



## Design Changes for Firefighter Pants

Tony Petrilli, Project Leader

The Forest Service, U.S. Department of Agriculture, first specified flame-resistant (FR) pants for fire personnel in 1974. That year, the Missoula Equipment Development Center announced the availability of Nomex flame-resistant pants for wildland firefighters. Since then, the pants material and design have been changed periodically, mostly in response to feedback from firefighters.

pockets, different waist adjustment buckles, and new cuff cinch straps. Pants incorporating these changes began to be produced in 2008. The 34-inch inseam length for regular-size pants was changed to 33 inches. A long size with a 36-inch inseam was added. Three inseam sizes (short—30-inch, regular—33-inch, and long—36-inch) will help firefighters find pants that fit better. Existing stocking levels will dictate when pants with all these changes will be available through the General Services Administration (GSA) Wildland Fire Equipment Catalog.

### 2005 MTDC Product Review Leads to Design Changes

In the summer of 2005, the Missoula Technology and Development Center (MTDC) conducted a nationwide product review to evaluate firefighter satisfaction with the current design of FR pants (figure 1). Nearly 2,000 firefighters from various Federal agencies throughout the United States responded. In response to this feedback from firefighters, several design changes were made: stronger seam construction, increased seat/leg room, expanded cargo

### Highlights...

- Nearly 2,000 firefighters responded to the Missoula Technology and Development Center's 2005 nationwide product review of flame-resistant pants worn by firefighters.
- The pants design was improved based on the firefighters' responses.
- The General Services Administration now includes flame-resistant pants made from a para-aramid blend (Kevlar) fabric, as well as the existing meta-aramid blend (Nomex) fabric.

**Wildland Firefighter Clothing**

The Missoula Technology and Development Center (MTDC) maintains specifications for much of the **personal protective equipment** purchased through the General Services Administration's Wildland fire catalog and worn by Federal and State wildland firefighters. To meet the needs of field personnel, MTDC needs to learn about the utility of two of the products used by wildland firefighters – **flame-resistant pants and heavy-duty leather gloves**. Please assist us in improving these products. Feel free to make additional copies as needed.

*Flame-resistant clothing for wildland firefighters should allow the firefighter's own heat to escape, protect the firefighter from the fire's radiant heat, and limit the likelihood that the clothing will ignite.*

The following questions refer specifically to the **BDU (battle dress uniform) style flame-resistant pants** currently available through the National Cache system or GSA (NSN 8415-01-464-3676).

1. What **size** pants do you wear? Waist \_\_\_\_\_ (inches)                      Length \_\_\_\_\_ (inches)
2. Pants now are available in waist sizes 26 to 44 inches, and inseam lengths of 30 and 34 inches.
  - 2a. Do you think **additional waist sizes** are necessary?     No     Yes  
If yes, what waist size? \_\_\_\_\_ (inches)
  - 2b. Do you think **additional inseam lengths** are necessary?     No     Yes  
If yes, what length? \_\_\_\_\_ (inches)
3. How would you rate the overall fit of the pants? (**circle a number** for each response)
 

|      |   |   |           |
|------|---|---|-----------|
| poor | ← | → | excellent |
| 1    | 2 | 3 | 4         |
| 1    | 2 | 3 | 4         |
4. Rate the way the **pants fit** you:
 

|               |           |   |   |           |
|---------------|-----------|---|---|-----------|
|               | too loose | ← | → | too tight |
| Waistband     | 1         | 2 | 3 | 4         |
| Seat and hips | 1         | 2 | 3 | 4         |
| Crotch/rise   | 1         | 2 | 3 | 4         |
| Leg           | 1         | 2 | 3 | 4         |
| Length        | 1         | 2 | 3 | 4         |
|               | too short | ← | → | too long  |
|               | 1         | 2 | 3 | 4         |
5. Rate your **level of satisfaction** with the following pants' features:
 

|                  |             |   |   |           |
|------------------|-------------|---|---|-----------|
|                  | unsatisfied | ← | → | satisfied |
| Front pockets    | 1           | 2 | 3 | 4         |
| Hip pockets      | 1           | 2 | 3 | 4         |
| Cargo pockets    | 1           | 2 | 3 | 4         |
| Waist adjustment | 1           | 2 | 3 | 4         |
| Cuff adjustment  | 1           | 2 | 3 | 4         |
|                  | unsatisfied | ← | → | satisfied |
| Articulated knee | 1           | 2 | 3 | 4         |

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Figure 1—In 2005, MTDC provided forms to firefighters across the country so they could provide feedback about flame-resistant pants.

## 2005 and 2006 Field Trials for New Fabrics

In 2005, MTDC also began evaluating alternative fabrics for use in FR pants. Five new fabrics were chosen for wear testing. The current fabric was included as the experimental control. The six wear-test fabrics were:

- A—Current fabric, Nomex (meta-aramid) blend, (Forest Service Specification 5100-88 Type I) 7.5 oz/sq. yd, twill weave, wicking finish
- B—Kevlar (para-aramid) blend, 7.0 oz/sq. yd, ripstop weave, durable water-repellent (DWR) finish
- C—Nomex (meta-aramid) blend, ripstop weave, wicking finish
- D—Nomex (meta-aramid) blend, ripstop weave, durable water-repellent finish
- E—Nomex (meta-aramid) blend, smooth ripstop weave, wicking finish
- F—Indura FR cotton blend, 11 oz/sq. yd, plain weave

The 2005 product review identified two improvements firefighters wanted in FR pants: better protection from certain types of vegetation, such as brush and briars, and better thermal comfort in hot weather conditions, to reduce the likelihood of heat stress.

Evaluators thought the FR cotton pants provided the most protection from brush and briars. However, two characteristics led to FR cotton fabric being eliminated from further consideration. The FR cotton readily absorbed water and took a long time to dry. Evaluators also thought the fabric was too hot.

The Kevlar (para-aramid) blend received the second highest rating for protection from brush and briars. This blend had the second “coolest” rating of any fabric tested; only the current fabric was rated cooler. These factors make this fabric the best candidate for offering firefighters increased protection from brush and briars. This fabric also:

- Was more comfortable in cooler weather
- Had higher heat protection ratings during thermal and radiant tests
- Was requested by many firefighters

Forest Service specification (5100-92) for FR pants has been revised to include the para-aramid blend fabric. The 5100-92 specification now includes Type I pants, made with the meta-aramid blend (Nomex) fabric, and Type II pants, made with the para-aramid blend (Kevlar) fabric.

## New Firefighter Pants Available Now

The 2009 GSA catalog includes the current meta-aramid blend (Type I, \$75.54) pants and a brief announcement of the new para-aramid blend (Type II, \$119.89). Both types incorporate the new design features described earlier (figure 2). Initially, the Type II pants will be available only in the most used sizes. Other sizes will be available later. The two choices of fabrics provide firefighters with greater flexibility to match their clothing to the diverse environments where firefighters may work, given their national mobility and extended fire seasons.



Figure 2—Type II flame-resistant pants made of a para-aramid blend in a rip-stop weave are now available through the General Services Administration.

Forest Service funds can be used to purchase these pants only when they are ordered from the GSA Wildland Fire Equipment Catalog or the Wildland Fire Equipment section of GSA Global Supply (<http://www.gsaglobalsupply.gsa.gov>). The specific NSN (National Stock Number) ordering number (table 1) must be provided when ordering the pants. For more information on ordering the Type II pants, go to the GSA Fire Program Web page (<http://www.gsa.gov/fireprogram>).

Table 1—Type II (para-aramid blend) pants available through the GSA. The inseam lengths are short (30-inch) and regular (33-inch). Other sizes will be available later.

| GSA ordering number | Waist size (inches) | Inseam length |
|---------------------|---------------------|---------------|
| 8415-01-559-3540    | 28–32               | Regular       |
| 8415-01-559-3545    | 28–32               | Short         |
| 8415-01-559-3543    | 30–34               | Regular       |
| 8415-01-559-3542    | 30–34               | Short         |
| 8415-01-559-3544    | 32–36               | Regular       |
| 8415-01-559-3549    | 32–36               | Short         |
| 8415-01-559-3547    | 34–38               | Regular       |
| 8415-01-559-3541    | 34–38               | Short         |
| 8415-01-559-3548    | 36–40               | Regular       |
| 8415-01-559-3546    | 36–40               | Short         |

## The Future

Firefighters are participating in field trials to evaluate lighter weight fabrics in new material blends as a possible replacement for the Type I pants material. The goals are increased thermal comfort in hot weather, improved durability, lower costs, and overall firefighter satisfaction.

## About the Author

**Tony Petrilli** is an equipment specialist for the fire and aviation and safety and health programs at MTDC. He has a bachelor's degree in education from Western Montana College. Petrilli began working for the Forest Service in 1982 and joined MTDC full time in 2000. He has worked as a firefighter for the Lewis and Clark and Beaverhead National Forests and as a smokejumper for the Northern Region. He is a division/group supervisor, type III incident commander, and has served on more than 20 fire entrapment review or investigation teams.

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Nearly 2,000 firefighters responded to the Missoula Technology and Development Center's 2005 nationwide product review of flame-resistant pants worn by firefighters. Design changes based on the firefighters' responses included stronger seam construction, expanded cargo pockets, different waist adjustment buckles, and new cuff cinch straps. Six fabrics for firefighter pants were field tested during the 2005 fire season. Based on the field tests, the para-aramid (Kevlar) blend fabric was added to the Forest Service's specification for flame-resistant pants. The General Services Administration will now include flame-resistant pants made from a blend including para-aramid fibers (Kevlar) as well as the existing blend that includes meta-aramid fibers (Nomex).

**Keywords:** clothing, fabrics, fire fighting, firefighting, flame resistant, FR, Kevlar, meta-aramid, Nomex, para-aramid, specifications



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