

2.4 – External Breathing System

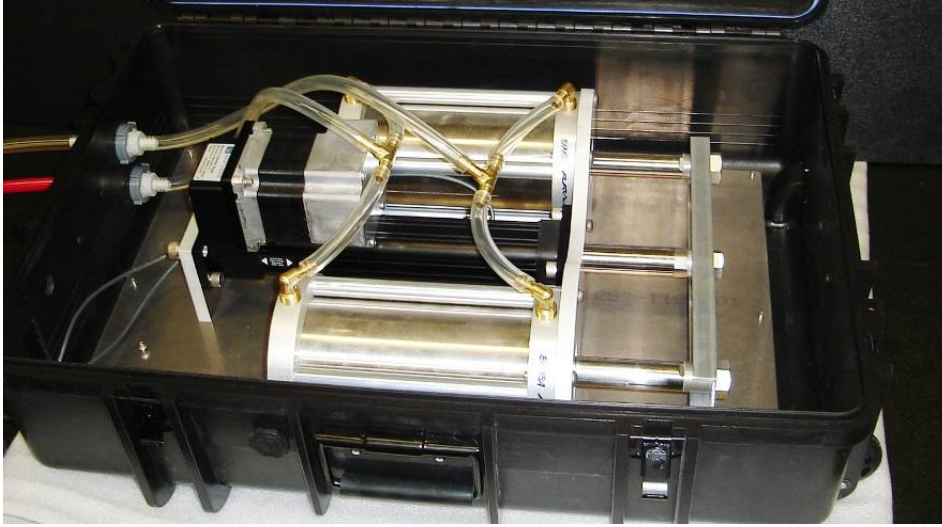


Figure 5 – External breathing tubes and suitcase enclosure

- Two pneumatic cylinders are cycled in and out by a servo linear actuator to replicate the cycle, frequency, and volume of human breathing.
- Each cylinder volume is approximately 1.0 liters, for a total volume of 2.0 L.
- Breathing system is configured to provide temperature controlled and humidified air.
- **As shown below**, a breathing manifold is installed behind the manikin face which allows for breathing through the nose, or mouth, or nose/mouth combination. Settings are made by using a control valve accessed (via screwdriver) through a small hole at the back of the head.

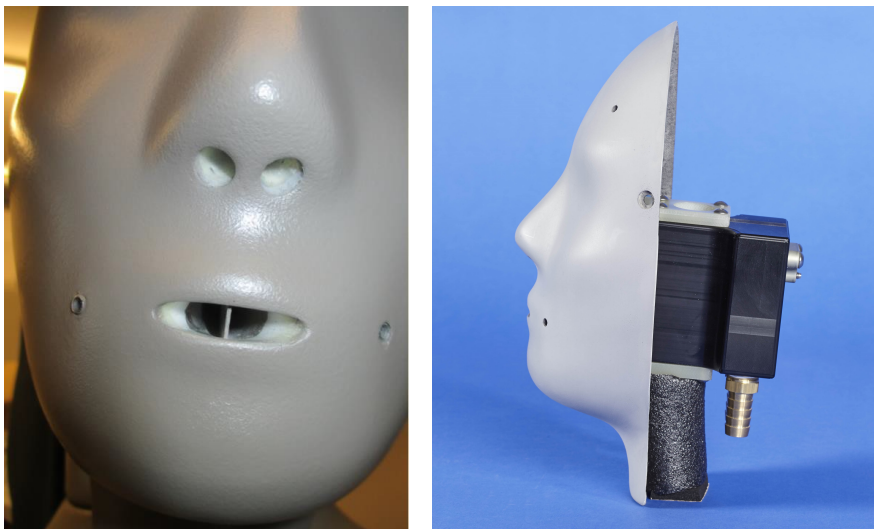


Figure 6 – Manifold

- The external breathing system is housed in a rugged suitcase for easy transport and storage. The system connects to the manikin with hoses for inhaling and exhaling. Tubes are routed through the head mounting post or the lower back of the manikin torso (as per customer preference) for connection to the breathing manifold. The manifold merges inlet and outlet airways into openings for the mouth and nose.

The breathing system control panel has three user adjustable variables: tidal volume (0.1-2.0L), breathing rate (20-40 cycles/min.), and I:E ratio (1:5). Newton's ThermDAC control system automatically monitors user-set inputs and adjusts the motion of the air cylinders accordingly. The tidal volume will be controlled by the distance that the pistons are moved in the cylinder, and the breathing rate will be determined by the speed that the piston moves. The piston speed can be different on the inhale and exhale cycles.

Section 3.0 – Instrumentation, Controls, and Software

3.1 – Control Electronics

The general architecture of the system is illustrated below. All the intelligent control electronics are located inside the manikin, using a small controller circuit board attached to each zone. This controller has been developed by Thermetrics specifically to support thermal manikin functions of heating, fluid flow, and accurate temperature measurement:

- Handling and cabling to the manikin is much simpler. The manikin is connected by two small cables: one for heater power (48VDC), one for controller power (5VDC) and data transfer through RS232 cable.
- Modular design allows easy maintenance and flexibility in zone segmentation. One controller per zone, with a maximum of 127 zones possible.
- Increased measurement accuracy by eliminating voltage drop and electrical noise pickup on signal cables. All measurements are digitized within inches of their source.
- Rapid stability time and accurate control. Real-time control of each zone is handled by a dedicated microprocessor, freeing the computer from time-critical tasks.

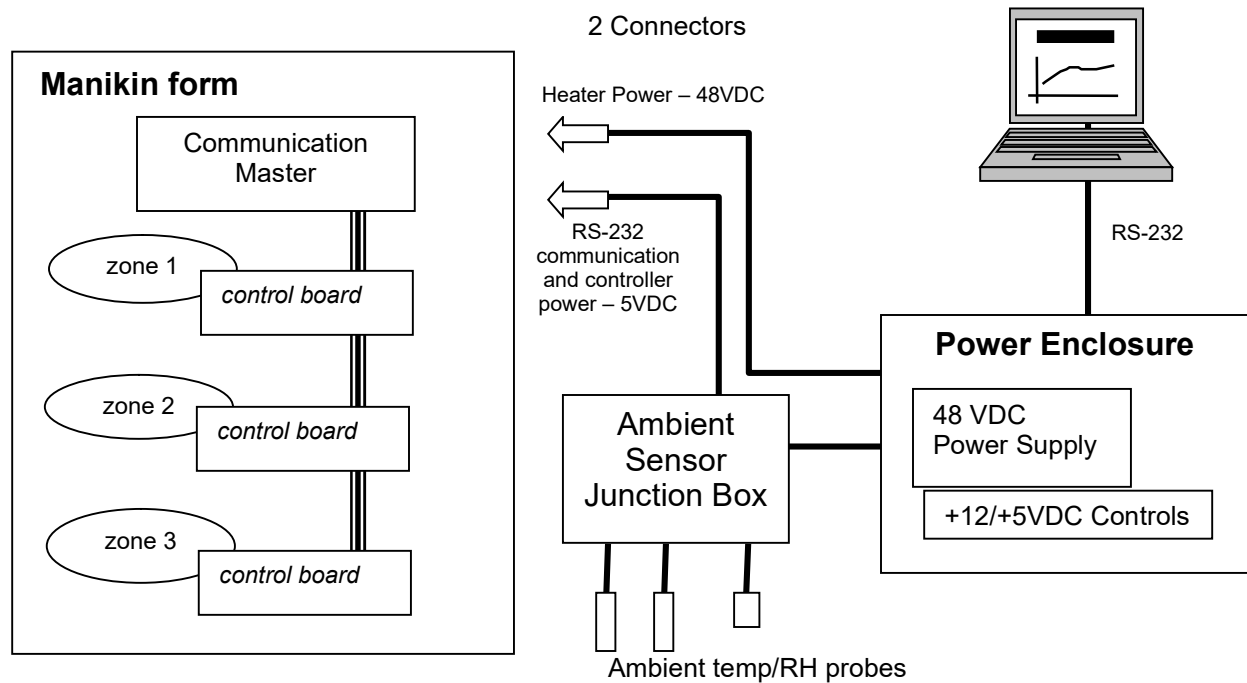


Figure 7 – Manikin control architecture