

United States Department of Agriculture



Natural Resources Conservation Service  
Southern Rocky Mountains Regional Soil Survey Office  
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**MLRA OFFICE 6 TECHNICAL NOTE NO. 13**

**Date: November 18, 2010**

**SUBJECT:** SOI – Application of Soil Temperature Data to Soil Temperature Regimes

Purpose: To provide instructions on applying measured soil temperature data to the criteria in *Soil Taxonomy* for determining soil temperature regimes.

Effective Date: This technical note is effective when received.

Background: Electronic data loggers are increasingly being used to collect soil temperature data. These loggers measure temperature as with an apparent precision that is beyond the precision of the taxonomic criteria. The data must be rounded correctly to properly determine the soil temperature regime. This Technical Note reiterates the rounding conventions used in *Taxonomy*. In addition, the use of old data in degrees Fahrenheit is discussed.

Filing Instructions: File after MLRA Office 6 Technical Note No. 12. Discard the previous tabulation sheet and insert the current tabulation sheet.

A handwritten signature in cursive script that reads "Steve Park".

STEVE PARK  
MLRA Team Leader

Attachment

DIST: All MO6 Soil Scientists



**MLRA OFFICE 6 TECHNICAL NOTE SERIES  
TABULATION SHEET**

TECH NOTE NO.	ISSUE DATE	TITLE	COMMENTS
1	22-May-97	Key to the Use of Cation-Exchange Activity Classes	
2	20-Apr-98	Identification and Description of Albic Horizons, Glossic Horizons,...	
3	2-Feb-99	Template for Taxonomic Unit Descriptions	Made obsolete by Feb 2004 Reissue
	3-Feb-04	NASIS Reports and Instructions for Generating Taxonomic Unit Descriptions	Reissue of Tech Note 3 dated Feb 1999
4	14-Jun-99	Metric-English Conversion Guides	
5	30-Mar-00	Macro to Format Map Unit Descriptions	
6	30-Mar-00	Report to Generate Map Unit Descriptions in NASIS	
7	24-Aug-04	Guidelines for Populating Slope Aspect in NASIS	
8	16-Sep-04	Suggested Order and Guidelines for Populating a New Map Unit in NASIS	Made obsolete by updated 2008 version.
	25-Jan-08	Suggested Order and Guidelines for Populating a New Map Unit in NASIS	Update 2008 version to account for NASIS changes.
9	18 Oct 05	Guidelines for Populating Surface Organic Layers in NASIS	Correction to previous guide (was not a Tech Note)
10	5 April 07	Guidelines for Estimating and Interpreting Carbonate Clay	
11	25-Jan-08	Guide for Populating Horizons with Stratified Textures	
12	24-Jun-10	Spreadsheet to Calculate Field Calcimeter Data	
13	18-Nov-10	Application of Soil Temperature Data to Soil Temperature Regimes	



**MO6 TECHNICAL NOTE 13**  
**APPLICATION OF SOIL TEMPERATURE DATA TO**  
**SOIL TEMPERATURE REGIMES**

**November 2010**

Soil survey crews in the Lakewood MLRA Soil Survey Region are collecting an increasing amount of soil temperature data using electronic data loggers. The commonly used HOBO Data Loggers measure in hundredths or thousandths of a degree, in both Fahrenheit and Celsius. This precision is well beyond the precision of the critical values given in the criteria for soil temperature regimes in Soil Taxonomy. The following provides guidance on using either Fahrenheit or Celsius data, and how to correctly convert these data for application to the taxonomic criteria.

Celsius temperatures are used as criteria for temperature regimes in Soil Taxonomy. When there is a choice, measurements should be made directly in Celsius. Data from electronic temperature loggers can be exported into spreadsheets at whatever precision is recorded, which is commonly hundredths or thousands of a degree. This data should be rounded when reported as average temperatures (such as monthly or annual averages). For uniformity of data analysis in the MO6 Region, it is recommended that average temperature values be expressed in tenths of a degree C.

Further rounding is needed when applying measured data to Soil Taxonomy. The convention in Soil Taxonomy is to round a measured soil property to the same precision as the critical value in the taxonomic criterion. Temperature regime critical values are in whole degrees C, therefore measured values must be rounded to whole degrees C for the purpose of determining the temperature regime.

Because of rounding, sometimes MAST values fall into unexpected regimes. For example, using the criteria for the mesic and frigid regimes:

Mesic -- MAST 8° C or higher but lower than 15° C.

Frigid – MAST between 0 and 8° C.

A measured MAST of 7.8° C must first be rounded to 8°, then applied to the criterion. Because 8° satisfies the criterion for mesic (“8° C or higher”), the correct regime is mesic for a measured MAST of 7.8°. It is incorrect to conclude that the regime is frigid because 7.8° is less than 8°, or because 7.8° falls “between 0 and 8°”.

Do not interpret the above rounding convention as suggesting the unrounded values have no utility. Rounding to whole degrees is for application to Soil Taxonomy only; values in tenths of a degree C certainly have use in NASIS, soil temperature studies, scientific reports, and general comparisons between similar sites.

Much of our current soil temperature data was measured in degrees Fahrenheit. To correctly determine the temperature regime, these values must first be converted to Celsius, then rounded to whole degrees as described above. The conversion formula is: °C = (°F-32)\*1.8. Although we routinely used degrees F for many years to informally define temperature regimes, this was in error and possibly lead to some incorrect temperature regime classifications. It is incorrect to convert the 8° frigid/mesic critical value to 46° degrees F and then to use that value as the taxonomic criterion.

Rounding procedures for use with Soil Taxonomy are posted as a job aid at the National Soil Survey Center ftp website:

[ftp://ftp-fc.sc.egov.usda.gov/NSSC/job\\_aids/classification/rounding.pdf](ftp://ftp-fc.sc.egov.usda.gov/NSSC/job_aids/classification/rounding.pdf)

This job aid describes a rounding procedure that is slightly different than many common methods, such as the procedure used in Excel spreadsheets. It uses a “round to even” method rather than the “round up” method when the last digit is 5.

On the following page is a table to assist in determining mesic, frigid, and cryic regimes from data in degrees F. It shows some common measured values in degrees F, corresponding values converted to degrees C, then rounded to whole degrees C, and finally the temperature regime.

## Conversion of Measured Fahrenheit Temperatures for Application to Taxonomic Criteria

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Table 1.

Frigid: <8 deg C. MAST Mesic: >=8 deg C. MAST			
Deg F.	Deg C.	ST Value	Class
44.2	6.783	7	Frigid
44.4	6.894	7	
44.6	7.006	7	
44.8	7.117	7	
45.0	7.228	7	
45.1	7.284	7	
45.2	7.339	7	
45.3	7.395	7	
45.4	7.450	7	
45.5	7.506	8	
45.6	7.562	8	
45.8	7.673	8	
46.0	7.784	8	
46.2	7.895	8	
46.4	8.006	8	
46.6	8.118	8	
46.8	8.229	8	
47.0	8.340	8	

Table 2.

Cryic: <15 deg C. MSST Frigid: >=15 deg C. MSST				
Deg F.	Deg C.	ST Value	Class	
56.8	13.789	14	Cryic	
57.0	13.900	14		
57.2	14.011	14		
57.4	14.122	14		
57.6	14.234	14		
57.8	14.345	14		
57.9	14.400	14		
58.0	14.456	14		
58.1	14.512	15		Frigid
58.2	14.567	15		
58.3	14.623	15		
58.4	14.678	15		
58.6	14.790	15		
58.8	14.901	15		
59.0	15.012	15		
59.2	15.123	15		
59.4	15.234	15		
59.6	15.346	15		

Table 1 - Common mean annual soil temperatures (MAST) near the mesic–frigid break. This table may also be used for the frigid-cryic break for mineral soils, not saturated, and with a surface O horizon (closed forest canopy). (Cryic <8 C MSST, Frigid >= 8 deg C MSST)

Table 2 – Common mean summer soil temperatures (MSST) near the frigid-cryic break for mineral soils, not saturated, and without a surface O horizon (forest canopy is insignificant).

### Columns

*Deg C.* -- Deg F converted to Celsius  $(F-32)*0.556$

*ST Value* -- Deg C rounded to precision required for application to Taxonomic criterion

*Class* -- Temperature regime in which the data row classifies