ATT-22/22, MOISTURE CONTENT, Oven Method
Part I, Soil and Gravel

1.0 SCOPE

The determination of moisture content involves removing by oven-drying a sample at 110°C until a constant weight is reached (this usually constitutes heating it overnight). The moisture content is expressed as a percentage of its oven-dried weight. This method may be applied to fine, medium and coarse grained soils.

2.0 EQUIPMENT

Lab Drying Oven – thermostatically controlled heating chamber capable of maintaining a uniform temperature of 110 ± 5°C.

Electronic Balance - for measuring the mass of wet and dried aggregate samples
Capable of reading to 0.1 grams.
The balance must be operated as per manufacturer's recommendations.
Balances must be inspected, cleaned, and calibrated annually.

plastic pails or plastic bags – to transport the samples to the lab

drying pans	thermometer (calibrated)
heat-resistant gloves	wash basin
large mixing pan	putty knife

Data Sheet: Moisture Content, such as MAT 6-24

3.0 PROCEDURE

3.1 Soil

1. Obtain a representative soil sample, as per ATT-38 SAMPLING, Gravel and Sand, and protect it against loss of moisture prior to determining the weight. Store samples in an air-tight container, or plastic bag, at a temperature between 5°C and 30°C, and in an area that prevents direct contact with sunlight. **The moisture content minimum sample size for soils should be approximately 1000 grams.**

2. Complete the “Heading” and “Sample Identification” portions of the data sheet. An example is illustrated in Figure 1.

3. Label a drying pan, and record as “Container Number”.

4. Weigh the drying pan and record as “Tare of Container” on line "C", to the nearest 0.1 gram.

5. Dump the contents of the plastic pail, or plastic bag, into a wash basin.

6. Break up the soil in the wash basin, using a putty knife, so that there are no lumps larger than 15 mm in diameter.

7. Use ATT-57 to reduce the sample to 400 grams.
Place the sample into the drying pan.

8. Spread the sample evenly over the bottom of the pan.

9. Weigh the drying pan and its sample contents immediately and record as “Wt. of Wet Sample + Tare” on line "A".

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10. Place the drying pan and sample in the oven set at 110 ± 5ºC.

11. Dry the sample to a constant weight. To verify, after a couple of hours of drying, weigh the sample. Replace the sample in the oven for approximately one hour and then re-weigh. Continue drying and weighing, each hour, until two consecutive weights are the same.

12. Cool the pan and dried sample just until the pan can be handled without gloves. Weigh the cooled sample and pan. Record as “Wt. of Dry Sample + Tare” on line "B", to the nearest 0.1 gram.

13. Calculate the “Weight of Water” on line "D", to the nearest 0.1 grams, as follows:

Wt. of Water (g) = (Wt. of Wet Sample + Tare) – (Wt. of Dry Sample + Tare)

14. Determine the “Weight of Dry Sample” on line "E", to the nearest 0.1 grams, as follows:

Wt. of Dry Sample (g) = (Wt. of Dry Sample + Tare) – (Tare of Container)

15. Calculate the “Moisture Content” of the sample, to the nearest 0.1%, on line "E", using the formula:

$$\textit{Moisture Content (\%)} = \frac{\textit{Wt. of Water}}{\textit{Wt. of Dry Sample}} \times 100\%$$

FIGURE 1

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MAT 6-24/22

MOISTURE CONTENT

PROJECT :	Hwy 36:04	Contractor :	ABC Const.
CONTRACT NO. :	12345	DATE :	18-Aug-2021
ATT-15 MOISTURE CONTENT, Part I, Oven Method		TECH :	J. Jones

SAMPLE IDENTIFICATION					
DATE	18-Aug-2021		18-Aug-2021		18-Aug-2021
LOT NUMBER					
TEST NUMBER					
SAMPLE SOURCE	Road		Road		Road
STATION	9+183		9+391		9+516
LOCATION	2.0m Rt		1.0m Lt		3.5m Lt
DEPTH BELOW GRADE OR LIFT	0.05 - 0.10		0.00 - 0.05		0.10 - 0.15

MOISTURE CONTENT							
	CONTAINER NUMBER		g	x		y		z
A.	WEIGHT OF WET SAMPLE + TARE		g	568.8		593.2		580.7
B.	WEIGHT OF DRY SAMPLE + TARE		g	514.3		532.8		525.1
C.	TARE OF CONTAINER		g	165.0		172.5		168.3
D.	WEIGHT OF WATER	A - B	g	54.5		60.4		55.6
E.	WEIGHT OF DRY SAMPLE	B - C	g	349.3		360.3		356.8
F.	***MOISTURE CONTENT***	**(D/E) x 100**	%	***15.6***		***16.8***		***15.6***

REMARKS: ***FINE GRAINED SOIL SAMPLES***

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3.2 Aggregate

1. Obtain a representative aggregate sample, as directed in ATT-38, SAMPLING, Gravel and Sand, and protect it against loss of moisture prior to determining the weight. An air-tight plastic pail, or plastic bag, is best for this purpose. **The moisture content aggregate sample size should be approximately 3000 grams.**

2. Complete the “Heading” and “Sample Identification” portions of the data sheet. An example is illustrated in Figure 2.

3. Label a drying pan, and record as “Container Number”.

4. Weigh the drying pan and record as “Tare of Container” on line "C", to the nearest 0.1 gram.

5. At the field laboratory, use ATT-57 to reduce the sample to 3000 grams.

6. Place the moisture content sample into the drying pan.

7. Record as “Wt. of Wet Sample + Tare” on line "A".

8. Place the drying pan and contents into the oven set at 110 ± 5°C and dry the sample to a constant weight. Cool the pan and dried aggregate until the pan can be handled without gloves.

9. Calculate moisture content of the aggregate (line "E") by repeating steps 11 to 15 of Section 3.1.

FIGURE 2

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MAT 6-24/22

MOISTURE CONTENT

PROJECT :	Hwy 36:04	Contractor :	ABC Const.
CONTRACT NO. :	12345	DATE :	18-Aug-2021
ATT-15 MOISTURE CONTENT, Part I, Oven Method		TECH :	J. Jones

SAMPLE IDENTIFICATION						
	DATE		18-Aug-2021		18-Aug-2021	18-Aug-2021
	LOT NUMBER					
	TEST NUMBER					
	SAMPLE SOURCE		Stockpile		Windrow	Windrow
	STATION				9+391	9+516
	LOCATION				1.0m Lt	3.5m Lt
	DEPTH BELOW GRADE OR LIFT				2nd Lift	2nd Lift

MOISTURE CONTENT								
	CONTAINER NUMBER		g	X		Y		Z
A.	WEIGHT OF WET SAMPLE + TARE		g	3910.2		3897.5		3842.1
B.	WEIGHT OF DRY SAMPLE + TARE		g	3797.9		3778.3		3732.7
C.	TARE OF CONTAINER		g	737.5		733.6		741.5
D.	WEIGHT OF WATER	A - B	g	112.3		119.2		109.4
E.	WEIGHT OF DRY SAMPLE	B - C	g	3060.4		3044.7		2991.2
F.	***MOISTURE CONTENT***	**(D/E) x 100**	%	***3.7***		***3.9***		***3.7***

REMARKS: ***AGGREGATE SAMPLES***

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4.0 HINTS AND PRECAUTIONS

1. Ensure that ***SOIL*** moisture content samples are between 350 to 400 grams.
   Ensure that ***AGGREGATE*** moisture content samples are approximately 3000 grams.

   Too Large Sample Sizes will increase the drying time, while *Too Small Sample Sizes* may lead to inaccurate results.

2. Ensure that the oven temperature is maintained at 110°C ± 5°C. Do not allow the oven door to stay open for too long, as it takes a while for the oven to regain the set drying temperature.

3. The drying rate of test samples will be affected by the moisture conditions and number of samples in the drying device. When wet samples are placed in the drying device along with nearly dry samples, the drying cycle will have to be re-started.

4. Do not put moist samples in the oven on a shelf below dry samples. Moist samples should be placed on the top shelf, and all partially dried samples placed on the lower shelves.

5. ***Do not over-load the lab drying oven***, as this will create a much longer drying time.

6. Oven dried soil samples left to cool too long before weighing may absorb moisture from the atmosphere, thereby altering their weight. Instead, remove the oven dry samples from the oven, then ***COOL the pan and dried sample just until the pan can be handled without gloves, and then IMMEDIATELY weigh the samples.***

7. Keep the laboratory countertops clean so that any spilled samples can be readily noticed and retrieved.

8. ***Checking every moisture content sample to determine if it is dried to a constant weight is impractical.*** In most cases, drying of a moisture content sample overnight (16 hours) is sufficient. Drying times may need to be extended if the oven if full. Sand samples may often be dried to constant weight after 7 hours.

9. ***Moisture Content samples should be discarded after testing, and should not be used in any other tests***, due to particle breakdown, chemical changes or losses, melting, or losses of organic constituents.

10. Use heat-resistant gloves, or tongs, when handling hot samples.

11. It is recommended that Balance Check Weights should be used daily, and the results recorded, to identify if calibration drift has occurred. Drift can occur for any number of reasons: such as temperature changes, being moved, or aging electronics.

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