National Personal Protective Technology Laboratory (Morgantown, WV)

Physical Test Laboratory

The Physical Test Laboratory is equipped for a range of physical conditioning and testing of fabrics and materials used in personal protective equipment (PPE). The methods uses include ASTM International (ASTM), American Association of Textile Chemists and Colorists (AATCC), National Fire Protection Association (NFPA) standards. Some of these physical challenges include tensile strength, tear strength, breaking strength, elongation, abrasion resistance, flexing durability, pilling resistance, absorbency resistance, air permeability, spray rating, and resistance to blood spurt. In addition, this lab includes a large cutting table for handling rolls of fabric.

Firefighter Fatality Investigation and Prevention Evaluation Laboratory

The Firefighter Fatality Investigation and Prevention Evaluation Laboratory is utilized to conduct evaluations of protective clothing and equipment worn by firefighters during incidents resulting in a line of duty death or serious injury. The lab is equipped with various self-contained breathing apparatus (SCBA) tests to determine if the SCBA worn during the incident remains compliant with the applicable regulations. This lab has additional space to visually inspect complete firefighter ensembles as well as a limited-access evidence storage area.

Heat and Flame Laboratory

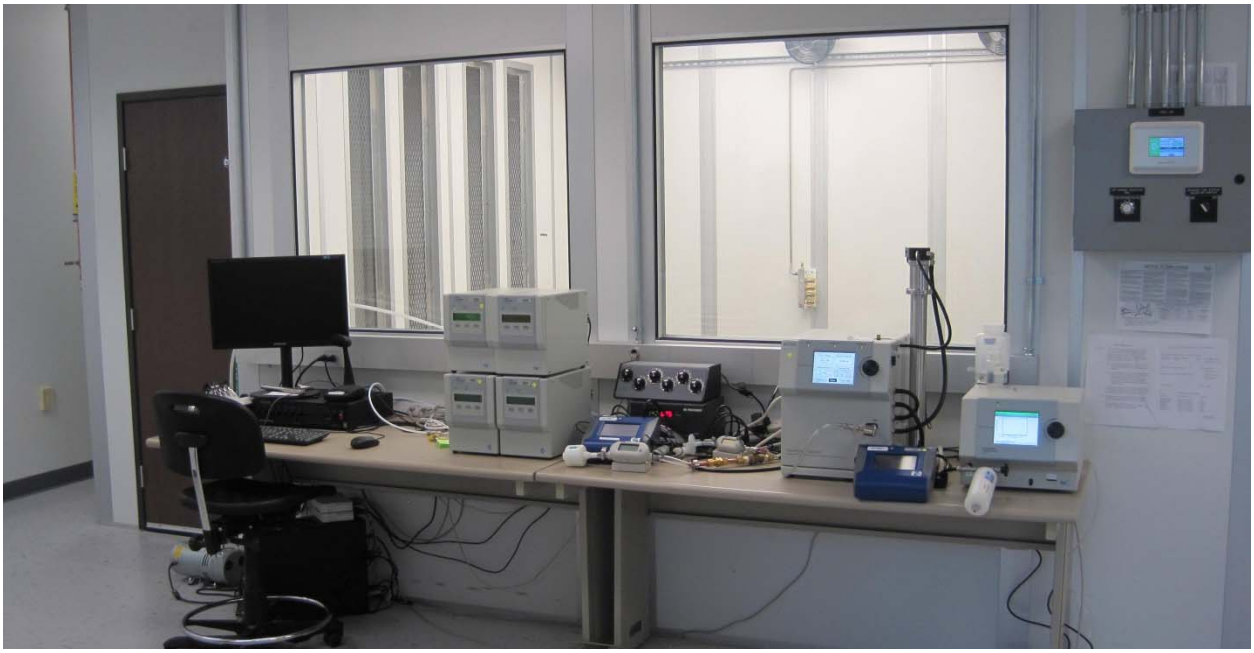
The Heat and Flame Laboratory is utilized to conduct testing on protective clothing and equipment. The primary focus of the lab is to perform heat resistance, thermal shrinkage resistance, and flame resistance on personal protective equipment (PPE) for firefighters and other first responders. These methods include ASTM International (ASTM), International Organization for Standardization (ISO) and National Fire Protection Association (NFPA) standards.

Laundering and Conditioning Laboratory

The Laundering and Conditioning Laboratory is equipped with various preconditioning and laundering equipment. The lab includes a launder-o-meter, a home washer and dryer, and an industrial washer and dryer that are specifically designed per the specifications in ASTM International (ASTM), American Association of Textile Chemists and Colorists (AATCC), and National Fire Protection Association (NFPA) standards. In addition, the lab has an air-dryer designed specifically for conditioning first responder gloves as required in NFPA standards, a large cutting table for handling and storing of rolls of fabric, and gear racks for room temperature conditioning of personal protective clothing and equipment.

Respirator Inward Leakage Measurement Laboratory

The Respirator Inward Leakage Measurement Laboratory measures the concentration of a challenge agent inside and outside of a Respiratory Protective Device (RPD) while it is worn by human test subjects performing exercise routines designed to challenge the facepiece seal of a RPD. Human exercise routines include the basic OSHA exercises in which test subjects are asked to stand and perform simple head movements, bend at the waist, breathe normally and deeply, move their arms, and talk while wearing various RPD models. Additional exercises may be added to the routine dependent on the respirator model being evaluated. An overall Fit Factor is calculated from individual fit factors measured during each exercise and this is equated to a respirator protection level which can be used to determine the ability of a particular RPD model to fit a range of facial sizes and to determine the Total Inward Leakage (TIL). The RPD TIL is inversely proportional to the Fit Factor and is expressed in terms of percent. This laboratory has two chambers and provides for the use of three challenge agents; one chamber is used for the generation of corn oil (liquid aerosol) and the other chamber is used for the generation of sodium chloride (solid aerosol) and sulfur hexafluoride (gas).



Gas and Vapor Laboratory

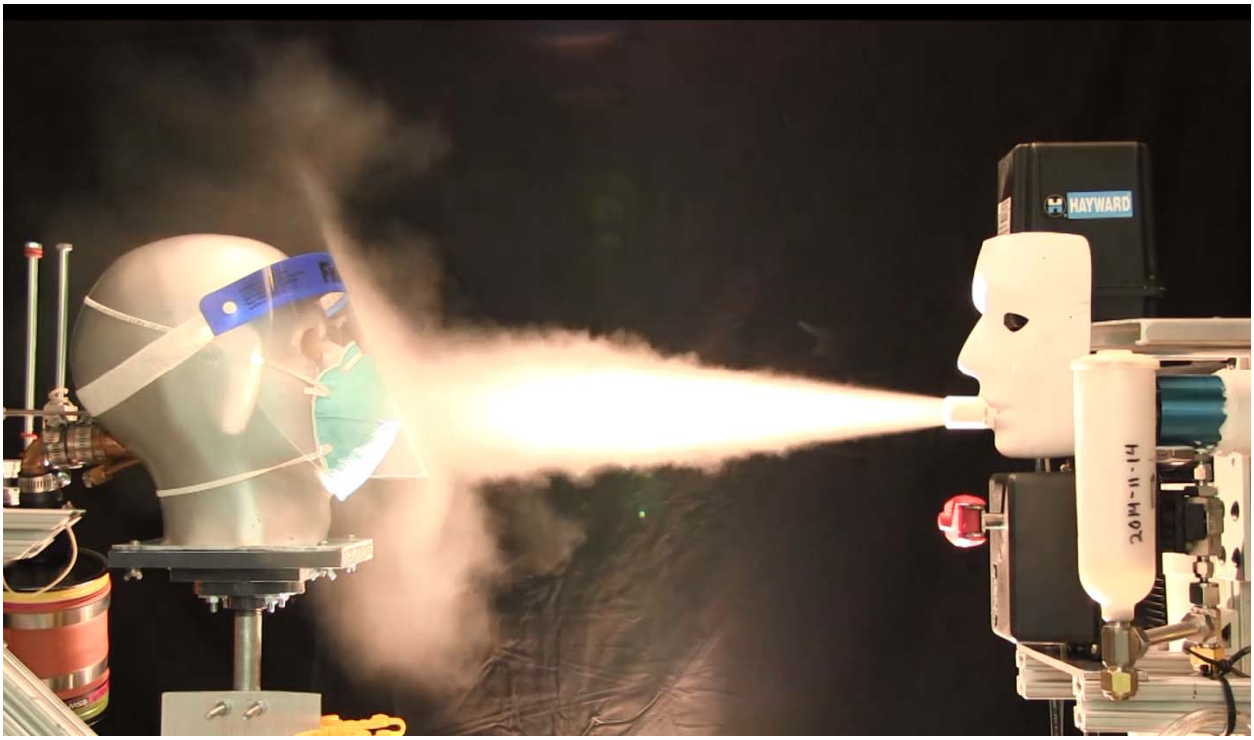
The Gas and Vapor Laboratory is used for respirator cartridge and canister testing under the NIOSH respirator certification program in addition to wildland firefighting certification testing and non-traditional and toxic industrial chemical gas and vapor research testing. The laboratory has 3 fume hoods in which the testing is performed. Test gas mixtures are made using Model HCS-401 Miller-Nelson Flow, Temperature and Humidity Controllers with the introduction of measured amounts of pure gases to create the required airflows and concentrations of challenge gases. The challenge gases are passed through the respirator cartridges or canisters mounted in a test chamber. Challenge or upstream concentrations and breakthrough concentrations are measured by using Interscan Corporation direct reading gas detectors or FOXBORO MIRAN-1A CVF Portable Ambient Air Infrared Analyzers.

The laboratory is also set up for sensor research development. Several setups are available to evaluate micro chemical sensors with environmental controls of temperature, contaminate concentration, flow rate, and relative humidity.

The laboratory is also set up for canister chemical research using an in-house built flow system with NIOSH developed software. This system offers a computer-control of mixed gas and humidified air flow into a chemical test chamber to evaluate the chemical capacities of canister materials. The challenge gases include CO_2, O_2, and CO. Gas concentrations are monitored at 3 points in the air stream using homebuilt sensor arrays. Additional laboratory equipment includes 3 fume hoods, glove box, analytical balance, 3 Altair-5 multi-gas monitors, and an Agilent 6890N gas chromatograph with an Agilent 5973N mass selective detector fitted with a Merlin Microseal injector for SPME analysis of organic off-gassing.

Influenza transmission research laboratory

This lab studies how influenza is transmitted from person to person by airborne particles and how to protect healthcare workers from exposure to these particles. The lab includes an environmental chamber that contains a coughing aerosol particle simulator and a breathing simulator. The system simulates a patient in a medical exam room who is coughing out potentially infectious airborne particles and a healthcare worker caring for the patient. The room is used to study how long airborne influenza remains infectious, where and how quickly the infectious particles spread, and how well different types of personal protective equipment protect the worker from the airborne particles.

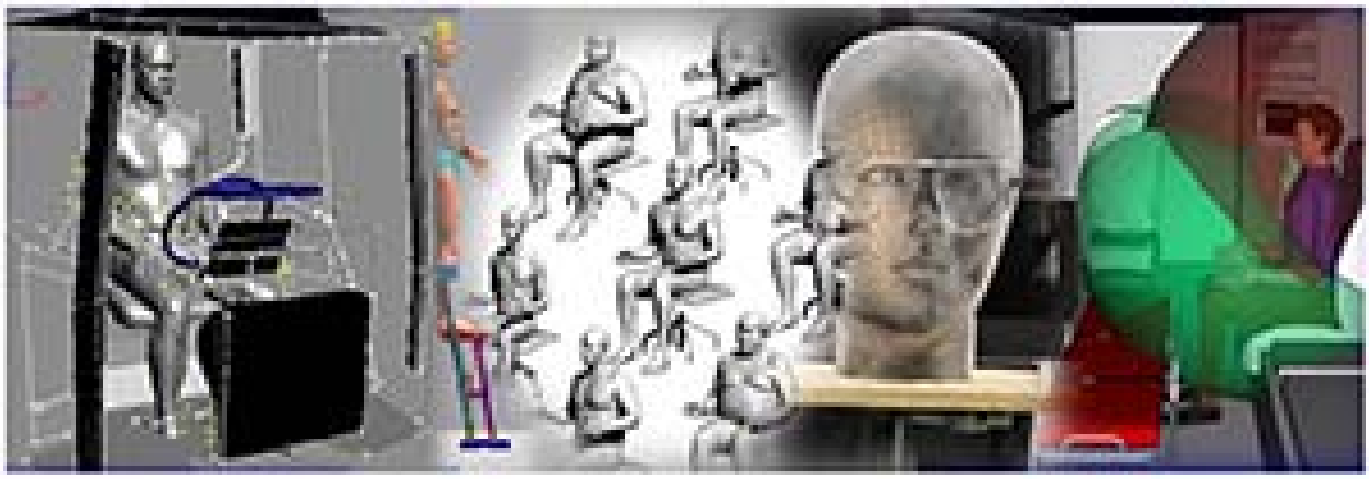


Anthropometry Laboratory

Changing human anthropometry (i.e., population composition, body size, body shape, and aging) in the American workforce requires that workplace layout, equipment, and personal protective devices be re-evaluated in order to accommodate diverse worker populations for effective injury prevention and control. NIOSH researchers have utilized the NIOSH Anthropometry Research Laboratory to collect and quantify human body size and shape of various occupational groups for use in developing improved equipment designs for worker protection.

The NIOSH Anthropometry Research Laboratory, which is equipped with a series of low-energy three-dimensional scanning devices, was developed in 1995 and remains among only a few research facilities worldwide with similar capabilities and advanced technologies. Four scanning systems (whole body, head, foot, and hand-held small object scanning) are available for use in a wide variety of research applications. The whole-body scanner has a resolution of 3 mm and requires only 17 seconds to complete a scan. The head scanner captures high resolution image of a subject's head in just a few seconds. The foot scanner records a subject's foot in 3-dimensional modes in a few second and reports linear dimensions of the foot as well. The hand held scanner can be used to capture small stationary objects (such as tools and hands) or large objects (such as cab interiors).

NIOSH scientists have developed a series of anthropometry study procedures for collecting anthropometry data, quantifying human body shape, and evaluating human-equipment interfaces for various protective equipment and workspace design applications.



Digital Modeling Laboratory

Changing human anthropometry (i.e., population composition, body size, body shape, and aging) in the American workforce requires that workplace layout, equipment, and personal protective devices be re-evaluated The Digital Human Modeling Laboratory is the NIOSH focal point for digital human model development and computerized human-system interface research. The software industry, academia, and research organizations regularly use updated digital human models for biomechanical simulations, various computational health research applications, and product design. This laboratory allows for the development of digital human models of occupational populations for the above mentioned applications. The occupational models have distinct body dimensional features as compared to the typical digital models of general civilian population and military personnel.
This laboratory incorporates high-end computer workstations and software applications for the establishment and analysis of digitized models of the human form. Software packages include JACK, Polyworks, ANSYS, ADAMS, 3DS Max, among others. The laboratory, which was developed in 1995, has developed a series of digital models of farm tractor operators, truck trailer drivers, fall-arrest harness users, and firefighters. The laboratory also has been used for other projects, such as farm tractor protective volume estimation, biomechanical assessment of lower extremity joint loading during drywall stilt use, development of truck driver body models for truck cab design, determination of eyewear protective coverage, design of ambulance compartments for emergency responders and patient safety, and fall-arrest harness fit assessments.

Mobile Anthropometry Laboratory

Like the in-house Anthropometry Research Laboratory, the Mobile Anthropometry Laboratory contains a whole body and head scanner mounted inside a 30 foot trailer. The mobile laboratory also houses foot and hand scanners and space for traditional measurement using calipers.

The mobile laboratory allows us to capture a broader demographic of workers from different geographic locations. Previous NIOSH studies on firefighters and truck drivers have revealed the difficulty in recruiting subjects who reside more than 30 miles away from data collection sites. This mobile data collection unit provides a solution to reach out to target worker populations in a time and cost effective manner for on-going and future projects. The trailer has been moved across the United States to capture different populations of workers, such as emergency medical service (EMS) workers.