

## IMS TIME CORRECTIONS—TOP IMS LEVEL EVENTS

The most accurate and complete system provided by IMS to produce corrected times is the Constructed Course. This name means that the course sailed is described leg by leg (or parts of legs) taking into account the direction of the wind with regard to the direction of the course. Possibly also the wind speed.

The corrected time of each boat will be obtained from the IMPLIED WIND interpolated in their performance curve for that course, and the boat with the highest implied wind will be the winner, and the scoring will be made deriving a corrected time from the implied wind.

The IMPLIED WIND is calculated interpolating on the Performance curve, when the distance is known, and so is the elapsed time obtained in the race.

In order to obtain an implied wind that is close to the one measured on the water the course construction must be correct, and the performance predictions need to be realistic.

## IMS CONSTRUCTED COURSE EXPLANATION

### PRIOR TO RACE START: COMPARATIVE TIME ALLOWANCES

With this specific numbers we can easily adapt the VPP predictions of the certificate to the scheduled course to sail in our event.

**SCRATCH SHEET:** the Race Committee will deliver, based on the course defined in the Sailing Instructions, a sheet comparing the theoretical velocities of each boat in the different wind conditions, calculated with reference to the fastest boat (lowest GPH) of each group/class/fleet. (As shown below)

### STARTING POINT: TIME ALLOWANCES IN THE IMS CERTIFICATE

Wind Velocity:	6kt	8kt	10kt	12kt	14kt	16kt	20kt	CHECKSUM
BEAT ANGLES:	44.0°	41.7°	39.3°	37.8°	36.9°	36.4°	36.4°	( 272.5)
BEAT VMG:	918.0	784.8	722.8	690.0	671.0	660.0	653.7	( 5100.3)
R	529.3	526.7	501.3	487.3	478.6	473.2	468.1	( 3528.5)
E	557.7	504.8	483.7	471.1	462.9	457.4	451.5	( 3389.1)
A	532.8	486.8	463.3	450.2	441.2	434.7	426.4	( 3235.4)
C	536.5	483.4	459.8	441.2	427.2	417.3	406.2	( 3170.6)
H	549.8	488.7	455.4	435.0	418.5	406.6	390.1	( 3146.1)
135°	584.1	506.5	468.9	442.0	420.4	402.6	375.5	( 3200.0)
150°	700.7	561.8	502.0	467.9	441.5	418.7	379.1	( 3471.7)
RUN VMG:	854.1	671.5	568.5	509.4	474.3	447.6	403.6	( 3929.0)
GYBE ANGLES:	138.6°	142.2°	149.3°	164.4°	170.2°	173.1°	174.1°	( 1111.9)

NOTE: To convert any time allowance above to speed in knots: Kt = 3600/TA

Boat speeds in Seconds per mile  
7 wind conditions  
10 different boat courses  
Speed in knots = 3600 / Time allowance

Scratch Sheet (rel) ° ° Scoring System °  
Race Number : 01 ° ° Constructed Course °

SailNumber	Yacht	Class	GPH	6	8	10	12	14	16	20
ESP6336	ZURICH	B 2	595.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESP6262	FORUM FILATELICO	B 2	595.1	0.1	-0.6	-0.7	-0.4	-0.2	0.0	0.5
ESP6326	RETEVISION	B 2	595.5	-5.1	-2.2	-3.5	-2.2	-0.1	2.1	4.8
ESP5855	TELEFONICA MOVISTAR	B 2	597.0	-6.8	0.4	-0.9	0.5	2.1	3.7	5.6
ESP6110	FERMAX	B 2	597.5	-4.3	-0.6	-2.2	-0.5	1.9	4.3	7.7
ESP6125	ONO	B 2	598.3	0.7	0.6	-1.5	0.2	2.5	4.9	8.0
ESP6367	ICUE DOS CEMENTOS ESFERA	B 2	634.8	63.0	47.9	37.3	33.5	34.7	36.5	38.7

This Sheet is generated using the vector calculated as it is explained in 1 to 3 below, with the expected theoretical wind angles.  
This information should be published on the Official Notice Board and made available to competitors prior to the start of the races. The reference boat can be changed in the printout.

### DURING THE RACE: WIND DIRECTION MEASUREMENTS

EXPECTED WIND



**TRUE WIND DIRECTION:** The Race Committee takes readings of the wind direction in the race area (bearing and optionally also speed).  
**LENGTH of legs:** RC checks the distance and bearing between marks.

Once this data has been collected it's decided the LEGS in which the COURSE is divided

Leg	distance	course bearing (°)	wind bearing (°)
Beating leg 1	2.23	170	180
Running leg 2	2.00	350	180
Beating part-leg 3	0.97	170	170
Beating part-leg 4	1.03	170	185
Running part-leg 5	1.03	350	185
Running part-leg 6	1.17	350	170

Total length = 8.43 (miles)

**1st step:** Calculation of real bearing of the leg (difference between leg and wind bearing). Depending on this value, the following criteria to obtain the expected times are applied, knowing that Nt is the distance in miles of every leg:

- If 0, distance (Nt miles) multiplied by Beat VMG value
- If bearing between 0 and Beat Angle,  $Nt * \text{Beat VMG}$  is divided by  $\text{Cos}(\text{angle})$
- If bearing is bigger than Beat Angle,  $(\text{Interpolation between Beat VMG}-52°) * Nt$
- If coincident with certificate value, is multiplied by Nt
- If other angles:  $(\text{Lagrange Interpolation between nearest fixed angles}) * Nt$
- If bearing bigger than Gyb Angle,  $Nt * \text{Run VMG}$  is divided by  $\text{Cos}(\text{angle})$

### AFTER THE FINISH: CALCULATION OF IMPLIED WIND

**2nd Step:** Once completed the former calculation, a table is obtained for EACH BOAT with her own expected times for every leg with every wind speed:

Leg	Course B. (°)	Wind B. (°)	diff.	6kt	8kt	10kt	12kt	14kt	16kt	20kt
1	170	180	10	1947.74 sec.	1708.14	1596.79	1541.89	1513.79	1497.75	1492.48
2	350	180	170	1832.92 sec.	1457.71	1231.20	1080.72	964.91	890.06	791.39
3	170	170	0	860.29 sec.	754.46	705.28	681.03	668.62	661.54	659.21
4	170	185	15	882.38 sec.	773.83	723.39	698.52	685.78	678.52	676.13
5	350	185	165	925.85 sec.	736.32	621.91	545.90	479.19	446.07	393.28
6	350	170	180	1088.80 sec.	865.91	731.36	641.97	573.18	528.72	470.10

**3rd Step:** For each wind speed, all the theoretical times are summed up and the result is divided by the total of miles to complete the course:

Leg	Length (miles)	6kt	8kt	10kt	12kt	14kt	16kt	20kt
1	2.23	1947.74 sec.	1708.14	1596.79	1541.89	1513.79	1497.75	1492.48
2	2.00	1832.92 sec.	1457.71	1231.20	1080.72	964.91	890.06	791.39
3	0.97	860.29 sec.	754.46	705.28	681.03	668.62	661.54	659.21
4	1.03	882.38 sec.	773.83	723.39	698.52	685.78	678.52	676.13
5	1.03	925.85 sec.	736.32	621.91	545.90	479.19	446.07	393.28
6	1.17	1088.80 sec.	865.91	731.36	641.97	573.18	528.72	470.10
	<b>8.43 m. total</b>	<b>894.18</b>	<b>746.90</b>	<b>665.47</b>	<b>615.66</b>	<b>579.53</b>	<b>557.85</b>	<b>531.74</b>

A 7 figures vector is obtained defining theoretical speeds that the boat should have reached in case a 100% performance for each wind speed is obtained, as calculated by the IMS VPP.

### AFTER THE FINISH: CALCULATION OF IMPLIED WIND

**4th Step:** Elapsed time is calculated, subtracting the starting from the finish time. This time is translated into seconds and it is divided by the total length in miles of the real course (this data is delivered by the Race Committee).

The real boat's speed in sec/mi in the race is obtained:

Starting time: 11:23:00      Elapsed time in seconds: 6327  
 Finishing time: 13:08:27      miles: 8.43  
 Elapsed time: 01:45:27      **speed during the race (secs / mile): 750.534**

**5th Step:** At the end, a cubic spline (the same used in other IMS calculations) operates the vector obtained in Step 3, in order to extract the wind speed that would match to the speed of the boat to complete the course:

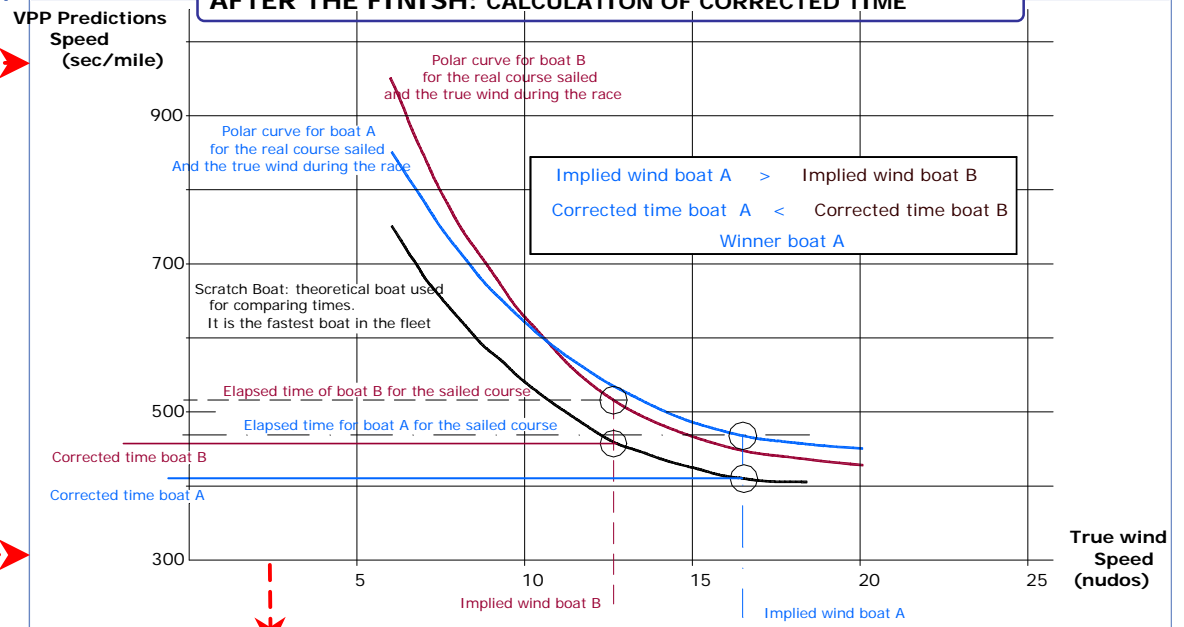
**750.534 sec/mi » 7.93 knots**

In this case, the obtained speed of 750.534 sec/mi is interpolated between the 6 and 8 knots true wind columns. The value obtained is 7.93 knots.

This wind speed is known as the **IMPLIED WIND**, that the boat has got to sail the course set by the Race Committee in the real wind conditions found (angle of wind with regard to each leg course bearing).

3rd Step

### AFTER THE FINISH: PREDICTION OF CORRECTED TIME



With this wind the CORRECTED TIME is calculated, according to the method described on the graphic chart above, which shows an example with two theoretical boats, A and B.

**1st Step:** The elapsed time of each boat is taken from the vertical axis toward its polar curve, and then to the horizontal axis to get its IMPLIED WIND.

**2nd Step:** This data is carried on the SCRATCH BOAT's curve (the fastest boat of the fleet in GPH terms). The Corrected time for the Scratch Boat will be the same as its Elapsed Time.

**3rd Step:** From the Scratch boat's polar curve the vertical axis is intersected to obtain the Elapsed Time for each boat. Usually the Scratch boat is the fastest boat in the race, but not necessarily has the highest Implied Wind, which determines the winner of the race.

### RESULTS: CLASSIFICATIONS AND ADDITIONAL INFORMATION

All these calculations are performed in the race scoring program, and once they are checked, they are posted on Official Notice Board.

In this example, a column has been added to show the IW (Implied Wind) of each boat, in order to make easier to check the relationship between Implied Wind and Corrected Time, but usually this column is not shown on the results sheet.

Pos	SailNr.	Yacht	Type	Class	Finishing Time	Elapsed Time	Corrected	IW	Obs	Points
1	ESP6326	RETEVISION	SINERGIA 40	B 2	16:14:40	01:24:40	00:00:00	17.75932		1.00
2	ESP6262	FORUM FILATELICO	B&C 41	B 2	16:14:13	01:24:13	00:00:03	17.70451		2.00
3	ESP6110	FERMAX	SINERGIA 40	B 2	16:15:43	01:25:43	00:00:40	17.12622		3.00
4	ESP6336	ZURICH	B&C 41	B 2	16:15:02	01:25:02	00:00:49	16.99601		4.00
5	ESP5855	TELEFONICA MOVISTAR	IMX 40	B 2	16:15:42	01:25:42	00:00:50	16.99265		5.00
8	ESP6125	ONO	SINERGIA 40	B 2	16:17:23	01:27:23	00:02:15	15.87554		8.00
13	ESP6367	ICUE DOS CEMENTOS ESPERA	FIRST 36.7	B 2	16:23:56	01:33:56	00:03:48	14.89589		12.00

### COURSES

Class	Starting Time	Course Number
2	14:50:00	02

Length	Bear.	Bear.	Speed	Bearing	Speed
Leg Course	Wind	Wind	Current	Curr.	
1.00	213.0	205.0	0.0	0.0	
1.21	213.0	210.0	0.0	0.0	
0.85	90.0	210.0	0.0	0.0	
1.97	29.0	210.0	0.0	0.0	
1.97	209.0	210.0	0.0	0.0	
2.27	28.0	210.0	0.0	0.0	

Distance 9.27

Scratch Sheet (abs)      Scoring System  
 Race Number : 01      Constructed Course

To make possible to check the correct application of the constructed course, legs and wind bearing for each of them, the Race Committee should publish the **CONSTRUCTED COURSE** applied after each race.

Moreover, the absolute Scratch Sheet may not be the same as the one published before the race, because the effect of the real wind conditions encountered in the race may cause some differences. For this reason they need to be published.

SailNr.	Yacht	Class	GPH	6	8	10	12	14	16	20
ESP6336	ZURICH	B 2	595.0	939.6	772.1	683.4	624.8	585.3	559.6	530.5
ESP6262	FORUM FILATELICO	B 2	595.1	939.8	771.5	682.7	624.4	585.2	559.6	531.0
ESP6326	RETEVISION	B 2	595.5	934.5	769.9	679.9	622.6	585.2	561.6	535.4
ESP5855	TELEFONICA MOVISTAR	B 2	597.0	932.8	772.5	682.5	625.2	587.4	563.2	536.1
ESP6110	FERMAX	B 2	597.5	935.3	771.5	681.2	624.3	587.2	563.9	538.2
ESP6125	ONO	B 2	598.3	940.3	772.7	681.9	625.0	587.8	564.4	538.5
ESP6367	ICUE DOS CEMENTOS ESPERA	B 2	634.8	1002.6	820.0	720.7	658.2	620.1	596.1	569.2