

Simple Solution Stops Pepper Spray

Pepper spray stops bears. That's why Forest Service employees working in bear country carry it.

Pepper spray also stops humans. A 1-second burst of spray directly in someone's face could cause temporary blindness; induce choking, coughing, and nausea; and



A pressure gauge proved whether containers leaked.

restrict breathing. If the spray accidentally discharged in a vehicle, the driver would have difficulty stopping safely.

The center was asked to develop a container that could be used to safely carry bear spray.

Mechanical engineer Dick Karsky not only needed to figure out a solution, he needed to figure out a realistic test to show that it actually worked.

Karsky sealed the bear spray canister in a PVC plastic container that would prevent any leakage. A pressure gauge showed that the container held 150 pounds of pressure per square inch for 4 hours without leaking. Karsky had calculated that 150 pounds of pressure could be generated if the canister were heated to 125 degrees, as could easily happen in a vehicle on a summer day.

For the test, Karsky rigged a handle on a threaded rod sealed into the cap. When he twisted the handle, the end of the rod fired the bear spray inside the container. The pressure rose to 60 pounds per square inch. The container didn't leak. The problem was solved.

But Karsky wasn't finished. He knew that the O-rings that sealed the container's caps could fail if

they weren't installed properly or cracked with age. He also knew that it would be impossible to open the container if it were sealed at low altitude and taken to high altitude. He recommended that a tire valve be installed on the cap of all PVC containers so they could be tested to prove they held pressure and to relieve pressure when they were taken to different elevations.

Mark Matheny, founder of pepper spray manufacturer UDAP Industries in Bozeman, suggested storing pepper spray in a simple 2-liter Nalgene container. Meanwhile, Dave Dieziger from the Forest Service's Missoula regional office had tested terry cloth pouches. Dieziger found that the terry cloth trapped the pepper oil while allowing the propellant to escape. The pepper oil is not dangerous when it is a liquid.

Karsky combined the approaches. First he tested the Nalgene container. It held just 50 pounds per square inch of pressure before leaking, not enough to contain the aerosol if the container burst. He lined the container with 1½-inch-thick open-cell, fine-pore urethane foam used for furniture padding. Karsky drilled a vent hole into the container's top and placed a 2-inch-thick circular plug of foam under the top.

For testing, he drilled another hole into the top of the container and used a rod to fire the pepper spray. The foam trapped the active ingredient. The problem was solved a second time.

This solution was inexpensive, simple enough for anyone to make, and relatively



The recommended storage container is a simple Nalgene plastic bottle lined with open-cell furniture foam. The foam traps the active ingredient while allowing the propellant to escape.

foolproof. This is the solution that Karsky recommended. Matheny now sells this container as an accessory.

Each year, Matheny hears about canisters of bear spray that have leaked or exploded after being left in a hot car. One canister left on a dashboard blew out the windshield.

Matheny has never heard of a problem from anyone who was using the container to store bear spray. Forest Service safety regulations now require that pepper spray be in one of the MTDC-approved containers whenever pepper spray is carried in a vehicle or in a light aircraft. The spray cannot be carried on commercial aircraft.

How T&D Solves Problems

Identify Problems

Forest Service employees submit project proposals.

Rank Problems

National steering committees select the most important projects.

Assign a Project Leader

Project leaders tap resources within the center, the Forest Service, and outside.

Consider Alternative Solutions

Most problems have more than one solution.

Test the Solutions

Compare the potential solutions.

If Everything Else is Equal, Choose the Simplest, Least-Expensive Solution

Simple solutions are usually better than complex solutions that aren't affordable or don't get used.

Implement the Solution

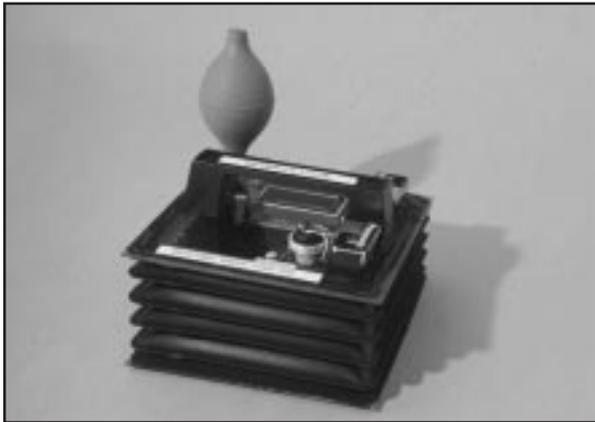
Find ways to produce the product, or share the knowledge through field trips, reports, videos, CDs, or Web sites.

Patenting Successful Products

Patents can interest industry in producing products the government develops. That's the philosophy behind patents now held by the Forest Service for products developed at the center.

The philosophy appears to have worked for at least one product, an electronic meter that measures the moistness of the layer of decaying leaves and needles (duff) on the forest floor. When forest managers use fire to thin small trees, they need to know just how moist this layer is. If the layer is too dry, the fire may burn the entire layer, leaving the soil exposed. If the layer is too moist, the fire may smolder and smoke without killing small trees as intended. Without the meter, the only accurate way to determine duff moisture is to weigh samples before and after heating them in an oven.

The duff moisture meter is now being sold by Campbell Scientific, Inc., which negotiated a license to use the patents (Patent No. 5,920,195 and 6,078,181). The center developed the meter in cooperation with scientists at the Forest Service Rocky Mountain Research Station.



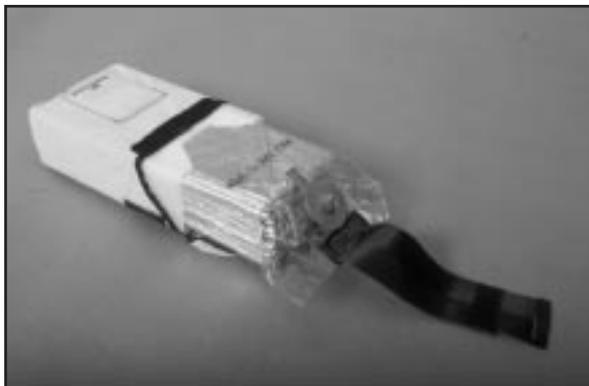
This electronic meter measures moisture content instantly, helping fire managers make better decisions.

The meter will help fire managers determine whether conditions are right before they decide to ignite a prescribed fire. In addition, the meter will help fire managers predict the behavior of wildland fires.

Other center products with patents include:

- Insulated camera box to allow a camera to take pictures from within a wildland fire (Patent No. 5,835,806).
- Pull strap that allows firefighters to open the fire shelter container with one gloved hand (Patent No. 5,921,388).
- A device that maintains the brightness of a battery-powered headlamp as the batteries are wearing down (Patent No. 4,949,014).
- A portable water bag system using a nylon duck cover with a replaceable plastic liner to deliver water to firefighters (Patent No. 5,230,566).
- Campground water pump that can be operated by people with disabilities. Just 5 pounds of force is needed to operate the pump (patent to be applied for).

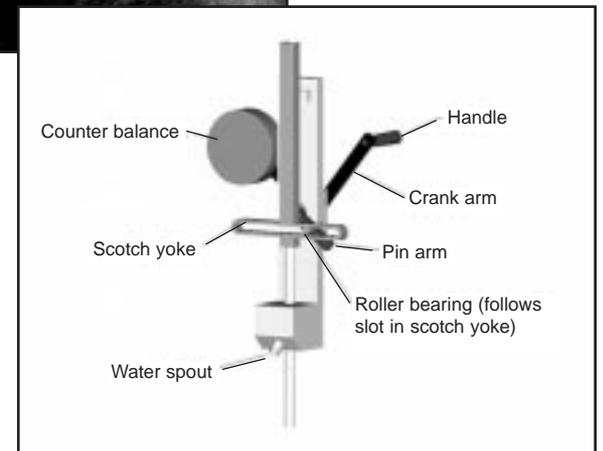
Aside from the few products that have been patented, all of the center's work is freely available for use by the public, private industry, or Government agencies. Once the center has developed a prototype, mass production is done by private contractors.



This pull strap allows firefighters to open the fire shelter container and begin removing the shelter with just one gloved hand.



The center developed nylon fabric water bags with replaceable plastic liners to assure that drinking water was sanitary. The bags are available in different sizes for carrying on a firefighter's back, in a truck, or slung beneath a helicopter.



The design of this water pump will allow it to be used by people with disabilities.

Contracts Save Big Bucks

Buying firefighting equipment through contracts saved taxpayers an estimated \$34 million last year compared to the cost of buying the same items in small quantities. The purchases are based on contract specifications established by Forest Service technology and development centers in Missoula, MT, and San Dimas, CA.

Savings add up when you consider how much equipment is needed each season by firefighters in the Forest Service, Bureau of Land Management, National Park Service, Bureau of Indian Affairs, Fish and Wildlife Service, and other agencies.

Last year, agencies ordered 129,455 pairs of the newest model of flame-resistant pants for a savings of almost \$9 million. Another \$3 million was saved buying 73,221 yellow flame-resistant shirts.

Dennis Davis is in charge of specifications at the center. He specifies the requirements

a contractor must meet when mass-producing flame-resistant shirts or other items. Technical drawings show a contractor the exact dimensions of each item.

In many cases, these items would not exist without the Forest Service's technology and development centers. Prototypes of the flame-resistant shirt and pants, fire shelter, and similar items were developed and tested by the technology and development centers. The final specifications allow contractors to produce the items in large quantities for field use.

The General Services Administration provides the specifications when soliciting bids from contractors. Once a contract has been awarded, Davis inspects the "first article" to make sure the product meets the specifications. The contractor has to correct any mistakes in materials or construction before large quantities of the item may be produced for the Forest Service.



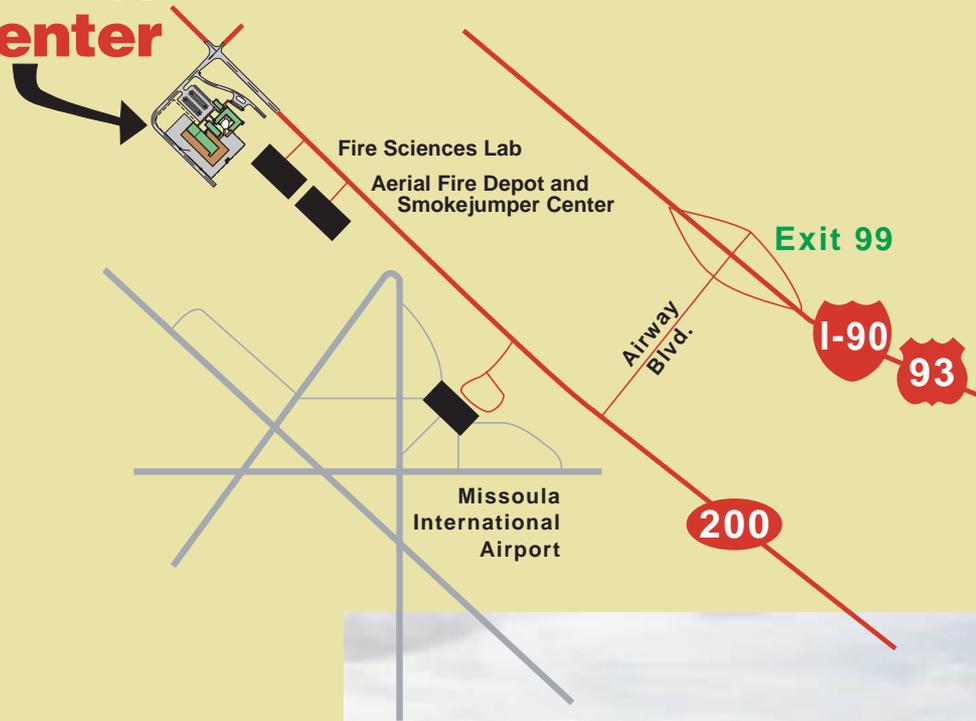
Dennis Davis inspects items to make sure they meet contract specifications.



Savings for firefighters' protective clothing purchased during 2001.

Missoula Technology and Development Center

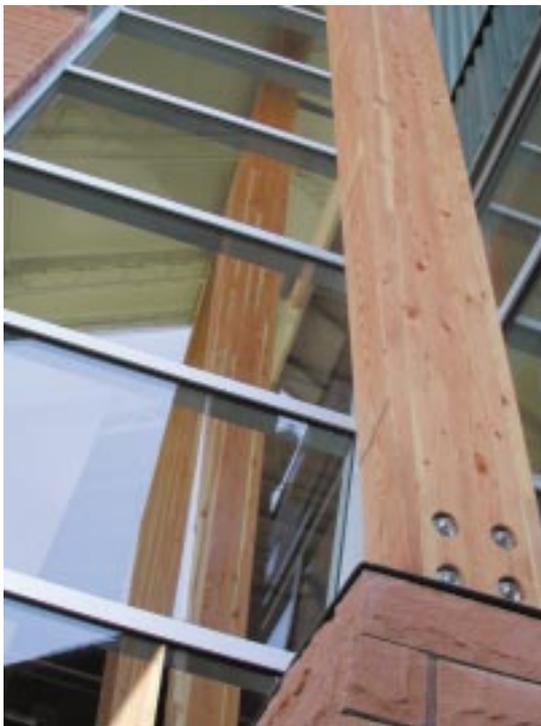
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New Building Conserves Resources and Displays Technology



Our new facility lets us work effectively while it conserves resources and displays new technology. Recirculated groundwater cools the building, which has no traditional air-conditioning units. The system saves energy and eliminates the use of refrigerants that could contribute to global warming. Natural light keeps most areas of the building bright and cheery, even when the energy-saving fluorescent lighting is not turned on.

Switches allow one bulb or all three bulbs to be turned on in each fluorescent light. After working hours, timers automatically turn off all but a few lights. The system allows the number of lights left on to be varied during different conditions.

Urinals that do not require flushing save an estimated 60,000 gallons of water a year. Most of the site's landscaping consists of recently seeded native grasses and plants that won't require irrigation.

Pressed boards made from wheat straw (otherwise a waste product) are used on some walls, balcony rails, and in the reception desk. Sweeping laminated wooden beams reach from the floor more than 30 feet to support the roof, displaying modern uses of forest products.

The facility was built with recycling in mind. The carpets, metal siding, and aluminum door frames and windows will be easy to recycle if the building is no longer useful.