Quick Start Guide for the BIA 310e

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Chapter 1: General Theory

The theory of bioimpedance relates to the flow of an electrical current through an object and how its measurement can be used to determine the object's physical properties.

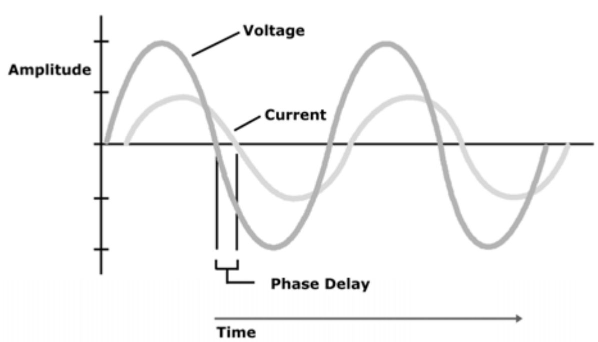
Impedance is the overall propensity of an object to conduct electrical current and is defined as the ratio of the voltage in an object to the current in an object. Its units are ohms, after the physicist.

The constituent components of impedance are resistance (R) and reactance (X). Resistance is a direct indicator of a material's propensity to dissipate energy; reactance is an indicator of energy storage. All materials both dissipate and store energy.

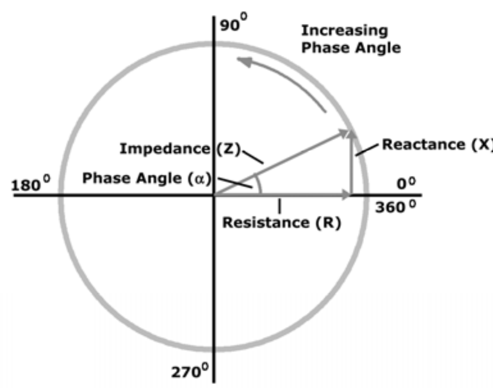
It turns out that impedance and its relationship to energy dissipation and storage can be used to evaluate mass and fluid compartments of the body.

By correlating measurements of the body (gender, age, height, weight, resistance and reactance) to those taken by expensive and invasive techniques, equations can be derived for estimating body compartments.

The time relationship of voltage, current, and phase is shown in the first figure below. The vector relationship between impedance, resistance, reactance, and phase angle, represented with polar coordinates, is shown in the second figure.



time relationship of voltage, current, and phase



polar coordinates showing relationship between impedance, resistance, reactance, and phase angle

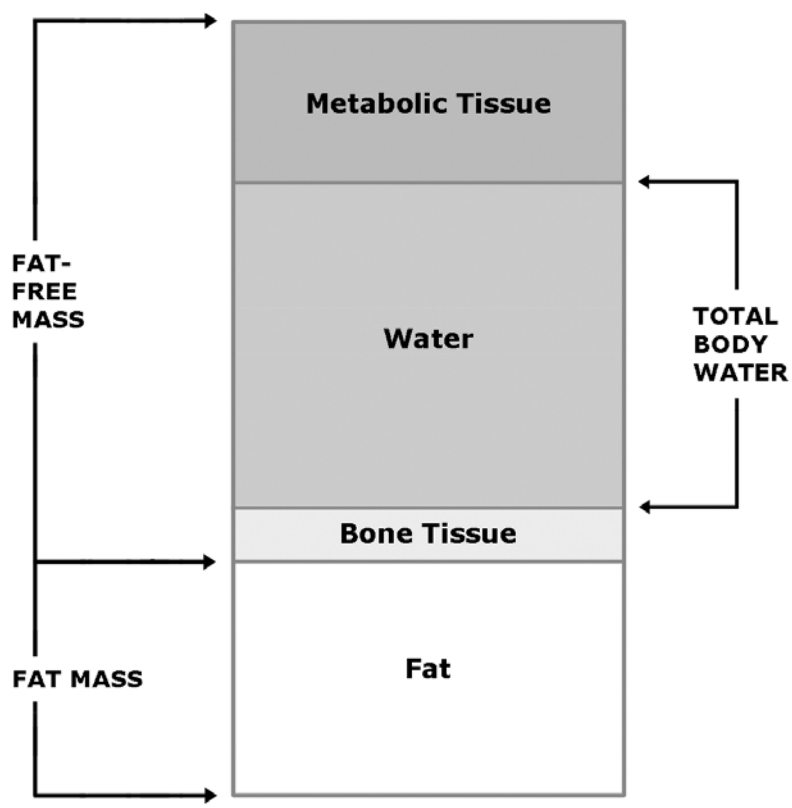
Body composition analysis is the clinical assessment of tissue and fluid distribution in the human body. The body is modeled as a series of tissue and fluid compartments.

Fat Body Weight (or Fat Mass) is the total amount of stored lipids in the body and consists of the following types of fat:

> **Subcutaneous Fat** is located directly beneath the skin. Subcutaneous fat serves as an energy reserve and as insulation against outside cold.
>
> **Visceral Fat** is located deeper within the body. Visceral fat serves as an energy reserve and as a cushion between organs.

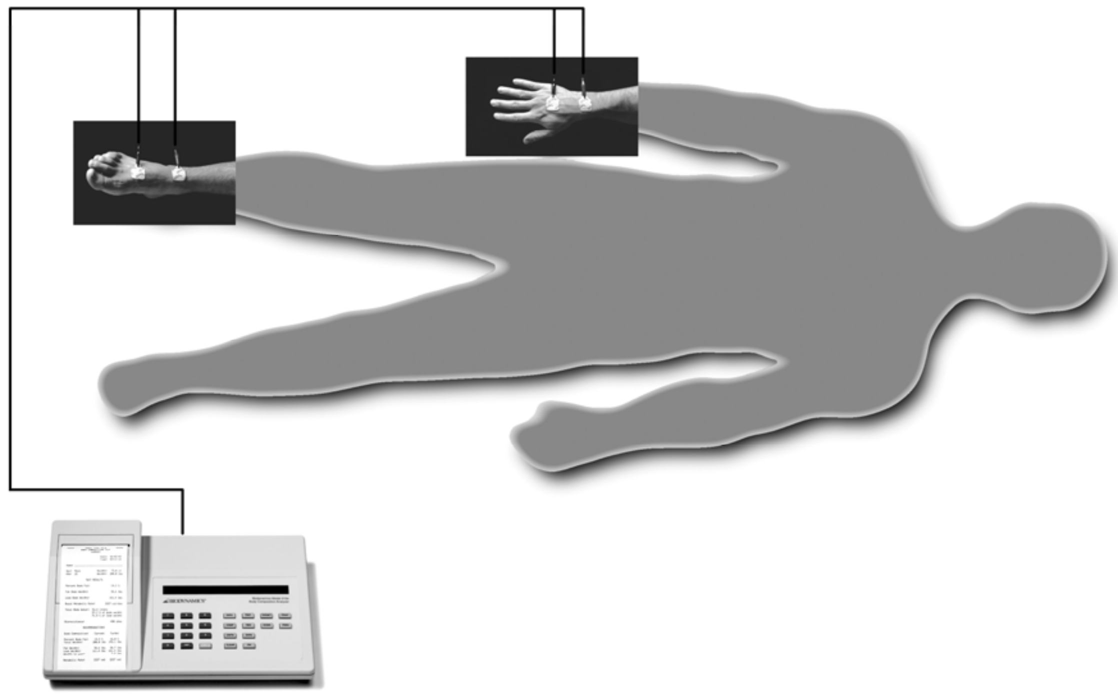
Lean Body Weight (or Fat-Free Mass) is the total amount of lean (nonfat) parts of the body. It consists of approximately 73% water, 20% protein, 6% mineral, and 1% ash.

The figure below provides a graphical representation of the compartments in the human body.



Four-Compartment Model

Chapter 2: Conducting a Test



Tests are to be performed on a non-conductive surface such as an examination table, bench, or mat. Adhere to the following test protocol:

1. Instruct the subject to remove their right shoe and sock and lay down on their back. Feet should be 12 to 18 inches apart. Hands should be palms down and 6 to 12 inches from torso.

2. Place two adhesive sensor pads on the right wrist/hand and two on the right ankle/foot.

3. Attach the cable set to the analyzer. Fully extend the cable. Remove any coils. Attach the clips to the pads, red clips closest to the heart.

4. Turn the analyzer on, press the DATA key and enter subject data: gender, age, height and weight.

5. Ask the subject to relax and remain motionless.

6. Press the TEST key. The subject feels nothing, and in a few seconds the test is complete.

7. The analyzer shows the test results on its display.

8. Press the PRINT key and the analyzer prints out test results.

Chapter 3: Subject Preparation

To ensure the best test results, ask your subjects to observe the following guidelines:

- No alcohol consumption within 24 hours prior to taking the test.
- No exercise, caffeine or food for 4 hours prior to the test.
- Consume 2 to 4 glasses of water within 2 hours prior to the test.

The conductivity of an individual's lean body weight depends on its water content. In other words, hydration levels will affect bioresistance readings.

Alcohol causes dehydration and may result in high body fat readings, as does caffeine, and some medications, including diuretics. Strenuous exercise may also cause dehydration.

Food consumption tends not to change test results, but there is a small effect because the digestion process tends to draw body water to the stomach area.

Abnormal body temperature may lead to high or low readings by changing the conductive properties of the body.

Chapter 4: Precautions

Bioimpedance testing is both clinically proven and safe. We take strong measures to ensure that safety plays a vital role in the design and operation of our bioimpedance analyzers.

Powered by rechargeable batteries, our analyzers apply a test current of less than one milliampere (800 µA) to the subject. This test current is significantly below the subject's sensory level.

The test current (800 µA at 50 kHz) is well below the Association for Advancement of Medical Instrumentation's (AAMI) standard (ES1-1985), for "Safe Current Limits."

Despite the use of a low current, it is our policy that bioimpedance testing should not be performed on the following subjects without physician supervision:

Persons Not Intended for Bioimpedance Testing without Physician Supervision

- Pregnant women
- Persons with any implantable electronic device
- Persons with diagnosed heart problems

It is important to note that there is no historical or clinical evidence that bioimpedance testing is unsafe for pregnant women or persons with preexisting heart conditions. However, an extra measure of caution is always warranted in these cases, and is recommended.

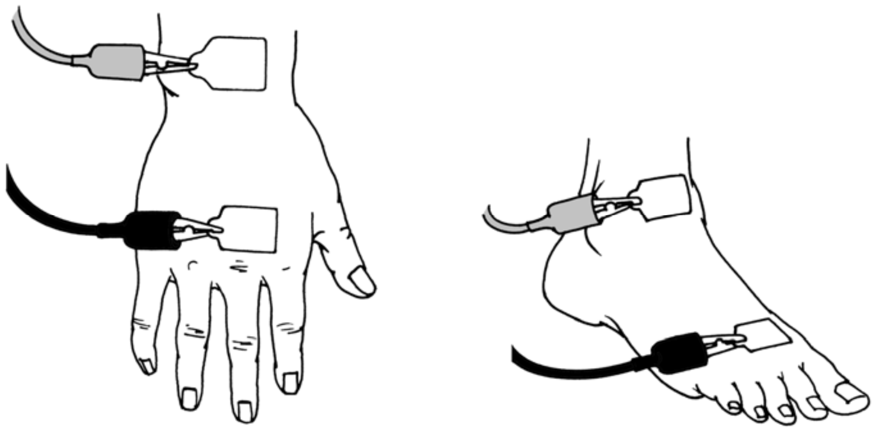
Bioimpedance testing will not damage a pacemaker. While there is no historical or clinical evidence that pacemakers are affected by bioimpedance testing, pacemaker manufacturers recommend that persons with pacemakers should avoid external electrical currents.

Possible Effect of External Electrical Currents On Pacemakers

- The pacemaker may temporarily stop.
- The pacemaker may temporarily revert to a preset rate, which is used when the voltage level of the heart is not able to be measured.
- The pacemaker may temporarily interpret an inaccurate voltage level within the heart, causing the pace rate to decrease or increase.

Chapter 5: Placement of Sensor Pads

Two pairs of sensor pads are placed on the subject - one on the right wrist and hand and the other on the right foot and ankle.



To position the wrist pad, draw or visualize a line connecting the two prominent wrist bones (heads of radius and ulna). Place the pad midway between the bones on the wrist with one-half above and one-half below the line. The tab faces outwards away from the body.

Place the hand pad with the edge of the pad about one-half inch above the knuckle line toward the middle of the hand. The tab faces outward from the body.

To position the ankle pad, draw or visualize a line over the crest of the ankle and connecting the two prominent ankle bones (lateral and medial malleoli). Place the pad on this line at the ankle crest with one-half of the pad below the line and one-half the pad above the line.

Place the foot pad with the edge approximately one inch above the toe line toward the middle of the foot. The tab faces outward from the body.

Improper electrode placement is the most common cause of test variability and inaccuracy. If the wrist or ankle sensor pads are located over the joint or closer to the fingers or toes than is described above, body composition results will tend to be high.

- Remember: Red clips closest to the heart.
- Remember: All measurements should be performed on the RIGHT side of the body.

Chapter 6: Test Position

To ensure accurate results, an impedance test should be conducted using the following test position protocol:

1. Subject should lay on their back on a non-conductive surface. This can be an examination table, bench, or mat.

2. Subject should relax and be as still as possible with hands at least 6 inches from the body, palms facing down. The upper-inner arm should not be touching the torso. If necessary, increase the distance between the arm and the body.

3. Subject's feet should be 12 to 18 inches apart so that the legs are not touching at the thighs. If necessary, increase the distance between the feet.

4. Subject's right ankle and wrist are exposed. Nylon hosiery should be removed.

The regression equations used in the analyzer to calculate body composition were developed using the above test position. Deviations from this position may change the normal path followed by the test current as it flows through the subject's body. Body-composition tests conducted with the subject's arms on the chest, or with legs crossed or too close together, may lead to erroneous low body composition results.

Standing vs. Sitting Test Position

If room is not available to test subjects lying down, then impedance testing can be done with the subject standing or sitting.

When subjects are tested while standing or sitting, their resistance (R) readings will be slightly lower, (5 - 10 ohms standing, 20 - 25 ohms sitting) due to skeletal compression. This difference results in slightly lower body fat results when compared to measurements in the supine position.

Therefore, if there is not available room to test subjects lying down, it is recommended that impedance testing be conducted with the subject standing. The differences in body composition results are far smaller and more consistent than testing in a sitting position.

Note: When testing standing subjects, maintain the basic test procedure with the subject's legs spread shoulder-width apart, and arms held away from the body 6 - 10 inches.

```
*****     BODY COMPOSITION TEST    *****
                SUMMARY

                          Date:  11/17/22
                          Time:  03:13 pm


Name: __________________________________

Sex:  Male           Height:    73.0 in
Age:  28             Weight:   200.0 lbs

               TEST RESULTS

Percent Body Fat:                19.3 %

Fat Body Weight:                 38.6 lbs

Lean Body Weight:               161.4 lbs

Basal Metabolic Rate:       2227 cal/day

Total Body Water:  52.4 liters
                   57.7 % of body weight
                   71.5 % of lean weight

Bioresistance:                   450 ohms

             RECOMMENDATIONS

Body Composition:    Current     Target

Percent Body Fat:    19.3 %      16.0 %
Total Weight:       200.0 lbs   192.1 lbs

Fat Weight:          38.6 lbs    30.7 lbs
Lean Weight:        161.4 lbs   161.4 lbs
Weight to Lose:                   7.9 lbs

Metabolic Rate:      2227 cal    2227 cal
```

Chapter 8: Definitions

Percent Body Fat
The amount of fat in the body expressed as a percentage of total body weight.

Fat Body Weight (or Fat Mass)
Fat body weight is the total weight of all fat in the body. It consists of all the extractable lipids from adipose and other tissues.

Lean Body Weight (or Fat-Free Mass)
Lean body weight is the total amount of lean (nonfat) parts of the body. It consists of approximately 73% water, 20% protein, 6% mineral, and 1% ash. Lean body weight contains virtually all the body's water, all the metabolically active tissues, and is the source of all metabolic caloric expenditure.

Basal Metabolic Rate (BMR)
Basal metabolic rate is the number of calories consumed at a normal resting state over a 24-hour period. BMR is based solely an individual's lean body weight.

Total Body Water (TBW)
Total body water is the amount of water contained in the body expressed in liters.

Total Body Water as a Percentage of Body Weight
The amount of water contained in the body expressed as a percentage of total body weight. Men generally have between 50 and 65 percent water to body weight and women have between 45 and 60 percent.

Total Body Water as a Percentage of Lean Weight
The amount of water contained in the body expressed as a percentage of lean body weight. Normal percentages (or hydration levels) indicate that lean body weight contains approximately 69 to 74 percent water.

Bioresistance (R)
Bioresistance (or resistance) is the effect on an alternating current that is caused by resistivity or the energy dissipating characteristics of the body. Resistance is measured directly from the human body by the bioimpedance analyzer.

A low resistance is consistent with large amounts of lean body weight. A high resistance is consistent with low amounts of lean body weight.

Recommendations
After a test, the analyzer automatically provides target recommendations based on optimal body-fat values which are stored in the analyzer's memory.

Initial recommendations are based on target fat values equal to either the subject's current percent fat or the optimal percent fat value, whichever is smaller. Adjustments may be made to the recommendations by the practitioner to better meet the subject's body composition and weight management goals.

Chapter 9: Normal Reference Values

MALES	Age 15-24	25-34	35-44	45-54	55-64	65-74	75-84	>85
Anthropometric[1]								
Height (in)	69.9	70.0	69.6	68.5	68.2	67.6	67.2	65.2
Weight (lb)	154.6	163.8	166.3	163.2	165.8	167.4	160.1	157.9
Body Mass Index (kg/m^2)	22.3	23.5	24.1	24.4	25.1	25.7	24.9	26.1
Mass Distribution								
Fat Body Weight (% wt)	11.6	15.2	17.6	19.7	22.2	24.6	26.3	31.4
Lean Body Weight (% wt)	88.4	84.8	82.4	80.3	77.8	75.4	73.7	68.6
Basal Metabolic Rate (cals/day)	1934	1966	1938	1853	1825	1785	1669	1532
Water Compartments								
Total Body Water (% wt)	64.1	61.4	59.7	58.0	56.0	54.2	52.8	49.7
Total Body Water (% lbm)	72.4	72.4	72.5	72.2	72.0	71.9	71.6	72.5
Impedance[1]								
Resistance (ohms)	484	474	470	469	468	466	482	486
Reactance (ohms)	61.9	62.1	59.4	58.8	54.3	49.9	45.1	39.1

FEMALES	15-24	25-34	35-44	45-54	55-64	65-74	75-84	>85
Anthropometric[1]								
Height (in)	65.6	65.2	64.5	64.2	63.4	62.7	62.0	60.3
Weight (lb)	128.6	129.4	129.4	133.4	138.5	144.6	138.0	130.3
Body Mass Index (kg/m^2)	21.0	21.4	21.9	22.7	24.2	25.8	25.2	25.2
Mass Distribution								
Fat Body Weight (% wt)	21.6	22.5	23.9	25.8	29.1	34.3	35.8	37.6
Lean Body Weight (% wt)	78.4	77.5	76.1	74.2	70.9	65.7	64.2	62.4
Basal Metabolic Rate	1426	1420	1395	1401	1388	1345	1254	1151
Water Compartments								
Total Body Water (% wt)	56.8	56.2	55.2	53.4	50.6	48.0	47.4	46.9
Total Body Water (% lbm)	72.4	72.5	72.5	71.9	71.5	73.2	73.8	75.0
Impedance[1]								
Resistance (ohms)	601	582	572	557	563	555	569	570
Reactance (ohms)	69.3	66.8	66.8	63.3	58.7	52.6	47.7	44.7

[1]Kyle UG, et al. Fat-Free and Fat Mass Percentiles in 5225 Healthy Subjects Aged 15 to 98 Years. *Nutrition*, 17:534-541, 2001.

Chapter 10: Setting Targets

Target Recommendations

The analyzer can be used to provide your subject with personalized body-composition and weight-control goals based on your professional judgment.

After a test, the analyzer automatically provides a target body fat percentage, and a target weight for your subject. To display these values, press the TARGET key. The target fat percentage is based on the following optimal body-fat values which are stored in the analyzer's memory:

	Optimal Fat Levels	
Subject's Age	Male	Female
< 20	15	19
20 – 29	16	20
30 – 39	17	21
40 – 49	18	22
50 – 59	19	23
60 +	20	24

The initial target fat value is set equal to either the subject's current percent body fat or the optimal percent body fat value, whichever is smaller.

The initial target weight value is set equal to either the subject's current weight or the optimal weight, whichever is smaller.

If the recommended values are appropriate for your subject, press the PRINT key to obtain the desired printout.

Resetting Target Values

If you wish to tailor the recommendations to better meet the weight-management objectives of your subject, you can set either a new target fat, target weight, or both.

The following examples demonstrate how to set personalized target values.

Resetting Target Fat

You may find the recommended target weight is appropriate for your subject, but feel that a target fat goal that is higher or lower than recommended is more suitable. You will, therefore, want to reset target fat.

For example, suppose you want to set a new goal for an athletic subject by setting a lower target fat value without changing his or her recommended target weight. To do this, follow these easy steps:

1. Enter a new value while the cursor is in the TARGET FAT field.

2. Press the PRINT key to obtain a printout.

The analyzer will recalculate the appropriate lean-weight and fat-weight goals corresponding to the new target fat value you entered.

Resetting Target Weight

You may find that the recommended target fat is appropriate for your subject, but feel that a target weight goal that is higher or lower than recommended is more suitable. You will, therefore, want to reset target weight.

For example, for a subject with low lean body weight, you may want to increase his or her target weight value without changing the recommended target fat value. To do this, follow these steps:

1. Press ENTER to move the cursor to the TARGET WT field.

2. Enter a new value in the TARGET WT field.

3. Press the PRINT key to obtain a printout.

The analyzer will recalculate the appropriate lean-weight and fat-weight goals corresponding to the new target weight value you entered.

Resetting Both Target Fat and Target Weight

You may want to specify both a new target fat and target weight for your subject. The analyzer will allow you to set both a desired fat percentage and a desired weight.

For example, suppose you want to set an intermediate weight loss goal for an obese subject. To do this, follow these steps:

1. Enter a new value while the cursor is in the TARGET FAT field.

2. Press ENTER to move the cursor to the TARGET WT field.

3. Enter a new value in the TARGET WT field.

4. Press the PRINT key to obtain a printout.

The analyzer will recalculate the appropriate lean-weight and fat-weight goals corresponding to the new target fat and target weight values you entered.

Chapter 11: Interpreting Hydration Status

Total Body Water

The following information may be useful when interpreting a subject's hydration status or total body water (TBW) test results.

The analyzer provides information on TBW expressed as liters of water, water as a percentage of body weight, and water as a percentage of lean body weight (or fat-free mass). Since most of the body's water is contained in lean tissue, TBW expressed as a percentage of lean body weight is most meaningful and is used most commonly.

Predicting Total Body Water

The analyzer uses a predictive regression equation to predict total body water. With respect to hydration status, it is useful to consider two groups - normally hydrated subjects and abnormally hydrated subjects. Abnormally hydrated subjects are those with systemic conditions that cause dehydration or superhydration, such as renal or cardiac disease, or subjects using diuretic or anabolic medications.

The equation was developed through the study of a population of normally hydrated subjects. Accordingly, the equation is very useful in detecting temporary dehydration in a normally hydrated subject, but does not predict as well for the abnormally hydrated population.

Interpreting Body Composition Test Results

Hydration status can be useful when reviewing the results of a body composition test. For an adult, body water is expected to be 69-74% of lean body weight. For an adolescent, it is expected to be slightly higher. A reading below 69% for an adult may indicate dehydration and result in a body fat reading that is 3-5% too high. Your professional judgment is needed in these cases to confirm that the subject is dehydrated. (See *Other Factors* below.)

A low reading (68% for example) indicates statistical dehydration in an individual when compared to the normal population as a group, but may be the normal hydration status for this individual and should not automatically be a source of concern.

In the normal population, the theoretical hydration coefficient of lean weight is usually assumed to be 0.723, or 72.3%. This represents the ratio of TBW to lean body weight, (Pace and Rathburn, Journal of Biological Chemistry, 158). In normal men, *the actual ratio is as low as .65 and as high as .85* in cases of severe anasarca (temporary fluid imbalance - Sheng and Huggins). In chronically ill persons, values as high as .80 have been observed (Moore and Boyden).

Other Factors

The analyzer's TBW reading gives you an initial indication of dehydration, but factors such as use of diuretics, anabolic medications, diet, hydration habits, and exercise habits should be considered when evaluating an individual's hydration status. If, after considering all these factors, you conclude that the subject is dehydrated, you may consider adjusting the body fat readings.

The following guidelines are recommended for adults:

Total Body Water (% Lean Weight)	Adjustment (% Fat)
69% and above	none
68.0 - 68.9 %	subtract 1 %
67.0 - 67.9 %	subtract 2 %
66.0 - 66.9 %	subtract 3 %
below 66.0 %	subtract 4 %

No adjustments are recommended for adolescents.

In all cases, when a weight management program is indicated, we recommend that subjects drink at least 4 eight-ounce glasses of water per day.

Chapter 12: Unexpected Results

On occasion, your analyzer may provide a body composition result that is more than 4-5% higher or lower than expected. Common causes include data input errors, failure to follow pre-test protocol, improper electrode (sensor pad) placement and sensor cable hook-up, and errors in subject position.

If you receive unexpected results, please follow this troubleshooting procedure (be sure to print out a report for your reference):

1. **Confirm proper data input and settings:**

   a. Correct sex input (i.e. male versus female)
   b. Proper measurement units (i.e. inches versus centimeters)
   c. Accurate height (i.e. inches versus feet)

2. **Confirm that the subject observed the following pre-test protocol:**

   Did your subject observe the following guidelines?

   a. No alcohol consumption within 24 hours prior to taking the test.
   b. No exercise, caffeine or food for 4 hours prior to taking the test.

   If not, then any combination of the following pre-test conditions may yield high or low fat mass results that vary by 2-3%:

   a. Alcohol intake (high results).
   b. Diuretic medications and caffeine (high results).
   c. Abnormal body temperature (high or low results).
   d. Diseases that affect total body water (high or low results).
   e. Strenuous exercise (high results).
   f. Recent food intake (high results).

   The conductivity of an individual's lean body weight depends on its water content. Therefore, hydration levels will affect bioresistance readings. Alcohol causes dehydration and may result in high body fat readings. Caffeine and some medications, including diuretics, will also cause dehydration, as can strenuous exercise. Food consumption tends not to change test results, but there is a small effect because the digestion process tends to draw body water to the stomach area. Abnormal body temperature may lead to high or low readings by changing the conductive properties of the body.

   Note: Subject hydration can be reviewed by checking the total body water. Normal hydration levels indicate that lean body weight contains approximately 69% to 74% water. Total body water reading less than 69% of the subject's lean body weight may indicate dehydration. This information can provide a useful explanation for a high body fat reading.

3. Check for proper electrode placement.

Two pairs of sensor pads are placed on the subject - one on the right wrist and hand and the other on the right foot and ankle.

To position the wrist pad, draw or visualize a line connecting the two prominent wrist bones (heads of radius and ulna). Place the pad midway between the bones on the wrist with one-half above and one-half below the line. The tab faces outwards away from the body.

Place the hand pad with the edge of the pad about one-half inch above the knuckle line toward the middle of the hand. The tab faces outward from the body.

To position the ankle pad, draw or visualize a line over the crest of the ankle and connecting the two prominent ankle bones (lateral and medial malleoli). Place the pad on this line at the ankle crest with one-half of the pad below the line and one-half the pad above the line.

Place the foot pad with the edge approximately one inch above the toe line toward the middle of the foot. The tab faces outward from the body.

- Remember: All measurements should be performed on the RIGHT side of the body.

Improper electrode placement is the most common cause of test variability and inaccuracy. If the wrist or ankle sensor pads are located over the joint or closer to the fingers or toes than is described above, body composition results will tend to be high.

4. Check for good electrode-to-skin adherence.

Proper electrode-to-skin adherence means that at least 75% of the electrode has contact with the subject's skin. For subjects with a large amount of body hair, use of an electrode gel and/or tape may be required to ensure proper contact.

If one or more of the sensor pads have poor contact with the skin, resistance to the injected current may result in a high body fat reading. With good electrode to skin contact using the four-site electrode technique, the impedance of the sensor pad contact with the skin does NOT affect the measurement of total body impedance.

5. Check for proper sensor cable hookup.

The red clips should be attached to the pads at the wrist and ankle joints. The black clips should be attached to the pads above the knuckles and toes. If one or both sets of cable clips are attached in reverse order, high fat mass results may occur.

- Remember: "Red clips closest to the heart."

6. Check for proper subject test position.

a. Subject is lying down, face up in supine position.
b. Subject is relaxed with head back.
c. Hands are at least six inches from sides, palms down. The upper inner arm should not be touching the torso. If necessary, increase the distance between the arm and body.
d. Feet are twelve to eighteen inches apart. For heavy-set or overweight individuals, the feet need to be far enough apart so that the upper thighs do not touch each other.
e. Right ankle and wrist are exposed. Nylon hosiery is removed.

The regression equations used in the analyzers were developed using the same body position for all subjects. Deviations from this position may change the normal path of the current through the body. Body-composition tests conducted with the subject standing, sitting, arms on the chest, legs crossed or close together, may lead to erroneous body composition results, both high and low.

7. Machine failure.

If all the above causes have been ruled out and consistently high or low body composition results still occur, then the unit or cable set may need servicing.

Please contact our Product Support Department at 206-526-0205.

Chapter 13: Field Calibration

Our meters are modern, digital, and measure impedance precisely, independent of the amount of capacitance in the measurement. When measuring human subjects, this capability is critical. The meters are of a solid-state, digital design. They do not drift or require recalibration.

The accuracy of your analyzer can be confirmed with the use of a test plug. The test plug simulates the bioimpedance of the human body. The plug can be obtained by contacting Biodynamics.

To Use the Plug:

1. Remove the sensor cables from the connector at the back of the analyzer.
2. Insert the plug into the connector on the back of the analyzer.
3. Turn the analyzer on.
4. Press the DATA key. Enter data representative of an actual subject.
5. Press the TEST key twice.
6. When the results are displayed, press the OHMS key. Note the resistance value. Results should compare with the value of the test plug.
7. Repeat steps 5 and 6 to confirm results.

If the readings are outside of the range printed on the plug, the meter is malfunctioning. If you have any questions, please contact our Product Support Department by calling 206-526-0205.

Chapter 14: Charging the Analyzer

The analyzer is powered by a rechargeable battery pack. A full battery charge provides enough power to test and provide reports for over 100 subjects.

Charging the Analyzer

Included with the analyzer is a battery charger. To charge the unit, connect the charger to the back of the unit, and plug the charger into a standard electrical outlet. Be sure the master power switch at the back of the unit is in the on position (indicated by the "-" symbol on the switch). Charge the analyzer for 14 to 16 hours. While charging, the analyzer will display its percent charge level. When the unit is fully charged, it will display 99%.

Checking the Battery Charge

To check the charge level, press the ON key. The analyzer automatically performs a self-test and checks the charge of the battery. The charge level in percent is displayed for three seconds. Once the unit is turned on, the charge level can be checked by pressing the COMP key and then pressing the ENTER key until the battery charge level is displayed.

Recommended Charging Procedure

Continuously charging over time will result in a shortened battery life. Therefore, while the analyzer can on occasion be charged at any level, it is recommended that you wait until the battery level is below 25% before charging.

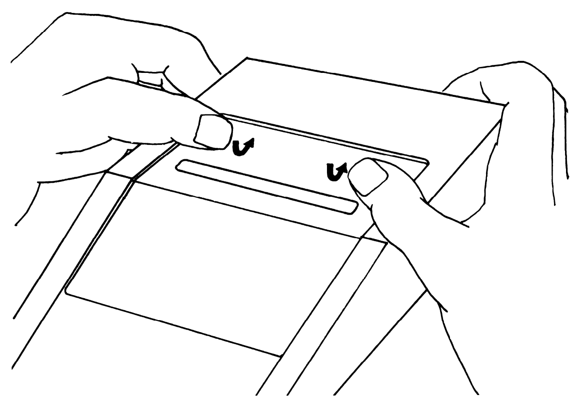
Chapter 15: Loading Paper

Each roll of paper should provide at least 100 printouts. Normally, when the paper supply is low, a red stripe appears along the paper edge. When it first appears, there are about 10 printouts left.

To change the printer paper, perform the following steps:

1. Make sure the analyzer is turned off.

2. Open the access door by pressing the top of the door as shown below. The bottom will open, allowing you to remove the door.

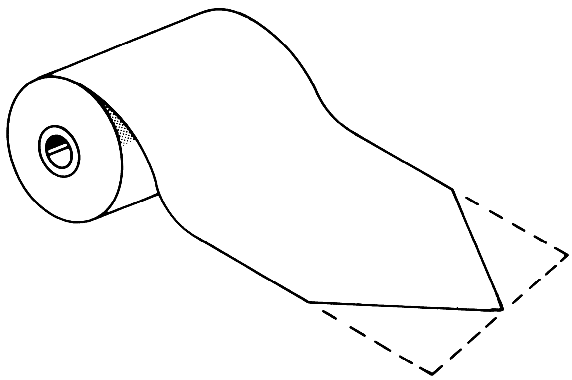


Opening the Access Door

3. If the old roll still contains paper, cut (or tear) the paper near the paper roll and pull the remnant forward through the top of the printer. Then, to remove the old roll, simply turn the unit over and the paper roll will drop out.

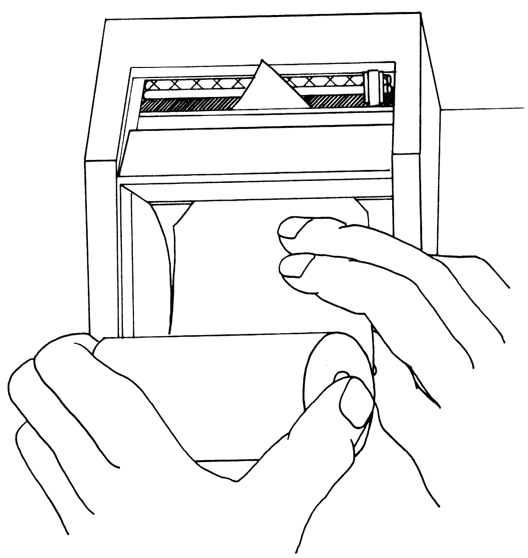
CAUTION: Never pull the paper from inside the access door back down through the printer. To remove the paper, cut (or tear) the paper and pull the remnant forward through the top of the printer.

4. Remove and discard the first six inches of the new paper roll. (This part of the roll usually contains glue and may jam the printer). Unroll an additional six inches of the new paper roll and cut the paper as shown below.



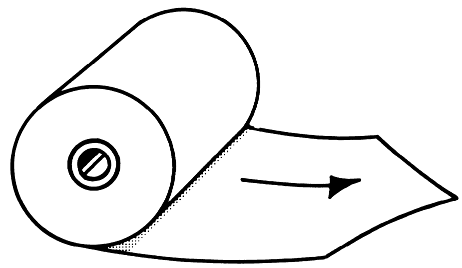
Cutting the Print Roll

5. Insert the end of the paper into the analyzer as shown below.



Inserting the Print Roll

IMPORTANT: The printer can print on one side of the paper only. Therefore, the roll must be inserted as shown below:



6. Feed the paper through the slot until the point of the paper appears through the top of the printer.

7. Carefully pull the paper through the printer until you have about two inches of paper free. Center the paper in the printer slot while pulling it through.

   You will hear a clicking noise when pulling on the paper. This sound is normal and does not mean anything is wrong.

8. Wind up any slack paper on the roll and place it in the paper roll holder.

9. Feed the paper through the slot in the access door and close the door.

10. Turn the analyzer on and press the DATA key to activate the printer. Press the FEED key several times to advance the paper.

Chapter 16: Setting the Date and Time

Before the analyzer is shipped from the factory, the time and date are preset to Pacific Standard Time. To reset the time and date to your local time, press the DATE key. The display changes to:

DATE:	Month>	11	Day	17	Year	22
TIME:	Hour	15	Min	13		

Type in the date in numeric form and press ENTER after each entry. For example, type 11 ENTER, 17 ENTER, 22 ENTER for November 17, 2022.

Type in the time in a 24-hour format. For example, type 15 ENTER 13 ENTER for 3:13 pm. Like the date field, press the ENTER key after the hour and after the minute entry. This allows you to change the time when daylight savings time occurs or when the unit is moved to another time zone. You also may need to reset the time occasionally as the electronic clock gains or loses a few minutes each month.

Chapter 17: Error Messages

The following information relates to the analyzer error messages and the conditions under which they occur:

INCOMPLETE TEST (or Invalid Test)
Check Sensor Cables

- Error Code 2
  Open Circuit

  a. Sensor cables are improperly connected to the subject.
  b. Sensor cables are defective. Wiring in the cable has become separated. Cables must be repaired or replaced. Contact Biodynamics for replacement of cables.

- Error Code 3
  Short Circuit

  a. Sensor cables are improperly connected to the subject.
  b. Sensor cables are defective. Wiring in the cable has shorted. Cables must be repaired or replaced. Contact Biodynamics for replacement of cables.

- Error Code 4
  Test Out of Range (or Resistance/Reactance Out of Range)

  a. Measured resistance is less than 200 ohms or greater than 1500 ohms, reactance is greater than 300 ohms, or phase shift is greater than 20 degrees. The calculated percent fat mass is less than zero or greater than 75 percent.

  b. These range limits were determined statistically. While it is theoretically possible to have subjects whose resistance is less than 200 ohms or greater than 1500 ohms or phase shift (between input current and output voltage) of greater than 20 degrees, it is extremely unlikely.

  c. Accordingly, while it is possible that this error could be generated with the machine in fully operational order, it is highly unlikely. This error generally occurs when the system is defective. It can occur when the oscillator and/or sensor cables are defective, most likely indicating a miswired sensor cable resulting from wear and where a short or open circuit is not detected.

  d. Action to be taken: First, verify test procedure; second, repair or replace sensor cables; third, contact Biodynamics for assistance.