

# New Labs Pave Way for Continued Advances in Small-Scale Testing

The ink was barely dry on the blueprints for the new Research Campus in West Glocester, R.I., USA, when, in 2001, FM Global began to ponder where to locate the company's small-scale laboratories. Most of these smaller labs were located in a 40-year-old facility in Norwood, Mass., USA — a facility that had been pushed to its limits.

Small- and intermediate-scale testing has long been used by FM Global researchers to explore fundamental issues surrounding fire testing and property protection. Small-scale testing supports FM Global's risk services group in resolving critical client-specific issues, and also is used to conduct applied research projects. While FM Global's advanced small-scale testing programs have resulted in a reduced need for some large-scale tests, there is still much work to be done, noted Paul Croce, vice president and manager of research at FM Global.

"In order to continue moving toward our goal of reducing the need for expensive large-scale testing, it was imperative we upgrade our laboratory facilities to accommodate the future," Croce emphasized. With plans in

place to consolidate large-scale testing at the Research Campus, the time was right to focus on achieving similar improvements in small- and intermediate-scale test facilities. "We had simply outgrown our previous lab facility. The growing sophistication and diversity of the work we are doing demanded state-of-the-art infrastructure."

## Something Old, Something New

After extensive evaluation, FM Global chose to renovate an existing building at the Norwood facility. Laboratory managers and researchers were asked to provide a list of requirements for their new laboratories. Along with duplicating current capabilities, the new laboratories also would include many pieces of new equipment, some entirely new labs and increased space for all.

Renovations began in the spring of 2003, following an aggressive schedule that included gutting the building and installing all new mechanical, electrical and plumbing systems. In this case, the design required not only normal heating, ventilation and air conditioning, but also special exhaust systems and environmental controls for laboratories.

FM Global researchers and engineers worked closely with the designers and contractors to ensure the special needs of each laboratory were met. Some labs required special filtration for incoming air, others needed special exhaust ducts for small amounts of combustion products.

One lab with special requirements is the water-mist technology laboratory. Research Scientist Benjamin Ditch and lead investigator, Principal Research Scientist H.Z. (Bert) Yu, use a sophisticated instrument known as a phased Doppler particle analyzer to measure the velocity, particle size, trajectory and distribution of microscopic droplets of water contained in water-mist spray.

"We needed a 10 by 10-ft. (3 by 3-m) clear area, up to the full 13-ft. (3.9-m) ceiling height to accommodate our water-mist research; the contractor worked with us to make that happen," Ditch said. "The new labs are far superior in every way to our former facilities. We are able to set up and conduct tests much faster and with greater consistency," he added.

In January 2004, more than 200 researchers, engineers and administrative staff from FM Approvals, research



and other groups moved into the newly renovated 141,000-ft.<sup>2</sup> (13,099-m<sup>2</sup>) facility. The US\$27 million renovation project was completed in less than a year.

## A Model Future

One of the key additions built into the new research laboratories is space for computers to support various modeling programs. These computers are used to advance the overarching goal of using small-scale tests and simulations to refine, supplement and, eventually, replace much of the intermediate- and large-scale testing currently conducted. At this time, modeling and simulation projects are focused on flammability, natural hazards, wind uplift, probabilistic failure analysis, structural dynamics, machine stress analysis, fire modeling and reliability analysis.

One of the four new computer labs incorporated in the renovations is the reliability computer lab, managed by Senior Research Specialist Enrique Susemihl, a member of the risk and reliability research group. Susemihl and his colleagues use the new computer lab to run simulations to analyze

industrial equipment reliability as part of a strategic program that may someday help reduce property losses.

“One of our areas of study is the life expectancy of transformers,” said Susemihl. “We are collecting data from transformer oil analyses conducted by our clients. We hope to one day be able to correlate trends in oil analysis and probabilistically predict the life expectancy of transformers in the field. This study has the potential to someday reduce losses for our clients. Transformer failures can be spectacularly damaging, including fires, explosions and extended business interruptions.”

One of the oldest research labs to be moved to the new facility is the flammability lab, managed by Senior Research Scientist Mohammed “Mo” Khan and Senior Research Assistant Steve Ogden. “We’re using the original Fire Propagation Apparatus (FPA) developed by FM Global in the 1970s,” said Khan. “At times, it was a struggle to get our work done in the old labs because they were in a very small space. We now have the space to accommodate new equipment and expanded research efforts.”

According to Khan, the new small-scale research labs will help accelerate the development of computer-based models to predict large-scale fire behavior. “One of our efforts is focused on reducing the reliance on the large-scale parallel panel test (PPT) by correlating the results from small-scale tests to those from the PPT,” he explained. “Our goal is to reduce the cost of testing for our clients and provide faster product evaluations.”

## New Efficiency Benefits All

The FM Approvals’ electrical group, headed by Assistant Vice President Bob Martell, also benefited from the move. His group was able to consolidate labs from several locations to achieve, perhaps, the greatest efficiency gains of any laboratory group. “We had conditioning ovens in four different labs or rooms throughout the old building,” said Martell. “We were spread out from the second floor to the basement, and our technicians and engineers spent a great deal of time moving from one area to another. Collaboration also was more difficult.”



*Geary Yee, senior research scientist in the structures and materials research area, FM Global, loads a sample tube that contains adsorbed volatile emissions from a heated polymer onto an Automated Thermal Desorption/Gas Chromatography/Mass Spectroscopy (ATD/GC/MS) system for analysis. The ATD/GC/MS system desorbs, separates, identifies and quantitates the volatile emission components from heated plastics.*

Now, the group's five new labs are located along one hallway, creating easier access to equipment and easier collaboration. Shipping and receiving also is located near the new laboratories, making it easier to handle products arriving for FM Approvals' evaluations. "Our new labs are helping to reduce product test cycle-times and giving us additional space to grow," Martell said.

According to Croce, the new laboratory facility will equally benefit FM Global and its clients. "We now have a world-class research facility that can accommodate our future needs. In the near-term, these new facilities will help us provide a greater range of services to assist our engineers in solving problems for clients. In the long-term, the advances we achieve in small-scale testing and computer modeling in these new labs will someday translate into reduced testing costs, faster turnaround and reduced frequency and severity of property loss."

## New and Improved!

Following is a list of FM Global's research and FM Approvals laboratories housed in the newly renovated facility in Norwood, Mass., USA. Also listed is basic information for each lab, including key instruments, software and projects/programs.

### Research Labs

#### Advanced Flammability Measurements

- Advanced flammability measurement apparatus to support more broadly the science and use of the Fire Propagation Apparatus (FPA)

#### Analytical Chemistry

- Gas chromatography/mass spectroscopy, automated thermal desorber system, thermal desorber system, ion chromatography, fourier transform infrared spectroscopy, microscope system for microscopy and florescent microscopy, heating oven, centrifuge, fluorometer
- Example projects:
  - Detection, diagnosis and characterization of micro-biologically influenced corrosion
  - Plastic volatiles
  - Smoke damage of stored commodities
  - Stress-corrosion cracking computer and instrument support
- General computer support and computer operations
- General instrument support for research operations

#### Computer

- Houses parallel computer and other large computer systems

#### Electrical Ignition

- Addresses the coupling of strength of various ignition sources with the ignition energy requirements of different materials

#### Environmental Chamber

- Large environmental chamber simulates environments found in industry—from extreme cold to high temperatures

#### Fire Propagation Apparatus

- Dedicated to the FPA from Fire Testing Technology Ltd., West Sussex, U.K.
- ASTM-E 2058
- Used to make measurements for critical heat flux, thermal response parameter, effective heat of combustion, chemical and convective heat-release rates, fire propagation index, average corrosion index and smoke yield
- Used for burning material property measurements

#### Flammability

- Original 50 kW FPA; also a 500 kW apparatus
- Development of an operator-independent method to determine ignition time
- Strategic research to reduce the need for intermediate- and large-scale fire tests by using computer models and property measurements collected in FPA-based tests

### **Flammability Support**

- Test sample preparation area/shop

### **General Research**

- Space for expansion
- Temporary housing for large computer systems

### **Heat Flux Gauge**

- New laboratory
- Dedicated to the calibration of heat-flux gauges, including angular calibration

### **Materials Damage**

- First-ever cleanroom simulator—an FM Global invention
- Dedicated to studying ways to reduce exposure and corrosion losses due to fire and fire byproducts

### **Materials Science**

- Metallurgical studies
- Additional capabilities to be added during 2005

### **Polymer Research**

- Ovens, ultraviolet exposure and other instruments to examine polymer aging
- Currently testing roofing membrane materials to determine impact of accelerated weathering

### **Reactivity Instrumentation**

- Supports explosion and reactivity strategic research
- Development of instruments for field application

### **Reliability Computer**

- MatLab from The MathWorks for technical computing software for the development of algorithms and applications
- Reliasoft Suite of reliability analysis software
- SAPHYRE

### **Structures Computer**

- ABAQUS/Standard – finite element-analysis software
- ABAQUS/CAE – pre- and post-processing software

- SolidWorks – solid modeling software
- NESSUS – probabilistic analysis and design
- HAZUS-MH – software from Federal Emergency Management Agency
- USWind and USQuake – software from EQECAT
- Risklink – software from Risk Management Solutions

### **Thermal Barrier**

- Dedicated to high heat-flux apparatus to evaluate the effectiveness of thermal barrier materials

### **Water-Mist Technology**

- Phased Doppler particle analyzer
- Radiant wind tunnel

### **X-ray Diffraction**

- Dedicated space for the X-ray diffractometer

## **FM Approvals Labs**

These labs are used by the FM Approvals' electrical group to test many types of products in accordance with Approval Standards. Products tested here include equipment used in conjunction with flammable gas, fuel and combustion controls; combustion safeguards; gas detection instruments; oil and gas safety shutoff valves; electrical signaling; electrical equipment; hazardous location electrical equipment; and electrical heat tracing systems.

### **Environmental Lab**

- Four product test ovens
- An environmental chamber for testing electrical devices in extreme temperatures and harsh atmospheric conditions
- Acoustic test chamber for fire and smoke alarm testing

### **General Electrical**

- Numerous bench test instruments

### **Spark and Gas**

- Optical comparator for measuring tolerances in electrical circuitry for intrinsic safety testing
- Gas detection instruments used to test products for use in hazardous locations

### **Systems and Fuels**

- Used for testing products for use in hazardous locations

### **Vibration Lab**

- Vibration simulator mounted on 14,000-lb. (6,350-kg) concrete base to test alarm monitoring systems and other devices with simulated vibration stress