Protocol for Rapid Deployment Thermocouple Probes (RDTCPs)

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The rapid deployment probes were designed to be mounted quickly within surface fire plots and to minimize soil and fuel disturbance near the measurement area (see Bova and Dickinson 2008).

Materials

- ✓ Ceramic-base, high-temperature 12" (30 cm) type-K TCPs sheathed by 304 stainless steel (Omega.com)

- ✓ Thermocouple wire with high-temperature ceramic sleeving and (optional) stainless steel or Inconel overbraiding (Omega.com)

- ✓ Ceramic fiber blanket (Cotronics.com)

- ✓ Fire shelter material

- ✓ Hobo type-K thermocouple data loggers (Onsetcomp.com)

- ✓ L-shaped rebar stakes

- ✓ Ring stand hook connectors

HOBO® data loggers

The data loggers described in Bova and Dickinson 2008 have been retired by the Onset Computer Corp. The authors have no experience with the current logger model (U12-014). Note that it will accommodate multiple TCP types, but only the Type-K TCPs

described above should be used if you are employing the relations in the paper. If rates of spread are to be estimated, the logger interval should be set to minimum (1 s^{-1}). Longer intervals may be used otherwise, but this may decrease the accuracy of time-integrated temperature.

Assembling the probes

1) Connect the shielded cable to the activated HOBO data logger and a ceramic-based thermocouple probe. Leave data logger in its plastic anti-static bag.

2) Sandwich the data logger and portion of the cable between two squares of ceramic fiber blanket. Be sure to cover the ceramic cable connector so that it is not exposed directly to flame. *NOTE: The ceramic blanket material, though not a health hazard, may cause skin irritation.*

3) Wrap the sandwiched logger in a pre-cut square of fire shelter material. Wrap tightly enough to hold the logger in place, but do not over-compress the ceramic blanket material. If assembling off-site, write the logger number on the outside of the shelter material so that it can be recorded in the field.

Deployment

To estimate a fire spread vector, a set of three RDTCPs are placed in an L-shape (x-y axis), or a set of four may be placed in a square (fig. 1) (Simard et al. 1984). The advantage of a square shape is that the configuration may be regarded as a set of two reflected axes, so that two estimates of the spread vector can be generated. The disadvantage is a slightly increased time of deployment. Regardless, the estimated rate

and direction of spread will be an average over the area "contained" by the probes. In other words, greater area can be covered by increasing the spacing of a single set, but at the expense of spatial and temporal resolution. It is best if the *spacing* and *orientation* of each set are the same. For example, all "y-axes" might point north and "x-axes" point east, and the probe tips be set at 1 m apart. Though orientations and areas could vary (e.g., if a greater resolution is required in a particular spot), keeping them uniform will greatly facilitate analysis of the data.

1) Drive the rebar stake far enough into the ground to be steady and secure. The stake should be placed so that its base is outside of the sampling area (see fig. 1). *Disturb the fuels in the sampling area as little as possible.*

2) Use a hook connector to position the probe so that its tip points downward and is about 25-cm from the mineral soil (fig. 2).

3) Set the shielded logger at the maximum possible distance from the probe so that it is *not in the area contained by the set* (fig. 1). Clear a space in the litter (~ 30-cm diameter) and set the shielded logger in the middle of the space. This is to minimize flame contact with the fire shelter material. The logger will be adequately protected unless fuel consumption is more than ~10 tons/acre and/or woody fuels are close by. Where fuel consumption is high, more shielding is required. In intense fires avoid burying the loggers because the soil retains heat.

4) Repeat for the rest of the set. Measure and record the probe positions and the distances between the tips of the probes (see data sheet below).

Disassembly

- ✓ Keep the hobo loggers in their anti-static bags.

- ✓ If it is relatively undamaged, save the shelter material and ceramic blanket squares.
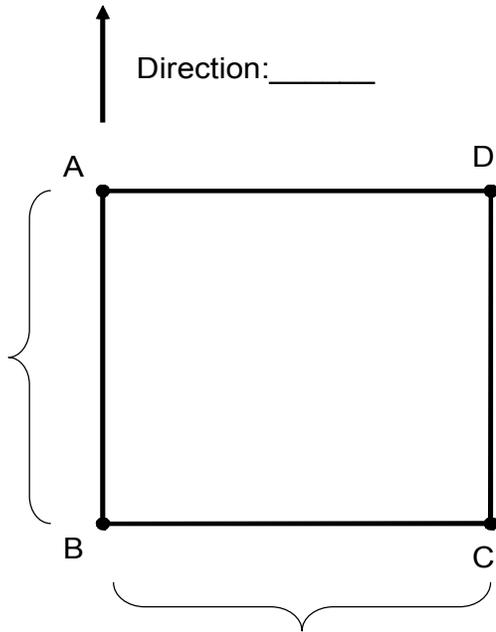
Rapid Deployment Thermocouple Probe Data Sheet

Date:

Set ID: **GPS position of set:**

On the figure below, record orientation and distance (m) between probe tips:

Direction:_____

A   D

B   C

HOBO logger ID numbers:
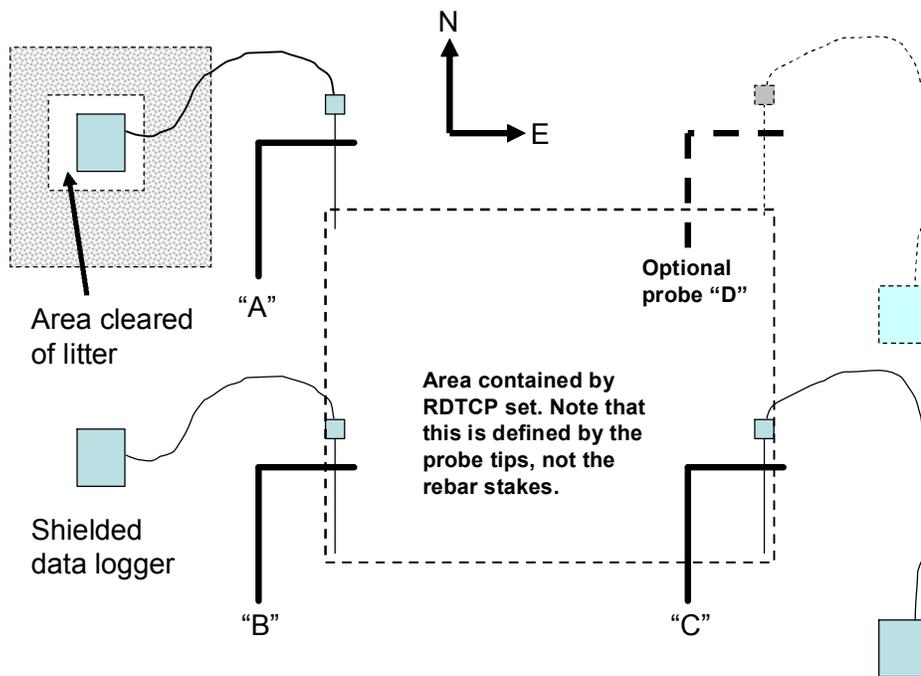
Probe A:

Probe B:

Probe C:

Probe D:

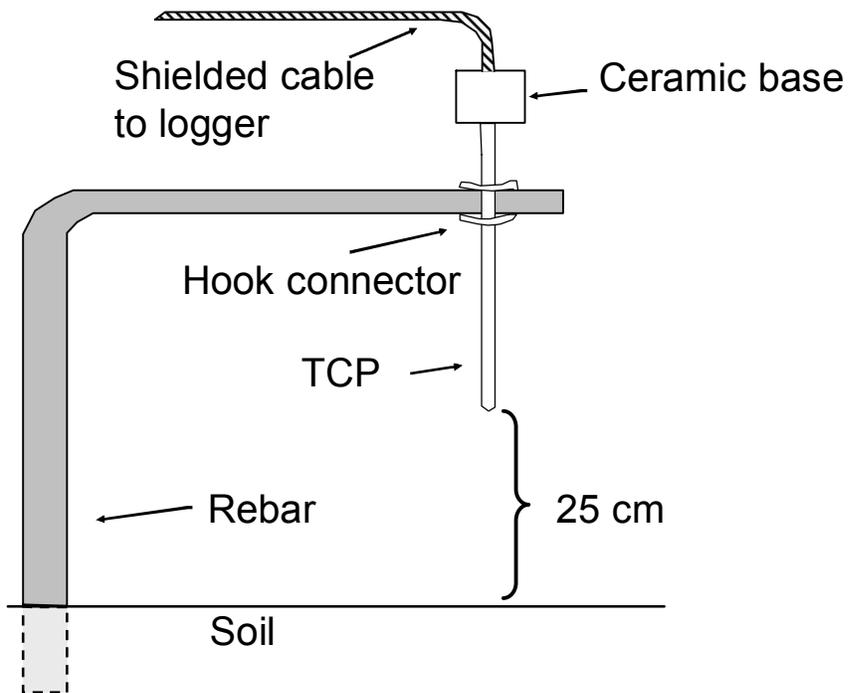**Figure 1. Deployment of a TCP set**

Figure 2. Setup of a single TCP

Citations

Bova, A.S., and Dickinson, M.B. 2008. Beyond fire temperatures: calibrating thermocouple probes and modeling their response to surface fires in hardwood fuels. Canadian Journal of Forest Research **38**:1008-1020.

Simard A. J., Eenigenburg J. E., Adams K. B., Nissen R. L., & Deacon A. G. 1984. A general procedure for sampling and analyzing wildland fire spread. Forest Science **30**[1], 51-64.