New Technology for Fire Attire

A project for improving firefighting gear typifies NASA demonstrations of technology designed to provide better ways of meeting public needs

Firefighting is the most hazardous public service occupation in the United States. Little can be done about reducing the risks to which firefighters are exposed; risk is the nature of the job. But something can be done to curb firefighting injuries and fatalities. That's the goal of Project FIRES, a program jointly sponsored by NASA and the Federal Emergency Management Agency's, U.S. Fire Administration (USFA).

FIRES is an acronym for Firefighters' Integrated Response Equipment System, which describes the program's objective: improving the firefighter's "envelope," including the major elements of protective clothing and equipment. After five years of study and development, Project FIRES reached a milestone this year when a number of U.S. fire departments began field evaluation of an advanced technology ensemble—suit, helmet, boots and gloves—that could become the standard firefighting attire of the future.

Project FIRES involves application of advanced materials and design concepts to update protective gear which had gone basically unchanged for half a century. Existing "turnouts," as firefighters call their gear, do not adequately protect against many of the hazards encountered in fire suppression activities. They may, in fact, contribute to exhaustion because they are heavy and restrict mobility.

The program represents a systematic approach to developing ensembles which offer maximum protection and greater ease of movement at significantly reduced weight and at a cost which fire departments can afford to pay. Technical management for Project FIRES was provided by Marshall Space Flight Center, working with a User Requirements Committee whose membership included various segments of the firefighting community. Prime contractor for the project is Grumman Advanced Development Division, Bethpage, New York.

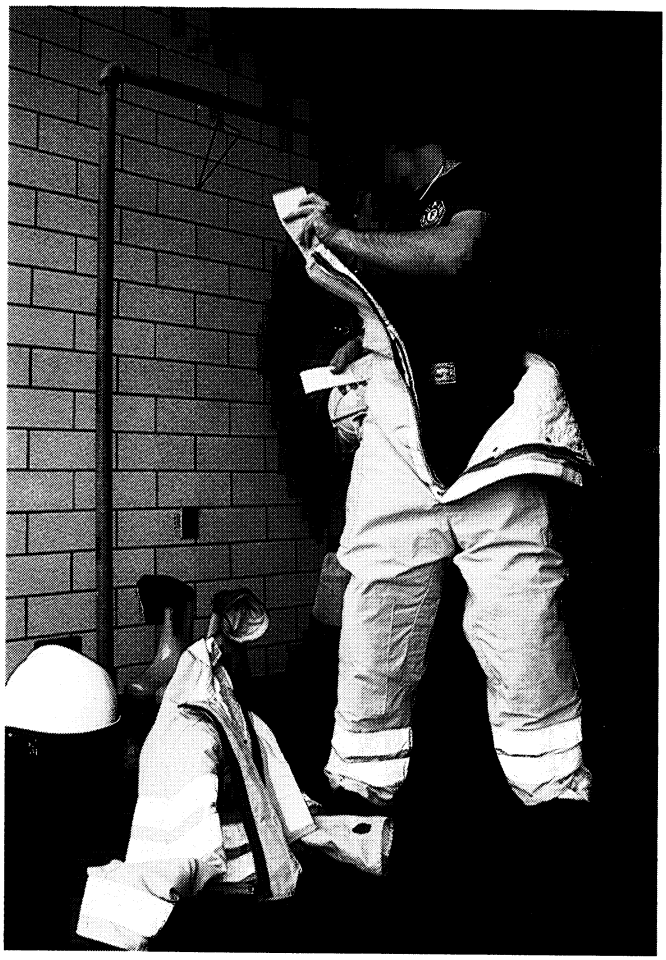
A major focus of the effort involves application to the FIRES ensemble of lightweight, fire-resistant,

Members of the Alexandria (Virginia) Fire Department show off their new firefighting gear, developed in a joint NASA/U.S. Fire Administration program to improve fire suppression equipment and reduce fireground injuries. At left, the yellow and green suits are slightly different in design and are made of different types of lightweight, fire-resistant materials. At upper right, one firefighter is donning the "short-jacket" ensemble. Far right, the long-jacket version is modeled against the backdrop of a 19th century steam pump. The Alexandria unit is one of 14 U.S. fire departments participating in a nine-month nationwide evaluation of the gear.

heat-protective materials originally developed for use in astronauts' space suits or in spacecraft components which require thermal protection. An example is a material called polybenzimidazole, or PBI©, produced by Celanese® Corporation, New York. In the aftermath of the tragic Apollo fire of 1967, Celanese began development of PBI—in conjunction with NASA and the Air Force Materials Laboratory—as a flight suit material which would afford pilots and astronauts maximum protection from fire; it was subsequently used on Apollo flights. PBI fabric does not burn or melt at temperatures encountered in structural fires, it has high abrasion resistance and, in addition, it offers flexibility and wearer comfort. Materials with similar characteristics being evaluated in FIRES are blends of Nomex® and Kevlar®, produced by DuPont Company, Wilmington, Delaware. The FIRES ensemble weighs only about 12½ pounds—40 percent less than current equipment.

Another area of focus is the "vapor barrier," a middle lining between the exterior fire-resistant material and the inner thermal lining. The vapor barrier is designed to maintain thermal protection by keeping the thermal liner dry. The barrier must protect against heat while keeping the body dry; it must also allow the body to "breathe." This feature protects against excessive heat stress, which causes almost half of all firefighter fatalities experienced annually. The Project FIRES turnout accomplishes this by using a lightweight barrier material called GORE-TEX® film—produced by W. L. Gore & Associates, Elkton, Maryland—that contains some nine billion pores per square inch. The GORE-TEX barrier keeps the turnout gear absolutely waterproof while allowing moisture vapor and body heat to dissipate outward through the tiny pores. This is possible because each pore is 700 times larger than a molecule of water vapor but 20,000 times smaller than a drop of water.

Similar careful attention was given to the design and selection of materials for other elements of the ensemble—boots, gloves, helmet and face shield. Marshall Space Flight Center required that all of this equipment be thoroughly tested for heat, impact, cut and penetration resistance before it was released for field evaluation.



Fourteen municipal fire departments are participating in the field evaluation, which will continue through 1983. The municipalities, located from coast to coast and from the northern to southern borders of the U.S., offer a representative cross-section of American firefighting experience as regards geographical location, climate, frequency of alarms and varied usage of equipment. Data from the evaluation will form a basis for development of new nationwide protective ensemble standards.

Project FIRES exemplifies a special area of NASA's Technology Utilization Program: demonstrations to show how application of advanced technology may help solve major problems or provide better ways of meeting public needs. Some product spinoff may evolve from such demonstrations, but product commercialization is not the primary aim; the intent is to create awareness of the advantageous technology and to inspire its broader application. The following pages contain other examples of NASA's participation in similar programs.