

CardioCoach MAX

User Manual

CardioCoach MAX

User Manual

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Section 1

Product Overview

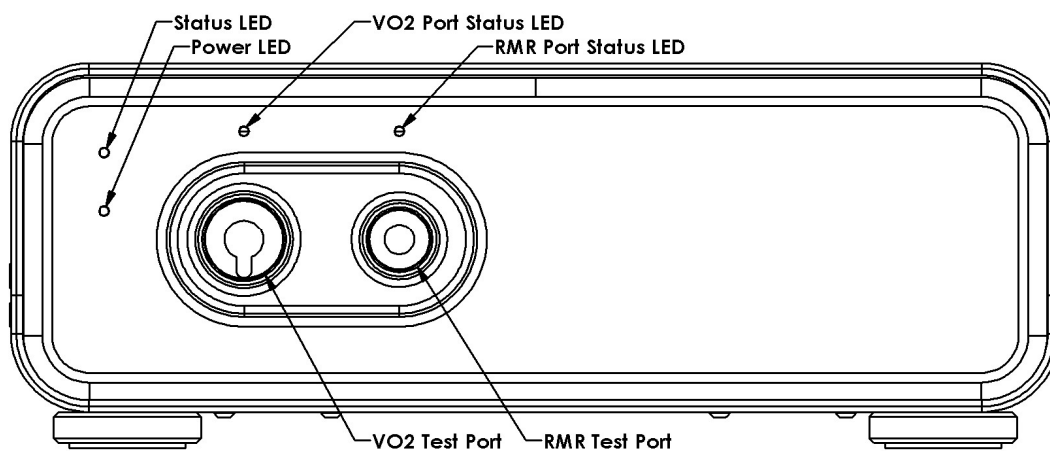
Introduction to the CardioCoach MAX Unit

The CardioCoach MAX™ performs two kinds of fitness tests, using oxygen uptake measurements. One test is performed during exercise to evaluate VO_2 max (maximal) oxygen consumption; the other test is performed during rest to evaluate the resting metabolic rate.

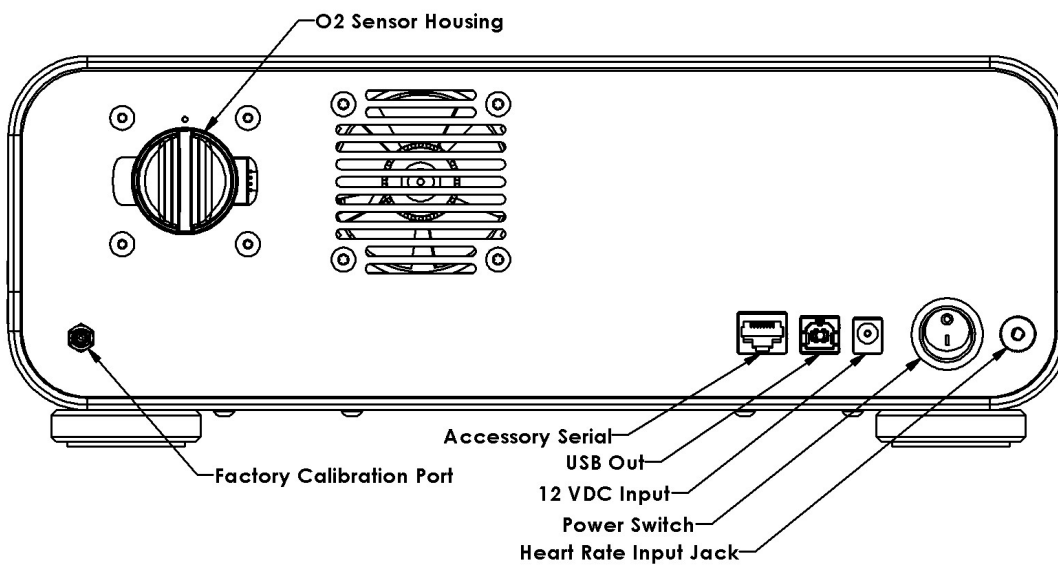
VO_2 Max (maximal) oxygen consumption refers to the maximum amount of oxygen that an individual can use during intense or maximal exercise. This measurement is generally considered the best indicator of cardiovascular fitness and aerobic endurance. The more oxygen a person can use during high level exercise, the more energy a person can produce. This test is the gold standard for determining cardiorespiratory fitness because the muscles need oxygen for prolonged aerobic exercise, and the heart must pump adequate amounts of blood to meet the demands of aerobic exercise. The device collects exhalations through the port labeled VO_2 Port.

Resting Metabolic Rate (RMR) refers to the amount of oxygen that an individual consumes during a period of strict rest and is the number of calories your body burns to maintain vital body functions such as heart rate, brain function and breathing. This measurement is considered most important when determining the baseline of calories required to lose or maintain weight. The CardioCoach MAX collects expired gases through the port labeled RMR Port, which uses a dedicated flow sensor sensitive to low flow rates. This gives the CardioCoach MAX a high degree of accuracy for RMR testing.

Front of Unit



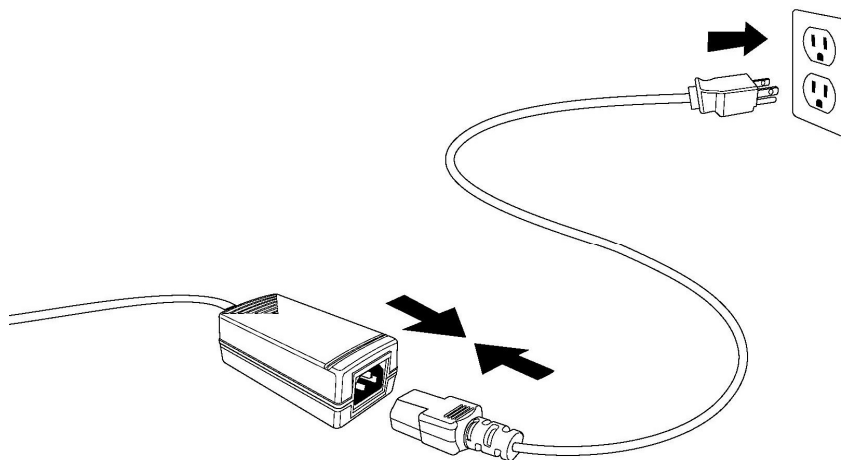
Back of Unit



Accessories

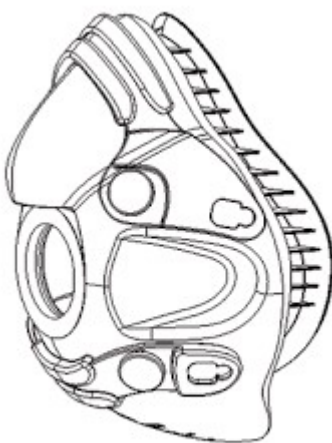
Power Supplies

A power supply and power cord is included with each unit and provided with the shipping quote.



Mask

The Hans Rudolph reusable mask is a single piece mask, made of soft Silicone rubber. It has an anatomically contoured design for a leak free, comfortable fit around the nose, and an integrated chin cup for stability. The three most common sizes, Medium, Small, and Petite, are included in the Quick start package. Large and Extra Large sizes may be purchased separately.



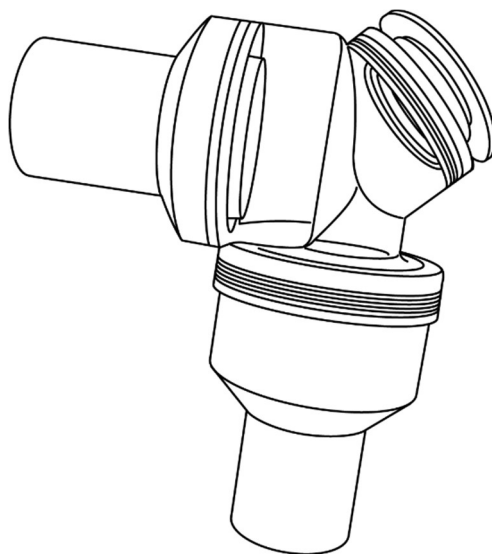
Headstrap

The four-strap CardioCoach MAX headgear features quick-release strap clips.



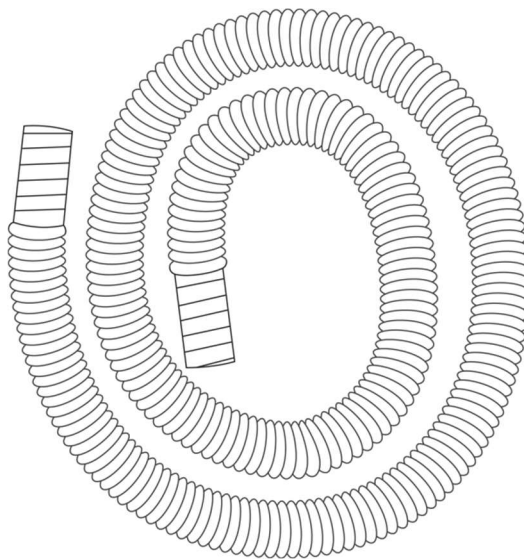
Y-Valve

The Hans Rudolph Y valve is a two-way Non-Rebreathing Valve (NRBV) designed to separate the patient's inspiratory and expiratory flows at the high flow rates expected during an exercise test. The valve is reusable and can be disassembled for cleaning.



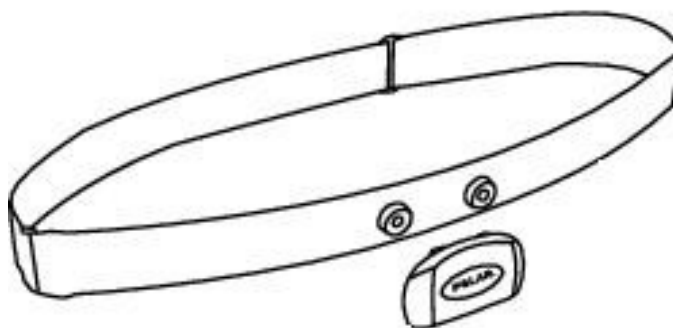
VO₂ Hose

The CardioCoach MAX has a 6-foot hose for VO₂ testing.



Heart Rate Monitor

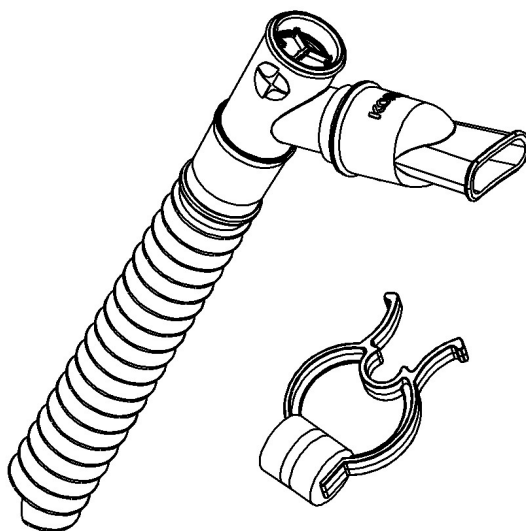
A Polar heart rate monitor chest strap with Bluetooth capabilities is included. The battery life is 400 hours of operation time. The battery is user-replaceable. The heart rate monitor fits chests measuring 22 to 34 inches.



MetaBreather Valve and Tubing

The CardioCoach MAX MetaBreather valve is a two-way Non-Rebreathing Valve (NRBV) designed to separate the patient's inspiratory and expiratory flows at the low flow rates expected during a resting test. The valve is single-use only and must be discarded after testing.

A disposable nose clip is included to ensure all exhaled air is analyzed during a resting test.



Feature Matrix

CardioCoach is available in four different models. The table below lists the various features of each model.

	CardioCoach	CardioCoachPLUS	CardioCoachMAX	CardioCoachPRO
VO ₂ Max	X	X	X	X
RMR		X	X	X
RER (RQ) during exercise			X	X
RER at Rest				X
Computer required, wireless	X	X	X	X
Workout zones defined	X	X	X	X
Customizable caloric intake recommendations		X	X	X
Interfaces with CC application	X	X	X	X
Email results may be sent to client	X	X	X	X
Wireless heart rate pick-up	X	X	X	X
Data storage for 50 tests	X	X	X	X
Dual differential pressure sensors for increased low flow accuracy		X	X	X
Score to determine test quality	X	X	X	X
SMART Trainer & ergometer interface	X	X	X	X
Simplified printout	X	X	X	
Detailed results with multiple graphs				X
Extended testing periods (1-2 hours)				X
Incorporates SMO2				X
Data Analysis Tools				X

Product Overview

Installation and Settings

CardioCoach Operation

Quality Test Procedures

Important Notes

Maintenance

Requirements

PC/Tablet Requirements

- Windows 10 version 1709 or later
- USB or Bluetooth

Software Requirements

- Microsoft SQL Server Express (included)

Heart Rate Monitor Requirements

- Bluetooth v4.2 Compatibility or later

Initial Setup

To install the software, follow the steps below.

1. If needed, download the CardioCoach setup file from the [KORR website](#).
2. Double click the file name to run the setup.
3. If you have security software installed, it may ask if you want to allow the file to run. Respond to the prompts to allow the file to run.
4. In case of an “unknown app” warning, click “more info” and then “run anyway.”
5. A popup window will ask if you want to allow the device to run as an Administrator. Click **Yes**.
6. If Microsoft SQL Server Express has been installed on your device previously, the installation will begin automatically. Otherwise, click **Yes** to allow the installation of SQL Server Express.
7. Respond to any error messages as necessary.
8. The software will run automatically after successful installation. Contact KORR if the installation is unsuccessful.
9. Enjoy your CardioCoach software!

CardioCoach Mobile App Registration

To register to use the CardioCoach App, follow the steps below.

1. If you don't already have a CardioCoach mobile app subscription, see the [App Registration](#) section of this manual.

2. Run the CardioCoach software.
3. Navigate to **Help** from the top menu.
4. Click the **App Registration** button.
5. If you have not already entered a valid email and registration key combination, you will be prompted to enter those. Otherwise, a popup message will confirm that your registration is up to date.
6. If you have a paid subscription but unable to verify your registration, contact KORR.

CardioCoach MAX Connections

Connect CardioCoach MAX to PC/Tablet via Bluetooth

1. Connect the power source to the CardioCoach MAX.
2. Power on the CardioCoach MAX.

Note: The green status indicator will flash to indicate there is no connection.

3. Navigate to the Bluetooth and other devices page in the Windows Settings menu. This can be done by clicking the gear icon from the Windows Start menu, and then selecting Devices.
4. Click Add Bluetooth or Other Device.
5. From the options that pop up, select Bluetooth.
6. When the CardioCoach MAX appears on the list of devices, select it. The device name will have the format KORR-[SERIAL NUMBER]-####. The serial number is found on a label on the back of the CardioCoach MAX and uses the format LL-NNNN (two letters, a dash, and four numbers).

Example: Windows settings shows KORR-AA-1234-22A3, where AA-1234 is the serial number that is shown on the back of the device. (The last four characters on your screen after the serial number may be disregarded.)

7. Follow the computer's prompts to pair the device.
8. When prompted for a PIN, enter 0000 (four zeroes).
9. Run the CardioCoach software.
10. After a few seconds, the software should recognize and connect to the CardioCoach MAX. If the software is already running but cannot connect to the unit, restarting the software may help.
11. When connected, the connection indicator will stay lit and the word "Connected" will appear in the lower left corner of the CardioCoach software screen.

12. If the status indicator continues flashing a couple minutes after the software is fully loaded or the message “CardioCoach Not Connected” in the lower left corner of the software continues to display, see the [Troubleshooting](#) section of this manual.

Connect CardioCoach MAX to PC via USB

13. Connect the power source to the CardioCoach MAX. Power on the CardioCoach MAX.
14. The status indicator (the green LED to the left of the two testing ports as shown on the diagram in the [Product Overview](#) section of this manual) flashes to indicate there is no connection.
15. Ensure that the CardioCoach software is running on the PC or tablet.
16. The message, “CardioCoach Not Connected” is displayed in the lower left corner of the CardioCoach software.
17. Use a USB cable to connect CardioCoach MAX to the PC or tablet.
18. Wait for Windows to recognize and configure the CardioCoach MAX. If a Windows message appears in the lower right corner of your screen to “click here to finish setting up your device,” ignore it. The status indicator light on the unit will continue flashing as before.
19. Run the CardioCoach software. The message, “CardioCoach Not Connected” is displayed in the lower left corner of the CardioCoach software.
20. After a few seconds, the software should recognize and connect to the CardioCoach MAX. When connected, the status indicator will stay lit and the message “CardioCoach Not Connected” will change to “Connected.”
21. If the status indicator continues flashing for a few minutes after the software is fully loaded, and if the message in the lower left corner of the software continues to say “CardioCoach Not Connected,” check the USB cable and replace if necessary. Also see the [Troubleshooting](#) section of this manual.

Connect the BLE Heart Rate Monitor via Bluetooth

Note: You may wish to connect your heart rate monitor during setup, especially if using a heart rate monitor other than the one originally provided with your CardioCoach. You may also connect your heart rate monitor after starting the testing process.

1. Run the CardioCoach software.
2. Follow the procedure shown in the section [Position the Heart Rate Strap](#).

Note: Most heart rate monitors must be properly fitted and strapped to a client before they will connect to the CardioCoach.

3. Navigate to **Help** from the top menu, then **About**.
4. Make sure your BLE heart rate monitor is powered on.
5. Click the **Heart Rate Device** button.
6. Wait for your heart rate monitor to appear in the list of BLE devices, and then select it.

Note: It may take a while for the list of BLE devices to generate. If you do not see your heart rate device listed, wait until you see the message "Enumeration Complete" before clicking refresh.

7. If you get an error message or do not see your BLE heart rate monitor on the list, you may click the **Heart Rate Device** button and try again.
8. If your BLE heart rate monitor still does not appear on the list, try the following:
 - a. Review the steps outlined in the [Position the Heart Rate Strap](#) section of the manual.
 - b. Check and/or replace the battery in the heart rate monitor.
 - c. Heart rate monitor straps wear out over time and a new one may be needed.
 - d. Reduce or remove other BLE devices in the area that may be causing interference.
9. If issues persist, see the [Troubleshooting](#) section of this manual.

Note: Pairing the BLE heart rate monitor using the Windows **Add Bluetooth or other device** setup process is unnecessary. CardioCoach software automatically searches for and connects to the heart rate monitor.

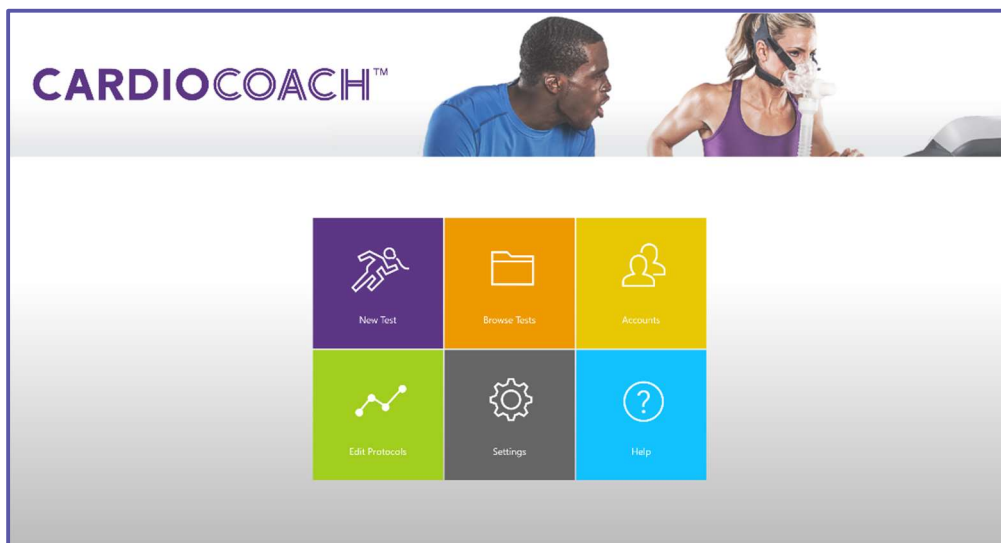
Connecting Exercise Equipment

1. Follow the instructions in your exercise device's (Treadmill /Ergometer) user manual for physically connecting it to your computer.
2. Run the CardioCoach software.
3. Navigate to the **Settings** page.
4. Select **Equipment Interface** from the list of settings options.
5. Select desired exercise equipment from the list.
6. Select the COM port that you connected the equipment to in step 1.

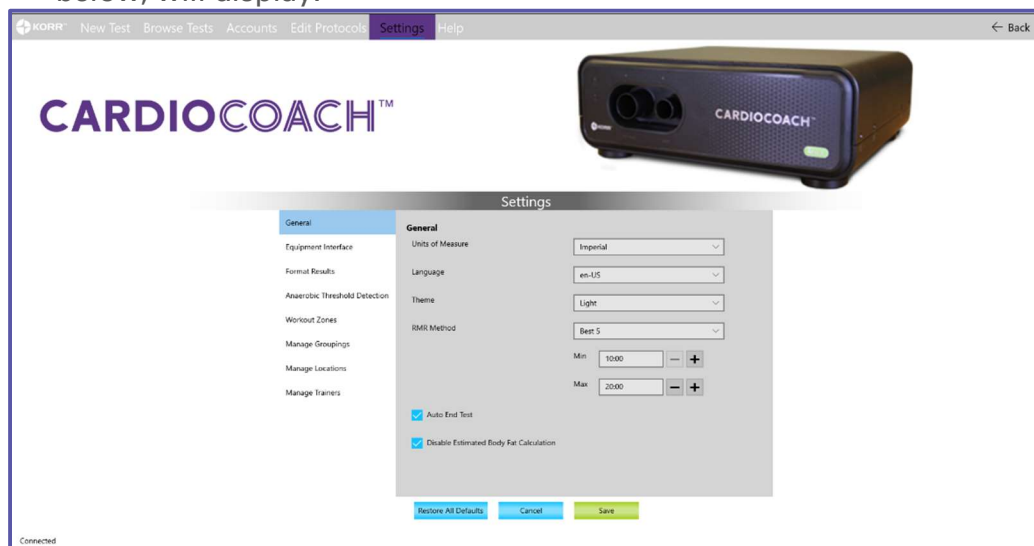
Settings

To adjust the settings of your CardioCoach MAX, follow the steps below.

1. Navigate to the main menu of the home screen.



2. Locate and click the **Settings** button. A Settings page similar to the one below, will display.



3. Enter the settings outlined in the next sections as desired.

General Settings

1. Complete the General Settings described below. Refer to the illustration in step 2, above.
 - a) **Units of Measure.** Units of measure can be adjusted between Imperial and Metric.
 - b) **Language.** The default language is English (US). Additional languages can be chosen from the drop-down. These languages must also be supported by the computer.
 - c) **Theme.** The background theme of the KORR software is dark. If desired, you can change the background to light.
 - d) **RMR Method.** Several methods are available:
 - **Best 5** (default method). KORR's proprietary Quality Score allows the unit to detect and report the best quality data collected throughout the test. This method discards the first 5 minutes per scientific protocol.
 - **Only Last 5.** Data from the first five minutes are discarded per protocol. Reports only the last five minutes of data collected.
 - **Douglas Bag Method.** The first five minutes of data are discarded. Reports all subsequent data per the Douglas Bag protocol.
 - e) **RMR Test Length.** Establish Minimum and Maximum test lengths:
 - Minimum Test Length is set at 10 minutes to meet the scientific standards required to acquire accurate data. In certain cases, when clinical studies are being performed, it may be required to set the minimum test length to a longer time.
 - If the client struggles to relax or reach stable breathing, a maximum test length will prevent a "never-ending" test. In the instance where the test ends due to the maximum test length setting, the Test Quality Score can help determine the issues and validity of the test results.
 - f) **Auto End Test.** The CardioCoach MAX is set to automatically detect when a quality test result has been reached. This feature may be disabled for clinical studies when a timed study is required.
 - g) **Disable Estimated Body Fat Calculation.** CardioCoach MAX implements a Resting Metabolic Rate measurement with the Cunningham equation to estimate percent Body Fat. This estimation will be displayed on the results screen. Check this box to disable this calculation.
 - h) Click or tap the **Save** button. **Cancel** exits the menu without saving.
 - i) **Restore All Defaults** resets ALL settings to factory defaults. Note that this does NOT remove previously entered data such as equipment settings, groupings, trainers, locations, and clients.

Equipment Interface

It is recommended that exercise equipment be set up prior to the first test. Any type of cardio equipment that allows a graded exercise test to take a client to a maximum heart rate may be used. Most VO₂ assessments are performed using a treadmill or stationary bike (ergometer), but other types of exercise equipment may be used with the CardioCoach MAX. The exercise protocols provided by KORR were designed for use with treadmills and ergometers and may not be appropriate for other exercise devices. That said, some customers have used CardioCoach MAX units with equipment other than treadmills and ergometers (such as rowing devices and climbing machines), but it is up to you to create a graded protocol that is consistent for the best results to suit your needs.

Any treadmill or ergometer can be used with the CardioCoach MAX by manually adjusting the resistance/speed/incline of the exercise equipment, as directed by the CardioCoach software.

Setting Up Exercise Equipment in CardioCoach

1. Ensure that the CardioCoach software is running.
2. From the home screen, navigate to the **Settings** page.
3. From the menu on the left, select **Equipment Interface**.
4. Determine equipment type.
5. Follow the steps below for the type of exercise equipment to be used with the CardioCoach MAX to conduct VO₂ testing.

Setup a Treadmill

Note: This equipment setup option is automatically set as default. To change the default, add a new device and select the **Make Default** checkbox.

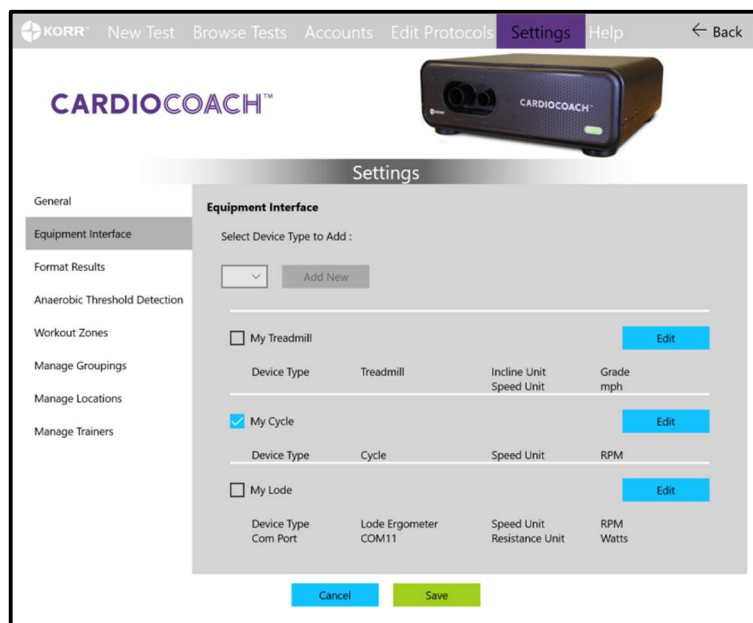
- a) Click **Edit** next to the default treadmill named "Treadmill."
- b) Edit name and incline/speed units as desired.
- c) Click **Save**.

Setup a Cycle

- a) Click **Edit** next to the default cycle named **Cycle**.
- b) Edit equipment name and speed/resistance units as desired.
- c) If this is the primary equipment you plan to use for testing with the CardioCoach MAX, check **Default**.
- d) Click **Save**.

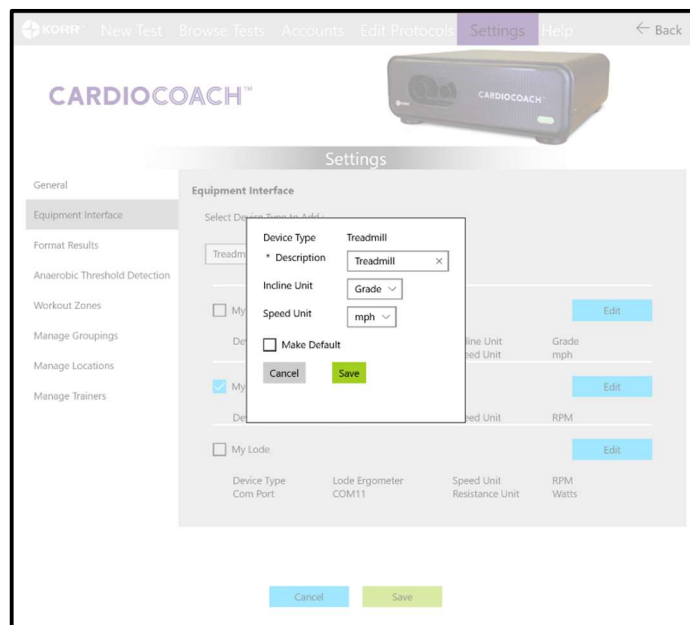
Adding a New Device

1. From the **Settings** menu, click on the **Equipment Interface** option on the left side of the screen. A screen similar to the one below displays.



2. Select the device type from the dropdown box and click the **Add New** button.

A popup box, similar to the one below, gives you the set-up options for the device.



3. Enter the options described below, and then click the **Save** button. Note that options may differ, depending on the type of equipment you select.
 - a) **Description.** Give the device a unique descriptive name that everyone in your facility will recognize.

- b) **COM Port.** Displays a dropdown list of serial devices connected to your computer. If your desired exercise equipment isn't showing in the list, make sure the equipment is connected to your computer via cable and powered on, then click **Refresh**. If it still doesn't show on the list or you have multiple options and aren't sure which is your desired exercise equipment, disconnect all devices that aren't needed and click **Refresh**.
- c) **Grade Unit.** Indicate the units your treadmill uses to communicate the increase in incline:
 - Grade (percent)
 - Incline (percent)
- d) **Speed Unit. Indicate the units your treadmill or cycle uses to communicate the increase in speed:**
 - miles per hour (mph)
 - kilometers per hour (kph)
 - rotations per minute (rpm) cycle only
 - min/mile treadmill only
 - min/km treadmill only
 - none
- e) **Watts Unit.** Indicate the units your cycle uses to communicate the increase in resistance:
 - watts
 - percent
 - level
 - none
- 6. Repeat step 5 until a setup has been added for each type of equipment you plan to use.
- 7. Select the primary equipment setup you plan to use and click **Default**.
- 8. Click **Save**.

Format Results

To format test results, follow the steps below.

1. From the Settings menu, click on **Format Results** on the left side of the screen.
2. Enter the plot colors and upload an image logo as described below. Then click the **Save** button.
 - a) **Plot Colors.** The colors for the graph lines (heart rate, VO_2 , AT, etc.) can be customized. Click on the colored circle you wish to change and select a color from the palette.
 - b) **VO2 Report Text.**
 - **Results Screen (What's Next).** Each page of the results has a field available for the trainer to insert custom instructions on the VO2 report client printout. For simplicity, a default

text may be added here, then edited for individual clients on the results screen as appropriate.

- **Graph Explanation.** Each graph on the client results printout has a place for the trainer to provide explanations. Use this space to enter a default text if desired.
- **Table Data Analysis.** Each table on the client results printout has a place for the trainer to provide explanations. Use this space to enter a default text if desired.
- c) **RMR Report Text.**
 - **Results Screen (What's Next).** Each page of the results has a field available for the trainer to insert custom instructions on the RMR report client printout. For simplicity, a default text may be added here, then edited for individual clients on the results screen as appropriate.
- d) **Logo.** Printouts can be customized by uploading a custom logo image. Click the **Upload Image Logo** button, select the image, and then click **Open** to upload.
- e) **Restore Defaults.** Use this button to return ONLY the settings on this Format Results page to the factory default.

Anaerobic Threshold Detection

The anaerobic threshold can be detected using different methods. With the CardioCoach MAX model 9300, you can choose between two methods:

- Ventilatory Threshold (Wasserman's Theory)*
- RER (Respiratory Exchange Ratio)

* Reference: Wasserman K, McElroy MB. 1964. Detecting the threshold of anaerobic metabolism in cardiac clients during exercise. Am J Cardiol 14: 844-852.

To set up the Anaerobic Threshold Detection mode, follow the steps below.

1. From the Settings menu, click on **Anaerobic Threshold Detection** on the left side of the screen.
2. Use the **+** or **-** buttons to increase or decrease the values.

Note: The **RER** option does not require the entry of values.

3. Click the **Save** button.
4. **Restore Defaults** returns ONLY the settings on this Anaerobic Threshold Detection screen to factory default settings.

Workout Zones

Workouts are designed around five intensity levels. The CardioCoach software allows you to define the limits of these workout zones based on either heart rate, or VO₂ readings from the test. Several methods for defining workout zones are provided:

- AT Threshold (default)
- % VO₂ Max
- % HR Max
- % HR AT (Anaerobic Threshold)

To set up workout zones, follow the steps below.

1. From the Settings menu, click or tap **Workout Zones** on the left side of the screen.
2. Use the dropdown box to select a method.
3. As needed, use the + or – buttons to increase or decrease the percentages.
4. Click the **Save** button.
5. **Restore Defaults** returns ONLY the settings on this Workout Zones screen to factory default settings.

Manage Groupings

A facility may use groupings as a way to organize their clients. For example, a training group or race group may be defined.

To set up Groupings, follow the steps below.

1. From the Settings menu, click or tap **Manage Groupings** on the left side of the screen.
2. Click the **Create Grouping** button at the bottom of the screen.
3. Enter a label for the grouping.
4. Click the **Save** button.
5. Repeat steps 2-4 to add more groupings as desired.
6. To edit a grouping name, click on the name of the grouping. Enter any changes and click **Save**.
7. Use the **Search** option to locate a particular grouping from a long list.

Manage Locations

If you are using the CardioCoach MAX at multiple locations, you can enter various locations to help you organize and sort clients and their test results.

Use the **Manage Locations** option to add locations.

To set up Locations, follow the steps below.

1. From the Settings menu, click or tap **Manage Locations** on the left side of the screen.
2. Click the **Add Location** button at the bottom of the screen.
3. Enter a label for the location (such as a city or street name).
4. Click the **Save** button.
5. Repeat steps 2-4 to add more locations as desired.
6. To edit a location name, click on the name of the location. Enter any changes and click **Save**.
7. Use the **Search** option to locate a particular location from a long list.

Manage Trainers

Trainers who perform testing can be used to organize and sort clients and their test results.

To manage trainers, follow the steps below.

1. From the Settings menu, click on **Manage Trainers** on the left side of the screen.
2. Search for an existing trainer or click the **Add New Trainer** button.
3. To add new trainer information, enter the information listed below into the **New Trainer** popup box.
 - Image (optional)
 - First name
 - Middle name (optional)
 - Last name
 - Email (optional)
 - Location (optional)
 - Notes (optional)
 - Mark whether the trainer is currently active or if not, remove the checkmark.
 - Click **Save**.

4. To edit existing trainer information, click on the name of the trainer, and then change the information on the popup screen. Click on the name of a trainer to open the record to make edits. To sort the list for ease in finding a particular trainer, click on the header of any column (**Last** name, **First** name, **Email**, or **Notes**).

You can do any of the following:

- Edit any field. Click **Save** to save your changes.
 - Mark a trainer active or inactive by respectively placing or removing the checkmark next to **Is Active**. Click **Save** to save your changes.
 - Delete a record.
 - If you delete a record, a prompt appears that alerts you to the clients who are assigned to that trainer and will allow you to reassign them to other trainers.
 - To reassign clients to other trainers:
 1. Select as new trainer from the dropdown menu.
 2. Check the box next to the name of each client you wish to assign to the trainer you just selected.
 3. Click **Reassign**.
5. The dropdown menu at the top of the screen under **Manage Trainers** allows viewing a group of trainers as follows:
 - a. **All**. Displays all trainers in the database.
 - b. **Active Only**. Displays only the trainers with a check in the box **Is Active** in their trainer profile.
 - c. **Inactive Only**. Displays all trainers with no check in the box **Is Active** in their profile.

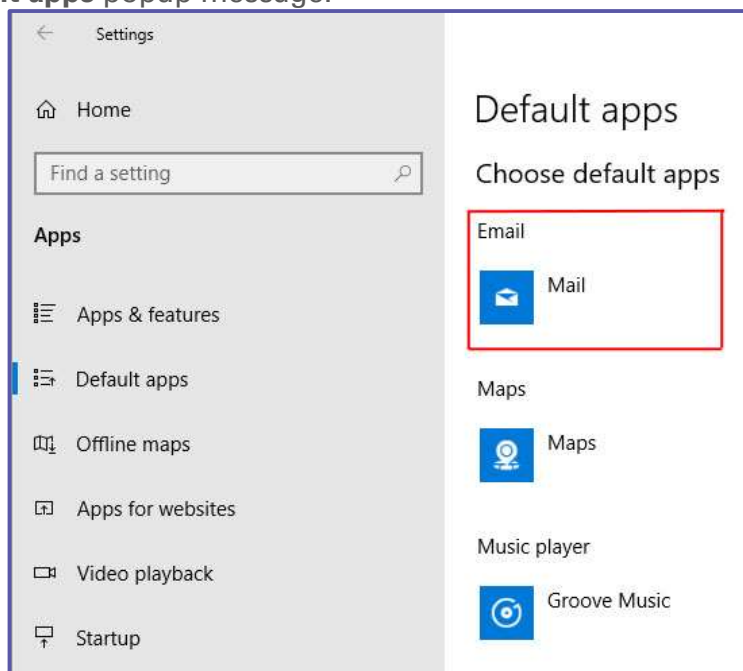
Setting Up Email

Setting up email is required in order to email clients a copy of their test results.

Note: CardioCoach software has been designed to function with the Windows 10 Mail app. Utilizing the Windows 10 Mail app and not Outlook or other mail apps ensures proper email functionality.

1. In **Windows 10** (not the CardioCoach software), open **Default Apps** Settings (search **Windows 10** for “default apps”).

2. Under **Email** ensure the **Windows 10 Mail** app is selected. If it is not selected, select the default app, then select **Mail** on the **Choose default apps** popup message.



3. Launch the Windows 10 **Mail** app (search for **Mail**).
4. Follow the prompts to setup your email. See your network administrator for assistance.

Section 3

CardioCoach MAX Operation

Powering On and Off

Turn the CardioCoach MAX unit on by flipping the switch on the back of the unit.

The red power LED on the front panel of the CardioCoach MAX will verify the power connection of the CardioCoach MAX.

VO₂ Max Exercise Testing

Client Preparation Prior to Arrival

Proper client preparation is important for successful testing and reliable results. The following guidelines are recommended:

1. Have the client complete the Participation Activity Readiness Questionnaire (PARQ) to determine their eligibility for testing. A copy of this form is located under [Forms](#) or in the software by navigating to **Help** -> **Forms** from the main menu.
2. The client should be dressed appropriately in comfortable exercise attire.
3. Instruct the client to refrain from exercise or endurance training for 12 hours prior to test.
4. The client should avoid food, tobacco, alcohol, and caffeine for at least 3 hours before testing.
5. Water may be taken as needed at any time.
6. The client should continue prescription medications as usual.

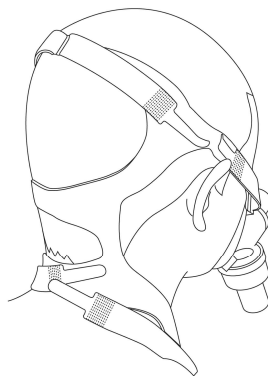
Client Preparation upon Arrival

1. Properly fit the mask, as instructed below.
 - a) Determine the correct size of mask by placing the faceplate over the client's nose and mouth.
 - b) Look for adequate coverage around the nose and mouth.

Note: The mask should not be too large so that it expands over the eyes or past the chin.
2. Attach the Y-valve to the mask face plate at the round opening by threading the valve into the grooves of the mask, as illustrated below. Note that the valve will be very tight against the mask and may require some effort to secure properly.



3. Attach the head strap to the top two clips of the mask. The GRAY side of the head strap will be facing out.
4. Place the head strap over the crown of the client's head with the mask positioned over the client's nose and mouth, as illustrated below.



5. Adjust the Velcro straps of the head strap to the appropriate size.
6. Attach the bottom two clips of the head strap to the mask.
7. With the mask in place, check the fit in the following way:
 - a. Cover the expiratory end of the valve with the palm of your hand.
 - b. Have the client blow out hard against your hand.
 - c. If you detect significant air leaking out around the mask, adjust the Velcro straps for a better fit.
 - d. Repeat the blow test. If significant leaks still occur, consider changing the size of the mask.

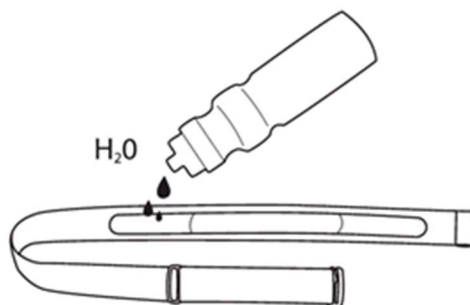


8. Once you have adjusted the straps for a good fit, you can set the mask aside until you are ready to begin testing.

Position the Heart Rate Strap

The heart rate sensors have two parts: the chest strap and the connector.

1. Moisten the electrode areas on the reverse side of the chest strap with water or electrode gel, as illustrated below.



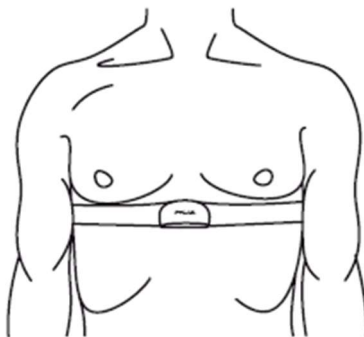
2. Attach the connector to the strap. Adjust the strap length to fit tightly but comfortably around your client's chest.



3. Tie the strap around the client's chest, just below the chest muscles, and attach the hook to the other end of the strap.

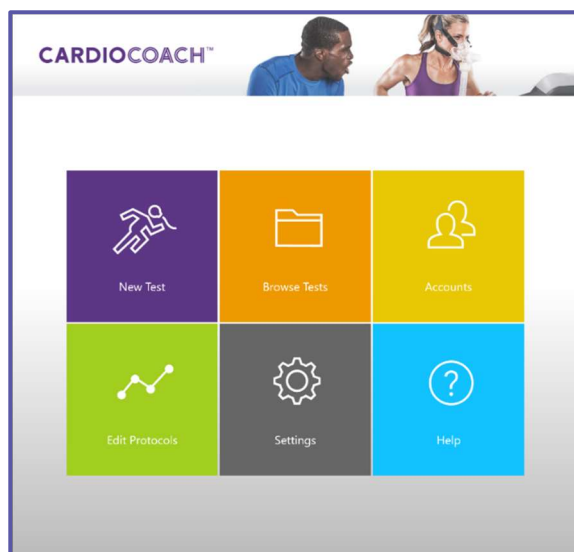


4. To ensure good heart rate signal detection, check that the moist electrode areas are firmly against your skin and that the logo or front of the connector is in a central and upright position.

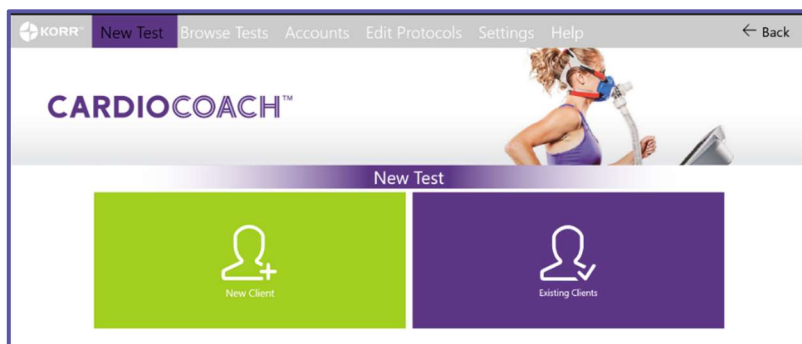


Begin Testing

To begin testing, open the CardioCoach software. The software will open to the Main Menu, shown below.



To begin testing, click the **New Test** icon on the Main Menu. The New Test menu will display **New Client** and **Existing Clients** options, as shown below.



New Client

1. When testing a client for the first time, you will need to create an account. The **New Client** option on the New Test screen allows you to create that account and enter test information, as described below.

Perez, Juan

* First Name Middle Name * Last Name
 Juan James Perez

* Email Phone
 JuanPerez@mail.com Enter phone #

* Height (ft' in") * Weight (lb) * Date of Birth
 5 10 143 June 30 1991

* Gender Trainer Add New Trainer
☒ Male ☐ Female Phillips, Dylan

Location Edit Locations Grouping Edit Groupings
 Select location Select grouping

* Test Type Notes
 VO2 Enter notes here

Equipment
 My Cycle

Protocol
 None

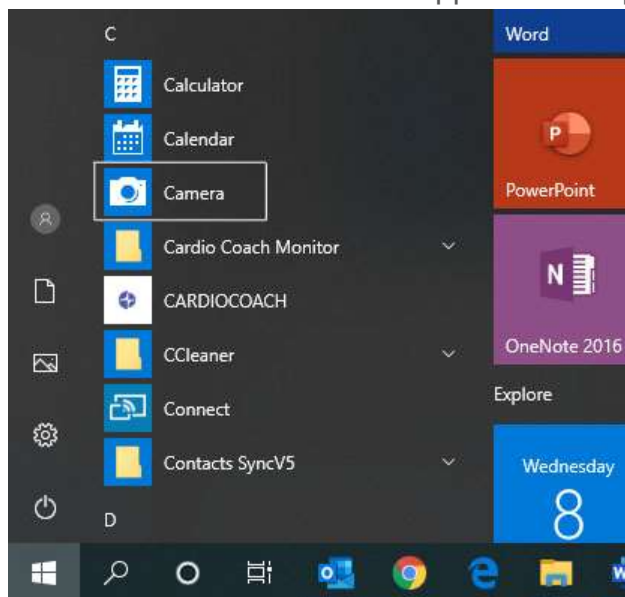
+ Add Image
 Clear Image

*Required Fields

Cancel Start Test

- a) **Personal Information.** Enter personal information about the client. Required fields are marked with an asterisk. **Phone** and **Trainer** are optional.
- b) **Trainer, Location and Groupings.** Enter the Trainer, Location, and Grouping assigned to the client.
 - Trainer (optional)
 - Allows you to choose from the list of trainers created during set-up. You may also edit the list by using the Add New Trainer option.
 - Location (optional)
 - Allows you to choose from the list of locations created during set-up. You may also edit the list by using the Edit Locations option.
 - Grouping (optional)
 - Allows you to choose from the custom groupings created during set-up. You may also edit the list by using the Edit Groupings option.

- c) **Test Type.** Identify VO2 as the **Test Type** when administering a VO2 Max Test.
- d) **Test Protocol and Level (optional).** Select the desired Protocol to either drive the equipment automatically or to prompt manual changes in workload. If a protocol is selected, a corresponding Level is then required to be selected.
- e) **Notes.** Free-form notes about this client may be entered.
- f) **Images (optional).** Click **Add Image** to add a photo image. Follow the steps below to take a photo using your computer.
 - Go to the Windows (not CardioCoach software) **Start** screen and select the camera app from the app list.



- Have the client look at the camera lens at the top of the screen and smile!
 - **Click the camera icon** to take the photo.
 - The photo will be saved to a file named Camera Roll in your Pictures folder.
 - To add the photo to the client's profile, click the **+Add image** button, then access the Camera Roll file on your computer.
 - Select the desired photo and then select **Open**.
 - The image can be removed by clicking the Clear Image option.
2. To begin testing, click the **Start Test** button.

Testing Existing Clients

1. Select the **Existing Clients** option from the New Test screen to display a list of existing clients and select the client's Account profile.

Existing Clients				
Choose an existing client.			Search	<input type="text"/>
Last ▾	First ▾	Location ▾	Grouping ▾	Trainer ▾
Alexander	Zachary			
Alexander	Tyler			Howard, Christopher
Bailey	Amber			
Bell	Juan			Phillips, Dylan
Bennett	Billy			Howard, Christopher
Bennett	Thomas			Phillips, Dylan
Brooks	Frank			Howard, Christopher
Brown	Patricia			
Brown	Walter			Howard, Christopher
Cox	Gary			

2.

Account profiles can be accessed the following ways:

- **Sort** — Each category (name, grouping, trainer, and so forth) can be sorted by clicking the arrows at the top of the header.
 - **Search** — The search bar allows you to search for a client by name or by the name of the trainer.
3. Selecting the client will bring up the appropriate Account profile as it was last saved. Edits may be made to any field within the profile. Any edits made will automatically save when the **Start Test** button is clicked.
 - a) **Test Type.** Select **VO2** when administering a VO₂ Max test
 - b) **Protocol.** Select the desired Protocol from the dropdown box.
 - c) **Images.** You may add or clear client images from this screen, if desired, as described in the New Clients section, above.
 2. To begin testing, tap or click the **Start Test** button.

Test Administration

1. **Start Test.** If you have not already done so, click the **Start Test** button to begin test administration.
2. **Verify the Connection.** Check the lower left corner of the software screen. When connected, the message **Connected** appears. If you see the software message, **CardioCoach Not Connected**, you have a connection problem. Refer to the [Troubleshooting](#) section of this User Manual. Connection difficulties must be resolved prior to testing.

3. **Calibration Cycle.** Calibration automatically begins at the start of a new test. A fan noise will be heard. CardioCoach displays a screen similar to the one shown below.

Alexander, Tyler

Heart Rate (BPM)	Test Time (min:sec)	Stage	Speed (mph)	Incline (Percent)	VO2 (mL/kg/min)
0	0:19	-	0	0	0.0

Calibrating

VO2 Test

Calibrating. Please wait.

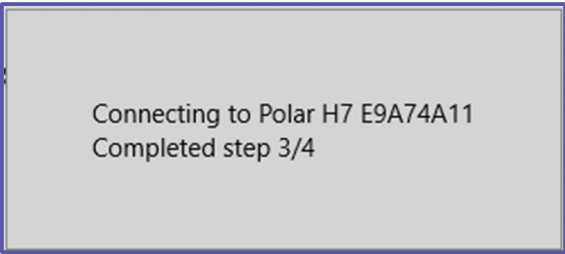
Find Heart Rate View Client Info Save Stage Abort

Note: Make sure that nothing is blocking the intake port during calibration so air can flow freely through the device. Make sure no hose is attached.

Note: If the airflow is constricted, an error message will show briefly and the light above the VO₂ MAX port will flash, prompting you to remove the restriction. The calibration can then be resumed.

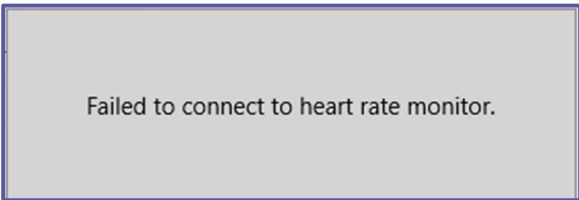
4. **Check Ports.** Determine that the RMR port is plugged and that air is flowing via the VO₂ port. A green light should appear over the VO₂ port. If not, check the center of the screen to make sure the Test Type indicated is VO2.
5. **Place Mask on Client.** While the device is calibrating, it is a good time to place the well-fitted mask, Y-valve and VO₂ hose on the client as shown in the [Client Preparation upon Arrival](#) section of this manual. Allowing clients to breathe through this apparatus for a few minutes while at rest helps them become accustomed to the sensation and avoids the poor data collection caused by hyperventilation.
6. **Calibration Complete.** When the calibration is complete, the device beeps and a *Waiting for First Breath* message displays.
7. **Check [equipment name].** When software-controlled equipment has been selected, this option appears. Checks the connection to the equipment. If the error "[equipment name] Not Ready" appears, end the test and check the equipment setup (see [Setting Up Exercise Equipment in CardioCoach](#)).
8. **Verify the Heart Rate Signal.** Check the Heart Rate Signal located in the first column of live data.
 - a) To connect with a BLE heart rate monitor, click the **Heart Rate Device** button. Locate your heart rate monitor by name or model number from the list of visible signals. Click your heart rate

monitor name to connect. ***The heart rate monitor must first be properly placed on the client as described in the [Position the Heart Rate Strap](#) section of this manual. Failure to do so may result in omission of your monitor from the list.*** Successful connection results in the display of the message below.



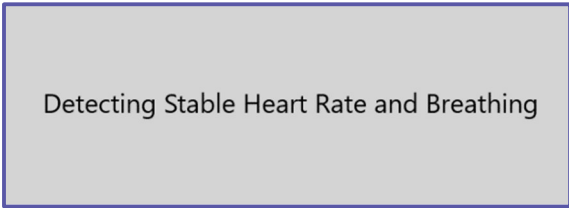
Connecting to Polar H7 E9A74A11
Completed step 3/4

- b) If no signal is visible, a message similar to the one shown below displays. Adjust the heart rate strap or add moisture or gel to improve conductivity.



Failed to connect to heart rate monitor.

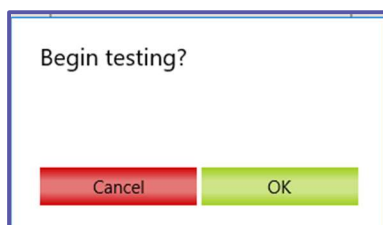
- c) If there continues to be no signal, troubleshoot per the [Connect the BLE Heart Rate Monitor](#) section of this User Manual. ***Any problems with heart rate signal must be resolved prior to connecting the VO₂ Hose to the CardioCoach MAX unit.***
9. **Connect the VO₂ hose.** Have the client begin to breathe through the hose. Then the following message displays.



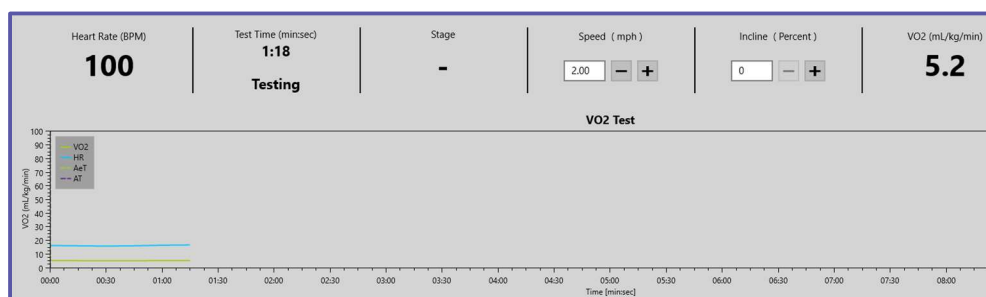
Detecting Stable Heart Rate and Breathing

10. **Connect VO₂ Hose.** Connect the VO₂ hose to the VO₂ MAX port of the CardioCoach MAX.
11. **Detect Stable Heart Rate and Breathing.** Ask the client to relax and breathe normally through the mask and hose. Once the CardioCoach MAX is filled with expired air and receiving a steady heart rate signal, it will be ready to begin testing (in approximately 1-2 minutes). One or two initial large breaths will help clear the mixing chamber and speed up this process. The client should not start exercising until the countdown is complete.

12. **Begin Testing.** When the CardioCoach MAX detects a stable heart rate and VO_2 , it will prompt you to begin testing. Click the **OK** button to begin the test.



13. **Start Client Walking or Pedaling Slowly.** Begin the graded exercise test. A page similar to the following displays.



14. **Increase Workload.** The graded exercise test consists of a test phase and a recovery phase.
- In the test phase, the intensity of the exercise is increased gradually to increase workload over a period of 6 to 24 minutes. This is typically done by increasing the speed/incline on a treadmill or the RPM/watts on a stationary cycle or ergometer, in one-minute intervals.
 - For more information on performing a graded exercise test, refer to the section on graded exercise tests in the Performing Quality Test Procedures chapter of this manual.
15. **Workload Stages.** As you increase the workload, the CardioCoach MAX will prompt you to enter the speed and incline or watts at each stage.
- a) Use the **+** and **-** buttons to enter Speed, Incline, or Watts.
 - b) Click the **Save Stage** button to save those settings for the given stage.
 - c) By recording stages of the VO_2 Max test, you can view both the heart rate and the equipment settings for each change in workload.
 - d) Manually recording the equipment settings is optional. The heart rate will automatically be recorded.

Note: If you run a published or custom protocol, CardioCoach will automatically record the workload at each stage.

16. **AT Detect.** When the **AT Detected** message is shown, tell the client that their anaerobic threshold (AT) has been detected and advise them to continue increasing their workload until they feel tired and do not want to continue any more. At least one stage of workload data past AT will be required to calculate the thresholds.

- If the client wishes to discontinue testing before the **AT Detected** message is displayed, he or she should be allowed to do so. In this instance, test results may not permit reliable data.

Note: In no case should the client ever be forced or encouraged to exercise at an intensity level beyond the level that has been determined to be safe by their physician.

17. **Submask Test.** The test may be terminated after the AT detect for a SubMax test. A submaximal test allows you to gather key information about a client without having to push them to a maximal effort. This is preferred for most non-clinical settings and is highly recommended. Once the AT has been detected, CardioCoach MAX will report the following cardio-respiratory data points:

- Aerobic Threshold,
- Anaerobic Threshold,
- Peak Heart Rate, and
- Extrapolated Max Heart Rate.

KORR uses an algorithm based on well validated studies to calculate an extrapolated VO₂ Max, when a Sub-Max test is performed. This algorithm utilizes both the trajectory of the heart rate measured during testing, as well as an age-predicted maximum, to determine the predicted VO₂ Max (had the client continued testing), or an extrapolated VO₂ Max.

18. **Peak Heart Rate.** The peak or highest heart rate reached during the test is recorded as the Peak Heart Rate.
19. **VO₂ Max.** If the client pushes their effort to a maximum effort, the PEAK HEART RATE will result in a VO₂ MAX measurement.
20. **End Test.** To stop the test, by click or tap the **Stop Test** button. This is usually done when the client indicates they want to stop the test.
- a) The **Cancel** button will allow the test to continue.
 - b) The **Abort** button will stop the test, save the data, but not tabulate results.
 - c) The **Stop Test** button will proceed to the option for recovery, save data, and tabulate results.
19. **Recovery.** Respond to the Begin Recovery Yes/No? prompt.
- a) Click **Yes** to begin a 2-minute recovery period. The mask may then be removed, but the heart rate monitor should remain securely on the client during the recovery period.

- b) Click **No** to return the CardioCoach MAX to test mode and continue testing.
20. **Max Effort.** Respond to the Max Effort Yes/No? prompt.
- Click **Yes** if client indicates they exerted a maximum effort. Peak heart rate will be used for VO_2 Max measurement.
 - Click **No** if client indicates they exerted a sub-max effort.
CardioCoach MAX algorithm will extrapolate an estimated VO_2 Max value for comparison data.
21. **Begin Drying Cycle.** At the completion of Recovery, the client can be disconnected. The CardioCoach MAX will begin an internal drying cycle that will automatically turn off after 20 minutes. To prolong the life of the unit, the drying cycle should be allowed to complete after testing. In the case of back-to-back tests, the cycle should be allowed to complete after the last test is completed.

Results

VO_2 Max Test Results

The CardioCoach MAX VO_2 Max test displays the results on a page similar to the one shown below.

CARDIOCOACH™

2019-04-04

Patient Information

Patient Name : Perez, Juan	Gender : Male Age : 39 Height : 5' 9" Weight : 121 lbs	Test ID : 250 Test Type : VO2	Trainer : Phillips, Dylan	Test Recorded : 2019-04-04 07:30:49
--------------------------------------	---	--	-------------------------------------	---

Test Results

Start VO2 (ml/kg/min) : 31.3 Heart Rate : 91 Calories per minute : 9	AeT VO2 (ml/kg/min) : 107.3 Heart Rate : 123 Calories per minute : 29	AT VO2 (ml/kg/min) : 162.4 Heart Rate : 159 Calories per minute : 45	VO2 Max VO2 (ml/kg/min) : 235.4 Heart Rate : 189 Calories per minute : 65
---	--	---	--

Workout Zones

Zone 1 Heart Rate : 0 - 91 Incline : 1.0 Grade Speed : 56.0 MPH	Zone 2 Heart Rate : 91 - 123 Incline : 3.0 Grade Speed : 58.0 MPH	Zone 3 Heart Rate : 123 - 159 Incline : 5.0 Grade Speed : 60.0 MPH	Zone 4 Heart Rate : 159 - 181 Incline : 3.0 Grade Speed : 66.0 MPH	Zone 5 Heart Rate : 181 - 189 Incline : 4.0 Grade Speed : 72.0 MPH
--	--	---	---	---

Recovery

Peak : 189
1 minute : 121
2 minute : 140

Fitness Level

Very Low Low Fair Good Excellent Superior

☐ ☐ ☐ ☐ ☐ ☒

Send to App Export View PDF Email

The information described below is included in the test results. **You may need to scroll down to view all results.**

- VO₂, Heart Rate, Calories burned per hour, and METs.
 - Values at Start
 - Values at Aerobic Threshold (AeT)
 - Values at Anaerobic Threshold (AT)
 - Values at Peak Heart Rate or VO₂ Max
 - Values at Extrapolated VO₂ Max (if VO₂ Max not reached)
- Workout Zones (5 zones defined)
 - Heart rate
 - Workload
 - Treadmill or Cycle Speed
 - Incline or Watts
 - Resistance
- Recovery rate
 - Peak heart rate
 - Heart rate at 1 minute after peak
 - Heart rate at 2 minutes after peak

Fitness Level

The Client's VO₂ Max or Extrapolated Max will be compared to a large database of VO₂ results categorized by fitness level. Those normative values are published by the Cooper Clinic and are available to view in the [Appendix](#).

Quality Score

CardioCoach MAX provides you with a test quality score that helps you ensure that your tests meet the minimum standards of a valid graded exercise test. A valid test will have a test quality score of 100. A lower score indicates that aspects of the test are inadequate.

Quality Score Interpretation

80 < Score < 100	Excellent test quality
60 < Score < 80	Good test quality
40 < Score < 60	Marginal test quality
Score < 40	Invalid test

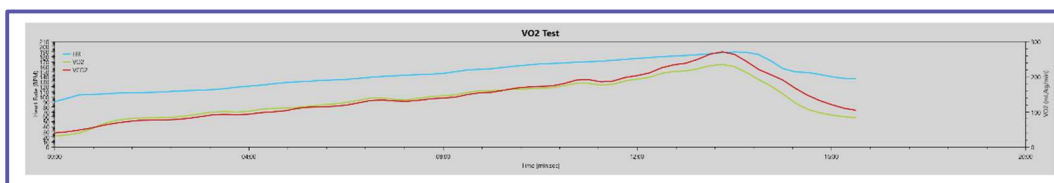
For more information about the Quality Score, see the [Troubleshooting](#) section of this manual.

Client Instructions

Use the **Add “What’s Next” Instructions** box to add your own instructions and notes to the client’s record. These instructions will be added to the client printout.

Graph VO2 Test Graph

The graph results display the waveforms of heart rate, VO₂ (volume of oxygen) and VCO₂ (volume of carbon dioxide) over time. Additionally, the software will indicate the markers of aerobic threshold and anaerobic threshold.

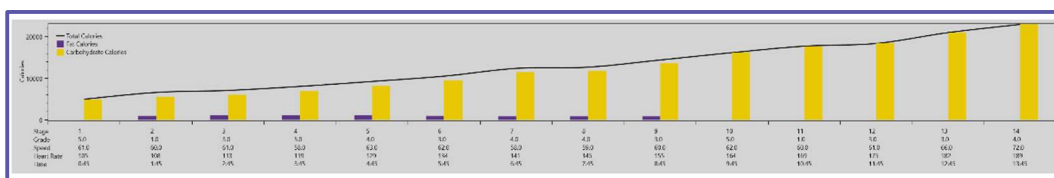


VO2 Test Graph Explanation

This is an optional field for the trainer to enter any notes for the client to help explain the results shown in the graph. Notes entered here will appear on the PDF report.

Effective Fat Burn Graph

This chart uses a bar graph to show the utilization of fat and carbs to allow you to see fuel sources compared directly to heart rate and workload.



Stage Averages Graph

This table shows the test results in chart format with data at each stage of the test.

Stage Averages Analysis

This is an optional field for the trainer to enter any notes for the client to help explain the results shown in the table. Notes entered here will appear on the PDF report.

Test Results Options

Test results may be handled several different ways, as shown in the illustration below.

Client Information				
Client Name : Alexander, Zachary	Gender : Age : 38 Height : - Weight : 169.8 lbs	Test ID : 306 Test Type : VO2	Trainer :	Test Recorded : 4/10/2019 3:29 AM
Test Results				
Start VO2 (ml/kg/min) : 22.3 Heart Rate : 91 Calories per Hour : 521 METs : 6.4	AeT VO2 (ml/kg/min) : 76.6 Heart Rate : 123 Calories per Hour : 1,748 METs : 21.9	AT VO2 (ml/kg/min) : 76.6 Heart Rate : 123 Calories per Hour : 1,748 METs : 21.9	VO2 Max VO2 (ml/kg/min) : 168.1 Heart Rate : 189 Calories per Hour : 3,920 METs : 48.0	
Workout Zones				
Zone 1 Heart Rate : < 105 Speed : - Resistance : -	Zone 2 Heart Rate : 105 - 116 Speed : - Resistance : -	Zone 3 Heart Rate : 116 - 129 Speed : - Resistance : -	Zone 4 Heart Rate : 129 - 165 Speed : - Resistance : -	Zone 5 Heart Rate : > 165 Speed : - Resistance : -
Recovery				
Peak : 190 1 Minute : 157 2 minutes : 136				
Edit Client Info Edit Effort Send to App Export View PDF Email				

- **View on screen.** Results appear on the screen automatically at the end of the test. If there were test quality issues, more information may be obtained by clicking **Click to View Issues** dropdown menu next to the quality score towards the lower left corner of the screen.
- **Edit Client Info.** If needed, the client's height, weight, date of birth, and gender may be edited.
- **Edit Effort.** Change the client's answer to whether they performed a maximum effort or not during the test.
- **Send to app.** If you have purchased the CardioCoach App, you can upload results to your client's mobile app. If your subscription hasn't yet been verified by the CardioCoach software, the error message "Check registration" will appear. For more information, see the [App Registration](#) section of the manual found in Section 3 under Help.
- **Export.** Results can be exported in a .cc4 file. Note that a .cc4 file contains the full report and can only be read by the CardioCoach software.
- **View PDF.** This option allows you to see the results in the PDF format. Choose from the following options:
 - **Print.** Print to any printer already set up in the PC or tablet's Windows operating system. You may need to first install a printer via Windows setup.
 - **Save.** Save the PDF file to your PC/tablet or external drive (such as a USB drive).

- **Email.** Opens the default email application in Windows and attaches the PDF report with the client's email address from the client's profile populated in the TO: field.

Note: KORR highly recommends using the Windows 10 email app and not MS Outlook, which currently is not a Windows 10 app and will not attach the PDF. If Outlook is used, you will need to save the PDF to your PC and attach it manually. To change the default mail settings, see [Setting Up Email](#).

- **Zoom In/Zoom Out.** These options allow you to change the size of the on-screen report.
- **Email.**
 - Opens the default email application in Windows and attaches the PDF report with the client's email address from the client's profile populated in the TO: field.

Note: KORR highly recommends using the Windows 10 email app and not MS Outlook, which currently is not a Windows 10 app and will not attach the PDF. If Outlook is used, you will need to save the PDF to your PC and attach it manually. To change the default mail settings, see [Setting Up Email](#).

Resting Metabolic Rate (RMR) Test

Client Preparation Prior to Arrival

Proper preparation of the client is important for successful testing and reliable results. The following guidelines are recommended.

- Client should avoid eating a meal 4 hours before the test.
- Exercise should be avoided the day of testing.
- If possible, avoid the use of stimulants such as caffeine, tobacco or cold medications the day of the test.
- Water may be taken as needed at any time.
- Client should continue prescription medications as usual.

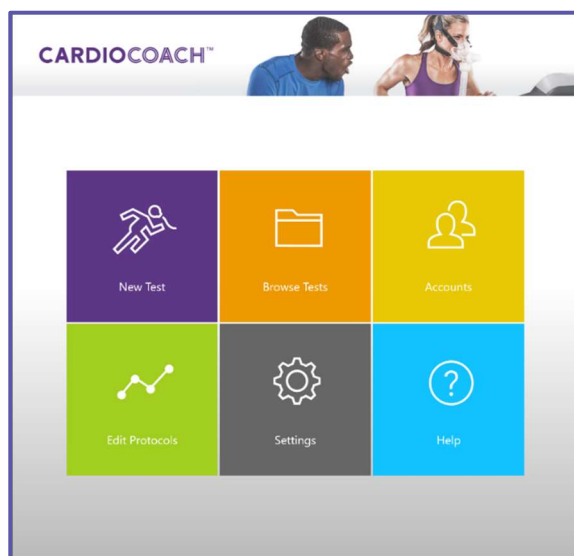
Client Preparation upon Arrival

1. Prepare a quiet place for the client to test.
2. Semi-recumbent is the optimal position for relaxation, either a recliner or a comfortable chair with a footstool.

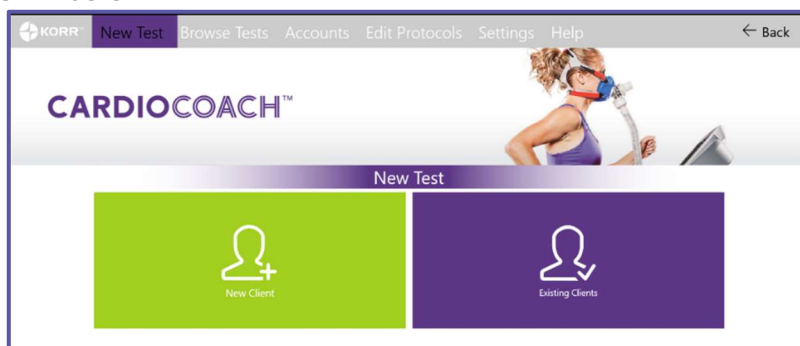
3. If the room is cold, have a blanket available. Shivering can measurably raise RMR.
4. Helping the client to relax can be a challenge. It can be useful to give the client a video with headphones. Studies indicate that content that keeps their mind engaged without stimulation is generally best. For instance, nature videos with a narrator work well.
5. Instruct the client to keep a good seal around the MetaBreatherMAX mouthpiece. Air leaks can cause inaccurate results. The client can remove the mouthpiece one to two times during the test to swallow or wipe their lips without negatively affecting the results.

Begin Testing

To begin testing, open the CardioCoach software. The software will open to the Main Menu, shown below.



To begin testing, click the **New Test** icon on the Main Menu. The New Test menu will display **New Client** and **Existing Clients** options, as shown below.



New Client

2. When testing a client for the first time, you will need to create an account. The **New Client** option on the New Test screen allows you to create that account and enter test information, as described below.

Perez, Juan

* First Name: Juan Middle Name: James * Last Name: Perez

* Email: JuanPerez@mail.com Phone: Enter phone #

* Height (ft' in"): 5 10 * Weight (lb): 143 * Date of Birth: June 30 1991

* Gender: ☒ Male ☐ Female Trainer: Add New Trainer Phillips, Dylan

Location: Edit Locations Select location Grouping: Edit Groupings Select grouping

* Test Type: VO2 Notes: Enter notes here

Equipment: My Cycle Protocol: None

+ Add Image Clear Image

*Required Fields

Cancel Start Test

- g) **Personal Information.** Enter personal information about the client. Required fields are marked with an asterisk. **Phone** and **Trainer** are optional.
- h) **Trainer, Location and Groupings.** Enter the Trainer, Location, and Grouping assigned to the client.
 - Trainer (optional)
 - Allows you to choose from the list of trainers created during set-up. You may also edit the list by using the Add New Trainer option.
 - Location (optional)
 - Allows you to choose from the list of locations created during set-up. You may also edit the list by using the Edit Locations option.
 - Grouping (optional)
 - Allows you to choose from the custom groupings created during set-up. You may also edit the list by using the Edit Groupings option.

- i) **Test Type.** Identify RMR as the **Test Type** when administering an RMR Test.
- j) **Activity Level/Cardio Exercise Frequency & Intensity.** This information is required in order to calculate estimated caloric burn through exercise.
- k) **Notes.** Free-form notes about this client may be entered.
- l) **Images (optional).** Click **Add Image** to add a photo image. Follow the steps below to take a photo using your computer.
 - Go to the Windows (not CardioCoach software) **Start** screen and select the camera app from the app list.



- Have the client look at the camera lens at the top of the screen and smile!
 - **Click the camera icon** to take the photo.
 - The photo will be saved to a file named Camera Roll in your Pictures folder.
 - To add the photo to the client's profile, click the **+Add image** button, then access the Camera Roll file on your computer.
 - Select the desired photo and then select **Open**.
 - The image can be removed by clicking the Clear Image option.
3. To begin testing, click the **Start Test** button.

Testing Existing Clients

4. Select the **Existing Clients** option from the New Test screen to display a list of existing clients and select the client's Account profile.

Existing Clients

Choose an existing client. Search

Last ▾	First ▾	Location ▾	Grouping ▾	Trainer ▾
Alexander	Zachary			
Alexander	Tyler			Howard, Christopher
Bailey	Amber			
Bell	Juan			Phillips, Dylan
Bennett	Billy			Howard, Christopher
Bennett	Thomas			Phillips, Dylan
Brooks	Frank			Howard, Christopher
Brown	Patricia			
Brown	Walter			Howard, Christopher
Cox	Gary			

5.

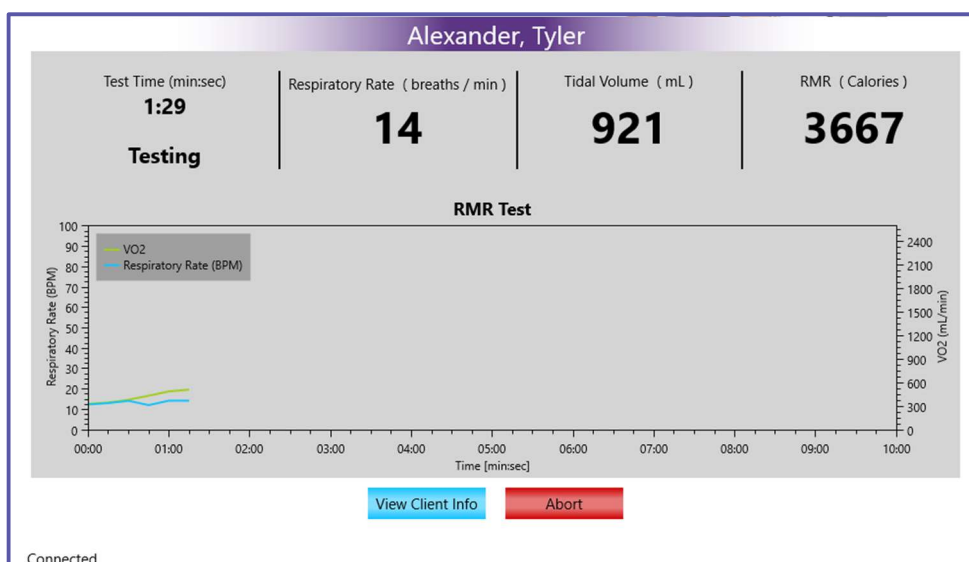
Account profiles can be accessed the following ways:

6. **Sort** — Each category (name, grouping, trainer, and so forth) can be sorted by clicking the arrows at the top of the header.
7. **Search** — The search bar allows you to search for a client by name or by the name of the trainer.
8. Selecting the client will bring up the appropriate Account profile as it was last saved. Edits may be made to any field within the profile. Any edits made will automatically save when the **Start Test** button is clicked or tapped.
 - a) **Test Type.** Select **RMR**.
 - b) **Activity Level/Cardio Exercise Frequency & Intensity.** This data is used to calculate the lifestyle portion of the energy balance equation.
 - c) **Notes.** Free-form notes about this client may be entered.
 - d) **Images.** You may add or clear client images from this screen, if desired, as described in the New Clients section, above.
9. To begin testing, tap or click the **Start Test** button.

Test Administration

1. **Check ports.** Determine that the VO₂ port is plugged and that air is flowing via the RMR port.
 - a. A green light should appear over the RMR port. If not, check the center of the screen to make sure the Test Type indicated is RMR.

- b. If the RMR port is errantly plugged, a red light will flash over the port. Simply move the cap to the other port.
2. **Wait for Device to be Ready.** Calibration automatically begins at the start of a new test.
 - a. Device will display, *Calibrating. Please wait.*
 - b. It is important that nothing is blocking the RMR intake port during calibration so air can flow freely through the device. Make sure no hose or plug is attached. If the airflow is constricted, an alarm will sound prompting you to remove the restriction. The calibration can then be resumed.
3. **Calibration Complete.** When the calibration is complete, the device indicates *Waiting for First Breath.*
4. **Connect MetaBreatherMAX to CardioCoach MAX.**
 - a. Place the single-use MetaBreatherMAX in the client's mouth.
 - b. Have the client make a good seal around the MetaBreatherMAX mouthpiece.
 - c. Connect MetaBreatherMAX to the RMR port of the CardioCoach MAX.
5. **Check Comfort.** Verify that that MetaBreatherMAX mouthpiece is comfortable.
 - a. Flex the tube to a position that will support itself.
 - b. The mouthpiece can be rotated within the tube to ensure comfort.
6. **Position Nose Clip.** Place the nose clip on the client's nose and verify that no air is leaking out of the nose.
 - a. If a nose clip is not used, air that is exhaled through the nostrils will not pass through the CardioCoach MAX, leading to erroneously low readings.
 - b. The client may remove or adjust the mouthpiece or nose clip at any time during the test for one or two breaths. Removing the nose clip or mouthpiece for a few breaths during the test will not degrade the accuracy of the measurement.
7. **Help Client Relax.** The most accurate results are achieved when the client is relaxed. Remove distractions. Avoid noise, cold, and stress.
8. CardioCoach MAX will display *Detecting Stable Breathing* until the client has completely relaxed and the unit has detected stable data.
9. **Start Test.** Once stable data has been detected, the CardioCoach MAX will begin testing.
10. **The RMR test will proceed for a minimum of ten minutes or until the minimum test time has been reached, based on the test time settings.**
11. **Display.** During the RMR test, a screen similar to the one shown below displays.



- **Test time.** The length of time the test has been running.
- **Respiratory rate.** Rate of breathing displayed in breaths per minute.
- **Tidal volume.** The volume of air in a single breath of expired air.
- **RMR.** The RMR is the current resting metabolic rate calculated at that point of testing, displayed in Calories per day.
- **View Client Info.** Replaces the data update at the top of the screen with the client's name and other information entered previously.
- **Abort.** To stop the test prior to its completion, click the **Abort** button. This stops the test and discards the data.

12. **Test Complete.** When the test has reached its minimum test length and has also gathered the required amount of steady state data, the CardioCoach MAX will indicate the test is complete with an audible alert.
 - a. Dispose of the MetaBreatherMAX and nose clip.
 - b. Prepare Results.
13. **Begin Drying Cycle.** At the completion of the test, the CardioCoach MAX will begin a drying cycle that will automatically turn off after 20 minutes.

Results

The following information is displayed in the Resting Metabolic Rate test results.

Alexander, Tyler				
Client Information				
Client Name : Alexander, Tyler	Gender : Male Age : 41 Height : 6' 0" Weight : 160.9 lbs	Test ID : 000001 Test Type : RMR	Trainer : Howard, Christopher Larry	Test Recorded : 3/30/2020 3:58 PM
Test Results				
Calories Burned RMR (Calories) : 2,898 Daily Activity Estimate (PAL): 1,449 Exercise: 518 Total Energy Expenditure per Day With Exercise: 4,865 Without Exercise: 4,347		Recommended Calorie Consumption Weight Loss: 2,898 Weight Maintenance: 4,347 How does your metabolism compare? Fast		
Link VO2 Edit Calories Edit Client Info Send to App Export View PDF Email				
Connected				

Calories Burned

- **RMR.** Resting Metabolic Rate, or Resting Energy Expenditure
- **Daily Activity Estimate.** Calories burned through daily activities, such as your time spent at work. Calculated from the Activity level question in the profile and the PAL formula noted in the Important Notes section of this manual.
- **Exercise.** Calories burned through exercise. All exercise performed in a week is added up and divided into an average per day. METS formula utilized. For more details, refer to the "Important Notes" section.

Total Energy Expenditure per Day

- **Total with Exercise.** RMR plus Daily Activities plus exercise. This is known as Total Daily Energy Expenditure.
- **Total without Exercise.** RMR plus Daily Activities.

Recommended Calorie Consumption

- **Weight Loss.** Many experts believe that balancing caloric intake with Resting Metabolic Rate is an effective way to lose weight.
- **Weight Maintenance.** Many experts believe that balancing caloric intake with Resting Metabolic Rate + Daily Activity Calories is an effective way to maintain weight.

How does your metabolism compare?

CardioCoach MAX compares the measured RMR value to the predicted RMR based on the Mifflin St Jeor formula. This field reports whether the client's actual measurement was slower, the same or faster than would be predicted for others of their same age, height and weight.

Estimated Body Fat (BMI)

CardioCoach MAX uses the Cunningham equation to estimate percent body fat. If you do not have a way to measure, this can be a means of estimating body fat.

Test Quality Score

CardioCoach MAX uses a unique algorithm to determine the quality of an RMR test. It scores how stable the breathing is, assures the client is in a resting state, and checks for over-breathing. The score ranges from 0 to 100. This allows you to determine if the test results are reliable enough to be trusted.

Quality Score Interpretation

80 < Score < 100	Excellent test quality
60 < Score < 80	Good test quality
40 < Score < 60	Marginal test quality
Score < 40	Invalid test

Results Options

Test results may be handled in any of the ways.

- **View on screen.** Results appear on the screen automatically at the end of the test. If there were test quality issues, more information may be obtained by clicking **Click to View Issues** dropdown menu next to the quality score towards the lower left corner of the screen.
- **Link to VO₂ Test.** The exercise portion of Total Energy Expenditure defaults to a METS measurement. If the client has performed a VO₂ Max test prior to the RMR test, that data can be accessed to calculate calories burned during exercise.
- **Edit Calories.** The recommended calorie consumption can be edited based on the professional user's expertise. This should be done prior to viewing, printing or sending results.
- **Edit Client Information.** Allows changes to client's height, weight, birthdate, and gender.
- **Send to App.** Click to allow the client to utilize their results in the [CardioCoach app](#).
- **Export Data.** Export a .cc4 file.
- **View PDF.** The results will be formatted in a PDF that can be used for immediate teaching, emailing, or to print out.
- **Email Report.** Send a PDF of results directly to client's [email](#).
- **Attach Client.** This button appears when an imported test does not match any client in the database and allows assigning the imported test to an existing client.

Browse Tests

The Browse Test function first sorts the tests by test type.

To browse tests, follow the steps below.

1. Select the Browse Tests option from the menu. A screen similar to the following displays.

Browse Tests

Choose a test type. VO2

Showing 126 Results Search

Choose an existing test.

Client	Test Date	Test Type	Grouping	Trainer	Location
<input type="checkbox"/> Parker, Tiffany	4/26/2019	VO2			9100
<input type="checkbox"/> Alexander, Zachary	4/10/2019	VO2			9100
<input type="checkbox"/> Murphy, Harold	4/5/2019	VO2			9100
<input type="checkbox"/> Perry, Maria	4/5/2019	VO2			9100
<input type="checkbox"/> Washington, George	4/5/2019	VO2			9100
<input type="checkbox"/> Diaz, Dorothy	4/5/2019	VO2			9100
<input type="checkbox"/> Nelson, Charles	4/5/2019	VO2			9100
<input type="checkbox"/> Bennett, Billy	4/5/2019	VO2			9100
<input type="checkbox"/> Williams, Christina	4/5/2019	VO2			9100
<input type="checkbox"/> Williams, Jesse	4/5/2019	VO2			9100

Add Filter Compare Tests (0)

2. Select the type of test you are searching for, RMR or VO₂ Max, from the dropdown box.
3. The Browse Tests screen allows you to locate tests, using the following options.
 - **Search.** The Browse Tests screen allows you to locate tests by searching the client's name or the trainer's name in the search bar.
 - **Sort.** The arrows at the top of the columns allow you to sort each field alphabetically or numerically. Simply click on the arrow to sort. To reverse the order, click again.
 - **Add Filter.** Click the **Add Filter** button at the bottom of the screen. The filter options will appear. Use this option to filter by the following categories:
 - **Client.** Bring up all tests performed by the client of that name.
 - **Test Date.** Select a single date or a range and locate all tests performed during that time.
 - **Grouping.** Locate all tests recorded under a particular grouping.
 - **Trainer.** Locate all tests performed by a particular trainer.
 - **Location.** Bring up all tests performed at a particular location.
 - Additionally, you can continue to drill down using multiple filters. Simply select the **Add Filter** button to add an additional filter to your search. For instance, you can filter to view all tests conducted last week by a particular trainer. To remove a filter from the logic, select the **Remove Filter** button.
4. To view a test, select the desired test and click the View Test button.

Compare Tests

Using the compare tests functions, you can compare:

- One client's results over time
- Multiple clients' results

After comparing tests, you can also export test results to a .csv file for further data analysis.

To compare test results, follow the steps below.

1. **Check the box** next to the test results you wish to compare, as shown below.

Browse Tests

Choose a test type. VO2

Showing 126 Results Search

Choose an existing test.

Client	Test Date	Test Type	Grouping	Trainer	Location
<input type="checkbox"/> Alexander, Zachary	4/10/2019	VO2			9100
<input checked="" type="checkbox"/> Bennett, Billy	4/5/2019	VO2			9100
<input checked="" type="checkbox"/> Bennett, Billy	4/4/2019	VO2			9100
<input checked="" type="checkbox"/> Bennett, Billy	8/1/2018	VO2			9100
<input type="checkbox"/> Bennett, Thomas	-	VO2			9100
<input type="checkbox"/> Brown, Walter	7/27/2011	VO2			9100
<input type="checkbox"/> Diaz, Dorothy	4/5/2019	VO2			9100
<input type="checkbox"/> Evans, Michael	5/8/2016	VO2			9100
<input type="checkbox"/> Jackson, Ashley	4/3/2019	VO2			9100
<input type="checkbox"/> Jackson, Ashley	-	VO2			9100

Add Filter Compare Tests (3)

2. Click the **Compare Tests** button at the bottom of the screen. A screen similar to the example below will display. You may need to scroll down to view all results.

Browse Tests				
Bennett, Billy				
Test Date	4/5/2019	4/4/2019	8/1/2018	
Weight	110.2 lbs	132.3 lbs	134.5 lbs	
Quality Score	90	90	90	
Start	VO2	34.4	28.7	28.2
	VCO2	44	36	36
	HR	91	91	91
	Calories per Hour	521	521	521
End	VO2	118.0	98.3	96.7
	VCO2	107	90	88
		<div>Done</div> <div>Save As Spreadsheet</div>		

- If desired, click on the **Save As Spreadsheet** button to save this result comparison.

Accounts

To add a new client directly to the database, follow the steps below.

- Select **Accounts** from the main menu.
- Click **New Client**.
- Enter the following:
 - Personal information** about the client.
 - Trainer (optional)**. Allows you to choose from the list of trainers created during set-up. You may also edit the list by using the edit button.
 - Grouping (optional)**. Allows you to choose from the custom groupings created during set-up. You may also edit the list by using the **Edit** button.
 - Location (optional)**. Allows you to choose from the list of locations created during set-up. You may also edit the list by using the **Edit** button.
 - Notes (optional)**.
 - Image (optional)**. A photo image of the client may be uploaded via the computer. To take a photo using your computer, simply:
 - Select the **Camera** app on the Windows Start screen (NOT in the CardioCoach software).

- b. Have the client look at the camera lens at the top of the screen and smile!
 - c. Click the camera icon to snap the photo.
 - d. The photo will be saved to a folder named **Camera Roll** in your **Pictures** folder.
 - e. To add the photo to their profile, click the **+Add Image** button, then access the **Camera Roll** file on your computer.
 - f. Select the desired photo, click the photo, and then select **Open**.
 - g. The image can be removed by simply clicking the **Clear Image** option.
4. Click the **Save** button to save the record.

To edit Account profile records, select the **Accounts** option from the menu. Select **Existing Clients**. Search for and select the client's record. Type in the revisions, and then click the **Save** button.

Client records may be deleted by displaying the client's record and then using the **Delete** button.

Edit Protocols

Protocols determine the change in workload throughout a graded exercise test (VO2 but not RMR tests). Protocols are not required but may be used to help with ease and consistency of testing. Protocols can either be implemented manually by the user with prompts from the software or automatically controlled by the CardioCoach when connected to compatible exercise equipment. See [Equipment Interface](#) for the latter situation.

Note: CardioCoach does not check exercise protocol workloads for validity or safety. Use your exercise equipment's user manual and other appropriate sources to ensure appropriate workloads.

1. From main screen, select **Edit Protocols**.
2. You may utilize to publish protocols, edit existing protocols, create new protocols, or import/export protocols.
3. To delete a protocol, click on the protocol, then click the **Delete** button at the bottom of the protocol.
4. Clicking Cancel at any time while viewing or editing a protocol removes any changes made since the protocol was opened last.

Utilize Published Protocols

You may use pre-loaded published treadmill protocols.

1. Select desired protocol from list.
2. Modify name and description if desired.
3. If any changes were made, click **Save**.

Edit Existing Protocols

Follow the step below to edit protocols.

1. Select the **Edit Protocols** option from the main menu or the menu bar at the top of the screen.
2. From the list of protocols, select the protocol you wish to edit. A screen similar to the one shown below displays.

Stage	Speed (MPH)	Incline (Grade)	Duration	Total
1	3.3	1	1:00	1:00
2	3.3	2	1:00	2:00
3	3.3	3	1:00	3:00

3. Edit any of the following items.
 - a) **Title.** You can change the name of the protocol to a customized title.
 - b) **Description.** Enter a custom description.
 - c) **Speed Unit.** Change the units of speed.
 - d) **Incline Unit.** Change the units of incline
 - e) **Stage.** To edit a Stage of the protocol, click the **pencil** icon on the right side of the screen. This will display an **Edit** popup box. You can change the incline, speed, incline, and/or duration of this stage. You can also enter a message. Click the Save button in the popup box to save your changes and return to the protocol screen.

- The **trash can** icon will delete the stage from your sequence.
 - The **(+) Add Stage** button will allow you to add a new stage to your sequence.
 - You may need to scroll down to see all stages.
4. When you are finished editing a protocol, click the **Save** button.

Create New Protocols

To create a new protocol, follow the steps below.

1. Select the **Edit Protocols** option from the main menu or the menu bar at the top of the screen.
2. Click the **Create New** button. A popup box similar to the following displays.

The screenshot shows a modal form for creating a new protocol. It has the following fields and controls:

- * Title**: A text input field.
- Description**: A text input field.
- * Equipment**: A dropdown menu with 'Cycle' selected.
- Resistance Unit**: A dropdown menu with 'Select Unit' selected.
- Speed Unit**: A dropdown menu with 'Select Unit' selected.
- Buttons**: 'Cancel' and 'Save' buttons at the bottom.

3. Complete the information, as described below. Some fields are specific to the type of equipment selected.
 - a) **Title**. Create a name for your protocol.
 - b) **Description**. Enter a custom description.
 - c) **Equipment**. Select the equipment from the dropdown box. The next options appear after an equipment type is selected.
 - d) **Resistance Unit**. Shown only when **Cycle** is selected as the **Equipment**. Select the units of resistance from the dropdown box.
 - e) **Speed Unit**. Select the units of speed from the dropdown box.
 - f) **Incline Unit**. Shown only when Treadmill is selected as the Equipment. Define the units of incline from the dropdown box.
4. Click the **Save** button. A screen similar to the following displays:

5. A new level with the previously created protocols appears.

Level: A *level* is a subset of settings within a particular protocol designed for testing clients with different levels of fitness. These levels will appear as options when the protocol is chosen for testing. Each level is designed for one test.

6. The descriptive box with the default description "Level1" can be customized to help trainers know which level is most appropriate for clients. Type a description into the box to replace "Level1," if desired.
7. Stage 1 is automatically created when a new level is added.

Stage: A *stage* is a group of settings within a level to indicate a change in resistance, incline, or speed for a specific amount of time during a test. A sequential series of stages within a level creates the protocol for a single test.

8. Click on the pencil icon to the right of the stage to make changes as desired. Click **Save** to save the stage.
9. Click the (+) **Add Stage** button to add a new stage to your sequence. You may need to scroll down to see the **Add Stage** option.
10. Use the + and - buttons to set the speed, incline, or watts requirements of that stage.
11. If desired, enter text into the **Message** box.
12. Click the **Save** button to save the stage.
13. Repeat steps 8-11 to add each stage of the level of this protocol.
14. To *reorder* the stages within a level, click the up and down arrows on the right of each stage.
15. To *delete* a stage, click the trash icon to the right of the stage.
16. To *edit* a stage, click the pencil icon to the right of the stage.

Note: The CardioCoach software expects the final step in a protocol to be the recovery step. Once the CardioCoach enters Recovery Mode, the protocol will skip to the final step in the script if it hasn't already done so.

17. To *add* a level, click the green + button to the right of the level descriptive box.
18. To *delete* a level, click the trash icon to the right of the level descriptive box.
19. When more than one level is created, click the desired tab above the description box to edit that level. You may need to click the left and right arrows to the right of the description box to view all level tabs.
20. Click **Save** to save the level and the protocol.
21. To make additional changes to levels and stages within a protocol, click the name of the newly created protocol from the protocol list and edit as desired, beginning with step 6 above.

Import/Export Protocols

A protocol created within CardioCoach software can be shared between CardioCoach users as a .ptcl file.

To import a CardioCoach protocol, follow the steps below.

1. Verify that you have a **.ptcl file** on your computer.
2. Go to **Edit Protocols**.
3. Click the **Import** button at the bottom of the **Edit Protocol** page.
4. Navigate to the folder where the .ptcl file is stored. The CardioCoach software will seek to identify the protocol file.
5. Highlight the file, and then click the **Open** button.
6. Modify the protocol as desired.
7. Click **Save**.

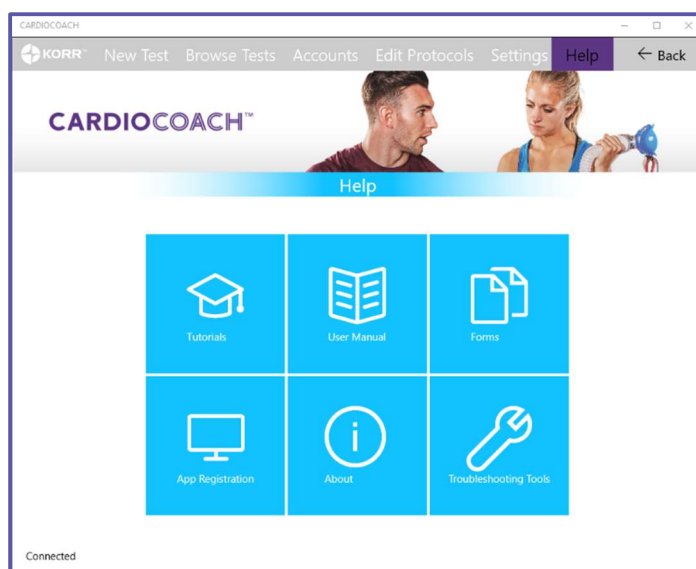
Note: Imported protocols are not added to your protocol list if not saved.

To export a CardioCoach protocol, follow the steps below.

1. Go to **Edit Protocols** and open the desired protocol.
2. From the bottom of the screen, click the **Export** button.
3. Select a location to save the protocol file.
4. Edit the name of the file if desired. Click **Save**.

Help

The CardioCoach Help menu includes the options shown and described below.



Tutorials

This option gives you access to video tutorials for set-up, use and care of the CardioCoach. You must be connected to the internet to use the tutorials.

User Manual

This option takes you to [Adobe Acrobat Reader](#) and displays the User Manual. Adobe options are displayed on the right and may be used to search, export and modify the file. Adobe options at the top of the screen may be used to find text, print, email and zoom into the document.

Forms

[PARQ form](#). Physical Activity Readiness Questionnaire. This questionnaire is used to see if participants should check with their doctor before becoming much more physically active.

[Medical Records Release Authorization](#). A standard release form in case you need to access a client's medical records.

[Medical Clearance form](#). A standard form for a client to take to their physician to receive medical clearance prior to testing.

App Registration

The CardioCoach software itself does not require registration to operate. However, the CardioCoach mobile app requires a paid

subscription. See <https://korr.com/product/cardiocoach-app-upload-subscription/> for more information and to order.

This mobile app module will allow you to upload, store, and send test results from a secure server to your clients with the CardioCoach mobile app. There is no limit to the number of client results you can upload with a single software license. The module is an add-on to existing CardioCoach software systems.

After you confirm you have a valid subscription, enter your email address and the key provided with your software to register your CardioCoach software with KORR.

If you have a valid app subscription but your email and/or key are not accepted, contact KORR.

About

This option provides information about the CardioCoach software and devices in use. It may also be used to check app registration, send an error report to KORR, connect to a Heart Rate Device from a fitted heart rate monitor (if Bluetooth is enabled), or refresh the unit's connection to the CardioCoach software.

Tools

This tool may be utilized under the direction of KORR customer support.

Section 4

Quality Test Procedures

Test Quality Score

A graded exercise test evaluates the subject's fitness over a range of intensity levels. It is assumed that the intensity level will be increased at a reasonable rate and will cover a wide range of exercise intensity levels. A valid test includes measurements of VO_2 , VCO_2 and heart rate beginning at or near a resting state and at increasing levels of exercise intensity approaching $\text{VO}_{2\text{max}}$. The duration at each intensity level should be sufficiently long to allow for the subject's physiology to stabilize at each level.

The CardioCoach provides you with a test quality score that helps you ensure that your tests meet the minimum standards of a valid graded exercise test. A valid test will have a test quality score of 100. A lower score indicates that aspects of the test are inadequate. If your test quality scores are low, evaluate the following:

1. Is the client starting the test at a near resting state?
2. Is there an adequate time at each exercise level?
3. Has the test continued long enough to approach a maximum effort?

Graded Exercise Tests

The CardioCoach test is done by performing a simple graded exercise test while CardioCoach measures the client's oxygen consumption, ventilation, and heart rate. This section of the manual discusses how to perform a Graded Exercise Test on various types of equipment.

Definition

During a Graded Exercise Test, the client's workload (exercise intensity) is gradually increased from a resting level (or light exercise level) to higher levels of workload (intensity). The workload is increased in increments at a set time interval. Figure 1, below, illustrates a Graded Exercise Test.

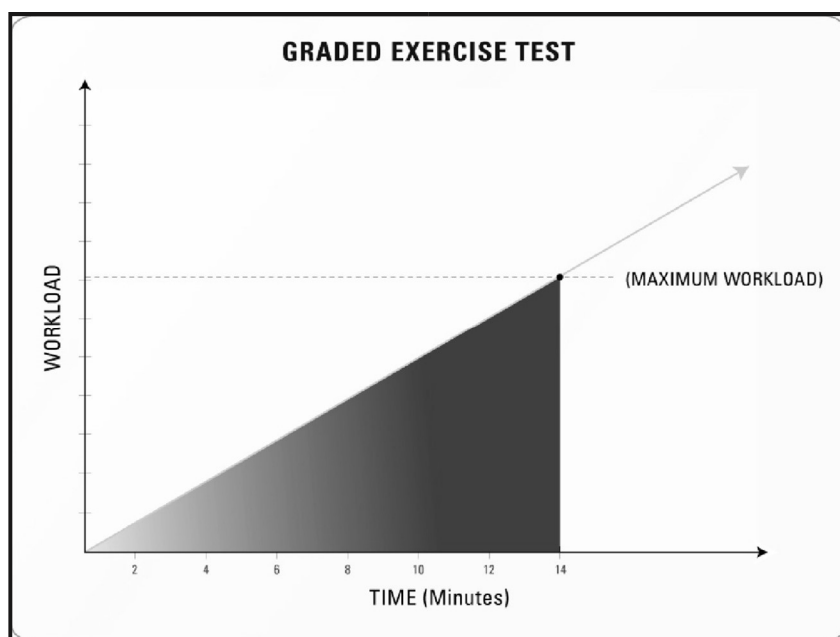


Figure 1: General Description of a Graded Exercise Test

Maximum versus Sub-Maximum Tests

**When performing a VO_2 fitness assessment, you may choose to perform a test where either the client exercises to a maximum effort (VO_2 Max) or a sub-maximal effort. During a maximum effort test, the client continues the test until reaching exhaustion.

A Submax test can easily be performed using the CardioCoach. CardioCoach will detect the client's Anaerobic Threshold (AT) during the test. ***Once the AT is detected, the test needs to continue for at least one more minute before stopping the test.***

Figure 2 demonstrates the relationship between the workload at the anaerobic threshold, maximum workload, and the ending workload in a sub-maximum effort test.

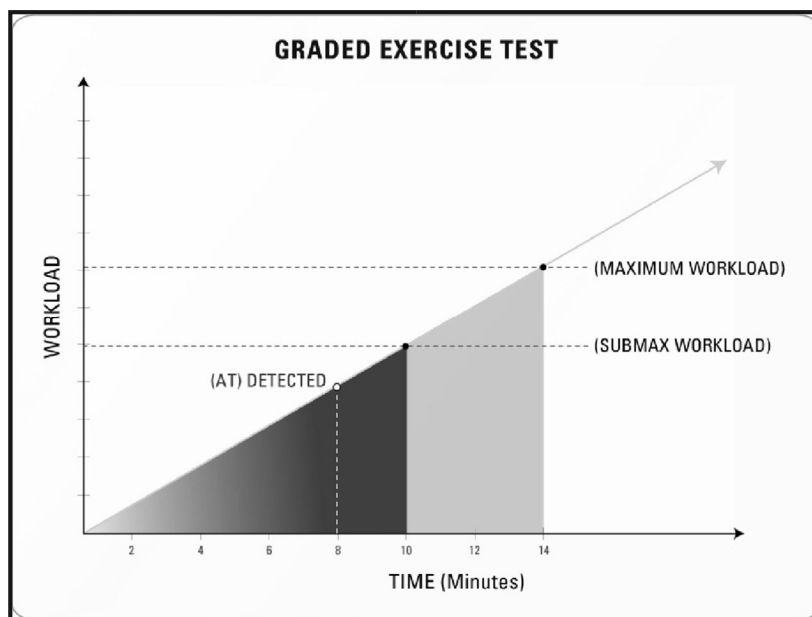


Figure 2: Relationship between the workload at the anaerobic threshold, maximum workload, and the ending workload in a sub-maximum effort test.

Sample Testing Sequences

Treadmill Test:

When performing a VO_2 /Exercise test on a treadmill there are two variables that must be considered:

- Workload (% incline)
- Cadence (Speed MPH/KPH).

One variable should remain constant while the other variable is being adjusted during the test. In other words, adjust either the incline or the speed during each stage, but not both during the same stage.

Ask your client before the test where they are comfortable with the speed. Some people may like a fast walk to a light jog, and others prefer a moderate to fast jog. On average, the speed could be between four – seven mph.

The following protocol provides a gradual heart rate increase that should provide optimal results.

Time	Speed	Incline
1 minute	2.0 mph	0%
2 minute	2.5 mph	0%
3 minute	3.0 mph	0%

Time	Speed	Incline
4 minute	3.5 mph	0%
5 minute	4.0 mph	0%
6 minute	4.5 mph	0%
7 minute	5.0 mph	1%
8 minute	Choice of 0.5 mph increase or 1% incline increase	
9 minute	Choice of 0.5 mph increase or 1% incline increase	
10 minute	Choice of 0.5 mph increase or 1% incline increase	
11 minute	Choice of 0.5 mph increase or 1% incline increase	
Continue with this pattern until client exceeds AT by 1 min, or signals "Stop"		

WARNING: During the test periodically ask your client how they are feeling! Tell them to signal to stop the test at ANY TIME they feel discomfort of any kind.

When the client signals to stop the test, stop the treadmill or slow the treadmill down to two mph at 0% incline and let the client walk to cool down. Take the mask off while the heart rate monitor continues to monitor recovery time.

At this point, click the **Stop Test** button on the CardioCoach software. It will ask you to start recovery from **Now** or **Peak**. If a minute or so has passed while taking care of your client, select **From Peak**.

You've just completed a graded exercise test!

Cycle / Ergometer Test

When performing a VO_2 /Exercise test on a cycle/ergometer there are two variables that must be considered:

- Workload (Watts)
- Cadence (RPMs)

One variable should be constant while the other variable is being adjusted during each stage of the test.

Figure 3 illustrates a graded exercise test on a stationary cycle. Many bikes allow the workload (Watts) to be set. Some stationary bikes can be programmed to perform a power increment test.

Figure 3 shows a power increment test starting at 50 Watts and increasing at a rate of 25 Watts or 20 Watts every minute. This is the simplest way to perform a graded exercise test.

The client should maintain a constant RPM the entire test. This is generally set at 60 – 80 RPMs. It is crucial that the cycle or ergometer has the means of displaying Watts and RPMs for a successful test.

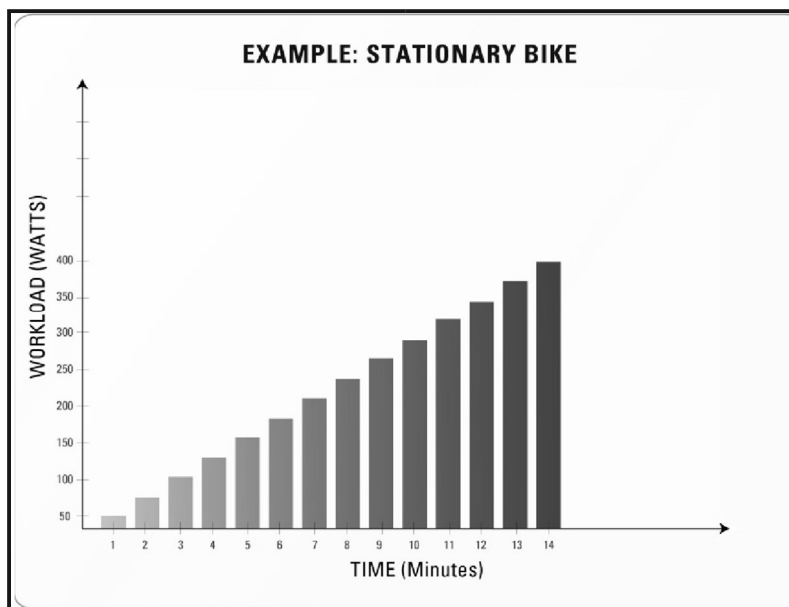


Figure 3: Stationary Bicycle Test Example.

Cycle Test, Manual Cycle

Try to keep the speed constant and increase the tension $\frac{1}{4}$ turn for every minute during the test. If a $\frac{1}{4}$ turn is not enough, try $\frac{1}{2}$ turn the next test. You will have to try by trial-and-error to get a good testing feel for the graded exercise test on a manual cycle.

Other Tests

The CardioCoach test can be conducted on any piece of stationary equipment where you can control and monitor the cadence and workload during the test. Always remember the graded exercise test is designed to take the client from rest and gradually increase the intensity over time in a linear fashion.

Consent

As with any activity requiring physical exertion, there are issues of safety and liability. To help you address those concerns, you will find sample forms and questionnaires in Appendix A of this manual, or by navigating the software to **Help** then **Forms**. These include a sample consent form and medical clearance form. You may wish to consult legal counsel to develop your own forms to suit your specific needs and applicable law.

Troubleshooting

Computer Crashes or Freezes Mid-Test

- Be aware that if the computer has an issue during the test that affects the software, continue running the test as the CardioCoach unit is still recording data.
- The test will automatically be saved onto the unit as long as it is ended successfully.
- To retrieve the test from the CardioCoach unit, once the computer is up and running, contact KORR customer support at 1 (800) 895-4048 or (801) 483-2080 for assistance.

Green Status Light Continues Flashing—USB Connection

Note: If at any point during troubleshooting the green Status LED stops flashing, there is no need to continue troubleshooting.

Verify that a USB cable is securely connected into the CardioCoach and your PC/Tablet. Then try the following options. If none of these options are successful, contact KORR.

Power Cycle the CardioCoach.

1. Power the CardioCoach off, then back on.
2. Allow a few seconds for the software to recognize the CardioCoach.

Restart the Software.

1. Power the CardioCoach off, then back on.
2. Allow a few seconds for the software to recognize the CardioCoach.

Refresh the CardioCoach Connection.

1. Navigate to the **Help** page from the main screen.
2. Click **About**.
3. Verify that the words **CardioCoach Not Connected** appear at the bottom of the **About** page.
4. Click **Refresh CardioCoach** at the bottom of the screen.
5. Allow a few seconds for the software to recognize the CardioCoach. Verify that the words **CardioCoach Not Connected** are replaced by information about your CardioCoach, beginning with the model name.

Test the USB Cable.

1. Unplug the USB cable from the PC/laptop and connect to another available USB port, if possible.

2. Ensure that the USB cable successfully connects to other USB devices (such as printers or scanners) from your PC/laptop.
Replace the USB cable.

Green Status Light Continues Flashing—Bluetooth Connection

Note: If at any point during troubleshooting the green Status LED stops flashing, there is no need to continue troubleshooting.

Turn off all unnecessary Bluetooth devices. Verify that the CardioCoach is in close proximity of the PC/Tablet. Then try any of the following options (if desired, some options may be done simultaneously for quicker troubleshooting). If none of these options are successful, contact KORR.

Ensure Bluetooth is Turned On.

1. Close the CardioCoach software.
2. In Windows, navigate to Settings->Devices->Bluetooth & other devices.
3. Under Bluetooth, ensure that the toggle indicates "on."

Ensure your device has been paired.

1. Close the CardioCoach software.
2. In Windows, navigate to Settings->Devices->Bluetooth & other devices.
3. Find your CardioCoach in the list of saved devices.
4. If your CardioCoach is not listed, follow instructions for pairing your device under [Connect CardioCoach to PC/Tablet via Bluetooth](#).
5. Restart the CardioCoach software.

Power Cycle the CardioCoach.

1. Power the CardioCoach off, then back on.
2. Allow a few seconds for the software to recognize the CardioCoach.

Refresh the CardioCoach Connection.

1. Navigate to the **Help** page.
2. Click **About**.
3. Verify that the words *CardioCoach Not Connected* appear at the bottom of the About page.
4. Click **Refresh CardioCoach**.
5. Allow a few seconds for the software to recognize the CardioCoach. Verify that the words *CardioCoach Not Connected* are replaced by information about your CardioCoach, beginning with the model name.

Reset the PC/Tablet's Bluetooth Function.

Note: If any Bluetooth devices are connected to your PC/Tablet, the connection will be lost temporarily. Some devices may need to be reconnected manually.

1. Close the CardioCoach software.
2. In Windows, navigate to Settings->Devices->Bluetooth & other devices.
3. Click the toggle under Bluetooth so that it indicates "off."
4. Click the toggle again so it indicates "on."
5. Restart the CardioCoach software.

Reset CardioCoach Pairing.

1. Close the CardioCoach software.
2. In Windows, navigate to Settings->Devices->Bluetooth & other devices.
3. Find your CardioCoach in the list of saved devices.
 - a. If your CardioCoach **is not** listed, follow instructions for pairing your device under [Connect CardioCoach to PC/Tablet via Bluetooth](#).
 - b. If your CardioCoach **is** listed, select it so the **Remove device** button appears and click **Remove device**. Follow instructions for pairing your device under [Connect CardioCoach to PC/Tablet via Bluetooth](#).
4. Restart the CardioCoach software.

Bluetooth Heart Rate Monitor Does Not Appear in Bluetooth Device List

Note: Enumerating Bluetooth devices may take a few minutes.

1. Ensure your heart rate monitor is powered on and in range.
2. Ensure that Bluetooth devices are enumerated correctly:
 - a. Wait until the word *Done* appears at the top of the list.
 - b. If *Please Try Again* appears, click *Refresh List*.
 - c. If *Please Try Again* continues to appear after several attempts at clicking *Refresh List*, contact KORR.
 - d. If possible, ensure that some heart rate monitors do appear in the list when *Done* appears.
3. Ensure that Windows is able to detect your device:
 - a. Close CardioCoach software.
 - b. In Windows, navigate to Settings->Devices->Bluetooth & other devices.
 - c. Click **Add Bluetooth or other device**.
 - d. Click **Bluetooth**.

- e. Wait for your device to appear. If device does not appear, skip to step 4.
 - f. Restart CardioCoach software and attempt to connect your heart rate device again.
 - g. If device still does not appear, contact KORR.
4. Follow any troubleshooting steps in your heart rate monitor's user manual.
5. Follow instructions for [Heart Rate Monitor Pickup Issues](#) in this manual.

Bluetooth Heart Rate Monitor Does Not Connect with CardioCoach Software

Note: Some Bluetooth heart rate monitors are not compatible with the CardioCoach software. You may want to consider using a Polar heart rate monitor if you are not already.

1. Ensure your device appears in the list of Bluetooth devices (see [Bluetooth Heart Rate Monitor Does Not Appear in Bluetooth Device List](#) in this manual).
2. Ensure that you selected the correct Bluetooth device from the list of available Bluetooth devices.
3. Ensure your heart rate monitor meets minimum Bluetooth heart rate monitor requirements found in the requirements section of this manual.
4. Follow any troubleshooting steps in your heart rate monitor's user manual.
5. Follow instructions for [Heart Rate Monitor Pickup Issues](#) in this manual.

Heart Rate Monitor Pickup Issues

1. Carefully check the Bluetooth connection steps as outlined in [Position the Heart Rate Strap](#).
2. Additional help can be found here: <https://youtu.be/J65isR94ruE>.
3. Any heart rate strap with Bluetooth LE signal can be used.
4. Replace the battery in the snap-on component of chest strap.
5. Heart rate strap sensors will become worn out over time. A new heart rate strap may be needed: <https://korr.com/product/coded-heart-rate-chest-strap/>.
6. Bluetooth connectivity can be affected by a nearby Bluetooth devices. Move away from other devices and/or shut off other devices to reduce interference.
7. If Bluetooth signal is unreliable at your location, it may necessary for you to use direct connection of heart rate pick up. KORR can provide a Polar coded heart rate pick up from www.korr.com/coded-heart-rate-pickup (KORR part number 9FG0190).

8. HR strap sensors will become worn out over time. A new HR strap may be needed: <https://korr.com/product/coded-heart-rate-chest-strap/>
9. Contact KORR Customer Support for further troubleshooting if needed.

CardioCoach Indicates "Waiting" After Clicking "Start Test"

1. Click **Abort**.
2. Restart test.
3. If errors persist, contact KORR.

RMR Results that Seem Unusually High

- Many obese people will test higher than you might expect. Studies show that predictive formulas are particularly inaccurate for the obese. When obese patients lift their heavy frame around, they develop lean body mass simply to support their large bodies.
- False high readings
 - Clients breathing fast and shallow (hyperventilating)
 - Clients moving around or fidgeting
 - Clients who have eaten, consumed stimulants, or exercised prior to testing
- Research at the University of Utah indicates that the most helpful environment for people to relax for an RMR test is to watch nature videos with headphones on. The narration is distracting to the brain while the subject matter fails to be stimulating.

RMR Results seem unusually low

- Air leakage. Check for air leakage around the client's mouth, at the nose clip, or at the connecting point of the hose.
- Re-test. A low metabolic rate may be a red flag of other medical issues. If a second test is significantly low, refer to a physician for follow up.

Error Messages

Couldn't Read Battery Level

1. The CardioCoach could not read the heart rate monitor's battery level. This may or may not be an indication of a low battery.
2. As long as there is a heart rate being detected, the test may proceed.

No CardioCoach has been connected

Note: If at any point during troubleshooting you click **Try again** and the message does not re-appear, there is no need to continue troubleshooting.

1. Ensure CardioCoach is powered on and red power LED is lit.
2. Verify connection setup:
 - (USB Only) Ensure USB cable is securely connected.
 - (Bluetooth Only) Ensure Bluetooth pairing has been established and Bluetooth is enabled.
3. Click **Try again**.
4. Allow a few seconds for the software to recognize the CardioCoach.
5. If the green Status LED turns solid, click **Try again**.
6. If the green Status LED continues to flash:
 - USB Only:* Go to [Green Status Light Continues Flashing—USB Connection](#).
 - Bluetooth Only:* Go to [Green Status Light Continues Flashing—Bluetooth Connection](#).
7. Power off the CardioCoach, then power it back on.
8. Repeat steps 4, 5, and 6.
9. If problems persist, contact KORR.

No Equipment Interface settings selected

3. Go to [Equipment Interface](#).
4. Make sure the equipment you wish to use is selected as default.
5. If problems persist, contact KORR.

Check Heart Rate

Note: If at any point during troubleshooting you click **Try again** and the message does not re-appear, there is no need to continue troubleshooting.

1. If applicable, ensure device heart rate monitor is powered on.
2. Ensure heart rate monitor is connected.
 - Bluetooth Only:* See [Connect the BLE Heart Rate Monitor via Bluetooth](#). This process needs to be repeated each time a test is started.
 - Coded Heart Rate Monitor only:* Ensure heart rate plug is fully inserted into Heart Rate Input Jack.
3. Follow any troubleshooting steps in the user manual for your heart rate monitor.

No Heart Rate Found

Note: The Bluetooth device you selected may not offer a heart rate service.

The battery in the heart rate monitor may have exhausted just before the connection was finished, or there may be interference with the Bluetooth signal. Click **Try Again**. If the error persists, see [Bluetooth Heart Rate Monitor Does Not Connect with CardioCoach Software](#) in this manual.

Failed to read heart rate

Note: The heart rate monitor you selected may not be supported.

It is possible that the device selected from the list is not a heart rate monitor. Otherwise, click **Try Again**. If the error persists, see [Bluetooth Heart Rate Monitor Does Not Connect with CardioCoach Software](#) in this manual.

Failed to connect to heart rate monitor

Note: The Bluetooth signal may have been lost before connection was completed.

It is possible that the device is powered off and it was selected before the list had time to update. Inactive heart rate devices often appear on the device list in the first few seconds, so you may need to wait a moment before selecting a device from the list to ensure that the desired device is active. Click **Refresh List** and search for another heart rate monitor. If the error persists, see [Bluetooth Heart Rate Monitor Does Not Connect with CardioCoach Software](#) in this manual.

Error Codes

CODE	ERROR	SOLUTION
1001	Flow port obstructed. Unit beeps and flashes light above obstructed port.	Remove hose, mask, or cap from the indicated port.
1002	Flow port open Unit beeps and flashes red light above open port.	Place cap on indicated port.
1010	Barometric Pressure Error.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange

CODE	ERROR	SOLUTION
		for service at the nearest KORR authorized service center.
1011	Relative Humidity Error.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1012	Temperature Error.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1013	Differential pressure sensor error reported by sensors.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1020	SD Card Error.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1021	SD Card Full.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1030	CO2 Unit Error. CO2 unit has reported an error.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1031	CO2 Unit Error. CO2 not measuring.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1003	Flow zeroing error. Could not zero the flow.	Cycle power on the unit. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1040	Oxygen sensor expired.	Routine oxygen sensor replacement required. Order replacement kit from www.korr.com . Follow replacement instructions as indicated in the Maintenance section of this manual. Restart test.

1041	No oxygen sensor connected.	Oxygen sensor replacement required. Order replacement kit from www.korr.com . Follow replacement instructions as indicated in the Maintenance section of this manual. Restart test.
1044	Oxygen Sensor older than 18 months.	Acquire new oxygen sensor soon from www.korr.com .
1042	Oxygen sensor reading too high.	Allow unit to sit motionless for a time then try running test again. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1043	Oxygen sensor reading unstable.	Allow unit to sit motionless for a time then try running test again. If error persists, contact KORR at www.korr.com/support/service to arrange for service at the nearest KORR authorized service center.
1050	Negative Flow Detected	RMR testing: Try using a different MetaBreatherMAX in case of a faulty valve. VO ₂ Max Testing: Was the Y-valve taken apart recently? Check the diaphragm. It may be in backwards, or not nested in correctly. Reference this video for instructions regarding reassembling the Y-valve properly: https://youtu.be/Ve5PkfMMpTk
1051	VO ₂ readings too low during test. Test will end, or abort unless corrected quickly.	If error pops up prior to test, have the client take five-six big deep breaths. This will force air to accumulate in the mixing chamber and trigger the 90 second countdown to start. If error pops up mid test, volume of air measured is too low. May be due to a leak in the accessories. Check for the following: <ul style="list-style-type: none"> • Good seal around MetaBreatherMAX mouthpiece • Mask fits snugly • Y-Valve assembled correctly • Hose intact, no holes • Hose attached securely

1052	No breath detected. Unit has stopped measuring breaths. Test will end, or abort unless corrected quickly.	<p>If error pops up prior to test, have the client take five-six big deep breaths. This will force air to accumulate in the mixing chamber and trigger the 90 second countdown to start.</p> <p>If error pops up mid test, the volume of air measured is too low. May be due to a leak in the accessories. Check for the following:</p> <ul style="list-style-type: none"> • Good seal around MetaBreatherMAX mouthpiece • Mask fits snugly • Y-Valve assembled correctly • Hose intact, no holes • Hose attached securely
1053	No Heart Rate. Unit has stopped reading heart rate.	<ul style="list-style-type: none"> • Ensure proper skin contact with the entire strap, using gel and following instructions in the section Position the Heart Rate Strap. • Replace battery in snap on component of chest strap. • Bluetooth connectivity can be affected by a nearby Bluetooth device. Move away from other devices and/or shut off other devices to reduce interference. • If Bluetooth signal is unreliable at your location, it may necessary for you to use direct connection of heart rate pick up. KORR can provide a Polar coded heart rate pick up from www.korr.com/coded-heart-rate-pickup. KORR part number 9FG0190. • HR strap sensors will become worn out over time. A new HR strap may be needed: https://korr.com/product/coded-heart-rate-chest-strap/ • Call KORR Customer Support for any questions.
1054	Unit still in warm-up. Warning if the CC is still warming up when user attempts to start test.	Wait for warm-up to complete. If test proceeds, test quality score will be low.

2001	Communications lost during test.	Reconnect CardioCoach to the PC and restart the test.
1055	Temperature unstable. Unit's temperature reading has not stabilized during warmup period.	Allow unit to reach room temperature, and then restart the test.
1056	New Oxygen sensor installed successfully	No action necessary.

Section 5

Important Notes

Intended Use

The CardioCoach is a complete system for use in exercise metabolic testing. The CardioCoach is designed to measure oxygen consumption during a graded exercise test.

WARNING: The CardioCoach is NOT a medical device. It is not intended to be used for the diagnosis or treatment of disease.

WARNING: Before participating in a fitness test, you should have a complete physical examination by your physician. Consult your physician for the heart rate appropriate for your fitness level. No person should be tested using the CardioCoach beyond the level of exertion that is safe for that person as determined by his or her physician.

WARNING: The CardioCoach is NOT intended for the treatment or prevention of disease, nor as a substitute for medical treatment, nor as an alternative to a medical advice. It is designed to only provide information about a client's fitness and nutrition state. Before beginning any exercise or dietary program, always consult with your physician or health professional. Use of the programs or recommendations based on information provided by the CardioCoach is at the sole choice and risk of the user.

Theory of Operation

Metabolic Testing

The CardioCoach is designed to gather physiological performance data during a graded exercise test. During this test, the body is subjected to gradually increasing exercise levels. The CardioCoach measures the body's metabolic status and performance at each exercise level. This data may then be used to define a precise, personalized exercise regimen to reach specific training goals.

Metabolism is the process of converting food into heat or energy. The rate with which the body converts food to energy is referred to as the metabolic rate. The most direct method of measuring metabolic rate is to measure

the amount of heat produced by the body. This method is referred to as direct calorimetry. Direct calorimetry is difficult and impractical, as it requires a client to be placed in a special insulated room where the flow of energy into and out of the room is measured and controlled. A more common method of metabolic rate measurement is indirect calorimetry. Indirect calorimetry is a measurement of the amount of oxygen consumed, rather than the amount of heat produced. Every calorie consumed requires a fixed amount of oxygen to be converted to energy. The rate at which oxygen is consumed is directly proportional to the rate of caloric expenditure. In short, measuring the rate of oxygen consumption is equivalent to measuring the number of calories being used.

The volume of oxygen consumed per minute is commonly written as VO_2 . Values of VO_2 are reported in milliliters per minute (ml/min). These values are often normalized to the weight of the person being measured. The weight-normalized VO_2 is reported in milliliters per minute per kilogram of body weight (ml/min/kg). The maximum weight-normalized amount of oxygen that an individual can consume in a minute is referred to as their " VO_2 max" and is a measure of their level of fitness. Factors that affect a person's VO_2 max include level of cardiac and pulmonary fitness, muscle mass, muscle perfusion, fat mass, and other variables. Exercise levels for a given individual are often determined as a percent of their maximum VO_2 .

Oxygen Consumption

The CardioCoach calculates oxygen consumption by measuring the volume of air that is exhaled and the concentration of oxygen in that air. The volume of air exhaled multiplied by the difference between inspired and expired oxygen concentration is equal to the oxygen consumption. The CardioCoach measures the concentration of exhaled oxygen 50 times each second. The concentration of inspired (room) air oxygen is measured during an automatic calibration cycle prior to each test. The CardioCoach also measures the temperature, relative humidity and barometric pressure to compensate for local variations and further improve the accuracy of the calculations. Note that the concentration of oxygen in the inspired air remains constant over the course of an exercise test.

To measure oxygen consumption, all of the air exhaled by the user must pass through the CardioCoach. Two (2) one-way valves are connected in or near a mask or mouthpiece. This ensures that fresh air is inhaled and all exhaled gas passes through the hose and into the CardioCoach. Because of the one-way valves, the user can never inhale gas from the hose or the CardioCoach, thereby eliminating the possibility of cross-contamination between users. When a mouthpiece is used, it is important to use a nose clip so that there is no leak through the nose and the CardioCoach analyzes all exhaled air.

Calorie Calculation

The number of calories expended for a given amount of oxygen consumed is approximately five calories (0.005 Kcal) for every milliliter of oxygen consumed. The exact relationship between calories expended and oxygen consumption is affected by the ratio of carbon dioxide produced by the body and the amount of oxygen consumed.

Because the volume of oxygen changes depending on the barometric pressure (elevation above sea level), the room temperature where the measurement is made and the humidity of the exhaled air, it is necessary to convert all measurements to a standard temperature and pressure. Adjusting measurements to standard conditions is called STPD, (Standard Temperature and Pressure Dry) correction. The CardioCoach measures barometric pressure, relative humidity and temperature during each automatic calibration cycle. Using these measured parameters, the CardioCoach automatically converts all VO_2 and metabolic rate measurements to standard (STPD) conditions.

Anaerobic Threshold Detection

The CardioCoach uses the Ventilatory Threshold (Wasserman method) to detect anaerobic threshold. ¹

Anaerobic threshold (AT) detection requires a graded exercise protocol. This means that the level of exertion needs to begin well below the AT and continue to well beyond AT. The test should continually increase the exercise intensity, such that every level is more strenuous than the previous level. Failure to continually increase exertion may result in inaccurate AT determinations. The anaerobic threshold detection system requires that tests last at least six minutes and less than 24 minutes. The amount of exhaled air (relative to the entered body weight) must reach a minimum threshold for a valid determination. Additionally, if it is obvious from the heart rate and VO_2 measurements that the level of exertion decreased during the test, it will not be possible to accurately determine the AT.

In summary, the requirements for a valid AT determination are:

- Continuously increasing level of exertion throughout the test.
- A beginning level of exertion well below AT and a final level of exertion well above AT.
- Test duration of more than six minutes and less than 24 minutes.
- Ventilation (volume of exhaled air) of at least 900 ml/Kg/minute at the time of AT detection.

Note: It is not necessary to reach a maximum VO_2 to determine AT. The system display indicates when exercise intensity has reached a level that is sufficient for AT detection. While the CardioCoach is capable of determining maximum VO_2 , it is not necessary to do so for AT detection.

In no case should testing proceed beyond the intensity level deemed safe by the user's physician.

Zone Training

The CardioCoach allows you to customize the workout zones based on various methods utilized throughout the fitness industry: percent VO_2 Max, Percent HR MAX and so on. The default zones calculated at the end of testing are based on a system of Cardiorespiratory training originally developed by Blau, et al.²

Zone 1	Warm-Up	Below 85%
Zone 2	Low Intensity/ Active Recovery	85 - 94% AT
Zone3	Endurance	94 - 105% AT
Zone 4	Tempo	105% AT - 50% Δ
Zone 5	VO_2 Peak Training	50% Δ - VO_2 Peak

Error Check: If Lowest measure is greater than 90% of AT, use 60 bmp, if already lower than 60 use 0 for starting point.

* If 105% AT is greater than 60% Max, Zone2 = 20% of (Max - AT) + AT

Estimated Values

CardioCoach MAX uses a number of estimated values within its results.

Resting Metabolic Rate Results

Calories Burned Through Exercise. If the client has not performed a VO_2 Max test, this number must be estimated based on METS. The METS are calculated accordingly:

- Light = 3 METS (walking a dog)
- Moderate = 6 METS (jog/walk combination 4 mph)
- Hard = 9 METS (running 5.2 mph)

Calories Burned Through Activities of Daily Living. This caloric burn is estimated using the PAL (Physical Activity Level, see glossary) formula as a factor of RMR. PAL is applied as follows:

Women

PAL	Rating	Description
1.2	Inactive	Chair-bound or bed-bound
1.4	Sedentary	Seated work with limited option of moving around
1.6	Moderately Active	Seated work, some moving about
1.8	Active	Standing work (housework, sales clerk)
2.0	Very Active	Strenuous work (construction)

Men

PAL	Rating	Description
1.2	Inactive	Chair-bound or bed-bound
1.5	Sedentary	Seated work with limited option of moving around
1.7	Moderately Active	Seated work, some moving about
1.9	Active	Standing work (housework, sales clerk)
2.4	Very Active	Strenuous work (construction)

(See Reference 3)

Percent Body Fat

CardioCoach MAX has the option of estimating body fat using the Cunningham equation. The Cunningham Equation uses the known factor of Resting Metabolic Rate to estimate Fat Mass.

(See Reference 4)

Extrapolated VO₂ Max

KORR uses an algorithm based on well-validated studies to calculate an extrapolated VO₂ Max, when a Sub-Max test is performed. This algorithm utilizes both the trajectory of the heart rate measured during testing as well as age-predicted max to determine the predicted VO₂ Max that would have been observed had the client continued testing, or the extrapolated VO₂ Max. (See references 4 and 5).

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Warnings

- Warning:** The CardioCoach is NOT a medical device. The CardioCoach is NOT intended for the diagnosis or treatment of disease.
- Warning:** The MetaBreatherMAX is a single-client use disposable item. Re-use of the disposable mouthpiece may contribute to the spread of disease. Malfunction of the mouthpiece leading to inaccuracy of the measurement is likely if the MetaBreatherMAX is re-used.
- Warning:** Read and understand all instructions in the User Guide before using the CardioCoach.
- Warning:** Always follow basic safety precautions when using the CardioCoach to reduce the risk of injury, fire, or electrical shock.
- Warning:** Protect the CardioCoach from extreme temperatures or moisture that can damage internal components and sensors.
- Warning:** Before participating in a fitness program, you should have a complete physical examination by your physician. Consult your physician for the heart rate appropriate for your fitness level. No person should be tested using the CardioCoach beyond the level of exertion that is safe for that person as determined by his or her physician.
- Warning:** The CardioCoach is NOT intended for the treatment or prevention of disease, nor as a substitute for medical treatment, nor as an alternative to medical advice. It is designed to only provide information about a client's fitness and nutrition state. Before beginning any exercise or dietary program, always consult with your physician or health professional. Use of the programs or recommendations based on information provided by the CardioCoach is at the sole choice and risk of the user.
- Warning:** Use of power sources not expressly recommended for this equipment may lead to overheating, fire, electrical shock or other hazards. Use only power sources provided by KORR Medical Technologies.
- Warning:** CardioCoach should be operated on a hard, flat surface.

Section 6

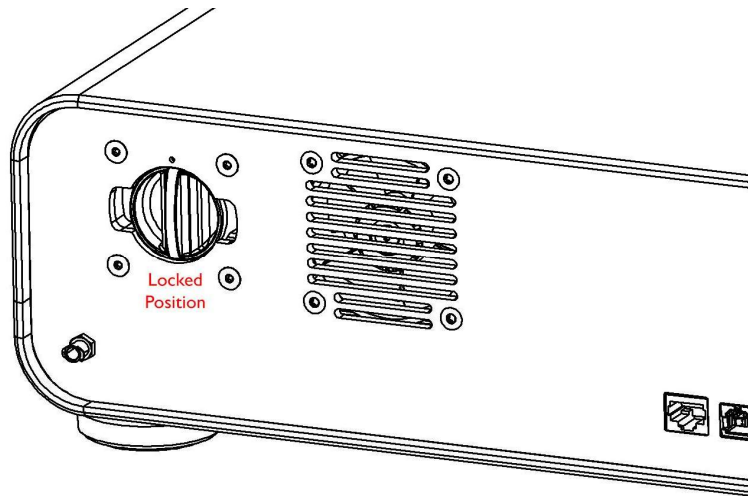
Maintenance

Maintaining Device Effectiveness

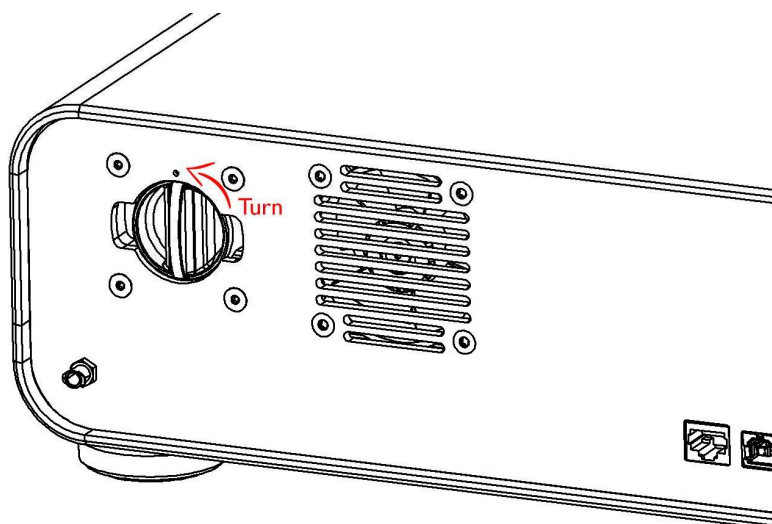
- Do not obstruct free flow of air to vent holes beneath or behind the CardioCoach.
- Operate on a hard, flat surface.
- Let the drying cycle complete at the end of testing.

O₂ Sensor Replacement

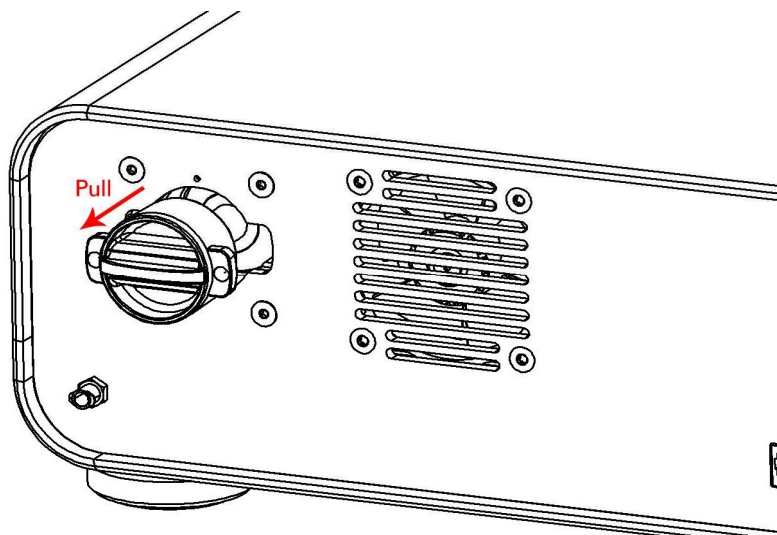
1. Turn off and unplug the CardioCoach from its power supply.
2. Locate the O₂ Sensor Cover Lock at the back of the CardioCoach.



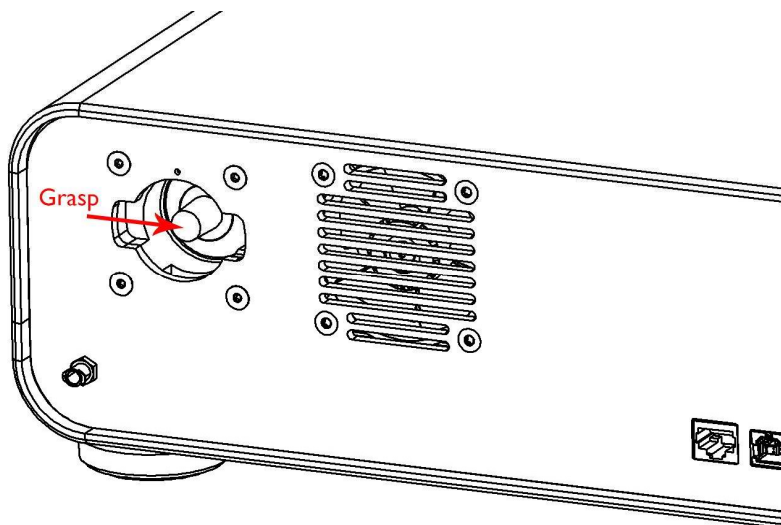
3. To remove cover lock, grasp the vertical cover lock handle. Press in, and while pressing in, rotate the cover lock ¼ turn in a counterclockwise direction until the handle is horizontal (90 degrees to the left).

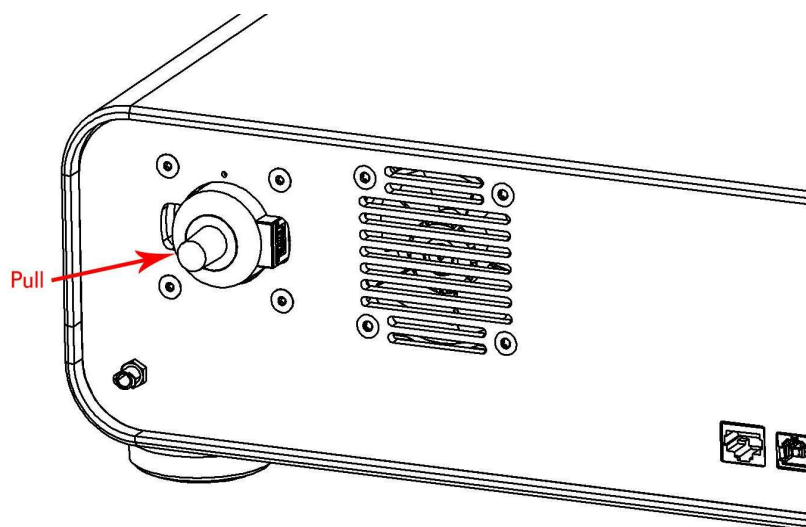


4. Pull the cover lock/spring assembly straight out of the back panel.

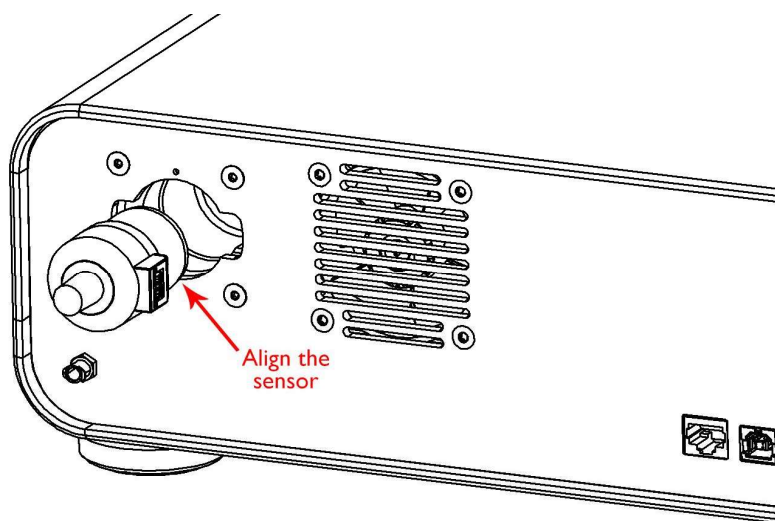


5. Locate the O₂ Sensor Assembly. Grasp the stud on the O₂ sensor and pull straight out of the housing.

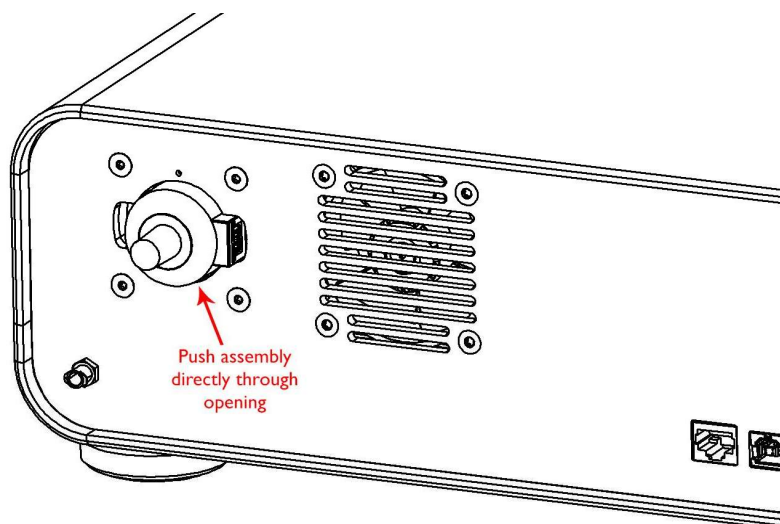




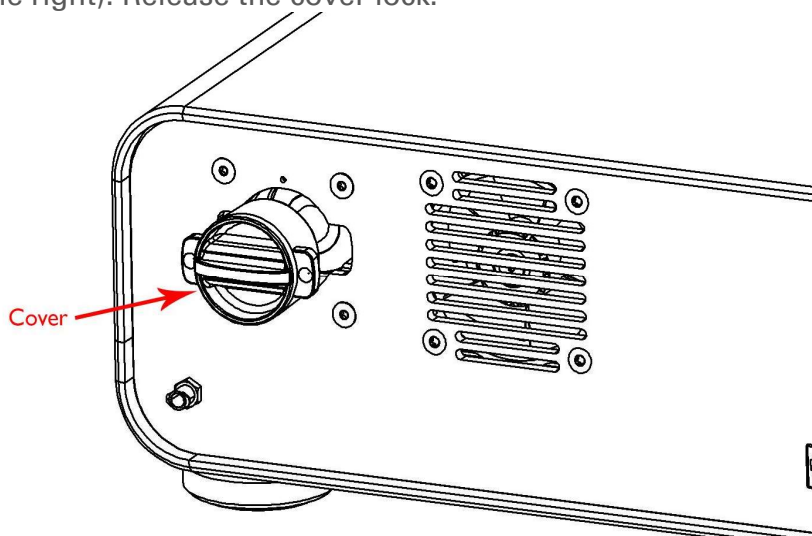
6. Remove the new O₂ sensor assembly from the packaging. Align the bump-out with the electrical contacts to the groove on the right side of the sensor housing.

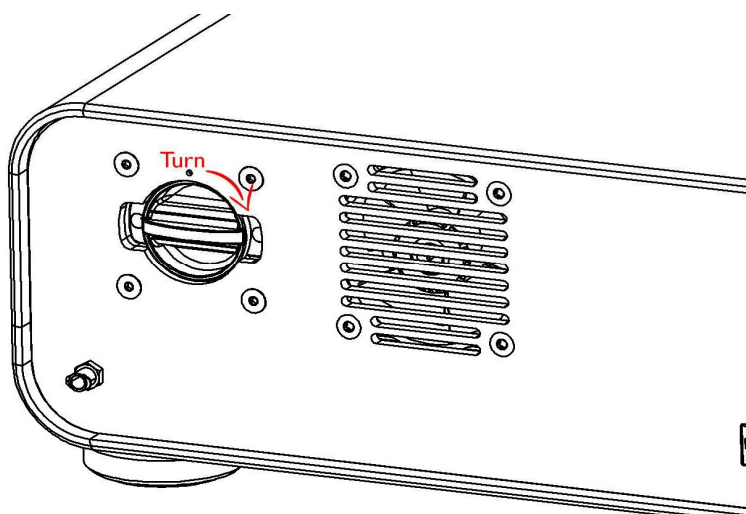


7. Push the O₂ sensor assembly straight in until it comes to a stop. There will be a little resistance as the electrical contacts seat before the hard stop.



8. Reinstall the cover lock/spring assembly by aligning it into the opening on the back panel. Press in on the cover lock and then rotate $\frac{1}{4}$ turn in a clockwise direction until the handle is vertical (90 degrees to the right). Release the cover lock.





9. Reconnect the power supply.

On the next powering on of CardioCoach the calibration data in the O₂ sensor will read into the system and be ready for use.

Cleaning and Storage

Recommendations for the Unit

- Protect the CardioCoach from extreme temperatures or moisture that can damage internal components and sensors. Storage outside at 59 to 86°F (15 to 30° C) will cause damage and void warranty.
- Clean the exterior case with a lint-free damp cloth (70% Isopropyl Alcohol). Do not use solvents.

Recommendations for Cleaning Accessories

The degree of risk of cross-infection of patients via cardio-pulmonary testing equipment has yet to be quantified. Based on current evidence, elaborate precautions are not justified, but attention to appropriate routine cleaning and disinfection protocols is important. The following are recommendations made based on the existing research as summarized in a study published in Respiratory Medicine in 2003. (Infection control of lung function equipment: a practical approach. A.H. Kendricka, D.P. Johnsb , J.P Leeming. Respiratory Medicine (2003) 97, 1163-1179).

Masks and Y-valves

These valves, such as those from Hans Rudolph, are heat sensitive to temperatures above 40 degrees C and are damaged by prolonged exposure to hypochlorite solutions. Dismantling, washing in hand-hot soapy water,

rinsing and air drying should be sufficient to ensure adequate cleaning and disinfection.

VO₂ Hose

In practice, disinfection at the end of each day, rather than between each patient, should be sufficient. Both internal and external surfaces of the tubing should be decontaminated. Wash in hand-hot soapy water, rinse and dry.

Head Strap and Heart Rate Strap

These should be cleaned between patients using alcohol-impregnated wipes and by wiping the outside surface of the equipment.

MetaBreatherMAX Mouthpiece, Valve and Hose

The MetaBreatherMAX is a single-client use disposable that utilizes a one-way valve to ensure that users only inspire room air. The valve closes the circuit to exposure to potential contaminants from previous users. Re-use of the disposable mouthpiece may degrade the quality of the valve, decrease its effectiveness, and contribute to the spread of disease.

Malfunction of the mouthpiece leading to inaccuracy of the measurement is also likely if the MetaBreatherMAX is re-used.

Warranty Policy

This KORR Medical Technologies, Inc., product, together with its standard accessories, except for certain disposable products, is guaranteed for a period of TWO YEARS from the date of shipment.

This warranty covers the repair or replacement, at KORR's sole discretion, of the product or defective parts. KORR reserves the right, at its sole discretion, to perform warranty service at its factory, at an authorized repair station, or at the customer's facility.

Claims for damages during shipment must be filed promptly with the transportation carrier.

Any instrument or accessory returned to KORR for warranty service must be accompanied by a clear and detailed explanation of the defect or problem found, and must specify the model name, model number, and serial number as it appears on the product. Written or verbal permission must be received before any product is returned to KORR for warranty service.

The warranty does not cover: a) consequences caused by accident, abuse, tampering, misuse, alteration, or other external causes; b) consequences caused by operating the product outside of the permitted or intended uses as described by KORR; c) consequences caused by failure to follow KORR's specific operating instructions; d) consequences caused by service performed by anyone other than a KORR representative or at a KORR authorized repair station; e) use of a faulty breathing device not manufactured by KORR.

KORR strongly recommends use of a KORR manufactured MetaBreatherMAX to ensure measurement accuracy. KORR cannot guarantee the ability of this product to accurately measure metabolic rates when a breathing device other than a MetaBreatherMAX is used. Furthermore, improper or incorrectly performed maintenance or repair voids the warranty.

To the extent permitted by law, this warranty and the remedies set forth above are exclusive and in lieu of all other warranties, remedies, and conditions, whether oral or written, statutory, express, or implied. If KORR cannot lawfully disclaim statutory or implied warranties, then to the extent permitted by law all such warranties shall be limited to the duration of the express warranty and to the repair or replacement of the product as specified above. Furthermore, KORR expressly disclaims any liability for direct, indirect, incidental, special, or consequential damages of any nature. If any term of this warranty is held to be illegal or unenforceable, the legality or enforceability of the remaining terms shall not be affected or impaired.

Service Policy

KORR Medical Technologies provides Warranty Service Support to its customers for products under standard or extended KORR warranty. Service requests can be submitted via the web at www.korr.com or by telephone at (801) 483-2080. Details for shipping service items to the KORR factory are available for download on the KORR website.

KORR also provides factory direct technical support to its customers through a technical support group located in Salt Lake City, Utah. It is suggested that any person calling in for technical support have the inoperative equipment available for preliminary troubleshooting as well as product identification.

Appendix

CardioCoach Specifications

The **Absolute Maximum Ratings** are those limits for the device that, if exceeded, will likely damage the device. Exceeding the absolute maximum ratings voids any warranty and/or guarantee. If the device is not used properly, the protection offered by the equipment may be impaired.

The **Operating Characteristics** are those limits for the device that, if exceeded, will cause the device to operate out of specification. Under these conditions, values reported from the device will be unreliable. After the “out-of-limit” condition is corrected, the device will return to normal operation after either running an auto-calibration cycle or after the device has been powered down and then powered back up.

Flow Port Specifications

Absolute Maximum Ratings	
Maximum Flow Reading	300 LPM
Operating Characteristics	
Type	Fixed Orifice
Accuracy	±2% of Reading or ±0.10 LPM
Extended Range Accuracy	±5% of Reading or ±0.50 LPM
Resolution	0.1 LPM
Minimum Range	-40 LPM (-667 ml/sec)
Maximum Range	300 LPM (5000 ml/sec)
Frequency Response	> 12 Hz
Sample Rate	60 Hz
Dynamic Resistance	< 2.0 cmH ₂ O @ 60 LPM
Low Flow Drop Out	1.0 LPM
Type	Fixed Orifice

Oxygen Sensor Specifications

Operating Characteristics	
Type	Galvanic Fuel Cell
Accuracy	greater of $\pm 2\%$ of Reading or $\pm 0.2\% \text{ O}_2$
Extended Range Accuracy	greater of $\pm 4\%$ of Reading or $\pm 0.4\% \text{ O}_2$
Resolution	$0.01\% \text{ O}_2$
Minimum Range	$10\% \text{ O}_2$
Maximum Range	$30\% \text{ O}_2$
Nominal Sensor Life	> 24 Months in air
Sample Rate	> 25 Hz
Frequency Response	$t_{10-90} < 10 \text{ Sec}$

Barometric Pressure Specifications

Absolute Maximum Ratings	
Maximum Pressure (absolute value)	1100 mBari
Operating Characteristics	
Accuracy	greater of $\pm 2\%$ of Reading or $\pm 5 \text{ mmHg}$
Extended Range Accuracy	greater of $\pm 4\%$ of Reading or $\pm 10 \text{ mmHg}$
Resolution	< 2 mmHg
Minimum Range	540 mmHg
Maximum Range	780 mmHg

Relative Humidity Sensor Specifications

Absolute Maximum Ratings	
Maximum RH Value (absolute value)	90% non-condensing
Operating Characteristics	
Accuracy	$\pm 5\%$ Relative Humidity
Resolution	5% Relative Humidity
Minimum Range	10% Relative Humidity
Maximum Range	90% Relative Humidity
Frequency Response	$t_{10-90} < 10 \text{ sec}$

Ambient Temperature Specifications

Absolute Maximum Ratings	
Maximum Readings	75 °C
Operating Characteristics	
Accuracy	±2 °C
Resolution	1 °C
Minimum Range	10 °C
Maximum Range	40 °C
Frequency Response	$t_{10-90} < 10 \text{ sec}$
Sample Rate	> 1 Hz

VO₂ Specifications

Operating Characteristics	
Accuracy	greater of ±10% Reading or ±10 ml/min O ₂
Resolution	1 ml/min O ₂
Minimum Range	70 ml/min O ₂
Maximum Range	4000 ml/min O ₂

FeO₂ Specifications

Operating Characteristics	
Accuracy	greater of ±2% of Reading or ±0.2% O ₂
Resolution	0.01% O ₂
Minimum Range	10% O ₂
Maximum Range	30% O ₂

Tidal Volume Specifications

Operating Characteristics	
Accuracy	greater of ±5% of Reading or ±10 ml
Resolution	1 ml
Minimum Range	200 ml
Maximum Range	4000 ml

Minute Volume Specifications

Operating Characteristics	
Accuracy	greater of $\pm 5\%$ or 0.3L
Resolution	0.1 L
Minimum Range	0 L
Maximum Range	100 L

Respiratory Rate Specifications

Operating Characteristics	
Accuracy	2 breaths per minute
Resolution	1 breaths per minute
Minimum Range	4 breaths per minute
Maximum Range	30 breaths per minute

Resting Metabolic Rate (RMR) Specifications

Operating Characteristics	
Accuracy	greater of $\pm 10\%$ of Reading or ± 100 kcal/day
Resolution	7 kcal/day
Minimum Range	500 kcal/day
Maximum Range	5000 kcal/day
Measurement Time	10 min (typical)

VC02 Specifications

Operating Characteristics	
Accuracy	greater of $\pm 10\%$ Reading or ± 10 ml/min CO ₂
Resolution	1 ml/min CO ₂
Minimum Range	70 ml/min CO ₂
Maximum Range	4000 ml/min CO ₂

FeCO2 Specifications

Operating Characteristics

Accuracy	greater of $\pm 3\%$ of Reading or $\pm 0.4\%$ CO ₂
Resolution	0.1% CO ₂
Minimum Range	0% CO ₂
Maximum Range	10% CO ₂

Safety and Conformity Declaration

Manufacturer: KORR Medical Technologies Inc.

Address: 3487 W 2100 S Bldg. 300
Salt Lake City, UT 84119
USA

Phone: +1 801-483-2080

Fax: +1 801-483-2123

Manufacturer of the following equipment:

CardioCoach Model 9100
CardioCoach PLUS Model 9200
CardioCoach MAX Model 9300
CardioCoach PRO Model 9400

Safety

System meets the combined requirements for EN 61010-1 Electrical Equipment for Measurement, Control & Laboratory Use, including those for CE Mark.

EMC

System meets the combined requirements for FCC and CE Mark: EN61326-1:2013 - Electrical Equipment Measurement, Control, & Laboratory Use (normal environment).

Normative Data for VO₂ Max

Female (values in ml/kg/min)

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<25.0	25.0 - 30.9	31.0 - 34.9	35.0 - 38.9	39.0 - 41.9	>41.9
20-29	<23.6	23.6 - 28.9	29.0 - 32.9	33.0 - 36.9	37.0 - 41.0	>41.0
30-39	<22.8	22.8 - 26.9	27.0 - 31.4	31.5 - 35.6	35.7 - 40.0	>40.0
40-49	<21.0	21.0 - 24.4	24.5 - 28.9	29.0 - 32.8	32.9 - 36.9	>36.9
50-59	<20.2	20.2 - 22.7	22.8 - 26.9	27.0 - 31.4	31.5 - 35.7	>35.7
60+	<17.5	17.5 - 20.1	20.2 - 24.4	24.5 - 30.2	30.3 - 31.4	>31.4

Male (values in ml/kg/min)

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<35.0	35.0 - 38.3	38.4 - 45.1	45.2 - 50.9	51.0 - 55.9	>55.9
20-29	<33.0	33.0 - 36.4	36.5 - 42.4	42.5 - 46.4	46.5 - 52.4	>52.4
30-39	<31.5	31.5 - 35.4	35.5 - 40.9	41.0 - 44.9	45.0 - 49.4	>49.4
40-49	<30.2	30.2 - 33.5	33.6 - 38.9	39.0 - 43.7	43.8 - 48.0	>48.0
50-59	<26.1	26.1 - 30.9	31.0 - 35.7	35.8 - 40.9	41.0 - 45.3	>45.3
60+	<20.5	20.5 - 26.0	26.1 - 32.2	32.3 - 36.4	36.5 - 44.2	>44.2

Table Reference: The Physical Fitness Specialist Certification Manual, The Cooper Institute for Aerobics Research, Dallas TX, revised 1997 printed in Advance Fitness Assessment & Exercise Prescription, 3rd Edition, Vivian H. Heyward, 1998. p48

Glossary of Terms

Accuracy - Accuracy is the sum of the absolute value of the bias plus the precision. Reported accuracy is given as percent of reading, unless otherwise specified.

AeT - Aerobic Threshold. The oxygen consumption level where complete aerobic metabolism is no longer sufficient, and anaerobic energy pathways begin to assist with energy production.

AT - Anaerobic Threshold (ventilatory threshold) - During exercise, the oxygen consumption above which aerobic energy production is supplemented by anaerobic mechanisms, causing a sustained increase in lactate and metabolic acidosis. Lactic acid (which is a byproduct of energy being made from glucose) starts to build up quickly in the blood.

bias - Bias is the measurement of central tendency based on the mean.

common-mode pressure - The pressure applied to *both* ports of the differential pressure transducer.

ergometer - An apparatus which measures work or energy expended during a period of physical exercise.

FSO – Full scale output.

hyperventilation - Exhaling more than is being inhaled during accelerated breathing.

level - A subset of settings within a particular protocol designed for testing clients with different levels of fitness. These levels will appear as options when the protocol is chosen for testing.

LPM – Liters per minute.

metabolism - The chemical processes that occur within living organisms in order to maintain life.

METS - Metabolic equivalents. Used in exercise testing, exercise prescription, and evaluation of functional capacity. One metabolic equivalent (MET) is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O₂ per kg body weight x min. The MET concept represents a simple, practical, and easily understood procedure for expressing the energy cost of physical activities as a multiple of the resting metabolic rate. The energy cost of an activity can be determined by dividing the relative oxygen cost of the activity (ml O₂/kg/min) x by 3.5.

(PubMed.gov)

oxygen consumption - The amount of oxygen consumed by the tissues in the body, usually measured as the oxygen uptake in the lung.

PAL - Physical Activity Level. The PAL formula is defined as a person's total energy use over a 24-hour period divided by his or her RMR.

Precision - The precision shall be based on a one (1) standard deviation variance assuming a Gaussian (Normal) distribution.

recovery heart rate - The recovery heart rate, or the speed at which the heart rate returns to normal after exercise, can indicate physical cardiac condition and the risk of certain diseases. For instance, according to the [New England Journal of Medicine](#), people whose heart rate recovery time is long are at a higher risk of death than people with shorter recovery times regardless of physical condition or other risk factors. According to the [National Emergency Medicine Association](#), measuring heart rate recovery rates is one way to tell whether an exercise program is effective.

REE - Resting Energy Expenditure. Same as RMR.

RER - Respiratory Exchange Rate. Ratio between amount of carbon dioxide produced in metabolism and oxygen used. Measured at the mouth. Indicates which fuel (carbohydrate or fat) is being metabolized in order to supply the body with energy.

RMR - Resting Metabolic Rate. Whole body metabolism during a time period of strict and steady resting conditions. Measurement provides resting caloric needs.

stage - A group of settings within a level to indicate a change in resistance, incline, or speed during a test. A sequential series of stages within a level creates the protocol for a single test.

Sub VO₂ Max – Sub-maximal volume of oxygen consumption. A graded exercise test that is terminated prior to the client reaching max exertion.

threshold - The intensity that must be reached for a certain metabolic change to occur in response to increased effort of exercise.

VO₂ - Volume of oxygen consumption, uptake, or utilization.

VO₂ Max - Maximal volume of oxygen consumption. Measured at the point of max exertion during a graded exercise test, which is a reflection of a client's cardiorespiratory fitness level.

Forms

The sample forms listed below are included on the following pages:

- Medical Clearance Form
- Medical Records Release Authorization
- Participant Activity Readiness Questionnaire

SAMPLE Medical Clearance Form

Dear Doctor:

During application for enrollment at the Fitness Center, your patient
_____ completed a Health History and Activity Profile Form.

Information on this form indicates your patient will require a physician's clearance form.

The patient has indicated the following health risk(s):

The patient's exercise program will take place in the Fitness Center located in
_____ and will be administered by qualified personnel trained in
conducting exercise programs. If you know of any medical, or other reasons why
participation in the Fitness Center by the applicant would be unwise, please indicate so on
this form. By completing the form below you are not assuming any responsibility for our
administration of the exercise program.

PHYSICIAN REPORT

Please check one:

- ☐ I know of no reason why the applicant may not participate.
- ☐ I believe the applicant can participate but I urge caution because (please list
limitations):

- ☐ The applicant should not engage in the following activities:

- ☐ I recommend that the participant NOT participate.

Information other than what is requested is also greatly appreciated. Thank you in advance for your
recommendations and support of this individual.

Physician Signature _____ Date _____

Address _____ Phone _____

City and State _____ Zip _____

Please return Medical Clearance Form to:

*Fitness Center
Address
Phone
FAX*

SAMPLE MEDICAL RECORDS RELEASE AUTHORIZATION

I give permission to release any medical information that may be beneficial for preparing an exercise program to the Fitness Center.

Patient Signature: _____

Date _____

Patient Name: _____

Participant Activity Readiness Questionnaire

1. Has a doctor ever said you have a heart condition and that you should only do physical activity recommended by a doctor?
Yes ☐ No ☐
2. Do you feel pain in your chest when you do physical activity?
Yes ☐ No ☐
3. In the past month, have you had chest pain when you are not doing physical activity?
Yes ☐ No ☐
4. Do you lose your balance because of dizziness or do you ever lose consciousness?
Yes ☐ No ☐
5. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
Yes ☐ No ☐
6. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
Yes ☐ No ☐
7. Do you know of any other reason why you should not do physical activity?
Yes ☐ No ☐

***If you are over 69 years of age, and you are not used to being very active, check with your doctor.*

Medications

Please list all medications (including herbs and vitamins) that you are currently taking:

Name of Medication:	Dosage:	Taken for:

Do any of your medications affect your heart rate? If you are uncertain, please consult your physician.

I have reviewed these questions and answered them to the best of my ability. I understand that these materials will be reviewed and I may be asked to see my doctor before participating.

Date of Birth: _____ Age: _____

Signature: _____ Date: _____

Print name: _____

Witness Signature: _____