

# ToD vs ToT and Sira/TYC

Steve Adkins

This is a comparison between ToD and ToT and how it would impact Sira/TYC. It is mostly based on Sira/TYC historical data and is meant to get a feel for the difference and give some Idea as to how Sira/TYC would be impacted if we moved to ToT.

## The questions:

The need for ToT

ToT Parameters

How will ToT/ToD impact the Racers ability to keep track of his on-course progress wrt the competition?

How will ToT/ToD impact the finish Position (Place)?

~~How will ToT/ToD impact the competitiveness?~~

How will ToT/ToD impact the complexity of the Committee boat job. and scoring?

**If you only read one page of this document read Page 2 and study the plots.**

To start, **the Formulas**

**ToD Finish Time** = Finish Time + ToD Hdcp \* Distance

**ToT Finish Time** = Finish Time \* ToT Hdcp

ToT Hdcp = SF / (CF + ToD Hdcp)

ToD Hdcp as issued by NB PHRF

SF = ToT Scaling Factor, referred to as Parameter "A" in most of the online Documentation. **It has no impact on how the boats Place.** It is often used to min Fleet Spread (Base Boat + CF). "It is used to make the numbers look nice."

CF = ToT Conversion Factor to ToD, referred to as Parameter "B" in most of the online Documentation.

## Of Particular Note

Correction increases as boat speed decreases. (ToT corrects for variation in Wind)

Note ToD favors slower boats as speed Increases and Faster boats as speed decreases.

Lower CF adds more correction to Slower boats. (Increasing CF favors faster Boats).

ToT reduces the **spread** of the corrected finish times.

ToT is recommended for fleets with large PHRF Spreads.

ToT is not recommended for very long races.

## The Need for ToT

ToD is based solely on distance. The correction added never changes. However, as the time it takes to complete a race increases the time delta between boats is expected to increase.

Here is a very simplified example with 2 cases. In all cases the distance is always the same.

**Case 1**, Base Boat and boat A that is 0.1 Knot faster.

With Base Boat = 4 kts, boat A = 4.1 knots. In a 5 mile course, boat A would finish 110 Sec before the Base Boat.

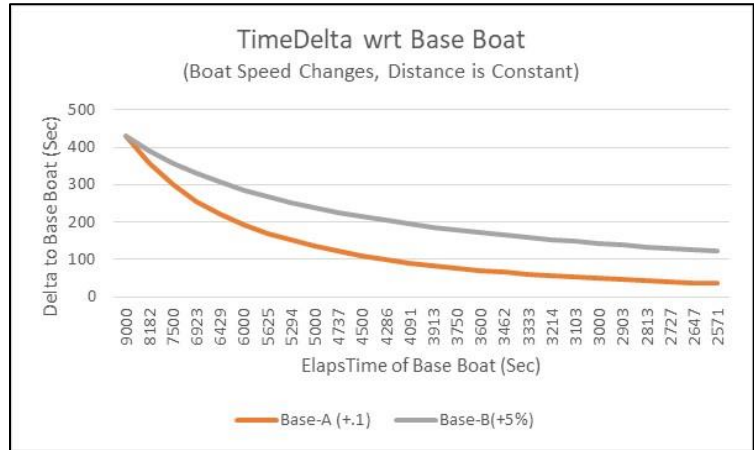
With Base boat = 5 kts, boat A = 5.1 knots. In a 5 mile course, boat A would finish 71 Sec before the Base Boat.

**Case 2**, Base Boat and boat B that is 5% faster.

With Base Boat = 4 kts, boat B = 4.2 knots. In a 5 mile course, boat A would finish 214 Sec before the Base boat.

With Base boat = 5 kts, boat A = 5.25 knots. In a 5 mile course, boat A would finish 171 Sec before the Base boat.

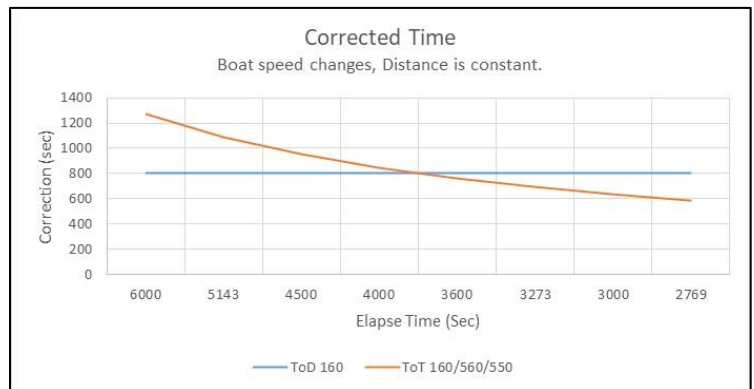
In each of these cases as the Boat speed increases the Delta between the boats decreases.



Here is a comparison between ToD and ToT. ToD is constant. It never changes, no matter how long the race takes.

Whereas with ToT the Correction increases as Time increases (boat speed Decreases).

ToT is a "little" better representation of the real world.



## ToT Parameters.

There is a lot of consensus as to how to set CF in the Online Documentation. There is also some disparity in the recommended values.

	SF	CF			
		Heavy	Avg	Light	
US Sailing Off Score Racing	650	480	550	600	<a href="https://www.ussailing.org/competition/offshore/phrf/">https://www.ussailing.org/competition/offshore/phrf/</a>
PHRF NB	650		550		<a href="https://www.phrf-nb.org/sites/default/files/racersguide.pdf">https://www.phrf-nb.org/sites/default/files/racersguide.pdf</a> <a href="https://www.phrf-nb.org/sites/default/files/timeontimeoverview.pdf">https://www.phrf-nb.org/sites/default/files/timeontimeoverview.pdf</a>
PHRF NE	650	480	550	600	<a href="http://www.phrfne.org/page/handicapping/timeontime">http://www.phrfne.org/page/handicapping/timeontime</a>
SMSA	650	520	560	620	<a href="https://www.smsa.com/Race/2018/Information/SMSA%20TOT%20scoring.pdf">https://www.smsa.com/Race/2018/Information/SMSA%20TOT%20scoring.pdf</a>
PHRF – LO	566		401		<a href="https://www.ussailing.org/wp-content/uploads/2018/01/Time-on-Time-by-Bob-Porter.ppsx">https://www.ussailing.org/wp-content/uploads/2018/01/Time-on-Time-by-Bob-Porter.ppsx</a>
SPSC	600		600		<a href="https://www.southportsailingclub.com/PDF/time_on_time_comparison.pdf">https://www.southportsailingclub.com/PDF/time_on_time_comparison.pdf</a>
PHRF-CB	650		550		<a href="http://www.phrfchesbay.org/page/organization/fleet_policies">http://www.phrfchesbay.org/page/organization/fleet_policies</a>
PHRF-NC	650		550		<a href="http://www.ncphrf.com/timeontime.html">http://www.ncphrf.com/timeontime.html</a>
Sira/TYC	650		550		

In general it is recommended to set CF based on the “0” boat (or Base Boat).

Set CF = (Time Base Boat sails 1 nm) - (Base Boat PHRF)

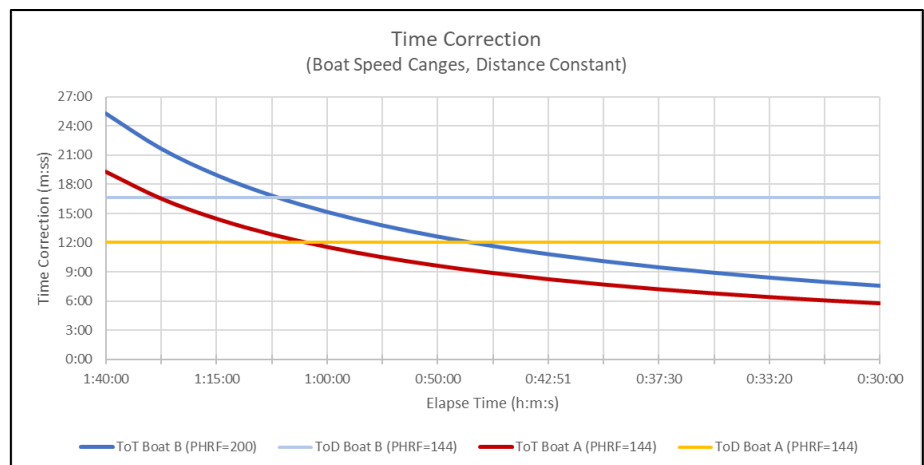
Assuming the Base boat has a PHRF of 100 and the average Windspeed is 10-15knts (Time Base Boat sails 1 nm = 650 Sec then CF =650 -100 = 550.

SF is then set to make the numbers look nice. **One option is to set SF = CF + Base boat PHRF (SF = 550 +100 = 650).** Another Recommendation would be to set SF so that the base Boat ToT correction = ToD correction at the Ideal conditions.

For Sira/TYC the average PHRF is 160. The average Boat Speed is 4.4 Kts. And, the average Wind Speed is 11 kts. (Base on the Sira/TYC Average from 2017 to 2022.) Based on this Recommended CF would be 662. If we set SF at 598 then the Base boat ToT correction = Base Boat ToD Correction at a boat speed of 5knts.

**My Recommendation would be to continue to use CF = 550 and set SF = 560.** Changing SF to 560 would have no impact on how boats place, but it would make the ToT correction closer to ToD at an average boat speed of ~5knts.

The Plot to the right shows how the correction added changes with boat speed. The Darker Heaver Lines are **ToT**, the lighter lines are **ToD**, Blue is a boat with PHRF = 144, Orange is a boat with PHRF = 200. Note, the **ToD Correction is constant**, it does not change. The **ToT correction decrease as the boat speed increases**. This is one of the promoted/desired benefits of ToT.



(Note the Nomenclature of the ToT line names HDCP/SF/CF).

## Impact of ToT/ToD on the Racers ability to keep track of his on-course progress

**With ToD** the Correction is simple. It is based on the delta between your handicap and your competitor's handicap. It can be calculated once at the start or prior and does not change during the race. Also, with ToD the Correction is added to the time (whereas ToT is multiplied).

$$\text{ToD Finish Time} = \text{Finish Time} + \text{ToD Hdcp} * \text{Distance}$$

$$\text{Finish Time Margin} = (\text{Your Hdcp} - \text{Competitors Hdcp}) * \text{Distance}$$

If at any point in the race you are better than the Finish Time Margin you are winning.

**With ToT** the true correction cannot be calculated until the Race is finished. The Time Margin changes as the race progresses.

$$\text{ToT Finish Time} = \text{Finish Time} * \text{ToT Hdcp}$$

However, there are ways to estimate the Time Margin during the race. **The Simplest Easies way** is to create a **lookup table beforehand**. Here is an example for Karinosa that covers the "B" Fleet, Summer 1 and 2.

At 50 Min into a Race, Karinosa flying Spinnaker needs to be 3:27 in front of Twinkle Twinkle racing non-Spinnaker.

Your Boat	PHRF											SF	560		
Karinosa	145	Jezebel		Andiamo		Audacious		Wicked		Faith		Twinkle Twinkle		Sea Haven	
PHRF	132	144	138	154	140	154	141	158	167	173	174	193	177	190	
Elapse Time	Time Margin														
30	-00:34	-00:03	-00:18	00:23	-00:13	00:23	-00:10	00:34	00:57	01:13	01:15	02:04	01:23	01:57	
40	-00:45	-00:03	-00:24	00:31	-00:17	00:31	-00:14	00:45	01:16	01:37	01:40	02:46	01:51	02:35	
50	-00:56	-00:04	-00:30	00:39	-00:22	00:39	-00:17	00:56	01:35	02:01	02:05	03:27	02:18	03:14	
60	-01:07	-00:05	-00:36	00:47	-00:26	00:47	-00:21	01:07	01:54	02:25	02:30	04:09	02:46	03:53	
70	-01:19	-00:06	-00:42	00:54	-00:30	00:54	-00:24	01:19	02:13	02:49	02:55	04:50	03:13	04:32	
80	-01:30	-00:07	-00:48	01:02	-00:35	01:02	-00:28	01:30	02:32	03:13	03:20	05:32	03:41	05:11	
90	-01:41	-00:08	-00:54	01:10	-00:39	01:10	-00:31	01:41	02:51	03:38	03:45	06:13	04:09	05:50	
100	-01:52	-00:09	-01:00	01:18	-00:43	01:18	-00:35	01:52	03:10	04:02	04:10	06:54	04:36	06:28	
110	-02:03	-00:09	-01:06	01:25	-00:47	01:25	-00:38	02:03	03:29	04:26	04:35	07:36	05:04	07:07	
120	-02:15	-00:10	-01:13	01:33	-00:52	01:33	-00:41	02:15	03:48	04:50	05:00	08:17	05:32	07:46	

Your Boat	PHRF											SF	560		
Karinosa	161	Jezebel		Andiamo		Audacious		Wicked		Faith		Twinkle Twinkle		Sea Haven	
PHRF	132	144	138	154	140	154	141	158	167	173	174	193	177	190	
Elapse Time	Time Margin														
30	-00:34	-00:03	-00:18	00:23	-00:13	00:23	-00:10	00:34	00:57	01:13	01:15	02:04	01:23	01:57	
40	-00:45	-00:03	-00:24	00:31	-00:17	00:31	-00:14	00:45	01:16	01:37	01:40	02:46	01:51	02:35	
50	-00:56	-00:04	-00:30	00:39	-00:22	00:39	-00:17	00:56	01:35	02:01	02:05	03:27	02:18	03:14	
60	-01:07	-00:05	-00:36	00:47	-00:26	00:47	-00:21	01:07	01:54	02:25	02:30	04:09	02:46	03:53	
70	-01:19	-00:06	-00:42	00:54	-00:30	00:54	-00:24	01:19	02:13	02:49	02:55	04:50	03:13	04:32	
80	-01:30	-00:07	-00:48	01:02	-00:35	01:02	-00:28	01:30	02:32	03:13	03:20	05:32	03:41	05:11	
90	-01:41	-00:08	-00:54	01:10	-00:39	01:10	-00:31	01:41	02:51	03:38	03:45	06:13	04:09	05:50	
100	-01:52	-00:09	-01:00	01:18	-00:43	01:18	-00:35	01:52	03:10	04:02	04:10	06:54	04:36	06:28	
110	-02:03	-00:09	-01:06	01:25	-00:47	01:25	-00:38	02:03	03:29	04:26	04:35	07:36	05:04	07:07	
120	-02:15	-00:10	-01:13	01:33	-00:52	01:33	-00:41	02:15	03:48	04:50	05:00	08:17	05:32	07:46	

The Above Table is an embedded Excel spread sheet with Formulas. Double click and make changes for you boat and your Competitors.

### The Impact on the Finish position (Place).

Below is a summary of the impact on Finish position (Place) as a result of switching from ToD to ToT for all the races between 2018 and 2021. In general, about 90% of the time the racers would Place the same using ToD as they would using ToT and the Top 3 would stay the same 98% of the time. Changing from ToD to ToT would have minimal impact on the End-of-Season Awards.

Year	A	B	C	D	Graves	Spin	NonSpin	Total
2018	90.2% (6)	85.5% (11)				84% (8)	96.9% (2)	98% (27)
2019	96.7% (2)	96.2% (2)				87.1% (4)		94.1% (8)
2020	81.4% (11)	90.3% (7)	84.6% (8)			82.1% (7)	96.7% (5)	93.3% (38)
2021	91.4% (5)	94.4% (2)		91.3% (2)	90.5% (2)	75.9% (14)		90.3% (25)
<b>Total</b>	89.9% (24)	90.7% (22)	94.9% (8)	97.6% (2)	90.5% (2)	81.5% (33)	92% (7)	90.2% (98)
								90.2% (196)

One that I thought was particularly interesting was the Graves in 2021 Summer 1 Race 2. They switched Place based on ToD vs ToT. Vela and October are both Graves Constellation with small difference that result in a small difference in Handicap (The difference in NB PHRF HDCP-SP is 6 Sec).

In this case it was a 3-mile Race that took about 1 hr. 12 min (wind SSW at 5, course shortened). A slow short race. Vela finished 27 Sec in front of October. Based on ToD Vela beat October by 9 sec but based on ToT October beat Vela by 8 sec.

### 2021 Summer 1 Race 2 Graves Fleet - Wind SSW 5, Course 11 Shortened

Boat	Boat Model	Spin	HDCP	Distance	Elapsed Time	ToD -Elapsed Time	SF	CF	ToT Elapsed Time
October	Graves Constellation	X	186	2.95	1:12:26	1:03:17	694	550	1:08:18
Vela	Graves Constellation	X	180	2.95	1:11:59	1:03:08	694	550	1:08:26
Delta					0:00:27	0:00:09			0:00:08

Since this race was interesting and these boats are very similar boats with small difference, I thought I would use it to show the impact of a change in speed for a couple different scenarios. We will keep the course distance the same and increase the average boat speed. In both example we would have 3 cases. Case 1: average boat speed of approximately 3 Knots, as in the original race. Case 2: average boat speed of approximately 4 Knots. And, Case 3: average boat speed of approximately 5 Knots.

In Example 1 we will change the speed, but keep the finish time Delta the same.

**Example 1 - Increased speed, Keep the Finish Time Delta Constant**

Boat	Boat Model	Spin	HDCP	Distance	Elapsed Time	ToD -Elapsed Time	SF	CF	ToT Elapsed Time
October	Graves Constellation	X	186	2.95	1:12:26	1:03:17	694	550	1:08:18
Vela	Graves Constellation	X	180	2.95	1:11:59	1:03:08	694	550	1:08:26
Delta					0:00:27	0:00:09			0:00:08
October	Graves Constellation	X	186	2.95	0:55:26	0:46:17	694	550	0:52:16
Vela	Graves Constellation	X	180	2.95	0:54:59	0:46:08	694	550	0:52:16
Delta					0:00:27	0:00:09			0:00:00
October	Graves Constellation	X	186	2.95	0:38:26	0:29:17	694	550	0:36:14
Vela	Graves Constellation	X	180	2.95	0:37:59	0:29:08	694	550	0:36:07
Delta					0:00:27	0:00:09			0:00:08

This scenario would **not** be the norm since we would expect the finish time Delta to decrease as speed increases, but **this is the scenario ToD corrects for**. In this scenario the ToD elapsed time delta does not change as speed changes, but the ToT elapsed time delta will, shifting the advantage toward the faster boat as speed increases. Again, this is **not** how we expect the finish time delta to behave.

In Example 2 we will change the speed, but also change the finish time Delta to correspond with the change in Speed.

**Example 2 - Increased speed, reduce Time delta**

Boat	Boat Model	Spin	HDCP	Distance	Elapsed Time	ToD -Elapsed Time	SF	CF	ToT Elapsed Time
October	Graves Constellation	X	186	2.95	1:12:26	1:03:17	694	550	1:08:18
Vela	Graves Constellation	X	180	2.95	1:11:59	1:03:08	694	550	1:08:26
Delta					0:00:27	0:00:09			0:00:08
October	Graves Constellation	X	186	2.95	0:55:26	0:46:17	694	550	0:52:16
Vela	Graves Constellation	X	180	2.95	0:55:08	0:46:17	694	550	0:52:25
Delta					0:00:18	0:00:01			0:00:08
October	Graves Constellation	X	186	2.95	0:38:26	0:29:17	694	550	0:36:14
Vela	Graves Constellation	X	180	2.95	0:38:16	0:29:25	694	550	0:36:23
Delta					0:00:10	0:00:08			0:00:08

This scenario **would be** the norm since we would expect the finish time Delta to decrease as speed increases. **This is the scenario ToT corrects for**. In this scenario the ToT corrected time delta would remain the same. Whereas, the ToD time delta will shift the advantage toward the slower boat as speed increases. This is the normal case and ToT corrects for it.

**Bonus Example**

We will use this race to explore one other scenario. We will keep the Distance and Speed the same, but vary the ToT parameters, SF and CF

**Example 3 - The Impact of changing SF and CF**

Boat	Boat Model	Spin	HDCP	Distance	Elapsed Time	ToD -Elapsed Time	SF	CF	ToT Elapsed Time
October	Graves Constellation	X	186	2.95	1:12:26	1:03:17	534	390	1:07:09
Vela	Graves Constellation	X	180	2.95	1:11:59	1:03:08	534	390	1:07:26
Delta					0:00:27	0:00:09			0:00:17
October	Graves Constellation	X	186	2.95	1:12:26	1:03:17	694	550	1:08:18
Vela	Graves Constellation	X	180	2.95	1:11:59	1:03:08	694	550	1:08:26
Delta					0:00:27	0:00:09			0:00:08
October	Graves Constellation	X	186	2.95	1:12:26	1:03:17	924	780	1:09:17
Vela	Graves Constellation	X	180	2.95	1:11:59	1:03:08	924	780	1:09:17
Delta					0:00:27	0:00:09			0:00:00

SF will impact the finish time, but it will not impact the place. It can be used to correct to a reference boat. If we set  $SF = CF + 144$  then ToT will correct all times to a range that corresponds to a boat with a HDCP = 144. CF will impact the Place. As CF increases the advantage shift to the Faster Boat.

### **Impact of ToT/ToD impact on the Committee boat job. and scoring.**

With ToT distance is not important. There is no longer a need to keep track of distance in a race. This also means that it is possible shorten a race or to change a course at any point without having to recalculate the distance. ToT would make it possible to shorten the course at any point.

Elapsed time becomes very important. There are 2 ways to get this. Record both the Start and Finish times **or** use a timer. Timers can be problematic; reliability, operation, access, .... I would recommend recording the start and finish times and if possible, use GPS time.

ToT would make the Race Committee, Committee Boat, and Scorers job easier.





**NB PHRF** does provide a method to estimate on course progress wrt the competition. Their explanation was a little confusing and their example does not quite work. But based on their process we were able to figure out the correct formula and recreate a Table that does work. Here are the Formulas.

**ToD Hdcp** as issued by NB PHRF

**ToT Hdcp** = SF / (CF + ToD Hdcp)

**PHRF Delta** = ToD<sub>Your Boat</sub> – ToD<sub>Competitors Boat</sub>

**ToT On Course Multiplier** = 60 \* (ToT<sub>Your Boat</sub> – ToT<sub>Competitor</sub>) / ToT<sub>Competitor</sub> in sec/minuet

To use, at any time during the race you can determine your required lead by

**Margin = Elapsed Time \* ToT On-Course Multiplier**

### Example – On Course estimation of Progress against the Competition

Boat	Boat Model	ToD HDCP	ToT Hdcp (multiple elapsed time )
Jezebel	Etchells 22	132	1.018
Wicked	J/30	141	1.004
Karinos	J/30	144	1.000
Twinkle Twinkle	J/24	174	0.959
Satori CNC	C & C 33	177	0.955

In a race with Jezebel, Wicked, Satori CnC, and Twinkle Twinkle, At 30 min into the race, Karinos needs to be

within 30 \* (1-1.018)/ 1.018 = 31 sec of Jezebel

Within 30 \* (1-1.004)/ 1.004 = 8 Sec of Wicked

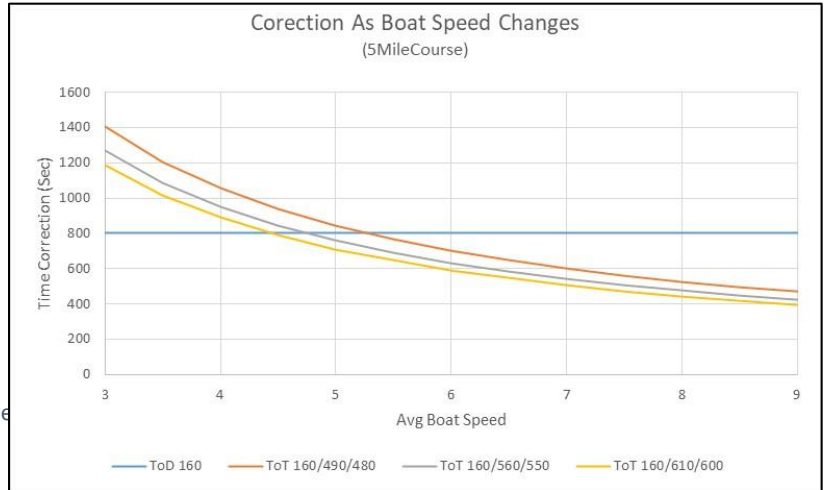
ahead of Twinkle Twinkle by 30 \* (1-0.959)/ 0.959 = 78 sec

ahead of Satori CNC by 30 \* (1-0.955)/ 0.955 = 86 sec

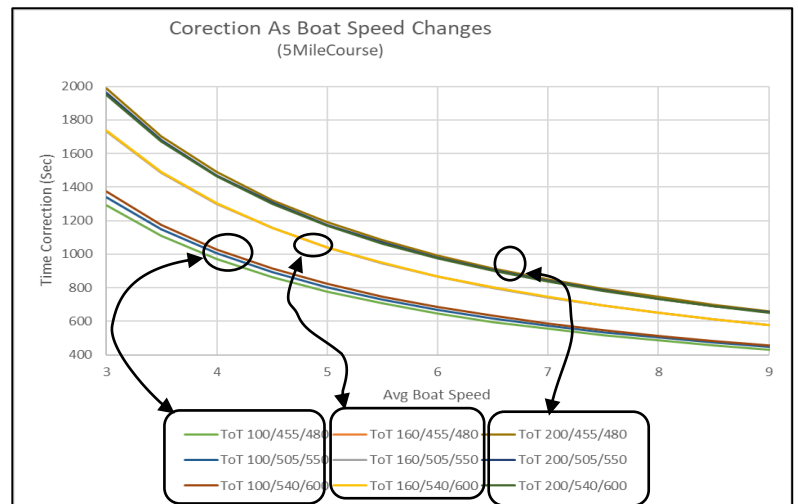
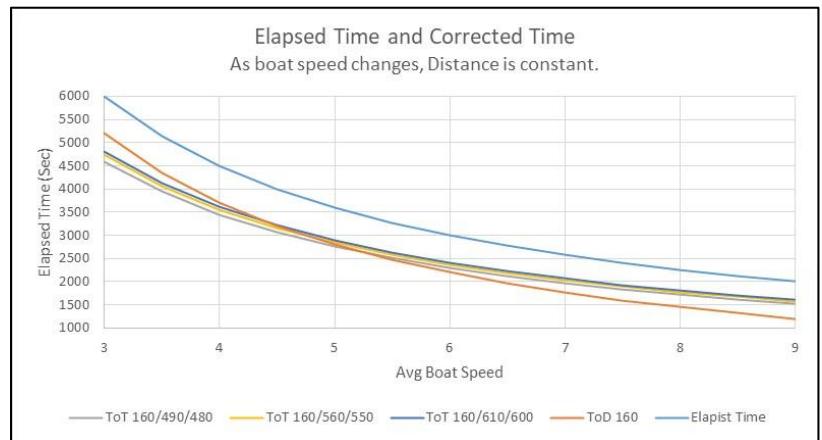
ToD is easier to keep track of the on-course progress wrt the competition. With ToD the Correction Time can be calculated once prior to the race based on distance for each Competitor. With ToT it is an ongoing process, the true correction cannot be calculated until the race is finished, and calculating an estimate on the spot can be very consuming. But, the process can be eased by creating a lookup table that covers most of the situation during the race.

**My Recommendation would be to continue to use CF = 550 and set SF = 560.** Changing SF to 560 would have no impact on how boats place, but it would make the ToT correction closer to ToD at an average boat speed of 5 knots.

The Blue line is the ToD Correction. It is constant, it does not change. The Gray line is the ToT correction for CF = 550 and SF = 560. Note, the amount of correction added decrease as the boat speed increases. This is the promoted/desired benefit of ToT

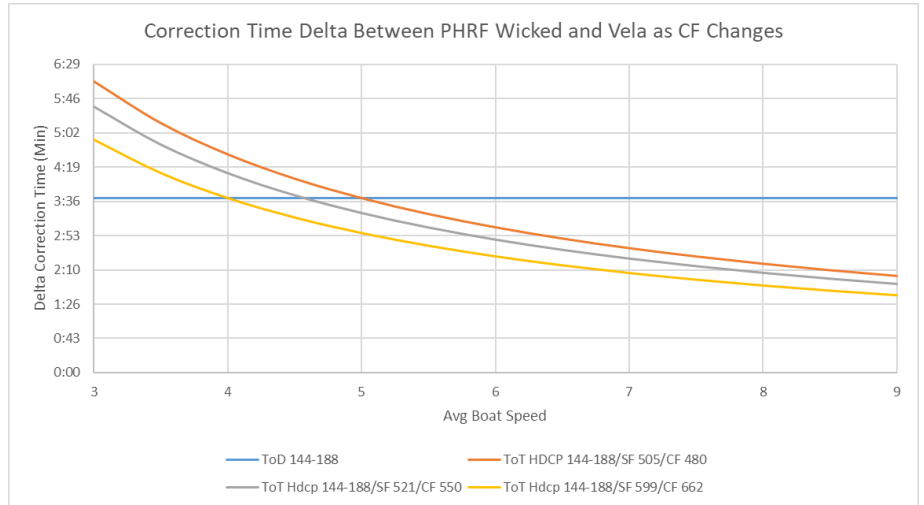


The plot to the right Shows the impact of changing CF with changing boat Speed. The first plot is the corrected time. The Blue Line is the Elapsed time, the light orange line is the ToD corrected time, and the others are the ToT corrected times. (ToT name nomenclature in the charts, ToT Hdcp/SF/CF).

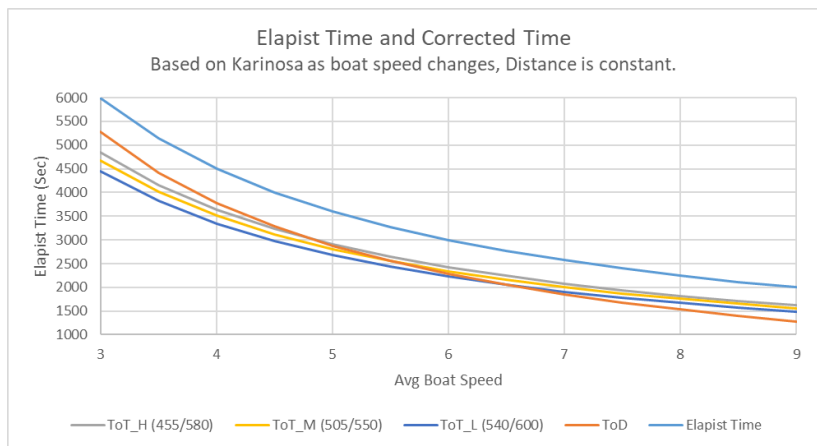


The Plot to the left shows how Delta in the correction Time between Wicked and Vela would change in a 5 mile race as the CF Changes

Note the Blue line is ToD and does not change. The Gray line is the 550 CF. Using the Gray line, we can see that at low-speed Vela would have a greater handicap, but as the speed increases the handicap difference would stat decreasing.



This is a example using Karinosa. The Distance is constant at 5 Miles. Note the delta between the Elapsed Time and the ToD Corrected time is constant. As Speed increase the ToT Corrected time gets closer to the Elapsed Time. **Less Correction as speed increases**



The second plot is the Correction that will be added to the Elapsed time. Things to note. The ToD does not change. The ToT correction decreases as speed increases.

