Alaska Fuels Drying and Data Entry Instructions

The following process can be used for drying duff, foliar, woody, and herbaceous fuel moisture samples along with entering data and calculating moisture content and CFFDRS Indices.

Fuels Drying

All fuel moisture samples must be weighed before drying. This is the ***Wet Weight***. Next, take the lids off of the containers and place the containers (with the lids underneath) in the oven. Set the oven temperature to 100°C (or 212°F). Foliar, woody, and herbaceous samples should dry for 24 hours. Duff samples should remain in the oven for 48 hours.

> ***Note:*** *If drying spruce needles (foliar) samples only, set the oven temp to 80°C (176°F) to prevent the release of excessive sticky resins in the sample containers.*

Remove the containers (and lids) from the oven and weigh the samples to get the ***Dry Weight***. Discard the fuel samples and weigh the empty containers for the ***Tare Weight***. You may skip the Tare Weights if you have a spreadsheet or list of weights for all of your containers.

Record all of the weights on the paper data sheet (*Fuel Moisture Data Sheet.doc*).

Data Entry

1. Data Entry Spreadsheet (FuelMoisture_DataEntry_Year_Site.xls)

Open the spreadsheet and enter data from the paper form on to the ***Moisture Data Entry*** tab. The columns with red font (% Gravimetric, % Volumetric, and Bulk Density) are formulas. In general, samples are collected using gravimetric techniques (where moisture content is calculate by weight opposed to volume) therefore the *% Volumetric Moisture* and *Bulk Density* fields **will not be used**.

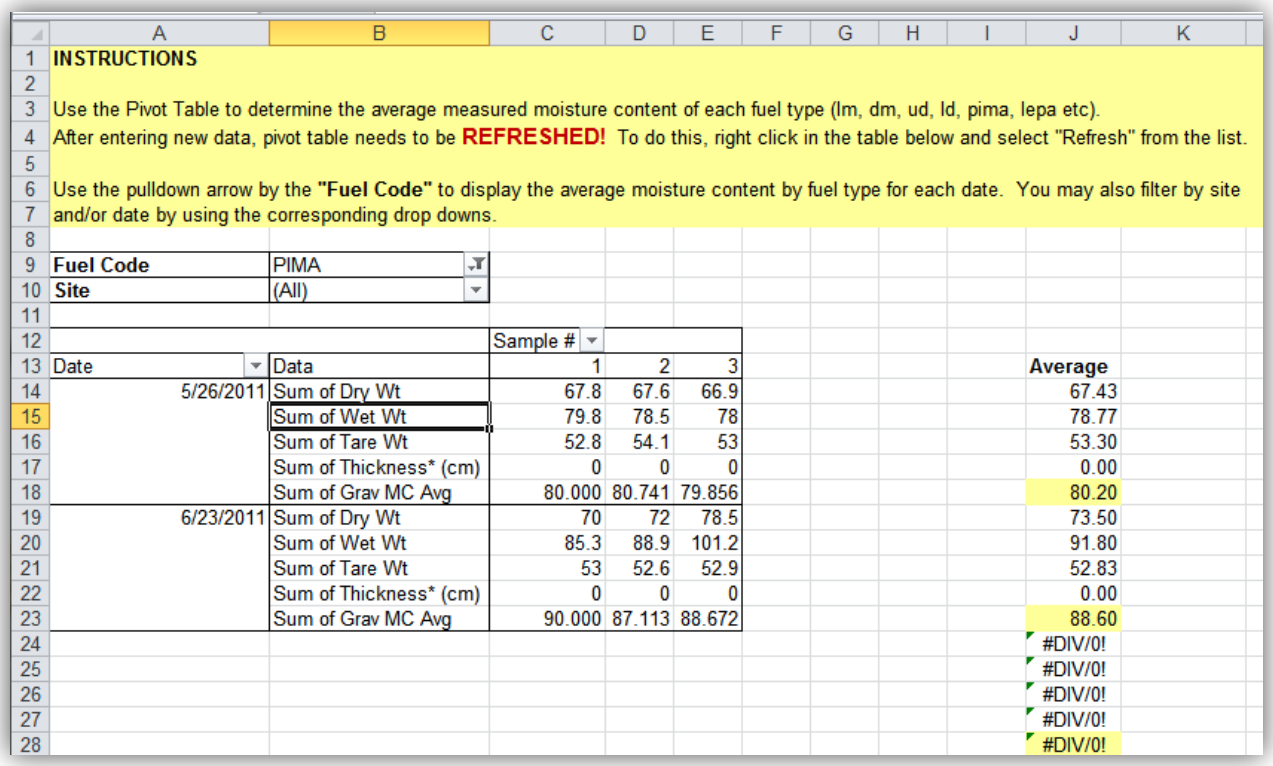
> ***Note:*** The *% Volumetric Moisture* field will only be accurate if you do exact duff plug dimensions of 3" x 3" and record accurate thickness measurements. Gravimetric sampling is recommended when calculating bulk density is not needed.

2. Calculating Average % Gravimetric Moisture Content

Open the ***Summary Grav MC*** tab. Right click inside the pivot table and select ***Refresh*** to update the data. You must **REFRESH** the table every time you add data in the ***Moisture Data Entry*** tab.

Use the pull down arrow next to ***Fuel Code*** (on the top of the spreadsheet) to select the fuel type you want to average. For example, select PIMA to show all of the black spruce foliar moistures and the average moisture content (Figure 1).

Optional: You can also filter by site if you want the average for an individual site. Use the pull down next to ***Site*** to select an individual site or leave it showing ***All*** sites.



	A	B	C	D	E	F	G	H	I	J	K
1	**INSTRUCTIONS**										
2											
3	Use the Pivot Table to determine the average measured moisture content of each fuel type (lm, dm, ud, ld, pima, lepa etc).										
4	After entering new data, pivot table needs to be **REFRESHED!** To do this, right click in the table below and select "Refresh" from the list.										
5											
6	Use the pulldown arrow by the **"Fuel Code"** to display the average moisture content by fuel type for each date. You may also filter by site										
7	and/or date by using the corresponding drop downs.										
8											
9	**Fuel Code**	PIMA									
10	**Site**	(All)									
11											
12			Sample #								
13	Date	Data	1	2	3					**Average**	
14	5/26/2011	Sum of Dry Wt	67.8	67.6	66.9					67.43	
15		Sum of Wet Wt	79.8	78.5	78					78.77	
16		Sum of Tare Wt	52.8	54.1	53					53.30	
17		Sum of Thickness* (cm)	0	0	0					0.00	
18		Sum of Grav MC Avg	80.000	80.741	79.856					80.20	
19	6/23/2011	Sum of Dry Wt	70	72	78.5					73.50	
20		Sum of Wet Wt	85.3	88.9	101.2					91.80	
21		Sum of Tare Wt	53	52.6	52.9					52.83	
22		Sum of Thickness* (cm)	0	0	0					0.00	
23		Sum of Grav MC Avg	90.000	87.113	88.672					88.60	
24										#DIV/0!	
25										#DIV/0!	
26										#DIV/0!	
27										#DIV/0!	
28										#DIV/0!	

Figure 1. Screen shot of ***Summary Grav MC*** tab.

The pivot table should now show you all the samples collected for the selected fuel code, separated by date. The far right column shows the calculated average gravimetric moisture content (highlighted in yellow).

The average gravimetric moisture content will need to be manually entered into the **Fuel Moisture Data Summary** tab.

3. Fuel Moisture Data Summary

Fill out the table on the ***Fuel Moisture Data Summary*** tab with the site name and date (Figure 2). Record the average moisture content for each fuel type you collected. This information will come from the ***Summary Grav MC*** tab. Follow the instructions above. You will need to switch the ***Fuel Code*** pull

down to get all the fuel types you sampled. If you didn't sample a specific fuel type – leave it blank. If you have other fuel types sampled, add additional columns with the plant names.

> ***Tip:*** You can use the copy and paste function to transfer average values from these two tabs. When pasting the average %MC into the ***Fuel Moisture Data Summary*** tab, you must *right click* in the cell, select *paste special*, and then select *values*.

	A	B	C	D	E	F	G	H	I
1									
2	**Site**	**Date**	**Live Moss %MC**	**Dead Moss %MC**	**Upper Duff %MC**	**Bk Spruce PIMA %MC**	**Shrub Birch BEGL %MC**	**Labrador Tea LEPA %MC**	**Blue Joint-Calamagrostis CACA %MC**
3	Site 1	**26-May-11**	12.5	65.09	95.52	80.2	152.15	90.64	20.46
4	Site 2	**23-Jun-11**	385.8	405.61	500.9	88.6	123.12	128.04	156.3
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Figure 2. Data entry table on the ***Fuel Moisture Data Summary*** tab.

4. Calculating CFFDRS Fuel Moisture Codes & RAWS Comparison

Open the ***CFFDRS Data Summary*** tab. The *Site, Date, Live Moss %MC, Dead Moss % MC*, and *Upper Duff % MC* fields will auto-populate from the data on the ***Fuel Moisture Data Summary*** tab. No need to copy and paste! (However, if you chose to sample Lower Duff, the averages will need to be manually transferred between tabs).

The equation to calculate DMC from % moisture content and two options to calculate DC from % moisture content have been entered into the table for you and will also auto-calculate (Figure 3). The equations (and descriptions) are provided above the table for your reference.

Enter the *RAWS* (Remote Automated Weather Station) *Name, RAWS FFMC, RAWS DMC*, and *RAWS DC* values from the nearest FWI (Fire Weather Index) reporting weather station to compare weather generated and moisture calculated CFFDRS Fuel Moisture Codes. All reporting stations can be found in the FWI Database on the AICC webpage (http://fire.ak.blm.gov) under Fuels/Fire Danger.

CFFDRS Calculated and Weather Stations comparison

FORMULAS USED: (to calculate the % fuel moisture predicted by CFFDRS using RAWS data)

DMC Formula's

Lawson, Dalrymple and Hawkes 1997

DMC Canadian National Standard

Eq1	MC = exp[(DMC-244.7)/-43.4] + 20	DMC = {[ln(MC - 20)](-43.4)} + 244.7

DMC White spruce, feather moss (Whitehorse, Yukon)

Eq2	MC = exp[(DMC - 149.6)/-20.9]	DMC = {[ln(MC)](-20.9)} + 149.6

DC Formula's

Brenda Wilmore's Calculated DC related to Gravimetric % MC of UD for Feather Moss, Black Spruce

Eq 3	MC = -108.09 ln(DC) + 833.15	DC = 1 / exp[(MC - 833.15) / 108.09]

Lawson and Dalrymple 1996, White spruce duff (Whitehorse, Yukon)

Eq 4	MC = 488.4/exp(DC/267.9)	DC = [ln(488.4/MC)]x267.9

Site	Date	Live Moss %MC	RAWS FFMC	Dead Moss %MC	RAWS DMC	Calc DMC from DM %Grv MC (EQ 2)	Upper Duff %MC	RAWS DC	Calc DC from UD Grv MC% (EQ 3)	Calc DC from UD Grv MC% (EQ 4)	Lower Duff % MC	Raws Station
Site 1	26-May-11	12.5	93.4	65.1		62.3	95.52	151.3	919.9	437.2	210.5	FBK
Site 2	23-Jun-11	385.8		405.6		24.1	500.90		21.6	-6.8		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		
#N/A	#N/A	#N/A		#N/A		#N/A	#N/A		#N/A	#N/A		

Figure 3. Screen shot of the ***Duff CFFDRS Data Summary*** tab.

> ***Note:*** FFMC equations are not included in the comparison table. Values fluctuate throughout the day and localized weather, topography, and time of day will impact your calculated FFMC. However, if you want a "snapshot" of the FFMC at the time your samples were collected, equations are provided on the ***Formulas*** tab.

5. Equations and Data Sheets

The equations used to calculate CFFDRS Fuel Moisture Codes can be referenced on the ***Formulas*** tab. Indice calculation values are also available to compare Fuel Moisture Code equations, given the same % moisture content. The equations are written in an excel friendly format should you want to incorporate additional equations into the ***Duff CFFDRS Data Summary*** tab.

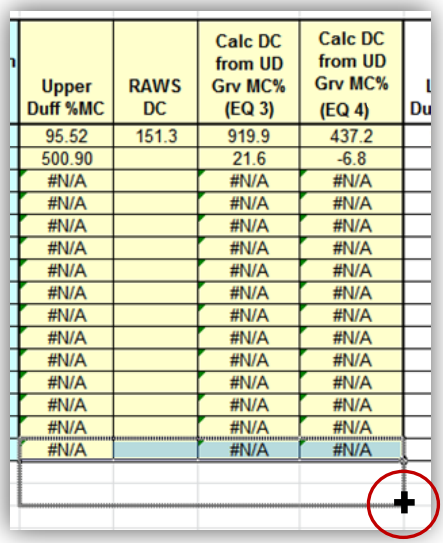
A blank field data sheet is on the ***Blank Data Sheet*** tab. The fuel moisture data sheet can be printed from this tab.

6. Expanding Tables with Formulas

The ***Moisture Data Entry*** and ***Duff CFFDRS Data Summary*** tabs contain formulas. If you need to add more rows to incorporate more data, you must highlight the cells with formulas and drag the formulas down. Make sure you "grab" and drag the corner of the highlighted cells with the "✚" mouse symbol showing (Figure 4).

DO NOT use the "Insert Row" function (by right clicking on the numbered rows on the far left of the spreadsheet and selecting "Insert"). The excel formulas will not work.

The pivot table on the ***Summary Grav MC*** tab is built to accommodate up to 7 samples of the same fuel code on a single date. For example, the pivot table will calculate the average % MC for up to 7 PIMA samples on 26-May-11, 7 PIMA samples on 23-June-11, as so forth.



Upper Duff %MC	RAWS DC	Calc DC from UD Grv MC% (EQ 3)	Calc DC from UD Grv MC% (EQ 4)	Du
95.52	151.3	919.9	437.2	
500.90		21.6	-6.8	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	

Figure 4. You must highlight and drag the formulas down with the "✚" mouse symbol to expand tables on the ***Moisture Data Entry*** and ***Duff CFFDRS Data Summary*** tabs.

To expand the pivot table, ***Insert*** a column between the last sample in the table and the ***Average*** column (Figure 5). Repeat until you have enough columns to accommodate all of your samples. Generally, additional columns are not needed.

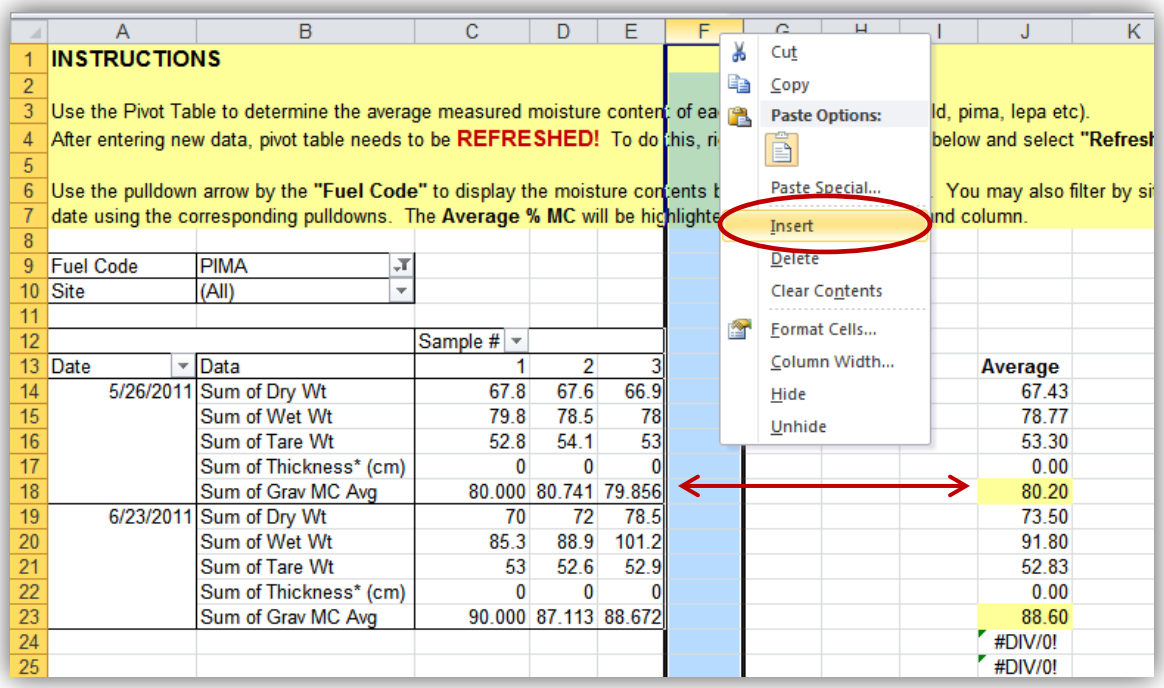


Figure 5. ***Insert*** a column between the edge of the pivot table (or last sample) and the ***Average*** column to accommodate more than 7 samples of a single fuel code on a single day.