

## Traffic Signs for Wildland Fire Incidents: Meeting National Standards

—Donna Sheehy, Northern Region traffic management engineer; and Charles Showers, program leader, Missoula Technology and Development Center

In the past, signs for USDA Forest Service wildland fire incidents were created from whatever supplies were readily available, including cardboard, paper plates, glow sticks, and flagging. Each fire season since 2000, the Northern Region Traffic Safety Teams have procured commercially produced signs that meet the standards required for highway temporary traffic control zones. Standard signs help motorists and incident personnel recognize incident activities so they can slow down and pass safely through the area. Lessons learned by the Northern Region during the past 3 years regarding signing and other traffic control devices for incident management have national implications. Several projects are underway that will provide national standards and program direction for temporary traffic control for all incidents, including wildland fires.

The USDA Forest Service is responsible for fire management and suppression activities on 192 million acres of National Forest System lands. The last several years have seen some of the most extreme wildland fire behavior in recent history. Numerous traffic and congestion problems, especially in the wildland-urban interface (figure 1), pose a major threat to the safety of fire personnel and motorists. Their lives depend on being able to recognize traffic hazards associated with incident activities and passing safely through areas affected by the incident. These areas, known as Temporary Traffic Control (TTC) zones, are created by using temporary traffic control devices, flaggers, uniformed law enforcement officers, or other authorized personnel to notify motorists of the zones. Some of the TTC zones created during incident management activities include:



Figure 1—Standard signs are especially important at incidents near the wildland-urban interface. This sign pointed to the incident base for the 2003 Robert Fire in Columbia Falls, MT, at the intersection of Highway 2 and the North Fork Road. This design has been replaced by one saying *INCIDENT BASE*.

- Locations where large volumes of incident-related traffic enter and exit highways at intersections that otherwise would have little or no traffic
- Areas where suppression operations are conducted on or adjacent to roads open to traffic
- Facilities for incident personnel, such as the incident base, spike camps, helispots, fueling sites, and dropoff locations
- Stretches of road where smoke from wildland fires impairs visibility
- Road and area closures in and around incidents

More than 40,000 people are injured and more than 1,000 are killed each year by motor vehicle crashes in TTC zones. These zones are among the most dangerous areas on roads. Traffic-related accidents account for a disproportionate share of incident injuries and fatalities.

According to national studies, TTC zone crashes tend to be more severe than other crashes. Federal statistics indicate that more than 80 percent of those killed in TTC zone crashes are drivers or passengers, not road workers. These statistics also show that rear-end crashes are by far the most common type of fatal accident in TTC zones. Too many motorists fail to reduce their speed enough to drive safely through TTC zones.

Proper use of standard signs (figure 2) and other appropriate temporary traffic control devices can help mitigate the risk of accidents by providing for the reasonably safe and efficient movement of traffic through or around TTC zones.



Figure 2—The illustration shows proper sign placement with a warning sign before the guide sign. These signs served a helibase near the Blackfoot Fire in northwestern Montana during 2003.

### **Requirements of the Manual on Uniform Traffic Control Devices**

By law, traffic signing for incident operations must comply with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD). All 50 States have adopted the MUTCD for public roads under their jurisdiction. Federal law (23 CFR 655.603) requires all Federal agencies to follow the MUTCD for all roads open to public travel.

USDA Forest Service policies in the Forest Service manual (FSM 7103.3, 7731.15 and 7730.04 [9]) require adhering to the MUTCD for all warning and regulatory signs on all National Forest System roads, regardless of their maintenance level. Guide signs on maintenance level 3, 4, and 5 roads (all maintained for passenger cars) must conform to the MUTCD. Guide signs on maintenance level 1 (closed to highway vehicles) and level 2 roads (maintained for high-clearance vehicles) may deviate from the MUTCD.

All signs intended to guide motorized traffic must meet certain standards (figure 3). These standards are based on the latest highway safety research and are the result of a rulemaking process that included extensive public comment. Signs shall:



Figure 3—Often signs erected during the early stages of an incident don't provide adequately for the safety of motorists or incident personnel. These signs were at a blind intersection near a helibase serving more than two-dozen helicopters near the Ninemile Fire in western Montana during 2003.

- Be retroreflective. This means that the signs shall be designed to reflect the light from a vehicle's headlights back to the motorist, making the sign relatively easy to read at night or when fog or smoke reduce visibility.
- Have a consistent standard shape, color, and message.
- Be sized according to the speed of the approaching traffic.
- Be crashworthy.
- Meet installation standards for mounting height and distance from the edge of the road.

**Incident Management Requirements**—Chapter 6B of the 2003 MUTCD is a new section for incident management. This chapter requires that “The control of road users through a temporary traffic control zone *shall be* an essential part of highway construction, utility work, maintenance operations, and incident management.”

The safety of road users and incident personnel, as well as the efficiency of traffic flow, are integral elements of every TTC zone, from their planning through their installation. The safety of the public traveling through TTC zones and the safety of

personnel performing tasks within the zones are equally important. TTC zones, especially those involving fire incidents, present constantly changing conditions that are unexpected by the road user. The unexpected and unpredictable nature of TTC zones heightens the vulnerability of incident management personnel working on or near the roadway. Effective use of TTC zones also can provide for efficient completion of whatever activity interrupted normal use of the roadway.

Many incident facilities are located in remote rural locations. Darkness, smoky conditions, and vegetation often make it hard to see intersections clearly, especially if they are marked with small, paper signs that are not retroreflective. Standard signs can help crews, delivery personnel, support staff, and other incident personnel find their destinations safely, even under adverse conditions.

### **Incident Management Signing—The Beginning**

During 2000, wildfires in the Northern and Intermountain Regions burned 1.6 million acres and more than 400 structures. These incidents triggered one of the largest firefighting mobilizations in history as 25,000 personnel were brought in from as far away as Australia. More than 50 major fire camps were established in the Northern Region alone.

Large fires began escaping control during July. As the situation continued to worsen through August and into September, the Northern Region engineering staff became concerned about the haphazard signs appearing on many of the major highways and the city streets of affected communities. Staging areas and fire camps were in the middle of some cities and towns. Fire activities and large amounts of traffic affected State highways, county roads, city streets, and USDA Forest Service roads, posing an ongoing threat to the safety of incident personnel and motorists.

The Northern Region asked Donna Sheehy, regional traffic and transportation management engineer, to organize a response. Two technical sign experts were brought in from other regions (Greg Watkins from the Pacific Southwest Region and Jim Abernathy from the Pacific Northwest Region). Dave Neeley, formerly of the Intermountain Region, was brought out of retirement.

These experts were assigned to work with a local member of the engineering staff who knew local contacts and the areas where fires were burning. Teams were organized to visit incident sites and develop sign plans in coordination with the incident logistics or ground support staff. Sign plans were faxed back to the Northern Region offices in Missoula, MT.

The need for signs and traffic control devices for road closures and for incident facilities quickly exceeded agency and commercial inventories in western Montana. Several local sign manufacturers and construction companies and the USDA Forest Service's Sign Shop in Redding, CA, were contacted so they would be ready to start manufacturing additional signs. Orders were grouped according to the type of sign and material (such as vinyl) used to produce the sign. Orders were rotated among manufacturers to ensure quick production.

Signs were received within 1 or 2 days after orders were placed. The sign teams picked up the signs, delivered them to the incident, and installed them within a few days of their initial visit.

Sign manufacturers and the Redding Sign Shop personnel put in a lot of overtime while providing signs for the incidents. Several companies shipped signs overnight or delivered them to sign teams at meeting points partway to the incident. By the end of August, all incidents were marked with standard signs.

After the 2000 fire season ended, the sign teams and the regional traffic and transportation management engineer reviewed the season's work, including the types of signs that had been ordered and provided to the incidents. Standard messages were developed for the signs. Sign sizes were consolidated to make signs easier to order, manufacture, store, and ship. The group developed a draft incident sign catalog.

The 2001 and 2002 fire seasons saw little fire activity in the Northern Region. The Northern Region's engineering staff easily handled the few incidents that did occur. The draft incident sign catalog was used to determine sign needs at the incidents. Incident management teams became more familiar with the signs that were available or that could be provided for special situations. Additions and changes were made to the draft catalog, further standardizing signs for incident management. This catalog will be available to USDA Forest Service and U.S. Department of the Interior, Bureau of Land Management employees over the USDA Forest Service's internal computer network at: [http://fsweb.r1.fs.fed.us/e/signs/signs\\_index.shtml](http://fsweb.r1.fs.fed.us/e/signs/signs_index.shtml).

During the 2003 fire season, Montana and northern Idaho had more than 30 major wildland fire incidents. Missoula, MT, where the Northern Region has its headquarters, was surrounded by large fires that threatened local subdivisions and surrounding communities. The traffic safety teams went back into action with members from the Northern and Pacific Northwest Regions. Teams visited each incident several times over the course of 2 months. Some incident facilities were in place for much of that time.

Signing needs changed almost daily. Signing also changed when incident management teams rotated and were replaced by new teams. Some incident teams took the standard signs with them so they would have them at their next assignment.

Additional sign vendors were used in 2003 because of the quantity of signs being ordered. Many of the signs were produced on the same day they were ordered. This extraordinary response from the vendors allowed the traffic safety teams to respond immediately to requests for critical warning signs. Incident management teams appreciated this effort to provide for their safety. The vendors, who responded nearly immediately to the growing number of sign orders, deserve much of the credit.

## **Safety Issues**

Through the course of the 2000 to 2003 fire seasons, several traffic safety issues were identified. They include road signing, road closures, and flagging.

**Road Signing**—Before standard signs were provided, most traffic signs (including  
*Engineering Field Notes, Volume 36, Issue 1—2004*

signs on roads approaching the incident and signs used within the incident facility itself) did not meet even the minimum mandatory requirements of the MUTCD. Improvised signs were made from cardboard boxes and paper plates using felt-tip markers (figure 4).

When teams received a set of MUTCD standard signs (figure 5), the signs tended to stay with the team. In one instance, a Type II Incident Management Team from the Pacific Northwest arrived at an incident with a trailer full of MUTCD standard traffic control signs. When the team demobilized after 14 days, it took the signs home. This left the incident without appropriate signing, even though the incident's traffic and signing needs continued for several weeks after the team left.

**Road Closures**—Many of the initial road closures related to the incidents were not implemented with proper signs and traffic control devices (figure 6). Persons staffing roadblocks sometimes set up camp in the center of the road they were closing. People sat or stood in front of barricades. Often military vehicles were parked in the middle of the road with no signs installed to warn traffic approaching the vehicle from the rear. Signs were blocked by messages and fire notices.

Many barricades were simple sawhorse structures with no retroreflective signs or markers for night visibility. Others were wire gates with little or no signing. The barricades were not designed to stay upright during the high winds typically found during extreme fire behavior.



Figure 4—Cardboard signs are typical at incident bases.



Figure 5—Standard signs are easier to read at an incident base during the day and especially at night, when much of the base's activity takes place.



Figure 6—Standard signage is important at barricades. Here, notices cover the message explaining the barricade. Another problem illustrated here is that the road guard will have to cross an open lane of traffic to speak to motorists who stop at the barricade.

**Flagging**—In some situations, individuals with little or inadequate training were flagging traffic on major roads, without the required safety equipment or signs. Flagging is one of the most dangerous temporary traffic control jobs. Construction traffic-control supervisors and flaggers are the workers most likely to become work zone casualties. All personnel working near traffic need to be trained, but training for flaggers should be a priority. The MUTCD, part VI, section 6E-2, states that flaggers should be trained in safe traffic control practices and shall have the proper equipment.

Figure 7 shows a flagger at great risk of being struck by a vehicle because standard safety procedures were not followed. The flagger is not wearing mandatory high-visibility safety apparel as required by the MUTCD. Nomex firefighting clothing is not approved high-visibility safety apparel.

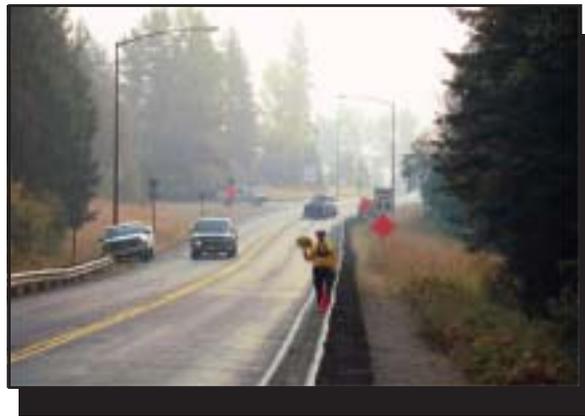


Figure 7—This flagger is not complying with standards established to increase motorists' safety without unnecessarily endangering flaggers.

High-visibility safety apparel is fluorescent orange-red or fluorescent yellow-green background material with retroreflective material that is orange, yellow, white, silver, yellow-green or a fluorescent version of those colors. It is visible for at least 1,000 feet, and it is designed to identify the wearer as a person. The flagger's stop/slow paddle in figure 7 is homemade and does not meet mandatory standards. This paddle is not acceptable!

Stop/slow paddles are at least 18 inches wide, have letters at least 6 inches high, have a *STOP* red background with white letters and border on one side, have a *SLOW* orange background with black letters and border on the other side, are octagonal, and are retroreflective.

Furthermore, the flagger in figure 7 is not using proper flagging technique. The paddle face should be aimed toward road users in a stationary position with the flagger's arm extended horizontally away from the body.

The flagger should not be standing in the lane with moving traffic. Instead, he should be on the other side of the guardrail so he could escape if necessary. The flagger should use a long pole to steady the paddle and provide support when he is holding the paddle out to the side.

All warning signs in figure 7 are behind the flagger. No warning signs are in front of the flagger. Drivers have not been alerted that a flagger is ahead and that they need to be prepared to stop.

Finally, there should be two flaggers—one for each side of the intersection. Most States require that flaggers on State roads be certified. Flagger certification might have prevented some of the unsafe practices shown in figure 7.

## **Incident Management Traffic Control Projects and Recommendations**

**National Coordination**—The USDA Forest Service is working on several projects to help supply MUTCD-approved signs for all incident management traffic control activities and to help train incident managers in their use.

The USDA Forest Service is coordinating with the American Association of State Highway Transportation Officials (AASHTO), the Western Association of State Highway Transportation Officials (WASHTO), and the U.S. Department of Transportation, Federal Highway Administration (FHWA). National and State agreements are being developed to assure that signs and traffic control devices meeting MUTCD standards are in place on public roads during incident operations as soon as possible.

New incident management traffic sign standards will be incorporated into the 2004 revision of the USDA Forest Service Signing Standards and Guidelines. These standards will be incorporated in a supplement to the MUTCD, with FHWA cooperation.

The Local Technical Assistance Program at Montana State University in Bozeman, MT, has produced the first incident management signing course in cooperation with the USDA Forest Service. This course is available to all local, State, and Federal agencies involved in incident management. For further information on the course, contact Steve Jenkins, director of the Local Technical Assistance Program at Montana State University (406-994-6671, [stevenj@coe.montana.edu](mailto:stevenj@coe.montana.edu)).

**Sign Catalog**—An incident sign catalog has been developed with standard and custom messages and with sizes appropriate for most signs needed at incidents, including wildland fires and prescribed burns. The catalog shows standard signs that should be used for marking approach roads, internal camp roads, pedestrian crosswalks, facility locations, or staff offices (figure 8). Sign teams use this catalog when working with

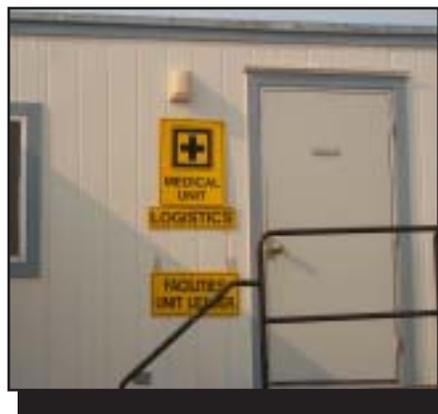


Figure 8—Standard signs for incident offices help incident personnel locate the right trailer or tent at the incident base.

incident personnel to determine an incident's sign needs.

Several of the new sign messages developed for specific incident-related needs include: *INCIDENT BASE*, *HELIBASE*, *FIRE TRAFFIC ENTERING ROAD*, and *FIRE ACTIVITY AHEAD*. Blank plates are provided for naming the incident. The incident name can be critical when an area has more than one incident. Work is continuing to make the sign messages appropriate for all types of incidents, not just fires.

Some of the more important and popular road signs are the *DROP POINT* and the *DROP POINTS* signs. Drop points are places where fire personnel and supplies are dropped off or picked up. Traditionally, drop points have been numbered and marked using paper plates, cardboard, or flagging (figure 9). These materials are not visible on high-speed roads, at night, or in smoky air. Such signs also can be confused with local notices in urban areas. Without proper signing of drop points (figure 10), incident personnel can get lost, and supplies can be delayed or delivered to the wrong location.



Figure 9—Vendors and incident personnel need to be able to find drop points, where personnel and supplies are dropped off or picked up. Motorists traveling on Highway 93 outside of Missoula, MT, during the 2003 fire season could not see this pie plate easily.



Figure 10—The standard orange drop point sign helps vendors and incident personnel find the drop point in Upper Miller Creek on the outskirts of Missoula, MT. Standard signs are much easier for motorists to see at night or in smoky air near a wildland fire and are less likely to be obscured by other notices. The paper plate that had first served as a drop point sign was covered with notices.

Hundreds of drop point signs have been delivered to incidents. They have been ordered either with printed drop zone numbers or with blank areas where the number can be filled in with a grease pencil or felt-tip marker. Testing is underway to determine how best to remove marker ink so a sign can be reused for several incidents.

Additional messages are being developed and standardized. These include: *VEHICLE WASH STATION*, *SAFETY ZONE*, *HELICOPTER OPERATIONS*, and *FUELING STATIONS*.

**Sign Kits for Initial Attack Engines**—Typically, USDA Forest Service fire engines are responsible for the initial attack on fires adjacent to public roads. Most of these engines do not carry standard warning signs. These engines need to have rollup sign kits that include warning signs and collapsible tripods. Such kits would allow the crew to set up the signs quickly to warn oncoming traffic that fire engines are working next to roads.

**Technology and Development Projects**—Three projects affecting signing at incidents have been approved for the USDA Forest Service Technology and Development Program during the 2005 fiscal year: fire cache sign kits, incident base sign installation guides, and flagging and temporary traffic control during roadside fire management activities.

### Field Testing of the New Color for Incident Management Signs

The FHWA worked with the Northern and Pacific Northwest Regions to experiment with a proposed new incident sign color.

Incident signs are normally retroreflective orange or fluorescent orange. Orange may not be the most effective color for incident signs. If a wildland fire incident occurs near or in conjunction with an existing highway work zone (figure 11), motorists may be unable to differentiate between incident signs and work zone signs.

Also, motorists may not believe signs in areas where work zone signing has not been faithfully covered or removed before or after a project. Drivers tend to ignore signs when they are left up after an activity has been completed.

**Methodology**—The 2003 wildland fire season in western Montana provided an opportunity to experiment with the proposed incident sign color, coral (fluorescent pink), and compare it with the standard fluorescent orange color (figure 12).



Figure 11—Coral (fluorescent pink) traffic signs related to incident management are easy to distinguish from orange road construction signs.



Figure 12—Fluorescent orange signs were compared with new fluorescent pink signs in Northern Region field tests during the 2003 fire season.

The USDA Forest Service distributed the following questionnaire to foremen of two engine crews and to incident managers.

1. What color are your signs? \_\_\_ Orange \_\_\_ Coral
2. In what situation did you use signs? \_\_\_ Initial Attack \_\_\_ Incident \_\_\_ Both
3. Have you used work zone-type warning signs for warning of your engine's activities in the past? If so, please describe the signs and their use.
4. How effective were the signs for warning motorists of your engine's activities?
5. Have you had any positive reaction/comments to your signs?
6. Have you had any negative reaction/comments to your signs?
7. Is there a preference to one color over the other based on your experience?

**Signing and Responses**—The signs were placed at major wildland fire incidents along U.S. Highways 93 and 200, and Interstate 90 in western Montana. The following fires were involved: Gold1, Cooney Ridge, Big Creek, Black Mountain, and the Fish Creek Complex. Fabric signs were provided to two engine crews for use during the incidents, and questionnaires were provided to the crew foremen.

General comments from all individuals involved with camp management or transportation and deliveries praised the improved signing at the incidents. Most individuals had never worked on an incident that had proper signing before, regardless of the colors used. They appreciated working in a safer environment.

Incident signing was the responsibility of three to five two-person teams who evaluated the need for signing at incidents and ordered and installed the correct signs. Local sign companies made the signs to MUTCD specifications on short notice, usually overnight and sometimes on the same day.

Anecdotal evidence suggests that fluorescent pink signs are very effective. The incident management teams who used them in western Montana took them to their next incidents because they knew they would be unlikely to have such signs otherwise. Signs are not stocked in the fire cache for regular deployment.

Peter Odegard, who retired as the sign coordinator for the Lolo National Forest, observed separate incidents signed with fluorescent orange (the standard color for construction and maintenance signs) and fluorescent pink signs. His observations were that fluorescent pink signs made it much easier to find the incident bases and associated incident locations than orange signs.

“Driver reaction to the fluorescent pink signs was noticeable and incident traffic management was easier and safer. Wildfire activities are so unpredictable and in [such] remote locations that travel to these camps can be very confusing and often results in drivers being lost or confused, leading to potentially erratic operator behavior. Vehicle operators will notice the fluorescent pink signs and actually read the messages, making it easier for operators to get to the incident locations more efficiently and safely.”

Odegard said.

Doug Mueller, maintenance chief for the Montana Department of Transportation, is responsible for approving all signing used on Montana highways in the Missoula area. He believes that having a separate color for emergency incidents is a good idea.

“Having good, adequate, appropriate signing really increases the level of safety on the roadway for both the traveling public and the traffic associated with the incident,” Mueller said.

Gary “Stan” Benes, Deputy Forest Supervisor on the Custer National Forest, was the incident commander for a number of 2003 wildland fire incidents, including the Fish Creek and Cathedral Fires. Benes believes that “good professional-looking signs significantly increase safety.” He did not have firsthand experience with coral signs, but felt confident that the use of a “good, highly visible, reflective sign, different from the standard road construction orange, would be a very positive step toward safer incident signing.” He also said that having good, professional signs elicits only positive comments from the public, while handwritten signs on paper plates and cardboard elicits only negative responses.

Kathy McAllister, Deputy Regional Forester for the Northern Region, said: “Complete, appropriate, professional signing is a necessary part of incident operations. This year, because of the magnitude of the wildfires, it was critical to have really good signing.” McAllister didn’t feel that color was as important as the consistency, visibility, and placement of the signs. “Good signing early in the incident is very important to the early operations,” she said. Incident signs appear to be most effective where regulatory speed signs and police monitoring are used.

**Sign Color Recommendation**—Based on the information gathered from participants in wildland fire incidents near Missoula, MT, the USDA Forest Service recommended that the FHWA designate coral as the national standard color for incident management. The color was officially recognized as an optional color for incident management signing in chapter 6 of the 2003 MUTCD.

## **Other Recommendations**

**Emergency Sign Plans**—Forests should develop emergency sign plans for sites that are frequently used for incident management. There are several major benefits:

- Signs could be stored at the site and installed before the incident team arrives, to help team members find the site.
- Sign locations can be predetermined and underground cable located before an incident occurs.
- Sign mounts, such as polyvinyl chloride pipe, can be installed in the ground in advance.
- Sign posts can be dropped in and bolted when needed and removed easily at the end of the incident.
- Unsafe intersections—those with limited sight distance, inadequate turning radius, located on curves, and so forth—can be redesigned or relocated to assure maximum safety at all sites.

**Training**—Training needs to be incorporated at the appropriate levels in the engineering and fire organizations.

## **Potential Benefits**

These projects and recommendations will have major impacts on temporary traffic control zones related to incident traffic management. They will improve employee and public safety and reduce property damage, injuries, and fatalities from collisions and other accidents. Also, their use will result in USDA Forest Service compliance with regulations and policy contained in the MUTCD and USDA Forest Service regulations.