



PVDOMICS: Cardiopulmonary Exercise Testing (CPET) Training

Cardiovascular Physiology Core
Cleveland Clinic, Cleveland OH
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NHLBI Pulmonary Vascular Disease Phenomics Program

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the Pulmonary Hypertension Association*

Equipment and Supplies

A. Cycle ergometer

- Mechanical or electromagnetically braked (the electronically braked ergometer is strongly preferred because of its compatibility with incremental protocols)
- Upright cycle ergometer
 - Supine bicycle ok in specific situations especially for invasive CPET
- Capable of calibration
- Handlebars and seat that adjust in height



Equipment and Supplies

B. ECG system

C. Blood pressure

- Sphygmomanometer (cuff measurement method)
- Direct method using in-dwelling arterial catheter

D. Gas analyzers

E. Flow measurement device

- May be provided as part of a commercial metabolic exercise system

F. Data-acquisition computer, monitor and keyboard

G. Resuscitation cart



Equipment and Supplies

- H. Supplemental O₂ equipment and delivery systems
- I. Pulse oximeter finger or ear probes
- J. Chart displaying the Borg RPE scale (Appendix 1 in the MOP chapter)
- K. Barometer (or other valid method to obtain barometric pressure) and accurate thermometer

Equipment Quality Control

- The CPET machine should be regularly checked for quality control and maintained as per the manufacturer's recommendations.
- Biological control checks should be done at least once every 6 months
- Follow your normal site protocols





Subject Preparation: Pre-Test Instructions

- Identify the participant using two separate identifiers.
- Check to make sure that a current signed consent is on file for the participant.
- Record recent medications taken, the last time participant ate, and the last time participant exercised.
 - Each participant may have a different definition of “exercise”. This is okay, we want to know if they have recently tired themselves out.
- Record any current symptoms (e.g. dyspnea, wheezing, chest pain, leg pain, etc.).

Subject Preparation: Pre-Test Instructions

- Explain:
 1. The purpose of the test – that it is a maximum stress test
 2. The end-points of the test (attaining max heart rate, developing limiting symptoms, or an out-of-range measurement on blood pressure, ECG, or O₂ saturation)
 3. That the mouthpiece or mask must be in place for the duration of the test
- Reassure the participant about safety.

Subject Preparation: Pre-Test Instructions

- Explain the Borg scale.
- The participant will need to **point** to the number they feel best represents how hard they are exercising each time you ask them.
 - They need to point to the number because they cannot talk during the test. They'll have a mouthpiece or mask monitoring their breathing

0	Nothing at all
0.5	Very, very slight shortness of breath
1	Very mild shortness of breath
2	Mild shortness of breath
3	Moderate shortness of breath or breathing difficulty
4	Somewhat severe
5	Strong or hard breathing
6	
7	Severe shortness of breath or very hard breathing
8	
9	Extremely severe
10	Shortness of breath so severe you need to stop

Subject Preparation: Pre-Test Instructions

- Things to keep in mind...
 - Mouthpiece (although sometimes uncomfortable) is preferred to a mask. Leaks can occur with the mask and cause erroneous results.
 - Go through alternative communication signals with the participants (such as pointing at a number on the RPE scale rather than saying it) so they feel comfortable not talking.
 - For pulse oximetry, ear probe is preferred over finger probe. The contraction of the hand muscles while holding the handlebar of the cycle can alter blood flow to the finger.

Selecting the Exercise Protocol

There are 3 different continuous ramp protocols:

1. 10 Watts/min
2. 15 Watts/min
3. 20 Watts/min



Pick the protocol based on the activity level and physical abilities of the participant.

Selecting the Exercise Protocol

Ask each participant:

1. Do you become short of breath or fatigued when you walk around your house?
 - NO → ask question 2
 - YES → select a **10 Watt** continuous ramp protocol
2. Are you able to climb 1 flight of steps without becoming short of breath or fatigued?
 - NO → select a **15 Watt** continuous ramp protocol
 - YES → Select a **20 Watt** continuous ramp protocol



Procedure Notes

- Factors that can influence test results & need to be documented include:
 1. Participant effort
 - RER should be ≥ 1.10
 2. Medications
 - Beta-blockers, Ca^{2+} channel blockers, etc. may affect the heart rate response.
 - Bronchodilators may affect the ventilatory response.
 3. Participant coordination and/or physical limitation
 - e.g. inability to coordinate pedaling effort or orthopedic constraints
 4. Leaks associated with participant, connections, tubing, valves, etc.

Procedure Notes: Form 290

- Fill out Form 290 both in paper and in the electronic database
 - Or, if doing an invasive CPET, fill out Form 291 (*only fill out one of those forms, never both*)

Revision of 02/06/2018



Form #290
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PVDOMICS STUDY Center Cycle Ergometer Non-Invasive Cardiopulmonary Exercise Test (CPET) Procedure Notes #290

Instructions: Review PVDOMICS MOP Chapter 110 prior to completing Cardiopulmonary Exercise Test (CPET). This worksheet/form is used for non-invasive CPET results. Invasive CPET results are reported on Form 291.

CPET Transmission to the CPC

1. De-identify the CPET file

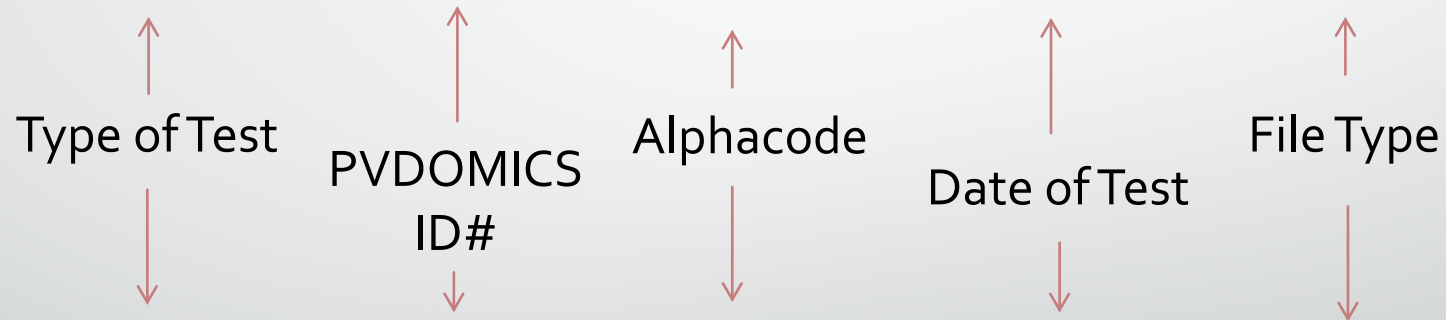
- If this CPET was done for research only, then it should not contain any identifying information.
 - If there is identifying information anywhere in the file it should be removed/deleted before being sent to the DCC
 - Note: date of birth (DOB) can remain in the file because age is required for predicted value calculations
- Verify that each CPET file contains the participant's 6 digit ID #, their 2 letter alphacode and the date of the CPET test somewhere
 - If any of this data is missing & there's no suitable field to add it to (e.g. name), add the necessary element into a notes field

CPET Transmission to the CPC

2. Name the CPET file according to the following convention:

MedGraphics/MGC

CPET_#####_ac_mmddyyyy.cow



Vmax/Vyair

CPET_#####_ac_mmddyyyy.vmx



CPET Transmission to the CPC

3. Submit CPET to DCC.

- Transfer the raw data file to the CPC through the secure WinSCP portal.
- Send the “.cow” or “.vmx” file (not a copy of the report)

4. Complete Form 290 (or 291) and enter it into the PVDOMICS Study database.

- Complete either Form 290 or Form 291. Never complete both for one participant.

5. File the paper copy of Form 290 (or 291) in the participant's study record.

For Questions Please Contact

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