## INDEX

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Lane Specifications</td>
<td></td>
</tr>
<tr>
<td>A. Regulation Bowling Lane</td>
<td>3</td>
</tr>
<tr>
<td>1. Synthetic Products</td>
<td>3</td>
</tr>
<tr>
<td>2. Approach</td>
<td>3</td>
</tr>
<tr>
<td>3. Foul Line</td>
<td>3</td>
</tr>
<tr>
<td>4. Composition</td>
<td>4</td>
</tr>
<tr>
<td>5. Length</td>
<td>4</td>
</tr>
<tr>
<td>6. Width</td>
<td>4</td>
</tr>
<tr>
<td>7. Surface</td>
<td>4</td>
</tr>
<tr>
<td>B. Lane &amp; Approach Marketings or Designs</td>
<td>4</td>
</tr>
<tr>
<td>C. Synthetic Bowling Lanes</td>
<td>5</td>
</tr>
<tr>
<td>1. Identification</td>
<td>5</td>
</tr>
<tr>
<td>2. Gaps &amp; Drop Off</td>
<td>6</td>
</tr>
<tr>
<td>II. Pit Area Specifications</td>
<td></td>
</tr>
<tr>
<td>A. Pin Deck</td>
<td>6</td>
</tr>
<tr>
<td>1. Composition</td>
<td>6</td>
</tr>
<tr>
<td>2. Edgeboards</td>
<td>6</td>
</tr>
<tr>
<td>3. Synthetic Edge Strip</td>
<td>6</td>
</tr>
<tr>
<td>4. Pin Spots</td>
<td>6</td>
</tr>
<tr>
<td>5. Synthetic Pin Decks</td>
<td>6</td>
</tr>
<tr>
<td>6. Tail Plank</td>
<td>7</td>
</tr>
<tr>
<td>B. Other Pit Area Specifications</td>
<td></td>
</tr>
<tr>
<td>1. Round Gutter</td>
<td>8</td>
</tr>
<tr>
<td>2. Flat Gutters</td>
<td>8</td>
</tr>
<tr>
<td>3. Reinforced Flat Gutters</td>
<td>8</td>
</tr>
<tr>
<td>4. Flat Gutter Molding</td>
<td>8</td>
</tr>
<tr>
<td>5. Reinforced Flat Gutter Molding</td>
<td>9</td>
</tr>
<tr>
<td>6. Kickbacks</td>
<td>9</td>
</tr>
<tr>
<td>7. Kickback Plates</td>
<td>9</td>
</tr>
<tr>
<td>8. Rear Cushion</td>
<td>9</td>
</tr>
<tr>
<td>9. Pit</td>
<td>9</td>
</tr>
<tr>
<td>III. Bowling Ball Specifications</td>
<td></td>
</tr>
<tr>
<td>A. General Bowling Ball Specifications</td>
<td>13</td>
</tr>
<tr>
<td>1. Material</td>
<td>13</td>
</tr>
<tr>
<td>2. Surface</td>
<td>13</td>
</tr>
<tr>
<td>3. Weight</td>
<td>13</td>
</tr>
<tr>
<td>4. Hardness</td>
<td>13</td>
</tr>
<tr>
<td>5. Devices</td>
<td>13</td>
</tr>
<tr>
<td>6. Mechanical Aids</td>
<td>13</td>
</tr>
<tr>
<td>7. Plugs and Designs/Logos</td>
<td>13</td>
</tr>
<tr>
<td>8. Cleaning</td>
<td>13</td>
</tr>
<tr>
<td>B. Ball Manufacturing Specifications</td>
<td>14</td>
</tr>
<tr>
<td>1. Physical Specifications</td>
<td>14</td>
</tr>
<tr>
<td>a. Circumference and diameter</td>
<td>14</td>
</tr>
<tr>
<td>b. Roundness</td>
<td>14</td>
</tr>
<tr>
<td>c. Hardness</td>
<td>14</td>
</tr>
<tr>
<td>d. Radius of Gyration</td>
<td>14</td>
</tr>
<tr>
<td>e. Coefficient of Restitution</td>
<td>14</td>
</tr>
<tr>
<td>f. Coefficient of Friction</td>
<td>14</td>
</tr>
<tr>
<td>g. Approval Logo</td>
<td>14</td>
</tr>
<tr>
<td>h. Markings</td>
<td>14</td>
</tr>
<tr>
<td>C. Drilling Specifications</td>
<td>15</td>
</tr>
<tr>
<td>1. Holes</td>
<td>15</td>
</tr>
<tr>
<td>2. Balance</td>
<td>15</td>
</tr>
<tr>
<td>3. Plugs &amp; Design</td>
<td>15</td>
</tr>
<tr>
<td>IV. Lane Dressings &amp; Lane Dressing Measuring Equipment</td>
<td></td>
</tr>
<tr>
<td>A. Technical Specifications for Lane Dressing</td>
<td>16</td>
</tr>
<tr>
<td>B. Technical Specifications for Lane Dressing Tape Take Up Device</td>
<td>16</td>
</tr>
<tr>
<td>C. Technical Specifications for Ultra Violet Sensitive Tape Reader</td>
<td>17</td>
</tr>
<tr>
<td>D. Technical Specifications for Lane Dressing Pick Up Tape</td>
<td>18</td>
</tr>
<tr>
<td>V. Bowling Pin Specifications</td>
<td></td>
</tr>
<tr>
<td>A. General Tenpin Specifications</td>
<td>19</td>
</tr>
<tr>
<td>1. Material</td>
<td>19</td>
</tr>
<tr>
<td>2. Type of Construction</td>
<td>19</td>
</tr>
<tr>
<td>3. Adhesives</td>
<td>19</td>
</tr>
<tr>
<td>4. Weight</td>
<td>19</td>
</tr>
<tr>
<td>5. Center of Gravity</td>
<td>19</td>
</tr>
<tr>
<td>6. Radius of Gyration</td>
<td>19</td>
</tr>
</tbody>
</table>
VIII. Appendixes

A. Testing for Moment of Inertia and Radius of Gyration of Bowling Balls .......................................................... 39
B. Issuance of Certificate ................................................................. 41
C. Resurfacing Requirements .......................................................... 41
D. Method of Test for Moment of Inertia and Radius of Gyration of Bowling Ball ................................................. 42
E. Method of Test for Coefficient of Restitution .................................................. 45
F. Method of Test for Coefficient of Friction of Bowling Balls .................................................. 47
G. Method of Test for Coefficient of Friction of Lane Surfaces .................................................. 48

IX. Glossary .................................................................................. 49
REGULATION BOWLING LANE

A regulation bowling lane, including flat gutters, kickbacks and approach, must be constructed of wood and/or other materials which have been tested according to ABC/WIBC procedures for the specified time period and approved.

Note: For areas beyond the pin deck not covered in the ABC/WIBC Bowling Equipment Specifications Manual, standard installation procedures are acceptable unless, upon inspection, it is deemed that an area in question may affect specifications and/or scoring. In these instances the ABC/WIBC Equipment Specifications Department should be contacted.

Synthetic Products:
All non-wood material used in the manufacturing of lane components must be presented to ABC/WIBC for evaluation and possible testing before use in sanctioned competition. If approved, they may not be altered by the use of coatings, etc., unless these coatings have been presented to ABC/WIBC for evaluation and possible testing. In addition, all products must contain an approval label with the following requirements:

1. The label must be permanent, lasting the life of the product.
2. The label must be clearly visible after the product is installed in the bowling center.

3. The label must identify the company as the manufacturer.
4. The label must contain an approval number assigned by ABC/WIBC and state “ABC/WIBC Approved.”

Approach:
Extending from and exclusive of the foul line there shall be an unobstructed level approach which shall be:

1. Not less than 15 feet in length
2. Free from depressions exceeding 1/4 inch.
3. Not less than the width of the lane.

Foul Line:
The foul line shall be:

1. Not less than 3/8 inch nor more than 1 inch in width.
2. At a minimum, the entire width of the lane.
3. Distinctly marked upon or embedded between the lane and approach.

It may be required that the foul line be plainly marked on the walls, posts, division boards or any point on a line with the regular foul line.

(For more information on the foul line see the section on Automatic Foul Detecting Device.)

ABC/WIBC Regulation Bowling Lane Dimensions
Typical Cross Section of Bowling Lane—Round Gutters from foul line to pin deck area.

*NOTE: This particular measurement is not an ABC/WIBC specification but is an accepted standard for installing bowling lanes.
**Composition:**
The lane must be constructed entirely of wood and/or synthetic materials which have been approved by ABC/WIBC.

**Length:**
1. The overall length of a regulation lane, including the pin deck, has a reference dimension of 62 feet, 10 3/16 inches, measured from the lane side of the foul line to the rear edge of the pin deck (not including the tail plank).
2. It must be 60 feet, plus/minus 1/2 inch, from the lane side of the foul line to the center of the No. 1 pin spot.
3. It must be 34 3/16 inches, plus/minus 1/16 inch, from the center of the No. 1 pin spot to the rear edge of the pin deck (not including the tail plank).

**Width:**
The lane shall be 41 1/2 inches, plus/minus 1/2 inch, wide.

**Surface:**
1. The surface must be free of all continuous grooves or ridges.
2. There shall be no depressions or crown in excess of 40/1000 inch on the surface of the lane over a 42 inch span.
3. There shall be no crosswise tilt in excess of the 40/1000 inch over the width of the lane.
4. The same lane finish coating shall be applied from the edgeboard to edgeboard.
5. The Coefficient of Friction of all lane surfaces shall not exceed .29 when measured with an ABC/WIBC approved device.

All bowling lane finish coatings as well as all synthetic lane surfaces must be submitted to ABC/WIBC for coefficient of friction testing before use in sanctioned competition. In addition, all lane surface coatings must bear labels stating “This product complies with ABC/WIBC specifications when applied as directed by the manufacturer.”

---

**ABC/WIBC Regulation Bowling Lane Dimensions**

Typical Cross Section of Bowling Lane — Round Gutters from foul line to pin deck area.

![Diagram of bowling lane dimensions](image)

*NOTE: This particular measurement is not an ABC/WIBC specification but is an accepted standard for installing bowling lanes.*

---

**Lane and Approach Markings or Designs**

Lane and approach markings shall only be permitted in accordance with the following specifications:

1. Measured from the foul line, a maximum of seven (7) guides may be embedded in or stamped on the approach at each of the following points: 2-6 inches; 9-10 feet; 11-12 feet, and 14-15 feet. Each series of guides shall be parallel to the foul line and each guide shall be circular in shape, and shall not exceed 3/4 inch in diameter.
2. At a point 6-8 feet beyond the foul line and parallel thereto, there may be embedded in or stamped on the lane a maximum of ten (10) guides. Each guide shall be uniform, circular in shape, and shall not exceed 3/4 inch in diameter.
3. At a point 12-16 feet beyond the foul line, there may be embedded in or stamped on the lane a maximum of seven targets. Each of the targets shall be uniform and may consist of one or more dowels, darts, diamond, triangles or rectangular designs. The overall surface covered by each target shall not be more than 1 1/4 inches in width and 6 inches in length. Each target must be equidistant from one another and set in a uniform pattern.
4. At a point 33-44 feet beyond the foul line, there may be a maximum of four targets. Each target must be uniform in appearance and shall not be wider than a single board nor longer than 36 inches.
5. Embedded markings or designs shall be of wood, fibre or plastic, and shall be flush and level with the surface of the lanes and approaches.
6. When the markings are stamped on wood lanes, they shall be applied to the bare wood and then covered with lacquer, urethane, or similar liquid transparent material generally used in resurfacing. All such installations in any one center shall be uniform as to design and measurement and at least on natural pairs of lanes.
7. Glow/Cosmic bowling may only be sanctioned on lanes that meet all of the specifications under Lane and Approach Markings or Designs.
All synthetic bowling lanes must be ABC/WIBC approved and meet all specifications for regulation bowling lanes in addition to the following:

**Identification:**
On synthetic lane surfaces, each panel must have at least one label that meets the following requirements:

1. The label, identifying the manufacturer, must be permanent, lasting the life of the product, and clearly visible after it is installed.
2. The label must contain an approval number assigned by ABC/WIBC and state “ABC/WIBC Approved.”
3. Overlay and complete systems with the same top surface must have the same approval number.
4. The color of the label can be similar to the colors used in the pattern, as long as they are visible upon close inspection.

**Gaps and Drop Off:**
On synthetic lane surfaces, either panelized or overlay, where two panels meet, the following specifications must be met:

1. The leading edge of one panel shall be flush with, or not more than $\frac{25}{1000}$ inch below the trailing edge of the adjoining panel at any point across the width of the lane.
2. The leading edge of the first panel shall be flush with, or not more than $\frac{80}{1000}$ inch below the trailing edge of the foul line at any point across the width of the lane.
3. The gap between the leading and trailing edge of adjoining panels, across the width of the lane, shall not exceed $\frac{50}{1000}$ inch at the time of installation.

(See the following diagram for description of “leading” and “trailing” edges.)

**Surface:**
The surface of a synthetic lane may not be altered (coated) with any material unless first tested and approved.
PIN DECK AREA

Composition:
The pin deck may be constructed entirely of hardwood. Synthetic materials, alone or in combination with other materials, may be used provided these materials have been tested and approved by ABC/WIBC.

Pin Spots:
There must be 10 visible pin spots on the pin deck that meet all specifications. (see pin spots below).

Edgeboards:
The edgeboards must be rounded on a radius of not more than \( \frac{5}{32} \) inch. If the radius is removed, such radius must be restored. The edgeboard may be constructed entirely of hardwood without testing. Synthetic materials, alone or in combination with other materials, may be used provided these materials have been tested and approved by ABC/WIBC.

Synthetic Edge Strip:
A synthetic edge strip, measuring not more than 1/2 inch in thickness and:
1. not less than 1 1/2 inches in depth, at time of installation on a new edgeboard
2. not less than 1 inch in depth, at time of installation on an existing edgeboard

May be attached to the side of the pin deck nearest the gutters and at a minimum, shall extend from a point opposite the No. 1 pin to the pit. It must be installed vertically so the synthetic material exposed on the pin deck surface is not in excess of 1/2 inch.

Composition:
The pin deck may be constructed entirely of hardwood. Synthetic materials, alone or in combination with other materials, may be used provided these materials have been tested and approved by ABC/WIBC.

Edgeboards:
The edgeboards must be rounded on a radius of not more than \( \frac{5}{32} \) inch. If the radius is removed, such radius must be restored. The edgeboard may be constructed entirely of hardwood without testing. Synthetic materials, alone or in combination with other materials, may be used provided these materials have been tested and approved by ABC/WIBC.

Synthetic Pin Decks:
If the pin deck surface includes the tail plank, the end of the lane must be visibly identified with a minimum mark of at least 2 inches in length on the 10 pin side of the pin deck for the life of the pin deck.

If nonwood pin decks are in use with either wood or non wood lane surfaces, the leading edge of the pin deck must be flush with to not more than \( \frac{25}{1000} \) inch below the trailing edge of the adjoining lane section across the width of the lane.

The gap between the pin deck and the adjoining lane section, across the width of the lane, shall not exceed \( \frac{50}{1000} \) inch.

Pin Spots:
All pin spots, upon which the pins must be set, shall be clearly identified for the life of the pin deck and be 2 1/4 inches in diameter, plus/minus 1/16 inch, and meet the following location specifications:
1. Spaced 12 inches plus/minus 1/16 inch, (non accumulative) in an equilateral triangular.
2. 3 inches, plus/minus 1/16 inch, from the center of 7, 8, 9 and 10 pin spots to the pit (not including the tail plank).
3. 2 3/4 inches, plus/minus 1/4 inch, from the center of the 7 and 10 pin spots to the adjacent side of the pin deck.
4. 12 1/16 inches, plus/minus 1/16 inch, from the center of the 7 and 10 pin spots to the nearest kickback.
5. The No. 1 pin spot shall be equidistant from both edges of the lane and both kickbacks with a tolerance of plus/minus 1/8 inch, and never less than 30 inches from its center to the kickbacks.
6. 31 3/16 inches, (reference dimension) from center of the No. 1 pin spot, to a perpendicular line drawn through the centers of the back row of spots.
7. 34 3/16 inches from the center of the No. 1 pin spot, to the pit (not including the tail plank).
Tail Plank:
A tail plank, not to exceed 2 inches in thickness, may be attached to the rear of the lane. The tail plank may be constructed entirely of hardwood without testing but synthetic materials, alone or in combination with other materials, must be evaluated by ABC/WIBC before use. The exposed edge of the tail plank may be covered with a piece of synthetic material which must have a radius of 5/8 inch, plus/minus 1/8 inch at the intersection of the top edge and rear face of the tail plank. At no time may there be more than 5 inches of flat playing surface including the tail plank in back of the centers of the 7, 8, 9, and 10 pin spots.
Gutters shall be placed on each side of the lane and shall begin at the foul line and extend parallel with the lane to the pit.

**Round Gutters:**
1. The width, shall be 9 1/4 inch, plus/minus 1/4 inch.
2. They must be concave in shape.
3. They must measure at least 1 7/8 inch in depth at center at time of manufacture.

**Flat Gutters:**
Flat gutters, must be constructed of wood or other materials which have been tested according to ABC/WIBC procedures for the specified time period and approved.
1. The width shall be 9 1/4 inches, plus/minus 1/4 inch, including the molding.
2. From a point opposite or within 15 inches ahead of the No. 1 pin spot, the gutter must have square bottoms and must be at least 1 7/8 inch beneath the surface of the lane.
3. Opposite the center of the rear row of pin spots the depth shall be 3 1/2 inches, plus/minus 1/8 inch.

**Reinforced Flat Gutters:**
1. The dimensions shall be the same as flat gutters.
2. The reinforcing material may cover the entire length and width of the bottom, or be 4 inches, plus/minus 1/2 inch, in width and cover the total length.
3. If vulcanized fibre reinforcing is used, it shall not exceed 3/16 inch in thickness.
4. If laminated phenolic reinforcing, Grade “C” or “CE”, is used, it shall not exceed 1/8 inch in thickness.

**Flat Gutter Molding: (Solid Hardwood)**
A strip of molding extending the entire length of the flat gutter shall be securely fastened to the bottom of the flat gutter. The molding may be constructed entirely of hardwood without testing. Synthetic materials, alone or in combination with other materials, which have been approved by ABC/WIBC after testing may be used.
1. They may not exceed 7/8 inch high, at the leading edge, gradually increasing to a maximum of 1 1/2 inches high opposite the 7 and 10 pin spots. (Measured from the top surface of the flat gutter to the top of the molding).
2. They may not exceed 3/4 inch in width.
3. The top exposed edge shall be rounded to a radius of 5/8 inch, plus/minus 1/8 inch.
Reinforced Flat Gutter Molding:
1. They must meet all physical dimensions of solid hardwood flat gutter molding.
2. The wearing surface may be reinforced from the pit to at least the point opposite the No. 1 pin spot.
3. If vulcanized fibre is used, it may not exceed 1/4 inch when used on the side or 1/2 inch thick when used on the top. (See drawing)
4. If laminated phenolic material Grade “C” or “CE” is used, it shall be 1/8 inch thick.

Kickbacks:
The kickback may be constructed entirely of hardwood without testing. Synthetic materials, alone or in combination with other materials which have been approved ABC/WIBC after testing may be used. The kickbacks, or side partitions, shall be placed parallel to the lane and shall meet the following requirements:
1. It shall extend from a point opposite or within 15 inches ahead of the No. 1 pin spot to the rear cushion wall.
2. The distance between the wood faces of the two kickbacks shall be 60 1/8 inches, plus/minus 1/8 inch.
3. The height above the lane shall be 20 1/2 inches, plus/minus 3 1/2 inches.
The kickbacks, behind the tail plank, may be covered with impregnated fibre glass, hard vulcanized fibre, or laminated phenolic (Grade “C” or “CE”).

Kickback Plates:
The kickbacks may be covered with a single layer of reinforcing material, not to exceed 3/16 inch in thickness. The following materials may be used:
1. Hard vulcanized fibre.
2. Laminated phenolic (Grade “C” or “CE”).
3. Rigid thermoplastic vinyl copolymer.
Other materials, may be used provided they have been tested and approved by ABC/WIBC.

Rear Cushion:
The rear cushion shall in all cases be covered with material of a dark color and shall be so constructed as to prevent the pins from rebounding onto the lane. (For pit and rear cushion measurements on automatic pinsetting devices see section on Automatic Pinsetting devices in this manual.)

Pit:
1. For lanes without automatic pinsetting devices, there shall not be less than 10 inches from the pit floor to the top of the lane and it shall not be less than 9 1/2 inches from the top of the pit mat to the top of the lane. The pit shall not be less than 30 inches in depth from the rear edge of the lane (including the width of the tail plank as a portion of the measurement) to the face of the rear cushion.
2. For lanes with automatic pinsetting devices, see the diagrams on page 12.
*Note: These are not specifications but accepted standards for installing bowling lanes.

REGULATION BOWLING LANE DIMENSIONS PIT END VIEW

- KICKBACK: 60 1/8" ± 1/8" WOOD TO WOOD
- GUTTER WIDTHS PLUS WIDTH OF BOWLING LANE MUST TOTAL SAME AS OVER-ALL SPREAD, WOOD TO WOOD
- KICKBACK PLATE: 3/16" max. thickness
- PIN DECK: 41 1/2"
- GUTTER MOULDING: 1 1/2" x 3/4"
- ACROSS REAR ROW OF PIN SPOTS: *15"
REGULATION BOWLING LANE DIMENSIONS

Side View - Pit End

*Cushion Plank
- 18" * 13/4"*
- 21/2" *
- 28" *

*Kickback
- 9 7/8" *
- 15" *
- 50"

*Pitch
- 2"

*Pit Floor
- 50"

*Note: This particular measurement is not an ABC/WIBC specification but is an accepted standard for installing bowling lanes
PIT MEASUREMENTS — AUTOMATIC PINSETTING DEVICE

AMF/VANTAGE

BOWL-MOR, and Z-3

HEDDON H-300-R

MENDES MM-2001

BRUNSWICK, HEDDON H-4, DACOS

BRUNSWICK GS-10
**Markings**
Any bowling ball used in ABC/WIBC sanctioned competition must be approved and identifiable as a ball listed in the “approved bowling ball” list located on the Specifications and Certifications page on www.bowl.com. Additionally, for identification purposes, each ball must have some form of serial number (this may be engraved or re-engraved by the bowler). Since all bowling balls manufactured prior to the creation of the ball list (January 1991) have been previously approved, the acceptance of these balls is at the discretion of the tournament director and/or league official.

**Material:**
1. The ball shall be constructed of solid material ie: no liquids, and without voids in its interior.
2. Any materials added to or included in the coverstock shall be equally distributed throughout the entire coverstock of the ball, except for materials used in logos and other required markings.
3. The density of any piece/component in a ball (i.e.: core, coverstock, weight block, etc.) shall not exceed 3.80 g/mL (i.e.: no pure metals or high density materials).
4. Following approval of the ball, the introduction of substances that are not comparable to the original material used in manufacturing of a bowling ball is prohibited. Likewise, altering a bowling ball in any way so as to increase its weight or cause it to be off balance outside the specifications is prohibited.

**Surface:**
The surface of the ball shall be free of all depressions or grooves of specific pattern, except for holes or indentations used for gripping the ball, identification lettering and numbers, and incidental chipping or marking caused by wear. Engraved pictures are not considered grooves of specific pattern.

No foreign material may be placed on the outer surface of the ball.

If the surface friction of the ball is altered by sanding or polishing, the entire surface of the ball must be sanded or polished.

Plugs and grips may not extend beyond the surface of the ball.

**Weight:**
The weight of the ball shall not exceed 16.00 pounds. There is no minimum weight.

**Hardness:**
1. The surface hardness of bowling balls shall not be less than 72 durometer D at room temperature (68 - 78 degrees F).
2. The use of chemicals, solvents or other methods to change the hardness of the surface of the ball after it is manufactured is prohibited.

**Cleaning:**
Cleaners may be used provided:
1. They do not affect the hardness of the ball.
2. They are totally removed from the ball before delivery.

Any ball cleaner which does not conform to any of these provisions may not be used in ABC/WIBC sanctioned competition.

**Devices:**
Movable devices are not permitted in a ball except that a device for changing the finger span or the size of finger and thumb holes may be inserted, providing the device is locked in position during delivery and cannot be removed from the ball without destroying the device. (Excluding Tape)

Removable devices shall be permitted, provided:
1. Such devices are used for changing the span, pitch or size of the gripping holes
2. Are constructed of a non-metallic material.
3. Are locked in position during delivery.
4. No device shall be employed for the purpose of adjusting the static balance of the ball.
5. No voids shall be permitted under the device.
6. Density not to exceed 1.5 grams per cubic centimeter.

**Mechanical Aids:**
A bowling ball must be delivered entirely by manual means and shall not incorporate any device either in the ball or affixed to it which is either detached at time of delivery or is a moving part in the ball during delivery, except that any person who’s hand or major portion thereof has been amputated may use special equipment to aid in grasping and delivering the ball provided the special equipment is in lieu of the amputee’s hand (see ABC or WIBC Rule Book for further clarification).

Plugs and Designs/Logos:
1. Plugs may be inserted for the purpose of redrilling the ball.
2. Designs may be imbedded in the ball for guides, observation, or identification purposes, provided such designs are flush with the outer surface of the ball.
3. In all cases there shall be no interior voids.
4. Plugs and designs must be made of material similar to, although not exactly the same as the original material of which the ball was made, and shall otherwise comply with all other specifications for a bowling ball.
5. Density not to exceed 1.5 grams per cubic centimeter.
MANUFACTURING SPECIFICATIONS

The Equipment Specifications Committee may establish specifications for a bowling ball as to roundness, size, materials, and physical properties. A manufacturer producing any new product, or a new manufacturer, shall submit samples to the ABC/WIBC Equipment Specifications Department for testing. (See page 35 for details.) Any ball used in sanctioned competition must be ABC/WIBC approved.

PHYSICAL SPECIFICATIONS

At time of manufacture, all balls must meet the following technical specifications when tested at room temperature (68-78 degrees F):

<table>
<thead>
<tr>
<th>Specification</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Circumference</td>
<td>26.704&quot;</td>
<td>27.002&quot;</td>
</tr>
<tr>
<td>2. Diameter</td>
<td>8.500&quot;</td>
<td>8.595&quot;</td>
</tr>
<tr>
<td>3. Roundness</td>
<td>none</td>
<td>0.010&quot;</td>
</tr>
<tr>
<td>4. Hardness (durometer D)</td>
<td>72</td>
<td>none</td>
</tr>
<tr>
<td>5. Radius of gyration*</td>
<td>2.430&quot;</td>
<td>2.800&quot;</td>
</tr>
<tr>
<td>6. Differential radius of gyration*</td>
<td>none</td>
<td>0.080&quot;</td>
</tr>
<tr>
<td>7. Coefficient of restitution*</td>
<td>0.650</td>
<td>0.780</td>
</tr>
<tr>
<td>8. Coefficient of friction*</td>
<td>none</td>
<td>0.320</td>
</tr>
</tbody>
</table>

* These specifications are for balls weighing 13.00 pounds or greater.

Circumference and Diameter:
A bowling ball shall not have a circumference of more than 27.002 inches (diameter of 8.595 inches) nor less than 26.704 inches (diameter of 8.500 inches).

Roundness:
A bowling ball shall be spherical and shall not be out of round by more than 0.010 inches.

Hardness:
The surface hardness of a bowling ball shall not be less than 72 durometer D.

Radius of Gyration:
The radius of gyration of a 13.00 lb. or more bowling ball, about any axis, shall not be less than 2.430 inches nor more than 2.800 inches. In addition, the maximum differential radius of gyration between any two axes of the same ball shall not exceed 0.080 inches. These shall be tested in accordance with an ABC/WIBC approved test procedure (see Appendix D).

Marking Location:
There shall be an identifying mark, logo, trademark, serial number, or product name imprinted over the heaviest portion of an undrilled ball. In addition, the center of the heaviest portion of an undrilled ball is to be indicated by a mark or letter locator.

Coefficient of Restitution:
The coefficient of restitution of a 13.00 lb or more bowling ball shall not be less than 0.650 nor greater than 0.780 when tested in accordance with an ABC/WIBC approved test procedure (see Appendix E).

Coefficient of Friction:
The coefficient of friction of a 13.00 lb or more bowling ball shall not exceed 0.320 when tested in accordance with an ABC/WIBC approved test procedure at a relative humidity of between 30% and 50% (see Appendix F).

The ball may be tested as received or anywhere between 320 grit to 3000 polish.

Approval Logo:
All boxes in which approved bowling balls are distributed must be clearly marked with the following approval logo which must be a minimum of 3 inches in diameter:
DRILLING SPECIFICATIONS

Holes:
The following limitations shall govern the drilling of holes in the ball:
1. Holes or indentations, not to exceed five (5), for gripping purposes.
2. One hole for balance purposes not to exceed 1-1/4 inch diameter. (Including the surface opening).
3. No more than one (1) vent hole to each finger and/or thumb hole not to exceed 1/4 inch in diameter. (Including the surface opening).
4. One mill hole for inspection purposes not to exceed 5/8 inch in diameter and 1/8 inch in depth.

Balance:
The following tolerances shall be permissible in the balance of a bowling ball used in sanctioned competition:
1. 10.01 pounds or more:
   a. Not more than three (3) ounces difference between top half of the ball (finger hole side) and the bottom half (side opposite the finger holes).
   b. Not more than one (1) ounce difference between the sides to the right and left of the finger holes or between the sides in front and back of the finger holes.
   c. A ball drilled without a thumb hole may not have more than one (1) ounce difference between any two halves of the ball.
   d. A ball drilled without any finger holes or indentations, may not have more than one (1) ounce difference between any two halves of the ball.
   e. A ball used without any hole or indentations may not have more than 3/4 ounce difference between any two halves of the ball.
2. For a ball weighing 10.0 pounds to 8.0 pounds:
   a. Not more than one (2) ounces difference between top half of the ball (finger hole side) and the bottom half (side opposite the finger holes).
   b. Not more than three quarters (3/4) ounce difference between the sides to the right and left of the finger holes or between the sides in front and back of the finger holes.
   c. A ball drilled without a thumb hole may not have more than 3/4 ounce difference between any two halves of the ball.
   d. A ball drilled without any finger holes or indentations, may not have more than (3/4) ounce difference between any two halves of the ball.
   e. A ball used without any hole or indentations may not have more than 3/4 ounce difference between any two halves of the ball.
3. Less than 8.0 pounds:
   a. Not more than three quarters (3/4) ounce difference between the top half of the ball (finger hole side) and the bottom half (side opposite the finger holes).
   b. Not more than 3/4 ounce difference between the sides to the right and left of the finger holes or between the sides in front and back of the finger holes.
   c. A ball drilled without a thumb hole may not have more than 3/4 ounce difference between any two halves of the ball.
   d. A ball drilled without any finger holes or indentations, may not have more than (3/4) ounce difference between any two halves of the ball.
   e. A ball used without any hole or indentations may not have more than 3/4 ounce difference between any two halves of the ball.

Plugs & Designs:
1. Plugs may be inserted for the purpose of redrilling the ball.
2. Designs may be imbedded in the ball for guides, observation or identification purposes, provided such designs are flush with the outer surface of the ball.
3. In all cases there shall be no interior voids.
4. Plugs and designs must be made of material similar to, although not exactly the same as, the original material out of which the ball was made, and shall otherwise comply with other specifications for a bowling ball.
5. No foreign material may be placed on the outer surface of the ball.
Only lane dressings containing an ABC/WIBC approved additive added by the dressing manufacturer, and meeting the following requirements, shall be acceptable for use on lanes where sanctioned competition is conducted:

1. The additive shall be ultraviolet sensitive and shall constitute 1/30 of 1 percent (1 part per 3,000) of the solid content of the dressing. “Solid content” means the lubricants remaining after subtracting all solvents and volatiles.

2. The dressing-additive mixture shall be so homogenized as to assure a storage life of not less than six (6) months with no noticeable separation of the additive.

3. The dressing-additive mixture shall comply with safety standards and shall not be harmful to health.

4. All dressing containers shall bear labels stating: This product contains an additive that complies with ABC/WIBC specifications.

5. Samples of dressing shall be submitted to ABC/WIBC upon request for evaluation of additive content and homogeneous characteristics.

The purpose of the additive is to provide a bowling surface condition enabling accurate measurement and recording of the relative amount of dressing across the width of the lane. There shall be no deviation from an approved additive/dressing without prior written approval from the ABC/WIBC.

**TECHNICAL SPECIFICATIONS FOR LANE DRESSING TAPE TAKE-UP DEVICE**

These specifications establish the requirements for the lane dressing take-up device (“device”) to be employed to apply the tape described in ABC/WIBC specifications for lane dressing pick-up tapes to, and remove it from, the surface of a bowling lane.

1. By mechanical action, the device shall apply one layer of tape to and across the width of a lane, with the adhesive side on the lane surface. A second mechanical action shall pick up the original tape and simultaneously affix a second like tape to the first tape, adhesive sides together, so as to encapsulate the lane dressing picked up by the first tape between the two layers of tape.

2. The device shall accept two rolls of the tape on separate spools. The free ends of the tapes, affixed together, shall be held firmly in place while the tape from one spool is applied to and rolled across the lane by means of a flexible wheel, guided by a channel provided by the device running across the width of the lane. Then, as the first tape is removed from the lane surface and picked up by the device, the second tape shall be dispensed from its spool and affixed, adhesive sides together, to the first tape. The combined sample can then be removed from the device.

3. The part of the device holding the free end of the tapes during dispensing shall have a holding force of not less than five (5) pounds to assure that the tapes will not pull free while being applied and picked up.

4. The device shall be capable of superimposing the second tape on the first with no more than 1/16 inch misalignment of the tape edges.

5. The device shall be capable of performing 10,000 operations as specified without failure or excessive wear. Lubrication, if required, at 100 hour usage intervals, shall suffice to assure effective operation of the device.

6. The device shall be capable of being cleaned by wiping with a cloth.

7. The device shall be designed and manufactured to “best commercial practice” and shall be operational without damage after being subject to the following tests:

   - Vibration: .01” displacement, 1 Hertz per second to 400 Hertz per second applied to any of four (4) sides. At least two (2) vibration tests, each of one minute duration, must be satisfactorily met.
   - Shock: 4 Gs when applied to any of six (6) sides.

Unless otherwise specified by ABC/WIBC, all examinations and tests shall be made at the following environmental conditions:

- Operating: +30 to +100 degrees F.
- Storage: -30 to +165 degrees F.

Only a device approved by ABC/WIBC as meeting these requirements shall be employed for application of the tape on lanes where sanctioned competition is conducted.
The manufacturer of an approved device shall be responsible for continuing compliance with these requirements, and ABC/WIBC reserves the right to perform any inspection and/or test which it deems appropriate to assure that the device does comply.

To that end, unless waived by ABC/WIBC, the manufacturer shall supply one device out of each 500 units manufactured for visual and mechanical inspection by ABC/WIBC, at the manufacturer’s site or as directed by ABC/WIBC. Such device may be selected at random by ABC/WIBC from the production line. At ABC/WIBC’s discretion the device may be subject to the environmental extremes and/or vibration and/or shock requirements of these specifications. Failure of the device to pass all requirements of these specifications shall constitute a basis for withdrawal of approval.

The manufacturer may recommend improved design changes. However, once approval has been given by ABC/WIBC, no modification may be made to the device without prior written ABC/WIBC approval.

LANE DRESSINGS AND LANE DRESSING MEASURING EQUIPMENT

TECHNICAL SPECIFICATIONS FOR ULTRAVIOLET-SENSITIVE TAPE READER

These specifications establish the requirements for an instrument (the reader) capable of measuring the amount of ultraviolet-sensitive additive in lane dressing which has been encapsulated as described in ABC/WIBC specifications for lane dressing pick-up tape.

1. The reader shall accept a (1) inch wide, two layer tape which has encapsulated the lane dressing and shall provide reading of the ultraviolet-sensitive additive in the lane dressing within the accuracies herein specified.

2. The ultraviolet sensing device within the reader shall be sensitive to 435 nanometer light and shall operate in the linear portion of the curve to provide a linear output of the read-out over its projected range. Detection shall be linear from .005 to .5 cc of percent nonvolatile material per square foot with a concentration of 0.033 percent ultraviolet tracer in the dressing. The reader’s sensitivity shall be capable of differentiating between .00835 cc per square foot.

3. The output reading shall be displayed to provide a comparison of the relative amount of additive encapsulated along the length of the tape.

4. The reader shall include a drive tape advancement mechanism that shall advance the tape in 1-1/16 inch increments with cumulative error of not more than 0.5 inch in 42 inches. The manual mechanism shall have detents at 1-1/16 inch increments.*

5. The tape path shall be constructed to minimize any sideward tape movement, while permitting hand feed of the tape until engaged by the drive mechanism, at which time the drive will advance the tape as specified in item 4.

6. The tape path shall be readily cleaned and constructed to prevent an accumulation of fluorescent debris.

7. Stray light shall not present interference in a brightly lit room or in direct sunlight.

8. The control for driving the tape shall be easily accessible to the operator and the reader shall otherwise be constructed to assure operator convenience, including the position of switches, lamps, controls, and overall size of the reader.

9a. The light source shall be a 375 nanometer ultraviolet light.

9b. On the front panel, an indicator will show the primary power is on and another shall indicate when the ultraviolet light is functioning.*

10a. With the unit at ambient temperature the stabilization time, from the time the unit is turned on until the unit can make accurate readings, shall be approximately 45 minutes. Verification shall be conducted by repeatable tests using the same tape and obtain readings produced previously plus/minus .2.

10b. The readout indications for a test tape shall be repeatable after the unit has been operational for one (1) hour without re-adjustment of the “null” control. Output shall be plus/minus 0.1 of original reading.*

10c. There shall be no noticeable change in the output reading when the AC input is varied between 105 and 125 VAC.

11. The reader shall be capable of 500 hours operation with no adjustment of internal controls, during which time the output shall remain linear with no distortion over the required range of the reader.

12. There shall be one external “null” adjustment allowing for setting the readout device to zero.*

* Applies to Orig Black Box Reader.
13. Unless otherwise specified by ABC/WIBC, all examinations and tests shall be made at the following environmental conditions:
   Operating.........................+30 to +100 degrees F.
   Storage.............................-30 to +165 degrees F.
   Relative humidity...............90 percent maximum — No minimum
   Altitude..........................Sea level to 8,000 feet

14. The units shall be designed and manufactured to “best commercial” practice and shall be operational, without internal adjustments, and shall have no mechanical failures (damage) after being subjected to the following tests:
   Vibration: .01” of displacement from, 1 to 400 Hertz/second when applied to any of six (6) sides.
   Shock: 2 G’s when applied to any of six (6) sides.

Only an ABC/WIBC approved device meeting the forgoing requirements shall be employed for evaluation of sample tapes taken from lanes on which sanctioned competition is conducted.

Lane Dressings and Lane Dressing Measuring Equipment

Technical Specifications for Lane Dressing Pick-up Tape

These specifications establish the requirements for the lane dressing pick-up tape (“tape”) to be employed with the take-up device described in ABC/WIBC specifications for lane dressing take-up device.

1. The tape shall be one (1) inch wide, substantially transparent when applied to a surface, having an adhesive side which, when rolled (with the take-up device) on and across a bowling lane, shall have the property of picking up all lane dressing from the lane surface. When a second like tape is affixed to the first tape, adhesive sides together, it shall effectively encapsulate the picked-up dressing. The combined tapes must permit comparative measurement of the ultraviolet-sensitive additive encapsulated along the tape’s length by use of the reader device. (See specification’s for ultraviolet-sensitive reader).

2. The tape shall have a usable life of not less than ten (10) years, including at least six (6) years subsequent to its application to a lane surface as described.

3. Unless otherwise specified by ABC/WIBC, the tape shall perform as above after being subjected to the following environmental conditions:
   Operating.............................+40 to +100 degrees F.
   Storage.............................-30 to +165 degrees F.

The manufacturer of an approved device shall be responsible for continuing compliance with the foregoing requirements and ABC/WIBC reserves the right to perform any inspection and/or test which it deems appropriate to assure that the device does so comply.

To that end, unless waived by ABC/WIBC, the manufacturer shall supply one device out of each 250 units manufactured for visual, electrical and mechanical inspection by ABC/WIBC, at the manufacturer’s site or as directed by ABC/WIBC. Such device may be selected at random by ABC/WIBC from the production line.

At ABC/WIBC’s discretion, the device may be subjected to the environmental extremes and/or vibration and/or shock requirements of these specifications. Failure of the device to pass all requirements of these specifications shall constitute a basis for withdrawal of approval.

The manufacturer may recommend improved design changes. However, once approval has been given by ABC/WIBC no modification may be made to the device without prior written ABC/WIBC approval.
Material:
ABC/WIBC approved pins shall be made of new (unused), sound, hard maple. Pins constructed of material other than hard maple may be used in ABC/WIBC sanctioned competition provided they comply with the technical specifications and have been approved and given an ABC/WIBC permit number.

Editor’s Note: Sound means that the wood shall be free of any decay that has advanced to a point where it can be recognized by color or softening of the wood and shall not have the following defects:
1. Cracks due to drying of the wood.
2. Skip, torn or chipped grain in ball zone exceeding a 2 square inch area or having a maximum depth greater than 1/8 inch.
3. Open glue joints in laminated pins due to either uneven facing surfaces, inadequate glue pressure or poor gluing.
4. Cross grain exceeding slope of 1 inch in 10 inches.
5. Knots and bark pockets with maximum dimension exceeding 1/4 inch in neck, 3/8 inch at pin bottom, 1 inch in head and 1 3/4 inches in ball zone.

Type of Construction:
Each pin may be constructed of one, or laminated of two or more pieces, provided the pins meet ABC/WIBC specifications. All lamination shall run parallel to the vertical axis of the pin.

Adhesives:
Adhesives used in laminating pins should be of such types that they will withstand the forces of temperature, moisture and play that occur in service of a bowling pin, and they should be sufficiently durable to provide satisfactory quality joints during the life of the pin. Only adhesives conforming to the quality required by commercial standards, or federal specifications for the appropriate adhesive, should be used.

It is advisable to obtain certification from the adhesive manufacturer that the adhesive is acceptable for laminating wood for bowling pins.

The bonding quality of the glue must not be affected by any process presently being used in the manufacture of any ABC/WIBC approved plastic coated pins.

Mixing, spreading, storage, working and assembly life should be in accordance with the manufacturer’s recommendations.

Each lot of adhesive should be certified as conforming to the applicable specifications.

Gluing procedures should conform to those described in the Forest Products Laboratory (U.S. Department of Agriculture) manual entitled “Fabrication and Design of Glued Laminated Wood Structural Members.”

Weight:

<table>
<thead>
<tr>
<th></th>
<th>Not less than</th>
<th>Not more than</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard wood pin</td>
<td>3 lbs., 6 ozs</td>
<td>3 lbs., 10 ozs</td>
</tr>
<tr>
<td>Plastic coated (wood core)</td>
<td>3 lbs., 6 ozs</td>
<td>3 lbs., 10 ozs</td>
</tr>
</tbody>
</table>

Nonwood (synthetic) pin will set its own weight limit at time of testing. The weight range may not exceed a total of 2 ounces from minimum to maximum and any pin out of its approved weight range is unacceptable for ABC/WIBC sanctioned competition.

Center of Gravity:
The center of gravity of any tenpin shall be measured from the bottom of the pin. This measurement shall not be higher than 5-60/64 nor lower than 5-40/64 inches except synthetic pins (see Technical Specifications For Non-Wood Synthetic Pins).

Radius of Gyration:
The radius of gyration, measured around the horizontal axis through the center of gravity, for all pins shall be 3.727 inches, plus/minus .094 inches except for synthetic pins (see Technical Specifications For Non-Wood Synthetic Pins).

Such determination of the above specification shall be accomplished under the bifilar method (see Appendix A).
Moisture Content:
Moisture content at time of manufacture of all non-synthetic tenpins shall not be less than 6 percent nor more than 12 percent. In laminated pins, the individual pieces should not vary more than 2 percent in moisture content at the time of gluing.

Finish:
Single piece or laminated maple tenpins shall be finished with regularly accepted wood finishes. Regular wood finishes of $4/1000$ inch film thickness are acceptable. Any tenpin with a film thickness in excess of $4/1000$ inch shall be submitted to ABC/WIBC for testing and approval. (See Technical Specification for Wood Core Plastic Coated Pins).

Pins used in ABC/WIBC competition shall only bear the name and trademark of the original manufacturer or distributor and be marked “ABC/WIBC Approved”. Except for reasonable wear, neck markings and color, the pins in each set must be uniform in appearance including finish and labels.

Coatings:
The coating of single piece or laminated maple tenpins must be transparent (clear) or solid color with the exception of neck markings, identifying symbols or name which must be clearly visible or of a contrasting color.

Coefficient of Restitution:
The coefficient of restitution of a bowling pin shall not be less than 0.605 nor greater than 0.735 when tested in accordance with an ABC/WIBC approved test procedure.

Hardness:
Hardness determinations of the coating shall be established by a scleroscope hardness test. Minimum and Maximum hardness values shall be established for each specific approved plastic coating, which shall be calculated from 10 measurement readings from 1 to $1-1/2$ inches apart at the largest diameter on the pin, $4-3/4$ inches above the pin base. The specification for each pin will be set at the average of these readings with a tolerance of plus/minus 10.

Design and Measurements:
The height of each pin shall be 15 inches, plus/minus $1/32$ inch.

The top of the pin shall have a uniform arc with a radius of 1.273 inches. A plus/minus tolerance of $1/32$ inch shall be permitted.

All diameter tolerances shall be plus/minus $1/32$ inch. The taper from station to station shall be gradual so that all lines have a graceful curve.
# BOWLING PIN SPECIFICATIONS

## Station Specification Tolerance

<table>
<thead>
<tr>
<th>Station</th>
<th>Diameter Maximum</th>
<th>Diameter Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 1/2” Above Base</td>
<td>2.547”</td>
<td>2.516”</td>
</tr>
<tr>
<td>12 5/8” Above Base</td>
<td>2.406”</td>
<td>2.375”</td>
</tr>
<tr>
<td>11 3/4” Above Base</td>
<td>2.094”</td>
<td>2.063”</td>
</tr>
<tr>
<td>10 7/8” Above Base</td>
<td>1.870”</td>
<td>1.839”</td>
</tr>
<tr>
<td>10” Above Base</td>
<td>1.797”</td>
<td>1.766”</td>
</tr>
<tr>
<td>9 3/8” Above Base</td>
<td>1.965”</td>
<td>1.934”</td>
</tr>
<tr>
<td>8 5/8” Above Base</td>
<td>2.472”</td>
<td>2.441”</td>
</tr>
<tr>
<td>7 1/4” Above Base</td>
<td>3.703”</td>
<td>3.672”</td>
</tr>
<tr>
<td>6 1/4” Above Base</td>
<td>4.563”</td>
<td>4.532”</td>
</tr>
<tr>
<td>4 1/2” Above Base</td>
<td>4.766”</td>
<td>4.735”</td>
</tr>
<tr>
<td>3 3/8” Above Base</td>
<td>4.510”</td>
<td>4.479”</td>
</tr>
<tr>
<td>2 1/4” Above Base</td>
<td>3.906”</td>
<td>3.875”</td>
</tr>
<tr>
<td>3/4” Above Base</td>
<td>2.828”</td>
<td>2.797”</td>
</tr>
<tr>
<td>Base – with 5/32” radius – Flat Diameter</td>
<td>2.031”</td>
<td>2.000”</td>
</tr>
</tbody>
</table>

## Other Specifications

### Specifications Tolerance

<table>
<thead>
<tr>
<th>Specification</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>15” (15.000”)</td>
<td>14.969”</td>
</tr>
<tr>
<td>* Hole Depth (Standard, not specification)</td>
<td>2” (2.000”)</td>
<td>1.969”</td>
</tr>
<tr>
<td>Hole Size</td>
<td>27/64” (0.422”)</td>
<td>0.406”</td>
</tr>
<tr>
<td>* Cup Diameter (Standard, not specification)</td>
<td>3/16” (0.750”)</td>
<td>0.734”</td>
</tr>
<tr>
<td>Radius at Base</td>
<td>5/32” (0.156”)</td>
<td>0.125”</td>
</tr>
<tr>
<td>Center of Gravity</td>
<td>5 50/64” (5.781”)</td>
<td>5.625”</td>
</tr>
<tr>
<td>Radius of Gyration</td>
<td>3.727”</td>
<td>3.633”</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>12%</td>
<td>6%</td>
</tr>
<tr>
<td>Coefficient of Restitution</td>
<td>(0.670”)</td>
<td>0.605”</td>
</tr>
</tbody>
</table>
BOWLING PIN MEASUREMENT SPECIFICATIONS
Bases:
No part of the base shall protrude beyond the base attachment, but that portion of the base within the base attachment may be recessed as much as .025 inch.

As an alternate specification, the area of the base within the base attachment may be concave so that it is recessed at least .025 inch at the junction with the base attachment, gradually declining toward the center to a depth of .125 inch.

When any portion of the pin protrudes beyond the base attachment such pin is unacceptable for ABC/WIBC sanctioned competition until necessary corrections have been made to comply with the foregoing specifications.

All pins shall be rounded at the outer edge of the base by the manufacturer on a 5/32 inch (.156) radius with a plus or minus tolerance of 2/64 inch (.031). The diameter of the base, exclusive of the rounded edge, shall not be less than 2 inches.

Any base diameter under two inches is unacceptable for ABC/WIBC sanctioned competition. For the life of the pin.
Base Attachments:
Base attachments must be ABC/WIBC approved and manufactured in accordance with the specifications established by the ABC/WIBC Equipment Specification Committee (see specs for Base Attachments).

Label and Marking:
Pins manufactured for ABC/WIBC competition shall bear the name and trademark of the original manufacturer or distributor and be marked “ABC/WIBC Approved.”
All pins shall bear two labels for the life of the pin. One label shall be a manufacturer’s label and it shall include the following items in its design:

1. The trade name.
2. The ABC/WIBC Permit number under which ABC/WIBC approval was authorized.
3. The ABC/WIBC Certification mark in a size measuring at least 3/4 inch in diameter. See Certification Mark Below.

The following designation (in full or acceptable abbreviation form) must appear on the manufacturer’s label when applicable:

1. “Controlled Weight”
2. “Densified”
3. “Plastic Coated”
4. Reference to type of reinforcement (i.e. “nylon reinforced”)
5. Synthetic
6. Refurbisher’s Permit Number

Manufacturers or distributors shall use a distinctive label, reserved exclusively for pins meeting ABC/WIBC specifications.

In addition to the manufacturer’s label, a second label shall be a special “ABC/WIBC Label” made in conformity to design provided by the ABC/WIBC. It shall be affixed diametrically opposite the manufacturer’s label.
American Bowling Congress and the Women’s International Bowling Congress is the owner of the following certification marks applied to tenpins by the manufacturer to certify the tenpins meet ABC/WIBC specifications.

Tenpins having the proper certification mark are approved for use in competition sanctioned by the American Bowling Congress and the Women’s International Bowling Congress.

(1) Applies to all tenpins.

(2) Applies to approved plastic coated wood tenpins.

(3) Applies to approved synthetic tenpins.

(4) Applies to all test pins.
Procedure for ABC/WIBC Approval:

Four pins (wood core) of each grade with a coating thickness of .004 inch or more to be used in sanctioned competition shall be submitted to the ABC/WIBC Equipment Specification Department for evaluation prior to being tested for approval. The department will provide further details on test procedures.

Manufacturers and/or distributors who, under their own trademark or name, sell tenpins produced to these specifications shall file an application for approval with ABC/WIBC stating the manufacturer’s name with a copy of the trademark or trade name under which such tenpins are sold. This application shall be manually signed by a company officer or another authorized person.

Manufacturers and distributors shall furnish ABC/WIBC with a sample of each type label affixed to the approved pins.

Renewal of ABC/WIBC Permit:

Each year all manufacturers and distributors shall complete and return an application supplied by ABC/WIBC. In addition, one (1) pin of each grade with a coating thickness of less than .004 inch and/or four (4) pins with a coating thickness of greater than .004 inch shall be submitted for examination to insure continued compliance with ABC/WIBC specifications. The ABC/WIBC shall be further authorized to select one or more pins from a manufacturer or distributor’s open stock at cost for testing purposes at any time. The Equipment Specifications Department shall submit a detailed report to the manufacturer or distributor on each grade of pins which shall clearly explain any deviation from the approved specifications.

Manufacturers of tenpins which meet ABC/WIBC specifications shall submit an application for approval stating the trade name by which such tenpins will be designated and that they will be produced in conformity with these specifications. This application shall be manually signed by a company officer or another authorized person.

In the event pins do not meet ABC/WIBC specifications, additional tests will be required.

Spot check of pins in production to insure that pins meet specifications is to be made daily by the manufacturer.

Maintenance of Pins:

The use of steel wool or sandpaper to remove dirt and surface splinters, the application of supplementary finish and/or the patching of plastic coated pins are permissible preservative measures providing these practices conform to the procedures outlined in this manual. At no time may a pin be painted or any supplemental finish be applied that has not been evaluated and approved by ABC/WIBC

Supplementary Finish:

A preservative coat of ABC/WIBC acceptable finish will be permissible provided the total accumulation of all such coats conform to the contour of the pin, does not exceed .006 inches and does not obscure, obliterate or destroy the original labels (substitute labels will not be acceptable).

At no time may a pin be painted or any supplemental finish be applied that has not been evaluated and approved by ABC/WIBC.

Patching Plastic Coated Pins:

Surface patching of the pin below the neck must conform to the contour of the pin, shall not exceed a total of 6 square inches, providing no single surface patch exceeds 2 square inches. Such surface patching shall be accomplished so it does not obscure, obliterate or destroy the original labels.

Head Patching Plastic Coated Pins:

The materials used for head patching shall be limited to plastic patching material or white pigmented lacquer. No synthetic reinforcing material (knitted cap, etc.) is permitted except those which have been examined and accepted by ABC/WIBC.

Pins that have been stripped of the original plastic coat, turned down or trimmed, shall not be accepted for ABC/WIBC sanctioned competition. The same is true for any procedure which destroys or alters the radius of the pin base attachment or base flat diameter, normal wear and tear excepted.
Wood core (plastic coated) tenpins must meet the requirements listed under ABC/WIBC Tenpin Specifications plus the following:

**Scope:**
Each specific type and grade of material to be used as a pin coating must be submitted to ABC/WIBC for testing and approval before it may be applied to tenpins which are acceptable in ABC/WIBC sanctioned competition.

Any combination of coating and reinforcing material for tenpins, not covered by an ABC/WIBC specification, shall be submitted to the ABC/WIBC for testing and approval. Application of such coating to tenpins to be used in sanctioned play shall be in accordance with any additional specifications required.

**Color:**
The coating shall be solid color and/or transparent (clear) with the exception of neck markings identification symbols and names which must be of contrasting color.

**Quality of Maple:**
Only maple cores, either single piece or laminated, composed of new (unused), sound, hard maple may be used in plastic coated tenpins.

**Thickness:**
Specific coating thickness for each type of plastic coated pin will be developed independently with each manufacturer at the head, neck, ball line and base. The following tolerance will apply:

<table>
<thead>
<tr>
<th>Coating Average</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>.001 - .075&quot;</td>
<td>Plus or Minus .015&quot;</td>
</tr>
<tr>
<td>.076 - .100&quot;</td>
<td>Plus or Minus .020&quot;</td>
</tr>
<tr>
<td>.101 - And Above</td>
<td>Plus or Minus .025&quot;</td>
</tr>
</tbody>
</table>

These tolerances are individually applicable at the head, neck, ball line and base locations based on the average of 10 equidistant measurements around the pin.

In addition, the measured coating must fall within the minimum/maximum tolerance (as determined from average measurements at the time of permit issuance) for each of the 10 measurements.

**Bases:**
Pins with coatings of the type herein described must be equipped with an ABC/WIBC approved base. (If a base attachment is used see page concerning base attachments.)

**Bond and Finish:**
The coatings shall adhere to the wood and be finished to minimize dirt pickup.

**Durability:**
Coatings over .004 inch and up to .010 inch thick: Field tests must indicate that such tenpins shall remain in play for at least 800 games, with not more than 10 percent of the pins in play showing two square inches of coating loss, slabbing or breakage in the ball line.

Coatings over .010 inch thick: Field tests by ABC/WIBC must indicate that such tenpins will remain in play for at least 1,000 games, with the following conditions:

1. Not over five percent of the pins in play shall show two square inches of coating loss at the ball line.
2. Not over two percent of the pins in play shall show wood failure at the neck.

**Scoreability:**
Scoreability of the coated tenpin shall be comparable to that of conventionally finished pins. The pinfall and action must not be noticeably different than conventional pins and the scoring level of the coated pins shall be comparable to that of all wood pins as determined in tests by ABC/WIBC.
TECHNICAL SPECIFICATIONS FOR NONWOOD (SYNTHETIC) TENPINS

Any bowling pin that is not made of wood shall be classified as a synthetic tenpin.

Approval:
Each specific type and grade of synthetic tenpin must be submitted to ABC/WIBC for testing and approval before it can be used in ABC/WIBC sanctioned competition. Approval agreements of any synthetic pin must be manually signed by an authorized company representative and countersigned by an ABC/WIBC designated officer.

Color:
The coating shall be solid color and/or transparent (clear) with the exception of neck markings identification symbols and names which must be of contrasting color.

Material:
1. Manufacturer’s specifications for (type of pin). ...............................................dated........to produce following or additional physical properties:
   Type of Material
   Tensile Strength...........p.s.i.
   Tear...........min. die...((ASTM..........................))
   Elongation............min.
   Modulus of compression............min. (at...........percent)
   Scleroscope hardness............min...........max...........mean
   (Hardness values effective after......hours, or......
   days mold, air, or forced cure time.) Test on Shore
   scleroscope, Model C-2, with diamond head
   hammer. Calculations obtained from average of ten
   (10) readings varying 1 to 1 1/2 inches apart at 4 3/4
   inches above pin base.
2. Thickness (if applicable):
   Individual measurement points, amount and
   tolerances to be established by laboratory test and
   mutual agreement if applicable.

   Weight:
   Synthetic pins will establish their own weight requirement
   and tolerance at time of testing provided this tolerance
   does not exceed a total of 2 ounces.

Core Filling: (if applicable)
Physical properties and others if applicable.
Material.................................................................
Weight of fill material....oz. plus/minus....oz.
Density...........pounds
Tensile Strength...........pounds per square inch
Yield...........p.s.i.
Tear...........p.s.i.
Elongation...........percent

Exterior Coatings: (If Applicable)
The material shall establish, upon laboratory test and
mutual agreement, its own physical property specifi-
cations, some of which may include: Tensile strength, yield,
tear, elongation, hardness and others if applicable.

Balance:
Pins to be balanced around the vertical axis with a
maximum tolerance of five grams.

Measurements:
The finished pin, complete with base attachment (if
applicable), shall be of the size prescribed in ABC/WIBC
Bowling Pin Specifications.

Base Attachment:
Attachment must have ABC/WIBC approval and comply
with technical specifications outlined for base attachments.

Center of Gravity:
Pins will set their own center of gravity and tolerance
based on the samples submitted at time of testing provid-
ed the tolerance does not exceed plus/minus 5/32 inch.

The manufacturer of tenpins described herein shall have a
device approved by ABC/WIBC to pinpoint the exact
center of gravity. A daily spot check of pins in production
to insure specification compliance is mandated.

Radius of Gyration:
Pins will set their own radius of gyration and tolerance
based on the samples submitted at time of testing provid-
ed the tolerance does not exceed plus/minus .094 inch.

Such determination of the above specification shall be
accomplished under the bifilar method (see Appendix A).

Scoreability:
Scoreability of the synthetic tenpin shall be comparable to
the scoring level of a plastic coated wood core pin as
determined in ABC/WIBC tests.

Durability:
Field tests conducted by ABC/WIBC must indicate that
such tenpins will remain in play for at least 2,000 impact
games (impact game is predicated on usage in automatic
pinsetting devices using 20 or 21 pins, i.e. each ten frame
game is equal to one half (1/2) impact game) per set.
Breakage not to exceed 5 percent in the area from the
shoulder to and including the base, and not more than 2
percent at or above the neck, based on the volume of pins
under test.

Labels — Two:
1. Manufacturer’s Label:
   (see Label and Marking section under ABC/WIBC
   Tenpin Specifications). ABC/WIBC Certification
   Mark not less than 3/4 inch diameter. ABC/WIBC
   permit number with a prefix letter “S.”
2. ABC/WIBC Label:
   Affixed diametrically opposite the manufacturer’s
   label. Label shall be a special “ABC/WIBC” label
   for synthetic pins made in conformity to a design
   provided by ABC/WIBC
TECHNICAL SPECIFICATIONS CONTROLLED WEIGHT PINS

Controlled weight pins may be classified as ABC/WIBC approved upon compliance with the following requirements:

1. To control the weight of wood core tenpins in order to provide uniformity within applicable weight requirements, the pin may be constructed with voids in its core, provided that such voids do not affect the pin balance around the longitudinal axis nor appreciably alter pin performance characteristics through its normal life, and provided further that the pin otherwise conforms to all specifications for a wood core plastic coated pin.

2. Any void in a pin must extend through the center block, or if not must be balanced by an equal and oppositely placed void on the same axis, and such axis must not be oblique to the longitudinal axis.

3. The manufacturer shall employ an ABC/WIBC accepted device to check such pins accurately for center of gravity tolerances, and spot checks of pins in production shall be made daily to insure that they meet specification.

TECHNICAL SPECIFICATIONS FOR PLASTIC BASE ATTACHMENTS

Plastic base attachments are those exposed on the outer edge of the tenpin bases when such pins are used for ABC/WIBC sanctioned competition.

1. No part of the base shall protrude beyond the base attachment, but the portion within the base attachment may be recessed as much as .025 inch.

As an alternate specification, the area of the base within the base attachment may be concave so that it is recessed at least .025 inch at the junction with the base attachment, gradually declining toward the center to a depth of .125 inch.

When any portion of the pin protrudes beyond the base attachment, such pin is unacceptable for ABC/WIBC sanctioned competition until necessary corrections have been made to comply with the foregoing specifications.

2. The base must be free of defective workmanship, machine marks and warpage.

3. The base attachment shall have a minimum 1⅜ inch inside diameter. The overall flat surface of the pin base, including the base attachment, shall not be less than 2 inches.

Such base attachments may extend a maximum of ¾ inch above the base on the outside of the pin. It may be embedded not more than ¾ inch above the base. Other dimensions shall meet ABC/WIBC General Tenpin Specifications.

Base attachments which differ in design from the illustrations in Figures A, B and C are permissible only when they do not exceed any of the prescribed measurement tolerances herein set forth and provided such change in design is not exposed to outer surface of the pin, and further provided such change in design has been submitted to ABC/WIBC and approved by ABC/WIBC.

4. The maximum specific gravity of the plastic material used for all base attachments may not be more than 1.45 inch, as measured in accordance with the techniques prescribed by the American Society for Testing Materials.

5. The scleroscope hardness values obtained shall be 42-52. (See Figures A, B and C for typical acceptable plastic base attachments.)

TECHNICAL SPECIFICATIONS FOR DENSIFIED PINS

A bowling pin shall be classified as densified when by a separate manufacturing operation, it has an area or areas where the wood is compressed, or impregnated and compressed, and the wood stabilized at the increased density so that it does not recover at the relative humidities that occur in service. The density shall be increased sufficiently so the hardness as measured by the Janka ball test (ASTM D-143-52 Sections 83 to 87) of the densified portion shall be at least 75 percent more than the undensified wood of the same pin.

The maple used in such wood modification in the ball line area shall be new (unused), sound, hard maple of the quality prescribed in ABC/WIBC Bowling Pin Specifications.

All densified tenpins must meet the same specifications as outlined under “ABC/WIBC Tenpin Specifications” as well as specifications for wood core plastic coated pins.
TECHNICAL SPECIFICATIONS FOR SYNTHETIC FIBRE REINFORCED COATINGS

In the construction of a synthetic fibre reinforced tenpin, the reinforced coating shall meet the following specifications:

1. Sufficient base coat material(s) shall assure good adherence of the coatings to the wood.

2. The basic material(s) used to assure longer life to the product shall be comprised basically of gel lacquer and a synthetic fibre reinforcing material which shall be incorporated in the gel lacquer. The reinforcing material shall be at least four inches in width with the bottom edge from two to three inches from the base.

3. The finished product shall contain a top coat material of sufficient thickness to assure minimum dirt pickup throughout the usable life of the pin.

4. The durability and scoreability of this synthetic fibre reinforced pin shall be determined on the basis outlined in the general specifications for wood core plastic coated tenpins over .010 inch.

5. All synthetic fibre reinforced plastic coated pins shall be labeled and marked in compliance with the provision outlined in the section identified as “Label and Marking.” Synthetic fibre reinforced plastic coated pins must also bear the inscription “With (name of material)” or some similar reference to the synthetic fibre reinforcing material.

TECHNICAL SPECIFICATIONS FOR REFURBISHED TENPINS

Any wood core plastic coated tenpin, to which a full nylon sock and additional plastic coating has been added, or any other modification not covered under normal maintenance of pins, shall be considered a refurbished pin. All pins must be approved by ABC/WIBC and meet the following specifications:

1. Only approved wood core plastic coated pins may be refurbished.

2. Both original labels on the pin must not be covered in any way.

3. The 2” base diameter must be restored to the pin if lost through normal wear.

4. The refurbisher label must include the trade name and permit identification number assigned to that refurbisher.

5. The label shall be so applied to remain clearly legible and last the life of the pin.

In addition, the injection of material under the plastic coating of a pin shall be considered a refurbishing process and must be submitted for approval by ABC/WIBC.

Renewal of ABC/WIBC Permit:

Each year all refurbishers shall complete and return an application supplied by ABC/WIBC. In addition two (2) pins shall be submitted for examination to insure continued compliance with ABC/WIBC specifications. The Equipment Specifications Department shall submit a report to the refurbisher of pins which shall clearly explain any deviation from the approved specifications.

Refurbishers of tenpins which meet ABC/WIBC specifications shall submit an application for approval stating the trade name by which such tenpins will be designated and that they will be produced in conformity with these specifications.

This application shall be manually signed by a company officer or another authorized person.

In the event pins do not meet ABC/WIBC specifications, additional tests will be required.
All automatic pinsetting devices must be ABC/WIBC approved and meet the following specifications:

1. Be designed to operate under all situations normally arising in a sanctioned league or tournament.

2. Be constructed so that it can be installed on any ABC/WIBC regulation lane except where approval has been obtained to modify or alter one or more of the specifications in the pit area.

3. Such device must perform entirely automatic. A push button may be installed to operate the device in the event of certain emergencies. Such push button to be installed where it is easily accessible to the bowler or scorer. An emergency shall be considered if and when the machine is unable to pick up a pin which has moved more than 1 3/4 inches off the pin spot (measured from center of spot to center of moved pin); or when pins are left standing at the conclusion of the third delivery in the 10th frame plus an occasional machine malfunction.

4. It must conform with all provisions of ABC/WIBC rules and regulations pertaining to pinfall. The device must be able to return any pin to the same position to which it has been moved by a previous delivery, except when an emergency shall have been considered, as described in requirement three.

5. The machine must be able to operate under permissible voltage fluctuations existing in the community where it is installed and in use.

6. The completed installation must comply with the requirements of the state or local inspection authorities.

7. There shall be a minimum of three seconds between the time the ball reaches the pit and activates the cushion or back stop, and the pin table descends and contacts the standing pins.

8. The pit floor at the tail plank shall measure not less than 4 3/4 inches below the pin deck surface.

9. The minimum distance from the end of the lane to the nearest point of the cushion shall be 25 inches. The measurement includes the width of the tail plank.

10. Each automatic pinsetting device shall be equipped with a curtain or other pin arresting device. The curtain and the cushion shall be so located and constructed that no pins may rebound from the curtain or cushion onto the pin deck. (See drawings on next page.)

11. Each automatic pinsetting device shall (on the first ball cycle) place the bowling pin completely on the pinspot of the pindeck.

12. In establishments using pinsetting devices, such devices must be checked annually by the local association secretary or his authorized representative at the time lanes are being checked for certification to determine if pins are spotted correctly.
PIT MEASUREMENTS — AUTOMATIC PINSETTING DEVICE

AMF/VANTAGE

BOWL-MOR, and Z-3

HEDDON H-300-R

MENDES MM-2001

BRUNSWICK, HEDDON H-4, DACOS

BRUNSWICK GS-10
An automatic scoring device which meets the following specifications and has been approved by ABC/WIBC may be used in sanctioned competition.

1. This device must record scores in accordance with ABC/WIBC General Playing Rules and Regulations as published in the ABC Rule Book and the WIBC Bylaws.
2. Any such device attached to approved equipment for automatically setting pins shall not affect their operational aspects to the point of altering score-ability.
3. Such device must detect and score off-spot pins so they will not be improperly registered as pins knocked down. An off-spot pin shall be defined as a pin that has moved, but one that an approved pinsetting device is still able to pick up and respot.
4. A means of manual correction must be provided which is easily accessible to the bowler or scorer to allow for correction of a score for incidents such as bowling out of turn, illegal or improper pin fall, provisional balls, late starts, dead balls, blinds, handicaps, out-of-range pins (a pin which has moved and cannot be picked up by an approved pinsetting device), malfunction of the device, etc.
5. The device must accommodate the existing pattern of bowling where the bowlers and/or team bowls on a pair of lanes, alternating after each frame.
6. The device must provide a printed record which can be audited frame by frame. This shall include the exact pinfall on each delivery.
7. Safeguards must be provided which prohibit the inadvertent loss of scores from the device by human error or other equipment failure.
8. An Automatic Foul detector may be incorporated into the Automatic Scoring device if so desired.
9. Each scoring device is to be individually presented to the ABC/WIBC Equipment Specifications Department for evaluation.

TECHNICAL SPECIFICATIONS FOR AUTOMATIC SCORING DEVICE

Each certified bowling center must have an approved automatic foul detecting device or provision to station a judge at the foul lines during ABC/WIBC sanctioned competition. If an automatic foul detecting device is used it must be ABC/WIBC approved and meet the following specifications:

1. The foul detecting device must be entirely automatic. No manually operated push buttons, switches, levers, or other devices will be accepted.
2. Any equipment necessary to the operation of an automatic foul detection device must be flush with the division board if mounted therein.
3. The automatic foul detecting device must be able to operate under permissible voltage fluctuations existing in the community where the device is installed and in use.
4. The automatic foul detecting device must be equipped with a visible signal. Such light signal shall be visible to the scorekeeper and bowler and shall remain visible for not more than fifteen (15) seconds nor less than (10) seconds. It is also recommended that a sound signal be provided. Such signal should be of sufficient intensity to be heard at the bowler settee area.
5. The beam of the foul detecting device shall be set not more than ¼ inch beyond the approach side of the foul line.
6. The completed installation must comply with the requirements of the state or local inspection authorities.
MANUFACTURERS FIELD TEST PROGRAM FOR PRODUCTS

This program is for the purpose of evaluating test products (excluding automatic scoring devices, automatic pin spot- ers) in the field for durability before official score testing by the ABC/WIBC. To conduct a manufacturer’s field test the following guidelines must be met:

1. Proposer shall notify the ABC/WIBC Equipment Specifications Department not less than thirty days prior to the proposed installation date. The proposed location, with address, telephone number and a contact person at the center, date of installation, number of lanes and a full description of the test product must accompany the request.

2. ABC/WIBC have the right to have their personnel present during the installation or at any time thereafter. The product must meet all ABC/WIBC installation certification specifications for the duration of the installation. ABC/WIBC representatives will inspect the installation for verification of acceptable tolerances before allowing any sanctioned competition to compete on the test product. They will inspect the installation at a minimum of every 4 months.

3. The proposer may have a maximum of 16 lanes per test. These test lanes may be divided between two bowling centers, but may include no more than half the lanes per center. Testing must be done on pairs of lanes (two lanes, four lanes, six lanes, etc.)

4. Each proposer may have a maximum of 5 field tests underway at one time. A field test may last a maximum of 1 ½ years before its termination or entering into an official ABC/WIBC test. If the official ABC/WIBC test is not started in that time period, the product must be removed or ABC/WIBC certification will be withdrawn. If the official ABC/WIBC test is started in that time period, the product can remain in use until the conclusion of the test and the Equipment Specifications Committee’s decision.

5. The Equipment Specifications Department has the right to refuse a field test if they feel the concept is inappropriate or compromises the integrity of the game. The proposer may provide supporting laboratory data as an appeal to the Equipment Specifications Committee.

6. ABC/WIBC can require the field test to be terminated at any time and have the test product removed from sanctioned competition. All cost of the installation or removal of the test product will be the proposer’s responsibility. Possible termination reasons could be, but are not limited to, product failure which could affect scoreability, product effects on scoreability compared to approved products, product creates a hazard to bowlers or bowlers’ equipment, or at the request of the center ownership.

7. Before installation of the test product, a field test agreement must be completed in full and returned to the ABC/WIBC Equipment Specification Department.

MANUFACTURERS FIELD TEST PROGRAM FOR PINS

1. Only pins that have passed the threshold stage and official ramp scoring test may be eligible for a field test.

2. Proposer shall notify the ABC/WIBC Equipment Specifications Department not less than sixty days prior to placing the pins into the field test. The proposed location, with address, telephone number and a contact person at the center, starting date and number of lanes and pins used, must accompany the request. A field test agreement form must be completed in full and returned to the Equipment Specifications Department before starting the test.

3. ALL pins to be used in the field test must be submitted to the Equipment Specifications Department not less than 60 days prior to the proposed start of the test. These pins will be tested by staff to ensure they meet all specifications and within the same parameters (i.e., scoring, center of gravity, weight) of those pins that passed the official ramp test. These pins must have permanent test pin labels when received by staff. Once tested and approved for the field test, staff will then permanently mark identification numbers on each pin.

4. The amount of pins is limited to a maximum of 18 sets for the test and the number of lanes is limited to a maximum of eight.

5. Staff reserves the right to inspect the pins at any time during the test.

6. The Test must be conducted in an area of the country acceptable to the Equipment Specifications Department.

7. Length of test is limited to one year.

8. The Equipment Specifications Department has the right to refuse a field test if they feel the concept is inappropriate or compromises the integrity of the game. The proposer may provide supporting data as an appeal to the Equipment Specifications Committee.

9. ABC/WIBC may terminate the field test at any time and have the pins removed from sanctioned competition. All costs of placing the pins in play or removal of the test pins will be the proposer’s responsibility. Possible reasons for termination could be, but are not limited to: pin failure, scoreability, poor pin performance in pinsetters, unacceptable to bowlers or at the request of the center ownership.
PROCEDURE FOR BOWLING BALL APPROVAL

In order to secure ABC/WIBC approval of a brand of bowling ball, the following procedure must be followed:

Balls to be submitted: Manufacturers must submit two (2) balls of the same brand for testing. These balls are subject to the following requirements:

- Weight: 1 sample to be at least 13.00 pounds or greater
  1 sample to be at least 15.00 pounds or greater

- *Top Wt.:* 2.5 - 3.5 oz
- *Pin Placement (if any):* 1 pin in, 1 pin out, if manufactured this way.

* Requested Range

**Physical Specifications:** Balls will be tested for the following:

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Avg.</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit</td>
<td>Limit</td>
<td></td>
</tr>
<tr>
<td>1. Diameter</td>
<td>8.500”</td>
<td>none</td>
</tr>
<tr>
<td>2. Roundness</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>3. Hardness (durometer D)</td>
<td>72</td>
<td>none</td>
</tr>
<tr>
<td>4. Radius of gyration *</td>
<td>2.430”</td>
<td>2.489”</td>
</tr>
<tr>
<td>5. Differential radius of gyration *</td>
<td>none</td>
<td>0.062”</td>
</tr>
<tr>
<td>6. Coefficient of friction *</td>
<td>none</td>
<td>0.290</td>
</tr>
<tr>
<td>7. Coefficient of restitution *</td>
<td>0.650</td>
<td>none</td>
</tr>
</tbody>
</table>

* These specifications are for balls weighing 13.00 pounds or greater.

**Approval requirements:** Each brand of ball submitted for approval must meet one of the following requirements.

1) Both balls must be within the lower and upper average (if any) of the specification range.

2) One ball must be within the lower and upper average (if any) and the other ball must be between the lower average (if any) and lower limit or upper average (if any) and upper limit of the specification range.

3) If the two balls are between the lower average (if any) and lower limit or upper average (if any) and upper limit of the specification range, eight additional balls must be submitted and all of these balls must be within the lower and upper limits of the specification range.

NOTE: Any results above the upper limit or below the lower limit of the specification range will result in the ball brand not being approved.

**Appeal Procedure:** Authority for approval or rejection of bowling balls is vested in the Equipment Specifications Department based solely on the test results. If a manufacturer wishes to dispute the decision on a bowling ball, the issue may be appealed to the Equipment Specifications Committee within 30 days. The committee will make their final decision at the next scheduled meeting.
1. Official test may be conducted in any Greater Milwaukee Area commercial center agreeable to the proposer and ABC/WIBC provided at least 6 eight team leagues conduct their schedule on the same group of eight lanes.

2. The test product is to be installed on two pairs of lanes which coincide with the selected 8 team leagues. Installation can be side by side or staggered at the option of the proposer. (The eight lane format consists of 4 test and 4 control lanes).

3. The leagues selected for scoreability data must bowl at least 28 weeks (4 rounds) exclusive of position rounds. This will provide for lane schedule equity of all teams.

4. Scoreability data will be compiled weekly in the following manner:

   A. Computer input will record all scores on an individual basis, including 200 games, 600 and 700 series and lanes on which the score was bowled.

   B. While scoring comparisons are based on the leagues grand average, only scores from bowlers who participate in 21 games or more of the schedule on both the test and control product shall be included in the final compilation for consideration by the committee.

5. Product acceptability is based on the test product qualifying within the criteria adopted as “ABC/WIBC Scoring Level Policy For Approval” (attached).

6. Test specifications including lane maintenance procedures, and product and lane dressing evaluations shall be agreed upon by the proposer and ABC/WIBC prior to commencement of the test.

---

**ABC/WIBC OFFICIAL PIN TEST PROCEDURE**

**Threshold Requirements:**
The first step in the approval process requires the proposer of the pin to send ABC/WIBC at least four sample pins for examination to ascertain whether the pins meet the established threshold specifications for tenpins.

In addition to the sample pins, ABC/WIBC requests in writing, a detailed explanation of the manufacturing process. The information is confidential with ABC/WIBC and is used only to assure uniformity of the product. The explanation should cover the type of material to be used in the pin construction including a technical data sheet with physical properties of any non-wood product; the manufacturing process for the pin; if the pin is hollow, what type, if any, filler material will be used; and what, if any, coating material will be used. Also required is a sample of the base attachments, along with its specifications, if one is used.

Following ABC/WIBC examination of the sample pins for threshold specifications and upon ascertaining they meet these specifications, a ramp test will be conducted at the testing facility.

**Ramp Test:**
ABC/WIBC requires 20 additional pins for evaluation at the test facility. A ramp will be utilized which can deliver the ball at a constant speed and rotation; and by moving this ramp to different angles, an idea of how the pins react compared to other approved pins can be determined.

Once a ramp test is scheduled, it would require approximately two weeks to complete. This test provides data on scoreability based on such factors as total strikes, total pins, pins left standing, etc. This data is compared to that already obtained for approved pins.

Following ramp testing and upon meeting the minimum requirements, ABC/WIBC will conduct an official score test in the Milwaukee area.
Official Test:
If an official test is warranted, ABC/WIBC would then require a minimum of 36 sets of pins (18 sets for a refurbished pin test) by Aug. 1. The test is conducted in the Milwaukee area. If centers cannot be found locally, the proposer may assist ABC/WIBC in locating bowling centers in which to conduct the tests.

The pins will be placed in two eight lane bowling centers (one eight lane center for refurbished pin test). The pins will be rotated weekly with a randomly selected approved pin. Thus the test pins will be in play for 14 weeks in each center (7 weeks for refurbished pin test).

Three leagues are selected from each center for monitoring of the scores (six leagues from one center will be used for a refurbished pin test). The scoresheets from competition against both ABC/WIBC approved, and test pins, are collected from the center at the end of each week’s play. Scores are checked for correct addition of both individual and team totals. The actual total pinfall is divided by the total number of games in each league in order to obtain the average per bowler, per game. (The same computation is made on alternating weeks when the ABC/WIBC approved pins are in use.) Total games bowled and average per bowler of both test and ABC/WIBC approved pins are collected for comparative purposes. Records are compiled on the number of 200 or better individual scores, and 600, 700 or better three game individual totals on a cumulative comparative basis.

Test pin scores in each league must bracket within a +2, -3 range compared to the control pin and show evidence that the test pin does not alter basic scoreability or reflect any erratic trends in scoring. Approval cannot be granted any pin if all composite league averages exceed or fall below the ABC/WIBC approved pin average. complete detailed scoring criteria can be found in section, “ABC/WIBC Scoring Level Policy for Approval.”

Note: The following information does not apply to refurbished pins.

The durability standards for synthetic pins that are applied during the test are covered in the ABC/WIBC Equipment Specifications Manual which states:

“Official tests conducted by the ABC/WIBC must indicate that such tenpins will remain in play for at least 2,000 impact games (impact game is predicated on usage in automatic pin-setting devices using 20 or 21 pins, i.e. each ten frame game is equal to one-half [1/2] impact game) per set. Breakage not to exceed 5 percent in the area from the shoulder to and including the base, and not more than 2 percent at or above the neck, based on the volume of pins under test.”

The durability standards for wood core plastic coated pins that are applied during the test are covered in the ABC/WIBC Equipment Specifications Manual which states:

“Official tests by ABC/WIBC must indicate that such tenpins with a coating in excess of .010 inch, will remain in play for at least 1,000 games, with the following conditions:

1. Not over 5 percent of the pins shall show 2 square inches of coating loss at the ball line.
2. Not over 2 percent of the pins shall show wood failure at the neck.”

In addition to the above procedure, a policy has been established regarding ABC/WIBC approved control pins used during the test period. Should the centers chosen for the test not have new pins, the proposers of the pins have agreed to provide those centers with ABC/WIBC approved pins at their cost. At the conclusion of the test period, arrangements can be made between the centers and the proposer to purchase the control pins at a price agreed upon between the two parties.

Label Requirements:
Following is an illustration of the test pin label which must be affixed to the test pins before they are placed in both the ramp and official test. These labels must meet the label specification which states in part:

(a) Manufacturer’s Label:...

(b) ABC/WIBC Test Pin Label:

Affixed diametrically opposite the manufacturer’s label.... Labels to be located on the tenpin in an area not less than seven inches above the base, and shall be clearly visible.”

Test pins do not need the ABC/WIBC Certification Mark at this time. However, a manufacturer’s label is a requirement. These labels must last the duration of the test. If approved, a similar label must be affixed to the approved pin and must last the life of the pin.
PIN AND PRODUCT TESTING TIMEFRAME

June 1
Letter of intention to test must be submitted to this office.

July 15
Pins must pass all threshold and ramp tests.

August 1
360 pins for official test (Which meet all requirements) must be in this office.

August 15
All products being tested must be installed.

ABC/WIBC SCORING LEVEL POLICY FOR APPROVAL

1. Scores of test products shall not exceed the control, ABC/WIBC approved, product by more than two (2) pins average, nor less than three (3) pins average for any given league.
   In addition, all results will be evaluated on an individual league basis. All test products to control product averages that are within a plus one (1) to minus one (–1) range will qualify a product for approval. However, when comparisons are greater than one (1) and less than a minus one (–1), at least 25 percent of these results must fall in both the positive, +0.1 to +2.0, range or the negative, –0.1 to –3.0, range.

2. Total pinfall of all qualified scores in the selected leagues divided by the number of games will determine the average from which test and control lane scores will be compared.

3. The committee shall also consider any unusual conditions or circumstances in its deliberations; i.e:
   (a) Consideration shall be given to the comparative balance of the number of 200 games, 600 or better series rolled during the test.
   (b) Possible change in lane conditions week to week.

4. The range of the +2, –3 bracket is interpreted as between +2.049 and –3.049, 2.050 is interpreted as 2.1, as 3.050 would be interpreted as 3.1.

Examples

| Even-Even-Even-Even-Even | Qualifies |
| +1, +1, +1, +1, +1 | Qualifies |
| -1, -1, -1, -1, -1 | Qualifies |
| +2, +2, +2, +2, -3 | Qualifies |
| +2, +2, +1, -1, -3, +2 | Qualifies |
| +2, +2, +2, +2, -3 | Not Qualified |
| -2, -3, +1, -1, -1, Even | Not Qualified |
APPENDIX A
Method of Test for
MOMENT OF INERTIA AND RADIUS OF
GYRATION OF BOWLING PINS

Scope:
This method is for the purpose of determining the moment of inertia of a bowling pin about a horizontal axis passing through the center of gravity of the pin.

Definitions:
The moment of inertia is a measure of and is defined as the opposition which a body offers to having its state of rotation changed. It is equal to the sum of the moments of the individual particles of a body, assuming the particles to be infinitely small, about the axis of rotation.

The radius of gyration is a numerical value equal to the radius of a thin hoop of the same mass, having the same moment of inertia as the bowling pin.

The moment of inertia will be expressed as ounce inches squared. The radius of gyration will be expressed as inches.

Test Method:
The test method will be based on the bifilar pendulum method described as follows:

\[
\frac{T}{\sqrt{\frac{K}{b}}} = \frac{\sqrt{\frac{2\pi}{Kg}}}{\left(\frac{\pi}{g}\right)^{\frac{1}{2}}}
\]

- \(T\) = Period of one complete oscillation in seconds
- \(K\) = Radius of Gyration squared, in inches squared
- \(b\) = One half distance between cords in inches
- \(Y\) = Length of cords in inches
- \(M\) = Total weight of Object in ounces
- \(g\) = Acceleration of gravity in inches per second squared
- \(l\) = Moment of inertia ounce inches squared

NOTE: 1.
Cords “y” must be of equal length and parallel.

NOTE: 2.
The object whose moment of inertia is to be determined must have its center of gravity reasonably centered between cords “y”.

\[ l = \frac{Yb^2Mg}{4\pi^2Y} \]
**Test Apparatus:**
A cradle is necessary to support the pin with its normal vertical axis in a horizontal position. It also is important to keep the cradle as light in weight as is practical. One may conveniently be made from $\frac{1}{2} \times \frac{1}{8}$ inch aluminum strip stock formed into two hoops and welded to a piece of aluminum channel. Attachments for supporting the pin can be attached to the bottom of the hoops by welding or bolting. See suggested design below.

Cords can conveniently be made from music wire, the “E” string of a guitar being appropriate. The cords are suspended from a rigid horizontal, level support and attached to the cradle. The cords must be of equal length and securely attached at both ends so that the total length of the cord which can oscillate can be accurately measured. Soldered connections are quite practical. It also is imperative that the cords be parallel. Following are the recommended dimensions.

**Procedure:**
Determine the moment of inertia ($I$) of the cradle by setting it in motion oscillating on a horizontal plane through an included angle of 15 degrees. Using a stopwatch, determine the time for 100 complete oscillations. Determine the time for one complete oscillation by dividing by 100. Determine the length of the cords and the distance between them. Using the formula shown under “Test Method,” calculate the moment of inertia of the cradle.

To determine the moment of inertia of a bowling pin, determine its weight and the location of the center of gravity above the base on the same plane as the vertical axis. Place the pin in the cradle and adjust to locate its center of gravity midway between the cords within $\frac{1}{16}$ inch. Start the pin in oscillation on a horizontal plane through an angle of approximately 15 degrees and calculate the time for one oscillation by measuring the elapsed time for 100. Determine the length of the cords under the load of the pin and calculate the moment of inertia of the cradle and the pin. Subtracting the moment of inertia of the cradle provides the moment of inertia of the pin.

$$I_{(pin)} = I_{(cradle + pin)} - I_{(cradle)}$$

In calculating the moment of inertia of the cradle and pin, the value for $M$ must include the weight of the pin plus the weight of the cradle.

The radius of gyration squared for the pin is determined by dividing the moment of inertia of the pin by the weight of the pin.
APPENDIX B
ISSUANCE OF ABC/WIBC REGULATION BOWLING LANE CERTIFICATE

All lanes upon which sanctioned leagues and tournaments are conducted shall be resurfaced in accordance with the requirements set forth in this section, and the section entitled “Resurfacing Requirements.” Based on compliance with these specifications, an ABC/WIBC Regulation Bowling Lane Certificate shall be issued annually to each center that qualifies. Lanes must be inspected annually by the joint certification and lane inspection committee within whose jurisdiction a center is located to determine the conformity of lane conditions with ABC/WIBC specifications.

1. When a center is planning to forego annual resurfacing, the inspection coordinator shall be notified prior to April 15 and the lanes inspected prior to June 15.

2. If the resurfacing anniversary is other than the summer months, the request for inspection must be made at least three (3) months before the expiration of the anniversary date and the inspection made within thirty (30) days from notification.

3. If the inspection indicates that the condition of the lanes still meets ABC/WIBC specifications and has not otherwise deteriorated, a certificate shall be issued.

4. If the inspection indicates the lanes do not meet surface and measurement specifications, the lanes affected shall be repaired and/or resurfaced and reinspected before the issuance of the certificate.

5. Likewise, in the event any of the lanes covered in the certification deteriorate during a season, as proven in an inspection, to the point where they no longer are within specifications, the pairs of lanes involved shall be repaired and/or resurfaced within thirty (30) days after notification has been provided to the proprietor.

6. If, after such an inspection, the inspection coordinator determines that resurfacing is necessary, the proprietor shall have the right to appeal the decision to the ABC/WIBC. In an appeal, ABC/WIBC’s findings, based on a review of the record, shall be final.

7. In case only some of the lanes in a center require resurfacing, both lanes of all natural pairs affected shall be resurfaced. The joint committee shall be entitled to charge an inspection fee for both examinations within the limits prescribed in the ABC/WIBC Constitution/Bylaws.

8. In all cases, the ABC/WIBC Regulation Bowling Lane Certificate shall be issued contingent on the results of inspection made by the joint inspection coordinator, or his/her authorized representative.

APPENDIX C
RESURFACING REQUIREMENTS

Resurfacing:
Resurfacing shall be defined as removing all substance(s) used in coating the lane from foul line to the pit down to the bare wood, leaving the lane as flat as possible, then refinishing with lacquer, urethane, or similar thin ABC/WIBC approved transparent material.

Indentification:
Upon completion of planning or resurfacing, and prior to the application of finish coatings, each lane shall be stamped or stenciled with the name of the firm or individual who resurfaced each lane, the city in which such firm or individual is located and the month and year of such resurfacing.

The stamp or stencil shall extend across at least three (3) boards and be placed on the bare wood surface in line with a point 5-7 feet in front of the No. 1 pin and approximately 2-5 inches from the 7 pin side of the lane.

Surface:
1. The surface must be free of all continuous grooves or ridges.

2. A tolerance of plus/minus 40/1000 inch (.040") will be permitted in flatness of the surface of the lane over a 42 inch span.

3. There shall be no crosswise tilt in excess of 40/1000 inch (.040") over the width of the lane.

4. At the pin deck, the surface lengthwise, shall not have a tilt to front or back of more than 3/16 inch (.187") within a span of 42 inches.

The lane surfaces shall not be altered or conditioned to create a ball path or otherwise affect the course of the ball by the use of abrasives and/or any other materials or methods. (For example, and without intending any limitation of the rule, the resurfacer, owner or employees are specifically prohibited from creating grooves or tracks in the lane to form a continuous ball path even though within allowable surface tolerances.)
METHOD OF TEST FOR MOMENT OF INERTIA AND RADIUS OF GYRATION OF BOWLING BALLS

Scope:
This method is for determining the principal moments of inertia of a bowling ball passing through the geometric center of the ball.

Definitions:
The moment of inertia is a measure of and is defined as the opposition which a body offers to having its state of rotation changed.

The radius of gyration is a numerical value equal to the radius of a thin hoop of the same mass, having the same moment of inertia as the bowling ball.

The moment of inertia will be expressed as pound (mass) inches squared. The radius of gyration will be expressed as inches.

Test Method:
The test method will be a single wire torsional pendulum which is described as follows.

\[ T = \frac{2\pi}{k_1} \]

\[ k = \frac{G I_n}{4\pi^2} \]

\[ K = \frac{I}{M} \]

The following equations govern the motion of an oscillating body

The constant \( k_1 \) is defined as

\[ k_1 = \frac{G I_n}{I} \]

where

\( G \) = shear modulus of wire

\( I_n \) = moment of inertia of a cross section of wire

\( I \) = length of wire
**Test Apparatus:**
See diagram below. Stopwatch or other means of timing oscillations also required, accurate to 0.01 seconds.

![Test Apparatus Diagram]

**Calibration:**
The apparatus must be calibrated before use to determine the torsional constant. Each device will have its own constant due to differences in the wire.

At least two known moments of inertia are required. The suggested masses are a sphere of uniform density (ie. made of only one material) and a steel cylinder of uniform density, both weighing between 10 and 16 pounds (a steel cylinder approximately 2 1/2” dia. and 9” long will weigh around 12 pounds and a solid polyurethane sphere with the same diameter as a bowling ball will also weigh around 12 pounds).

Accurately weigh the masses and measure the radius of the sphere and the radius and length of the cylinder. From these measurements, calculate the moment of inertia as follows:

- **Sphere**
  \[ I = \frac{2MR^2}{5} \]

- **Cylinder on axis**
  (standing upright)
  \[ I = \frac{MR^2}{2} \]

- **Cylinder on central diameter**
  \[ I = \frac{MR^2}{4} + \frac{ML^2}{12} \]

where
- \( I \) = moment of inertia (lbm-in^2)
- \( M \) = mass of sphere or cylinder (lbm)
- \( R \) = radius of sphere or cylinder (in)
- \( L \) = length of cylinder (in)

**Calibration Procedure:**
Determine the period of oscillation of the cradle by setting it in motion oscillating on a horizontal plane through an included angle of 15 degrees or less. Using a stopwatch or other timing device, determine the time for 10 complete oscillations. Calculate the time for one complete oscillation by dividing by 10. This value is \( T_c \).

Place the sphere in the cradle and determine the period as above. This value is \( T \). Repeat this procedure with the cylinder. The cylinder should be tested two different ways. Place the cylinder vertically in the apparatus and measure the period. Then place the cylinder horizontally in the cradle so that it is centered and again measure the period. These values are also \( T \).
For each measurement, solve for the torsional constant as follows:

\[ k_i = \frac{4\pi^2 I}{T^2 - T_c^2} \]

where \( I \) = moment of inertia of each mass (lbm-in\(^2\))
\( T \) = period of each mass and cradle (sec)
\( T_c \) = period of oscillation of cradle (sec)

**NOTE:** The moment of inertia of two objects is equal to the sum of the individual moments of inertia. However, since the moment of inertia of the cradle is not known, the above equation uses the relationship that the moment of inertia is proportional to the square of the period.

**Bowling Ball Test Procedure:**

The formula for moment of inertia is as follows:

\[ I = \frac{k_i T^2}{4\pi^2} \]

First calculate the moment of inertia of the cradle by substituting \( T_c \) into the above equation. This value is \( I_{\text{cradle}*} \).

A minimum of two separate measurements of the moment of inertia are to be taken for each ball. The maximum and minimum moments of inertia are required. The minimum moment of inertia occurs when the heaviest portion of a ball is located on the axis (vertically in the test apparatus). The maximum moment of inertia will occur when the heaviest portion of a ball is located furthest from the axis (90° from vertical in the test apparatus).

For existing bowling balls, the minimum moment of inertia usually occurs when the weight block (on 3 piece balls) or pin (on 2 piece balls) is aligned at the top of the ball when it is placed in the test apparatus. This will be called \( I_{\text{min}*} \).

For existing bowling balls, the maximum moment of inertia usually occurs when the weight block (on 3 piece balls) or pin (on 2 piece balls) is aligned horizontally when it is placed in the test apparatus. This axis will be located 90° from the \( I_{\text{min}*} \) axis. It may be necessary to test at several locations which are all 90° from \( I_{\text{min}} \) to determine the axis of maximum moment of inertia. This will be called \( I_{\text{max}*} \).

Place the ball in the cradle with each axis directed upward and measure the period of oscillation as in the calibration procedure. Calculate the moments of inertia using the above equation where \( T \) is the period of the ball and cradle in seconds.

The principal moments of inertia are calculated as follows:

\[ I_{\text{min}} = I_{\text{min}*} - I_{\text{cradle}} \]
\[ I_{\text{max}} = I_{\text{max}*} - I_{\text{cradle}} \]

The radius of gyration of each axis may be calculated by the following equation:

\[ K = \sqrt{\frac{I}{M}} \]

where \( K \) = radius of gyration (in)
\( I \) = moment of inertia (lbm-in\(^2\))
\( M \) = mass of bowling ball (lbm)
METHOD OF TEST FOR COEFFICIENT OF RESTITUTION

APPENDIX E

Scope:
This method is for determining the coefficient of restitution of a ball/pin combination.

Definitions:
Coefficient of restitution is an indication of the energy transfer between two objects upon impact. It is defined as the ratio of the relative velocity of the objects after impact to the relative velocity of the objects before impact. In the case of a bowling ball impacting a standing pin, the relative velocity before impact is simply that of the ball, and the relative velocity after impact is the difference in velocities of the pin and the ball.

Test Method:
The test method will be a ball/pin impact method in which a rolling ball will impact a standing pin. The following equation governs the determination of coefficient of restitution:

\[ \epsilon = \frac{V_1 - V_2}{V_2 - V_1} \]

where
- \( V_1 \) = velocity of pin after impact (combination of translational and rotational velocities)
- \( V_2 \) = velocity of ball after impact
- \( v_1 \) = velocity of pin before impact
- \( v_2 \) = velocity of ball before impact
- \( \epsilon \) = coefficient of restitution

NOTE: Velocities may be in any units provided all are the same.

Since the pin is stationary before impact, this equation may be simplified to the following:

\[ \epsilon = \frac{V_1 - V_2}{v_2} \]

Test Apparatus:
The equipment necessary for measuring the coefficient of restitution of a ball/pin impact includes the following:

- a means of rolling a bowling ball toward a standing pin with a constant velocity of at least 15 ft/sec.
- a flat, level surface upon which a pin may be placed and on which a ball may be rolled at the pin.
- a means of measuring the ball velocity immediately before impact with the pin, and the ball and pin velocity immediately after impact.

The following equipment is recommended for the determination of coefficient of restitution:

**Ball Acceleration Device**
A bowling ball may be accelerated toward a standing pin by means of a ramp consisting of two rails on which the ball may roll. The ramp should be constructed with sufficient height and slope so that the ball will achieve the required velocity at the bottom of the ramp without slipping on the rails. The top of the ramp should have a short level surface on which to place the ball. The bottom of the ramp should be tapered to a horizontal position to achieve a smooth transition to rolling onto a flat surface.
**Ball/Pin Impact Surface**
A synthetic pin deck serves as a good surface upon which the pin may be placed. Ample distance must be allowed between the end of the ramp and the pin to ensure that the ball is not bouncing when it strikes the pin.

**Velocity Sensing Equipment**
The nature of the motion of a pin after impact necessitates the need for laser precision to sense pin velocity. Two pairs of beams must be directed across the path of the ball and must be placed very close together (approx. 1 inch apart). The first pair is to measure the velocity of the ball just before impact and the second pair is to measure the velocity of the pin and the ball after impact. The first pair of beams is located across the ball path immediately in front of the pin. The second pair is initially blocked by the standing pin. The pin velocity will be measured by the pin leaving the path of the beams and the ball velocity will be measured by the ball breaking the path of the beams. All beams should be positioned at the height of the ball/pin impact (4.29”) off the pin deck.

**Velocity Measuring Equipment**
Timing devices are required which are capable of being triggered electronically and which are accurate to 1 µsec. Three separate timings are required so there must either be three timing devices or a single unit with at least three inputs and displays.

**Procedure**

**Pin Selection For Ball Testing**
Since coefficient of restitution is a property of both the ball and the pin, a standard pin must be selected to test a variety of balls. A magnesium pin (Magna Pin or Astro Diamond) has been chosen because it will withstand a very large number of impacts without permanent deformation. A standard pin will be provided to those who require a pin for testing.

**Ball Selection For Pin Testing**
Since coefficient of restitution is a property of both the ball and the pin, a standard ball must be selected to test a variety of pins. A zero balanced urethane ball has been chosen.

**Testing Procedure**
Place a pin on the level surface such that it is blocking the two rear laser beams with the front of the pin nearly blocking the second beam, and in a direct line with the path of the ball. Place the ball at the top of the ramp and allow it to roll freely down the rails and strike the pin. Calculate the velocity of the ball before the collision and the ball and pin after the collision by dividing the distance between the sensors by the time it took each object to cross the sensors. The coefficient of restitution is calculated using the equation under “Test Method”.
**Scope:**
This method is for determining the coefficient of friction of a bowling ball using a sled and a standard lane surface.

**Definitions:**
Coefficient of friction is defined as the ratio of the force opposing the relative motion of two surfaces to the normal force acting perpendicular to the opposing force.

**Test Method:**
The test method will be to measure the force needed to slide a bowling ball mounted in a sled across a lane surface at a speed of approximately 0.5 feet per second.

**Test Apparatus:**
The equipment necessary for the determination of bowling ball coefficient of friction includes the following:
- A standard lane surface sample at least 24 inches by 36 inches.
- A sled with the ability to secure the ball and prevent any rotation.
- A means of moving the ball at a constant speed, in a sliding motion across the standard lane surface.
- A means of measuring the force needed to move the ball and sled as a unit.

**Procedure**
The standard lane sample is cleaned thoroughly with isopropyl alcohol and allowed to dry completely.
The bowling ball is mounted and secured in the sled.
The sled is pulled at a constant speed of 0.5 feet per second and the average force needed to move the sled is recorded. This procedure is repeated for a total of 8 separate tests.
The eight readings are then each divided by the total weight of the ball and sled to calculate 8 separate coefficient of friction values. These 8 values are then averaged to determine the coefficient of friction.
SCOPE:
This method is for determining the coefficient of friction of a bowling lane surface using a weighted sled with urethane feet.

DEFINITION:
Coefficient of friction is defined as the ratio of the force opposing the relative motion of two surfaces to the normal force acting perpendicular to the opposing force.

TEST METHOD:
The test method will be to measure the force needed to slide a sled with a total weight of approximately 17 pounds across a lane surface at a speed of approximately 0.5 feet per second.

TEST APPARATUS:
The equipment necessary for the determination of the lane surface coefficient of friction includes the following:

- a lane surface sample at least 6 inches by 36 inches.
- a sled with approved urethane feet having the radius of a bowling ball.
- a means of moving the sled at a constant speed, in a sliding motion across the sample to be tested.
- a means of measuring the force needed to move the sled.

PROCEDURE:
The lane sample is cleaned thoroughly with isopropyl alcohol and allowed to dry completely.
The sample is then pre-treated by applying a heavy layer of lane conditioner (approximately 15 to 20 units when measured with an ABC/WIBC OPTICAL READER) and allowed to saturate for a total of 72 hours.
The sample is then cleaned thoroughly with isopropyl alcohol for a total of three times to remove all lane conditioner from the surface of the sample. The sled is then placed on the sample and weight is added to achieve a total weight of approximately 17 pounds.
The sled is pulled at a constant speed of 0.5 feet per second and the average force needed to move the sled is recorded. This procedure is repeated for a total of 8 separate tests.
The eight readings are then each divided by the total weight of the sled to calculate 8 separate coefficient of friction values. These 8 values are then averaged to determine the coefficient of friction.
This test is repeated every day over a three day period and the three results will then be averaged for each surface to determine the final COEFFICIENT OF FRICTION.
Glossary

Ambient Temperature:  
Temperature of the surrounding area. Same as room temperature.

ASTM  
American Society of Testing Materials.

Ball Track  
The area on which a ball makes contact with a lane.

Base Flat Diameter  
The diameter of the base of the pin which will contact a surface when a pin is stood upright on the surface.

Bifilar  
The use of two cords or wires to support the test cradle in testing the radius of gyration of a bowling pin.

Center of Gravity  
That point at which, if the object were suspended, would be perfectly balanced in all directions.

Coefficient of Friction  
The ratio of the force opposing the relative motion of two surfaces and the normal force acting perpendicular opposing force.

Coefficient of Restitution  
The ratio of the velocity of two objects after impact to the velocity before impact. In the case of a ball striking a pin, this will indicate the relative velocity of the ball and pin after impact as a fraction of the ball's velocity before impact.

Coverstock  
The outermost shell of the bowling ball that has contact with the lane surface.

Delamination  
Separation of glue joints in a wood core pin.

Differential Radius of Gyration  
The difference in radius of gyration between any two spin axis of an object. A perfectly symmetrical object will have no differential radius of gyration.

Durometer “D”  
A durometer is a device to check hardness. In bowling equipment, the durometer “D” scale is used to measure the relative hardness of hard rubber and plastics.

Edgeboard  
The last board on each side of a pin deck.

Friction  
The force which opposes the relative motion of two surfaces which are in contact with each other.

Hardness  
See “Durometer ‘D.’”

Kickback  
The partitions that enclose the pin deck area located on the outside of the flat gutters. Also used to support the pinsetting device.

Kickback Plate  
A plate (1/16” max. thickness) made of various materials that is used to protect the wood kickback.

Lane and Approach Markings  
Uniform markings on the playing surface as well as any targeting devices installed above the playing surface.

Modulus of Compression  
Ratio of the unit stress to unit strain within the proportioned limit of material in compression.

Nanometer  
A unit of measure used for measuring the wavelength of light. One nanometer equals 1x10^-9 meters or 10 angstroms.

Natural Pair of Lanes  
This refers to a pair of lanes used in sanctioned competition. Usually natural pairs of lanes have a common ball return and are numbered 1 and 2, 3 and 4, etc.
Non-high performance bowling ball
A polyester (plastic) ball with a pancake weight block or less.

Nonwood
Anything that is not made of wood.

Phenolic
A plastic-like material derived from the chemical “phenol.”

Pin Deck
The area of the lane on which the pins are spotted.

Radius of Gyration/Moment of Inertia
Radius of Gyration is the distance from the axis of rotation at which the total mass of a body might be concentrated without changing its moment of inertia. Moment of inertia is a measure of and is defined as the opposition which a body offers to having its state of rotation changed.

Reference Dimension
In drafting practices, this is a dimension which is specified on an engineering drawing but not used for checking.

Refinish
To put a new protective coating on lanes or pins.

Refurbish
To renew the life of an approved bowling pin by the use of plastic coatings and nylon reinforcing over the entire pin.

Roundness
See “Runout.”

Runout
States how far the actual surface is permitted to vary from the dimensions implied. The roundness of a bowling ball is checked with the use of a holding fixture and a dial indicator. The ball is supported by the fixture with the dial indicator contacting the top of the ball. The ball is then rotated while the dial indicator is observed for the minimum and maximum surface readings. The difference between these readings must be less than .010” to comply with the .010” total runout tolerance.

Scleroscope
The scleroscope is an instrument which measures the hardness of work in terms of elasticity. A diamond-tipped hammer is allowed to drop from a known height on the material to be tested. As this hammer strikes the material, it rebounds, and the harder the material, the greater the rebound. The extreme height of the rebound is recorded, and an average of a number of readings taken on a single piece will give a good indication of the hardness of the work.

Serial Number:
An identifying series of numbers and/or letters in order to identify a specific ball. If a serial number is no longer identifiable then a new one can be engraved in order to give it a unique identifying series.

Slabbing
See “delamination”

Synthetic
In bowling terms, any product not made of wood.

Tailplank
The board on the rear edge of the pin deck to protect and prolong the life of a pin deck. Technically, this is not part of the lane

Thermoplastic
A plastic material which when heated will melt but after cooling will return to a solid shape.

Ultra Violet
The light whose wavelength is just below that of a visible light (200-400 nanometers) at the violet end of the spectrum.

Void
A manufactured cavity with purposeful size, dimension, and/or location within the ball. This does not include small normal porosity found within the ball due to the manufacturing process.

Vulcanized
Rubber that has been treated with sulphur to make it harder and stronger.