1. INTRODUCTION/HISTORY

Water skiing was started in the USA in 1922 by Ralph Samuelson. Water skiing continued to grow and evolved into competition in the late 1940s. The Tournament Council basically performed all homologation/technical control duties as we know them today (some of the names in the late 1950 and 1960s were Bill Barlow Jr, Jim Sylvester, Ivan Pretty, Stan Parker (who invented the Johnson Meter System for jump) and a lot of others. Ref http://www.iwsf.com/history/facts.htm.)

It was not until 1976 that Homologation Rules were added to the American Water Ski Association (AWSA) Rule Book. The first Technical Controller Handbook was established in 2007 by Merle Vasbinder, Tom Dusin, Gene Davis, Dave Clark, Ed Brazil and others. Some of the current AWSA Ambassadors who helped develop the criteria/standardization and programs that we are still using today were Bob Corson (initiated MS Windows Video Jump Measuring & Trick Timing Program), Ed Brazil (Slalom End Course), Dave Clark (Scoring/Survey/Video Jump Setup Programs), Roger Dilling (Pre Gates).

It is intended that this manual be updated biannually or as needed to keep up with the latest changes and approved by the TC Committee and AWSA BOD.


Homologation (from the verb homologate, meaning to approve or confirm officially) is the certification of a product or specification to indicate that it meets regulatory standards.
2. PURPOSE

The purpose of this manual is NOT to duplicate the AWSA and/or the IWWF Rule Books but to provide an overview of the role and responsibility of the TC/Homologator. This manual provides/outlines some of the major criteria that the TC must understand and follow (Slalom 3.0, Jump 4.0, Tricks 5.0, Records 6.0). This manual is to be used in conjunction with the IWWF and AWSA Latest Rule Book. This manual may be considered a part of this Rule Book. The IWWF and AWSA Rule book is the upper tier document. Contact the AWSA TC Chairmen /Rule Committee Chairmen for any interpretations. In addition, this manual should be used with the ONLINE TC Clinic (video). Considerable information is on the AWSA Web site under TC Resources.

All IWWF World Record Tournaments (Class R), IWWF World Ranking List Tournaments (Class L) and AWSA Class E Tournaments must have a TC/Homologator who certifies that the site/tournament complies with both IWWF and AWSA rules. This Handbook along with the rule books covers all the criteria that the TC is to certify. A TC/Homologation Report must be completed and submitted certifying each tournament. The practices of copying a previous Homologation Report should be discouraged, as the Homologation Report is a Checklist to ensure that all requirements have been checked prior to the tournament.

To become a Technical Controller (TC), an individual must apply for a rating through the AWSA. A list of quantitative requirements must be completed prior to becoming a certified Technical Controller. These requirements include attendance at a Technical Controller’s clinic, in addition to completing various technical functions under the supervision of a certified technical controller. There are three levels of TC: REGULAR which allows to you to be the Chief TC for Class E only, but you should be ready to perform all the duties of the Chief TC. SENIOR TC which allows you to Chief any Class or INTERNATIONAL tournament. The next level is AMBASSADOR, a mentor to all other TCs (Reference AWSA Tech Controller Policy Manual/Application Form).

If it involves a measurement, it falls under the TC Responsibility. Your responsibility as a Technical Controller or Homologator is to ensure that all standards at your event are per the rules (equal to any other record capable tournament). The Technical Controller must be familiar with both AWSA and IWWF rules as written, record standards and their application.
The TC’s job is to measure the tournament organizer supplied site and equipment as a Homologator, not to be obligated to swim for the purpose of pulling down buoys or finding a tournament handle, shock tube, rope, etc. or bringing a truckload of equipment with all the other stuff we have, historically, been goaded into supplying.

The Technical Controller shall continue to be responsible for the certified condition of the competition courses throughout the tournament and must sign a statement (TC Report) at the conclusion of the tournament that, in his opinion, the courses were entitled to certification throughout the tournament.
3. SLALOM

3.1. SLALOM COURSE REQUIREMENTS

One of the most challenging tasks of the TC is to approve/certify that the slalom course, cameras and judging towers have been installed in accordance with the rules (Section 15.03(b)). Whatever the case, timing of the certification process is most important.

The TC must know how the course/buoys are installed, this will require getting in the water and performing an inspection (single anchor or cross line course; method of attachment - elastic installed on Gate buoys, measure height and size of the turn and gate buoys, etc.)

**Course Certification:** There are several ways in which this may be accomplished.

- Class E, L or R may be surveyed by a licensed surveyor and data submitted to the TC Chairmen for approval within the time period specified in the rule book (30 days), or
- Class E, L or R may be surveyed by an AWSA Senior TC within 90 days of the tournament and submitted with the Tournament Homologation/TC Report. IF the course was pre-surveyed, it is still the Tournament TC’s obligation to verify the accuracy of the course. Either perform a complete survey or spot checks of critical measurements and/or verify angles produced in the original survey. Or use the existing survey data and visually verifying that nothing has moved since the last survey. Either way, the method used must be documented in the TC Report.
- All CROSS-LINE COURSES should be checked by re-surveying within a few days prior to the tournament.
- Class N, I, or C tournament, certification can be as simple as using a tape measure. Measure the width of buoys 1, 2, 5, 6 with a tape and then visually sight each skier buoy line to ensure that the buoys line up. When using this method, it is also recommended that some of the distances between the gates be checked to verify the length of the course. If pre-measured polypropylene triangulation ropes are used to measure the course, they must be stretched and rechecked while still wet. When checking, the anticipated "in water" tension should be applied. Using these precautions, this method has been documented to be very accurate. (Polypropylene ropes will shrink as much as 5% if stored dry for extended periods of time.)
Survey and Survey Program: All survey data programs approved for use by the TC Committee are posted on the AWSA Website under the TC Resource Page. (These programs were written by Dave Clark, Ed Brazil, Emmanuel Lion).

Emmanuel Lion’s Survey Program is the one recommended by the AWSA TC Committee Members. It has several advantages for surveying an existing course. Using Ed Brazil’s or Dave Clark’s programs for installing courses is recommended. It is recommended that you read and have a clear understanding of all the Appendices 7.1 thru 7.8.

- Appendix 7.1 identifies the standard buoy nomenclature (2019).
- **Emmanuel Lions Homologation program/survey** uses the 4 gate buoys to determine the CL and all references are off that CL. If one of the gate buoys is out, the program may show several boat guides and turn buoys being out of tolerance, when actually it may be just one gate buoy that’s off. (Reference Appendix 7.5 and AWSA Web Site for instructions).

- A CL mark is to be placed on shore (EC Camera) and surveyed. This is very important for Cross Line course. The permanent CL mark can always be checked to ensure the 4 gates are correct before surveying the remaining buoys or making any corrections.

- **Dave Clark/Ed Brazil:** Some of the other programs, use all the boat guides, pre-gates, entry/exit gates to determine the CL. When these programs are used, and buoys are shown to be out of tolerance, it is recommended to remove the PRE GATES to determine if there is actually a problem with the internal course. Reference Appendix 7.7 and 7.8.

- **STAKEOUT (installing a course):** It is recommended to use Ed Brazil’s stakeout program. Reference Appendix 7.8. It is recommended getting 4 small weights/buoy setup and dropping those in first within 1/2m for the first 4 boat guides (excluding the gates). This gives the water crew a reference. Then install the permanent anchors. Its best to install the 12 boat guides first, having the water crew verify that the buoys are visually straight as you go. Then install Turn buoys and do any final adjustment to make sure everything is straight (visually).
Buoy: The easiest way to measure these is to fabricate a template. The rings are quite easy to make and accommodate buoys which are less than perfectly round.

- Gate and Turn buoys should be orange (red can be used, but sometimes are difficult to see under certain lighting conditions. ORANGE is best).
- The circumference (equator) of the buoy should be under the water line. (Refer to the 2019 Rule Book for the recommended minimum height and diameter: 20 cm diameter, 9-8.5cm height out of water)
- Gate/Turn buoys need to be able to move up and down with the wake (move out) for judging gates (recommend a minimum of 16 inches of elastic).
  Note: On cross-line courses where the buoy is weighted down, but travels freely up/down, it should have elastic material to allow the buoy to move out on impact, absorbing some of the impact, before actually moving the weight (5 -6 lbs.) up.
- It is best to adjust the size and height during middle to late afternoon so that the sun shining on the buoys will not cause them to “grow” at some later time.
- During this operation also check and size replacement buoys. This is also a good time to discuss with the tournament sponsor the procedure for replacing buoys that are pulled out or come loose during the event. Marking the recommended and minimum heights on the buoys makes them easy to check when replaced and during the tournament.
- Using cylindrical buoys for boat guides generally greatly reduces the number of buoys that must be replaced.
- Reference the AWSA TC Resources for Anchor and Attachment configuration (there’s basically only 2 different types used in the USA (Individual Anchors, Cross LINE), but a lot of other countries use a 4 LINE Course were the 4 lines run down the length of the lake).

- **Buoy Location:** Insure there are no obstructions within 10m (30 ft) of the turn buoy for skier safety.
3.2. JUDGES TOWER:

AWSA Rule 10.16 describes the requirements of the judges’ tower, there are several options. A judging tower is an elevated observation point that provides an unobstructed view of the slalom course, at least 3 meters (10’) above the water. This means that the platform must be 3 meters (10ft) above the water. If an observation point is located more than 100 feet back from the course centerline, it is recommended that it be elevated approximately ten percent above the water (one foot in height for each ten feet back) from the course. This is same for GATE Camera height.

- Configuration 1: Original setup- two towers at 44 deg (+/- 3 deg). With 4 judges (2 on each tower.) No GATE camera/video or Boat Camera required for Class E/L. Captured video is required for Class R because the video must be submitted if there’s a World Record. (Only has to be recorded for Class R, does not have to be transmitted to judges).

- Configuration 2: Two Center Towers, located between buoys 2 and 5, with gate camera video being transmitted to one or both towers (If only one tower, it would require a total of 3 tower judges, in lieu of only two judges). Boat Camera Video is not required for Class E/L, but Captured Boat Video would be required for Class R (World Record) but NOT required to be transmitted back to judge’s tower.

- Configuration 3: One Center Tower, with Gate Camera being transmitted to the tower. For Class E, no boat camera required. For Class L/R, the boat video must be transmitted live to the tower judges, or appointed judge. If the two tower judges have access for immediate play back, a separate boat video review judge is not required for Class L but is for Class R (2018).
3.3. HANDLE CHECKER:

It is the TC’s responsibility to ensure that there is a functional handle checker available at the starting dock to check all slalom handles.

- Verify the block to hold the handle is approx. 3 ½” wide (this is for curved handles) (cut from 2X4).
- Verify that the handle sets square on the block holding the handle.
- Verify that the markings are correct (1.50 actual and 1.525 max).
- Verify there’s a 20 Kg/44lb weight or scale available to measure handles.
- If a handle is found out of tolerance, it will be the TC’s responsibility to reverify the handle is out as described under Handle section above. The TC should ensure that the handle checker has not changed (correct) prior to declaring a handle is out of tolerance.

3.4. HANDLES:

It’s not the TC responsibility to verify skier handles. It is the responsibility of the TC to re-check a handle if an official has declared that it is out of tolerance after skiing (the TC should re-check the handle checker to ensure that it has not changed).

- Tournament supplied handle tolerance +/- 2.5 cm. (1 inch) minimum length is 1.475m and should not be longer than 1.5m.
- Also check the tournament supplied handle for being square, i.e., the grip forms a 90-degree angle with the tow section. Check that the rubber grip on the handle is secure and does not give or slip when twisted.
- Skier supplied handle, minimum is 1.400m
- Skier supplied handle before skiing SHOULD NOT be more than 1.50m and can NOT be longer than 1.525m after skiing.
- NOTE: A handle can stretch up to 1.3 cm (½”) pending on material and heat.
- If a handle is found out of tolerance, it will be the TC’s responsibility to reverify the handle is out of tolerance before skier is scored 0 (should recheck handle checker to ensure that it is still correct).
3.5. SLALOM ROPES:

It’s the TC Responsibility to verify (measure/inspect) all slalom ropes and tournament supplied handles.

- Ref AWSA and IWWF Rule book for specification for Slalom/Jump Line. This is one of the things that is impossible to verify. This has to be verified by the rope manufacture.
- Ref Appendix 7.10 for example of test reports for ropes.
- Use a metric tape and metric measurements to verify rope. You will find the task much easier.
- Verify that they are of the same manufacturer/supplier and model that will be used for each specific division. It is the TC’s responsibility to ensure the correct ropes are being used for the applicable division. Example: The MID Rope is a 12-strand rope (with 60-strands) that meets the AWSA Rope Specification requirement, but it is not to be used along with an 16 strand rope (80-strands) in the same division, unless requested.
- It is recommended that a tournament rope be skied with just prior to the tournament, then checked. It is recommended waiting approximately 30 minutes after a rope has been skied on before checking.
- Pulling ropes between cars and trees does NOT help. It needs to be wet and skied on.
- It takes about a 15 to 20-inch length of 80 strand rope inserted inside an 80-strand ski rope to shorten the ski rope approx. 1”.
- All ropes should be inspected very carefully for wear and tear and compliance with AWSA specifications. Look for broken strands, fraying around the splices, the length of the splices, and general wear in the take-off loop area. Also check the handle section attachment end for wear and fraying.
- Slalom Ropes should be replaced after each tournament. A slalom rope must have elasticity in it or it will not ski correctly (hard and it will actually feel as if there is no give), but again you do not want a rope that gives too much (it will feel spongey). A slalom rope has to elongate to a point, then spring back while skiing.
- Mark the rope (duct tape, marker), BUT DO NOT use a tie-wrap.
- Slalom ropes should be changed in and out, if not every other skier, about every couple of hours/round.
- Ropes should be measured each day of the tournament.
3.6. SLALOM VIDEO REQUIREMENTS

GATE Video:
Gate Cameras are to be placed as described above (tower judge option 1).
- The Gate Width on viewing screen must be 1/3 of view screen.
- The viewing screen should be a minimum of 8”X8” viewing screen.
- PTZ (Pan, Tilt, Zoom) camera, security box camera, or any camera can be used.
- Cat 5 cable can be used to provide power, video signal, PTZ by using a MuxLab Balun.
- For Security box cameras, ensure the backfocus is set per Appendix 7.14

EC Video:
The TC is to verify EC Video is setup correctly and monitored throughout the tournament to ensure it remains within spec. A judge/driver should be monitoring the EC at all times.
- Security box camera (CS mount) with a Canon F Mount to CS mount adapter, and a 100 to 300m Cannon F lens is the most common EC Camera setup. (see TC Equipment list under AWSA Web Site, TC Resources).
- As with the Gate camera, a BALUN can be used with CAT5 cable for power and video signal.
- The EC Camera needs to be elevated so that both entry and exit gates are visible.
- The camera (view) must be level.
- The exit (far) gates must be a minimum of 1/6 of the FULL view screen, BUT nothing less than 1/5 recommended.
- The boat pylon at the far gate must be in the video to plot at the far gates.
- If camera has an adjustment for backfocus, that must be adjusted prior to setting up per Appendix 7.14.
- Ensure the backfocus on the camera has been set. F-Stop should be about the mid setting (11) after focusing with far gates in focus
- The Capturing device must be at minimum of 640x400 resolution, which means that the DVR must be setup for 4:3 aspect ratio.
- Must be recorded at 30fps.
- IF the EC video is being monitored through a 4-grid viewing screen, it is recommended that the input signal of the EC be sent to a different monitor (20”) to be monitored by another judge/driver.
• A marker should be placed down the center of the viewing monitor so that the judge/driver monitoring the boat path knows where the center line is.
• Monitor the EC video throughout the day. The sun could cause the EC Camera pole to move (not capturing all the gates). It is not necessary for the near PRE-GATES to be within the viewing screen.
• IF the scoring computer is not being updated live (with current skier/judges/drivers), then a radio should be connected to the EC Camera or DVR to capture the radio information. TC should check with owner for type of radio and cable connection for recording on DVR prior to tournament.

Boat Video: IF a Boat Video is required based on the judges’ tower position and class of the event, then the TC shall verify that it is fully functional and is monitored throughout the tournament to ensure it remains within spec.
• The boat video signal must be clear and strong between Pre Gates and Exit gates in each direction.
• The boat video view must be such that the skier can be judged at all the various ski lines (especially at 38 off and shorter). It has been determined that a 4mm lens works best. An IP camera with a 4mm lens at a resolution of 720 or better, and Wi-Fi Unit for transmitting is the best setup overall. Ref Appendix 7.15.
• Based on tower/judge’s configuration, boat video transmitter may not be required. But for Class R, video from the boat is always required (capture on the device).
• Should be captured at 30 fps for playback/reviews.
• Should be captured at a minimum of 640x480.
• IF Class R, recommend mount a GOPRO on top of boat camera (internal recording only) which will provide a wider view and could be used for World Record review if required.
CAPTURE DEVICE: (AWSA rule 15.06)

- Most all TC’s/sites are using DVR’s to capture video, in lieu of VCRs.
- Most DVR’s at a minimum have a 4-grid view. When this is used for judging, a minimum of a 32 in monitor should be used.
- IF the EC video is being monitored through the 4-grid, it is recommended that the input signal of the EC be sent to a different monitor (20”) to be monitored by the other judge/driver.
- The EC Video input on the DVR must be set at 30fps, and it is recommended that all other capture video be set at 30 fps.
- All Video must be at a minimum of NTSC 640x480 resolution.
- Verify that the DVR clock is set to the same time as the scoring program.
- Verify that the DVR time is set to the same as the scorer’s computer and that the scorer will be input live (driver/judges/skier/input in the computer real time) for the Slalom Detail Export to match the DVR time. IF scoring is not being recorded live time, connect a radio to the DVR to capture skier name information.
- Verify the DVR is recording, and that video can be played back in a timely manner. Verify that the judges know how to play back boat/gate video.
- It is recommended that an Uninterruptible Power Supply (UPS) be used on all DVR’s. DVR’s are sensitive to noise and sag in power, the UPS will eliminate these issues.
4. JUMP

4.1. JUMP COURSE CERTIFICATION

All that was said about certifying slalom courses also applies to jump courses. When a survey is required, often times the jump and slalom course are close enough together to be surveyed at the same time. This is generally more efficient; however, it is very easy to confuse buoys, and the baseline used to measure each course is not the same.

- NO buoy or object should be within 8 meters of landing zone CL.
- The jump ramp should be 30 m (100 ft) from the shoreline (at several sites, the jump is actually less than 100ft from shore). At those sites, coordinate with skiers/safety to ensure that there is no object along the shore which could adversely impact the skier.
- Counter Cut area is the most dangerous area for the skier. Ensure there are no objects along that area with which the skier could come in contact in case of a fall. The shoreline in this area should be 100 ft from the boat CL.

Survey and Survey Program: Same as in slalom. Both Emmanuel Lion’s and the Corson/Brazil programs utilize the 15m line to determine the buoy and jump placement.

Lion’s Survey Program has two elements, one for the Jump Course, another for VJ Grid/Reference buoys. When surveying the jump course, ensure that the “X-Axis” is the 15st-15mt. When using the Lion Survey, R1 is always the corner of the ramp furthest from the boat path and R2 is the corner closest to the boat path. Sighting the center of the jump is unnecessary.

- In the VJ Buoy element, ensure the “X-Axis” is set to 15st-15mt for Corson/SplashEye. For Boettcher and Loreto, the “X-Axis” is Cam1-Cam2.

The Lion Video Jump element provides the necessary grid/reference buoy coordinates for entry into the various video jump programs. The Corson and SplashEye programs use a photogrammetric algorithm based on a trapezoidal grid on the water defined by 4 buoys plus a check buoy. Those buoys are the purpose of the "A-H" buoys in the Lion program. In contrast, the Boettcher (Super Jump) and Loreto programs use a trigonometric algorithm utilizing angles derived from the camera and reference buoy positions. Those are the Cam-1, Cam-2 and "20M-80M" buoys in the Lion program.
Irrespective of which system you use, the survey program merely reduces the sightings to x/y coordinates for entry into the chosen jump measurement program. The "x" coordinate is always the down course measurement as viewed from the boat direction of travel during the actual jump. The "y" coordinate is always the across course measurement 90° from the 15M or camera axis. The ramp is always x=0 and y=0 at the center of the departure edge of the ramp. The "x" buoys will almost always be + unless for some reason, a grid buoy is placed up course from the ramp departure edge. In which case it would be -.

In regard to Corson/SplashEye, all buoys located to the left of the extended ramp center line will be "-y". All buoys to the right of the extended ramp center line will be "+y".

Boettcher (Super Jump) and Loreto differ slightly from Corson/SplashEye. The baseline between the cameras is the "X-Axis". Regardless of which side of the ramp the cameras are located, the "y" coordinate for the cameras are always +. The +/- coordinate for the reference buoys will depend on whether they lie on the same side of the ramp extended center line as the cameras or the opposite side. If the reference buoys are located on the same side as the cameras, those buoy coordinates will be +y. If on the opposite ramp extended centerline, those buoy coordinates will be -y.

It doesn't really matter which buoys in the survey program you use for your setup. Irrespective of whether the buoy is called "A" or "G" or "60M", when you take the sight, it will be reduced to an x/y coordinate. That coordinate may be a "+x" a "-x" a "+y" or a "-y". So long as you adhere to the conventions stated above, it will work properly. THE SINGLE MOST IMPORTANT THING YOU CAN DO is to draw a diagram of your grid/reference buoy layout and label the buoys with one of the letter or number names in the survey element and whether they will be a + or – coordinate.

HAND Draw a sketch of the VJ Buoys/Grid with cameras to show Grids and expected range/distance for each. This should be posted at the VJ Computer Program.

Buoy size depends on the type of buoy (cylinder vs round), Reference Rule Book. Recommend using cylindrical (S-1 or Wally Guides) vs round buoys for boat guides to prevent rope from catching buoy (example 15MT/ET).

END Course buoys (old ride out) are required to be installed Ensuring that the boat path is straight thru the entire course.
• Video Grid Buoys may be bigger and different color. On some lakes, white/silver buoys show up the best, and some, black buoys are best. Test at different times of the day to determine what’s best.
• Ensure there are no extra buoys or anchors that could be mistaken for the actually surveyed grid buoys.
• A jump C/L buoy should be placed directly in front of and touching the jump.

4.2. JUMP ROPES

Jump ropes are much easier to deal with for two reasons. One is that they do not have all of the splices to stretch and give, and the other is that they have a greater tolerance to work with.
Most of the time you will not have to do much to a jump rope other than to measure and mark it. If adjustment is necessary, then use the same procedure as with slalom ropes.

Measuring Jump Line: It not necessarily the responsibility of the TC to check all the skier’s lines. TC is to ensure that there’s a place for the skiers to check there jump line/handle. Set up a place to pull the jump line with a minimum and maximum (+/-30 cm) mark. Ensure the Chief Judge has someone appointed to check the skier’s Jump Ropes. Tournament Jump Ropes should be skied on and reverified by the TC. For National/World Records, the TC shall check the rope/handle for compliance.

JUMP SWITCH:
For Elite and major tournaments (National/Regional) the TC should verify the jump switch is functional. This can be accomplished by using an Ohmmeter on the wiring connection and a scale connected to rope/handle.
The switch should close at approximately 125#. If a skier supplied switch is used (80# youth setting for example), the functionality of the switch is the sole responsibility of the skier. If a slow time is experienced due to a malfunction of the switch, no re-ride will be given. If the time is fast, score is zero.

4.3. JUMP RAMP SPECIFICATIONS

Jump Ramp Specifications
The AWSA rule book outlines the specifications for the jump ramp. Any deficiencies in the condition of the ramp should be reported to the tournament sponsor and/or the safety director for correction. During the inspection, the jump ramp anchoring system should be
inspected and, most importantly, be certain that at least 20 inches of the low-end ramp surface is under the water. Although there is not at the present time a specified requirement, it is advisable to have someone stand on the ramp at various places to ensure that the ramp has sufficient flotation and that the skier coming onto the ramp will not cause excessive deflection. One of the most important things for a great jump is adequate flotation. During the inspection is a good time to check raising and lowering of the ramp. Check the length/height ratios of each ramp setting to be used to ensure compliance with the AWSA and IWWF rule book. INSPECT jump surface to ensure no screws are exposed that could cause damage.

–Additionally, discuss the height changing procedure with the tournament sponsor. If the height is changed by installing blocks under the support mechanism, be certain that sufficient blocks are available for all combinations. For infinite setting ramps, if you can mark the height setting to be used during the tournament, you will probably save some time. It may be that additional floatation will be required under the low end of the ramp in order to achieve the proper/desired length/height ratios. If this is the case, determine the requirements at this time and insure availability. Several items which will provide the additional floatation are Styrofoam, old inflatable buoys, and sealable cans or buckets filled with air. If the tournament requirements include the "six-foot" ramp, i.e., the .271 ratio, determine what it will take to get the ramp to that setting, as on many ramps, this length/height ratio is difficult to achieve.

Remember, that when setting the height and angle of the jump ramp, the Technical Controller is obligated to set the jump as close as possible to the rule book specifications.

The ramp shall meet the following specifications:

1. Width: 3.7 meters (12’) to 4.3 meters (14’1¾”) at all points. 4.3 meters is the preferred width.
2. Length Out of Water: 6.4 meters (21’) to 6.8 meters (22’ 3¾”) at all points.
3. Length Under Water: 50 cm (20”) minimum.
4. The following ratios of ramp height at take-off edge to ramp length out of water shall apply: .271, .255 or .235 ramp; All of these ratios shall be set to within ± .003 for all Record Capability tournaments, or to within + .003/- .005 for all other tournaments. (See Ramp Setting Chart in the Appendix.) At the option of the sponsoring club, any division may jump height of less than 5 ft height (less .235 ratio).
(5) The maximum deviation from a flat surface, if larger than 1.0 cm, must occur in the center of the out of water surface +/- 50 cm (1'-7 11/16"). The location of the maximum deviation will be measured from the top edge. Example: If the jump surface out of the water is 6.8 m (22'-3 3/4"), then the maximum measured deviation must be between 2.9 m and 3.9 m (9'-6 3/16" to 12'-9/16") from the top of the jump.

(6) No overall convex deviation is allowed. Minor convex at bottom where the hinge is against the surface may occur or where there is a main support. The intent is that the ramp does not have a general upward bow (convex) from bottom to top.

(7) The tolerance is only permitted when the ramp deviates from perfectly flat due to aging, stress or imperfections in the building materials. Such deviations should be rectified if at all possible.

(8) The deviation from perfectly flat will be verified by two measurements:
- Place a taut string from the lower right corner (jump course side) of the surface to the upper left corner of the surface and measure the maximum distance between the ramp surface and the string.
- Place a taut string from the bottom center of the surface to the top center of the surface and measure the maximum distance between the ramp surface and the string. A good practical method is to use a block of the same thickness under each end of the string so that both concave and convex measurements can be recorded by subtracting the block thickness from the measurement.

(9) Aprons: Aprons shall extend the full length of the ramp and shall be at least 20 cm (8") under water when the ramp is raised to its full height. A left-sided apron is not required. The recommended apron angle is 30 degrees from vertical. For the first 1/3 of the apron at and below the water, the curtain may be approximately 60 degrees from vertical. It shall be radiused and blended to the surface to prevent skis from catching.

(10) Ramp Markings: 6.4-meter and 6.7-meter (21' and 22') length markings, clearly identified, shall be placed on the aprons and/or ramp surface so that they are readily visible. Extra marks, if identified, are allowed and desirable.
(11) Color Specifications: The ramp aprons and ramp surface shall be of different colors, both of which shall be different from the water surface. The ramp surface shall be one solid color without borders or decorations of any sort.

(12) Vertical Line: A 1 - 3 cm (¼" - 1") wide vertical line of contrasting color shall be plainly marked or painted at the center of and just below the take-off edge for meter sighting purposes if necessary. This vertical line may extend over onto the jump surface not more than 8 cm (3") to facilitate locating the centerline during surveys. The jump ramp must be securely anchored in place such that the center take-off edge will not vary more than the sighted width of the crosshair on all meters after coming to static rest. “Static rest” is the position assumed by the ramp in ambient water not affected by boat wakes, skier’s wakes, or backwash.

(13) (The recommended height and length are as follows, but this will vary from ramp to ramp. The length out of water should be as long as possible within the ratio tolerance to produce a ramp slope that is as flat as the tolerance allows.)

5ft - Recommend 5’-2½” with length 22’-2” to 22’-3” with hex/angle 1.8deg.

5.5ft- Recommend 5’-8” with length 22’-2 ½” to 22’-3” with hex/angle 1.8deg.

6ft- Recommend 6’-0” with length 22’-3” with hex/angle 1.8deg.

Ramp Angle

Measuring the angle of the jump to the jump course is a task that is best done by surveying methods. Survey the two corners of the jump and CL. CL sight is unnecessary with the Lion survey. When using the Lion Survey, R1 is always the corner furthest from the boat path and R2 is the corner closest to the boat path. Another option to place a marker/extension (pvc pipe) on shore (recommend both sides of shore) that lines up with the face of the jump (high end) (known as HEXM). (if this option is used in Emmanuel Lions program, it will show that the jump width is out, but the angle can be calculated). The program will provide the angle of the jump based on the 15m line.
The allowable amount of ramp angle open (low end of the ramp towards the jump course) is 1 – 2.5 degrees as specified by the Official Jump Course diagram in the AWSA rule book. The greatest concern is that the ramp not be "closed", (low end of the ramp away from the jump course) to the skier. The same limitations apply when the jump angle is calculated manually.

| 1 – 2.5 degrees open, with 1.8 degrees recommended. |

When performing this measurement manually, a line must be stretched from the 15-meter start timing buoy to the 15-meter mid-timing buoy. Measurements then must be taken from the high end of the jump (DH) to the line and from the low end of the jump (DL) to the line. The open angle can be calculated from the relationship: open angle = inverse tangent ((DH-DL)/Lj) where Lj is the distance from Dh to DL

This assumes the 15-meter buoy line is straight. If the measurements show the low end to be further from the 15-meter buoy line than the high end, the jump is closed, and corrections should be made before proceeding further. As a rule of thumb, the low end of the jump should not be more than five (5) inches closer to the jump course than the high end.

4.4. JUMP DISTANCE MEASUREMENT

Current rules require the use of video measurement for record tournaments events. For Class C, if using the shore mounted Johnson meter system Reference Appendix 7.15. There are four (4) video systems are currently approved. Bob Corson VJ, SplashEye, Boettcher and Loreto.

The most commonly used video measurement in the US utilizes a computer program written by Bob Corson; this system relies on cameras mounted at elevated locations in similar locations as the Johnson meter stands. The cameras view the landing area and use a grid of buoys as reference markers to calculate the jump distance with the Corson computer program and computer video capture. The programs are available through the AWSA website. The disadvantage is that the Windows Operating System has to be
Window XP.
The other system is the SplashEye Jump Program, where the computer and the program need to be purchased from SplashEye. This program and setup are the same as Bob Corson, but it uses the latest Windows Operating System. Corson is only a one video capture device/one grid view at a time, whereas SplashEye is a 4 video input capture device with a 2 or 3 jump grid setup view.
The other two approved systems are by Loreto and Boettcher. These two systems are similar in that they both use a trigonometric calculation between the two cameras and the two reference buoys.

**GRID SETUP - SplashEye/Corson VJ**

Dave Clark has written survey spreadsheet programs that can be used to help analyze, evaluate and/or manually calculate the VJ Grid.

- **VJVIEW16** - Input location of camera/s and grid buoys and the spreadsheet calculates if the setup is acceptable or not (this is just a guide).
  
  (Ref Appendix 10.3)

The camera angle view with Corson/SplashEye cannot be wider than 30 deg., distortion and distance on edge will be outside of allowable tolerance. ZOOM IN.

Cameras are normally set at approximately 18 ft or higher above water.

Appendix 7.9 provides example of different grid setups.

Appendix 7.11 (VJVIEW11) is a method to measure grid buoys using a tape measure for Class C/F tournament ONLY if a survey is not available.

**COMPUTER SETUP - SplashEye/Corson VJ**

On the TC CLINIC web page, there is video that can be viewed on how to setup Corson VJ Computer Program. The following link is to the SplashEye manual to setup and operate SplashEye VJ computer “SplashEye Manual”.

After setting up all grids, Run the "Accuracy Check" procedure – verify results for class.
Differential Tolerance is acceptable when measuring jump. One horizontal pixel shall not exceed. (The vertical may vary little more due to the resolution of screen).

Class R = 4 inches (0.10cm), Class L/E = 6 in (0.15cm), Class C = 8 inches (0.20cm).

Record the X/Y coordinate for the check buoy where it’s plotted/marked on the computer and record the survey X/Y coordinates. The X differential between the placement mark on screen and the survey must be within the tolerance referenced above. This data will be recorded on the TC Homologation Report.

The Jump Program (auto/internal) adds 2.1m to the point of impact (easier to select the point of impact on a jump). This is added because when using Johnson-type meter stations, the distance was measured using the plume. It was determined that the point where the feet touch the water is approximately 2.1m from first impact (tail hitting water).

Monitor the jump program to make sure that the camera has not moved during the day, Grids remain lined up on the marks.

**CAMERA SETUP:** SplashEye/Corson VJ

Most any analog camera will work for jump. Currently IP/Ethernet Camera will not work unless you have a converter to convert back to an analog signal. All jump computer capture cards (currently) are only analog.

Most any standard lens will work, as long as the grid is set up correctly and the camera is zoomed in with the grid buoys approximately 5 – 10% from edge of the screen. The most common camera now used is the Pan/Tilt/Zoom (PTZ) cameras. Just put up on the pole and PTZ from the DVR or a controller.

All jump cameras should be hardwired to the computer/capture device for judging, in lieu of wireless.

For standard security box camera, ensure the backfocus is adjusted per Appendix 7.14.
DVR- BACKUP RECORDER

SplashEye VJ does not necessarily require a backup DVR because it is always recording a 5 second loop. BC Video Jump and other programs do not auto record video. So, it’s recommended that you have a DVR for Backup.

Configuration:
SplashEye, you need a DVR for each Camera/Input.

Corson:
- Option 1- One 4 Channel DVR with all 3 cameras/grids going to the one DVR and OUTPUT going to ONE SplashEye Computer.
- Option 2- Same as Option 1 except split Channel 2 Input and the live feed goes to Computer #2. Computer #1 can be used for backup on Grid 2 if Computer 2 failed on Grid 2.
- Option 3: Two computers and 2 DVRs with Computer#2/DVR#2 connected to Camera/Grid 2 and Computer#1/DVR#1 connected to Camera/Grid 1 and 3.

CAUTION: The DVR output (compressed) is not the same as live feed view. So, when using a DVR for backup, make sure the normal feed going to the VJ Computer is going thru the DVR as if you were doing playback.

It is recommended that Uninterruptible Power Supply (UPS) be used on all DVR. DVR are sensitive to noise and sag in power, the UPS will eliminate any issues.
5. TRICKS

5.1. TRICK COURSE CERTIFICATION

Setting up the trick course is not a difficult challenge: throw two buoys in the lake at approximately the point you want to start on each end. Seriously, though you should make sure that the skier can easily see the starting point and that the trick course is long enough for the "high speed" tricker (22-24 mph) to get a 20-second run in without having to turn or run up on the bank. Another point that must be considered is the approach to the trick course. Is the initial leg long enough to adequately set the speed? The rule book specifies the color of the trick course buoys. The first one must be GREEN (set speed), and then 50 meters from the GREEN buoy a RED buoy (start). The tolerance on the distance between the two set of buoys is great enough so that even the most casual measurement should keep them within tolerance. If other events are conducted on the same lake, or in the same area, ensure that buoys from other event courses do not interfere with the trick course. Ask the Lake Owner or representative about the lake bottom contour to ensure the boat path is over a reasonably even surface and is deep enough.

Communicate with the chief boat driver and LOC to determine the best distance offshore for the path.

5.2. BOAT VIDEO

Both AWSA and IWWF allow the replacement of a boat judge by a camera operator; the duties of the boat judge are transferred to the boat driver. There’re two options for capturing/judging tricks for Class E/L/R (LIVE-wireless transmitted back to shore; RECORD on SD card). May be done with shore judges for Class F/C per rule book.

RECORD on SD CARD- This option is most common in USA.

- Test the Cameras with the Trick Timing Program and make sure it is set up correctly. Compare the computer timing with a stopwatch, or phone stopwatch, to ensure that timing and frames-per-second are correctly set to 30 FPS.
- It is recommended that you have several clip boards with running order and SD Card in each.
- The boat camera operator should record the sequence # beside the running order and record via text on back of clipboard or sign taped to gunnel/transom if a declared positioning trick will be performed or if the skier is not on the running order.
- Camera Operator needs to hold the camera as high as possible to ensure the ski can be clearly viewed over the boat wake.
• It is recommended that you record one to two skiers on one SD Card and submit that for review/judging.
• After timing and capturing the timed run on the computer, erase the video, cross out the skier’s name on running order and send back to the boat for later use.

LIVE (wireless feed): Ensure the wireless feed to shore recording device and to the judges monitor has no flicker or dropped frames. This is normally done only at major tournaments, such as the Masters (using Web Cast HI Tech equipment). Always record on the camera SD Card as backup and record the live feed on shore.

Another major concern when using WIFI, Digital camera, is freezing of frames and timing the tricks. Reference Appendix 7.15 on Wireless Feed.

CAMERA OPERATOR: Ensure the camera operators understand their responsibilities. Brief them and show them some examples of video. Make sure the camera operator sets up as high as possible to see the ski when directly behind the boat. (consider a boat cushion in the boat to sit on).

Make sure the camera operator understands the process of transmitting the video (live or SD Card) between the boat and the judges as described above.

**A note on AVI.** This was a file format invented in the days when digital editing was starting to become popular, but people were still originating the video with analog cameras. Running analog video through a ‘digital video converter’ and capturing software would create an AVI file which could be edited digitally. There are no cameras which create native AVI files. AVI files can be created from most types of codec using transcoding programs. Cameras which record directly MPEG4 (or DVD) should be avoided for trick videos because frame integrity is not secure.

Most current camcorders will record onto an SD card in a format called AVCHD. This opens readily on modern computers, can be edited with most editing packages and retains frame integrity. These files are not AVI files but they are AVI type files. The format uses a lot of compression, so if you run them through transcoding software to create true AVI files, quality will be lost.
5.3. VIDEO FRAME TIMING COMPUTER

IWWF/AWSA rules requires the use of video frame timing for class E/L/R events. Four systems are currently approved (same manufacturers as the jump programs). In addition, Windows/Mac video programs that have a frame-counter can be used if tested/approved by the site TC. This is not recommended when you have a lot of skiers (greater opportunity for errors).

For RECORDED SD Cards: The TC Committee recommends the SplashEye Trick Program. SplashEye can read SD Cards directly and allows the use of separate, independent, screens for timing and judging. The use of Class 10 SD Cards is highly recommended.

For LIVE Feed, Use either one of the approved programs. (Recommend SplashEye) Its easier and faster to determine the start of the trick while skier continues. Makes it faster for live feed.

The program requires the same general computer and camera equipment as the video jump system. Caution on Wi-Fi and digital camera. Referenced in Boat Video Section

SplashEye operating instructions can be found in the SplashEye manual "SplashEye Manual". Corson instructions are in Appendix 7.13.

5.4. VIDEO JUDGING SETUP

Setup can be done several ways:

**SD CARD:**
- Use camera to play SD Card, and split signal to monitors for judging and for timing computer. OR
- SplashEye- PLAY SD Card in the program and split HDMI out to separate monitor for judging only (setup computer up for split screen) OR
- SplashEye- Play SD Card in the program and duplicate the screen to separate monitor for judging (set computer up for duplicate screen). Do this if a judge had to help with timing at smaller tournaments.
- Ensure you save the raw video in case you have a record. The raw video quality is better for judging than what is saved in the timing programs.
- Judges should have separate screens depending on type of tournament. For major tournaments, use 3 to 5 monitors to separate the judges. For the normal weekend, just setup one 40” screen for the 3 judges.
LIVE:
- Ensure the live feed is being captured on a device that can be played back.
- Set up a computer to play back or use a DVR.
- Split the signal to timer computer and to judges monitor as described above.
6. RECORDS

6.1. AWSA NATIONAL AND IWWF WORLD RECORD APPLICATION

The TC will complete a RECORD Application for AWSA National RECORDS and will use the same application for USA Skier setting a WORLD RECORD. The RECORD Application form is in the WSTIMS Scoring Program. The TC will confer with the Chief Scorer prior to the trick event to ensure that all officials will be input into WSTIMS for each event. The scoring computer must have Excel installed or it will just print a text file. Please make sure all Record Application Forms are completed and submitted with Excel.

The TC is to complete the form making sure all the information is complete (rope length, etc.) The checklist on the last page of the record form indicates what documents are to be submitted. All documents are to be uploaded to the designated ADRIVE. If you have a question concerning the use of ADRIVE, contact the National or your Regional Committee TC Representative.

For other country/federation records, this form can be used if the skier does not have access to their record application.

Notify the AWSA TC Chairmen and AWSA HQ of the record within 7 days and if WORLD RECORD, notify IWWF TC Chairmen via email. All documents should be uploaded within 21 days and another email sent to the Chairman indicating that all documents have been uploaded.

RECORDS are based on Age Division. When Record is set in ELITE (OPEN/Master) Events, if criteria same as the age division (speed/jump height) the record maybe submitted for both.

WORLD Records can be set under the age division if the criteria the same. IN-ADDITION, U17 (B3/G3) can also set U17 WORLD Record if the event was run under the same criteria has U17.

The Record Review Board (RRB) responsibilities and guidelines are identified on page 1 of the record application (8 members on the RRB) (It takes 5 of 8 to accept or reject a record).
TRICKS: Video and Judges Sheets are required. Timing will be checked by TC Chairmen. Tricks (Credit/No Credit) are reviewed by the RRB. The TC Chairmen uploads the video on YOUTUBE (private) and then sends to the link to the RRB for review. If there’s any question on trick timing, that will also be submitted to RRB for start and last trick.

SLALOM: 
ROPE- The rope and handle to be checked approx. 15 minutes after skiing, if out, the TC shall maintain the rope/handle at normal room temperature and recheck after one hour. If out, no record. The measurements will be recorded on the Record Application form. EC Video- The last two boat paths are required. Boat Video- Required for MM and OPEN Events. Gate Video – The last two passes (Entry/Exit Gates) required for WORLD Record ONLY. The TC Chairmen or designee shall measure for any boat deviation from EC Video. If it is rejected based on deviation that is very close or hard to measure, it is submitted to another TC to measure and to confirm. See Appendix 7.16 for instructions on plotting Slalom Boat Path.

JUMP: Jump records are replotted (setting up grid and remeasuring). If different, it will be submitted to another TC to verify and to confirm.

All records for the calendar year are posted on the PENDING LIST, and the PENDING LIST is updated (monthly/bi Monthly). The MALE/FEMALE RECORDS LIST is updated at the end of each calendar year and Certificates are submitted to the record holder via USA-WSWS HQ.
7. APPENDIX

7.1 Slalom Course Buoys Names
7.2 Procedure for Setting Up (tripod & leveling Total Station)
7.3 PPM Correction Variables
7.4 Prism Offsets
7.5 Emmanuel Lion’s Homologation Survey Program
7.6 Leica Total Station Setting and ‘RS232’ connection to Lion Homologation Program
7.7 AWSA Survey Package Instructions (by Dave Clark 2004)
7.8 Ed Brazil Stakeout Program
7.9 SPLASHEYE/CORSON Video Jump Grid Setup (by Dave Clark)
7.10 VJVIEW 16 Spread Sheet (by Dave Clark)
7.11 VJVIEW 11 Spread Sheet (by Dave Clark)
7.12 EXAMPLE OF Slalom Rope TEST LAB REPORT
7.13 BC Video Trick Program
7.14 Camera Lens Backfocus Adjustment
7.15 WIFI Data Information
7.16 Slalom National Record Verification Procedure.
7.17 Johnson Meter System Procedure
7.1 Slalom Course Buoys names

There are differences in Slalom buoys names: AWSA names in use since the early 1960’s are identified in Green and Lion’s from 1990 are in RED. AWSA is trying to change over to Lion’s system because the boat guide schema (odd on the right) matches the turn buoy. These designators are used in various survey programs. Diagram shows both systems.

**Comparison Chart**

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<td>PG1</td>
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**Diagram - Official Slalom course**

In Red Lion’s buoys name  In Green AWSA buoys name

AWSA names in use since early 1960’s, uses progressive numbers starting from left side gate. P__ ---> Pre-Gate (1,2 - 15,16); G__ ---> Gate Buoys + boat guide buoys (1 to 16); S_ ---> Slalom skier buoys (1 to 6)

Lion names, in use since 1990’s, use the acronym of rule buoy’s name. PG__ ---> Pre-Gate (1 to 4); G_ ---> Gate buoys (1 to 4) S_ ---> Slalom skier buoys (1 to 6); B__ ---> Boat guide buoys (1 to 12)
7.2 Procedure for Setting Up (tripod & leveling Total Station)

If there’s not already a survey point and backsight reference point, it’s recommended to find a convenient location on shore near the center of the course so that you can clearly see all points that will be surveyed. For Slalom, set up on the shore approximately halfway between buoys 3 and 4. For Jump, set up at a point where you can see all of the jump course buoys and grid buoys. If the total station reads distances in the reflectorless mode, the survey point will need to be near the middle of the jump course in order to read distances for all of the buoys. Setting a permanent survey point in the ground will enable replication of the survey in the future.

**Setup/Level**: This can be one of the most time-consuming procedures in surveying, and one of the most critical. Any error in setting up the tripod is carried through the entire survey. Generally, small setup errors (1 or 2 mm) are not a problem because they are non-systematic, and the EDM on the Total Stations have an error of ± 3-5 mm. With newer instruments, sometimes it may initially be faster to just set up and survey. However, it is STRONGLY recommended that you use the same survey point and select a stationary backsight point that will not move. This can save time during a tournament if a buoy (or jump) has to be reset and resurveyed.

The following procedure is suggested.

1. **Setup the tripod.** Open up the tripod and extend the legs with one leg on the downhill/course side. Adjust the approximate height so that the total station will be at eye level when attached.
2. Start with the tripod instrument bolt close to the center of the hole in the tripod head. Peer though the instrument bolt and set the tripod over the survey point. Adjust the legs of the tripod so that the survey point is within view through the instrument bolt. The flat surface of the tripod head (foot plate) needs to be reasonably level. Otherwise, you may run out of adjustment on the tribrach foot screws when setting up the instrument. When this happens, you’ll have to restart the setup process.
3. Firmly set the tripod leg points so that the tripod is stable.
4. Attach the total station to the tripod at this point.
5. Using either the optical plummet or laser plummet on the total station, adjust the foot screws on the tribrach to where the plummet is centered on the survey point.
6. Adjust the length of the tripod legs to where the bubble level on the tribrach is reasonably level.
7. **Leveling the Instrument.** Align the barrel of the instrument so that it’s centered over one of the tribrach foot screws. Turning BOTH foot screws below the telescope eyepiece in opposite directions, center the bubble in the long level on the total station. Turn the instrument so that the barrel is aligned over one of the other foot screws and adjust the tribrach foot screws so that the long level bubble on the total station is centered. Repeat these for the third foot screw. Repeat these steps to fine tune the level. Some newer instruments do not require multi-point leveling and utilize electronics to aid in levelling. Note- newer instruments will not take measurements if not level, and the angles will also be off.

8. **Check alignment over point.** Use the optical or laser plummet on the instrument to check that the instrument is still centered over the survey point. Loosen the tripod head bolt and slide the entire tribrach/instrument assembly slightly to get centered over the point. If you move the tribrach, repeat the instrument leveling process.

9. **Bench Mark/Reference Point:** Identify a stationary backsight reference point to establish your baseline. With the Lion program, it doesn’t matter where the point is (including across the course). Turn the horizontal adjustment screw on the total station to where the instrument is centered on the backsight point. Zero the instrument so that it’s set to zero degrees.

10. **Setup:** Depending on your instrument, make sure all the settings are correct (Temp/PPM/ATM Pressure/Prism offset vs Non-Prism, etc.) Ref Appendix 7.3 & 7.4.

11. **Buoy:** Make sure buoys are correct size and height and are pulled down tight before starting.

12. **Survey:** Make sure there’s a permanent CL mark on shore that can be checked, especially on cross line course that is checked prior to making many corrections.

13. **Recheck:** After all buoys have been surveyed turn the instrument and center on the backsight point to ensure it reads very close to zero degrees. It’s not a bad idea to occasionally check the backsight during the survey if you are set up on loose ground or an older tripod etc.
7.3 PPM CORRECTION VARIABLES

by Doug Crook, President - Ingenuity Inc.

Calculating and applying the proper atmospheric correction, parts per million (PPM), to an EDM distance measurement is EXTREMELY important. The density of the atmosphere varies with changes in atmospheric pressure and temperature. The speed of the EDM light beam used to measure a distance varies with atmospheric density. Use as accurate an atmospheric pressure and temperature as you can obtain to calculate the PPM correction.

The most accurate atmospheric pressure is obtained by using an altimeter / barometer. The average atmospheric pressure at sea level is approximately 29.92 inches of mercury. As elevation increases, the pressure decreases. Remember that the atmospheric or barometric pressure that the Weather Bureau gives is corrected to sea level. DO NOT use this value directly for PPM calculations unless you are at sea level. The decrease is about one inch of mercury per thousand-foot increase in elevation. At an elevation of 5000 feet the actual (uncorrected) atmospheric pressure will be about 24.92 inches of mercury on a Standard Day. The UNCORRECTED value MUST be used in the PPM calculations. The most accurate temperature can be obtained using a thermometer. The temperature must be taken in the shade in still air to give the most accurate reading. There are today a number of atmospheric Apps available for smartphones which will produce temperature, raw atmospheric pressure and altitude.

The temperature and atmospheric pressure are used in combination to give a correction factor stated in parts per million. The correction is applied to the slope distance. Virtually all modern EDM units have a way of entering the PPM correction, either as a PPM value or the raw temperature and pressure.

An improper or invalid PPM value can cause inaccuracy in a distance measurement. Incorrect values of temperature and/or atmospheric pressure or a combination of the two can result in an invalid PPM correction. Most EDM can accept temperature in Fahrenheit or Celsius units and pressure in inches of mercury, millimeters of mercury, millibars or hecto-Pascals. Make sure you are entering the proper units.

Some Values:

1 Part per Million = .001 ft. per 1000 ft.

10 PPM = .01 ft. per 1000 ft.

2 degrees Fahrenheit = 1 PPM

.1 inch of mercury = 1 PPM

The best was to test the effect of the PPM correction is to measure a 1000-foot distance using 0 (zero) PPM and then shoot the same distance using 100 PPM. You should see a difference in the distance of about .1 foot.
7.4 Prism Offsets
by Chris Cothrun

In this installment of The Technical Side we are going to talk about prism offsets and what can happen when you ignore the differences in offsets that exist. To start off, I will give some background information on prisms that are used with electronic distance meters (EDM). These prisms are called corner cube prisms or retroreflectors. This is to differentiate them from the ones that Newton used to make rainbows or the one in your survey instrument that makes the image appear right side up. They are called corner cubes because the three surfaces that make up the 'pyramid' are at 90-degree angles to each other and thus form the corner of a cube. As you have noticed, light entering the prism is reflected back to its source, even at relatively large angles of incidence. The angle of incidence is the angular difference between the incoming light rays and an imaginary line perpendicular to the face of the prism. A beam of light entering the prism bounces off all three back surfaces and exits at the same angle it entered. Light also slows down when it enters glass. Both of these factors make the distance measured longer than the distance to the front face or even the back of the corner cube. This distance is called the offset. This offset is a constant amount that the distance measured is corrected for a particular prism. Further complicating things is the fact that various manufacturers position the corner cube differently in the prism housing and the speed of light changes in different kinds of glass. This results in a multitude of prism offsets. Below are some manufacturers' offsets.

- Hewlett-Packard: -28mm
- AGA: 0mm
- Sokkia / Lietz: 0mm, -30mm, -40mm
- Retro Ray (Lewis & Lewis / Lietz): -30mm, -40mm
- K & E: -30mm, -40mm
- Precision International: -40mm
- Kern: -70mm
- TOPCON: 0mm, -30mm
- Zeiss: -23.4mm, -40mm
- Omni Optical: 0mm, -30mm, -34mm, -40mm
- Wild: -34mm
APPENDIX 7.4  Page 2 of 2

Prism Offsets

As you can see, offsets vary greatly. There are different reasons for this. Some manufacturers designed prism offsets to correct for the difference between the actual plumb line through an EDM and the position of the photo diode in the EDM. Others sought to minimize the effects of having large angles of incidence (not pointing the prism at the gun) on the measured distance. If you are lucky, all your prisms were made by the same manufacturer and have the same offset. Unfortunately, old prisms from retired EDMs are often still around and get pressed into service. What happens to your survey when different offset glass is mixed? We will take the most common offsets, 0mm and -30mm, and throw some numbers around. The difference between the two, 30mm, is about a tenth of a foot. On a relatively short shot, say 300ft., this gives an accuracy of about 1 in 3000, not very good. As your distance increases the ratio will increase but never get as good as it could be. Another way to look at that 30 mm or tenth difference is 100ppm in a 1000ft shot. That extra care taken in measuring the temperature and pressure would have been wasted. What if your field procedures allowed that tenth to accumulate? It wouldn't take many shots to build up an error that would be unacceptable even for rough construction staking. In so many words, don't mix glass!

So, you aren't going to use all those different prisms with each other. What if you want to check some questionable prisms that aren't marked with an offset? Do they have the same offset as the rest of your glass? Measure the length from the face of the prism to the tip (how tall the 'pyramid' is.) and call it A. Then measure the distance from the face of the prism to the center of the 5/8x11 thread (it might be easiest to measure from the front of the prism can and subtract the difference from the front of the can to the prism face out.) and call this B. The prism offset will be (A x 1.509) - B. The 1.509 is the refractive index (or change in the speed of light) of the most common glass used for prisms. For some prisms this might be different, ranging from 1.50 to 1.57. Prisms from different manufacturing runs can vary about 1mm. As a check, compare EDM measurements to a prism with a known offset with measurements to the unknown prism.

360° prisms have come down in price substantially in recent years. Where a Leica 360° prism could cost as much as $700, Chinese knockoffs can be had for around $100 and perform very well. A handy tool if you have to float a buoy “hat” for a sight and don't want to hassle with getting a conventional prism pointed towards you.
Most all surveys are now (2019) being done using Emmanuel Lion’s Homologation program which includes the TC Report and the survey program/data. It includes Classic Slalom, 8 buoy slalom, Jump and Video Jump Grids. Using Lion’s program allows the data to be recorded directly to the cells in the program via Bluetooth or USB cable depending on your instrument.

Important NOTES to follow when using this program.
- Understand the buoy number system. It is different from the original AWSA system.
- The Deg-MIN-SEC are in entered in the program as DEG.MINSEC (Example 49°30’45” = 49.3045).
- As an alternative, based on the instrument used, you may shoot in Deg and tenths of a degree. Just ensure that your instrument and the program agree.
- IF using reflectorless instrument, check “Add Buoy radius” and make sure you have the correct buoy diameter.
- Follow the link below for Power Point Presentation on how to download and use the program (Written by Rodger Logan and located on AWSA Web Site under TC Resources).
- The following pages are from the Power Point Presentation.

http://www.usawaterski.org/pages/divisions/3event/TCResources/LionSurveyMethod.pptx

Lions’ Water Ski Homologation program and files can be collectively downloaded and installed from or go to AWSA TC Resource for the link: http://www.waterski-softwares.com/.
Emmanuel Lions Homologation Survey Program
(By Rodger Logan)

This program includes the Homologation Report software as well as the various survey files.

Note: If you use Google Chrome, it will report the program as "potentially malicious" as it does all executable files. We recommend the use of IE.

Once downloaded, the program is titled “Waterski Homologation” and will be listed along with your other installed programs. Executing it will allow you to create homologation reports and/or the various survey files.

This presentation is based, primarily, around the Topcon Total Station series. However, the majority of information is applicable to all instruments.
Example of Classic Slalom Survey

- Choose "Ranking List" for Record capability.
- "Polar" for single point measurement or "3 station" for 3 point angle only measurement.
- Check Box for "Reflectorless Total Stations".
- Buoys Diameter for "Reflectorless" sights.
- Mid Gate 1&2 to Mid Gate 3&4.
APPENDIX 7.5 Page 5 of 10

8 Buoy course example
APPENDIX 7.5  Page 7 of 10
Communicating (Start RS232 or Bluetooth)

The instrument must be in SD mode to transmit data. The program will only use the HD and H data.

Topcon_GPT theo for single point EDM sights, Topcon_GPT Angle theo for 3 point single only sight.
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Typical ASCII data string transmitted from a Topcon in "Slope Distance" mode.

Note: If doing a 3 point angle only sight, the instrument must be in HR mode i.e. ANG button.

The distance data is represented in the unit of 0.01m or 0.0005 ft. The data length is fixed 8 digits.

The angle data is represented in the form of ANG, or "°".
APPENDIX 7.5  Page 9 of 10

The European way of numbering things is:
St1, St2 and St3 are the cells for the theodolite stations. You only fill these in if you are doing a 2 or 3 point survey. It doesn't matter where these stations are but obviously the greater the baselines, the more accurate your survey will be. If you are doing Polar you ignore these because your instrument will give you angle and distance.

Slalom
PG = Slalom pre-gates. 1,2 on the left (as you look at the course) and 3,4 on the right
G = slalom gate buoys. again 1,2 on the left (as you look at the course) and 3,4 on the right
S = slalom skier turn buoys. 1,3,5, closest to you and 2,4,6 on the far side
B = boat lane buoys. 1,3,5,7,9,11 closest to you and 2,4,6, 8, 10, 12 on the far side
Tr = tower for slalom gate cameras. 1 on the near shore and 2 on the far shore

Jump
you have 15 and 19 followed by , ST, MT, ET, & EC for start time, mid time, end time and end course. There is also NT but ignore these as they are no longer used.
R1 and R2 are the top corners of the ramp (you don't need to use R). R1 is always furthest away from the course

Trick:
G= start buoy. 1 on the left and 3 on the right
PG = 50m buoy 1 on the left and 3 on the right

Video jump element:
This will just give you x and y coordinates for any buoy you want. It doesn't matter which system you are using. Corson, SplashEye, Bottcher, Loreto. The smart thing is, before you survey, to make a little drawing for yourself of the set-up and write on it what you are going to call each buoy. Then you fill in the ones you need in the program. Generally, Corson people name their buoys ABCD etc. and Bottcher use 20. 30,60 etc. but it really doesn't matter what you call them as long as you know. If you are using a bottcher system you need to survey the camera positions. With Corson, no need.

I suggest you play around with both systems and find what you are comfortable with. You should eventually be able to use any system in any configuration or even no pre-written software at all. You can use sketch-up if you want or AutoCAD or a slide rule. It is the answer that matters.

Remember that the buoy numbering system for Slalom is different from Dave Clark's. The Lion survey retains the same logic for the pregates, gates and boat guides as the skier buoys. That is: facing down course, all buoys to the right are odd numbered, all buoys to the left are even numbered.

- The value entry schema for degrees/minutes/seconds is Deg.MinSec.
- For example, 93°47’22” would be entered as 93.4722
- Note that leading zeros are unnecessary.
- It's also important to understand that, in contrast to Dave Clark's "Least Squares/Best Fit" approach, the Lion method complies with IWWF Rules which defines the Slalom centerline as a line extended from midway between the gate buoys. Therefore, a significant error in the position of those buoys can muck everything up. Likewise, the jump course is based along a line between the 15ST and 15MT buoys.
- It's therefore possible that a course could be following one method and not the other.
7.6 Leica Total Station Setting and 'RS232' connection to Lion Homologation Program

(Note this is on AWSA Web Page under TC Resources)

Leica Total Station 'RS232' connection to Lion Homologation Program

Leica Total Stations from the following series can be connected: Series 300, 400, 700 & 800 (e.g. TC/R 307, TC/R 405, TCR 705, TCR 805) FlexLine TS 02, 06, 09. Many other Leica instruments may also work but I have only tested the above models. The screenshots are taken from a TS06+ simulator. The display on your instrument may differ slightly.

First:

Ensure that Tilt Correction is activated. The instrument will not send complete information unless Tilt Correction is on and set to 2 Axis On your instrument you need the following settings:

- **COMMUNICATION SETTINGS**
  - Baud rate: 9600
  - Data bits: 8
  - Parity: NONE
  - Endmark: CR/LF
  - Stopbits: 1

- **SYSTEM SETTINGS**
  - Data Output: RS232 (or Interface)
  - GSI-Format: GSI16
  - GSI-Mask: MASK2

You can connect using cable or Bluetooth.

**Connection with cable:**


In the homologation program, you click on the RS232, choose which Leica.theo file to use, all as usual. Next, press the port update button which will tell you where your cable is plugged in. Choose the correct port. If you are using a GEV 189, this com port always has the same number. When using the GEV 267 or Bluetooth, the number changes when you re-start your computer. Put your cursor in the correct cell, press start, and the download will happen. Keep the Serial Port Reading window open at all times.

It should look something like this

With Leica TC models, after download, you may see a message on the theodolite screen which says: 'Communication failure'. This is because there has been no Acknowledgement, but it is not a problem. Press the red button to clear this and carry on. With FlexLine instruments you can turn off the Acknowledge signal. This means that you no longer get the error message. Go to Menu>Settings>Interface and on the second page there is an option for Acknowledge on or off. Turn it off. (see bottom of page)
Leica Total Station Setting and 'RS232' connection

**Connection using Bluetooth:** First you have to enable Bluetooth in the instrument. Go to the Menu>Settings>Interface and change Port from RS232 to Bluetooth.

Make sure that the Bluetooth tab is switched to Active. Then at the bottom of that screen on the left there is a notice that says BT PIN. Click on that and see what the pin number is. It is probably on the default which is 0000. You can change it to anything you want.

Next make sure the Bluetooth is switched on in your laptop. Go to the taskbar at the bottom right of your desktop and find the Bluetooth logo. Right click on it and click 'Show Bluetooth Devices'. That opens another window and you click on 'Add a Device'. Your computer should then find the theodolite. You click on the theodolite logo and then it asks how you want to connect. You pick the middle option which says something like 'Use device code'. That opens a box where you input the PIN number from the theodolite. (the one which was 0000). Now look at the theodolite and you will see a screen saying that something is trying to connect. Say yes and that's it. You are connected.

Now you need to find the port number that Bluetooth is using. With the latest version of the homologation software there is a port refresh button. Press this and you should see your connections in the drop-down box.

**Computer Port #:** When using Bluetooth or a GEV267 cable, this port number can change each time you restart your computer, so do a little check before pressing start. You can also check by clicking on the Bluetooth logo at the bottom of your computer screen, look at Bluetooth devices then right click on the Theodolite icon, then go to properties and look at the Hardware tab. It will say something like 'Standard Serial over Bluetooth Link Com9'. It might be COM18 or COM12.

Next in the homologation program, you click on the RS232, choose which Leica.theo file to use, all as usual. Next, where it says Port, you click in there and manually type in COM9 of whatever com port your Bluetooth is using that day.

Press start, and you are going. One other thing you may find with the FlexLine is that you can turn off the acknowledge signal. This means that you no longer get a message saying Communication Failure after you send data. Go to Menu>Settings>Interface and on the second page there is an option for Acknowledge on or off. Turn it off.
### Leica Total Station Quick Setup

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<tr>
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<td>Contrast 50%</td>
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<td>Trigger Key ALL</td>
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<tr>
<td></td>
<td>USER Key CheckTie</td>
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<tr>
<td></td>
<td>V-Setting Zenith</td>
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<td>Tilt Correction</td>
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<td>IF off data transferred will be 0, If on a dock that moving, set to OFF</td>
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<td>Page 2 of 4</td>
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<td>Beep Normal</td>
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Cable needed between instrument and computer (USB)
7.7 AWSA Survey Package Instructions

Page 1 of 20
(Written by Dave Clark)

DAVE CLARK SITE SURVEY AIDS Ver 3.44, APR 2004

The complete Water Ski Site Survey Aids package consists of this instruction file, plus a set of worksheet template files. Some of these are designed for laying out and installing a Slalom and/or Jump Course, and others for reducing the data obtained from surveying an existing Slalom Course or Jumping Site (including the judge's towers and/or the jump distance measurement system) in preparation for a Water Ski competition which is being sanctioned by the AWSA. The underlying layouts and standards are also compatible with IWSF Rules.

There is a separate section in these instructions for Slalom and Jump site certification, each of which addresses a number of topics:

1. Orientation and designation standards that are assumed. Field data recording forms are included—make several copies and utilize one each time a survey is conducted.
2. Brief notes on conducting the survey itself, following one of the various surveying procedures which have been developed for this purpose. Refer to the AWSA Technical Handbook for a more complete discussion on each of these surveying procedures and its applicability to specific site situations.
3. Instructions for utilizing the worksheet templates to reduce the survey data, and guidelines on interpreting the results.

The survey aid templates which are included may be processed on any personal computer which has spreadsheet software installed. These use basic functions only and may be utilized with any version of Lotus 1-2-3 from release 1A on, Excel or with any other spreadsheet utility which is capable of loading (or converting from) a .WKS format file.

INSTALLATION / SYSTEM PREPARATION: First, place the WSSURV34.EXE compressed distribution file into a suitable directory on your hard drive, then execute it to extract all of the included worksheets and instruction files. The instruction files may then be viewed onscreen with the BROWSE command, or may be printed (eighteen pages in total), by entering the following command from the DOS command prompt: COPY READSRV.TXT PRN (issued from the applicable directory) Requests for assistance, comments or suggestions for changes to these worksheet templates or the accompanying instructions and guidelines should be addressed to:

The Chairman of the AWSA Technical Committee

The balance of these instructions includes one section on setting out and installing courses using the one-point (EDM) or two-point survey methods, followed by additional sections on certifying an existing Slalom Course and/or Jump Site using any of three survey methods.
JUMP AND SLALOM SITE INSTALLATION INSTRUCTIONS

Explanation: Working from one or two survey base point(s) located on the shore alongside the area where courses are to be laid out, and given sightings to two reference buoys (or markers) along which the course is to be aligned, these worksheets will generate the sighting angles (and EDM distance values for the one-point method) for locating all of the standard course buoys and judge’s tower locating marks, and for a jump site, also the sightings to the ramp center and anchor locations, plus recommended meter layout and/or video measurement setup.

Separate installation templates are provided for the single-point (EDM) angle-and-distance method, or the two-point angle-angle method using two surveying instruments. For each of these methods, there are two installation templates provided, the first for installing a Slalom Course alone, and the other for a Jumping and/or Combined Site. The Combined Site includes a Slalom Course laid out parallel to the Jump Course, with the recommended arrangement (shown below) placing the Slalom Course boat path outside the 19M line of the Jump Course (with three boat gate buoys being shared—those marked as #). But ANY desired parallel interrelationship may be created, by using the provided shift adjustment parameters in cells B138 and C138.

INTERRELATED SLALOM AND JUMP COURSE LAYOUT

```
S2   S4   S6
P1   G1   G3   G5   G7   G9   G11   G13   G15   P3
*    *    *    *    *    *    *    *    *    *    *
*    *    *    *    *    #    #    *    *    *    *
S1   S3   S5   S7   S9   S11   S13   S15
*    *    #    #    #    #    #    #    #    #    #
*EC  *ET  *MT  *ST  *S1  *S3  *S5  150  180
[=] RAMP
```

COURSE LAYOUT PREPARATIONS  GENERAL

First, position a reference buoy or marker at a point located near each end of the course which is to be laid out. For a jump course, these will mark the 15M line of the boat gates—one should be placed at the approximate location of the 15EC end-course buoy, and the other on the extension of the 15m line at the approximate level of the 180M buoy which defines the beginning of the course. For a Slalom course, these will mark the course centerline, and should be placed about at the desired locations of the center of the entrance gates at either end of the course. While the up-and-down-course locations of these two reference markers are not critical (and may be adjusted for later, see below), their side-to-side positioning IS important, since they define the boat path as specified above.
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AWSA Survey Package Instructions

In the special case where you already have one course in place and intend to install the other course in an integrated manner, we have provided some specific guidance on the 4th page of this section of the instructions. See “Adding an Integrated Course” below.

Next, choose your survey point(s) and set up your instrument(s). For the single-point method, choose a convenient location on shore near the center of where the course is to be laid out, and identify a sighting reference point to establish your baseline (zero angles to your left, 180 degrees to your right). Then shoot angle and EDM distance to each of the two reference markers. If your instrument automatically provides corrected horizontal distances, then that’s all you need to prepare. Otherwise, record the Vertical distance from the EDM unit to the reflector when taking these two preliminary sightings (if your instrument will give you that), or else record the vertical angle as well on each of the two reference mark sightings.

For the two-point method, set up your two survey instruments at points on shore which are about 200-250 meters apart—or roughly near the end points of the course(s) to be laid out. Align both instruments to this common baseline (as you face the course, angle zero and Station “A” are to your left, 180 degrees and Station C to the right). Carefully measure and record the distance between the instruments (with an EDM if you have it, or else with a calibrated tape), then sight the two reference markers from each instrument, and record these sightings.

GENERATING THE COURSE LAYOUT SIGHTINGS

Take the data from these two preliminary sightings to any IBM PC (or compatible) which has any version of Lotus 1-2-3 (or any other spread-sheet processor which is capable of loading a .WKS type file). If you have a laptop or “notebook” variety available, bring it with you to the site and produce the installation data on the spot. Start up your spreadsheet program and load either the SLMINSTn or JMPINSTn template (use n=1 for the single-point (EDM) version, or n=2 for the two-point version) from your working copy of the distribution diskette, or from your hard drive if you’ve installed them this way. Use SLMINSTn if you are installing a Slalom Course alone or JMPINSTn where you are laying out a Jumping or Combined Site.

Enter the name of the site and the survey date in the heading section at the top of the worksheet, plus notes on the instrument base points and reference line. For the two-point versions, also enter the A-C baseline distance (in meters) in Cell D11. For a Jumping or Combined Site, you also need to indicate whether your sightings are being taken from the Ramp shore or the Boat Gate shore of the lake—enter either a 1 or a -1 in Cell J11 to indicate which orientation applies.

For a Slalom course, the worksheet will also help you position markers for the two required judge’s towers. At each end of the course, there will be two marker sightings generated, both of which will be placed.
exactly on the recommended 44-degree line from the respective entrance gate center, and at distances back from the course centerline of 35 and 50 meters (about 115 and 165 feet). These two off-center default values may be changed if necessary. For the Slalom-only worksheet, replace the contents in cells C56+. For the Combined worksheet, you will need to edit the formulas which appear in cells C178+, changing the constant values from 35 and 50 to whatever off-center distances are more appropriate to your shore contours.

For a Jump site, the worksheet will help you position a number of other objects, in addition to the boat course and skier buoys. These include recommended Jump Meter locations, assuming the shoreline is roughly parallel to the course. Meters A and C are planned about 3 M back from the shoreline and are based on an estimated ramp-to-shore distance in Cell G11 -- the default value of 40 M (about 130 ft) should be revised as necessary. Video camera markers plus reference grid buoy positions may also be generated. Input the details of your planned layout into the section below cell O45. In this particular area, the X and Y coordinates you provide are assumed to be relative to the jump Ramp as (0,0), so X coordinates will be down course from the ramp, and Y coordinates will be relative to the ramp centerline, with positive numbers to the right (toward the boat course) and negative numbers to the left. Finally, the recommended ramp anchor points are appropriate for water depths to about 10 ft—these sightings are not adjustable, but you will probably want to position the anchors further out in greater water depths.

The Jump site installation template now also includes the additional objects needed for a Ski Flying course. This includes an additional 240m skier turn buoy, and an additional row of boat gates at 21.3m from the ramp—these will coincide with slalom boat gates where you have the typically integrated layout.

If you are using the single-point method and your EDM unit does NOT automatically calculate corrected horizontal distances for you, then the worksheet will be working with slope distances throughout, and so you will need to enter the vertical height differential in Cell E11 (if your EDM unit calculates it for you), or else you can supply the vertical angle for the two reference sightings in cells O16+, and the worksheet will then compute the necessary height value for you.

Then enter the sighting data from each of the two reference marks. Examine the Course Coordinates of these two reference marks (shown near the top of the worksheet) and determine if the up-and-down-course positioning is appropriate. If not, you may enter a shift amount in Cell B11, to relocate the course either right or left as necessary. If you are working with the Jumping Site worksheet and plan to install a parallel Slalom Course, shift offset values may be entered in Cells B138 and C138 to adjust the location of the Slalom Course, relative to the Jump Course. Should you find it necessary to make any adjustments in the interrelationship, remember that the two reference markers are used to determine the 15m line of the boat gates for the Jump Course first—then the Slalom Course may be adjusted relative to that resulting Jump Course location.
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The interior boat gate width for the Slalom Course may be modified—the standard value of 1.15 meters is recommended where spherical boat guide buoys are being used on these interior gates, and a narrower width of 1.10 meters is recommended where narrower non-spherical types (like “bullet” buoys) are to be used. This adjustable parameter appears near the top of the Slalom section of either template file. Once you’ve got the recommended sightings for all the objects you need to place, check the sightings for the Slalom Tower markers and/or the Jump Meter station markers to be sure they fall in the appropriate areas on shore. You may need to adjust the off-center distance values for these objects, to accomplish that.

After making any such necessary adjustments, the worksheet presents the sightings (angles and/or EDM distances) from your base point(s) to all of the standard buoys, slalom judge’s towers, ramp center and recommended ramp anchors, plus jump meters or Video Jump reference grids plus cameras. Print the worksheet out (the range and setup parameters are pre-defined to give you all the section necessary) and take that printout sheet with you to install the course(s). For each buoy or marker, align the instrument(s) to the values shown on the worksheet, then coach the positioning crew from the instrument(s) until the buoy or marker is in the correct location.

ADDING THE INTEGRATED COURSE

If you’ve already got a Jump course in place and you want to add an integrated Slalom course, sight the existing 15ET and 15ST gate buoys and input those sightings as your left and right reference markers. Then put the value of 29.5 into cell B11, to align the “theoretical” jump course to those two existing buoys. Then the slalom course sightings which appear on the third page will give you the integrated fit desired—use the shift adjustments in B138 and C138 if needed.

The reverse situation (adding a Jump course to an existing Slalom course) is a little more tedious, since the reference markers are assumed to mark the 15M line of the jump course. Your alignment targets will be G4 and G10 of the existing Slalom course, which will also become 19ET and 19ST in the jump course. There’s two ways to proceed—the first would be to actually set 15ET and 15ST, placing these 4m offset from G4 and G10, and in line with those gates. Then sight those as your reference markers and proceed normally.

Alternatively, you could put G4 and G10 sightings into the worksheet as tentative markers, then have the worksheet “fudge up” theoretical sightings which will be 4 meters offset from those—where 15ST and 15ET are intended to go. Put the value of 29.5 into cell B11, then scroll down and put a value of -8 into cell C138. Next write down the theoretical sightings you see for G4 and G10 (on lines 149 and 162). Finally input those theoretical sightings as the reference markers at the top and reset C138 to zero. Then check to see that the new G4 and G10 theoretical sightings match your actual.
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CONDUCTING THE SURVEY—GENERAL GUIDELINES FOR ALL METHODS.

The AWSA Technical Handbook contains more detail and guidelines on preparing for and conducting such a survey—you should refer to that document unless you are already familiar with surveying techniques and their application to Water Ski sites. Note that a three-point survey is the preferred method, unless the site will not physically accommodate such a procedure.

Standard designation of Slalom Course Sightings: Entrance gate to your left as you face the course from the survey baseline is G1-G2, gate identifiers increase from left to right. Odd numbered Gate buoys are on the far side of the course, even numbers on the near side. Boat path alignment "Pre-gates" are labeled P1-P2-P15-P16. Skier buoys are also numbered from left to right, S1 therefore is on the near side to your left, and S6 is on the far side to your right. TNL is the Tower on the near shore to your Left (for gate G1-2), and TFR is on the Far shore to your Right (gate G15-G16).

a) Recommended Procedure—Three Point Baseline Survey:

Establish a baseline of two points (about 200-250m apart) along one shore of the lake, from which you can shoot a sighting on each of the listed slalom course targets. Station A is the left end of this line, and C is on the right. When setting up at station A, align the instrument so that station C (to your right) reads 180-0-0. At station C, align so that A reads 0-0-0. Then locate a third base point (B) in between A and C, which may be located on the A-C line if convenient, or may be located ahead of or behind that line—or even on the opposite side of the course, if necessary, although the point should NOT be located DIRECTLY across any of the sighting targets from either of the primary baseline points A or C. At this third point, align so that A reads 0-0-0.

At each station, sight the angle to each of the targets listed on the Slalom data recording form (page 5 of this section), including the base point cross sightings shown on the last line. Read angles in degrees, minutes and seconds, and record these sightings on a copy of the form. You will also need to measure and record the distances between all pairs of the sighting stations, using EDM equipment if you have it, or else a tape.

b) Modified Two Point Baseline Survey:

This is a simplified variant of the above procedure which omits the center sighting station "B"—although note that this may NOT be used to certify a course for Record Capability. Also, sightings to non-timing boat gate buoys (Pre-Gates, G3-G6 and G11-14) may be omitted, in which case the measurement basis centerline will be fitted to the remaining gate buoys.

Except for the differences cited immediately above, the survey procedure is otherwise exactly the same as for the standard three-point method, described in the preceding part (a).
c) One/Two Point Angle-and-Distance (EDM) Survey:

Establish a survey base point from which you can shoot a sight to each of the slalom course targets and establish your zero angle to a fixed reference point (to your left as you face the course). Set up your instrument over that base point and align it to zero on the reference point. For Record Capability purposes, you must locate a second shore sighting point from which you can also see all of the course targets, and which can also be sighted from the primary base point. While this point does not need to be on the same side of the course, it should NOT be located DIRECTLY across any of the course buoys from the primary base point.

Sight angle (zero to left, 180 to right) and EDM distance to each of the slalom course buoys, the Judge’s towers, and to the secondary sighting station, if applicable. Read angles in degrees, minutes and seconds, and distances in meters to two or three decimal places (or two places if in feet). Record the angle and distance readings for each sighting, using a copy of the supplied recording form (page 5 of these instructions).

This template presumes that your survey instrument is producing uncorrected slope distances for all sightings (except to the secondary sighting point), and will correct these into true horizontal distances internally—although you must either provide an adjustment value (in meters) for the vertical height differential between the EDM instrument and the reflector on the buoy sightings (if your instrument will provide this for you), or else provide the vertical angle on the sighting to entrance gate buoy G1. If your instrument does produce corrected horizontal distances, then simply input these as is, and leave the height adjustment at the zero default.

Where a secondary sighting point has been established (which is required for Record Capability surveys), set up your instrument over the secondary point, align it to zero on any convenient reference point to your left, then shoot sighting angles from this point to each of the listed sighting targets plus the primary base point, and record these in the Station C column.

REDUCING THE SURVEY—All Survey Types

a) Take the readings obtained in your survey to any IBM PC (or compatible) which has any version of Lotus 1-2-3 (or any other spreadsheet processor which can accept a .WKS type file). If you have a laptop or “Notebook” variety available, bring it to the site with you and reduce your survey right on the spot. Start up your spreadsheet processor and load the appropriate SLMSURVx file (x = 1, 2 or 3, depending on which survey procedure you’ve followed) from your working copy of the supplied distribution diskette (or from your hard drive if you’ve installed them this way).
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AWSA Survey Package Instructions

b) Enter the Name of the Site and the survey Date in the heading section at the top of the worksheet. For a two-point or three-point baseline survey, input the baseline segment length(s). For a single point survey, you will instead input either the vertical height adjustment, or the vertical angle for the G1 entrance gate sighting. If the course uses smaller-diameter non-spherical interior boat gate buoys, you should reset the interior gate width value (to the right end of the P1 line near the top of the worksheet) to 1.10 meters. Then input the sighting angles (and EDM distances for an angle/distance survey) in the input section. If your baseline or EDM distance values are in feet, enter each value as ".3048*xxx.xx" (where xxx.xx is the distance in feet to two places). This form will convert the results to the metric system, which is the official measurement basis.

IMPORTANT NOTE—If you should enter a set of sighting and/or distance values on the wrong row by mistake, DO NOT use the 1-2-3 (or equivalent for other systems) “Move” command to place these values on the proper row—you will have to re-key the data on the proper row, and then enter the correct values for the first row on top of the misplaced ones.

c) Double check the input section to ensure that each value has been entered into the worksheet correctly—then press the Calculate key (F9) to process the survey reduction. You can review the resulting derivations on the screen by moving the display window around, although it is usually preferable to print the results on paper so that you can see it all at once. The necessary Range and Setup parameters have already been pre-set in the worksheet to print the primary section—which consists of the input area plus the key derivative measures, including both tolerances and highlight flags. All of this information will print on a single sheet of paper.

d) Examine the printout or screen carefully—any value highlighted with asterisks (****) is outside the official tolerances for that measurement, according to the current rules. If you are looking at the worksheet on the screen, be sure to scroll over to the right to examine the one or two data columns which are lurking there. Triple check the input data relating to any buoy(s) which are involved in any such out-of-tolerance situations, before starting to move buoys around. Note that the column headed “Sight Err” (three-point baseline survey or two-point EDM survey spreadsheets only) presents the adjusted diameter of the inscribed circle in the error triangle at each target buoy. The allowed tolerance is up to 8 cm (or about three inches) for each target buoy. Large sighting error values indicate any of several different possibilities:

A Lack of precision in measuring the baseline, or a base-line which deviates significantly from straight (when it was INTENDED for the center station B to be located on the A-C baseline) will cause large triangles throughout the survey.

Buoy moving around during the survey can be caused by strong or variable winds, or other disturbances of the water during the sightings. Courses anchored in deep water, or buoys which are floating too high, will tend to exaggerate this problem. Occasional or seemingly random large sighting error values are generally of this sort.

An extremely large sight error probably reflects a data error, either in interpreting the vernier (for instruments so equipped), in recording the angles, or in entering these values into the worksheet. Also, miss identifying one or more of the buoys at
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the time the sightings are being taken can also result in this type of problem. For 3-
point baselines which are not in a straight line, there are two checks on your baseline
configuration, which are presented on the BSLN row. The sum of the interior angles
of a triangle should always add to exactly 180 degrees, and so the first check is to
add up the three vertex angles from the station-to-station cross-sightings. The
leftmost check value displayed is the amount by which your sum differs from a
"theoretically perfect" 180-0-0. Secondly, the spreadsheet then takes the three
station-to-station segment lengths that you have provided, derives what the three
vertex angles of such a triangle should be, then sums the differences between those
derived vertex angles and the actual reported vertex angles from your cross-
sightings. The rightmost check value is that sum of the differences (again presented
in seconds). See the notes in the worksheet, if either value is flagged.

Note that the section headed "Transformed Coordinates" shows the X (up and down
course) and Width locations of each buoy, relative to a least squares best fit
centerline down the center of the 8 (or 10) pairs of boat gate buoys. Be aware that
if one or more buoys at either end of the course are significantly off their nominal
positions, that could result in several other width measures showing out of tolerance,
instead of (or in addition to) those of the offending buoy(s).

e) MAKING CORRECTIONS—NEW FEATURES HERE—CHECK THIS OUT!
This latest revision includes a lot of new features to help you plan and execute
corrections to a slalom course. Those features are located to the right of the primary
data and derivatives area, at the top of the spreadsheet. To find this section, scroll
over to the right, to cell AA1. We've included a control parameter at the top of this
section, that controls whether this section works with Metric or English measures. If
cell AI4 contains a zero, then all error values will be displayed in centimeters, and
your inputs are assumed to be expressed in cm as well. If cell AI4 contains 1, then
the basis for both will be in inches instead of cm. Since the information you cook up
in this section will eventually be used to actually move things around later, you
should use whichever measurement basis you are more comfortable working with.

The top part of this section includes four sets of columns, arranged from left to right.
The leftmost columns display the unadjusted deviations from ideal placement, of
each buoy or object in your survey. The "X-Pos" error column is the deviation in the
up-and-down-course direction, and the "Width" error column is in the side-to-side
direction. These errors are signed, with Positive values in X-Pos meaning away from
the P1-P2 end, and Positive values in Width meaning away from the fitted centerline.
Negative values indicate the opposite directions.

At the bottom of each column you will find an MAD (Mean Absolute Deviation)
statistic, which is the average of the absolute values of the errors, in that respective
direction.

The second set of columns is where you will input your plan of correction
movements, with each movement separated into X-Pos and Width components.
These are also signed values, with the signs meaning the same directions as cited
above.

The third set of columns presents revised errors. Assuming that any correction
movements you plan will actually be made, this fits a new centerline to that revised
gate layout, and then calculates new error values from that new basis line for each
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object in the revised layout. There are also revised MAD statistics shown at the bottom of each column.

The fourth set of columns displays revised EDM sightings, as would be seen from one of your existing survey stations, for each object for which you have input a correction movement. Once you finalize your movement plan, this data can be used to actually accomplish those specific movements. Note that the EDM Distance values shown for each such sighting will always be expressed in meters—the Centimeters / Inches control parameter at the top, only applies to the deviation and movement plan columns.

Both the Initial and Revised width columns are accompanied by a tolerance check column. The revised section will continue to change, as your movement plan develops. There is also a complete length measurement derivation and check area at the bottom of this section, which reflects all of your planned movements. The content here is almost identical to what is shown in the primary measurement section, except that this area will reflect the effects of your planned corrections.

RECOMMENDED PROCEDURE TO DEVELOP A CORRECTION PLAN—

Since the fitted centerline is based on the locations of ALL 20 (or 16) gate buoys, moving ANY of these buoys will then also move the centerline, which in turn will affect all of the other deviation values for the whole layout.

Consequently, you need to develop your correction plan in a specific step-by-step fashion, and in a specific sequence. After you enter each planned movement value, you should press the F9 key to recalculate the spreadsheet to reflect that change, and then observe the effect of that change on all the other measurements. Follow that same iterative procedure through the following areas:

1) First plan side-to-side corrections in the gate buoys, beginning with those which are most obviously out of line with the others. The objective here is to eliminate all the Width error tolerance checks, and/or to reduce the MAD value which appears at the bottom of the revised Width error column.

2) Then plan the up-and-down-course movements of the gate buoys. The objective here is to eliminate all the Length tolerance checks in the Length check area at the bottom of this section, and/or to reduce the MAD value which appears at the bottom of the revised X-Pos error column.

3) Once the gate layout has been corrected, THEN you should plan any necessary movements to the skier buoys, based on their relationships to the revised refitted centerline. Use the “Thru Skier Buoys” section at the lower right and the Width errors on those skier buoy rows as guidance, and also check the revised “Skier Buoy Average Width”.

4) Finally, you can figure corrections in your Judges Tower markers, to correct the angle to the final entrance gate locations. It’s easiest to plan these corrections in the up- and-down-course direction, although your shoreline configuration may dictate movement in both axis directions in order to get the angle you want. Note that the Ideal angle is 44 degrees, and the +/- tolerance is 3 degrees—hence the “Good” range is 41-47.
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Then once you’re satisfied with your correction plan, you should print out a copy of this section (note the print range cited at the top of this section) and use that data to execute your movements. If you have an EDM instrument, you can guide the corrections using the “Revised Sightings” shown in the rightmost columns, which are figured from one of your existing survey base points.

Alternatively, you can accomplish your corrections thru visual alignment of each buoy to be moved, relative to its adjacent neighbors in both directions. Separate observers (coaches) in both the up-and-down-course and side-to-side directions, will help ensure that those movements are accomplished as intended. As an additional aid to this procedure, the revised spreadsheets also include a visual “Correction Movement Map” section, which you can print out and work from. Scroll over to column BA1 to find this new section and the associated print instructions.

f) After making any adjustments and/or corrections (and re-shooting all or part of the survey if necessary and re-processing the results), print out a final copy of the worksheet and attach it to the Technical Controller’s report from the tournament. Save a copy of the completed worksheet file—but DON’T save it to the original SLMSURVx name (which will wipe out your original master copy of the template), instead save it under a new name which will help you identify it, should you need to access it again at a later date.
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**AWSA Survey Package Instructions**

#### SLALOM SITE SURVEY DATA RECORDING FORM V3.43 4/2001 (Page 8 of 8)

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--- Site Description

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**Designation & Orientation Standards**

- Station A and zero angle to your left on baseline; G1-G2 entrance gate to your left, G15-G16 to your right. Odd gate buoy numbers on far side, even on near.
- Skier buoys (Sx) numbered 1 thru 6 from the left entrance gate. Boat path alignment “Pre-gates” (Px) outside entrance gates at either end. Judges’ Tower TNL is on the near shore to your left (for Gate G1-G2), and TFR is on the far shore to your right (for Gate G15-G16). BSLN are the A-B, B-C & C-B baseline cross sightings (Required Alignment: A-C=180, B-A=0, C-A=0)
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AWSA Survey Package Instructions

JUMPING SITE SURVEY AND REDUCTION INSTRUCTIONS

CONDUCTING THE SURVEY—General guidelines for all methods.

The AWSA Technical Handbook contains more detail and guidelines on preparing for and conducting such a survey—you should refer to that document unless you are already familiar with surveying techniques and their application to Water Ski sites. Note that a three-point survey is the preferred method, unless the site will not physically accommodate such a procedure.

All of the JMPSURVX variations provided here include support for the setup and verification of both the Johnson Jump Meter System, and the Corson Video Jump Distance Measurement System. Look at the Jump Site data recording form which is the last page of this section of these instructions and study the object designation and orientation notes which appear at the bottom of that form. Note that the bottom-most recording section may serve either the Meter OR Video systems. Those lines labeled Mt/Ck-A+ in that input section, are to be used either for Meter station pivot sightings when a meter system is being used, or for Video Check buoys with the video system. Similarly, the cell labeled Tst/Cam is to be used as the meter alignment/test point sighting for a meter system, or to identify a video camera location when video measurement is being used.

Sighting targets for all Jump Site survey variants include a wide variety of objects. On the water, these include 8 to 10 boat gate buoys (the ST, MT, ET and EC gates are required, the AG is optional), along with the 150/180/210 skier buoys, the inside and outside high end corners of the jump ramp plus the sighting mark at the center of the ramp (if present), and possibly a grid of Video system reference and check buoys in the jump landing area. On shore, these include the sighting arm pivots on all 3 jump meter stations, plus a meter sighting alignment/test point which should be located across from the meters near the center of the landing zone, and possibly one or more video camera support locations. Finally, the preferred method for establishing the rotation of the jump ramp is to place an additional marker on shore, along a line extended sideways off the high end of the ramp—this object is designated HEXM.
APPENDIX 7.7 Page 14 of 20
AWSA Survey Package Instructions

CONDUCTING THE SURVEY—Specifics for each alternative method.

a) Recommended Three Point Baseline Survey:

Establish a baseline of two points (about 200-250m apart) along one shore of the lake, from which you can shoot a sighting on each of the listed Jumping site targets. Station A is the left end of this line, and C is on the right. When setting up at station A, align the instrument so that station C (to your right) reads 180-0-0. At station C, align so that A reads 0-0-0. Then locate a third base point (B) in between A and C, which may be located on the A-C line if convenient, or may be located ahead of or behind that line—or even on the opposite side of the course, if necessary, although the point should NOT be located DIRECTLY across any of the sighting targets from either of the primary baseline points A or C. At this third point, align so that A reads 0-0-0.

At each station, sight the angle to each of the targets listed on the Jumping data recording form (page 6 of this section), including the base point cross sightings shown on the last line. Read angles in degrees, minutes and seconds, and record these sightings on a copy of the form. You will also need to measure and record the distances between all pairs of the sighting stations, using EDM equipment if you have it, or else a tape.

b) Modified Two Point Baseline Survey:

This is a simplified variant of the above three-point procedure which only uses two stations instead of three—although you should note that this variant may NOT be used to certify a course for Record Capability purposes. The survey procedure is otherwise exactly the same as the standard three-point method, described in part (a) above.

c) One/Two Point Angle-and-Distance (EDM) Survey:

Establish a survey base point from which you can shoot a sight to each of the targets specified above and establish your zero angle to a fixed reference point (to your left as you face the course). Set up your instrument over that base point and align it to zero on the reference point. For Record Capability purposes, you must locate a second shore sighting point from which you can also see all of the sighting targets, and which can also be sighted from the primary base point. While this point does not need to be on the same side of the course, it should NOT be located DIRECTLY across any of the sighting targets from the primary base point.

Sight angle (zero to left, 180 to right) and EDM distance to each of targets specified above. Read angles in degrees, minutes and seconds, and distances in meters to two or three decimal places. If your instrument only registers in feet, two decimal places is sufficient. Record the angle and distance readings to each point on a copy of the Jumping Site Recording form which is incorporated in these instructions.

This template presumes that your survey instrument is producing uncorrected slope distances for all sightings, and will correct these into true horizontal distances internally—although you must either provide adjustment values (in meters) for the vertical height differential between the EDM instrument and the reflector at the 180M.
buoy plus the various shore-based targets (if your instrument will provide these for you), or else provide the vertical angle on these sightings. These vertical angles or height adjustments should be recorded in the Station B column on the data recording form. If your survey instrument does produce corrected horizontal distances, then simply input these as is and leave the adjustment values at their defaults.

Where a secondary sighting point has been established (which is required for Record Capability surveys), set up your instrument over this secondary point, align it to zero on any convenient point to your left, then shoot sighting angles from this point to each of the various sighting targets plus the primary base-point, and record these sightings in the Station C Column.

**REDUCING THE SURVEY—All Survey types.**

a) Take the readings obtained in your survey to any IBM PC (or compatible) which has any version of Lotus 1-2-3, Excel (or any other spreadsheet processor which is capable of loading a .WKS type file). If you have a laptop or "Notebook" variety available, bring it with you and reduce your survey right at the site. Start up your spreadsheet processor and load the appropriate JMPSURVx file (x = 1, 2 or 3, depending on which survey procedure you've followed) from your working copy of the supplied distribution diskette (or from your hard drive if you've installed them this way).

b) Enter the Name of the Site and the survey Date in the heading section at the top of the worksheet, and then indicate in that same section which shore the survey was shot from, and which shore the meters are on. For a two-point or three-point baseline survey, input the baseline segment length(s). Then input the various sighting angles (plus the EDM distance values and height adjustments or vertical angles for an angle/distance survey) in the input section. If your baseline or EDM distance values are in feet, enter each value as ".3048*xxx" (where xxx is the distance in feet to two places). This will convert the results to the metric system, which is the official measurement basis. For an EDM survey, input the Vertical Height adjustment values (or vertical angles) on the 180M sighting row, as well as for all the shore-based points, which include the ramp alignment point, the meter test point and the meter pivots.

**IMPORTANT NOTE—**If you should enter a set of sighting and/or distance values on the wrong row by mistake, DO NOT use the 1-2-3 (or equivalent for other systems) "Move" command to place these values on the proper row—you will have to re-key the data on the proper row, and then enter the correct values for the first row on top of the misplaced ones.

c) Double check the input section to ensure that each value has been entered into the worksheet correctly—then press the Calculate key (F9) to process the survey reduction. You can review the resulting derivations on the screen by moving the display window around, although it is usually preferable to print the results on paper so that you can see it all at once. The necessary Range and Setup parameters have already been pre-set in the worksheet to print the primary section—which consists of
the input area plus the key derivative measures, including both tolerances and highlight flags. All of this information will print on a single sheet of paper.

d) Examine the printout or screen carefully—any value highlighted with asterisks (****) is outside the official tolerances for that measurement, according to the official rules. If you are looking at the worksheet on the screen, be sure to scroll over to the right to examine the one or two data columns which are lurking there. Triple check the input data relating to any buoy(s) which are involved in any such out-of-tolerance situations, before starting to move buoys around.

Note that the column headed “Sight Err” (three-point baseline survey or two-point EDM survey spreadsheets only) presents the adjusted diameter of the inscribed circle in the error triangle at each target buoy. The allowed tolerance is up to 8 cm (about three inches) for buoy and ramp sightings, and half that amount for the shore-based targets. See page 4 of the Slalom Course section of these instructions for a discussion of the causes of large sighting error values, or for an explanation of the check values presented on the BSLN row.

Note that the section headed “Transformed Coordinates” shows the X (up and down course) and Y (side to side) locations of each buoy and the ramp, relative to a least squares best fit centerline down the 15 Meter line of the timing course. You should be aware that if one or more buoys at either end of this line are significantly off their nominal positions, that could result in several other measures showing out of tolerance, instead of (or in addition to) the errors on the 15M line showing up. Consider this when evaluating the results.

e) After making any adjustments and/or corrections (and re-shooting all or part of the survey if necessary and re-processing the results), print out a final copy of the worksheet and attach it to the Technical Controller’s report from the tournament. Save a copy of the completed worksheet file—but DON’T save it to the original JMPSURVx name (which will wipe out your original master copy of the template), instead save it under a new name which will help you identify it, if and when you need to access it again at a later date.

f) Use the Meter Setup data which appears in the bottom right portion of the completed worksheet to align the protractors on the meter tables. Align the protractor on each meter station so that a sighting to the test point indicates the value shown on the worksheet. This will result in a metering system that will function most accurately in the actual operating range. As an additional check, actual sightings to the ramp and to 15ET should also match the worksheet values, although again the test point values are the preferred basis to use for protractor alignment, as long as you have selected a clearly visible test point which is out in front of the meters across the area in which the jumpers will actually be landing.
g) The Meter setup information mentioned above also provides the parameters required
to prepare the WSTIMS system to calculate jump distances for this site and is also
the same data which is needed in order to prepare a manual master-board (as a
backup device, in the event you do not have an independently-powered backup
computer system available).

h) The Video Reference Sightings (VRL1, VRR1, VRL2, VRR2, etc.) are provided to
establish the water surface coordinates of up to 8 individual reference marker buoys
for the Corson Video Jump Measurement System. There are also input cells provided
for up to 3 video check buoys, plus a video camera location (on shore). The derived
coordinates of these locations are presented on the left side of the second page of
the results and have been translated into a framework which has the ramp center as
the assumed (0, 0) origin point. These are the preferred values for input to the CVJ
Grid Setup screen.
### JUMPING SITE SURVEY DATA RECORDING FORM V3.43 4/2001 (page 6 of 6)

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</tr>
<tr>
<td>BGC BSLN</td>
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</table>

### DESIGNATION & ORIENTATION STANDARDS
- 15xx buoys are those closest to ramp. ROHC and RIHC are the Outside and Inside high-end corners of the ramp (in=closest-to-gates). Rctr is the Ramp Center (omit if no center mark). HEXM is a mark on shore extended across the high end of ramp, to derive rotation. VJ ref buoys are coded L/R as seen from ramp, in rows down course. Use Mt/CK-A/B/C for Jump Meters or Video Ck buoys (Meter A is closest to ramp). Test/Cam is Test Pt across landing area for Meters, or Video Camera loc. BSLN are the A-B, B-C and C-B baseline cross sightings (REQUIRED Alignment: A-C=180, B-A=0, C-A=0).
Slalom Survey Exercise

The following is intended to offer practical experience for using and understanding the Survey reduction spreadsheets employed to calculate the data collected during a 3 point survey. This will require the user to download the current version of wssurv34.exe located on the AWSA Web Site under TC Resources.

Slalom Survey Analysis Exercise -- Including Sample Sighting Data

This exercise has been created to help a survey user to become more familiar with the Slalom Survey tools, and how to use these to deal with a slalom course in need of adjustment.

Cut and paste the data below, into the "Sighting Values" section of the 3-point slalom survey spreadsheet template SLMSURV3.WKS. Then identify and correct a few errors that exist in this input data -- look for sighting error and baseline check flags. You should have enough information here to be able to figure out what those errors are and to correct them -- here are some hints to help you.

(1) For one of the baseline cross-sightings, the minutes and seconds values were reversed when they were recorded.

(2) You will see a pair of large sighting errors on one of the interior gates. The problem occurred at one of the three base stations, the recordings of those two sightings were reversed. By visualizing the setup at each station, and how that particular string (S2-G5-G6) would appear from each, you should be able to figure out and correct this error.

(3) The large sighting error on G14 is due to the degrees value on one of the three sightings having been read wrong by one degree. As above, visualize what the S6-G13-G14 string should look like from each station, and that will help you identify where the error is.

Once your input data is "good", then study the slalom course itself -- you will find a several "Out of Tolerance" conditions.

Use the "Correction Planning" features of the spreadsheet to develop a correction plan for this course.

Refer to the instructions included in the spreadsheet itself. Note that a "minimally acceptable" course can be produced by moving only 9 of the 28 buoys. Moving an additional 8 would result in a course where everything is within 5cm (2 inches) of ideal.

You are encouraged to develop both a "Minimally Acceptable" correction plan, and then another "More Idealistic" correction plan, and print out the "Movement Map" for each of these.
## Baseline Lengths

### Angular Sighting Input

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<th>Station B</th>
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<tr>
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</tr>
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</table>

**A to B**  194.231
**B to C**  197.05
**A to C**  204.091
Go to AWSA Web Site under TC Resources to download the Excel program. (The document too large to put on one page, Page 2 of this Appendix is not clear) Ed spent a lot of years installing course and develop this spread sheet that provided the direction in which to move the buoy in reference to the diver looking at the surveyor. This helps in communication.

1) READ the instructions at the bottom of Spread Sheet.
2) Requires 2 buoy mark for center line and which the one to your left (surveyor) will be the gates. 0 will be for X and Y axis.
3) IF you instrument provides a HORIZONTAL distance, input 0 for instrument height.
4) F9 is calculates the required buoy placement after you input the two reference buoys.
5) This program also uses the old number system as Dave Clark Programs.
6) Using the calculated Distance and Angle, install buoy.
7) After the first buoy is installed, input the survey points and press F9. To the left it will provide the distance in INCHES that the buoy needs to be mover as if the diver is looking at you, NOT X/Y to the reference buoys.
8) After re-inputting the distance and angle, press F9 to recalculate. IF the buoy shows 0 to the far right the buoy is OK, if it shows YES under FIX, the buoy needs to be moved as shown (in inches towards, away, left and right as the diver looking at you -surveyor).
9) SPARE at the bottom can be changed for the X/Y. F9 will calculate where to put the buoy. This X/Y are from the reference buoy, with the one on left being 0,0. This can be used to install a jump course with jump set in place or be used with existing slalom course (example G6).
7.9 SplashEye/Corson VIDEO JUMP GRID SETUP

Page 1 of 5
(written by Dave Clark)

1. Plan your camera and grid layout(s) – the measurement “view(s)”: 
   a. Where feasible, use one of the recommended cameras and reference grid layouts that are shown in the following diagrams on the following pages.
   b. For custom situations the VJVIEW16.wks planning tool; also available from the AWSA website can be used to explore key setup alternatives – most critically camera placement – see sample printouts. More detailed instructions included are within the spreadsheet template itself.

2. Install reference marker buoys and camera pylon(s), as planned.

3. Establish the exact water surface coordinates of reference grid buoys and check points – use one of three methods, as appropriate for class of competition:
   a. Survey the reference grid along with the rest of the jump course – required for class “R” – see the sample printout on following pages.
   b. Class C: If no survey, take manual measurements between reference grid buoys, and then use the VJGRID11.wks spreadsheet – recording form and examples on following pages.
   c. Use existing meter system and WSTIMS setup program to plot reference buoys – record X and Y coordinates reported for each point sighted.

4. Set up shore-based equipment and arrange it for use:
   a. Prepare computer equipment and turn on and hook up video cables(s).
   b. Install camera(s) and verify view(s) – adjust Zoom, Tilt & Pan as necessary.

5. Prepare measurement setup – repeats steps for each view, if more than one:
   a. Verify that camera view covers the intended landing area as planned.
   b. Input the grid point coordinates for this grid, if not previously saved.
   c. Mark the locations of the grid reference buoys on the display screen.
   d. Run the “Accuracy Check” procedure – verify results for class.
   e. Verify the coordinates of the independent check point.

6. Run Jumping Events:
   a. Periodically verify that reference marks are still centered on buoy images.
   b. Measure jump distances with accuracy and confidence!
Camera about 30m downcourse, 80m back, and 9m high.

If properly positioned, local tournament precision can be produced with one single camera viewpoint to cover the entire range of local tournament jumps.

Camera about 35m downcourse, 75m back, and 9m high.

For many sites, placing the camera viewpoint(s) on the opposite side of the lake from the "traditional" meter baseline may provide the necessary "further back" camera sightline(s).

However, Record Capability precision will typically require either 2 or 3 cameras. In general, placing the cameras higher up and/or further away from the landing area will work better than closer in or lower down. Exactly where
the cameras are positioned, and how the reference grids need to be set up, depends on how much room is available on
the site, and what the lay of the land is like. Six alternative recommended layouts are presented on the following three
pages, each of which is capable of meeting the most demanding Class “R” precision.

**Cameras on Left**

Cameras at (44, 90) and at 14m Tall

**“R” Spec Alternative #1 -- Two overlapping fields of view, covered by two cameras, both placed on one single tall pylon.**

**Cameras on Right**

Cameras at (50.85) and at 15m Tall

**“R” Spec Alternative #1 -- Two overlapping fields of view, covered by two cameras, both placed on one single tall pylon.**
Cameras on Left

Cameras at (60,45) and at 10m Tall

Cameras at (28,45) and at 9m Tall

“R” Spec Alternative #2 -- Two overlapping fields of view, covered by two cameras, each on its own separate pole.

Cameras on Right

Camera 2 at (58,60) and at 9m Tall

Camera 1 at (38,60) and at 11m Tall

“R” Spec Alternative #2 -- Two overlapping fields of view, covered by two cameras, each on its own separate pole.
“R” Spec Alternative #3 -- Three overlapping fields of view, covered by three cameras, each on its own separate pole.

Cameras on Left
- Camera 3 at (57, -45) and at 6m Tall
- Camera 2 at (34, -45) and at 6m Tall
- Camera 1 at (20, -45) and at 6m Tall

Cameras on Right
- Camera 3 at (60, -45) and at 6m Tall
- Camera 2 at (47, -45) and at 7m Tall
- Camera 1 at (34, -45) and at 7m Tall

Ramp is at (0, 0)
### 7.10 VJVIEW 16 View Planning Spreadsheet

**Examples:** VJVIEW16 “View Planning” analysis spreadsheet. Original proposed view at the top of the page fails in a few ways, while the revised view presented below that no longer shows any such failures.

<table>
<thead>
<tr>
<th>Camera Viewpt</th>
<th>Camera Elevation:</th>
<th>Camera Angles:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Left</td>
<td>10.77</td>
<td>Pan 14.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tilt -2.4</td>
</tr>
<tr>
<td>Lower Left</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Right</td>
<td>10.77</td>
<td>Pan 14.7</td>
</tr>
<tr>
<td>Lower Right</td>
<td></td>
<td>Tilt -2.4</td>
</tr>
</tbody>
</table>

#### Corson Video Jump Measurement System -- View Analysis

**Resolution** --- ---

- **Horiz Scrn:** 640
- **Min:** 10
- **Max:** 50
- **Pixels:**
  - (Pixels): 660
  - Intended Operating Distance Range (meters)
  - Widen?: (see notes if not zeroes here)
  - 1-Pixel Move?: 10
  - Adjusted Operating Distance Range (meters)
  - Viewpt?

<table>
<thead>
<tr>
<th>Water Surface</th>
<th>Grid &amp; Camera</th>
<th>Location Acrs</th>
<th>Acrs</th>
<th>Y</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up-Down</td>
<td>Screen TWIP Vertx</td>
<td>Projected TWIP dimensions of Ref Grid</td>
<td>K</td>
<td>^</td>
<td>^</td>
</tr>
<tr>
<td></td>
<td>X- Y-</td>
<td>d(R)</td>
<td>d(V)</td>
<td>d(D)</td>
<td>d(T)</td>
</tr>
<tr>
<td>Upper Left</td>
<td>6287 2131 115.97</td>
<td>High: Left 595</td>
<td>K</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Lower Left</td>
<td>6451 2117 115.97</td>
<td>Right 680</td>
<td>K</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Upper Right</td>
<td>10 8642 28.24</td>
<td>Wide: Far 6014</td>
<td>K</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Lower Right</td>
<td>15 7318 42.01</td>
<td>Near 6421</td>
<td>K</td>
<td>^</td>
<td></td>
</tr>
</tbody>
</table>

#### Corson Video Jump Measurement System -- View Analysis

**Locations**

- **Selected**
- **Landing Displacements for 1 Pixel Moves**

<table>
<thead>
<tr>
<th>in the Jump</th>
<th>Up-Down Acrs</th>
<th>Horizontal Move</th>
<th>Vertical Move</th>
</tr>
</thead>
<tbody>
<tr>
<td>X- Y-</td>
<td>d(R)</td>
<td>d(V)</td>
<td>d(D)</td>
</tr>
<tr>
<td>Long Jump 90%</td>
<td>50 60 0.078 -0.004 0.076 0.076 198</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Med-Low 70%</td>
<td>40 60 0.075 0.004 0.076 0.076 198</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Med Jump 50%</td>
<td>30 60 0.074 0.004 0.076 0.076 198</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Short-High 30%</td>
<td>20 60 0.077 0.004 0.076 0.076 198</td>
<td>K</td>
<td></td>
</tr>
</tbody>
</table>

---

**Notes:**

- Horiz Scrn: 612 x 792
- Field of View Width: 29.9
- Longer shows any such failures.

Measurement Recording Form

Far Left

Far Right

Check Point

Near Left

Near Right

For use with Spreadsheet VJGRID11.WKS -- which will derive the required grid coordinates that are needed for input to the Corson Video Jump

Take all indicated measurements -- record each of these to the nearest inch or
Sample of Manual Measurements

For use with Spreadsheet VJGRID11.WKS -- which will derive the required grid coordinates that are needed for input to the Corson Video Jump

Take all indicated measurements -- record each of these to the nearest inch or
The report above is a reproduction of the VJGRID11 spreadsheet, which calculates CVJ reference point coordinates from manual measurements. The actual input section near the top is highlighted in bold. Note that these measurements are keyed to the 11 numbered boxes on the data recording form. The data in this example are the actual measurements from the completed data recording form that appears on the preceding page. Note that the raw measurements can collected and input as either feet/inches, or as metric. But all coordinate results are in metric, as required by the CVJ programs. SEE next page for Continuation.
The derived coordinates of the reference buoys and check point are then presented near the bottom. The values in that section are also shown in bold here. These are the values that need to be entered into the “Surveyed X and Y” Coordinate boxes in the grid setup screen of the CVJ measurement program.

As a validity check, this spreadsheet also calculates derived lengths for the NL-FL and Ramp-CP distances, from the other inputs, and compares those to the actual measure lengths of these two segments. These check values appear at the lower left corner, and the “error” numbers are the differences between the actual and derived lengths. Ok as long as these are no large than about 0.15 meters (15cm or about 6 inches). (written by Dave Clark)
7.12 EXAMPLE OF LAB REPORT FOR YOUTH ROPE

PAGE 1 OF 2

NORTHWEST LABORATORIES of Seattle, Incorporated

Report To:  Maintenance USA
Attention:  Randy Nohaver
Report On:  Ski Ropes
Lab No.:  192369

IDENTIFICATION:
#1:  RPP5 5mm rope
#2:  RPP5 7mm rope
#3:  RPP5 8mm rope

TEST PROCEDURE:  Test Rope Per AWSA Rule 8.04.

TEST RESULTS:

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Elongation @ 250 Lbs.</th>
<th>% Elongation</th>
<th>Ultimate Load At Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.35</td>
<td>4.4</td>
<td>1.160</td>
</tr>
<tr>
<td>2</td>
<td>0.35</td>
<td>4.4</td>
<td>1.080</td>
</tr>
<tr>
<td>3</td>
<td>0.30</td>
<td>3.6</td>
<td>1.075</td>
</tr>
</tbody>
</table>

This report applies only to the actual samples tested. Northwest Laboratories does not certify, warrant, or guarantee any products manufactured by others. Samples will be discarded within thirty (30) days unless otherwise requested in writing by you.

NORTHWEST LABORATORIES, INC.

[Signatures]

Richard J. Schleiffl
Engineer

Richard J. Schleiffl
Technical Manager
# NORTHWEST LABORATORIES of Seattle, Incorporated

Established 1896
Technical Services for Industry, Commerce, Legal Profession & Insurance Industry
241 South Holden Street • Seattle, WA 98102-4320 • Phone: (206) 763-6260 • Fax: (206) 763-3465 www.nwlabsonline.com

**IDENTIFICATION:**
- A: ML 3/8” Poly Pro
- B: Freestyle 3/8” Poly Pro
- C: ML Poly E 16 strand
- D: Freestyle Poly E
- E: Freestyle Poly E

**TEST PROCEDURE:**
Test Rope Per AWSA Rule 8.04.

**TEST RESULTS:**

<table>
<thead>
<tr>
<th>Sample</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elongation @ 250 Lbs. 8” Gauge Length</td>
<td>0.24</td>
<td>0.28</td>
<td>0.42</td>
<td>0.52</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>% Elongation</td>
<td>3.0</td>
<td>3.5*</td>
<td>5.3*</td>
<td>6.5*</td>
<td>3.8*</td>
<td>2.2-3.0</td>
</tr>
<tr>
<td>Ultimate Load</td>
<td>2,135</td>
<td>1,320*</td>
<td>1,200*</td>
<td>1,225*</td>
<td>1,860</td>
<td>1,800 min</td>
</tr>
<tr>
<td>Weight per linear foot</td>
<td>0.577*</td>
<td>0.539</td>
<td>0.194</td>
<td>0.175</td>
<td>0.235</td>
<td>0.250 oz. max</td>
</tr>
</tbody>
</table>

*Fails to meet specified

This report applies only to the actual samples tested. Northwest Laboratories does not certify, warrant, or guarantee any products manufactured by others. Samples will be discarded within thirty (30) days unless otherwise requested in writing by you.

**NORTHWEST LABORATORIES, INC.**

Richard J. Schenck, Engineer

Richard J. Schenck, II, Technical Manager

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7.13 BC Video Trick Program

This document describes the Video Trick Timer 2004 program operation.

The intent of this redesign was to make the product more reliable by using commercial controls rather than shareware controls and to simplify its operation to make it more "user friendly".

The VTT04 consists of three basic screens as follows:

Setup
Capture
Timer

Menu Selections

View Log
View Manual
Exit

View Log
Each time a trick run is captured and processed through the timing screen, that information is recorded in this log. You can view any run or retim the run by selecting the desired run and then clicking the View button (or double-clicking the file) which will take you to the Timer Screen with the selected file loaded.

View Manual takes you to the screen you are now in; "Viewing the Manual".

Exit – Quit the program

Setup Screen Buttons and Controls

Proceed to Record Runs
This button takes you to the screen where you will record the trick run and operate the audible timer.

View Already Recorded Runs
This button takes you directly to the screen where you select the start of the trick run. From there you can load a run to view.

Save Video Files in this Directory
Type in the folder where you will save the captured video files

Import Skier Names Button
If you have an already existing list of all of the skier’s names, you can import this into the program. Once that is done, you only have to select the name from a list rather than typing it as the skier has his turn. The list should be a plain text list with one name per line like this:

Jimmy Siemers
Cory Pickos
Nicolas Leforestier
Appendix 7.13 BC Video Trick Program Page 2 of 3

And so on. You might want to alphabetize it if it is a large list.

Enable Barefoot
Checking the textbox sets the trick run time to 15 seconds for barefoot.

Show Configuration
Clicking this button reveals all of the technical parameter settings for your video hardware. This will vary for each system.

The most important items to select here are the resolution which probably should be **320x240**, the compression method (Microsoft 1 or Indeo) and the frame rate. The frame rate must be 30 (25 for PAL) for an R tournament, 15 or higher for an L and 10 for normal or class C. You must set these parameters to some combination where during the capture process, you will not drop frames (the faster your computer, the better). Making the picture smaller or the capture slower may be required so that you do not lose frames. Losing frames should not affect the timing, but it might affect your ability to select the correct start frame if you drop frames at that point.

Once all of these parameters have been set, you can hit the “Hide Configuration” button and should not need to access this screen again as all of the parameters are saved in the Registry on this individual computer.

Capture Screen

When you enter the capture screen, the program first checks the name of the file that you will save the capture to. The name of the file is the skier’s name followed by the pass number. If a file already exists for what you have set up, a warning will tell you, but not prevent you from saving the file. The Start Recording button will be highlighted. The idea is to start to record when the skier passes the 50m (green) “can’t change the speed” buoy. The recording is set to run for 40 seconds. A countdown timer will show how much time is left. You can just let the capture process happen and take no further action on this screen. It will automatically switch to the Timer Screen when it is finished.

You can also use the Start Recording Menu to start recording. Just hit the ALT key to select the menu and then when you are ready to start hit the ENTER key.

There is a Start Trick Timer button. The function of this button is to tell the program where the skier starts. This will make it easier to position to the exact start point in the timer screen. It also activates a start horn and then in 20 seconds an ending horn. A 20 second timer countdown (15 for barefoot) is shown. If you press the Start Trick Timer button and there is less than 20 seconds left on the recording time, the file recording time will automatically be extended by 25 seconds from that point.

To stop recording at any time, press the ESC key. Some examples might be if the skier falls or if the pass is over and you do not want to wait for the full 40 second time to end.

Pressing the ESC key or waiting until the recording time expires both have the same effect of switching to the timer screen.
Appendix 7.13  BC Video Trick Program  Page 3 of 3

Status boxes show the number of frames saved and the number of frames dropped. The initial configuration should be set so that no frames are dropped.

You can also go back to setup or on to the timer if you decide not to record the run.

Pressing the Select button brings up the list of skiers to select from if one had been loaded in. Just double-click on the skier you want, and that name will be loaded in. You may also type in a name.

**Timer Screen**

If you get to the Timer Screen via the recording process, the recorded file will be loaded. If you used the "Start Trick Timer" function, the video will be positioned at the point where you pressed the button. If you did not use the start timer function, the video will be positioned seven seconds after the start of the run, which hopefully will be close.

Use the slider, arrow buttons, or keyboard arrow keys to move to the exact start frame. Press the "Play before Start" button to play for 2 seconds up to the point you selected. Do this as much as required to ensure that your selection is correct. You can change the 2 second value if you want. You can also use the full screen by checking the option box that says: "Play using full screen". You get back to the regular screen by pressing Escape. Once you are happy with the selection press the "Mark Displayed Frame" button this will set that frame as the start and the play the last 5 seconds of the run up to the end of the run, so you can identify the last trick. You can also with the "Play to end, pause, continue" button, play past the end point as that may clarify what the last trick was. This process also locks in the start frame so that you can’t change it. If you want to you can also use the full screen by checking the option box that says: "Play using full screen". You get back to the regular screen by pressing Escape.

The normal process would then be to go back to the Recording Screen using the button.

You can also get to the timer screen directly to measure existing files. Use the selection button to pick a file to view or measure. When you select a file that already has been measured, you will receive a warning that tells you what the measured start frame already measured was.

You can also access the log file which will allow you to view the runs that you have already captured and measured. The status bar underneath the video player shows you the frame counts.
7.14 Camera Lens Backfocus Adjustment

Page 1 of 3

TECH TIP
VICON TECHNICAL SERVICES GROUP

1. Backfocus
The distance from the lens mounting surface on the front of the CCTV camera and the position of the pickup device (CCD chip or tube) is called the flange focal distance, or backfocus distance. The surface that the lens mounts up against is called the flange. On "C" style cameras, this distance is 17.5mm. On a "CS" style camera, the distance is 12.5mm. This distance is adjustable over a small range on virtually all CCTV cameras. "C" mount lenses may be installed directly on "C" style cameras, or, by using a 5mm C-CS adapter ring, on "CS" style cameras. "CS" lenses cannot be mounted on "C" style cameras. See Figure 1.

![Figure 1: "C" vs. "CS" Mounting Difference](image)

Theoretically, it should be possible to just thread in a lens and have the image in focus, but in reality, manufacturing tolerances on both lenses and cameras combine to make it necessary to backfocus whenever a lens is installed on a camera.

*If a lens is not correctly backfocused, it is highly likely that the camera/lens assembly cannot deliver a sharply focused picture either all the time or under conditions of reduced light levels.*

General
Backfocus adjustment can be performed on the bench; it does not have to be performed with the camera in place in its final location. Doing the procedure indoors greatly simplifies the process of...
reducing ambient light levels. *This procedure should always be done with the lens iris at its maximum open position.*

**Fixed Focal Length Manual Iris Lenses**

1. Thread the lens into the camera.
2. Adjust the focus ring on the lens to the maximum infinity setting. In most cases, the focusing ring can be recognized by the presence of distance numbers, usually marked in both meters and feet.
3. Open the lens iris to its maximum. If the picture on the monitor is too bright, reduce the ambient lighting (if you are indoors) until the monitor image is optimum.
4. While viewing a good, high-contrast target at a distance of at least 30 feet (10 meters) from the camera, move the camera’s backfocus adjustment until the monitor displays the sharpest possible picture.
5. Lock the backfocus adjustment in place, if the camera has a backfocus lock. Not all cameras have a separate backfocus lock.

**Fixed Focal Length Autoiris Lenses**

1. Thread the lens into the camera and make any wiring connections.
2. Adjust the focus ring on the lens to the maximum infinity setting. In most cases, the focusing ring can be recognized by the presence of distance numbers, usually marked in both meters and feet.
3. Reduce the ambient lighting (if you are indoors) until the lens is opened to its maximum. The simplest way to determine this is to look into the lens. If the location does not allow the reduction of ambient light, a neutral density filter may be used. Neutral density filters are described at the end of this Tech Tip.
4. While viewing a good, high-contrast target at a distance of at least 30 feet (10 meters) from the camera, move the camera’s backfocus adjustment until the monitor displays the sharpest possible picture.
5. Lock the backfocus adjustment in place, if the camera has a backfocus lock. Not all cameras have a separate backfocus lock.

**Motorized Zoom Lenses**

1. Thread the lens into the camera and connect the lens to a lens controller. If the lens has an autoiris, connect the lens iris cable to the camera.
2. Using the lens control, zoom in on a good, high-contrast target at a distance of at least 75 feet (25 meters) from the camera. Use the maximum telephoto setting.
3. Using the lens controller Focus Far control, obtain the best-focused image of the selected target.
4. **Non-Autoiris Zoom Lenses:** Reduce the ambient lighting (if you are indoors) until the lens is opened to its maximum. Use the lens control to open the iris. If the location does not allow the reduction of ambient light, a neutral density filter may be used.
Appendix 7.14    Camera Lens Backfocus Adjustment Page 3 of 3

5. **Auto-Iris Lenses**: Reduce the ambient lighting (if you are indoors) until the lens is opened to its maximum. The simplest way to determine this is to look into the lens. If the location does not allow the reduction of ambient light, a neutral density filter may be used.

6. While viewing a good, high-contrast target at a distance of at least 75 feet (25 meters), move the backfocus adjustment until the monitor displays the sharpest possible picture.

7. Zoom the lens to its maximum wide-angle setting, and repeat Step 6 to obtain the sharpest image.

8. Zoom the lens to the maximum telephoto setting to see if the image is still sharp. If it goes out of focus, readjust the lens controller Focus control (do not readjust the backfocus adjustment). Repeat the zoom in – zoom out cycles to obtain optimum focus.

9. Lock the backfocus adjustment in place, if the camera has a backfocus lock. Not all cameras have a separate backfocus lock.

**Neutral Density Filter**

This is a piece of gray tinted glass. They are widely available at photographic supply stores and come in different densities and diameters. To use it, simply hold it against the front of the lens while making adjustments. It is not necessary to fasten the filter to the lens.

Other means of reducing ambient light are the glass lenses used in brazeing masks (a number 2 or 3). Do not use a film or glass darker than ND 3.0; doing so may degrade picture quality and make focusing difficult.

2. **Auto-Iris Adjustments**

Most auto-iris lenses in use today fall in to one of two categories. Adjustments will vary between styles.

**Video Drive lenses:**

These lenses have internal circuitry to process the video signal and can be identified by the ALC and/or Level adjustments located on the lens barrel.

1. **Level**: This is the main adjustment for the video level that the lens will maintain under varying lighting conditions. Too high will open the iris and cause a bright picture; too low and the picture will be dark. After setting the level in daytime, place a dark filter over the lens to simulate night conditions. The iris should open to compensate for the reduced light level.

2. **ALC**: This will adjust the sensitivity of the iris. Adjusting towards Peak will allow the iris to react more quickly to changing light levels.

**DC Drive Lenses**: These lenses have no internal electronic amplifier circuits or external electrical adjustments.

1. If the camera has an "EE/AI" switch, place the switch in the "AI" position. Adjust the level control on the camera for the correct video level setting, as above under Video Drive Lenses.
7.15 WIRELESS VIDEO

5 GHz provides faster data rates at a shorter distance. 2.4 GHz offers coverage for farther distances but may perform at slower speeds. 2.4 GHz standard range outside is about 300ft, 5 GHz is 1/3 that.

Some of the newer higher powered WiFi Units like Picostation 2.4ghz has a range of 1300ft to 1 mile outside. When setup as an Access Point and another as a Station (Bridge/Client). It will cover the entire lake.

Experience has shown that WiFi radio waves "bounce" off the surface of the water causing poor quality transmission. Mounting the receiver low, nearer to the water surface minimizes the effect and improves reception.

Go to TC Resources under Equipment List to identify the equipment to set up a boat camera WiFi System. Need to have an understanding on how to setup WiFi. Very important for Boat, ensure that you connect directly to the battery with True Sine Wave Filter.

Boat Wi-Fi will be an Omnidirectional antenna signal (equal in all directions perpendicular to the axis), but on shore a Directional Antenna (specific direction) can be used at the end of the lake, or an Omnidirectional antenna in the middle. The setup just depends on site configuration (Island vs no Island). Some lakes with overgrown islands lose the signal when going around the islands.

WiFi signal can take up to 1 minute to reconnect if lost. This will not work if the signal is completely lost around the Island. You may have to setup different locations to determine what will work.

Another option is to setup WiFi Repeaters along the shore line, rather than setting up the one WiFi Unit as an Access Point/Station.

Multiple Boats: Head-to-Head: will require two shore units (station) with different address. But if just setting up multiple boats, where only one will be used at a time, have the one Station and all the boats set up with the same address. The Station will lock in on the first one that is received, so just turn off the other boats that are not be used. This will save time when changing out boats.

Camera: It hard to find a lens size that fits all. But the best lens is 4mm/6mm lens. The 4mm lens is great for shortline skiers (38-43off), were 6mm is better for the long line skiers, but is too close for the short line skiers. Its best to use the 4mm because the short line skiers is were the most review occurs and for record application. Another recommend, Class R were skiers can set World Record, attach a GOPRO on top of IP camera for backup. The will cover a wider recording view, but can be zoomed in if necessary for record review.
7.16 SLALOM NATIONAL RECORD PROCESS
Page 1 of 2

There are two programs that can be used to validate/measure boat deviation for Slalom.
Bob Corson and SplashEye.

1. Video must be converted to AVI file at 30FPS. Some AVI will not work in BC Record Checker due to different codec.
2. Survey data must be submitted with the record.
3. The boat C/L is based on the 4 entry/exit gate buoys from the survey data.
4. The program tarts at the entry gates and ends at the last frame when the boat is exiting the gates.
5. Program captures approximately 482 to 508 frames for a completed pass. Example: for 34.2mph @30 fps = 508 frames are captured. 36mph @30fps=482 frames are captured.
6. Sometimes it’s hard to see the boat at the gates. Use the table below to identify the frames to be used to back up for different speeds/rope length from when you see the skier going thru the gates (calculated by David Clark based on 30fps).
7. The boat path (pylon) is examined when the skier is approximately 4 meters in front of the turn buoy to where the skier is at the turn buoy.
8. Approximately 9 frames/sample points are taken at the turn buoy (approx. 0.5 m apart) to determine the maximum deviation and maximum cumulative deviation. These are dependent on the line length and boat speed.
9. Maximum deviation at any buoy is 20cm (8 inches). For cumulative deviation, see the table below
10. Plus (+) means that the boat is towards the turn buoy; Negative (-) means that the boat is away from the turn buoy.
11. The Total cumulative deviation (algebraic sum of the individual deviations) is based on the score as identified in table of the rule book (see below):

   **Example A:** Score 3 buoy
   #1 deviation =+15cm;  #2 deviation = +10cm;  #3 deviation = +15cm;
   Total cum dev = +40 (Max allowed for score of 3 is +35cm); Therefore, unacceptable.

   **Example B:** Score 3 buoy
   #1 deviation =+15cm;  #2 deviation = -15cm;  #3 deviation = +15cm;
   Total cum dev = +15 (Max allowed for score of 3 is +35cm); Therefore, its acceptable for a record, but should be unacceptable by the event judge (drivers on one side).
APPENDIX 7.16 SLALOM NATIONAL RECORD PROCESS

12. Boat Position- The following is an example to where the boat is when measuring the deviation. Again, all is dependent on-line length and boat speed. The program determines this position based on selecting the line length and starting and stop position on the entry/exit gates.

The following example (not the exact distance):
34mph/41off: Boat Position#1 sample (first) = 3m in front of boat guide.
Boat Position#9 sample (last) = 1m after boat guide.

<table>
<thead>
<tr>
<th>Cumulative Deviation Limit Score</th>
<th>Cum Limit</th>
<th>Score</th>
<th>Cum Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 - 1.0</td>
<td>20 cm</td>
<td>3.25 - 4.00</td>
<td>40 cm</td>
</tr>
<tr>
<td>1.25 - 2.00</td>
<td>28 cm</td>
<td>4.25 - 5.00</td>
<td>45 cm</td>
</tr>
<tr>
<td>2.25 - 3.00</td>
<td>35 cm</td>
<td>5.25 - 6.00</td>
<td>49 cm</td>
</tr>
</tbody>
</table>

For Slalom Boat Path Analysis of a Captured Video Clip

This table has been developed for working with slalom passes that have the boat going away from the camera, where it is difficult to determine the exact frame when the boat passes through the entrance gate. In such instances, you can instead identify the video frame where the skier passes through the gate, and then back up the number of frames shown in the table, for the applicable boat speed and line length.

The table computes the number of video frames that will elapse, between the time that the boat passes any fixed point (such as an entrance gate), until the skier passes that same fixed point.

The computation is a function of the Towline Length (L), Boat Speed (kph) and Frame Rate (Fps). The applicable Frame rate must be supplied by the user, and the resulting derived frame counts appear in the table.

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</table>

86
Distance Measurement (From the 2018 Rule Book)

A. General: Jump distances shall be derived using sightings taken from a system of Johnson-type meter stations, which shall be set up according to guidelines described in the following pages of this Technical Handbook. Distances shall be measured from a point at the water line directly below the center of the top edge of the jump ramp, to the point where the heels of the skier reach their maximum depression in the water (this point is usually indicated by a plume or spout of water which rises after the skier’s landing).

The approximate distance (within two feet) shall be communicated to the skier after each scoring jump, before the boat approaches the course for a subsequent jump by that same skier.

B. Rounding: All distances shall be calculated to the nearest whole foot. Partial distances of one-half foot or more will be rounded up to the next higher whole foot, while partial distances of less than one-half foot will be dropped. Metric distances shall be calculated as well, and in similar fashion rounded to the nearest whole tenth of a meter.

C. Three Meter System:

1. Three meter sighting stations of two meters each or video jump shall be used at Class C tournaments. At Class C tournaments or below, only one meter at any station may be used at the option of the Chief Judge. Where only one meter is used at a station, the single sighting value from that meter shall be used wherever the average value is called for below.

2. The point of the landing is defined as the center of the inscribed circle which is tangent to all three sides of the triangle formed by the three average sightings from the meter stations. The distance is calculated from that landing point back to the ramp. The size of the triangle is defined as the diameter of that inscribed circle.

3. If the top and bottom sightings from any single meter station are more than 0.6 meter (2') apart at the point of landing, then the average value and the single sighting with the smaller value will each be tried in turn, and whichever of these produces the smaller triangle will be used to derive the official distance.

4. If the official resolution of a particular set of sightings according to the above rules produces a wide triangle, and that set of sightings included a spread in excess of the 0.6 meter test limit at only one of the meter stations, which yielded a smaller triangle size by using the average rather than the
7.17 ON SHORE JUMP METER “Johnson” SYSTEM

shorter reading alone, then the longer reading from that station may be tried alone and used as official if it eliminates the wide triangle.

(5) At Class C tournaments or below, a jump which produces an official triangle greater than 0.9 meter (3’) shall be classified as a wide triangle. A jump classified as a wide triangle under either of these definitions shall be treated according to the provisions of E below, with the short vertex and long vertex distances defined as the distances to those vertices of the triangle which are closest and furthest from the ramp, respectively.

D. Two Meter System:
In Class F (Grass Roots) tournaments where two-meter stations of two meters each are being used, the landing point is defined as the intersection of the average sightings from those two stations. If one (or both) pair(s) of sightings is more than 0.6 meter (2’) apart at the point of landing, the intersections using each of the individual readings from that station (or stations) will be examined separately. If the difference between the distances from the closest and furthest intersections back to the ramp is greater than 1.2 meters (4’), then that jump shall be classified as a wide triangle and treated according to the provisions of E below, using the distances from the ramp to those closest and furthest intersections as the short vertex and long vertex, respectively.
7.17 ON SHORE JUMP METER “Johnson” SYSTEM

E. Wide Triangles: At the time it occurs, a jump which is classified as a wide triangle will tentatively be scored as the distance to the short vertex, and the skier will continue. If, after completing all three attempts in a set, a skier has had one or more jumps classified as a Wide Triangle, each of these shall then be resolved, in the order in which they occurred, according to the following provisions:

1. If the long vertex is less than or equal to the official distance of another of his jumps (or to the short vertex of another wide triangle jump), then the short vertex of that jump will be recorded as official, and the skier will have no options on that jump.

2. If the long vertex is longer than the longest official distance (or longest short vertex of another wide triangle jump), then the skier will have the option to either accept the short vertex as the official distance, or to take the jump again. If the skier elects to take the jump over, the result of that reride will be official, except that it may not be scored to a distance greater than the long vertex nor less than the short vertex of the original wide triangle jump.

3. In the event of a subsequent tie, where the short vertex of a jump which was originally classified as a wide triangle becomes an issue in determining placements, the competitor(s) affected shall then have the option of accepting that short vertex or of taking a reride. If the reride is taken, the outcome shall be official, although it may not be scored to a distance greater than the long vertex nor less than the short vertex of the original wide triangle jump.
7.17 ON SHORE JUMP METER “Johnson” SYSTEM

Electronic Masterboard

This is another name for a computer. Record Capability tournaments (“E” and “L”) require the use of a computer to calculate jump distances. There are a number of different computer programs in use, and as TC your responsibility includes checking the program to be used to ensure that it meets the AWSA Computer Jump benchmark. If the tournament is using the WSTIMS program, which has been approved by AWSA, you need only check that it is an acceptable current version. AWSA can provide you with the acceptable versions of WSTIMS. If the tournament is to use another program, check it thoroughly to verify that it totally meets the requirements of the benchmark. When using a computer to calculate jumps, a manual masterboard is also required, unless a second, separately powered, i.e., battery operated, backup computer is available. The program in the backup computer must also be checked. While you are checking the computer and/or masterboard operation is also a good time to look at communications between the meters, the tow boat, and the computer or masterboard. One thing that sometimes develops is interference between the computer and the communication system(s). Check the systems with both of them operating to ensure there is not a conflict. At some point you should coordinate with the Chief Judge to develop a procedure for stopping the tow boat when they have not received the jump distance. Communications and boat patterns frequently have a major role to play in this operation. Another problem that sometimes occurs is interference between the public address system and calling in meter readings. If at all possible, check on this aspect, and have an alternative available.

Manual Masterboard Setup

Setting up a manual master board is really just creating a scale model of the jump metering system. To accomplish this task, certain information is required, which was obtained during the meter setup procedure. The distances required are those between each meter, more commonly known as Distance AC, AB, and BC, and the distance along the extended meter base line to the intersection of the extended top edge (high end) of the jumping ramp, known as Distance L. If the meter stands are
Appendix 7.17 ON SHORE JUMP METER “Johnson” SYSTEM

not in a straight line, then knowing the distance that meter B is off the AC baseline or the distance that meter C is ahead of the AB base line, which ever case may apply, along with the distance along the baseline (the x-y coordinates of the meter) is very helpful. The angular measurements required are those between each meter, the sightings to the center of the jumping ramp, and the sightings to the 15m end timing ball. In addition to this information, some equipment is necessary. A board on which to construct the setup is essential. Any type of rigid material is acceptable; however, it should be noted that being able to insert pins, tacks, nails, etc. is very helpful. The minimum dimensions for the board are dictated by the site, since you are constructing a 1/8th inch scale model of the jumping area. From a practical standpoint, a board 30 inches by 24 inches is probably an acceptable minimum. Three jump meter protractors, a landing area grid, a sufficient quantity of string or fishing line, three fasteners such as mentioned above, tape or some method of securing the protractors and grid to the board, and a measuring device round out the required equipment. A 1/8th inch architect’s scale measuring up to 200 feet is also a very handy tool for constructing the masterboard.

Armed with this equipment and information, we are ready to begin our construction. The first step is to establish a baseline. Pick a location on the board for meter A. Usually this is located somewhere on the bottom right hand side of the board. From meter A draw a line in the direction of meters B or C, depending on which you are using for your meter baseline. Using the scale of 1/8th inch equal to 1 foot, measure along this line the distance AC to locate meter C, and mark this point C. Then locate meter B. If the meters are in a straight line, you can simply measure along the baseline from the meter a location the distance AB, and mark this point B. If the meters are not in a straight line, the task becomes somewhat more complex. If you were able to find the X & Y coordinates of meter B, using meter A as 0,0, locate point B using these coordinates. If not, it is time to install the protractors. Carefully place one protractor over point A, aligning the protractor baseline with the line on your board. Be certain that the center point on the protractor is exactly over point A and secure it to the board. Using one of your fasteners, attach a string to point A in such a manner that you can use the string to measure angles. Pull the string towards meter B, at the angle sighted from Meter A to Meter B. Repeat this procedure for point C, installing the protractor and string in a similar manner, again pulling the string towards meter B this time at the angle sighted from Meter C to Meter B. Mark the intersection of the two strings as point B. The scale measurements from point A to point B, and from point C to point B should equal the actual distances AB and BC. If you fail to achieve this result within reasonable accuracy, repeat the process until you obtain acceptable results. Now place the remaining protractor on point B, with zero (0) degrees aligned with point A. Secure the protractor to the board, placing the center point directly over point B. Attach a string to point B, using one of the fasteners, and pull the string to point C. The reading should equal the angular sighting from Meter B to Meter C. If not, recheck your work for an error. After you have achieved the proper alignment of the protractors on the Masterboard; measure along your baseline from point A towards the jumping ramp. At distance L place a mark. Now take the strings coming from each point on the masterboard and align them with the sightings from the meter stations to the jumping ramp. It probably is best to plot each reading separately and trace a line on the board. The intersection of these three lines is the location of the jumping ramp. If the intersection is not
Appendix 7.17 ON SHORE JUMP METER "Johnson" SYSTEM

A perfect point, the triangle formed should be within the limits described above, i.e., 0.15m (6 inches) for Record Tournaments, or 0.23m (9 inches) for Class C tournaments. Again, if you do not achieve these results, recheck your work for errors. After achieving an acceptable triangle on the ramp, repeat the process for the 15 end timing ball. Similar results must be achieved, applying the same tolerances. You are now ready to install the distance measuring grid. Place the center point of the jumping ramp on the grid directly over the intersection of the sighting lines from the meter points. If the distance grid has the 15 end timing ball marked on it, (it is usually a cross), place this over the intersection of the sightings for the 15 end timing ball. The center point of the ramp is the critical mark, ensure that it is accurately placed. It is likely that the 15 end timing ball mark will not fall exactly in place, since there is a fairly large tolerance on ramp location up and down the course. Even if this occurs, you can still use this mark to align the grid by lining up the horizontal, (up and down course) leg of the 15 end timing ball with the intersection on your board. Now take a straight edge and place it on the high end of the scale jumping ramp. This straight edge should very closely line up with the L distance mark on your base line. Slight variations are to be expected, since the L distance measurement is not a precision measurement. If you find major variations, recheck your work for errors. If your distance grid does not contain a mark for the 15 End Timing ball, you may either calculate measure and mark one on the grid or rely totally on the L distance method. Alignment of the grid is not critical, since the distance lines are in the form of concentric circles with the center of the jumping ramp as their center. Your masterboard is now setup and ready to use.

If the masterboard is to be used with two-meter readers at each station, either in a record tournament as a backup, or in a class C tournament it is advisable to establish a "Spread Angle Test Range" for each meter station to evaluate differences between meter sightings on the same jump. Accomplishing this take in advance will save enormous amounts of time during a jumping event in which the manual masterboard is being used as the primary means of jump distance calculation. First you must establish a "Normal Landing Zone" this is an area five to seven feet wide which research has shown passes through the following points:

- Down course distance: 30 60 90 120 150 180 210
- Left of Ramp Center: -12 6 16 21 21 18 12

This landing zone can also be marked on the masterboard with some type of marker for use in diagnosing large triangles. Generally, the corner of the triangle which lies closest to the landing zone is made up from the sightings from the two meters whose readings are correct. This situation is only a generality and should not be considered correct in every case.

To locate your "Spread Angle Test Range" (SATR), place the circle template that comes with the distance grid, or which you obtained from AWSA in the normal landing zone at the point which is closest to the meter station being evaluated and at the point which is farthest away from the meter station being evaluated. At each of these points find the difference in sighting angle to each side of the two-foot circle on the circle template. Note or record these angular values. These values will be used to determine whether or not differences that occur between sightings from that meter station are acceptable, must be tested, or are unacceptable. If the difference between the sightings is less than the small end of the SATR, you can be certain that the readings are acceptable, and immediately use the average of the readings to
Appendix 7.17 ON SHORE JUMP METER “Johnson” SYSTEM

calculate the difference. If the difference between the sightings is greater than the large end of the SATR you can be certain that the readings are unacceptable and must be tested in accordance with established procedures. It the difference between the sightings falls within the SATR, and then you will have to plot each of the readings from that meter and determine whether or not the spread produces a variation of more than two feet at the point of landing. To sight an example, when testing meter C with in the normal landings zone, the small end of the SATR is determined to be 0.6 degrees. This condition would occur on a short jump distance, because it would be farthest away from meter C. In our example, the large end of the SATR is found to be 1.2 degrees. This would be on a long jump, because it would be closest to meter C. We have now established meter C’s SATR as 0.6 to 1.2 degrees. This means that on any jump if the difference between sightings from meter C is 0.6 degrees or less, the average sighting can be used to calculate the jump distance without considering the spread. If the difference between the sightings if 1.2 degrees or greater, we must then test the readings in accordance with prescribed procedures. If the difference between the sightings is between 0.6 and 1.2 degrees, both sightings must be plotted to determine whether or not the spread produces a difference greater than two feet. You should establish this SATR for each meter station, and it is advisable to mark it on the masterboard for each meter station.

Your masterboard is now ready for use. It is to be used only as a backup to the computer in Record tournaments but can be used as the primary means of jump distance measurement for Class C tournaments. Experience has shown that using a masterboard with two-meter readers at each station is a cumbersome, time consuming, frustrating process which should be avoided if at all possible. If a masterboard is to be used at a class C tournament it is strongly suggested that only one-meter reader be used at each station, as jumping will progress much quicker, even if re-rides occur because of large triangles.
Appendix 7.17 ON SHORE JUMP METER “Johnson” SYSTEM

AWSA Computer Benchmark for Jump Meter Set-Up

**Meter Arrangement**
- Distance AC = 222 feet
- Meter B centered between A and C and set back 20.5 feet
- Distance AB = BC = 114.6 feet
- Ramp is directly opposite Meter A and 120 feet out

**Protractor Alignment**
- Meter A to Meter B = 180
- Meter A to Meter C = 153.6
- Meter B to Meter A = 0
- Meter B to Meter C = 121.2
- Meter C to Meter A = 14.4
- Meter C to Meter B = 0

Important Note: The example shown above is theoretical and does not imply that all meter systems must conform to this diagram. It is generally recommended that Meter B be positioned approximately 110 feet ahead of the ramp and, if practical, behind the AC baseline by up to 40 feet. Meters A and C should be equally spaced away from Meter B so that the AC distance is 2 to 3½ times the distance from the center of the AC meter baseline to the center of the landing zone.

The observed meter sightings to the ramp center sighting mark (see Rule 9.15.B.9), and to the 15ET buoy of the timing course, must produce triangles within the tolerances specified in Rule 9.16.A. Computer programs to be used for calculating jump distances must produce the results shown in the meter set-up cases shown below and in the distance calculation cases which appear on the following page.

For the meter and protractor arrangement shown above, the computer should produce the results shown below for the various ramp (upper table) and 15 ET (lower table) sighting angles listed:

**Upper Table**

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<tr>
<th>Meter A</th>
<th>Meter B</th>
<th>Meter C</th>
<th>Ramp X</th>
<th>Ramp Y</th>
<th>Triangle</th>
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Appendix 7.17 ON SHORE JUMP METER "Johnson" SYSTEM

AWSA Computer Benchmark for Jump Distance Calculation

To verify that a computer program in computing distances correctly according to the provisions of Rule 9.12, the operator must show that it produces identical results for all the test cases below, based upon the meter set-up shown on the preceding page. The first set of cases are based on the rules for Class C tournaments or below (see Rules 9.12.B and 9.12.C-4).

<table>
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<th>Case</th>
<th>Meter A Upper</th>
<th>Meter A Lower</th>
<th>Meter B Upper</th>
<th>Meter B Lower</th>
<th>Meter C Upper</th>
<th>Meter C Lower</th>
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</table>

Note 1: These should not be classified as wide triangles under Class C tournament rules (Rule 9.12.C-4).

Note 2: These are theoretical special cases which may cause difficulty with some computing devices or programs — consult the AWSA Technical Handbook if either of these cases fails or produces incorrect results.

The additional following test cases must also be run to verify that the special provisions for Record Capability tournaments function correctly (see Rules 9.12.B and 9.12.C-4):

<table>
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<tr>
<th>Case</th>
<th>Meter A Upper</th>
<th>Meter A Lower</th>
<th>Meter B Upper</th>
<th>Meter B Lower</th>
<th>Meter C Upper</th>
<th>Meter C Lower</th>
<th>Distance Ft/m</th>
<th>Triangle Size</th>
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</table>

Note 3: This should be classified as a Wide Triangle, with the short vertex distance at 122 feet (37.2 meters) and the long vertex distance at 123 feet (37.2 meters).