COMPUBALANCE™

USER'S

MANUAL

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Some states may provide additional legal rights to buyers that are not mentioned here.

CompuBalance^{tm} User's Manual

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EXAMPLES

About the Computer

The face of the computer that you will be using is shown in figure A. (Because of the rapidly changing technology, your computer may vary slightly in appearance.)

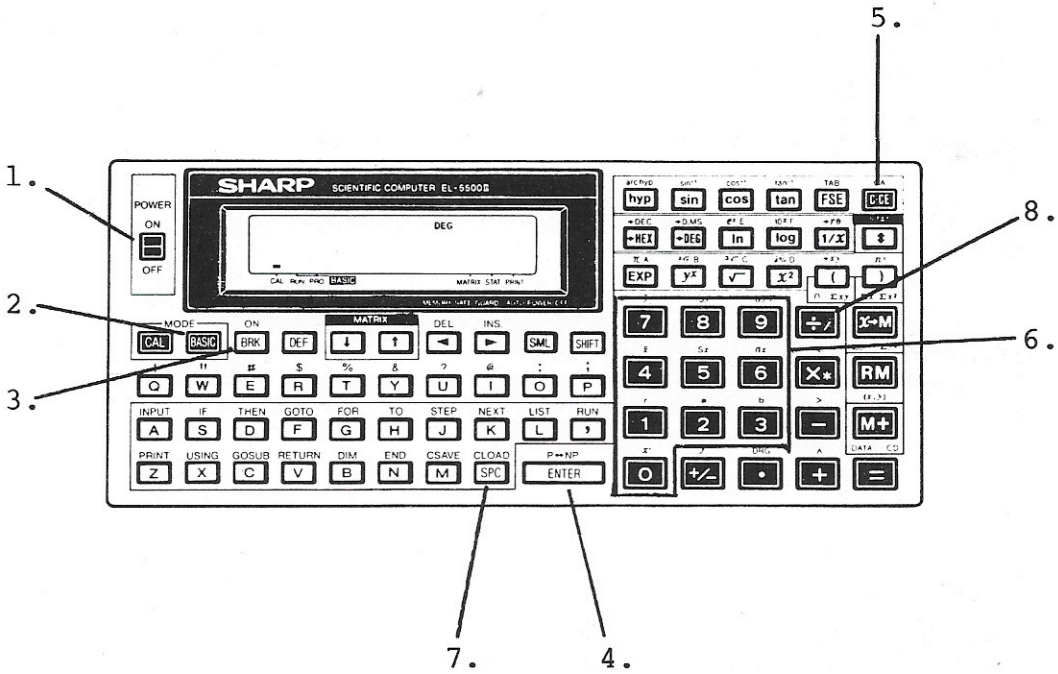


Figure A

1. This is the on/off switch. If you neglect to turn off the computer and it turns itself off, simply touch the BRK key to reactivate it for the next use.

2. This BASIC key should be touched once after you turn the computer on. A short dark bar above the letters CAL at the lower left of the display indicates that the computer is in the calculator mode when it is turned on. When the BASIC key is touched ONCE, the bar should move above the letters RUN. You will then be ready to use the computer as a computer.

3. This is the BREAK key. Use it to stop a calculation. To begin again, type RUN and touch the ENTER key.

4. This is the ENTER key. You must touch the ENTER key after each of your responses so that the computer will know that you are done inputting the answer to its question. The ENTER key is also used to signal that you are ready to receive certain of its output.

5. This is the CLEAR key. It may be used to erase a line of input before you touch the ENTER key. This key will erase the number or letter that is on the display, but the question being asked will remain on the display. Simply type the correct response and touch the ENTER key.

6. These numeric keys will be used for all numeric input.

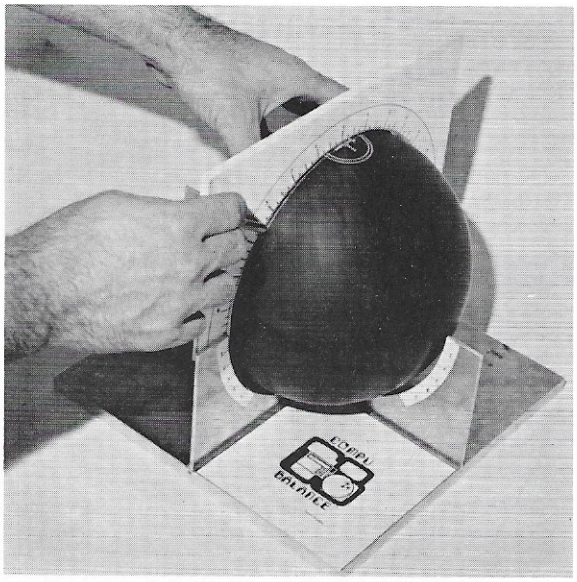
7. This SPACE key is extremely important; do not overlook it. It is used between whole numbers and fractions in input quantities to separate the two quantities. For example, to input 6 1/4 inches, one would have to touch the SPC key after touching the 6 key and before touching the 1 key. Failure to use the SPC key to separate the whole numbers and the fractional parts will result in incorrect output.

8. Use this division key when you input a fraction. For example, to input 3/4 you would touch the 3 key, then this division key, then the 4 key.

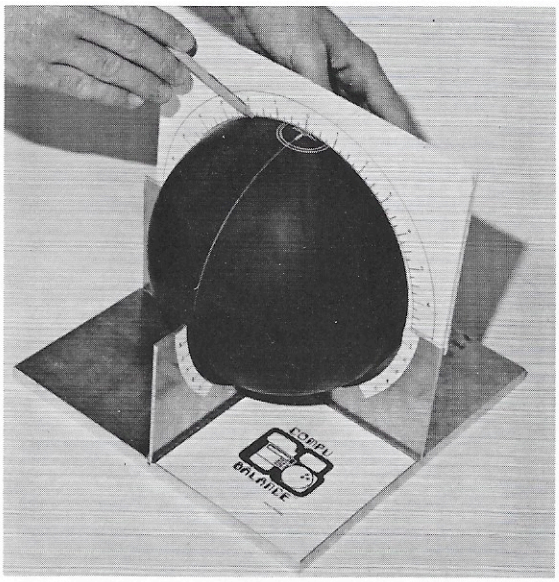
Very little care is required of the computer. You should avoid subjecting it to extreme temperatures. Under no circumstances should the computer become wet (or damp). Do NOT wipe the computer off with anything damp. Avoid dropping the computer, and avoid any circumstances that might crack the glass display screen.

The two lithium batteries that come with the computer should last for about 300 hours of operation. When the batteries go dead, you must send the computer back to the factory to have the batteries replaced. The computer will also have to be re-programmed at that time. Do not attempt to change batteries yourself; the program will be lost when the old batteries are taken out. It is recommended that you replace the batteries every two years even if they have not run down. Send in your computer to have the batteries replaced during your off-season. Your computer will be returned via a comparable carrier that you use to send it to the factory. Wrap the computer carefully and insure it against damage during shipment.

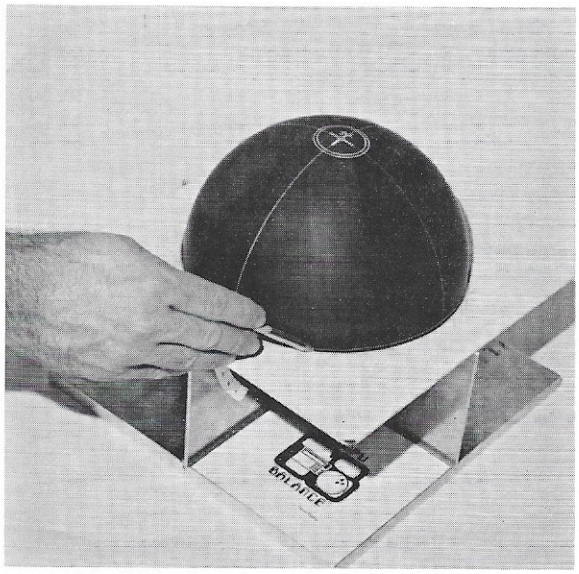
Marking a New Ball for Drilling



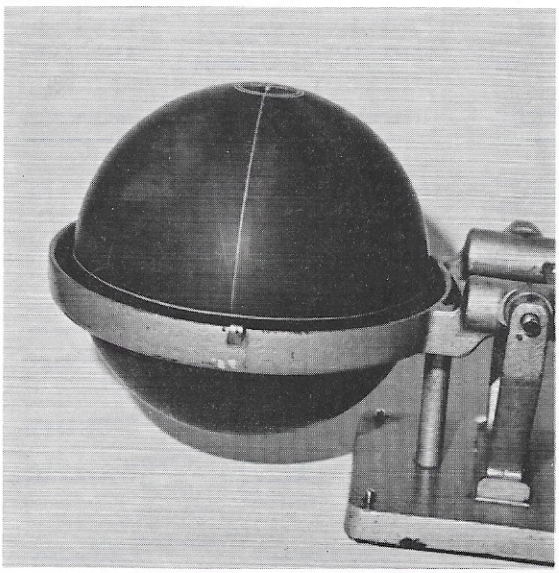
1. Place ball in cradle and draw an arc from one wing to the opposite wing.



2. Repeat process with opposite two wings.



3. Draw a circle around the ball.

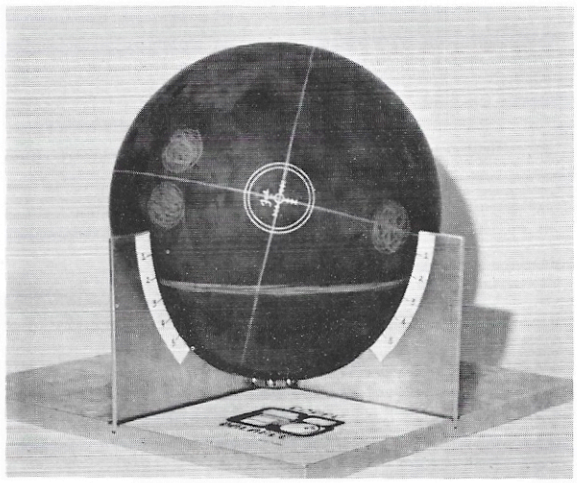


4. CAREFULLY line up arc on ball so that it is parallel to the receptacle on the dodo scale.

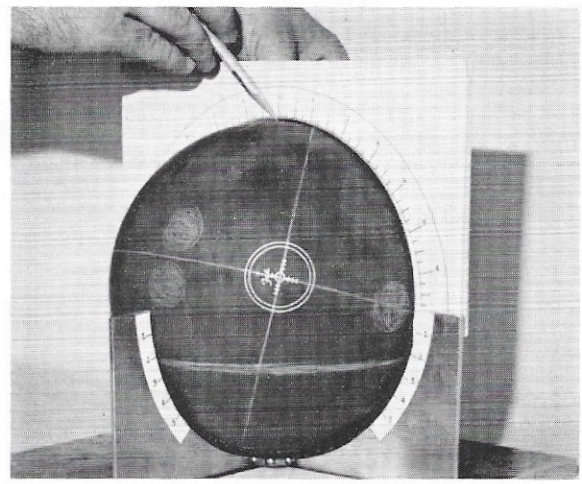
Now weigh the ball for existing side, finger, and top weights.

Axis-Weighting a New Ball

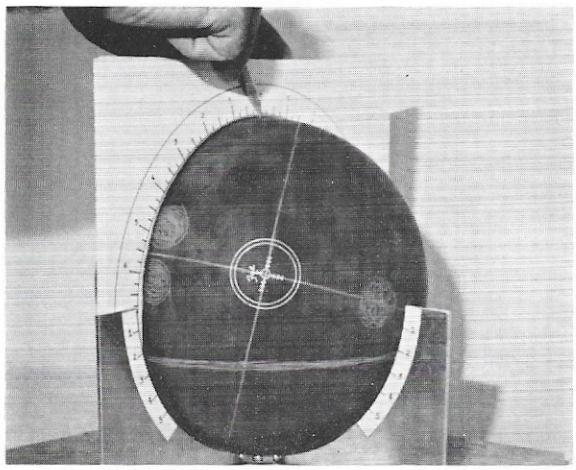
The following six photos represent a customer's ball that has already been drilled. The used ball will be used to determine the location of the axis-of-roll in the new ball. For purposess of illustration, gripping holes and the ball track have been drawn on the ball with a crayon. Notice that ball has been marked through the center-of-palm as illustrated in photos 1-3.



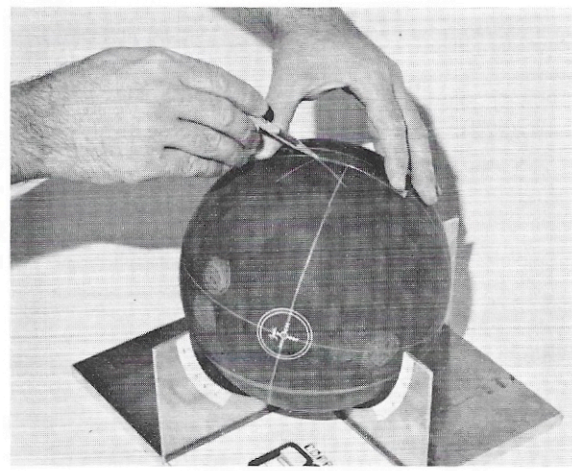
5. Place drilled ball in cradle. Rotate the ball until the ball track registers the same on all FOUR wings.



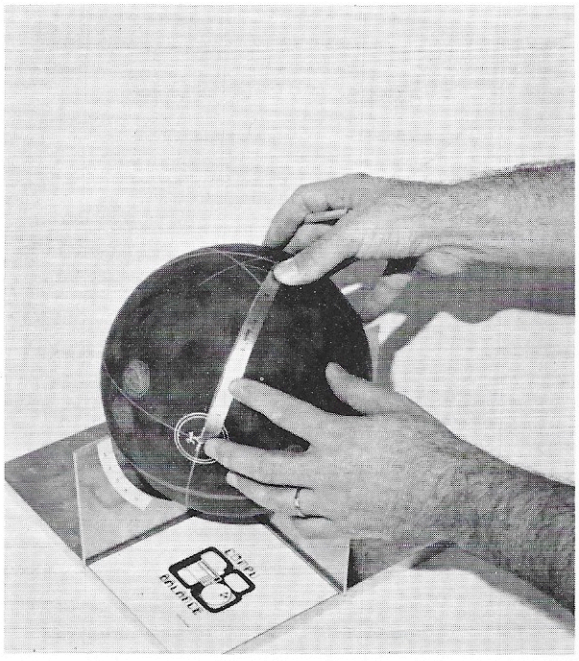
6. Place arcmaker over ball; mark a short arc on "top" of the ball.



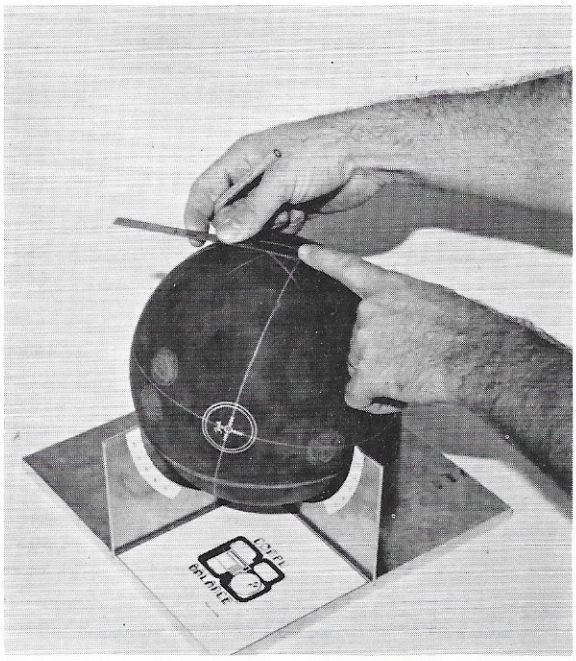
7. Mark a second short arc with the arcmaker against the other two wings. These two arcs should form an "x" at the axis-of-roll.



8. Draw an arc from this "x" to the arc that passes through the center-of-palm of the ball.



9. Measure and record the distance from the arc being drawn in photo 8 to the center-of-palm. The computer refers to this distance when it asks for the horizontal measure to the axis.



10. Measure and record the distance along the arc being drawn in photo 8 to the "x" that was drawn in photos 6 and 7. The computer refers to this distance when it asks for the vertical measure to the axis.

Now mark the new ball as shown in photos 1 through 3 and weigh the ball to determine the existing side, finger, and top weights. (Note: We will use the convention that thumb weight is negative finger weight and bottom weight is negative top weight.) Input the measurements into the computer and the computer will tell you a horizontal and a vertical distance to measure to get to the center-of-palm.

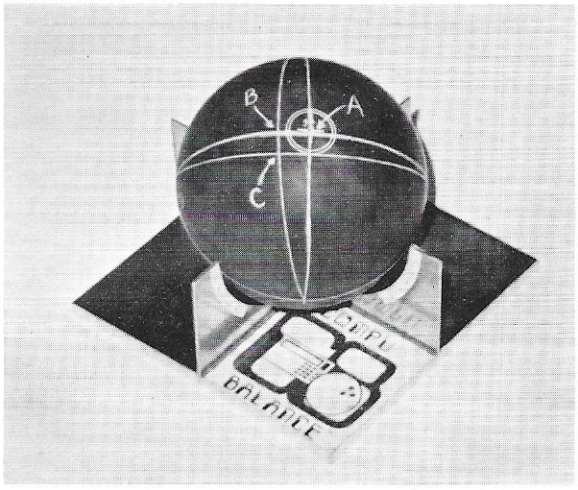


Photo 11

In photo 11 the original arcs intersected at point A. The distance from A to B is the horizontal distance given by the computer. Point C will be the center-of-palm as you drill the ball. The thumbhole will eventually lie on the arc through B and C and the finger holes will lie on either side of the arc through B and C. (Notice that the arc through B and C intersect two of the original arcs at a common point at the bottom of the photo.)

Creating Axis Weight in a Drilled Ball

Mark out the ball as illustrated in photo 5. Locate the axis-of-roll as shown in photos 6 and 7. Measure the horizontal and vertical distances to the axis-of-roll from the center-of-palm as shown in photos 9 and 10. Weigh the ball for existing side, finger, and top weights. From the computer you will get the location and size of the weight hole that must be drilled in order to create axis weight. (See page 15 for a complete example.)

When the computer asks "N)EW OR D)RILLED?" you should respond with D (and touch the ENTER key). Then input the existing side, finger, and top weights as they are requested by the computer. When the computer asks "Y)OU OR C)OMPUTER?", you should respond by touching the C key (and then touching the ENTER key).

When the computer asks "HORIZ. MEAS. TO AXIS?", input the measurement such as that being taken in photo 9. When the computer asks "VERT. MEAS. TO AXIS?", input the measurement such as that being taken in photo 10.

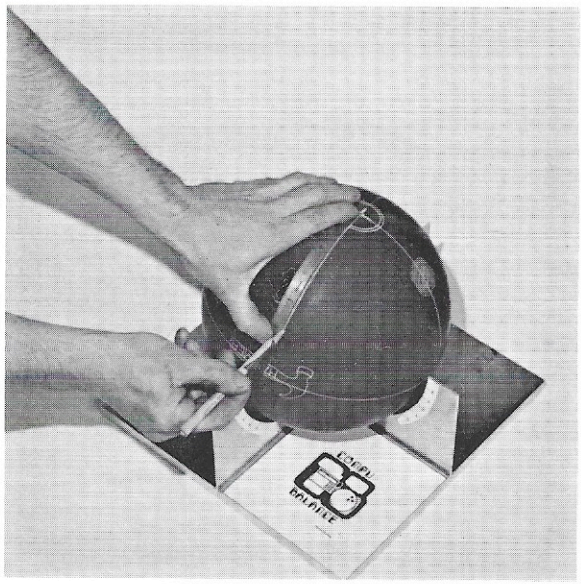
The computer will then give you the side, finger, and top weights that will make the drilled ball have axis weight. The computer will show you the maximum amount of weight that is allowed by current ABC specifications. For that reason, the ending side weight will almost always be given as positive 1 or negative 1 (left-handed bowlers or right-handed bowlers who roll backup balls). The only exception is for very unusual ball tracks in which the axis-of-roll is closer to the fingers than to the side of the ball.

You are not required to accept the maximum amount given by the computer. In fact, you are allowed to choose any percentage of these maximums from -100% to +100%. When the computer asks "WHAT % OF THESE?", simply input the percent of the maximum that you want. Suppose, for example, that the computer gives ending values of 1, .2, and .4 for the side, finger, and top weights respectively. If you choose 100%, you will end up with the stated weights. If, however, you choose 50%, the ending weights will be .5, .1, and .2 respectively. If you choose 0% the final weights will be 0, 0, and 0. If you choose -80%, the final weights will be -.80, -.16, and -.32 respectively. These are just some of the options that you could choose. Actually, any percent between -100 and +100 inclusive may be chosen.

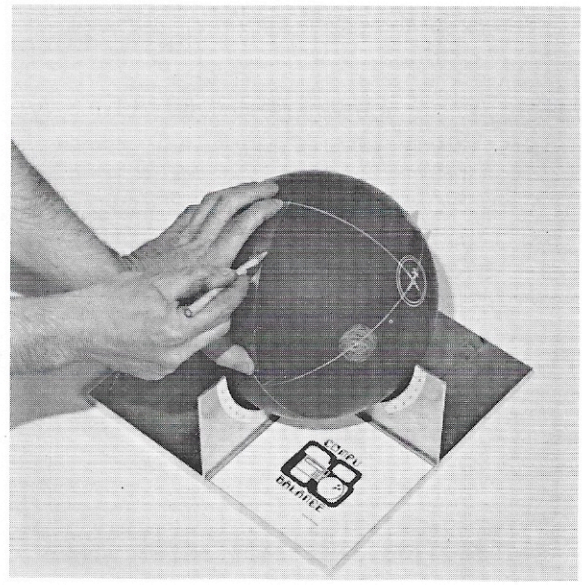
After inputting what percent of the maximum you would like the computer will instruct you to go calculated horizontal and vertical distances from the center-of-palm to reach the location of the weight hole. (When the computer displays "GO HORIZONTALLY", you must touch the ENTER key to get the distance. You must do likewise when the computer displays "GO VERTICALLY".)

The computer will ask for the ball weight which you should input after which you will be given a selection of possible combinations of drill bit sizes and hole depths that could be used at the location of the weight hole to achieve balance. (You must touch ENTER to get each bit size and hole depth. This was done to ensure that the computer goes at your pace.) You will reduce your margin of error if you choose the smallest drill bit size listed. At any rate, when you find an acceptable combination of bit size and hole diameter, you may turn the computer off.

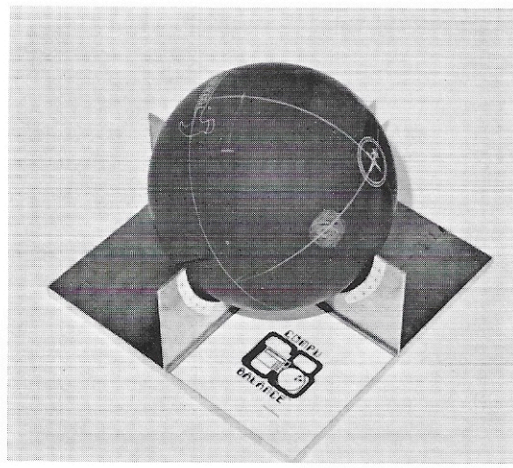
Locate the weight hole by following the steps outlined in these photos.



12. Measure the horizontal distance to the weight hole as given by the computer.



13. Measure the vertical distance to the weight hole. Notice that the ruler stretches from the horizontal mark towards intersection point of two arcs.



14. Weight hole should be drilled at position indicated.

Drilling a Weight Hole to Customer's Specifications

If a customer wants a weight hole drilled in a drilled ball but does not want axis weight, follow these steps in locating the weight hole and determining its size and depth.

Mark out the ball through the center-of-palm and weigh for existing side, finger, and top weights. Go to the computer and input the measurements that you get from the dodo scale.

When the computer asks "Y)OU OR C)OMPUTER?", you respond with Y. (Don't forget to touch the ENTER key.) Instead of asking "HORIZ. MEAS. TO AXIS?" and "VERT. MEAS. TO AXIS?" the computer will ask "DESIRED SIDE WT.?", "DESIRED FINGER WT.?", and "DESIRED TOP WT.?". You should answer each question as it appears following each response by touching the ENTER key.

The computer will tell you how far to go horizontally and vertically from the center-of-palm to reach the location for the weight hole. These measurements are made identically to those made in finding the location of the weight hole in the last example.

New Ball
Computer Determines Final Weights
Grips Used -- Fingers Only

In this example, a new or plugged ball is being balanced. The following dimensions will be used:

Existing side weight: -.1
Existing finger weight: 0
Existing top weight: 3.7

Horizontal distance from
Center-of-palm to axis-of-roll: 5 and 3/4 inches

Vertical distance from
Center-of-palm to axis-of-roll: 1/2 inch

Span: 4 and 3/8 inches

Drill bit size for middle finger: 31/32
Drill bit size for ring finger: 31/32
Drill bit size for thumb: 1 and 1/16 inch

No grip will be used in the thumbhole.

Ball weight: 14.2 pounds

The driller will request only 25% of the maximum available axis weight.

SPC represents the SPC key on the computer.
<E> represents the ENTER key on the computer.

Since at least one grip will be used, we must tell the computer that grips will be used when it asks G)RIPS -- N)O GRIPS. When the grip weight is requested for the thumb, we will respond with 0.

Begin by sliding the on/off switch to "on", touch the BASIC key, type RUN and touch the ENTER key. The following exchange between the computer and the driller will occur:

COMPUTER: N)EW OR D)RILLED?
DRILLER: N <E>

N: SIDE WT. NOW?
D: -.1 <E>

C: FINGER WEIGHT NOW?
D: 0 <E>

C: TOP WEIGHT NOW?
D: 3.7 <E>

C: Y)OU OR C)OMPUTER?
D: C <E>

C: HORIZ. MEAS. TO AXIS?
D: 5 SPC 3/4 <E>

C: VERT. MEAS. TO AXIS?
D: 1/2 <E>

C: ENDING SIDE WEIGHT 1.
D: <E>

C: ENDING FINGER WT. 0.12
D: <E>

C: ENDING TOP WEIGHT 0.24
D: <E>

C: WHAT % OF THESE?
D: 25 <E>

C: SPAN?
D: 4 SPC 3/8 <E>

C: G)RIPS -- N)O GRIPS?
D: G <E>

C: MIDDLE FING. SIZE?
D: 31/32 <E>

C: GRIP WEIGHT?
D: .3 <E>

C: RING FINGER SIZE?
D: 31/32

C: GRIP WEIGHT?
D: .35 <E>

C: THUMB SIZE?
D: 1 SPC 1/16 <E>

C: GRIP WT.?
D: 0 <E>

C: BALL WEIGHT?
D: 14.2 <E>

C: BEEP BEEP BEEP

```
C:  GO HORIZONTALLY
D:  <E>

C:  -7./16. IN.
D:  <E>

C:  GO VERTICALLY
D:  <E>

C:  -1./16. IN.
D:  <E>

C:  THUMB DEPTH
D:  <E>

C:  3. AND 1./8. IN.
D:  <E>

C:  MIDDLE FINGER DEPTH
D:  <E>

C:  2. AND 1./2. IN.
D:  <E>

C:  RING FINGER DEPTH
D:  <E>

C:  2. AND 3./4. IN.
D:  <E>

C:  >
```

Slide the on/off switch to "off" and proceed with drilling the ball.

It should be noted that the three BEEPs that the computer makes during the interaction indicate that it is impossible to remove enough weight using the required bit sizes to make the ball balanced. A fourth hole for balance will be required after the ball has been drilled to the specifications determined by the computer.

New Ball

Bowler Determines Final Weights
No Grips Used

In this example, we will assume that a new or plugged ball is being balanced. The following dimensions will be used:

Existing side weight: O
Existing finger weight: .1
Existing top weight: 3.4

Desired side weight: .8
Desired finger weight: .2
Desired top weight: .3

Span = 4 3/8 inches

No grips will be used.

Middle finger size: 15/16
Ring finger size: 13/16
Thumb size: 1 1/64

Ball weight: 15.76 pounds

In this example, SPC represents the SPC key on the computer and <E> represents the ENTER key on the computer. Slide the on/off switch on the computer to "on", touch the BASIC key, type RUN and touch the ENTER key. The following exchange between the computer and driller will occur:

COMPUTER: N)EW OR D)RILLED ?
DRILLER: N <E>

C: SIDE WEIGHT NOW?
D: O <E>

C: FINGER WEIGHT NOW?
D: .1 <E>

C: TOP WEIGHT NOW?
D: 3.4 <E>

C: Y)OU OR C)OMPUTER?
D: Y <E>

```
C:  DESIRED SIDE WT.?
D:  .8 <E>

C:  DESIRED FINGER WT.?
D:  .2 <E>

C:  DESIRED TOP WT.?
D:  .3 <E>

C:  SPAN?
D:  4 SPC 3/8 <E>

C:  G)RIPS -- N)O GRIPS?
D:  N <E>

C:  MIDDLE FING. SIZE?
D:  15/16 <E>

C:  RING FINGER SIZE?
D:  13/16 <E>

C:  THUMB SIZE?
D:  1 SPC 1/64 <E>

C:  BALL WEIGHT?
D:  15.76 <E>

C:  BEEP

C:  GO HORIZONTALLY
D:  <E>

C:  -1. IN.
D:  <E>

C:  GO VERTICALLY
D:  <E>

C:  -1./8. IN.
D:  <E>

C:  THUMB DEPTH
D:  <E>

C:  3. AND 1./8. IN.
D:  <E>

C:  MIDDLE FINGER DEPTH
D:  <E>
```

```
C:  1. AND 3./8. IN.
D:  <E>

C:  RING FINGER DEPTH
D:  <E>

C:  2. AND 1./16. IN.
D:  <E>

C:  >
```

Slide the on/off switch to the "off" position and proceed with drilling the ball.

Point C in photo 11 on page 5 represents the location of the center-of-palm as you prepare the ball for drilling. Point B represents a point whose horizontal distance from the original center-of-palm is -1 inch. Point C is -1/8 inch measured vertically from point B. (Distances have been slightly exaggerated for clarity.)

The BEEP that the computer makes indicates that the formula will not allow removal of sufficient top weight to make the ball balanced as desired. After drilling the ball as indicated by the computer, the driller should re-weigh the ball and drill a balance hole if necessary. The side/side and finger/thumb weights should be correct in spite of the BEEP. The driller may need to remove more top weight.

Balance Ball with Gripping Holes Already Drilled
Computer Determines Final Weights

A bowling ball that has already been drilled for gripping can be balanced by the CompuBalance™ method. This example shows how that can be done. The location of the axis-of-roll is determined by following the steps illustrated in photos 5 through 8 on page 4. Refer to photos 9 and 10 on page 5 to see how to measure the "HORIZ. MEAS. TO AXIS" and the "VERT. MEAS. TO AXIS".

In this example, the bowler will want the maximum AXIS WEIGHT that is currently allowed by the ABC. Notice that the computer will assign an ending side weight of 1 ounce, the maximum allowed.

To begin, slide the on/off switch to the "on" position, touch the BASIC key, type RUN and touch the ENTER key. As with the previous examples, SPC represents the SPC key on the computer and <E> represents the ENTER key on the computer.

COMPUTER: N)EW OR D)RILLED?
DRILLER: D <E>

C: SIDE WEIGHT NOW?
D: 0 <E>

C: FINGER WEIGHT NOW?
D: -.5 <E>

C: TOP WEIGHT NOW?
D: 1.7 <E>

C: Y)OU OR C)OMPUTER?
D: C <E>

C: HORIZ. MEAS. TO AXIS?
D: 5 SPC 1/8 <E>

C: VERT. MEAS. TO AXIS?
D: 3/4 <E>

C: ENDING SIDE WEIGHT 1.
D: <E>

C: ENDING FINGER WT. 0.19
D: <E>

C: ENDING TOP WEIGHT 0.4
D: <E>

C: WHAT % OF THESE?
D: 100 <E>

C: GO HORIZONTALLY
D: <E>

C: -2. AND 13./16. IN.
D: <E>

C: GO VERTICALLY
D: <E>

C: -1. AND 11./16. IN.
D: <E>

C: BALL WEIGHT?
D: 15.6

C: BIT SIZE
D: <E>

C: 1 1/8 IN.
D: <E>

C: HOLE DEPTH
D: <E>

C: 2. AND 1./2. IN.
D: <E>

C: BIT SIZE
D: <E>

C: 1 1/4 IN.
D: <E>

C: HOLE DEPTH
D: <E>

C: 1. AND 13./16. IN.
D: <E>

At this point the computer will cycle through the possible bit sizes and hole depths again in case you did not write down the combination you preferred. After you decide what combination you want, turn the computer off.

It should be noted that any of the bit sizes and corresponding hole depth could have been chosen from the options listed by the computer. To reduce your margin of

error, use the first option listed by the computer. At any rate, as soon as you decide on the combination that you want to use, you may turn the computer off; it is not necessary to go through the entire list.

Measure horizontally from the center-of-palm 2 and 13/16 inches to the LEFT. From that point measure vertically 1 and 11/16 inches DOWN. This is the location at which the balance hole should be drilled.

Place the ball in the drilling machine or drill press in such a way that the hole to be drilled will go directly toward the center of the ball (no pitch). Drill the hole using the combination of drill bit size and hole depth that you chose from the options listed by the computer.

A word of caution is in order here. If you are drilling a hole to INCREASE the weight in a ball toward its maximum allowed value, it is wise to drill the weight hole to a depth slightly less than indicated by the computer. Then weigh the ball to see if more weight can legally be taken out. If the ball has not yet reached its maximum weight difference on one or more sides, drill the hole a little deeper. Unfortunately, due to errors in measurements, there is no way to guarantee that the hole depth given by the computer will give EXACTLY the weight differences requested.

Left-handed Bowler

Bowler Determines Final Weights
No Grips Used

This example illustrates the way that negative quantities are interpreted by the CompuBalance™ method. It should be noted that left-handed bowlers will normally want NEGATIVE side weight, POSITIVE finger weight, and POSITIVE top weight. This is true since the axis of roll will normally be LEFT of the center-of-palm but still toward the finger half of the ball and on the top side of the ball. Therefore, the only difference in this example and an example with the same specifications for a right-handed bowler is the negative sign in front of the desired side weight.

As in the previous examples, SPC represents the SPC key on the computer and <E> represents the ENTER key on the computer. Begin by sliding the on/off switch on the computer to the "on" position. Then touch the BASIC key, type RUN and touch the ENTER key. The following exchange between the computer and driller will occur:

```
COMPUTER:  N)EW OR D)RILLED?
 DRILLER:  N <E>

       C:  SIDE WEIGHT NOW?
       D:  .1 <E>

       C:  FINGER WEIGHT NOW?
       D:  0 <E>

       C:  TOP WEIGHT NOW?
       D:  2.8 <E>

       C:  Y)OU OR C)OMPUTER?
       D:  Y <E>

       C:  DESIRED SIDE WT.?
       D:  -.8 <E>

       C:  DESIRED FINGER WT.?
       D:  .2 <E>

       C:  DESIRED TOP WT.?
       D:  .3 <E>

       C:  SPAN?
       D:  5 <E>

       C:  G)RIPS -- N)O GRIPS?
       D:  N <E>

       C:  MIDDLE FING. SIZE?
       D:  7/8 <E>
```

C: RING FINGER SIZE?
D: 11/16 <E>

C: THUMB SIZE?
D: 1 SPC 1/16 <E>

C: BALL WEIGHT?
D: 15.1 <E>

C: GO HORIZONTALLY
D: <E>

C: 1. AND 3./8. IN.
D: <E>

C: GO VERTICALLY
D: <E>

C: -5./16. IN.
D: <E>

C: THUMB DEPTH
D: <E>

C: 2. AND 1./2. IN.
D: <E>

C: MIDDLE FINGER DEPTH
D: <E>

C: 1. AND 5./8. IN.
D: <E>

C: RING FINGER DEPTH
D: <E>

C: 3. AND 11./16. IN.
D: <E>

C: >

Slide the on/off switch to the "off" position. Drill the ball according to the specifications given by the computer.

Notice that the computer instructs the driller to measure horizontally POSITIVE 1 and 3/8 inches from the reference point. Of course, that means to measure to the right of the reference point.

Questions and Answers

We would like to share a few ideas that may be of interest and of help as you use the CompuBalance™ method. If you have any questions about situations that are not covered here, please feel free to contact us. We would also like to hear how you have solved problems that have come up.

1. Question: When I slide the on/off switch on the computer to "on", push the BASIC key, and type RUN, none of the letters that I type appear on the display. What is wrong?

Answer: The contrast may need to be adjusted. The adjustment wheel is on the right-hand edge of the computer.
The batteries may need to be replaced. If so, send back to the factory. The computer will have to be re-programmed.

2. Question: Many of my customers like to use finger and thumb grips (inserts). How do I make the necessary adjustments in the depths of the holes that I will be drilling for gripping purposes?

Answer: When the computer asks G)RIPS OR N)O GRIPS?, respond with G and touch the ENTER key. Then when the computer asks for the finger/thumb sizes, input the DRILL BIT diameter that will be used for that hole. The computer will then ask for the grip weight which should be input as a decimal number. The computer will compensate for the grips.

3. Question: What do I do if I discover that I have input an incorrect number and I have already touched the ENTER key?

Answer: Touch the BRK key and begin again by typing RUN and touching the ENTER key.

4. Question: What do I do if I discover that I have made a mistake in an input number but I have NOT YET touched the ENTER key?

Answer: Touch the C-CE key (upper right-hand corner). The display will be cleared of the incorrect input, and you will be allowed to input the correct figure(s). All other numbers that were input before the error will remain in the computer.

5: Question: The instructions for drilling that came in the box with my ball expressly state that the gripping holes must be drilled within a certain area. The computer indicates that the holes should be drilled slightly outside that region. What should I do?

Answer: Re-weigh the ball to make sure that you weighed it accurately the first time. If you did, follow the directions given to you by the COMPUTER.

6. Question: When I stuck the transfer on my dodo scale the zeros did not line up exactly. Should I compensate for that when I weigh the ball?

Answer: The only problem that could arise from your situation is ending up with a ball that weighs over 16 pounds. Since ABC specifies that the DIFFERENCES in weights for six sides must fall within certain limits, there is no need for any compensation; use the numbers as they appear on the scale.

7. Question: Whenever I use the CompuBalance^{tm} method for a lefthanded bowler, it tells me that the ending side weight should be negative. Is this correct?

Answer: The problem lies with the semantics. With the CompuBalance^{tm} method, excess weight to the right is considered positive whereas excess weight to the left is considered negative. Here, right and left are relative to a ball that is positioned with the holes upward, thumb toward you, fingers away from you.

8. Question: Under what conditions would you recommend using a negative percent of the maximum calculated weight differences?

Answer: We would hardly ever make such a recommendation. The only situation that we can conceive of is very dry lanes. In such a situation, you would be better off to rely an a ball with a harder surface (if possible) than to rely on negative axis weight.

9. Question: We have a lot of young children who love to bowl but who get discouraged when they roll so many gutter balls. How can the CompuBalance^{tm} method help them?

Answer: The lightweight balls should be weighed the same way that is used for the heavier balls. Run the computer and choose the option Y when asked Y)OU OR C)OMPUTER. Input zeros when asked for the desired side, finger, and top weights. Drill a balance hole as indicated to get a perfectly balanced ball that will not be pulled into the gutter by the weight block. The process may require drilling successively deeper into the same hole between weighings to ensure that the correct amount of mass is being removed. We highly recommend doing this to all of your junior houseballs.

10. Question: I wanted to increase the side weight in my ball to 1 ounce. I followed the directions and ended up with 1.1 ounces which is illegal by the current ABC standards. Did the computer make an error?

Answer: It is imperative that caution be used when you are increasing a weight to its maximum. In such a situation, the balance hole should be drilled to a depth slightly less than given by the computer, weighed, then drilled more in the same hole if necessary. Repeat this process until the desired weight is attained. Fortunately, the process is not as bad as it may sound, and most people would be content with .9 oz. side weight instead of 1 oz. side weight. For the purist, however, it will take more time and care to reach the full maximum desired. Do the processs in two or three steps to avoid an irreversible problem.

11. Question: I drilled a ball for a bowler who rolls a full-roller. When I checked for balance after drilling the gripping holes, I found that the ball had .5 oz. too much top weight as indicated by the computer. If I drill a balance hole, it will be in the ball track. What should I do?

Answer: If a bowler rolls a full-roller, top weight neither helps nor hinders the hook of the ball. The computer will indicate 0 oz. top weight, but any other amount will work just as well.

12. Question: I have a customer who uses four holes for gripping purposes. Does the CompuBalance™ method accomodate such differences?

Answer: No. You might input middle and ring finger and thumb sizes about 80% of their actual values. Then, drill each of the three finger holes to the depth indicated on the computer. Check for balance and drill a balance hole, if necessary.

13. Question: When I input the information for drilling a new ball, the computer beeped 10 times and displayed the message "ERROR 5 IN 602". What went wrong?

Answer: It was impossible to remove the necessary weight to achieve balance by drilling holes the size that the bowler needed for gripping. You must either request a larger amount of desired top weight, then drill a balance hole after drilling the gripping holes, or choose a ball with less top weight to begin with.

14. Question: When I input the information for drilling a new ball, the computer display showed "ERROR 2 IN 499". What went wrong?

Answer: You tried to end up with more imbalance in the ball than already existed. In effect, you tried to create weight in the ball by drilling a hole -- a very tricky task indeed.

15. Question: My customers use a lot of grips in balls that I drill for them. Do I need to buy a scale so that I can weigh the grips?

Answer: No. A small scale could certainly be used but is not necessary; you can use your dodo scale. With the ball you are balancing in the scale, set the sliding weights to balance it. Place the grip on top of the ball and re-balance the scale. The difference in the two readings (with and without the grip) represents the weight of the grip.

16. Question: If I intend to use grips in a ball, what size should I input for fingers and thumb?

Answer: ALWAYS use the DRILL BIT SIZE that you will use to drill the hole.

17. Question: The computer says "GO HORIZONTALLY" but does not give a number. What is the problem?

Answer: In order that you have time to see all of the output, the computer is set up to stop between parts of the ouput. Simply touch the ENTER key and the computer will display the quantity that you desire.

18. Question: How much top weight should a new bowling ball begin with in order to end with an axis-weighted ball after drilling the gripping holes?

Answer: Under normal circumstances (16-pound ball, average size hand) you will want 2 to 2.5 ounces of topweight when you begin.

19. Question: How do I drill a ball so that I will get a weight hole at the axis-of-roll?

Answer: The process will require three steps. First weigh the ball for existing weight differences. Input those values into the computer and ask the COMPUTER to calculate the ending weights. (You will have to input the horizontal and vertical measurements to the axis-of-roll.) When the computer gives you the ending side, finger, and top weights, write them down.

Then RUN the computer again, this time requesting to give the ending side, finger, and top weights YOURSELF. When the computer asks for the desired weights, you input TWICE the values that you wrote down during the first step in the process. Drill the ball according to the specifications given by the computer during this run.

Finally, re-weigh the ball after drilling the grip holes and balance the ball by requesting the weights that you wrote down in the first step in the process. The computer should direct you to the axis and tell you a bit size and hole depth combination that will balance the ball and put the hole on the axis-of-roll.

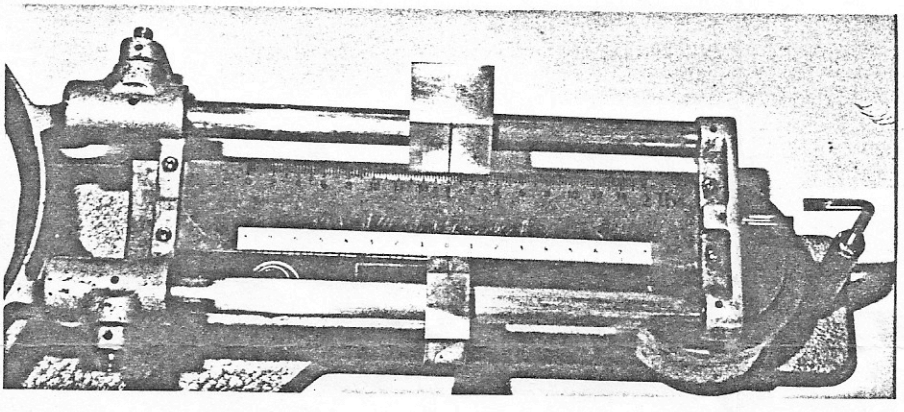
Save padded envelope for computer shipment.

PARTS LIST

1 ball cradle (with 4 wings)
1 set of ball bearings in race
1 circle-maker (doughnut shape)
1 arcmaker (horseshoe shape)
1 pocket computer
1 user's manual
1 china marker
2 decals for dodo scale (one is a spare)

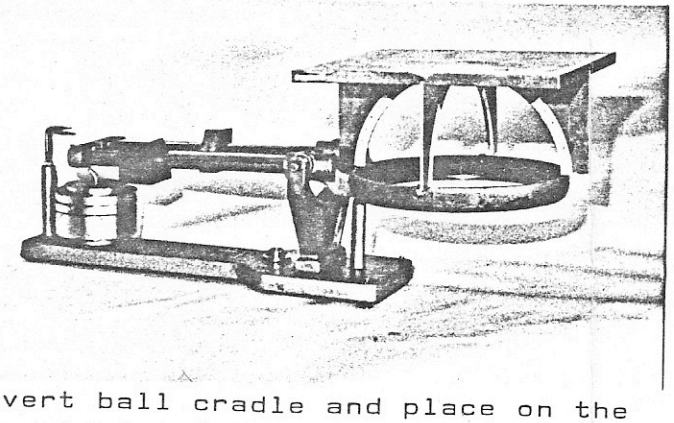
[X] videotape (optional) only included if box checked

Assembly Instructions

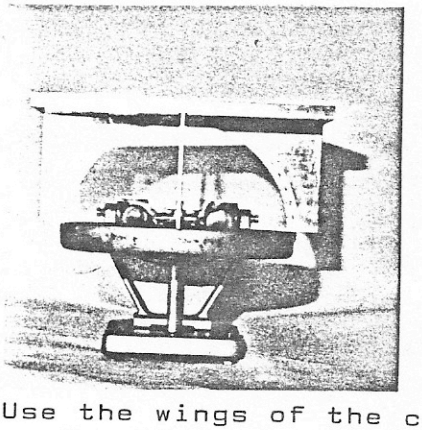


Peel off backing of decal and place decal on dodo scale as shown.

If the receptacle on your ball scale is not calibrated, follow these steps to mark the receptacle.



Invert ball cradle and place on the receptacle of the dodo scale so that the receptacle touches the wings of the cradle at equal distances from their edges.



Use the wings of the cradle as "gunsights" to line up the pin on the dodo scale that is used to indicate balance. Re-check wings to make sure that they are equal distances from the receptacle. Mark the positions of the wings on the receptacle. Align these marks with marks on ball when weighing ball.

Experimental Observations

There are several factors to consider with regards to a rolling bowling ball; lane friction, weight (im)balance, gyroscopic inertia, and internal ball construction to name some of the more important ones. Each factor contributes to the way that the ball reacts on the lane. In extreme cases, any one of these may be the predominant factor with the other factors playing less significant roles. Under normal conditions, all of these factors play a role.

Some dense-core balls may roll to a full roller regardless of the weight imbalance that they have.

If a ball has nearly uniform density, shifting the label to the axis and drilling a hole in it will not make the ball roll differently than a ball with the same weight imbalance in which the imbalance was achieved by a simple label shift.

The center of gravity of an axis-weighted ball lies on the axis of roll of the ball. Axis-weighted balls roll truer than any other type of ball and roll with a consistent, even arc.

The track on a dynamically unbalanced ball, such as a leverage weighted ball, may flair dramatically, and the ball may roll less consistently than a dynamically balanced (axis-weighted) ball.

By proper shifting of the label, weight can actually be "created" in a ball.

The proper combination of side weight and thumb weight can cause a ball to roll the same as if it had finger weight!

To make a Hammer roll true, it is necessary to dynamically balance the ball and place the pin along the axis of roll.

CompuBalance Leverage Weight

Follow these easy steps to get a leverage-weighted ball:

1. Locate the axis point on a drilled ball in the usual way by using the ball cradle and arcmaker.

2. Draw the horizontal and vertical lines on the used ball so that they intersect at the center-of-palm as usual.

3. Use the arcmaker to draw an arc from the axis point through the center-of-palm to the track as shown in Figure 4.

4. Measure the distance from the axis point to the track along this arc.

5. Mark a point on the arc halfway between the axis point and the track OR go in some other direction from the axis point this same distance and mark a point there.

6. Tell the computer that you are drilling a N)EW ball and have the C)OMPUTER calculate the final weights. When the computer asks for the HORIZ. MEAS. TO AXIS and the VERT. MEAS. TO AXIS, input the distances to the point that you marked in step 5 instead of the distances to the actual axis point. This will fool the computer into thinking that this is the actual axis point, and it will accordingly locate the center of gravity on a line through the marked point and the center of the ball.

Our experiments have shown that axis weight is superior to leverage weight for bowlers who stroke the ball. If a bowler puts enough revolutions on the ball to change the axis point as the ball rolls, leverage weight may be beneficial. Let us know how your experiments turn out.

". . . the rotations of an unsymmetrical top about the axes of the largest and smallest moments of inertia are stable, that about the axis of intermediate moment of inertia is unstable."[1]

Newton's Three Laws of Motion:

"A body at rest will remain at rest and a body in motion will remain in motion with constant velocity unless an external resultant force acts upon the body."[2]

"Force = mass times acceleration"[3]

"For every force which acts on a body (the action force) there is an equal and opposite force (the reaction force) which acts on some other body."[4]

". . . the inertia of a body for rotational motion depends not only upon the mass of the body, but upon the distribution of the mass within the body."[5]

". . . the farther the particle is from the axis of rotation, the more difficult it is to give it a specified angular acceleration."[6]

"The larger the distance of the mass from the axis, the larger will be its rotational inertia."[7]

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[1]Arnold Sommerfeld, Mechanics (New York: Academic Press, 1964), p. 250.

[2]Frederick Bueche, Introduction to Physics for Scientists and Engineers (St. Louis: McGraw-Hill Book Company, 1969), p. 64.

[3]Ibid., p. 66.

[4]Ibid., p. 64.

[5]Ibid., p. 189.

[6]Ibid., p. 190.

7Ibid., p. 194.

See also: Fogiel, Max.(ed.). The Physics Problem Solver. New York: Research and Education Association, 1976.

Serway, Raymond A. Physics: For Scientists and Engineers. Chicago: Saunders College Publishing, 1982.

BALANCE SHEET

December 1987

AXIS LINES: The general concept behind leverage weight is to locate the center-of gravity of the bowling ball on a line that makes a 45 degree angle with the axis-of-roll and the plane containing the ball track.

Figure 1 shows a ball whose track and axis point have been located. For this particular ball, the axis point is 8" from the track.

Figure 2 shows the same ball with a 4" radius circle centered at the axis point. Every point on the circle is 4" from the track and 4" from the axis point.

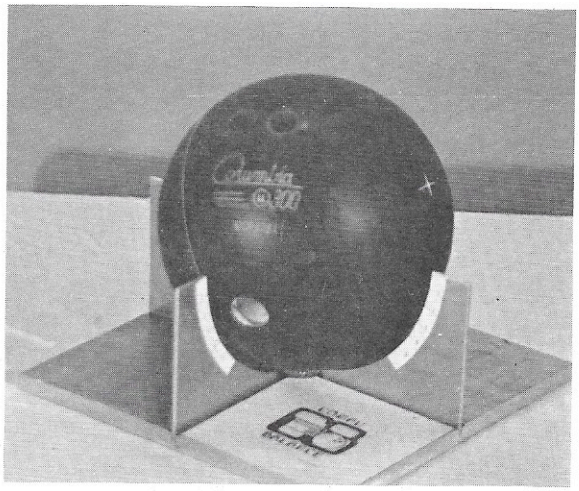

Figure 1

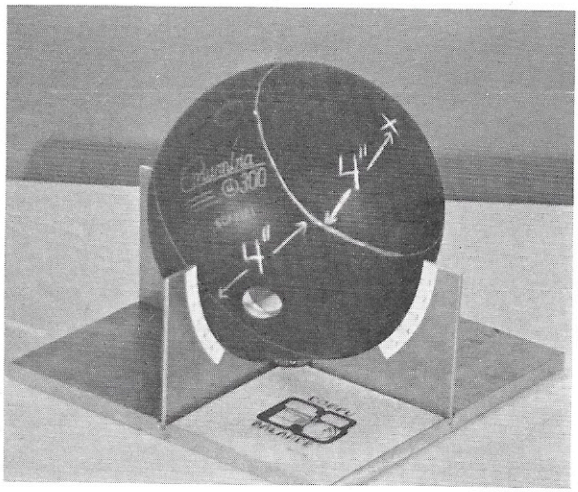

Figure 2

The object is to locate the center of gravity on a line that passes through the center of the ball and a point on this circle. The typical way to do this is to shift the label so that it is a point on this circle. The ball is then drilled in that position and excess side weight is removed by drilling a balance hole in the side, sometimes where the axis point would be located. Drillers who use this method neglect to compensate for the weight that is removed by drilling the gripping holes. When these holes are drilled, the heaviest part of the ball shifts past the label toward the axis point. As a result, the ball has less than maximum leverage.

Another potential problem is illustrated in Figure 3. If the new ball does not have enough label weight before drilling, the center of gravity might end up on a line through the center of the ball and point A or point B or some point on or near the circle between A and B. The resulting ball will have bottom weight and may roll up on the thumbhole.

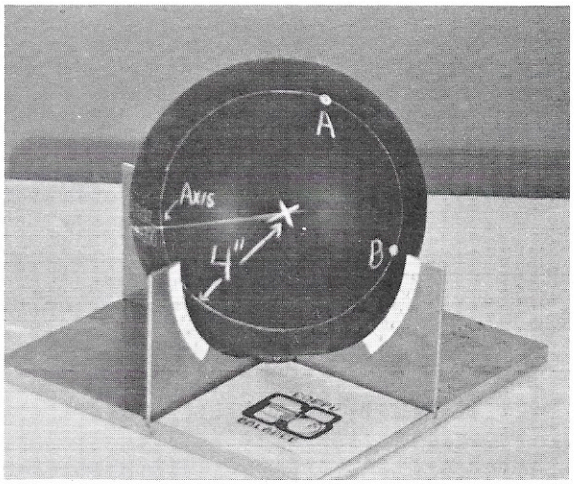

Figure 3

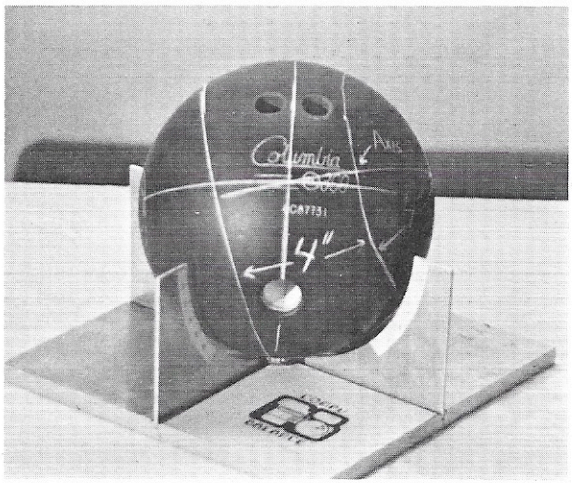

Figure 4

For starters, we recommend locating the center of gravity on a line through the point labelled "AXIS" in Figure 3 and Figure 4. If you do not own a CompuBalance System, you can use your experience to approximately locate the center of gravity in this location. Good luck! If you do own a CompuBalance System, this mailing should include an extra page that tells you how to easily locate the center of gravity at this desired point.

SPARE LINES: CompuBalance kits now come with optional VHS format videotapes that illustrate how the system works. You can order directly from us or through your favorite distributor. All kits include illustrated manuals. Kits are shipped C.O.D. via UPS. Kits without the videotape cost $395.00 and with the videotape they cost $419.95. Illinois residents must pay sales tax. You also pay shipping and C.O.D. costs (about $5). 90 day limited warranty. No assembly required. Call us for more information or to order.

BALANCE SHEET

February 1988

AXIS LINES:

We have performed a number of experiments with different weight values and distributions in an effort to answer some questions that have come up. Here is an experiment that we have tried that you can try.

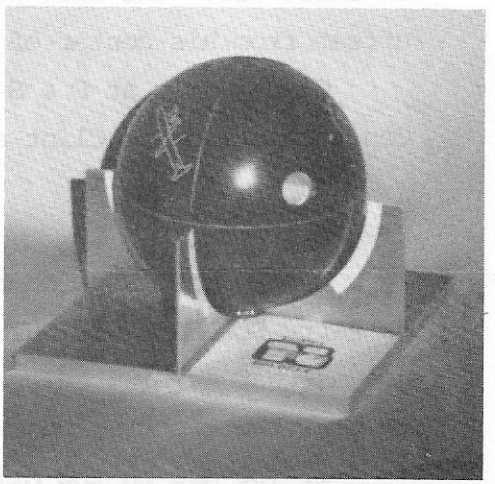

Photo 1

Use a ball that you will no longer want to use in competition. Roll the ball several times and watch the trajectory to the pins and its reaction with the pins.

If you own a CompuBalance^{tm} System, mark the ball in the usual way and use the marks on the ball to locate opposite points on the ball. (See Photo 1.)

If you do not own a CompuBalance^{tm} System, drill a pilot hole in the ball and insert a screw eye. Suspend the ball on a string by tying the string onto the screw eye. The screw eye may be placed anywhere, but we suggest that you choose the axis point the first time you try this experiment. Carefully lower the ball onto some baby powder that has been spread thinly on a tabletop. This procedure will locate two points that are directly opposite each other on the ball. (See photo 2.)

Remove the screw eye. Drill the deepest hole you can with the largest bit you have at the point marked with powder and the point where the screw eye was located. The two holes should meet at or near the center of the ball. The two holes will remove equal amounts of mass from opposite sides of the ball and thus, leave the static characteristics of the ball unchanged.

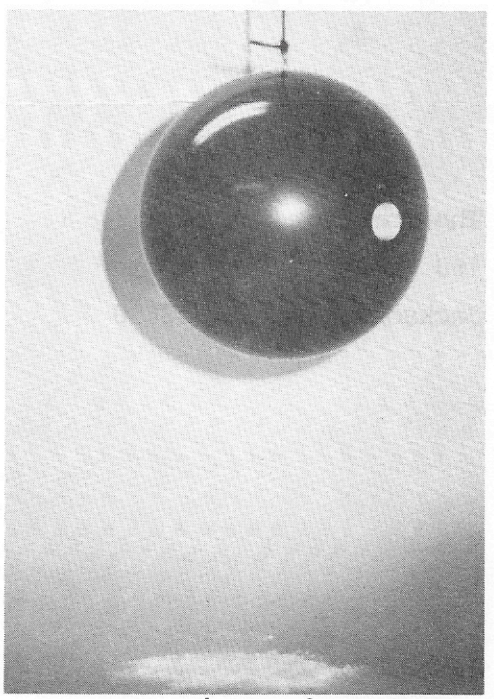

Photo 2

Now roll the ball again and compare the hook and pin reaction to what you observed earlier. We will publish our observations in the next "BALANCE SHEET". In the meantime, we certainly are interested in hearing about your results.

BOWLER SPOTLIGHT:

Clint Ekhoff is a 21-year-old YABA bowler who recently scored a 300 game with his CompuBalanced ball. Within a three-week period, Clint had games of 279, 289 and 300. During that same period of time, Clint had series of 736 and 741. The high scores broug Clint's 30-game average to 228.

Clint used a 60% axis-weighted black Hammer with no axis hole and bowled his scores on short oil. The axis point on Clint's ball is 4-1/4" horizontally and 1-3/8" vertically offset from his center of palm.

Clint bowls at F & S Lanes in Loveland, Colorado. Ben Sauer drills Clint's equipment. Congratulations to Clint and thanks to Ben for supplying the information.

SPARE LINES:

Due to the large number of units that we now have in operation, we may not be able to carry BOWLER SPOTLIGHT as a regular column. We are receiving so many reports of high scores that we will be unable to acknowledge them all in "BALANCE SHEET". We still like to hear the reports, however!

If you are in the Milwaukee area, consider attending a seminar on March 7 that we will be presenting in conjunction with Bob's Business, Inc.. For more information or to register, contact Bob's Business at 414-252-3888.

BALANCE SHEET

June 1988

Axis Lines:

If you axis-weight a ball that has a pancake weight block, the ball should roll very true under normal lane conditions. If you have been having trouble getting dense-core balls, such as Faball products, to roll true, the problem lies in the asymmetrical, dense core. When properly drilled, these dense-core balls will roll as true as any bowling balls. The following instructions will describe how to axis-weight a dense-core ball so that it will also be axis-balanced.

Begin by finding the pin location on the ball. (Some of you may refer to this as the pour hole.) On Faball products the pin will be located at a 45 degree angle from each crosshair in the bullseye. If the pin is difficult to see, apply some water to make it more visible.

Use one of the customer's drilled balls to determine the horizontal and vertical measures to the axis point or look up the information on the record that you keep for that customer. For illustrative purposes, suppose that the horizontal measure to the axis point is +5 inches and that the vertical measure to the axis point is +1 inch. We must reverse the process of measuring from the center of the palm to the axis point. To do this, start at the PIN and measure 1 inch DOWN. From that point, measure 5 inches to the LEFT. This procedure will locate the center-of-palm.

Drill the ball using your standard technique and apply inserts, if desired. Weigh the ball to find the existing weights, then use the computer to locate a balance hole. After you drill the balance hole as specified by the computer, the ball will be axis-weighted and axis-balanced. When selecting a ball to drill using this technique, find a ball with approximately two ounces of top weight.

If you want to leverage-weight a dense-core ball, place the pin at the leverage point. To do this, locate the leverage point on the customer's used ball. Determine the horizontal and vertical measures to the LEVERAGE point which you will input into the computer as the horizontal and vertical measures to the AXIS point. Measure backwards on the new ball as described above for axis weight to locate the center-of-palm. Drill the ball, then punch a balance hole as determined by the computer to make the ball fall within ABC specifications. Choose a ball with a beginning top weight of about 4 or 5 ounces.

Axis Tip:

When drilling Faball products for axis weight, choose balls in which the pin lies within the bullseye. That way the bullseye will mark the axis point, and it will be easy to see how true the ball rolls.

Bottom Lines:

Future issues of BALANCE SHEET will be provided free of charge to registered CompuBalance owners for a period of one year from the date of purchase. If you have not purchased a CompuBalance kit but would like to continue receiving BALANCE SHEET, please send a check for $20 to:

The Computer Tutor
BALANCE SHEET
160 E. Pennsylvania
Jacksonville, IL 62650

The $20 will entitle you to 10 issues.

Thank-you Lines:

Our thanks go out to Bob Rehder and his fantastic staff for inviting us to present a seminar in Minneapolis on 2 May 1988. Thanks also to those pro shop owners who attended.

Our summer schedule is already getting tight. If you are interested in hosting a seminar before the fall season begins, call us and arrange a date.

Victory Lines:

We said that we would not be able to offer Bowler Spotlight in each issue of BALANCE SHEET, but we couldn't pass up the chance to congratulate Don Noecker of Jacksonville, Illinois for winning the singles event in the Illinois ELKS state bowling tournament. Congratulations, Don!

BALANCE SHEET

November 1988

AXIS LINES:

Drilling a dense-core ball using the CompuBalance System will result in a very true-rolling ball. However, when the gripping holes are drilled as far from the top weight as the system requires, the ball may become so far out of balance that it cannot be balanced with a single hole. Another problem is that the required balance hole might lie in the bowler's track. Today we will show you how to avoid these potential problems.

Begin by using the computer to determine how much weight your customer's gripping holes will remove from the ball when it is drilled. When you RUN the computer, select the N)EW option and the Y)OU option. Input desired side, finger and top weights 0, 0 and 0. Then input the span and pertinent information pertaining to grips and ball weight. The computer will give you a range of top weights from which to select. Write down the smaller of the two numbers given. (We will call this number the customer's GRIPPING WEIGHT.) Continue with the program until the computer gives the hole depths for the fingers and thumb. Write these numbers down or ask for a paper copy if you have an optional printer.

Then go to your dense-core ball and measure vertically and horizontally from the pin to the eventual center-of-palm. Measure in such a way that the top-weight is located between the center-of-palm and the axis point (or leverage point if you are drilling leverage weight). Use the cradle, arcmaker and circlemaker to lay out the ball through this center-of-palm. Weigh the ball for side, finger and top weights from this point. Find the difference of (subtract) the top weight that you get and the gripping weight that you wrote down earlier. Be sure to subtract the gripping weight FROM the top weight. (If the gripping weight is larger than the top weight, subtract the top weight from the gripping weight and make your answer negative.)

RUN the computer again. This time select the D)RILLED option and the C)OMPUTER option. Input the horizontal and vertical measures to the axis point (or leverage point when drilling leverage weight), and input the existing side, finger weights that you got from weighing. Input the top weight that you got when you subtracted the gripping weight from the top weight.

At this point, the computer may or may not give you drill bit combinations and hole depths. If no combinations are given, the ball should not be drilled for that customer since the balance hole required for balancing would exceed ABC specifications in diameter. If combinations ARE given, you must determine whether or not the hole will lie at an acceptable location and not, for example, on the bowler's track. If the hole appears to be in an acceptable location, drill the gripping holes to the depths that you wrote down. You could also drill the balance hole as directed above, but as a last check, weigh the drilled ball for side, finger and top weights after drilling the gripping holes and before drilling the balance hole. Input the weights into the computer, and the computer will tell you where to drill and to what depths to drill the balance hole.

NEW LINES:

CompuBalance came out with an updated program this past summer. Some of the enhancements include:

* The computer tells you what top weight to select in a ball.

* If you select a ball with top weight in excess of the suggested values, the EXCESS weight is automatically shifted to the axis point.

* Default values are included for finger and thumb sizes when grips are being used. You must only touch <ENTER> instead of 31/32 <ENTER> for fingers and 1 1/8 <ENTER> for thumb when grips are used.

* The new program supports an optional printer. The regular printer ($100) is connected by a pigtail to the computer. It is about 2/3 the size of a VHS tape. The deluxe model ($125) and the computer connect to form a single unit. Both printers run on batteries or an AC adapter which is included with each printer.

The new program can be programmed into your old computer. The reprogramming package consists of an updated videotape, an updated user's manual, new batteries, and the new program. The cost is $75.

We just recently learned by accident that you will not lose your program if you change the batteries in your computer before the old batteries run out completely. When the contrast dial (located on the right edge of the computer) is adjusted to maximum and the display is dim, it is time to replace the batteries. Remove the two Phillips screws on the back of the computer. Slide the chrome battery retainer away, and replace the two CR-2032 lithium batteries. These batteries are a common size. If the batteries are out for more than a few minutes, you will lose the program, so keep two batteries on hand at all times to avoid losing your program. Replacing your own batteries will keep your costs down. We will inform you whenever there are any program changes that we think you might want to have.

BALANCE SHEET

December 1988

VECTORS:

Columbia's new line of bowling balls made a good impression on us. Rumor has it that some of you are not as happy as we are. We have gotten a lot of calls concerning the proper way to drill these new balls. In this **BALANCE SHEET**, we will explain how we think the Vector I and Vector II should be drilled.

If you have attended one of our seminars, you know that you must consider the interior design of a bowling ball as you plan your drilling approach. In the Vector series, Columbia has struck ground somewhere between their U-Dots and Faball's Hammer series. Columbia uses a larger, denser block in the Vectors than in their other balls, and the weight block is closer to the geometric center of the ball than the pancake in a U-Dot. Our experiments indicate that the best approach to drilling these balls is to drill them the same way that you would drill a Hammer.

To drill axis-weight in a Vector, you will want the label to lie on the axis point. To get the label in that position, you must **FIRST** measure vertically from the label and **THEN** measure horizontally from that point to a point which will become the center of grip when you drill the ball. (Refer to the manual for instructions for drilling Hammers.) The only difference will be that the **LABEL** instead of the pin will be on the axis.

Drill the gripping holes into the ball; weigh the ball for side-, finger-, and top-weight; use the computer to help you balance this drilled ball.

Everything is done exactly as we recommend for Hammers. This also means that the same pitfalls can plague you. To avoid the pitfalls, be sure that the ball that you will be drilling has the proper top-weight **before** you drill the gripping holes. We covered that idea last month, but it probably bears repeating. This time we will use specific numbers that you can use on your computer as you follow along with the example.

EXAMPLE:

Finger grips will be used:
middle finger = .3 oz.
ring finger = 3.3 oz.
Thumb size = 1"
Span = 5"
Ball weight = 16 lb.

I. Determine the bowler's **gripping weight.**

RUN the computer. Select the N)EW option followed by the Y)OU option. When the computer asks for the DESIRED SIDE WT., input 0. You should also input 0 when the computer asks for the DESIRED FINGER WT. and when it asks for the DESIRED TOP WT.

When the computer asks for the SPAN, input 5. Respond with G when the computer asks G)RIPS -- N)O GRIPS?. Input middle finger size of 31/32 and grip weight of .3. Input ring finger size of 31/32 and grip weight of .33. Input thumb size of 1 and grip weight of 0 (no grip being used in the thumbhole).

After you give a ball weight of 16, the computer will pause and suggest that you choose a ball with top-weight between 2.2 and 2.6 ounces. Write down the smaller number that it gives, in this case, 2.2. (That number represents the amount of weight that the bowler's grip removes from a 16-pound ball when it is drilled. Hence, we refer to that number as the bowler's **gripping weight.**)

Drilling will only remove that much weight if the holes are drilled to the proper depths, however. Continue with the program as follows.

Tell the computer that the SIDE WEIGHT NOW is 0, the FINGER WEIGHT NOW is 0, and the TOP WEIGHT NOW is 2.2. (Always use 0 for the side and finger weights and the **gripping weight** as the top weight.) The computer will tell you to GO HORIZONTALLY 0 IN, GO VERTICALLY 0 IN, and drill the thumbhole to a depth of 2 7/16", the middle finger hole to a depth of 1 7/8", and the ring finger hole to a depth of 2". Once again, write these depths down, for it is only by drilling to these depths that you can achieve the 2.2 ounces gripping weight.

III. Select a ball from stock. Determine the bowler's

horizontal and vertical measurements to his/her axis from a used ball. Measure backwards from the LABEL these distances to arrive at the center of grip. Follow the explicit instructions as presented on page 18 of the manual. (Note that in the manual we show a ball that has been marked from the PIN instead of the LABEL. For Vectors, measure backwards from the LABEL.) Weigh the ball from the point that will eventually be the center of palm. In this example, suppose that the ball that we chose has side weight of 2.5 oz., finger weight of .5 oz., and top weight of .75 oz. We must now subtract the **gripping weight** from the top weight. In doing so we arrive at -1.45 for the top weight. (For those of you who are unfamiliar with negative numbers, we always subtract the **gripping weight** from the top weight. In reality, the **gripping weight** will nearly always be greater than the top weight. If it is, simply subtract the top weight from the **gripping weight** and make the answer negative.)

Drilling gripping holes using the CompuBalance^{tm} System will not change the side weight nor the finger weight of the ball as measured above; they will remain 2.5 and .5 respectively. The top weight will diminish by the gripping weight, however. By subtracting the gripping weight from the top weight, we are able to determine what the weights will be in the ball after we have drilled the gripping holes.

IV. Determine whether or not the ball can be "made legal" with a balance hole, and determine the location of the balance hole.

If we chose a ball with too much top weight, we will not be able to drill a single balance hole of diameter less than or equal to 1 1/4". In that case, we must choose a ball with less top weight. If so, no harm is done since we have not yet drilled any holes in the ball.

If the balance hole will end up in the ball track, we will need to select a different ball, too.

To determine if we have chosen a satisfactory ball, follow these steps:

RUN the computer again and select the D)RILLED option. Then select the C)OMPUTER option and input the horizontal and vertical measures to the axis point. Suppose for this example that the horizontal distance is 5 inches and the vertical distance is 1 inch. The computer will tell you that axis weight can be achieved with 1 oz. side , .26 oz. finger, and .43 oz. top as the weights. Let us select 90% of these maximums. When the computer asks for the side-, finger- and top-weights now, input 2.5, .5, and -1.45 respectively. The computer will instruct you to measure horizontally 10 7/16" from the center of palm and 1/2" from there to arrive at the location of the balance hole. Input the ball weight as 15.85, and the computer will instruct you to use a bit size of 1 1/4" and drill a hole 2 15/16" deep.

Since the computer gave us a drill bit/hole depth combination we know that we will be able to successfully balance the ball with one hole. **If the computer had not given us a drill-bit / hole-depth combination, we would have had to choose a ball with lower top weight to begin with.**

With the first obstacle out of the way, you must then check to make sure that the balance hole will not lie on the ball track. If the hole will lie on the track, choose another ball with different top weight. Since we only got one combination of bit size/hole depth, and the bit size was maximum, we would have to choose a ball with less top weight. If we had been offered several bit size/hole depth combinations, we might have been able to choose a ball with more top weight.