Regulations for the Review of Bowlers Reported with Suspected Illegal Bowling Actions

(As amended by Executive Board at its meeting in July 2006)

A. Introduction

1. Except where otherwise stated these Regulations shall apply to all Test matches and One Day Internationals played under the auspices of the ICC as well as the ICC Super Series matches (international cricket).

2. Nothing contained herein shall override an umpire's responsibility and discretion to apply Law 24.

B. ICC Panel of Human Movement Specialists

1. The ICC shall appoint on an annual basis a panel of human movement specialists.

2. The members of this panel shall have the credentials, equipment and facilities to conduct analysis of the bowling actions of bowlers in accordance with the ICC Standard Analysis Protocols (Annexure A hereto).

C. Bowling Review Group

Upon receipt of an application for a Bowling Review Group hearing in accordance with paragraph F below, the ICC shall appoint a Bowling Review Group (BRG) in accordance with the following terms:

1. The BRG shall comprise the following persons: A current member of the ICC Code of Conduct Commission (in the Chair and with the casting vote only), a current ICC referee, an ex-international player, an ex-international umpire and a human movement specialist. The ICC General Manager – Cricket shall be an ex-officio member of the BRG.

2. The Chairman of the ICC Cricket Committee shall be responsible for appointing the Chairman of the BRG from the current members of the ICC Code of Conduct Commission. Once appointed, the Chairman of the ICC Cricket Committee and the Chairman of the BRG shall be responsible for selecting the other members of the BRG in accordance with paragraphs C 3, 4 and 5 below.

3. The ex-international player and umpire shall be appointed from the list of Full Member Boards' bowling advisors established in accordance with paragraph K 1 below.

4. The human movement specialist shall be appointed from the ICC panel of human movement specialists referred to in paragraph B above. The human movement specialist shall not be the same person as the specialist who conducted the independent analysis referred to paragraph E below.

5. It is preferable that at least one of the BRG shall be a qualified legal practitioner. In the event of the BRG, as appointed in accordance with the provisions of paragraphs C 1 - 4 above, not including a legal practitioner then a legal practitioner shall be appointed to the BRG in an advisory capacity only and he shall not have a vote.

consequences of such Law must apply. During this period a further Match Officials' Report will however have no consequence.

11. In the event that the Player does not accept the conclusions of the Independent Assessment he shall be entitled to a hearing of the BRG.

F. Bowling Review Group Hearing

1. The Player seeking a hearing of the BRG shall lodge with the ICC (in-house lawyer) written notice thereof within 14 days of the date of receipt by the Player's Board of the Independent Assessment. The BRG hearing will be held as soon as reasonably possible but at least within 21 days of receipt by the ICC of the Player's written notice referred to above.

2. The BRG hearing shall be held in person and not by telephone or video conference, although the BRG may, in its discretion, admit evidence at the hearing in any form.

3. The ICC shall be responsible for arranging the appointment of the BRG in accordance with paragraph C above and for determining in consultation with the Chairman of the BRG the time and place for the hearing. The ICC shall ensure that the Player, through the Player's Board, is given reasonable notice thereof.

4. The Player shall attend the hearing. However, if the Player has received notice of the hearing in terms of F 3 and fails to attend the hearing, the hearing may at the absolute discretion of the Chairman of the BRG, proceed in the absence of the Player.

5. The Player shall be entitled to a representative who shall be entitled to attend the hearing.

6. The BRG hearing shall be conducted in accordance with the Principles of Natural Justice as set out in the ICC Playing Handbook.

7. The BRG will consider the following:

    7.1 The video evidence referred to in paragraph D 6 above.
    7.2 The Match Officials' Report.
    7.3 The Independent Assessment together with any image based evidence accompanying such assessment.
    7.4 Any further evidence that the Player and/or his representative wishes to present in the Player's defence. This may include a written report, a verbal submission, any expert evidence and image based evidence.
    7.5 Any written or video evidence that the Player's Board wishes to be considered on behalf of the Player.

8. The Player and/or his representative shall be entitled to question any person called to give evidence in the course of the hearing on any issue relevant to the hearing. The members of the BRG shall be entitled to question the Player and/or any person called to give evidence on the Player's behalf.

9. After all the evidence and argument has been presented, the BRG shall adjourn the hearing to deliberate on its decision.

10. The BRG shall reach a decision by a simple majority vote. The Chairman of the BRG has the casting vote.

11. The BRG shall decide whether or not the Player has an Illegal Bowling Action and that (i) the suspension of, or the Warning to, the Player be maintained, or (ii) the suspension of, or the Warning to, the Player be lifted. The BRG must, in each case, set out the reasons why the decision has been reached, including a summary of the evidence on which the decision was based.

12. The ICC will communicate the decision of the BRG in writing to the Player, through his Board, within 48 hours of the hearing being adjourned in accordance with paragraph F 9 above.

13. Subject to the right of the Player to re-assessment in accordance with paragraph G 2 below, the decision of the BRG shall be final and binding.

G Re-assessment of Player's Action

1. A Player who has been suspended from bowling in international cricket under these regulations shall be permitted under the supervision and with the consent of his Board to continue to play domestic cricket.

2. Subject to the provisions of paragraph G 5 and paragraph H below, a Player who has been suspended from bowling in international cricket under these regulations, may at any time apply to the ICC for a re-assessment of his bowling action.

3. Such re-assessment shall be carried out in the same manner as the Independent Analysis referred to in paragraph E above save that the purpose of the comparison between the re-assessed action and the action of the Player as employed in the match in which he was reported shall be to determine the extent, if any, of the improvement to his action.

4. In the event of such re-assessment concluding that the player has remedied his action and that his action is no longer an Illegal Bowling Action the Player's suspension shall be lifted and he shall be permitted to continue bowling in international cricket forthwith.

5. The BRG shall have the discretion to specify a fixed period before the expiry of which the bowler shall not be entitled to approach the ICC for a re-assessment of his bowling action in terms hereof. Such discretion shall only be exercised in the instance of a frivolous application for a BRG hearing and the maximum period so specified shall be 1 year.

6. The Independent Assessment resulting from the re-assessment will stand in the place of the original Independent Assessment, and the provisions of paragraphs E 7, 8, 9 and 11 and of paragraph F will apply in respect of it.

H. Second and Further Reports

In the event of a Player being suspended from bowling in international cricket under these regulations for a second time within a period of 2 years from the date of the commencement of the first period of suspension, the Player shall be suspended from bowling in international cricket for a minimum period of 1 year. Only after the expiry of this 1 year period will the Player be entitled to approach the ICC for a re-assessment of his action in accordance with paragraph G above. (See also paragraph E 9 above)

I. Costs

1. The ICC will be responsible for the costs of the Independent Analysis and Assessment as well as the costs of the BRG hearing, including the costs incurred by the Player to attend thereat.

2. The Player and/or his Board shall be responsible for the payment of any costs of representation of the Player and for any subsequent re-assessments carried out at the Player's request.

J. ICC Under 19 Cricket World Cup and Regional Under 19 Events

1. The ICC shall appoint a bowling action review panel to attend each ICC under 19 Cricket World Cup (the Event).

2. The appointed panel shall consist of a member of the ICC panel of human movement specialists referred to in paragraph B above and two other bowling experts of suitable bowling or coaching experience.

3. This panel shall be responsible for identifying, in consultation with the match officials appointed to the Event, any bowlers with suspected Illegal Bowling Actions.

   Note: The panel (and match officials), in deciding whether to report a bowler as set out above, should use the naked eye viewing the action live and/or on television at normal speed. Slow motion television replays should only be used to confirm initial suspicions.

4. At the conclusion of the Event, the panel shall submit a report to the ICC detailing its concerns about the bowling actions of the bowlers so identified.

5. The ICC shall advise the reported bowlers' Boards of the fact that one or more of their bowlers' has been reported by the panel as having a suspected Illegal Bowling Action. The ICC shall furnish the Board(s) with copies of the panel's report(s).

6. Any bowler reported in accordance with this process shall be referred by his Board for analysis and assessment by the Board's group of bowling advisors (referred to in paragraph K 1 below). A copy of this assessment shall upon completion thereof be sent to the ICC.

7. Any bowler reported in accordance with this process shall not be selected by the Board as a bowler for any national representative team until such time as his action has been assessed in accordance with paragraph J 6 above and in the event of such assessment confirming that the bowler has an Illegal Bowling Action, until such time as his action has been remedied.

8. This process shall be adopted by each Regional Association (e.g. ACC) for all regional under 19 events.

K. Member Boards Policy

Each Board shall formulate and implement a policy and strategy to deal with bowlers with suspected Illegal Bowling Actions in its domestic cricket. Such policy and strategy shall as a minimum requirement:

1. Establish a group of bowling advisors comprising the following persons: An ex-international fast bowler, an ex-international finger spinner, an ex-international wrist spinner, an ex-international umpire and, if available, a human movement specialist. The persons appointed shall be the best available and shall preferably have appropriate coaching experience.

2. Establish a mechanism for identifying bowlers with suspected Illegal Bowling Actions. Primary responsibility for this shall be the umpires. In addition, for all national age group tournaments, a bowling action review panel (similar to the panel appointed in accordance with J 2 above) shall be appointed by the Board to attend such tournaments with the task of identifying any bowlers with suspected Illegal Bowling Actions.

   Note: Umpires and those responsible for identifying bowlers with suspected Illegal Actions, in deciding whether to call or report a bowler as set out above, should use the naked eye viewing the action live and/or on television at normal speed. Slow motion television replays should only be used to confirm initial suspicions.

3. Require that having identified a bowler with a suspected Illegal Bowling Action, be it by way of an umpire's report or otherwise, such bowler shall be referred to the Board's group of bowling advisors for analysis and assessment.

4. Require that any bowler reported in accordance with this process shall not be selected by the Board as a bowler for any national representative team until such time as his action has been assessed in accordance with paragraph K 3 above and in the event of such assessment confirming that the bowler has an Illegal Bowling Action, until such time as his action has been remedied.

Annexure A

ICC Standard Analysis Protocols

Biomechanical Analysis of a Bowling Action

1. Introduction

1.1 The ICC has introduced a revised process for the review of bowlers with suspected illegal bowling actions (Bowling Review Process).

1.2 In order for the Bowling Review Process to be conducted in a fair and consistent manner the following standard protocols for the collection of data and the assessment and analysis of bowling actions have been introduced.

1.3 The overall purpose of the report is to confirm the legality / or not, of the action of the player as used in the match situation. Thus the protocols are provided not only for how the action should be analysed in the laboratory setting, but also highlight the need for a detailed comparison between the action performed during the match in which the player was reported and the bowling action analysed in the laboratory.

1.4 The ICC has determined that it is the degree of elbow extension, as opposed to hyperextension or abduction / adduction that is prohibited. Elbow hyperextension and elbow abduction / adduction are involuntary movements that cannot be controlled by the individual during the bowling action. (See Paragraph 5.3 & Appendix A)

1.5 The conclusion of the report should be that having analysed the action in the laboratory and having compared it to the action as used in the supplied match footage, in the opinion of the expert, the bowler has faithfully reproduced his match technique in the laboratory. A statement concerning the legality of the action with respect of the amount of elbow extension measured and the 15 degree elbow extension tolerance threshold should then follow.

2. Video Footage from Match in which Player Reported

2.1 The television video footage of the entire bowling spell(s) of the player in the match where the report was made shall be presented on a master tape. (ICC to supply match footage. If possible, rear, frontal and lateral views of the action shall be provided.)

2.2 The master tape shall be converted to 50Hz / 60Hz (standard television footage is recorded at 25Hz) to enable more accurate evaluation of the player's bowling action on the day the bowler was actually reported.

2.3 Descriptive analysis during the match footage should compare the actions of the bowler e.g. positioning of feet, angle of run up, position of the torso, velocity of arm, velocity of delivery (95% of match speed etc). These comparisons should be clearly presented in the report.

3. Anthropometric Assessment (Both the bowling & non-bowling arms) See Appendix A

3.1 **Carry Angle**: The angle between the longitudinal axis of the upper arm and forearm, in the frontal plane. Note: The average range of carry angle for the human population is between 5º-15º.

3.2 **Hyperextension Angle**: The angle between the longitudinal axis of the upper arm and forearm, in the sagittal plane. (i.e. beyond full normal extension): Two measurements are required: a passive measurement, were there is no force applied and a second measurement where 'reasonable' force is applied. When the second measurement for the hyperextension angle is measured, the bowler is required to extend his arm back as far as possible. This is achieved by applying a 'reasonable' force, essentially the body weight of the bowler, leaning on each arm.

3.3 **Additional Physical Measurements**: Height, weight and assessment of general mobility of the shoulder, elbow and wrist joints.

3.4 **History of Previous Injuries**: A brief history of previous injuries should be determined as an aid in the biomechanical assessment - particular focus should be brought to the elbow and shoulder joints.

4. Bowling Analysis (Indoors – Laboratory conditions)

4.1 All biomechanical assessment shall be carried out with the player bowling off his normal full run-up, on a correct length cricket pitch.

4.2 A minimum of three synchronised cameras (using optio reflective markers) operating at a minimum of 200 frames per second and a maximum of 250 frames per second (preferable) should be used to collect the data. The cameras and computer to be operated and positioned in appropriate positions to facilitate a subsequent three-dimensional analysis of the shoulder, elbow, wrist and ball.

4.3 Video data (50fps) should also be collected in order to allow synchronisation with the 'optio reflective computer animation data'. A minimum shutter speed of 1000Hz is required to prevent blurred images.

4.4 Calibration and accuracy procedures must be undertaken in the delivery space prior to data collection. Accuracy analysis should indicate that the 3D methods employed are accurate to within ±1° (Note: A rigid bar (1m in length), with markers representing the shoulder, elbow and wrist (180º) can be used in the calibration procedures. The rod must be rotated in the same manner as a bowling arm. This should be repeated using a rigid bar representing a 160º angle. Accuracy analysis should again indicate that the 3D methods employed are accurate to within ±1°).

4.5 Optimal "levels of filter" must be used in the laboratory process. Ideally a laboratory environment using opto-reflective marker system will produce the environment with the least amount of error (Noise) and therefore less filtering can be used. This value or cut off frequency is calculated via the residual analysis method presented by Winter (1990) – (See Appendix B)

4.6 Warm up (player's own) – but must include the bowling of a number of deliveries at match pace prior to data collection. The player to have no clothing on the torso, in order to enable the correct marker set to be placed on the bowling arm. (See Appendix C) Automatic digitisation of the marker set will enable joint centres to be determined during each delivery.

4.7 In respect of a fast bowler, six 'normal' – good length deliveries, six 'yorkers' and six 'bouncers' must be recorded. Six deliveries of each spin variation for the leg or off spin bowler must be recorded. Standard video cameras should be used to assess the position the ball lands, along with the amount of bounce and turn created with each delivery. This video should also be presented in the report.

4.8 Three-dimensional analysis of the bowling arm to begin from back foot contact, to include 'arm horizontal' , maximum flexion, ball release and a minimum of 10 frames after ball release for each successful delivery.

4.9 The UPPER Arm is in the horizontal position in Figure 1b. "The horizontal position" i.e. The upper arm being level with shoulder and parallel to the ground.

4.10 The point of release is defined as the FIRST frame the BALL and HAND are NOT in contact. This is important as the exact time (frame – 250Hz) of release can potentially change results by three or four degrees. A marker (a piece of reflective tape) on the ball, a change in velocity of the ball, along with 50Hz video may all help with this process.

Figure 1a: Arm Horizontal – NO

Figure 1b: Arm Horizontal – YES

4.11 Every effort must be made to ensure that the player is bowling as close to match pace as possible. This can be measured after each delivery if the equipment is available (Radar Gun), or measured via the 3D data during analysis. If deliveries are not at a suitable speed (so as to represent match conditions) then the data shall be **invalid**.

5. Presentation of Results

5.1 A summary of the results of each delivery to be presented – graphical or table format.

5.2 The presentation of the three-dimensional analysis of the bowling arm to begin from a minimum of 10 frames before the arm reaches horizontal, , to include 'arm horizontal', 'maximum flexion', 'ball release' and a minimum of 10 frames after ball release.

5.3 The 'flexion-extension' and the 'abduction-adduction' curves should be presented separately. This data should be presented in graphical form. (The hyperextension component will show up in the flex-ext curve if it is present and there is no need to

separate it. If it is present it will be shown as the curve going beyond 180 degrees or below 0 degrees, depending on which represents “straight arm”)

5.4 The six trials for each type of delivery (e.g. Bouncer / Normal Length / Yorker), along with the average should be plotted on the same graph (i.e 3 graphs, one each for the bouncer, normal length and yorker deliveries) to show conformity.

5.5 The average of the different types of delivery (e.g. Bouncer / Normal Length / Yorker) to be displayed along with the standard error reading.

5.6 Ball release speeds to be presented for each delivery.

5.7 Stick figure representation, to include pictures of the various key positions to aid in the presentation of the results. (Alternatively, an avi file may be provided.)

6. Acceptable level of Elbow Extension

This should be set at a maximum of 15 degrees ‘Elbow extension’ for all bowlers and types of deliveries. This specifically refers to extension of the forearm relative to the upper arm to the straight position. Elbow hyperextension or adduction is not included in the 15-degree tolerance threshold. It should be noted that in order for the action to be classified as a legal action, the degree of ‘elbow extension’ recorded for each delivery should be within the 15 degree limit.

Appendix A: Movements.

Flexion - This movement takes place about a transverse axis and is a description of the movement that occurs when you move your arm forward. It is described as the approximation (moving closer together) of two ventral surfaces of the body e.g. flexing the elbow joint. There are a number of situations where this rule doesn't seem to apply e.g. at the ankle where the terms dorsi and plantar flexion are used to avoid confusion.

Extension - This movement is the opposite of flexion; it also takes place about a transverse axis and occurs when you approximate two dorsal surfaces e.g. straightening the elbow.

Hyperextension - An abnormal movement beyond the normal limit of extension, such as more than the 180 degrees of extension of the knee or elbow joints.

Abduction and Adduction - These movements take place about an antero-posterior axis and occur when the arm is taken sideways away from the body (abduction) and returned from such a position to the side of the body (adduction).

Appendix B: Filter Level.

When measurements are made using image-based analysis systems (Video and/or Automatic Tracking) they are contaminated with ‘Noise’ generated during the recording and digitising procedures. The sample signal can be considered to be the sum of the true signal, systematic noise and the random noise. The ‘TRUE’ signal can never be deduced from the measurements; only the best estimate of the signal.

There have been a number of techniques developed for the reduction of noise, including Butterworth filters, Quintic splines and cross-validated splines. Each of these techniques uses a mathematical function to approximate the data. The precise frequency components of the true signal are rarely known in sports biomechanics and some procedures must be adopted for the determination of the cut-off filter, or other smoothing parameter. The less noise in the system, the closer the raw data will represent the 'TRUE' signal, and the less smoothing will be required.

Ideally a laboratory environment using opto-reflective marker system will produce the environment with the least amount of error (Noise) and therefore a lower filtering value can be used. Optimal "levels of filter" must be used in the laboratory process. This value or cut off frequency is to be calculated for all bowling analysis using the residual analysis method presented by Winter (Biomechanics and Motor Control of Human Movement, 2nd edition, Wiley and Sons Publisher, 1990).

Previous work in this area has identified a Butterworth digital filter level of 12 – 14 Hz and a Woltring MSE of 20 – 25 cine appropriate. However a residual analysis, should be conducted for the bowler being analysed to derive the optimum filter level for the current data. Any significant different optimum filter level derived from the above values needs to be well justified and documented. Raw data should be graphed with filtered data and inspected by the expert to ensure the filtered curve closely reflects the raw data. These should be presented in the appendix to the report as background technical information for each analysis.

Appendix C: Marker Set

Cricket Upper Limb Model

The following guidelines are established to ensure conformity of elbow joint data across laboratories. Establishment of joint centres at the shoulder, elbow and wrist joints are therefore integral to this process.

Shoulder Joint

This joint centre should be determined from the recording of markers anterior, posterior and superior (acromion process) to the "joint centre of rotation". The anterior and posterior markers should be placed such that a line between the two represents the shoulder axis of rotation (approximate midline of the upper arm). The shoulder joint centre (SJC) is then calculated as the centre of these three markers or from where a vertical line dropped from the acromion intersects the line between the anterior and posterior markers.

The position of the calculated SJC is then recorded in a static trial relative to the coordinate system of the triad located on the upper arm. During a bowling trial the SJC can then be reconstructed relative to the position of the upper arm triad during every frame. Optimisation or helical axis techniques may be used to calculate the shoulder centre, which may modify the markers used about this joint.

Elbow Joint

The elbow joint centre may be calculated using markers placed on the lateral and medial elbow epicondyles or using "epicondyle pointer trials" with the elbow flexed to 90°. If a marker based approach is used the markers should be as small as the resolution of the opto-

electronic camera system will allow. Generally markers no bigger than 15mm in diameter are preferable. The position of the epicondyles should be reported with reference to a triad of markers placed on the upper arm. The elbow joint centre is then calculated as the mid point between these two re constructed epicondyle virtual markers. This means that no joint markers are required during bowling trials to reduce errors associated with skin movement. The cameras only need to track the upper arm triad during the bowling action to know where the elbow and shoulder joint centres are. For a background reading in this area refer to Lloyd et al., (Journal of Sports Sciences, 2000, v12). Helical axis determination may also be applied at the elbow joint.

Wrist Joint

The wrist joint centre may be calculated using "pointer trials" or by placing markers on the styloid processes at the wrist during a static trial. If a marker based approach is used the markers should be as small as the resolution of the opto-electronic camera system will allow. Generally markers no bigger than 15mm in diameter are preferable. The position of the styloid processes should be calculated as reference points (i.e. three-dimensional co-ordinates) to a triad of markers placed on the forearm. This triad needs to be placed relatively close to the wrist joint centre to avoid excessive skin movement during pronation / supination. The markers on the styloid processes can then be removed prior to bowling data collection. The wrist joint centre is then calculated as the mid point between the styloid process markers or landmarks from the pointer trials.