

## How Much Fuel Should I Carry?

It's the age-old question answered only by backcountry experience and deep wilderness wisdom: How much backpacking stove fuel do I *really* need to carry on my next trip? Pack too little and you could go achingly hungry, to say the least. Tote too much and you'll bear the burden of hauling extra weight, which will only slow you down.

So how do you calculate the right amount? Going beyond number of meals and number of days, we'll look at the criteria you need to consider when thinking about your trip as a whole. Here's what to factor into your fuel formula and why, along with some tips.

### Trip Criteria

Every adventure is different, but here are a few of the main variables to consider while packing fuel for your upcoming trip.

#### Know your numbers

As a baseline for fuel consumption in the backcountry, it's important to calculate how many people will be on your trip, and how many hot meals and hot drinks the group will require. If some members take their breakfast cold, you'll need less fuel, whereas firing up the stove for a morning cup of coffee and/or instant oatmeal will up your fuel consumption. As a general guide, you should bring enough fuel to boil one liter of water per person, per fully cooked meal (i.e. supper). This number will give you a rough sense of about how many liters of water you'll need to boil. If you're cooking a meal that doesn't require boiled water, still count that as a liter—the stove use time is likely about the same. Then factor in your stove's boil time (and total burn time if using canisters rather than liquid fuel).

Once you've made this estimate, use the chart below to determine how many ounces/grams of fuel your stove uses to boil 1 liter of water. Then do the math for total ounces/grams of fuel. Keep in mind that this is a rough estimate, but it gives you some scope—a place to start. Adverse factors like low temps, melting snow for your water, and wind can end up requiring 3-4 times as much fuel as your baseline number. Also, when using liquid fuel, there will always be a little fuel left in the bottle that the stove cannot access. Let's now look at the conditions affecting fuel consumption and how to adjust our baseline number according to them.

#### Conditions Affect Consumption

Traditionally stoves are tested at sea level in 70°F (21°C) temperatures with no wind. But these conditions are rarely the case for most of our backpacking expeditions. Seasons (and their fluctuating temperatures), altitude, and wind are big players in a stove's overall fuel usage. In general, water temperatures reflect air temperatures, meaning the warmer the ambient temperature, the warmer the water and the quicker it can boil—and the less fuel burned. Cold temperatures also affect fuel canisters by causing their pressure to drop. Upright-canister stoves usually work down to about 20°F (-6.5°C). But the further the mercury drops, the more the stove struggles and the more fuel used. For this reason, liquid fuel stoves are usually the choice of most backpackers for cold climate or winter use.

When it comes to altitude, the higher we go, the faster our water will boil due to a lower boiling point (from lower air pressure). Raw food cooks slower at lower temperatures – much slower. For every 18°F (-8°C) drop in boiling point (roughly the change from sea level to 10,000 feet / 3,048 meters), cook time will double as well as the fuel consumption.

Wind is also a major consideration. For open-flame-burner stoves (like the PocketRocket), a 5 mph (8kph) wind can cause as much as three times more fuel use in a given cooking period.

In the high alpine, melting snow often becomes the main water source. This adds another step to the water boiling process and additional stove time, which increases fuel consumption. Water from cold glacial streams and ponds will also increase boil time, so keep that in mind.

What type of backcountry chef are you? Simple boil-only meals are going to use a lot less fuel, while a multi-step gourmet meal will require more.

As these criteria change, so too does the way we approach our trip and ultimately the amount of fuel we need in the backcountry. Remember, every trip is unique and plan accordingly.

### **Stove Efficiency**

Now that you have a general idea about your environment, conditions and group needs, consider your stove itself. A stove's efficiency directly impacts how much fuel you'll need. Some stoves boil a liter of water much faster and use less fuel than others.

#### **Here are some tips for getting the most out of your stove.**

1. Be ready with your supplies— Have pouch-cook meals open and oxygen absorbers taken out before the water boils.
2. Always use a windscreen with liquid fuel stoves and wrap it close to the cookware (about ½" all the way around the cookware diameter) to increase the stove's efficiency. The screen helps direct hot exhaust gases around the sides of the pot instead of losing that heat to the air, and it protects from even light winds blowing heat away from the pot.
3. Placing a fuel canister in warm water before using it will help in cold temps.
4. Use a lid, and resist checking the water frequently (you can usually hear a difference in the sound or will see steam).
5. For sustainability and lower fuel costs long term, a liquid fuel stove is the way to go. It might be more expensive to purchase but the fuel is more economical over time and often easier to come by if you're traveling abroad. You also won't have to deal with empty canister weight on long trips, and you can always top off the fuel in your bottle rather than having partial canisters sitting around.

### **Final Thoughts on Fuel**

There are many nuances that affect fuel use and the more time you spend in the backcountry, the more you'll start to recognize how they impact it. The factors listed above offers a baseline to work from, but part of mastering fuel needs is experience, and a big piece of that process is trial and error. With fuel it's better to come home with some extra than to run out.

<b>MSR's Conventional Canister Stoves</b>	<b>Water Boiled (per 1 oz. / 28 g of fuel)</b>
MicroRocket	2L
PocketRocket 2	2L
SuperFly	1.8L
PocketRocket Deluxe	2.1L
WindPro II	1.8L

<b>MSR's Liquid Fuel Stoves</b>	<b>Fuel</b>	<b>Water Boiled (per 1 oz. / 28 g of fuel)</b>
WhisperLite Universal	White Gas	1.3L
	Kerosene	1.6L
	IsoPro	1.8L
WhisperLite International	White Gas	1.3L
	Kerosene	1.6L
WhisperLite	White Gas	1.5L
Dragonfly	White Gas	1.6L
	Kerosene	1.7L
	Diesel	1.7L
XGK EX	White Gas	1.5L
	Kerosene	1.7L
	Diesel	1.9L

### Example Calculation:

5 day trip with 8 people:

Breakfast – Instant oatmeal and coffee or hot chocolate (.5L/person)  
.5L boiled water/person/day x 8 persons x 5 days = 20 Liters

Lunch – Cup of soup (.25L/person)  
.25L boiled water/person/day x 8 persons x 5 days = 10 Liters

Supper – fully cooked meal (1L/person)  
1L boiled water/person/day x 8 persons x 5 days = 40 Liters  
Total = 70 Liters

Whisperlite International Stove using White Gas: 1.3L/oz. of fuel  
70L ÷ 1.3L/oz. of fuel = **54 oz. of white gas fuel required for trip**

This is a bare minimum. Having coffee with supper, heating water to wash dishes, adverse weather conditions, etc. will all increase fuel consumption. After adjusting for factors that will affect your fuel consumption, you should always plan on carrying one extra day of fuel reserve to be on the safe side. In this example, one extra day of fuel will be about 11 ounces. In addition, if this trip was in the mountains at an elevation of around 10,000 feet, the amount of fuel consumption could double.