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# NASA TECH BRIEF

## Marshall Space Flight Center



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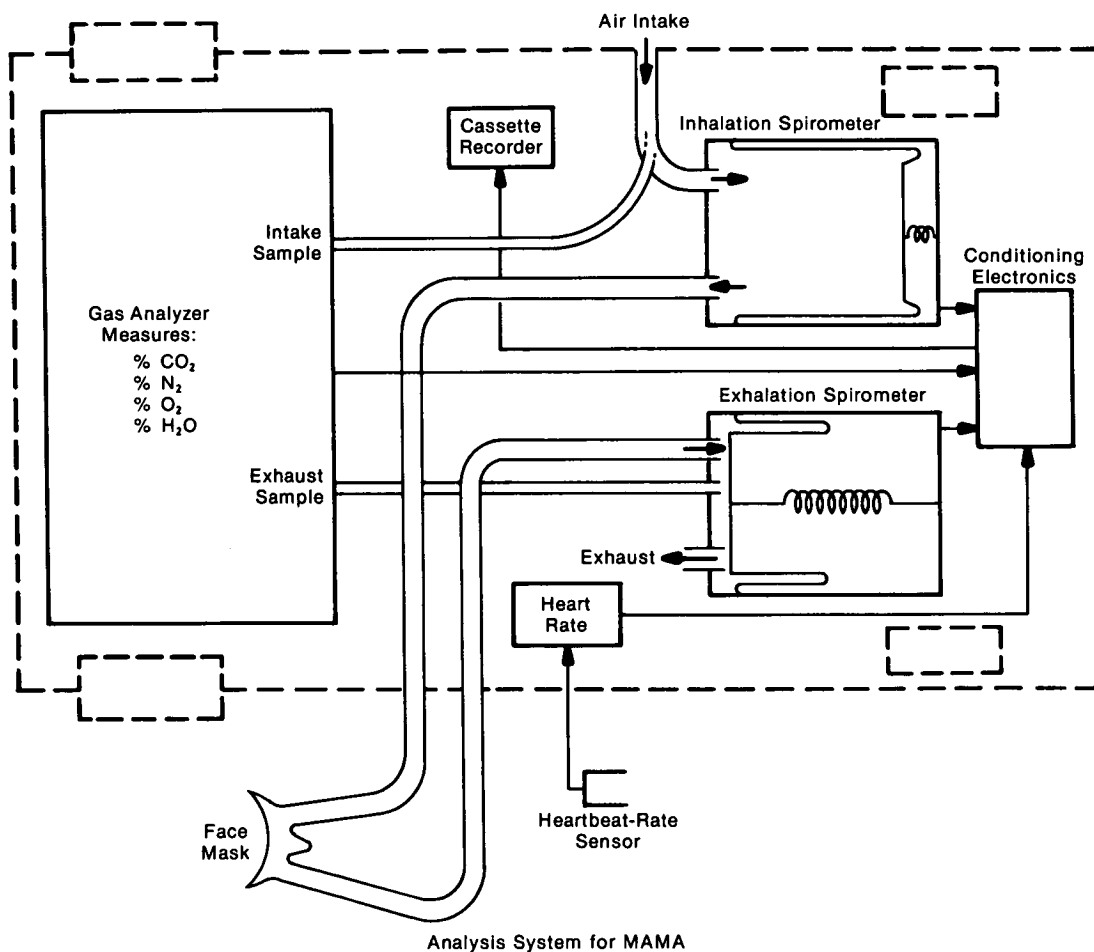
### Mobile Automatic Metabolic Analyzer

#### The problem:

One of the goals in the design and fitting of prosthetics is to minimize the amount of energy that must be expended to use them. Energy consumption is normally measured while the device is being worn by a patient walking on a treadmill. In the case of above-the-knee amputees, however, treadmill exercise does not allow the forward motion necessary to operate the prosthetic.

#### The solution:

By adapting technology developed for NASA's Apollo program, a mobile automatic metabolic analyzer (MAMA) has been developed to measure and analyze breathed gases. The analyzer is housed in a mobile cart that overcomes the treadmill problem by automatically moving alongside a walking patient.



(continued overleaf)

**How it's done:**

The patient wears a face mask attached to two flexible pipes that are connected to spirometers in the cart. Inhaled air volume is measured as it is drawn from one spirometer, and exhaled air volume is measured as it is breathed into the second spirometer. A sensor, worn on the ear and connected to the cart, is used to monitor the patient's heartbeat rate. The medical equipment in the analyzer is shown in the illustration.

The heartbeat rate and the volumes of inhaled and exhaled air are each recorded on a tape as a function of time. Inhaled air is analyzed once prior to an experiment, and exhaled air is analyzed after each breath. These results are also stored on the tape.

(These data are later fed into a computer to determine the metabolic rate.) The analyzer also includes a handswitch on an extension cord, for use by the physician to mark events of interest on the tape, and to stop the cart.

The cart is powered by three battery-operated electric motors. It may be operated manually or automatically. In the automatic mode, the system optically senses a guidance tape laid out on the floor. The transistorized, automatic, speed and acceleration controls include safety features to accommodate possible patient problems. Some specifications of the mobile automatic metabolic analyzer are shown in the following table.

Acceleration	1 to 3 ft/s <sup>2</sup>	(0.3 to 0.9 m/s <sup>2</sup> )
Speed (Level Ground)	0 to 5.5 mi/h ±1%	(0 to 2.5 m/s)
Speed (10% Slope)	0 to 4 mi/h ±3%	(0 to 1.8 m/s)
Braking (Normal Stop)	4 ft/s <sup>2</sup>	(0.9 m/s <sup>2</sup> )
Braking (Emergency Stop)	5 ft/s <sup>2</sup>	(1.5 m/s <sup>2</sup> )
Turning Radius	3.8 ft	(1.16 m)
Operating Time	3 to 5 h	

Specifications for Mobile Automatic Metabolic Analyzer

**Note:**

Requests for further information may be directed to:

Technology Utilization Officer  
 Marshall Space Flight Center  
 Code AT01  
 Marshall Space Flight Center, Alabama 35812  
 Reference: B75-10077

**Patent status:**

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel  
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