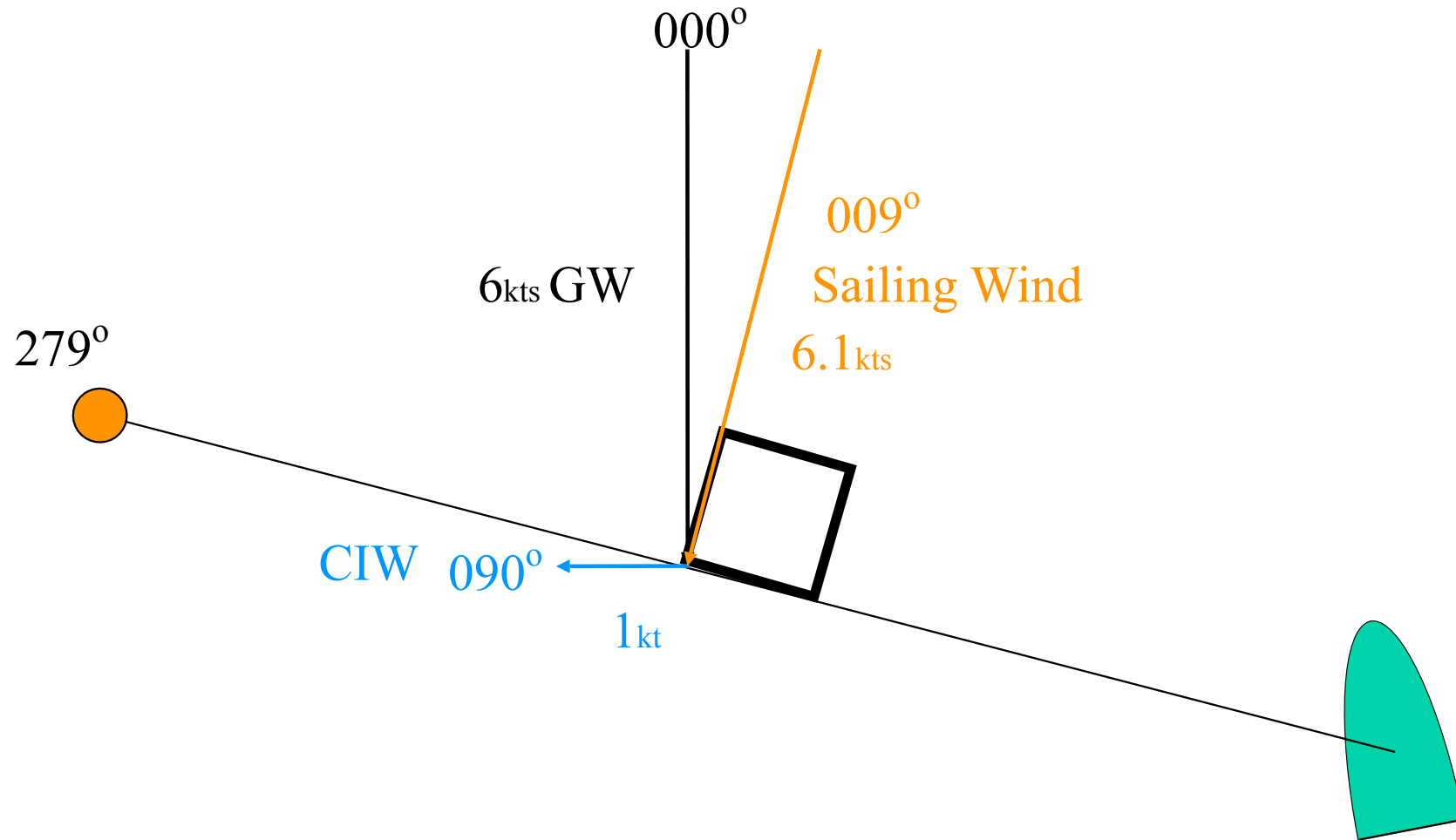
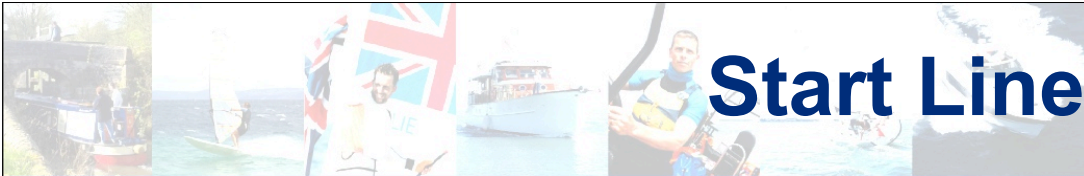
Sailing Wind:

Wind experienced by a boat not anchored or under way

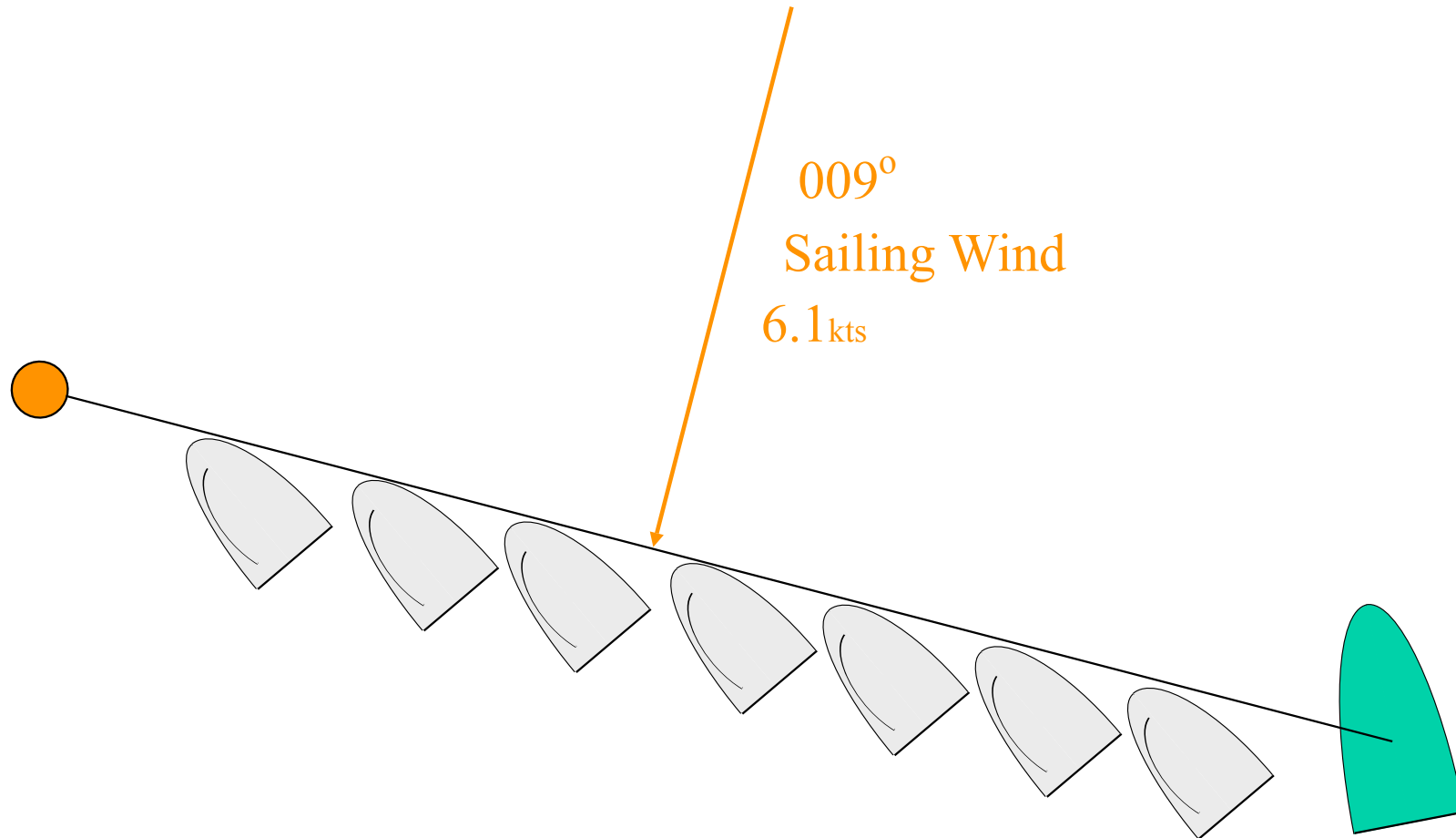
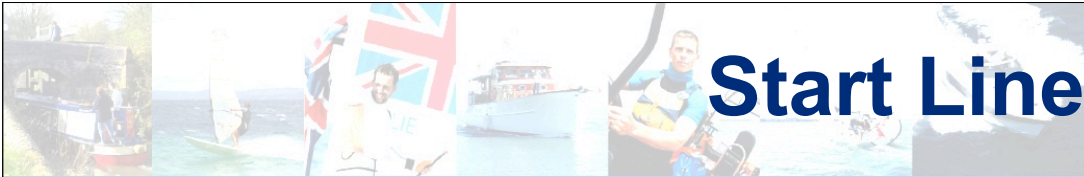


Wind and Current





Line is square to the 'sailing wind'



Achieved by setting the line square to the 'sailing wind'



Wind and Current



The current always influences the Sailing Wind

ALSO

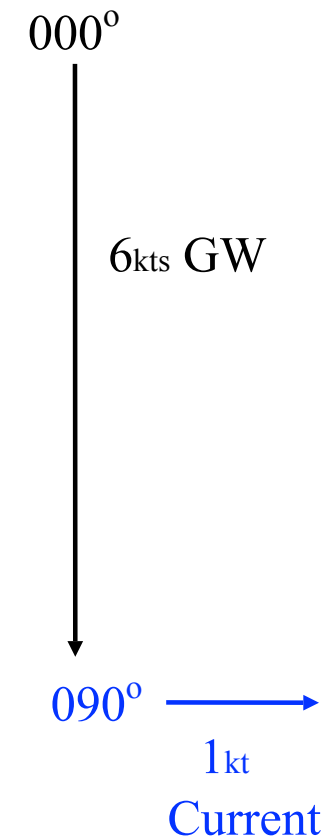
The current always influences the boat's COG

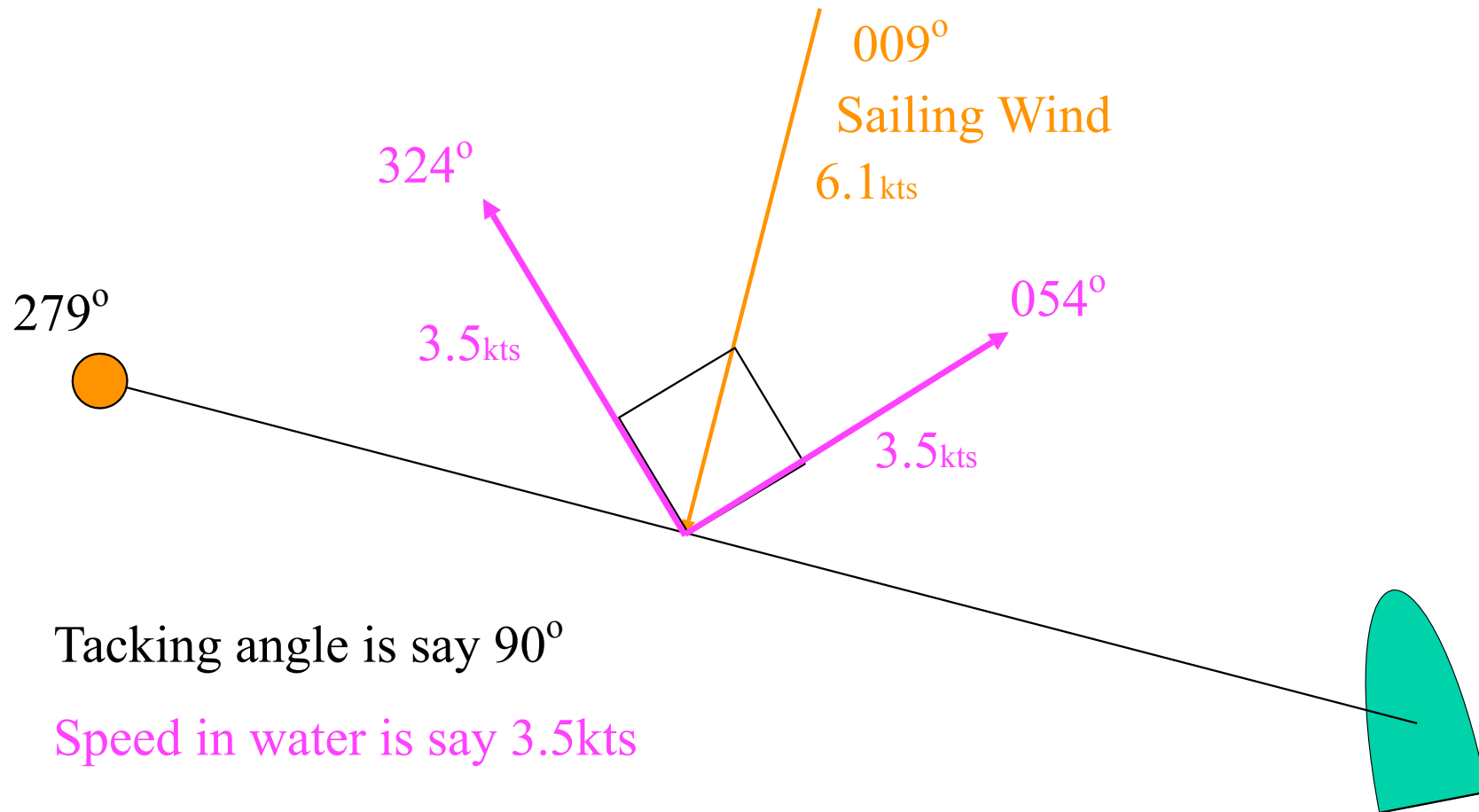
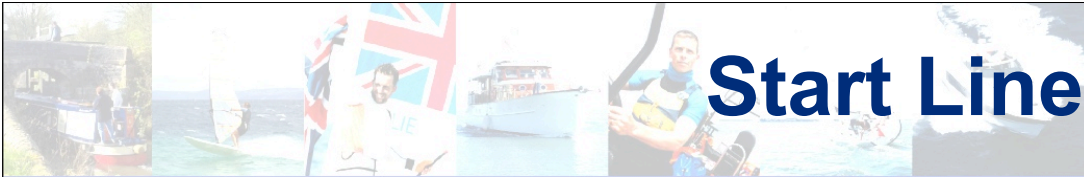
Effects of Current



Effect of current on a boat sailing?

- at 3.5 kts when beating with a tacking angle of 90°
- at 3.5 kts when running with a gybing angle of 90°





Tacking angle is say 90°

Speed in water is say 3.5kts

Direction through water (heading) = sailing wind $\pm 45^\circ$

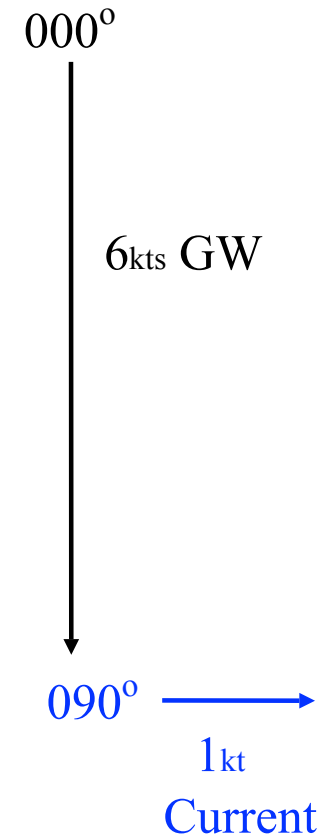
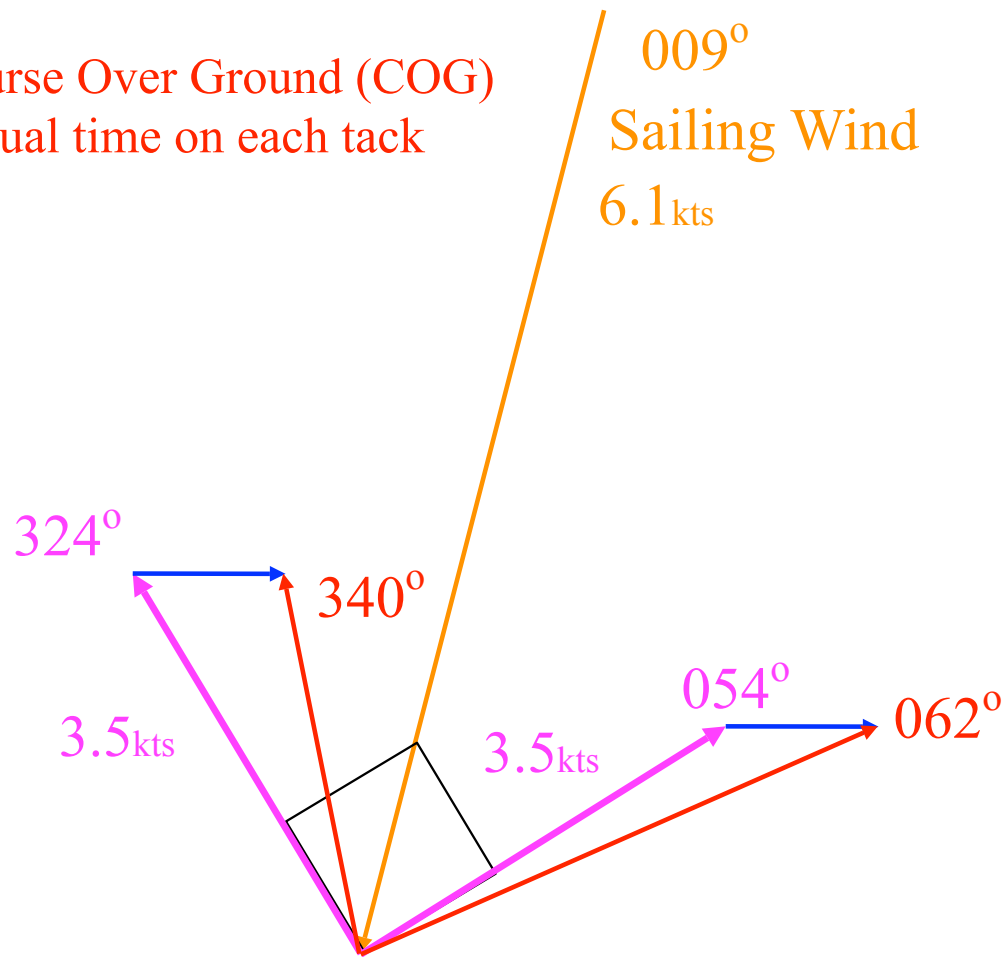


Windward Mark



Heading & Speed in water

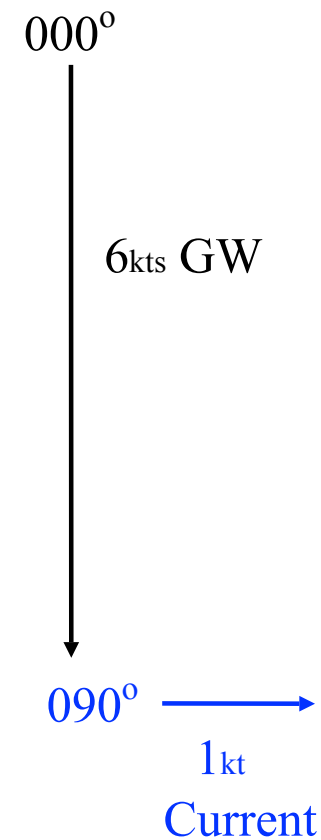
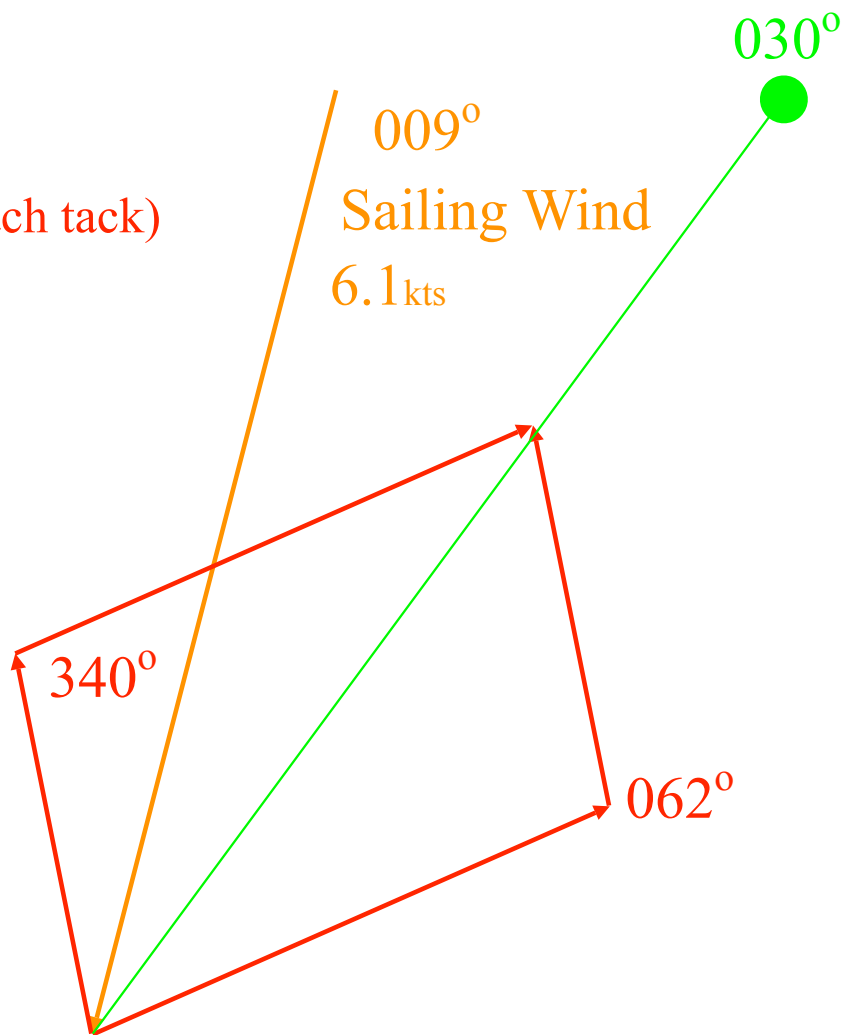
Course Over Ground (COG)
- equal time on each tack



Windward Mark

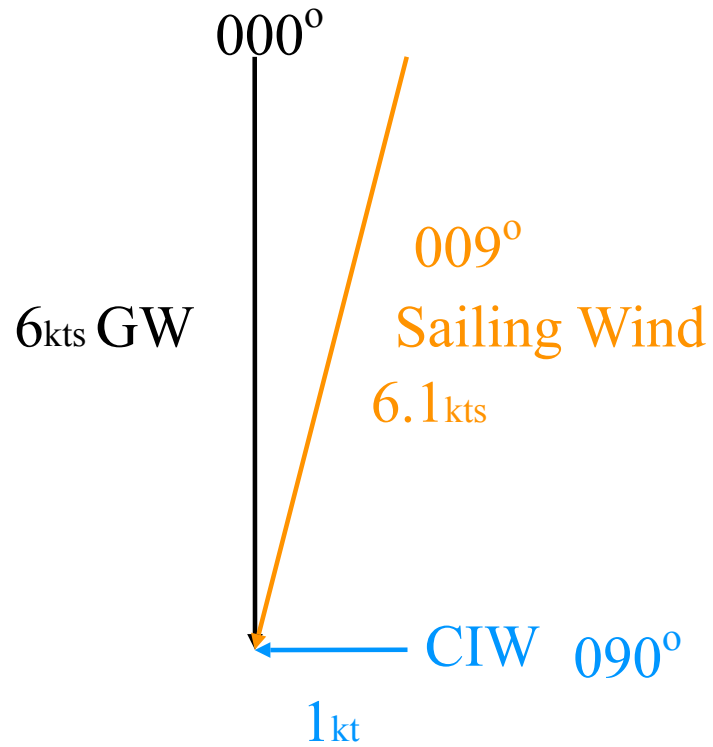


COG
(equal time on each tack)



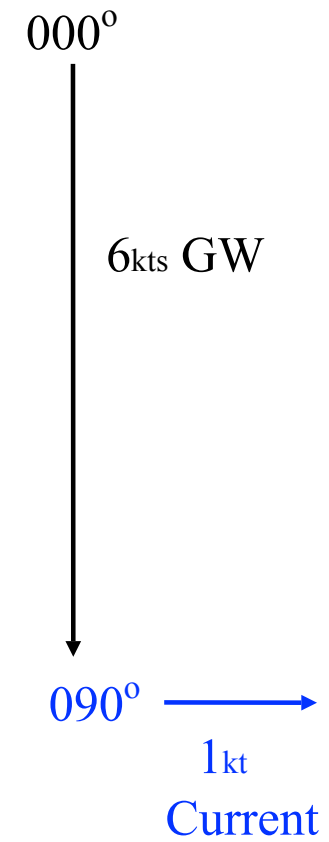
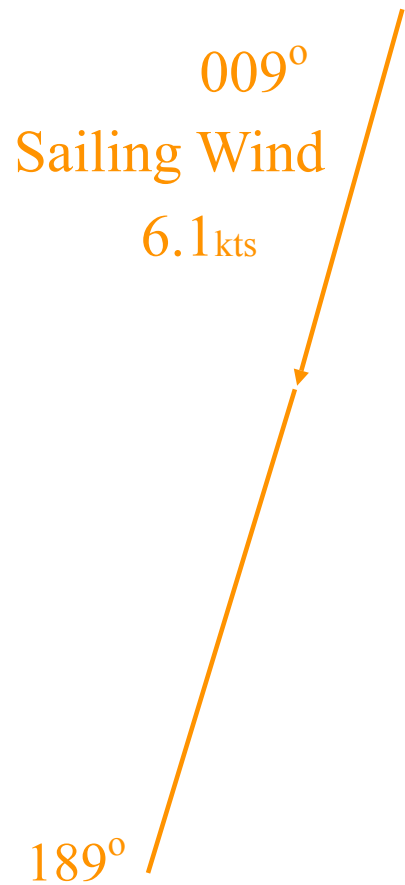


Leeward Mark



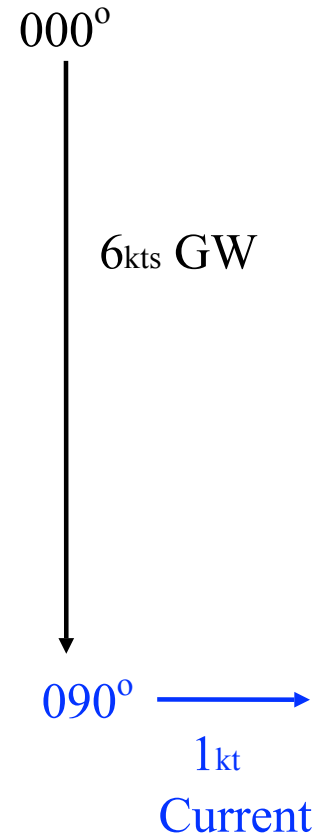
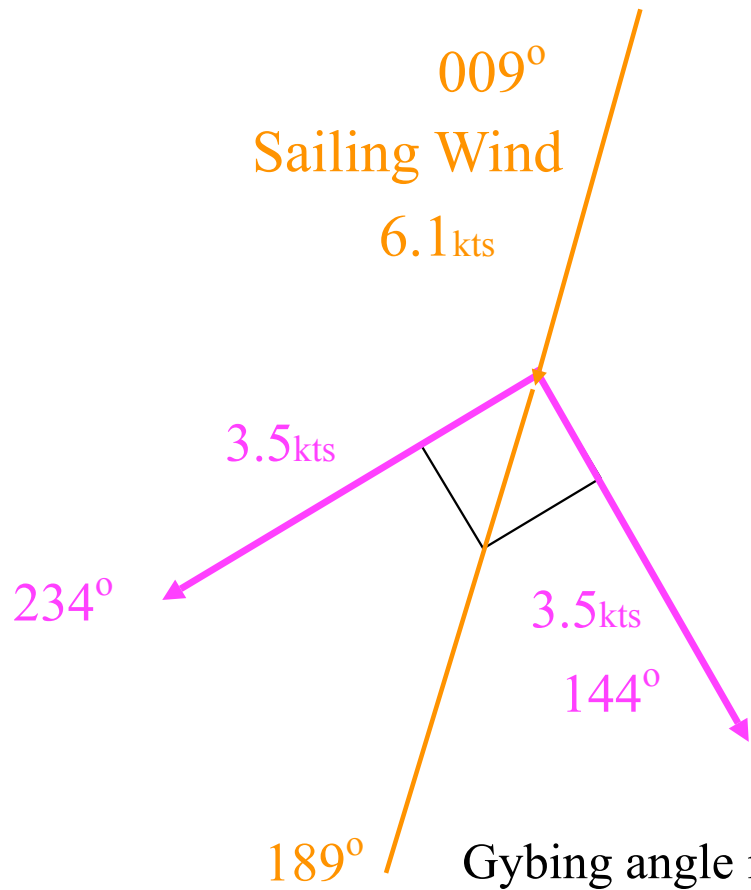


Leeward Mark





Leeward Mark

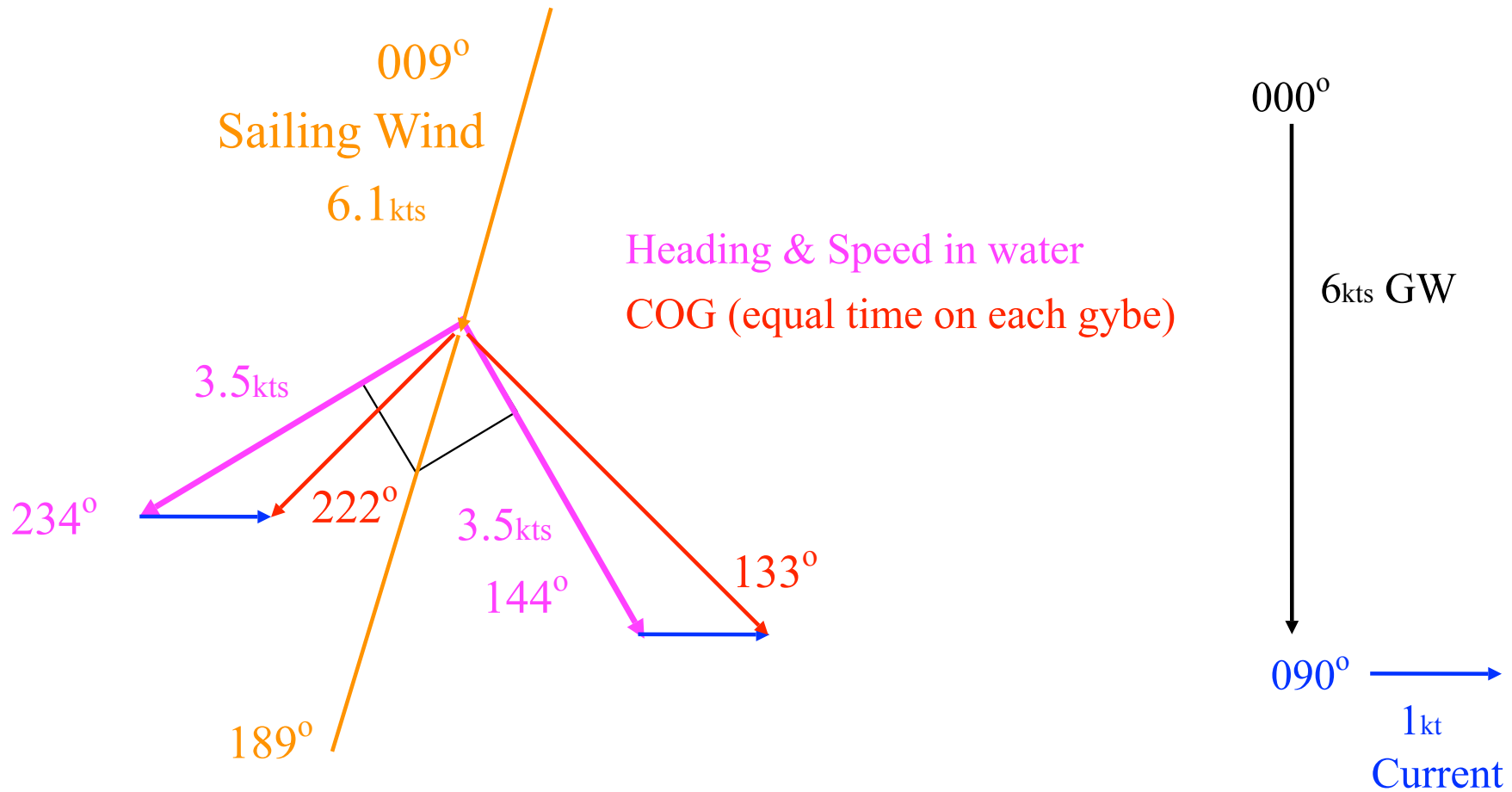


Gybing angle is say 90°
Speed in water is say 3.5kts

Direction through water (Heading) = sailing wind +/- 135°

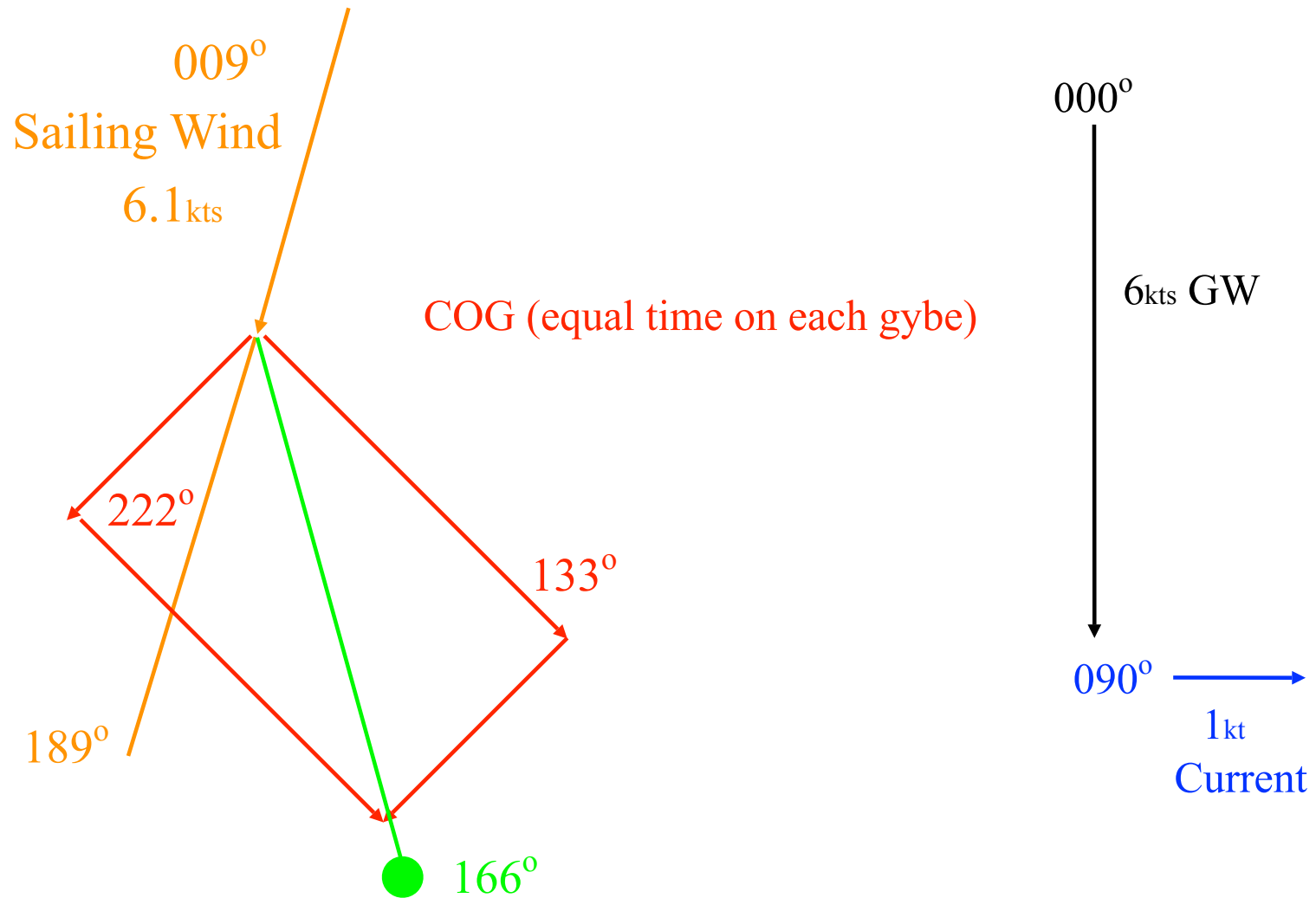


Leeward Mark





Leeward Mark





Wind and Current



The current always influences the Sailing Wind
ALSO
The current always influences the boat's COG

Ground Wind	000°	6kts
Cross Tide	090°	1kt
Sailing Wind	009°	
Pin End Moves	009° Upwind	(when current is left to right)
Windward Mark Moves	30° Downtide	(effects of current are cumulative)
Leeward Mark Moves	14° Downtide	(effects of current are subtractive)

Sailing Wind

Sailing Wind is that experienced by a boat *not anchored or underway*

Sailing Wind is *always* influenced by the current

Best measured by a boat that is *not anchored or underway*

Upwind

COG and SOG are *always* influenced by the current

The two effects are *additive*

Downwind

COG and SOG are *always* influenced by the current

The two effects are *subtractive* & so much less than upwind effect

Windward Leeward Course and Current



With cross-current:

WINDWARD LEEWARD COURSES WITH TWO MARKS

A perfect beat and a perfect run is impossible when there is cross-current

Problem

The run is the most important leg to set accurately

If a course is set to give equal time on each gybe (166°)

Then on the beat:

60 secs on long tack

5 secs on short tack

Compromise

Set up on the Sailing Wind

Equally skewed upwind and downwind

60 secs on long tack/gybe

26 secs on short tack/gybe (43%)

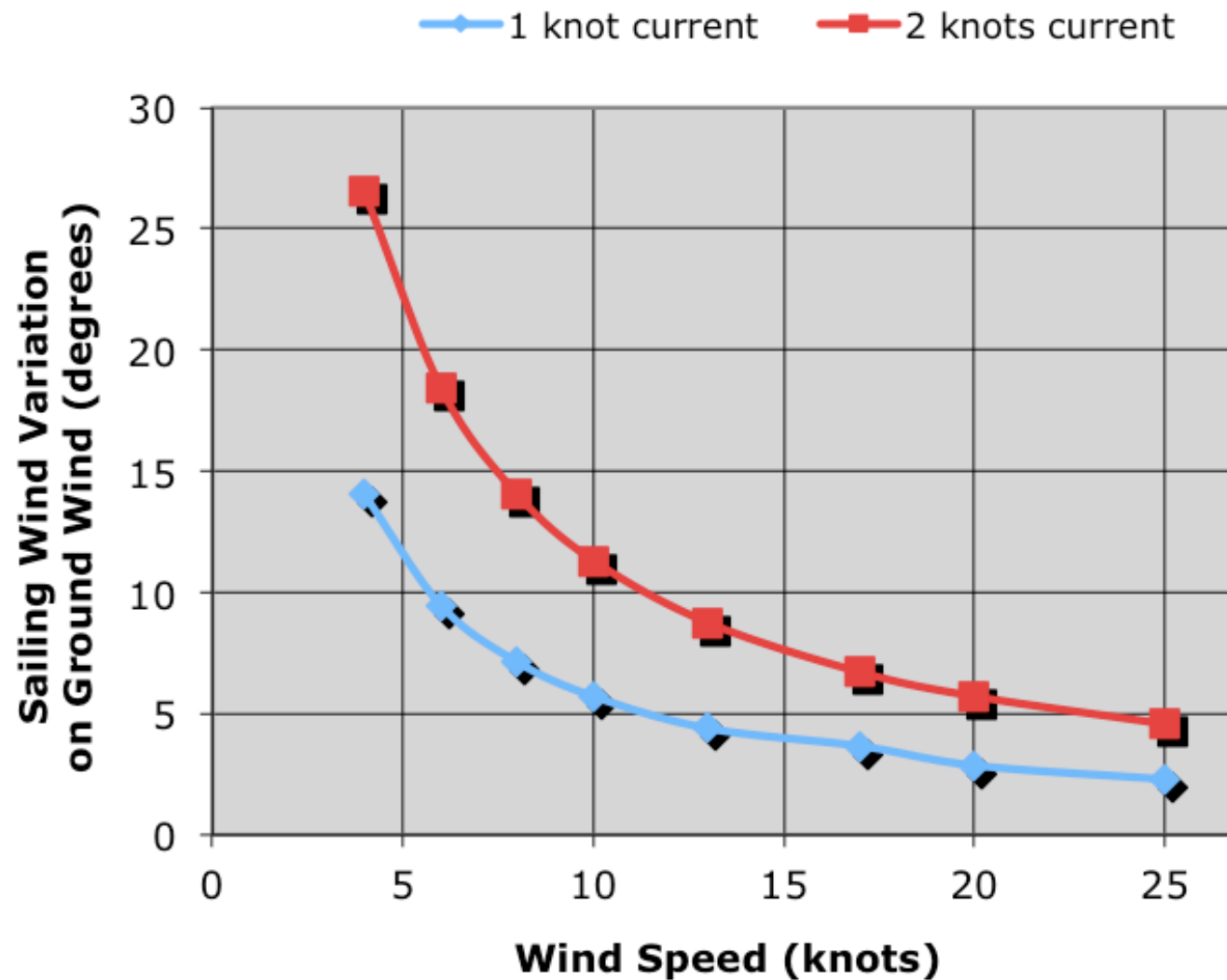


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Wind and Tide

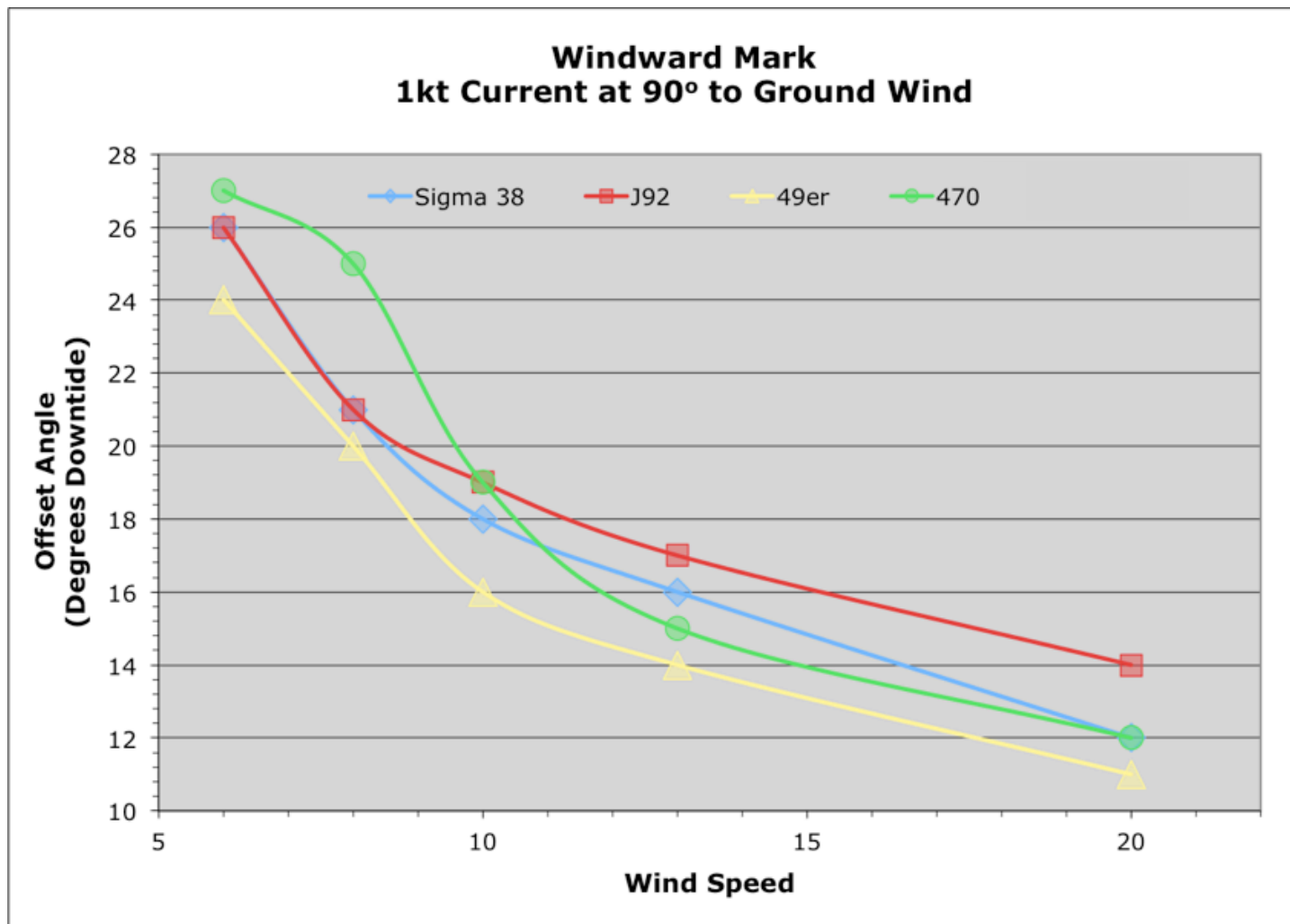
The Real World

Sailing Wind

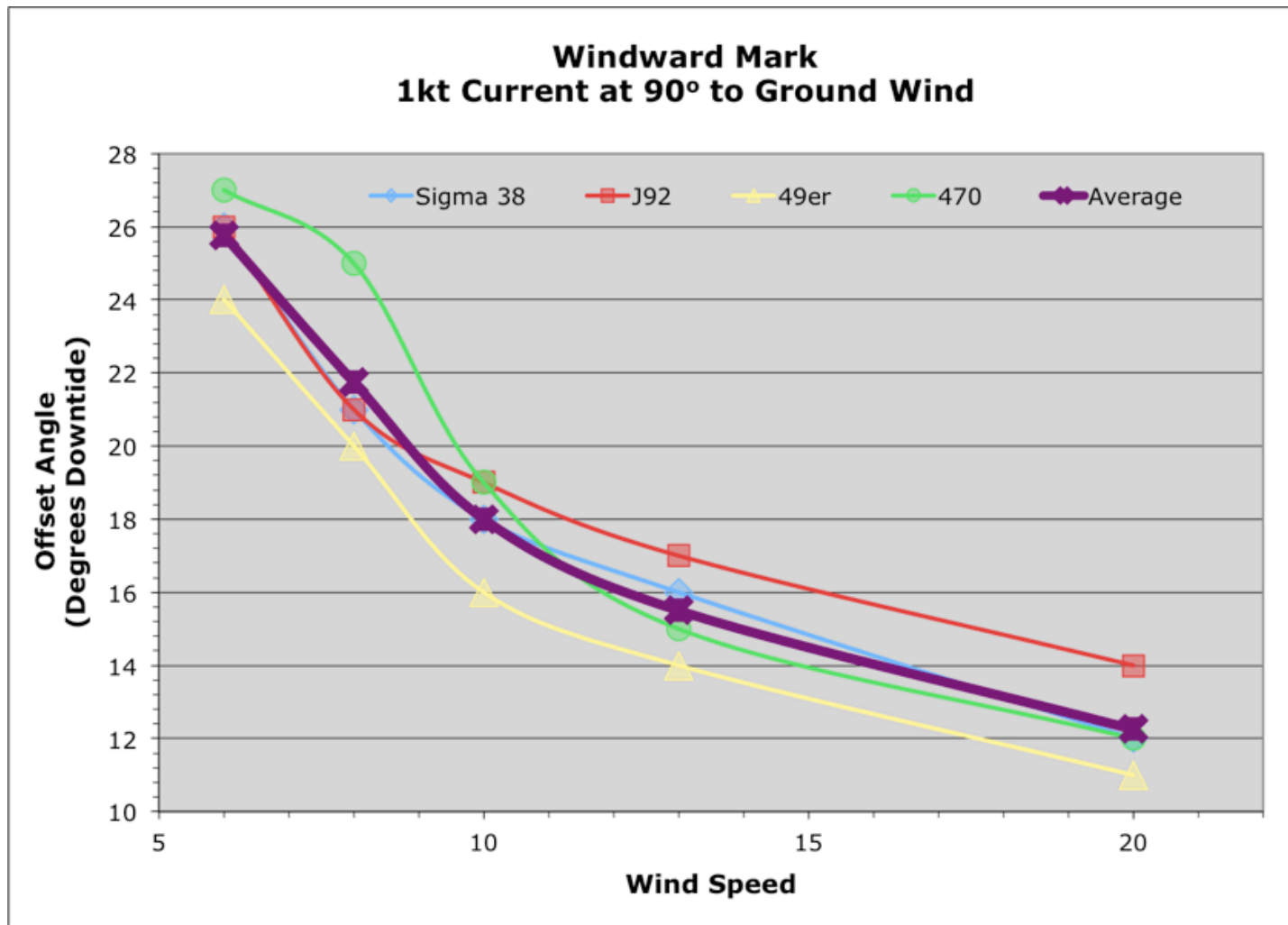


Current 90°
to ground
wind

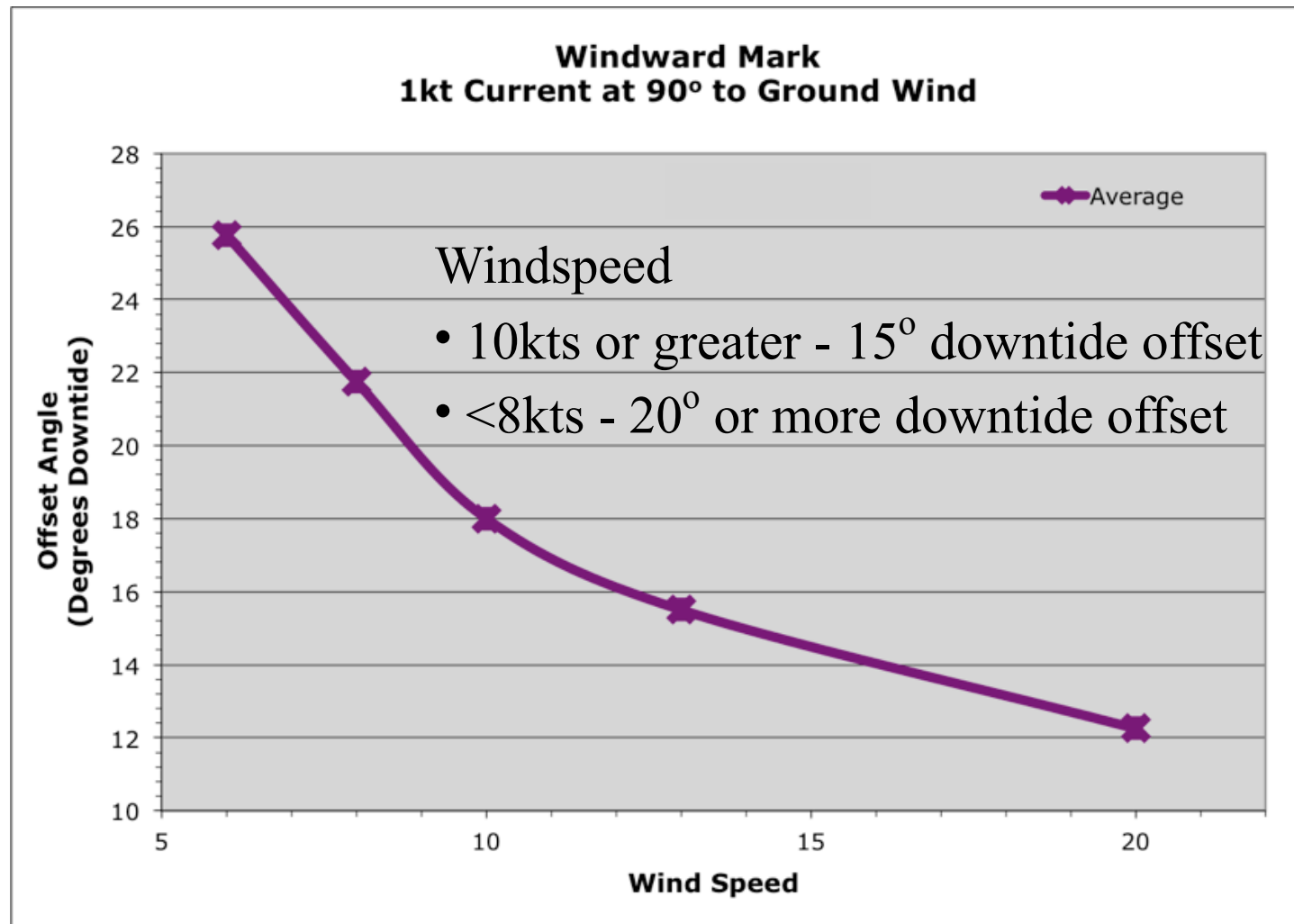
Specific Boats and Windward Mark Offset



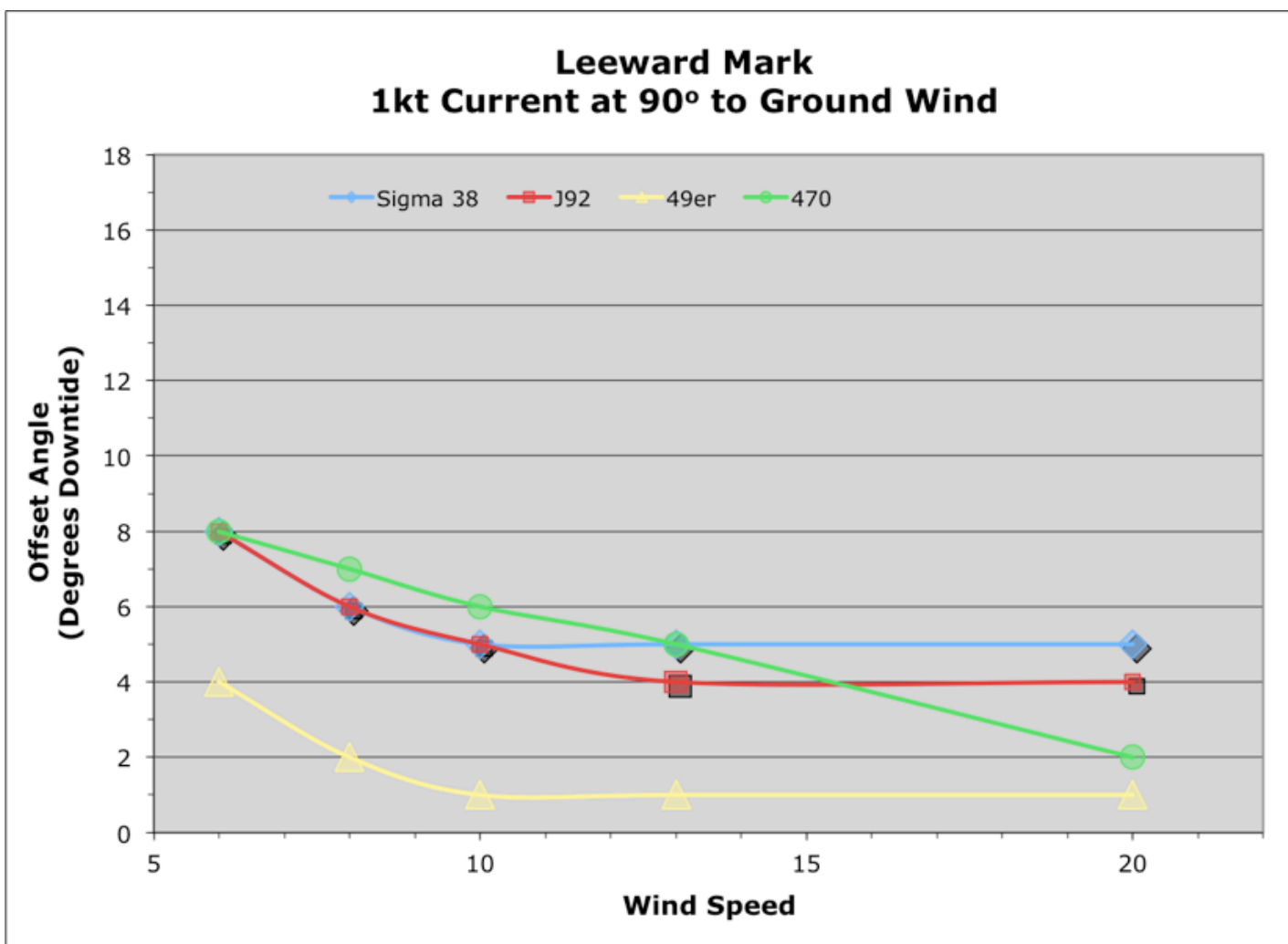
Specific Boats and Windward Mark Offset



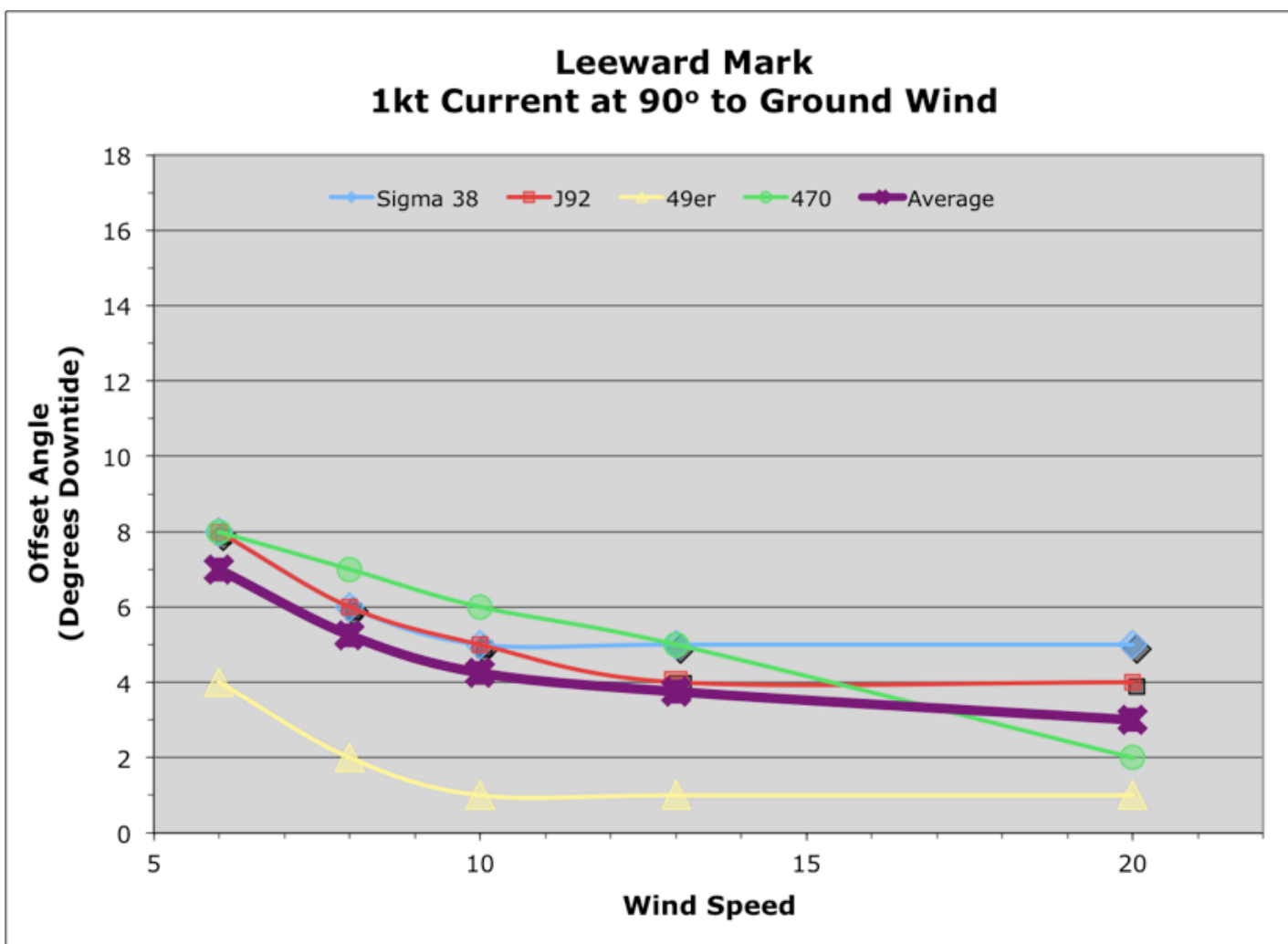
Specific Boats and Windward Mark Offset



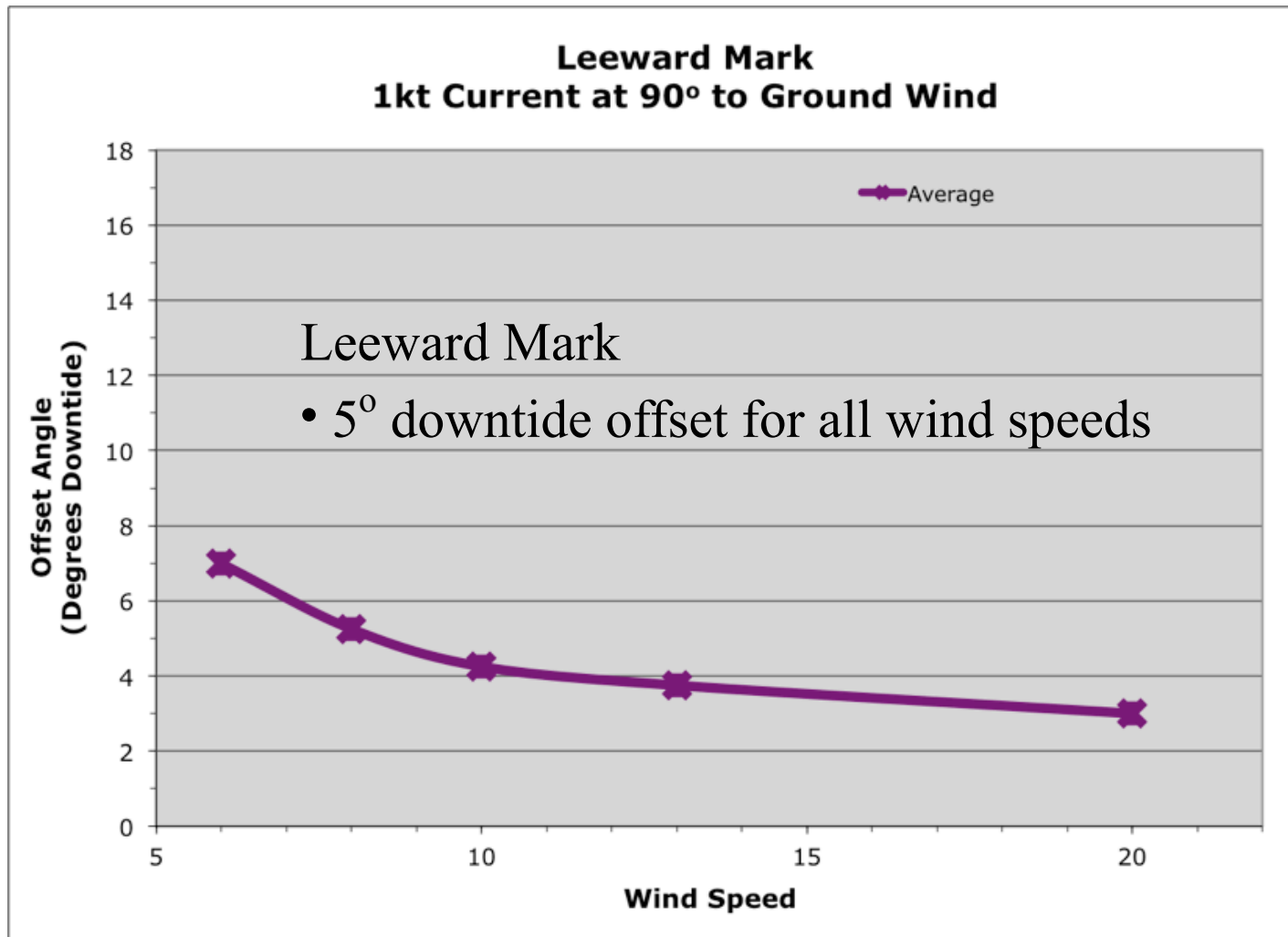
Specific Boats and Leeward Mark Offset



Specific Boats and Leeward Mark Offset



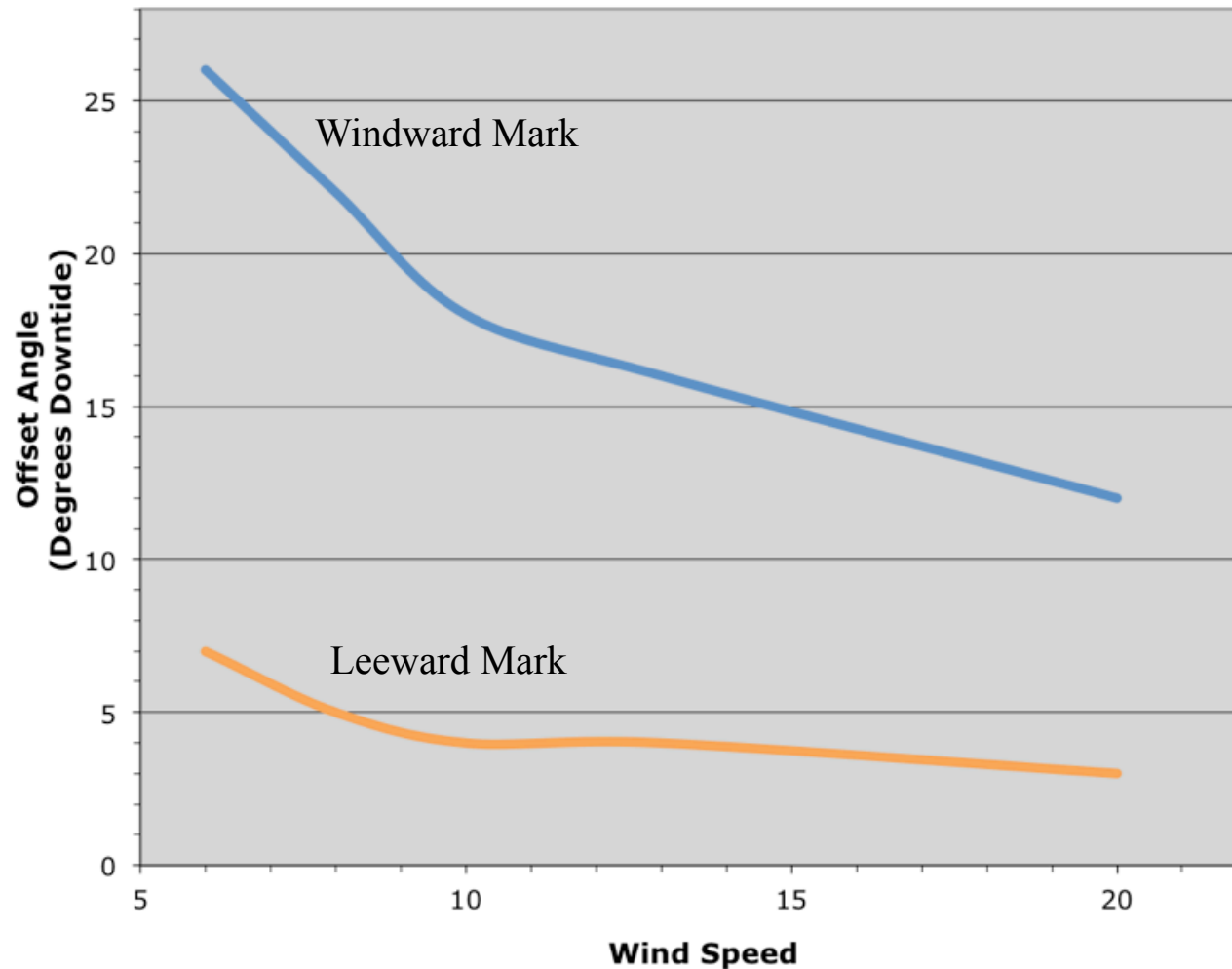
Specific Boats and Leeward Mark Offset



Windward and Leeward Mark Offset



1kt Current at 90° to Ground Wind





Rule of Thumb



Windward Mark Offset with 1kt Cross Current

10kts or greater - 15° downtide offset

<8kts - 20° or more downtide offset

Leeward Mark Offset with 1kt Cross Current

5° downtide offset for all wind speeds

More Current

2 kts tide - double the offset above

Current less than 90° to Ground Wind

Tide at 45° to ground wind - half of the offset above

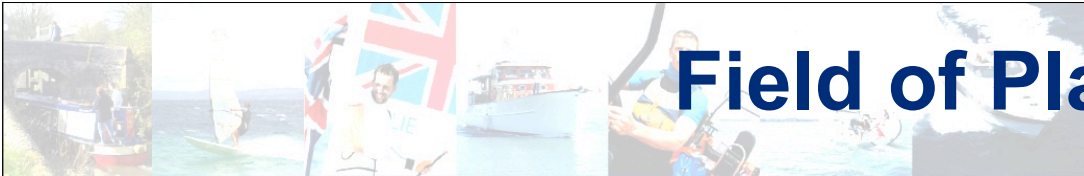
REMEMBER

Current is difficult to assess and is never uniform across the course!



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Wind and Tide Importance



Field of Play

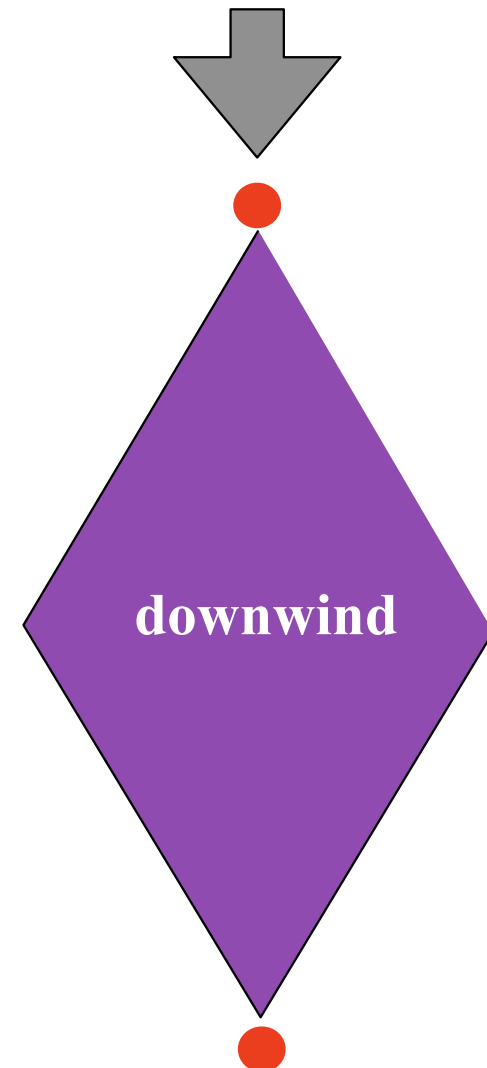
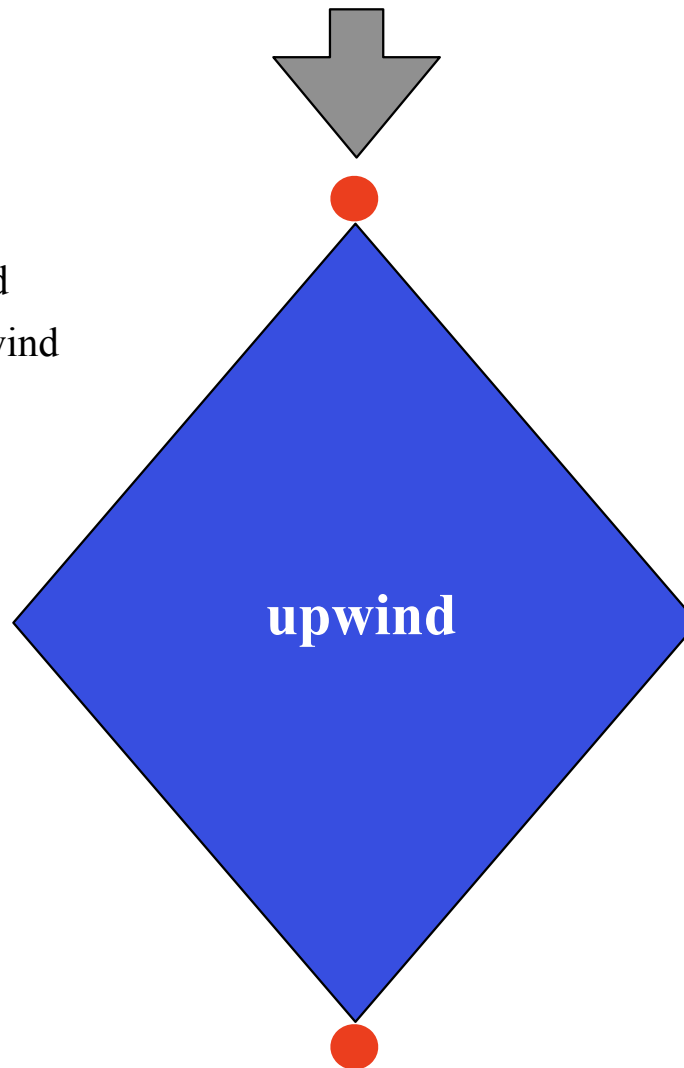


12 knots of wind

Sigma 38

80° tacking angle upwind

60° tacking angle downwind



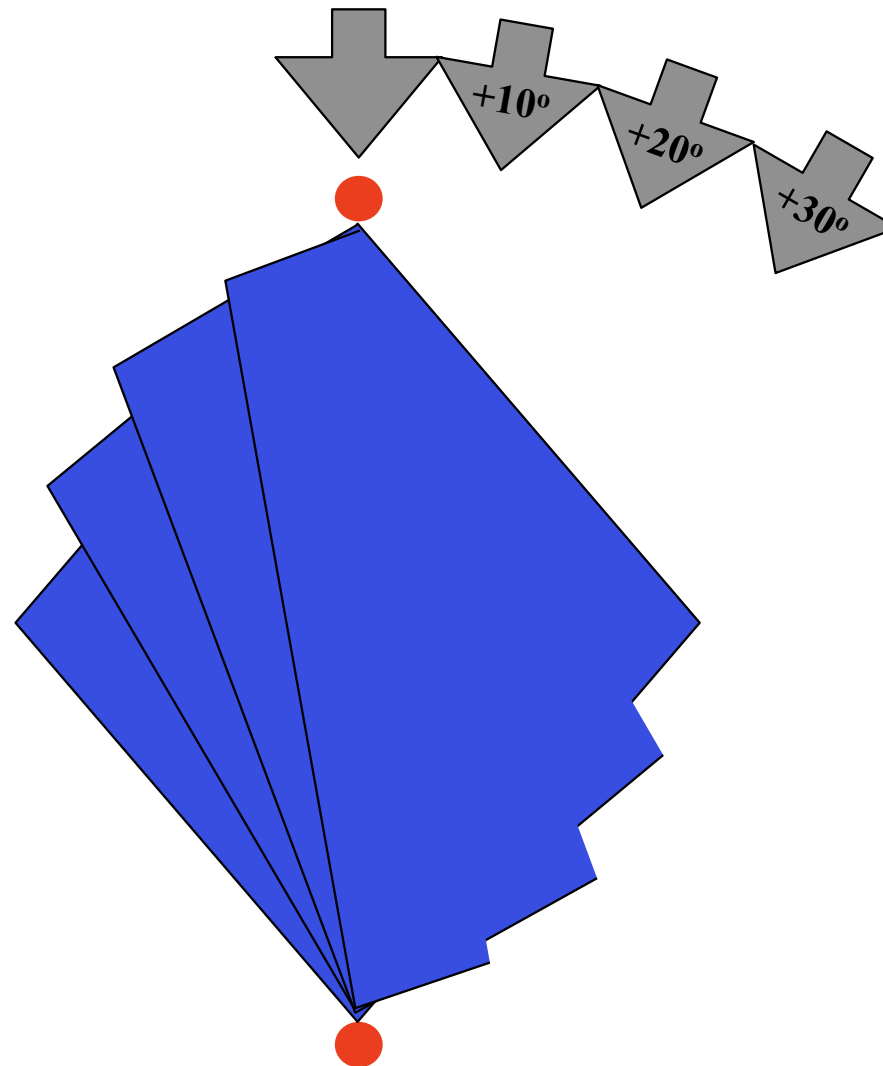
Field of Play Upwind



12 knots of wind

Sigma 38

80° tacking angle



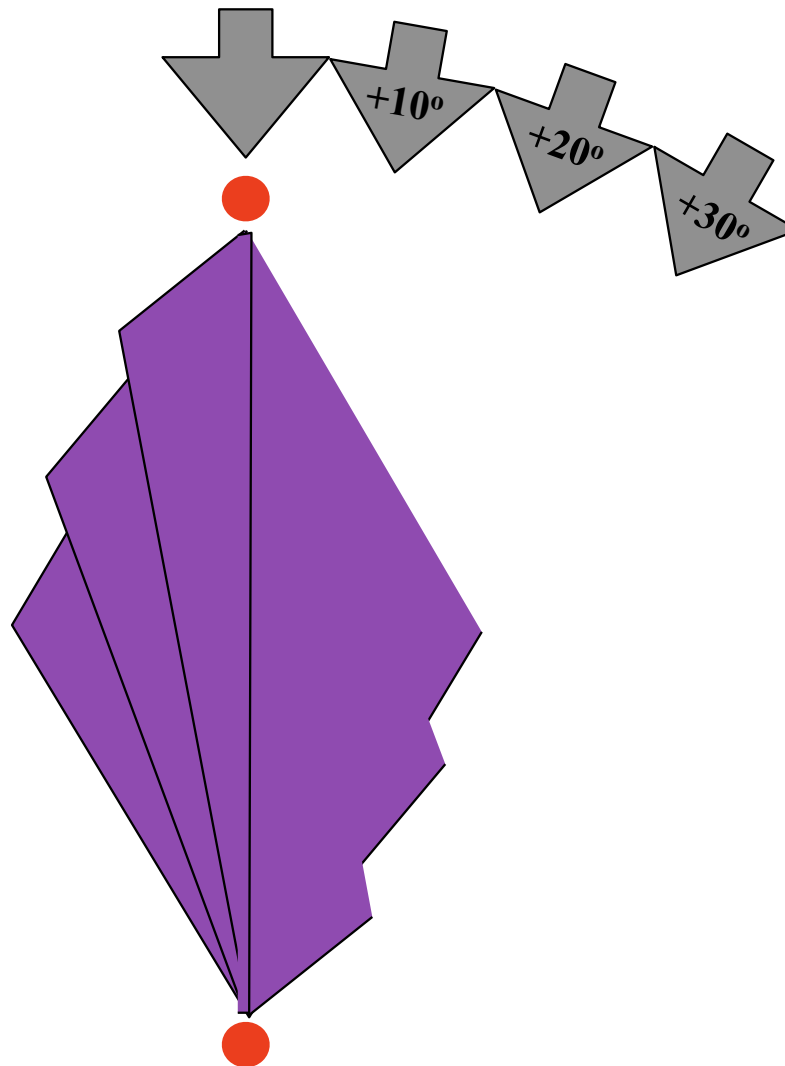
Field of Play Downwind



12 knots of wind

Sigma 38

60° tacking angle



ISAF RM Policies - Adjusting the Course



Wind Shift	Action
<10°	no change
10° to 15°	consider & adjust if you believe it's permanent
>15°	adjust the course
>45°	consider viability of race
Frequent/violent	abandon the race

This guideline may be altered in the presence of tide

Change leg length to achieve target time - do not make many changes

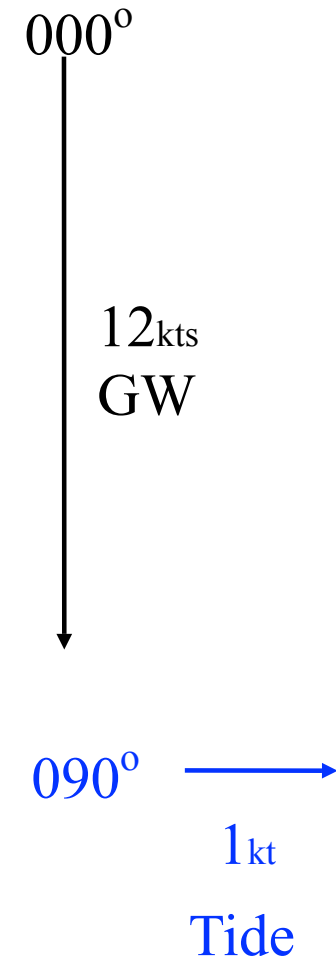
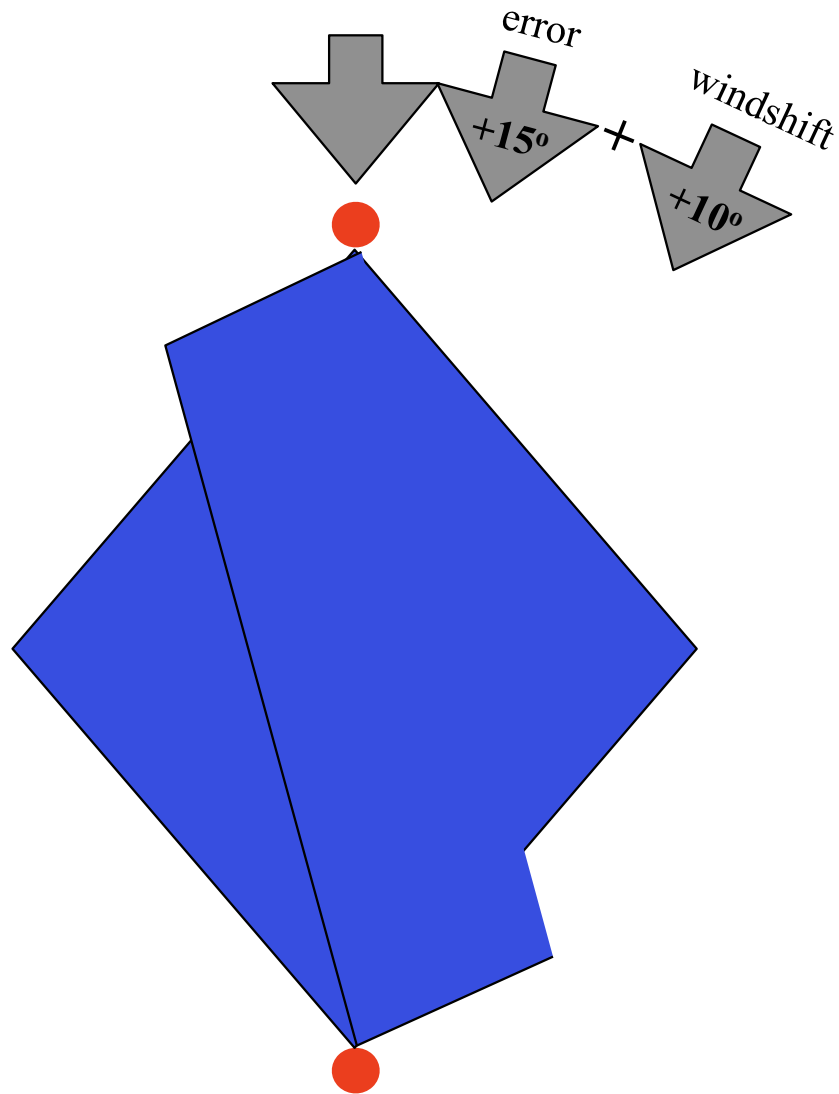
Change in leg length should be no less than 50% or more than 150% of original length

Shorten a course by C rather than S

Windward Mark - No Tidal Offset



12 knots of wind
Sigma 38
80° tacking angle



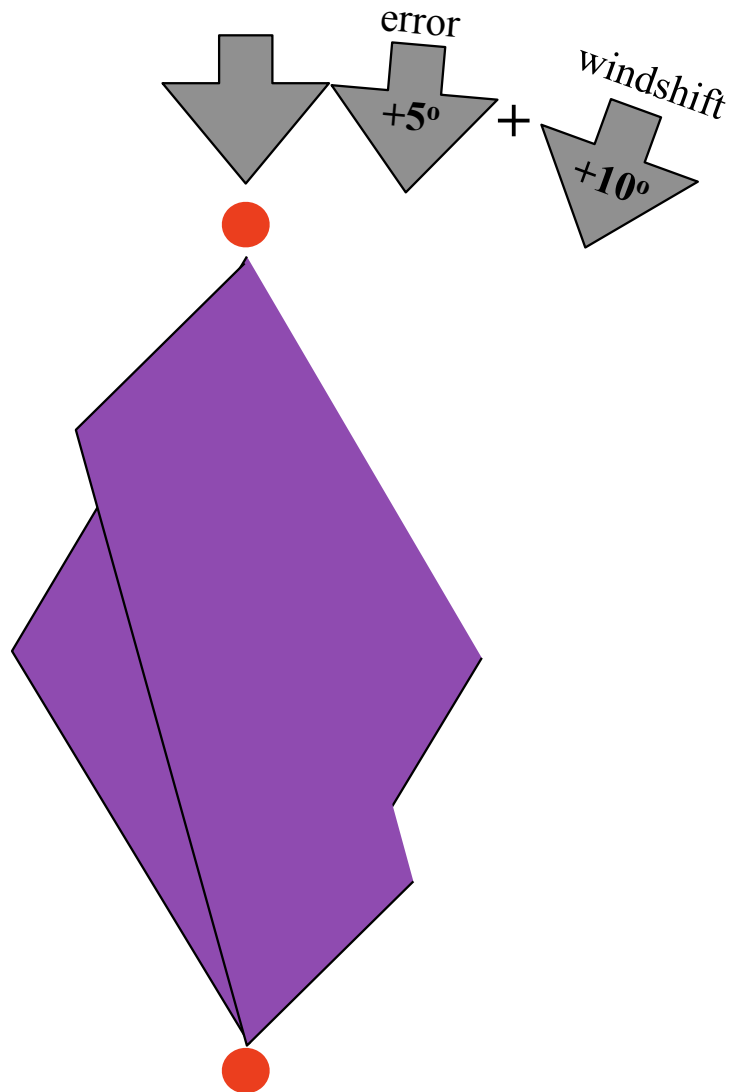
Leeward Mark - No Tidal Offset



12 knots of wind

Sigma 38

60° tacking angle



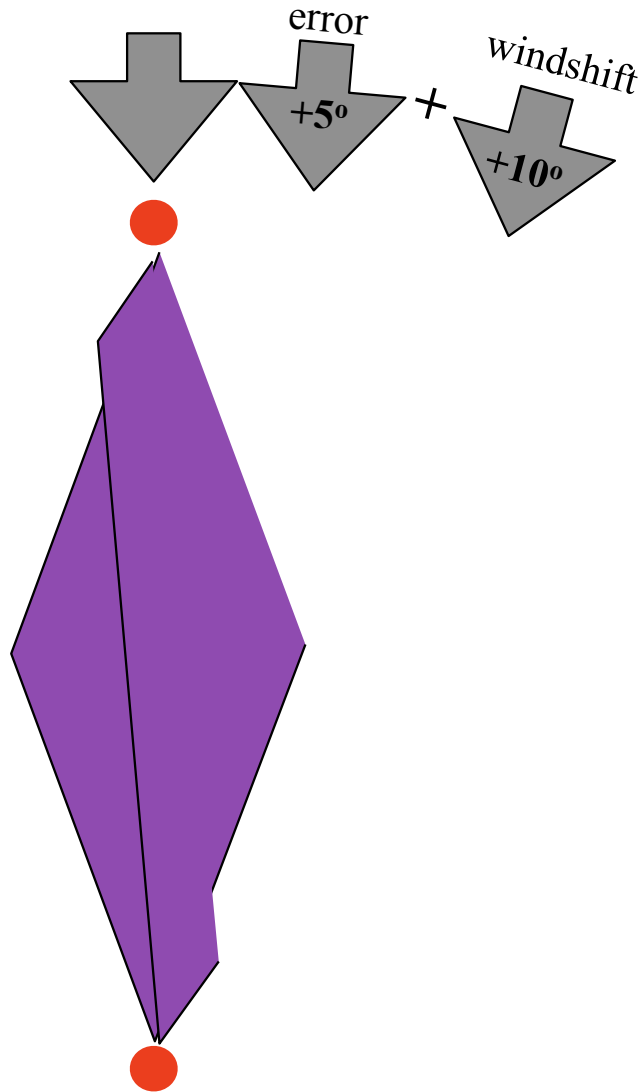
Leeward Mark - No Tidal Offset



16 knots of wind

Sigma 38

40° tacking angle



000°

12kts
GW

090°



1kt

Tide

Leeward Mark - No Tidal Offset

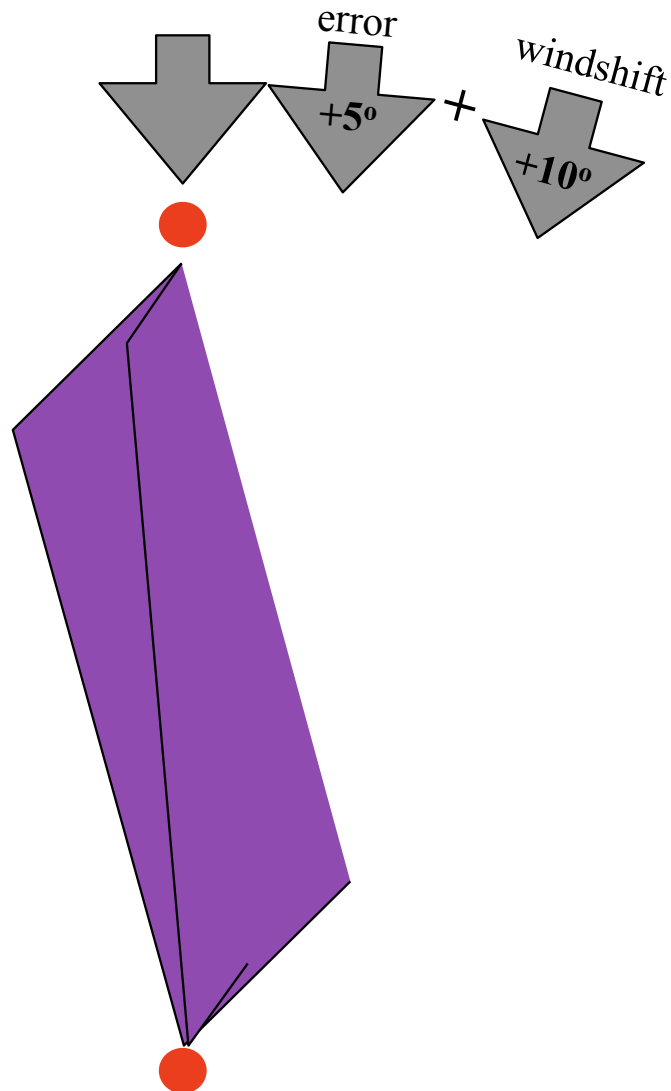


12 knots of wind

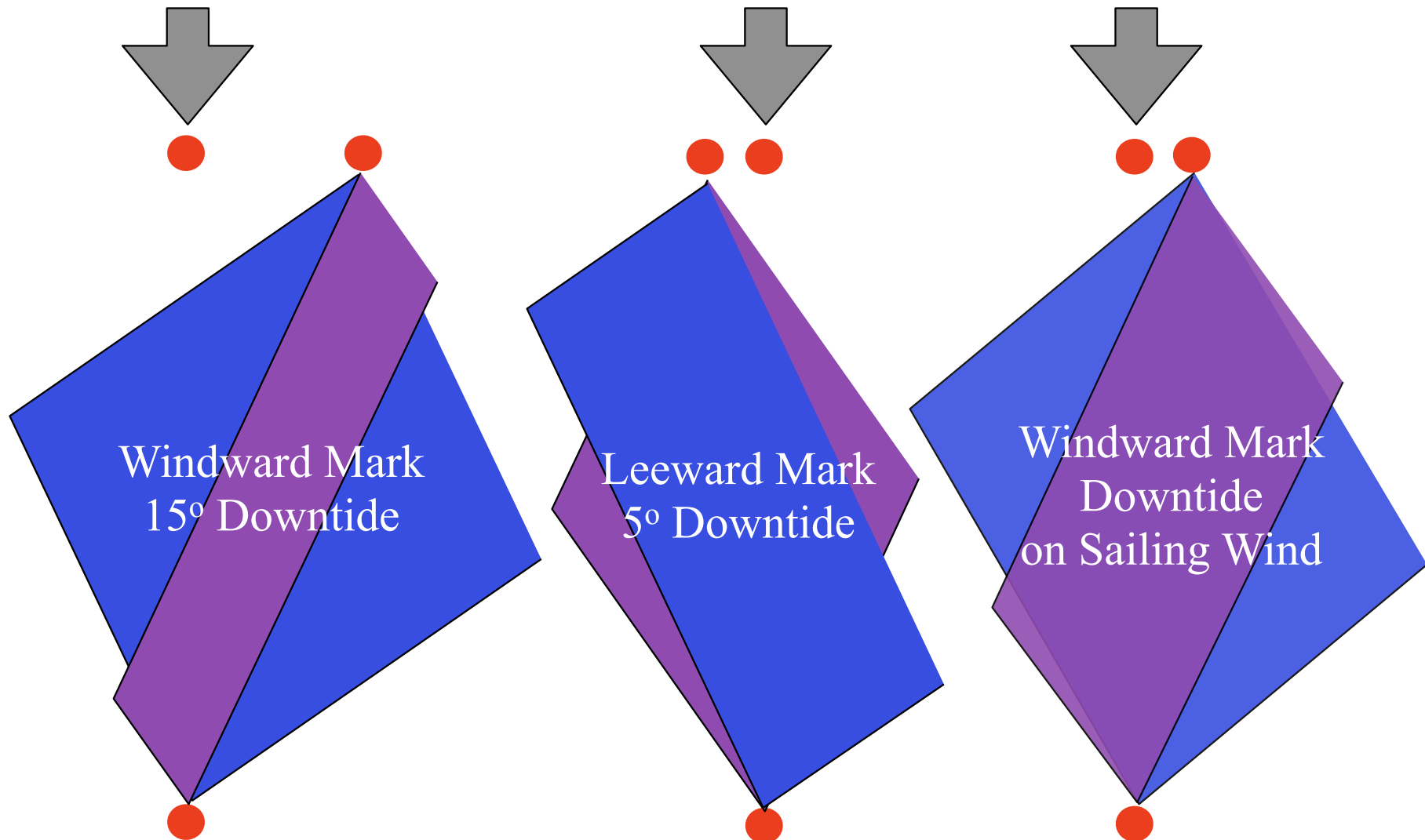
Sigma 38

40° tacking angle

+ 4 knots = 16 knots



W/L Course with Only 2 Marks





W/L Course with Only 2 Marks



With cross-current:

WINDWARD LEEWARD COURSES WITH TWO MARKS

A perfect beat and a perfect run is impossible when there is cross-current

Best Compromise

Set up on the Sailing Wind



Measuring Current



Throw into the water:

stick

sponge

bottle of water with small air pocket at top

Measure distance travelled in meters:

range finder

GPS

Time for 1 minute:

stopwatch

Current (knots) = distance measured (m) in 1 minute / 30.87

$$\text{Current (kts)} = \frac{\text{Distance (m) in 1 minute}}{30}$$