

## 25.08: Survey

### a) General

1. A 3-point survey/stations or a 1-point survey/station with laser range finder survey or an approved RTK- GPS System are the only acceptable methods to verify a course for L or R competitions.
2. For a 1-point survey/station, angle only spot checks from a second position are recommended.
3. For a 3-point survey, the maximum size acceptable triangle is one with an inscribed circle diameter of 10cm. If the diameter is greater than 10cm, one vertex may be used if it agrees with an alignment sighting.
4. The surveying instrument must have an accuracy of 20 seconds or better.

### b) Slalom

1. Individual Anchor Slalom Courses must be surveyed (full survey) within 90 days of the event and validated (G1 – G4 and S1 – S6) by the homologator within 3 days of the event. It is the responsibility of the homologator to ensure that the buoys have not moved prior to the event. If there is any doubt the homologator should make another full survey prior to the event.
2. A floating cable slalom course (approved single line, four-line, cross course) must be surveyed (full survey) within 10 days of the event and validated (G1 – G4 and S1 – S6) by the homologator within 3 days of the event. It is the responsibility of the homologator to ensure that the buoys have not moved prior to the event. If there is any doubt the homologator should make another full survey prior to the event.
3. The centreline is a line from the middle of the entry gates to the middle of the exit gates.
4. Each boat guide (B1...B12) has a width (distance from centreline/axis) tolerance of +/-11.5 cm, but the left side (B2,B4,B6,B8,B10,B12) and the right side (B1,B3,B5,B7,B9,B11) must each be visually straight. To ensure that each side is straight, it is recommended that each individual boat guide distance/width from the centreline/axis (1.15) is within 4cm of the average boat guide distance/width for that side.  
(Example: Axis-B1=1.15, B3=1.16, B5=1.12, B7=1.18, B9=1.15, B11=1.17; Avg.=1.155 (Meets requirements))
5. To ensure that the visual centreline (axis), as seen from the boat guides, is equal to the calculated centreline (axis), the difference between the average boat guide width on each side should not be more than 4cm.  
(Example: Axis B1-B11 Avg =1.155; Axis B2 -B12 Avg=1.20 (Does not meet requirement)).

### c) Jump

1. A jump course must be surveyed (full survey) within 10 days of the event and validated by the homologator within 3 days of the event. It is the responsibility of the homologator to ensure that the buoys have not moved prior to the event. If there is any doubt the homologator should make another full survey.
2. The Jump axis is a straight line, passing through the ramp centre, which is parallel to the line of buoys 15ST-15MT.
3. The boat path centreline is a line from the middle of the 15ST/19ST gates to the middle of the 15ET/19ET gates.
4. 4m buoy tolerance  
It is recommended that the 4m buoy width (15ST-19ST, 15MT-19MT, 15ET-19ET, and 15EC-19EC) is between 3.95m and 4.05m
5. Video Measurement system  
The video measurement systems must be configured in a fashion so that the maximum differential in jump distances which would result from one-pixel movements on the video screen, either of

any of the required reference point markers or of the landing point marker itself, and in either the horizontal or vertical direction should not exceed the following values at any point in the "operating field of view", which means the central 80% of the screen area. This criterion value depends on the class of the tournament, as follows:

- i) "R" events 10 cm.
- ii) "L" or lower-class events 15 cm.

Any existing video setup can be evaluated against this standard by testing actual movements of the reference markers and landing point markers and observing the reported changes in the calculated landing location which results from such movements between adjacent pixels. Such manual evaluations need to be systematically conducted throughout the expected operating range of the setup."

## 25.09: Boat Path Monitoring System (BPMS)

### a) General

1. Verification of RTK-GPS BPMS systems by the Homologator shall take place before the competition starts. It should be performed within 7 days of the competition (recommended the day before). The verification may be repeated during the competition if the Officials believe it is necessary. The Homologator or designee shall homologate the RTK-GPS BPMS system by verifying that the system is setup per the manufacturer's recommendations and these guidelines.

### b) Slalom

1. The Homologator must establish the centreline by plotting the entry and exit gates (G1,G2,G3,G4) using the RTK-GPS Antenna and verify centreline. Further, it is recommended that S1 and S6 are plotted and compared to the official survey to identify any errors in setup.
2. The Homologator must validate the setup by comparing the BPMS measurements to the Official Survey. This comparison may be completed manually or automatically using WaterSkiConnect. The differences between the RTK-GPS Setup and the Official Survey must not exceed the following tolerances:
  - a) Centreline (Axe) – G1 / G2: +/- 3cm
  - b) Centreline (Axe) – G3 / G4: +/- 3cm
  - c) G1 – G3: +/- 10cm
  - d) G2 – G4: +/- 10cm
  - e) Centreline (Axe) – S1 / S6: +/- 4cm
3. The Homologator and driver shall verify the centreline by driving through the course on the right-hand side, in each direction, and verify that the displayed deviations in each direction are similar.
4. During the tournament, the Homologator may need to re-validate as necessary depending on conditions. A re-validation check to ensure the course has not moved can be accomplished by rechecking at least one buoy at each end of the course (i.e., G1 and G3), with either a survey/station or RTK-GPS and comparing the results with the last validation. Discrepancies of more than 3cm give rise to concern and further checks done to verify course accuracy.

### c) Jump

1. The Homologator must establish the boat path centreline by plotting the 15ST, 19ST, 15ET, 19ET and 180m buoys with the RTK-GPS Antenna and verify centreline.
2. The Homologator must validate the setup by comparing the BPMS measurements to the Official Survey. This comparison may be completed manually or automatically using WaterSkiConnect. The differences between the RTK-GPS Setup and the Official Survey must not exceed the following tolerances:
  - a) Width between 15ST-19ST: +/- 4cm
  - b) Width between 15ET-19ET: +/- 4cm
  - c) Distance between 15ST-15ET: +/- 10cm
  - d) Distance between 19ST-19ET: +/- 10cm
  - e) Centreline (Axe) – 180m: +/- 20cm
3. The Homologator and driver shall verify the centreline by driving through the course split +2 and a split -2 and verify that the displayed deviations are correct.
4. During the competition, the Homologator may need to re-validate as necessary depending on conditions. A re-validation check to ensure the course has not moved can be accomplished by rechecking 15ST and 19ST, with either a survey/station or RTK-GPS and comparing the results with the last validation. Discrepancies of more than 4cm give rise to concern and further checks done to verify course accuracy.

## 25.11: Boat Path Monitoring System (BPMS) Technical Requirements

### Approved BPMS

#### Video Systems

- SplashEye

#### RTK-GPS Systems

- Sure-Path

### RTK-GPS System Technical Requirements

#### GENERAL

- a. Raw Data shall be recorded at a minimum rate of 10 times per second (10Hz).
- b. Limited “smoothing” should be applied to the series of raw data points measured as the boat travels through the course. Smoothing should be applied by averaging each raw data point with its immediate predecessor. “Smoothed” data is to be used for all scoring, display, and monitoring purposes.
- c. Raw unsmoothed data points shall be retained and available for export as required.
- d. All measured deviations as described below will be rounded to the nearest centimetre.
- e. All measured deviations shall be transmitted to the WaterskiConnect server for scoring.

#### SLALOM

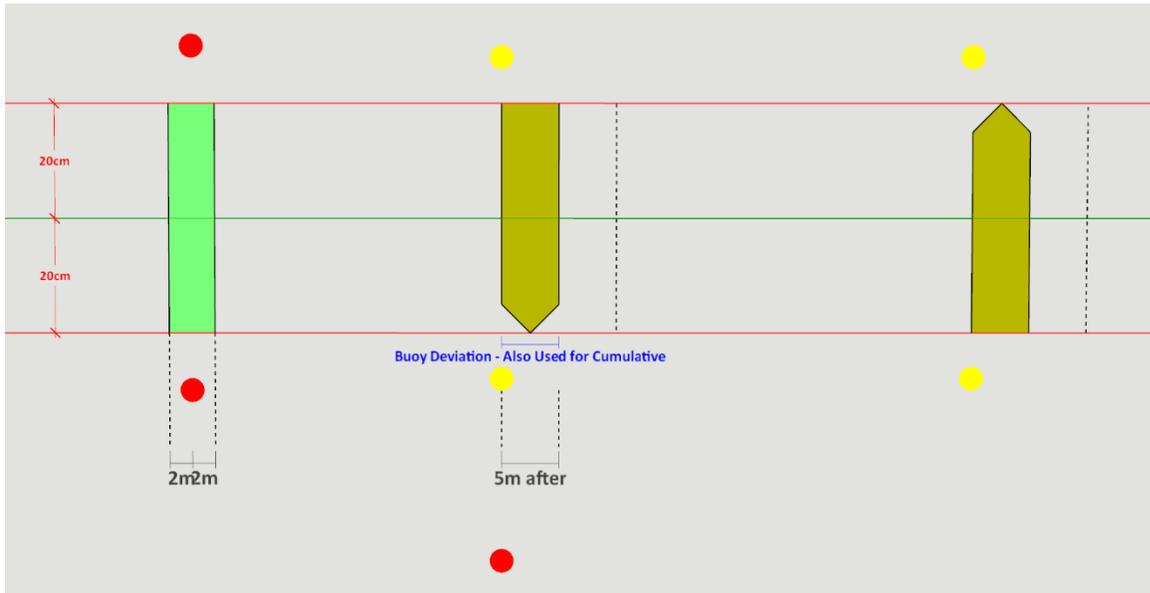
1. Deviation is measured from the Slalom Course Centreline (G1/G2 and G3/G4).
2. Slalom Buoy Deviation is defined as the reading nearest the skier, measured during the period from when the pylon is at the buoy to 5 meters after the buoy. This deviation is submitted to the scorer/judges.
3. Slalom Cumulative Deviation is defined as the arithmetic sum of the buoy deviations. This deviation is submitted to the scorer/judges.
4. Slalom Entry Gate Deviation is defined as the maximum reading from centreline measured during the period from when the pylon is 2m before to 2 meters after the gate.  
Entry Gate Deviation is not used in the cumulative deviation.  
Exit Gates are not measured for deviation.
5. Slalom Pre-Gate deviation is measured at the Pre-Gate or the first reading immediate after the pre-gate.  
Pre-Gate Deviation is not used in the cumulative deviation.
6. Zone Deviation is defined as the reading nearest the skier, measured during the period from when the pylon is 5 meters after the buoy to 10 m after the buoy. This is for driver information only and is not used for scoring.
7. For Slalom, a deviation away from the skier is Negative and a deviation towards the skier is Positive.

#### JUMP

1. JUMP boat course centreline Deviation is the deviation from the course boat centreline (15/19ST and 15/19ET). Deviations are measured at 180, ST, NT, MT, ET (or the first available reading after each point).
2. The skier may request the boat to drive a path offset from the centreline by +/- 1, 2 or 3 multiples of 30cm. Within the RTK-GPS system, deviations shall be measured and recorded from the true centreline but for scoring and display purposes, the appropriate offset shall be applied to the deviation readings.

3. For Jump, a deviation away from the JUMP is Positive and towards the JUMP is Negative.

Below is a diagram of the Slalom Gate and Buoy Deviation. A manufacturer may also provide a Zone Deviation, similar to the Buoy Deviation, in the Rover which is the reading nearest the skier during the period from when the pylon is 5 meters after the buoy to 10 meters after the buoy.



#### Video-Based BPMS Technical Requirements

1. Where practicable the deviation should be calculated at each frame within the relevant measurement zone and the single maximum recorded deviation used.
2. Where it is not practicable due to time constraints to measure at every frame a visual inspection process should determine the frame with maximum deviation and the maximum deviation should be measured from that frame.