

# Fire Management Tech Tips

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## Chain-Saw Use in Sampling Fuel Moistures

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### Introduction

This publication evaluates and recommends methods for field personnel to use to determine moisture content when using a chain saw to collect fuel samples in the 100-hour and larger fuel classes. The U.S. Department of Agriculture (USDA) Forest Service San Dimas Technology and Development Center (SDTDC) and the USDA Forest Service Pacific Southwest Research Station Forest Fire Laboratory in Riverside, CA, examined the use of chain saws and hand saws for collecting fuel moisture samples (3-inch diameter) in the 100-hour and larger fuel classes. The wildland firefighting community has been concerned that chain-saw-bar oil may compromise the fuel sample by keeping moisture from being “baked” out of the sample during the drying process. Another concern is that the oil may add an additional weight percentage to the sample.

SDTDC and Riverside Fire Lab personnel performed a series of tests to determine if there was a significant difference in moisture content between samples cut by a chain saw or hand saw. This information will be useful to anyone in the wildland firefighting community who needs to determine moisture content in the 100-hour or larger fuel classes.

### History

There are varying techniques for collecting fuel samples. Currently, there are no mandated protocols or agency standards for the collection of live and dead fuels moisture content. Also there is no standard for the equipment or tools used for fuel sampling, only recommendations.

In recent years, the United States has witnessed wildland fire events. With these catastrophic, destructive wildland fires there has been the unfortunate loss of life, property, and thousands of acres of our Nation’s resources. Within fire suppression, prevention, fuels, and vegetation management program areas, an attempt is underway to improve the recording and disseminating of fuel moisture information. In supporting the field with equipment alternatives, fuel moisture data collection could become more time efficient and may provide:

- Better prediction of fire behavior during wildland fires.
- Increased fire fighter safety.
- Improved preparation of fuel reduction projects.



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When collecting fuel moisture data, it is important to choose tools and equipment to safely and easily obtain precise data. Field personnel have stated that collecting fuel moisture data within the larger fuel classes can be very time consuming especially when tools or equipment choices are limited.

## Evaluation

The main objective of this study was to determine if the equipment used to cut samples within the 100-hour and larger fuel size class would have any affect on the fuel moisture content. We collected and processed the moisture content of test samples using two different cutting methods, a chain saw and a hand saw. We replicated each test three times.

We conducted the first evaluation in the winter of 2005. Fuel-sample material used to simulate 100-hour-size class fuel consisted of 8-foot-long, 3-inch diameter, debarked, lodgepole pine logs from a local lumber yard. We used cured logs to reduce the variability caused by the uncontrolled weathering of natural (fuels) vegetation. We used a band saw to cut the 8-foot-long logs into 10-inch lengths.

We randomly selected 10 pieces and placed them on a rack inside an environmental chamber set to 90-percent humidity for 24 hours. Also, we randomly assigned a cutting method to each sample when it was removed from the chamber. Five chain-saw and five hand-saw samples were used for each replication. To cut the chain-saw treatment pieces we used a Jonsered chain saw, model 520SP with a 16-inch bar. We used a 13-inch folding hand saw to cut the hand-saw treated pieces. We removed one log from the chamber and cut six “cookies” or slices from either end, working towards the center. We used a custom 1-inch jig for both cutting methods to ensure that all samples were cut uniformly. See figure 1. A second person quickly split the “cookie” slice and placed them into a 32-ounce polypropylene bottle and capped it. Once all the “cookie” pieces were processed, we weighed, uncapped, and placed the bottles in a drying oven. All samples were dried at 95 degrees Celsius until no more moisture was detected; then after they cooled, we capped and reweighed the bottles.



Figure 1—A jig being used with a hand saw (top) and a chain saw.

We performed the second evaluation in July 2005 to determine whether higher moisture content would affect the treatment (chain saw versus hand saw) test results. For each of the three replications, we placed 10 random 10-inch logs in a container of water for 6 days. The logs were forced under water to standardize exposure. At the conclusion of the soaking, we removed the logs from the water, shook off the surface water, and placed them in the environmental chamber for 24 hours to stabilize the surface moisture. We processed the samples using the same protocol discussed previously. For the second test, we used a Husqvarna chain saw model 141 with a 16-inch bar and the same 13-inch hand saw for the hand-saw treatment. Both the Jonsered and Husqvarna chain saws had automatic bar oilers; technicians serviced and cleaned them prior to use.

## Conclusions

The moisture content of each sample was based on the oven dry weight. The equation to determine the percentage of fuel moisture content (FMC) is:

$$FMC = (net\ wet\ weight - net\ dry\ weigh)/net\ dry\ weight \times 100\%$$

The mean moisture content results and standard error (SE = evaluation variability) for the two studies are shown in table 1.

Table 1—Mean moisture content and standard error study results.

Moisture Content Level (Percentages)	Treatment			
	Chain saw	SE	Hand saw	SE
Dry test	15.41	0.11	15.41	0.12
Wet test	39.28	0.42	39.24	0.42

We used the two-sample t-test to assess whether the average moisture content for each treatment are statistically different. The t-test substantiated that there were no differences between the two cutting-method treatments. These test results suggest that using a chain saw is a safe and time efficient means of collecting fuel moisture samples in the larger fuel classes.

## Recommendations

We recommend a chain saw (when practical) to collect samples in the larger fuel classes. The evaluation results did not show a difference between using a hand-cut saw or a chain saw to collect fuel samples. A chain saw is faster and makes collecting samples in the larger fuel class easier, especially when multiple samples are needed. However, using a chain saw requires additional training and protective personal equipment. Prior to sampling, ensure that all tools and equipment are inspected and serviced to support safe working conditions and dependable operation. Use all safety equipment as outlined by individual agencies directives.

### About the Authors

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For additional information on fuels projects, contact Sue Zahn at SDTDC. Phone 909-599-1267 ext. 226; or by e-mail at [szahn@fs.fed.us](mailto:szahn@fs.fed.us).

SDTDC's national publications are available on the Internet at: <http://www.fs.fed.us/eng/pubs>.

USDA Forest Service and U.S. Department of the Interior Bureau of Land Management employees also can view videos, CDs, and SDTDC's individual project pages on their internal computer network at: <http://fswweb.sdtdc.wo.fs.fed.us>.

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