Method of Test for

DETERMINING THE PERCENTAGE OF DRY ADDITIVES IN STABILIZATION OR TREATMENT PROCESSES

DOTD Designation: TR 436M/436-99

Method A - In-Place Mixing

I. Scope

This procedure is designed to determine the distribution of dry additives by bulk transport, including cement, lime or fly ash, when they are being mixed in-place with soil, aggregates, or soil-aggregate mixtures for stabilization or treatment, and to adjust the distribution of dry additives to meet the minimum spread rate.

II. Apparatus

A. **Scale** - accurate to 5 g (0.01 lb), with the capacity to determine the mass of the required sample.
B. **Sampling container** - A templet and one square meter sheet of canvas or heavy polyethylene or 2 drip pans (stock no. 26-66-1108) or other metal container meeting one of the configurations shown in Figure A-1 or an approved alternate, of sufficient size to contain the quantity of additive (including any overspread), but not less than a total of 0.3 m^2 (3 ft^2) of surface area.

Note A-1: *The sides of the container must be high enough to contain the entire spread of additive without spillage.*

C. **Field book** - for recording measurements and calculations not documented on specific forms (Figure A-2)
D. **Measuring device** - accurate to 1 mm (0.1 in).
E. **Tape** - a minimum of 30 m (100 ft), accurate to 1 mm (0.1 in).

III. Health Precautions

Do not breathe cement or lime dust extensively. Exercise caution when working with quick lime, because it is hazardous and can cause hydration burns. Wearing long sleeves and long pants is advised.

IV. Sample

The quantity of additive placed in the sample containers by the spreader.

V. Procedure

Note A-2: *Record all values and calculations in the field book.*

A. Determine the minimum spread rate in accordance with step V.A. and record.
B. Measure the inside dimensions (width and length) of the templet or the top of each container and record to the nearest 1 mm or (0.1 in).

Note A-3: *When the edges of the containers are not vertical, the measurements are to be taken at the inside, top edge.*

C. Using the dimensions obtained in step B, calculate the area of each container or templet to the nearest .001 m^2 (0.01 ft^2) and the total test area (C) in accordance with step V.B. and record.
D. Determine the tare mass of the canvas, polyethylene sheet or metal sampling container(s) and record.
E. Determine the maximum length of spread to the nearest 0.1 m (1 ft), in accordance with step V.C. and record.
F. Measure from the beginning point of the distribution to the maximum length of spread. Delineate the spread area with stakes placed at the beginning and end, as near as practical to the edge of the spread location.
G. Select a test site near the beginning of the truck's distribution area at the center of the spread away from any wheel path.
H. Place the tared canvas, polyethylene sheet, or sampling container(s) on the surface over which the additive is to be spread prior to the distributing of the additive. (Figure A-3)
I. Immediately after the additive has been spread over the canvas, polyethylene sheet, or sampling container(s), determine the spread rate of the additive as follows:
   1. Templet Method:
      a. Locate the canvas or polyethylene sheet and push the templet through the additive to the sheet.

b. Determine the mass of the additive captured inside the templet by either:
   (1) Removing the additive that is inside the templet and place into tared container(s) or
   (2) Removing from the sheet all additive that is on the outside of the templet and carefully determining the mass of the sheet and remaining additive.

c. Subtract the tare mass of the container or sheet from the mass of the container or sheet with additive and record.

2. Pan Method:
   a. Retrieve the container(s) with the additive.
   b. Determine the mass of each container with the additive.
   c. Determine the mass of the additive in each container by subtracting the tare mass of the container from the mass of the container with the additive and record.

J. Add the mass of the additives in each container (B) and record in the field book.

K. Determine the actual spread rate (A) in k/m^2 (lb/yd^2) in accordance with step V.D.

VI. Calculations

A. Determination of the minimum spread rate (M).

Note A-4: *The unit mass of portland cement will be 1500 k/m^3 (94 lb/ft^3). The unit mass of quicklime and hydrated lime will be 560 k/m^3 (35 lb/ft^3). If any other additives are used, verify the unit mass of the additive with the District Laboratory or the Materials and Testing Section and only use the formula to calculate the minimum spread rate.*

1. Formula Determination of the Minimum Spread Rate. Calculate the minimum spread rate (M) to the nearest 0.05 k/m^2 (0.1 lb/yd^2), using one of the following formulas:
   a. Metric Example:

$$M = \frac{t \times V \times U}{100\ 000}$$

where:

t = plan thickness, mm
V = specified % additive by volume
U = unit mass of additive, k/m^3
100 000 = constant

example:

t = 215
V = 10
U = 1500

$$M = \frac{215 \times 10 \times 1500}{100\ 000}$$

$$= \frac{3\ 225\ 000}{100\ 000}$$

$$= 32.2500$$

$$M = 32.25$$

b. English Example:

$$M = 9 \left(\frac{t}{12}\right) \left(\frac{V}{100}\right) U$$

where:

9 = constant (ft^2/yd^2)
t = plan thick., in of compacted course
12 = constant (in/ft)
V = specified % additive by volume
100 = constant (convert % to decimal)
U = unit wt. of additive, lb/ft^3

example:

t = 8.5 in
V = 10.0 %
U = 94 lb/ft^3 (portland cement)

$$M = 9 \left(\frac{8.5}{12}\right) \left(\frac{10.0}{100}\right) 94$$

$$= 9 \times 0.708 \times 0.100 \times 94$$

$$= 59.896$$

$$M = 59.9$$

2. Chart Determination of the Minimum Spread Rate (Figure A-4).
   a. Enter the chart at the % By Volume column. Find the correct % by volume vertically down the column.
   b. Read the chart horizontally to the right along the unit mass line A or B that matches the material being used until the plan thickness column is encountered. Read the minimum spread rate (M) at this juncture.

(1) Metric Example:

t = 225 mm
V = 6.0 %
U = 560 kg/m^3 (hydrated lime)

Enter the chart at the % By Volume column; read vertically to 6.0 %. Read horizontally to the right along the 560 kg/m^3 line. When the required plan thickness column for 225 mm is encountered, read the minimum spread rate of 7.56 kg/m^2.

(2) English Example:

t = 6 in.
V = 6.0 %
U = 35 lb/ft^3 (hydrated lime)

Enter the chart at the % By Volume column; read vertically to 6.0 %. Read horizontally to the right along the 35 lb/ft^3 line. When the required plan thickness column for 6 inches is encountered, read the minimum spread rate of 9.4 lb/yd ^{2}.

B. Determination of the total test area (C) to the nearest 0.01 m^2 (0.01 ft^2).
1. Calculate the test area of the templet or each container by multiplying length times width.
2. Calculate the total test area by adding the areas of each container determined in step 1.
3. Convert the total test area to square meter by dividing by 1 000 000 mm^2/m^2 or to square feet by dividing by 144 in^2/ft^2.
   a. Metric example *(using templet)*:

width = 810 mm   length = 865 mm

Templet Area = 810 x 865 =700 650 mm^2

$$C = \frac{700\ 650}{1\ 000\ 000}$$

$$= 0.700\ 65$$

$$C = 0.701$$

   b. English Example *(using 2 drip pans)*:

Container 1: width = 16.0 in length = 17.0 in
Container 2: width = 16.1 in length = 17.0 in

Area, Container 1: 16.0 x 17.0 = 272 sq in
Area, Container 2: 16.1 x 17.0 = 274 sq in

Total Test Area: 272 + 274 = 546 in^2

$$C = \frac{546}{144}$$

$$= 3.7916$$

$$C = 3.79$$

C. Determination of the Maximum Length of Spread for a Transport of Additive:

Calculate, to the nearest 0.1 m (1 ft), the maximum length of spread (L) a transport load of additive will cover at the minimum spread rate determined in step A or B by using one of the following formulas:

1. Metric Example:

$$L = \frac{D}{M \times W}$$

where:

D = mass of additive in transport, kg (from shipping statement)
M = min spread rate, kg/m^2
W = width of spread, m

example:

D = 23 330 kg
M = 32.25 kg/m^2
W = 7.6 m

$$L = \frac{23\ 330}{32.25 \times 7.62}$$

$$= \frac{23\ 330}{245.745}$$

$$= 94.935$$

$$L = 94.9$$

2. English example:

$$L = \frac{9 \times D}{M \times W}$$

where:

9 = a constant, ft^2/yd^2
D = mass of additive in transport, lb (from shipping statement)
M = min spread rate, lb/yd^2
W = width of spread, ft

example:

D = 51,440 lb
M = 59.9 lb/yd^2
W = 25 ft

$$L = \frac{9 \times 51440}{59.9 \times 25}$$

$$= \frac{462,960}{1497.50}$$

$$= 309.15$$

$$L = 309$$

D. Determination of Actual Spread Rate (A) to the nearest 0.01 kg/m^2 (0.1 lb/yd^2)by using one of the following formulas:

1. Metric example:

$$A = \frac{B}{C}$$

where:

B = sum of additive mass, kg
C = sum of container areas, m^2

example:

B = 22.869 kg
C = 0.701 m^2

$$A = \frac{22.869}{0.701}$$

$$= 32.6233$$

$$A = 32.62$$

2. English example:

$$A = \frac{B}{C} \times 9$$

where:

B = sum of additive mass, lb
C = sum of container areas, ft^2
9 = constant (9 ft^2 = 1 yd^2)

example:

B = 25.30 lb
C = 3.79 ft^2

$$A = \frac{25.30}{3.79} \times 9$$

$$= 6.6754 \times 9$$

$$= 60.0786$$

$$A = 60.1$$

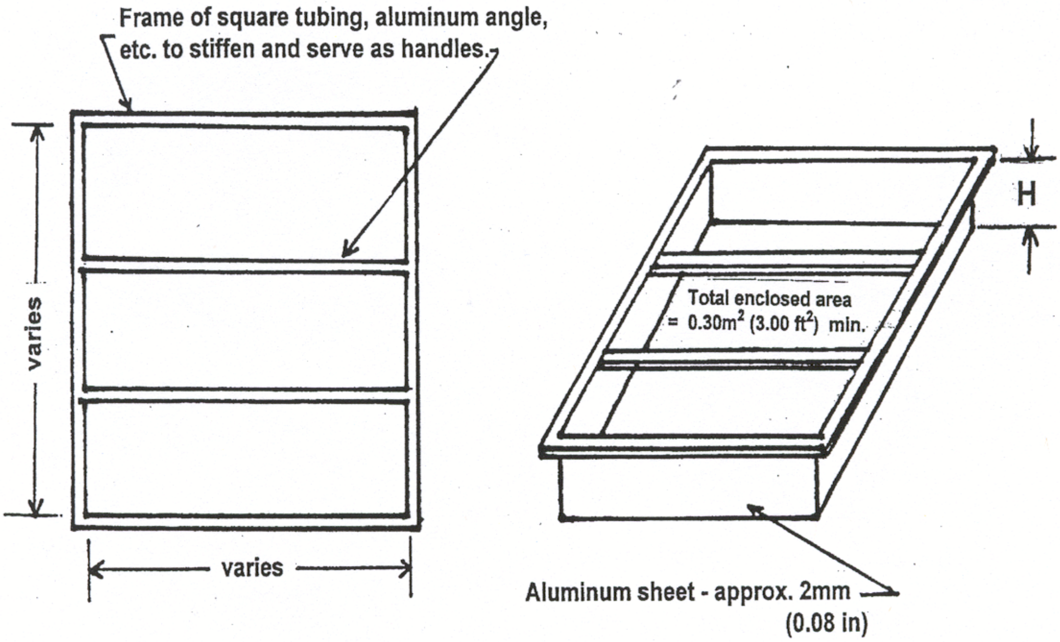
VIII. Report

Report the following data in the field book:

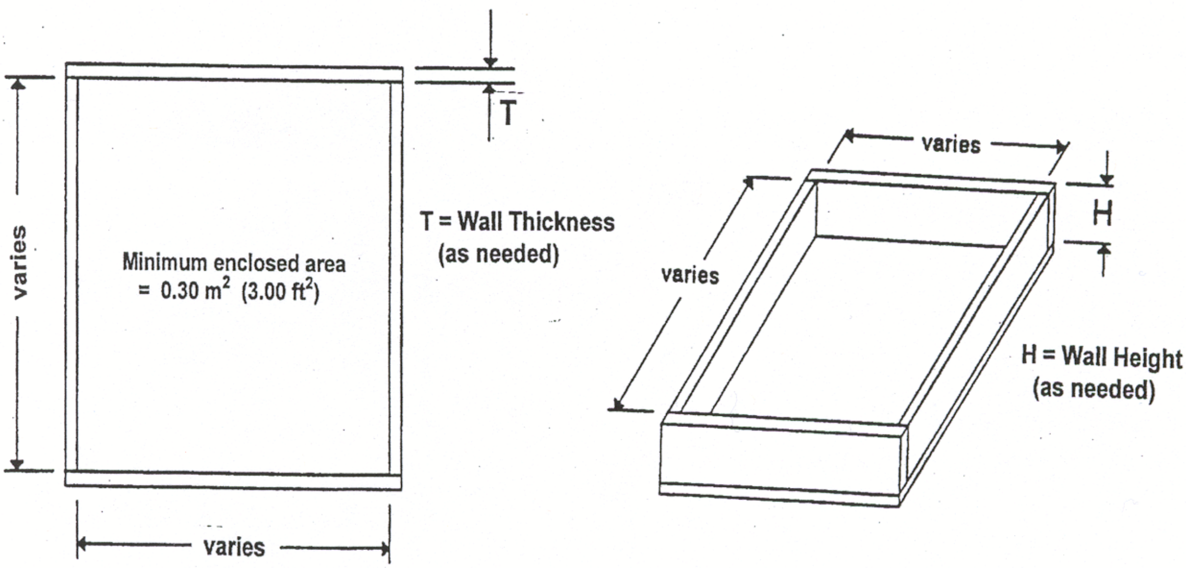
A. Type of additive and verified unit mass to the nearest kg (lb)
B. Percent of additive by volume required by design
C. Mass of additive in transport (D) to the nearest 0.5 kg (lb)
D. Width of spread (W) to the nearest 0.01 m (0.1 ft)
E. Maximum Length of spread (L) to the nearest 0.1 m (ft)
F. Minimum required spread rate (M) to the nearest 0.01 kg/m^2 (0.1 lb/yd^2)
G. Actual spread rate (A) to the nearest 0.01 kg/m^2 (0.1lb/yd^2)

VIII. Normal Test Reporting Time

The normal test reporting time is 20 minutes.



Templet Sampling Device



Pan Sampling Device

Figure A-1 Sampling Devices

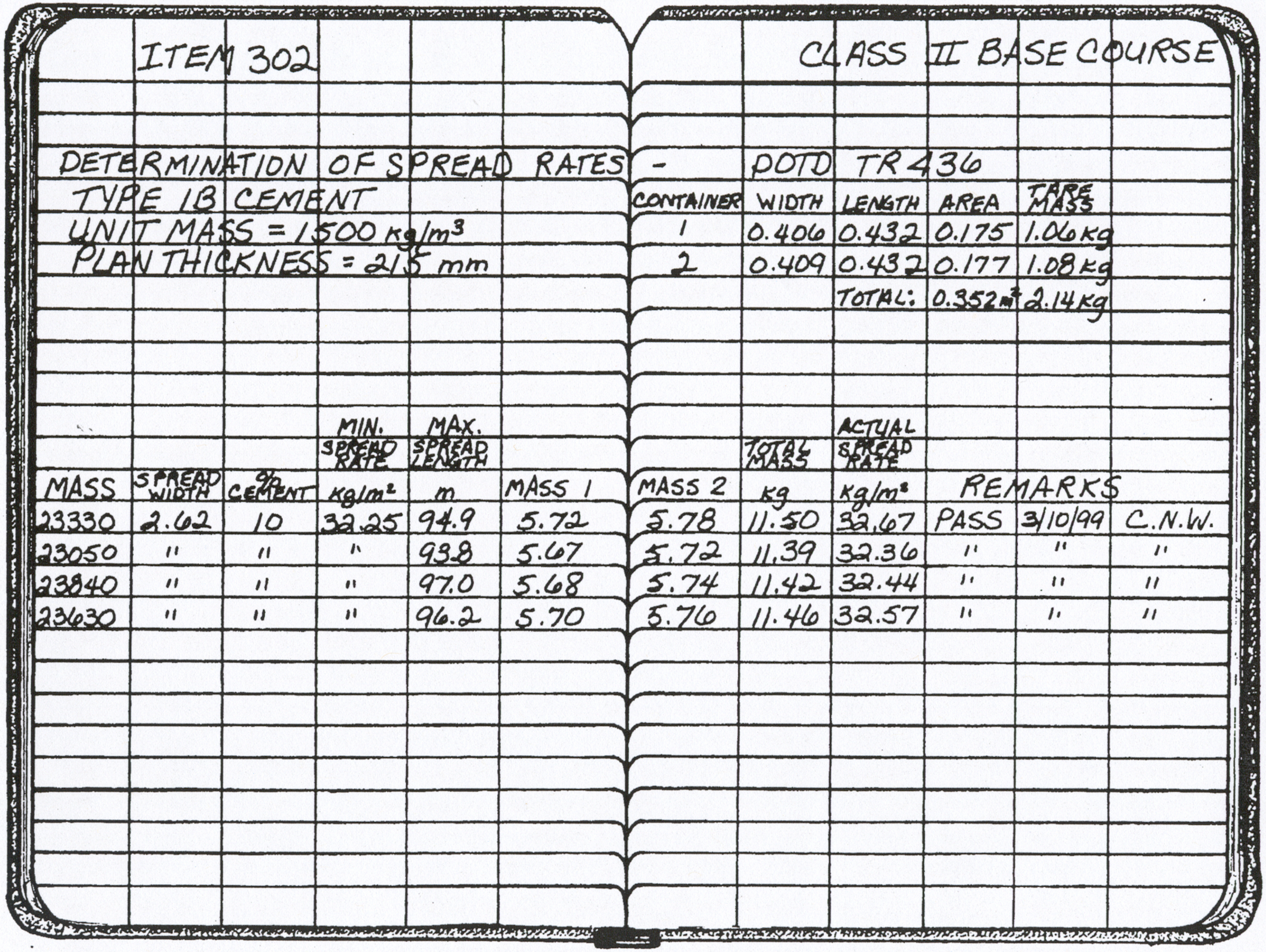
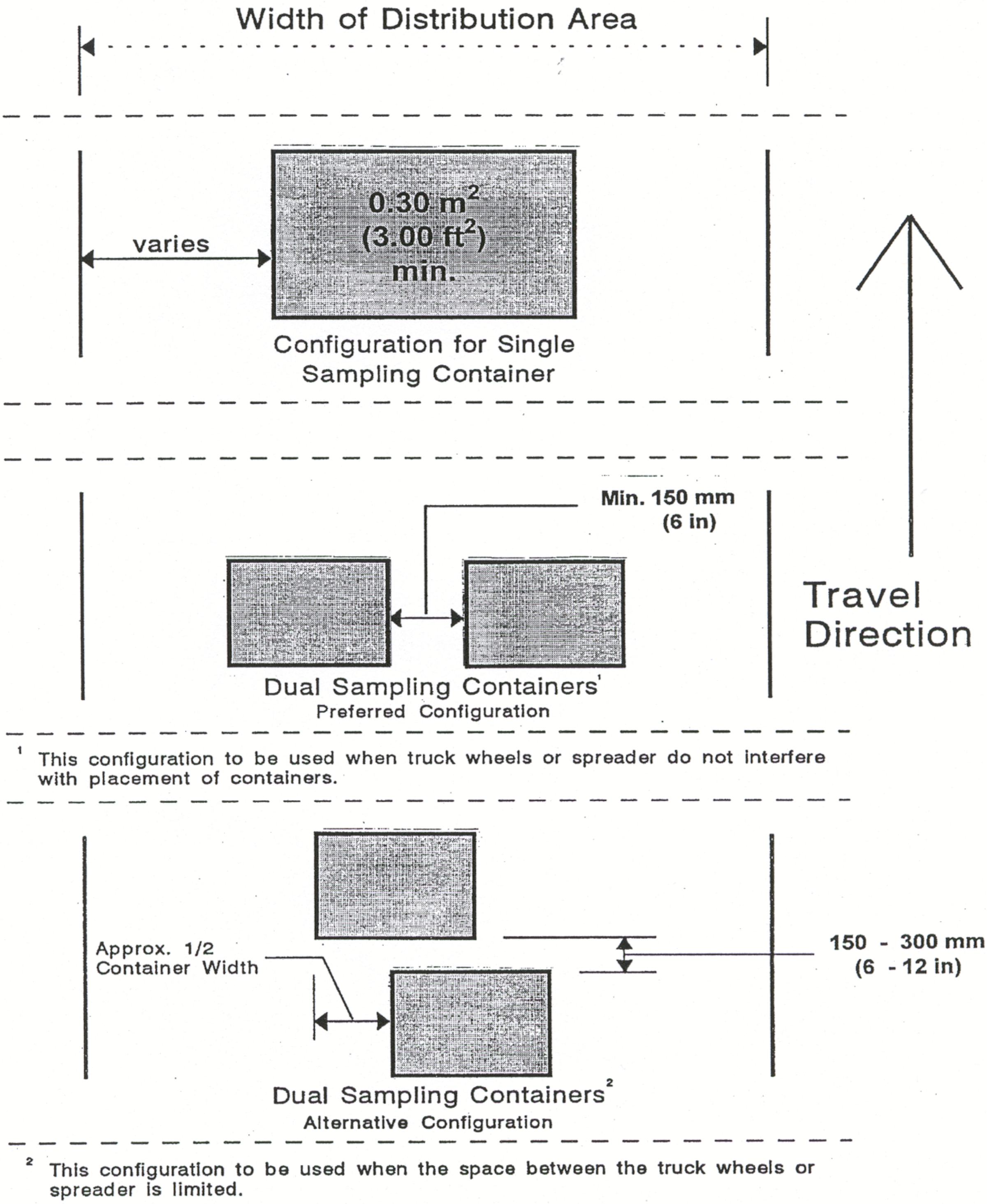


Figure A-2 (Metric) Example - Field Book



PLACEMENT OF SAMPLING CONTAINERS

Figure A-3

Plan Thickness, (mm)								
% By Volume	Additive Unit Mass (kg/m^2) A = 560 B = 1500	150	175	200	225	250	300	350
2%	A B	1.68 4.50	1.96 5.25	2.24 6.00	2.52 6.75	2.80 7.50	3.36 9.00	3.92 10.50
3 %	A B	2.52 6.75	2.94 7.88	3.36 9.00	3.78 10.13	4.20 11.25	5.04 13.50	5.88 15.75
4 %	A B	3.36 9.00	3.92 10.50	4.48 12.00	5.04 13.50	5.60 15.00	6.72 18.00	7.84 21.00
5 %	A B	4.20 11.25	4.90 13.13	5.60 15.00	6.30 16.88	7.00 18.75	8.40 22.50	9.80 26.25
6 %	A B	5.04 13.50	5.88 15.75	6.72 18.00	7.56 20.25	8.40 22.50	10.08 27.00	11.76 31.50
7 %	A B	5.00 15.75	6.86 18.38	7.84 21.00	8.82 23.63	9.80 26.25	11.76 31.50	13.72 36.75
8 %	A B	6.72 10.88	7.84 21.00	8.96 24.00	10.08 27.00	11.20 30.00	13.44 36.00	15.68 42.00
9 %	A B	7.56 20.25	8.82 23.63	10.08 27.00	11.34 30.38	12.60 33.75	15.12 40.50	17.64 47.25
10 %	A B	8.40 22.50	9.80 26.25	11.20 30.00	12.60 33.75	14.00 37.50	16.80 45.00	19.60 52.50
11 %	A B	9.24 24.75	10.78 28.88	12.32 33.00	13.86 37.13	15.40 41.25	18.48 49.50	21.56 57.75
12 %	A B	10.08 27.00	11.76 31.50	13.44 36.00	15.12 40.50	16.80 45.00	20.16 54.00	23.52 63.00
13 %	A B	10.92 29.25	12.74 34.13	14.56 39.00	16.38 43.88	18.20 48.75	21.84 58.50	25.48 68.25
14 %	A B	11.76 31.50	13.72 36.75	15.68 42.00	17.64 47.25	19.60 52.50	23.52 63.00	27.44 73.50
15 %	A B	12.60 33.75	14.70 39.38	16.80 45.00	18.90 50.63	21.00 56.25	25.20 67.50	29.40 78.75
16 %	A B	13.44 36.00	15.68 42.00	17.92 48.00	20.16 54.00	22.40 60.00	26.88 72.00	31.36 84.00
17 %	A B	14.28 38.25	16.66 44.63	19.04 51.00	21.42 57.38	23.80 63.75	28.56 76.50	33.32 89.25
18 %	A B	15.12 40.50	17.64 47.25	20.16 54.00	22.68 60.75	25.20 67.50	30.24 81.00	35.28 94.50
19 %	A B	15.96 42.75	18.62 49.88	21.28 57.00	23.94 64.13	26.60 71.25	31.92 85.50	37.24 99.75
20 %	A B	16.80 45.00	19.60 52.50	22.40 60.00	25.20 67.50	28.00 75.00	33.60 90.00	39.20 105.00

Note: *This chart is not suitable for use when Type IP Portland-Pozzolan Cement or Fly Ash is being used.*

Additive Spread Rate (kg/m^2) - METRIC
Figure A - 4

Plan Thickness, (Inches)								
% By Volume	Additive Unit Wt, (lb/ft^3) A = 35 B = 94	6	7	8	8.5	9	10	12
2%	A B	3.2 8.5	3.7 9.9	4.2 11.3	4.5 12.0	4.7 12.7	5.2 14.1	6.3 16.9
3 %	A B	4.7 12.7	5.5 14.8	6.3 16.9	6.7 18.0	7.1 19.0	7.9 21.2	9.4 25.4
4 %	A B	6.3 16.9	7.4 19.7	8.4 22.6	8.9 24.0	9.4 25.4	10.5 28.2	12.6 33.9
5 %	A B	7.9 21.2	9.2 24.7	10.5 28.2	11.2 30.0	11.8 31.7	13.1 35.2	15.8 42.3
6 %	A B	9.4 25.4	11.0 29.6	12.6 33.8	13.4 36.0	14.2 38.1	15.8 42.3	18.9 50.8
7 %	A B	11.0 29.6	12.9 34.5	14.7 39.5	15.6 41.9	16.5 44.4	18.4 49.4	22.0 59.2
8 %	A B	12.6 33.8	14.7 39.5	16.8 45.1	17.8 47.9	18.9 50.8	21.0 56.4	25.2 67.7
9 %	A B	14.2 38.1	16.5 44.4	18.9 50.8	20.1 53.9	21.3 57.1	23.6 63.4	28.4 76.1
10 %	A B	15.8 42.3	18.4 49.4	21.0 56.4	22.3 59.9	23.6 63.4	26.2 70.5	31.5 84.6
11 %	A B	17.3 46.5	20.2 54.3	23.1 62.0	24.5 65.9	26.0 69.8	28.9 77.6	34.6 93.1
12 %	A B	18.9 50.8	22.0 59.2	25.2 57.7	26.8 71.9	28.4 76.1	31.5 84.6	37.8 101.5
13 %	A B	20.5 55.0	23.9 64.2	27.3 73.3	29.0 77.9	30.7 82.5	34.1 91.6	41.0 110.0
14 %	A B	22.0 59.2	25.7 69.1	29.4 79.0	31.2 83.9	33.1 88.8	36.8 98.7	44.1 118.4
15 %	A B	23.6 63.4	27.6 74.0	31.5 84.6	33.5 89.9	35.4 95.2	39.4 105.8	47.2 126.9
16 %	A B	25.2 67.7	29.4 79.0	33.6 90.2	35.7 95.9	37.8 101.5	42.0 112.8	50.4 135.4
17 %	A B	26.8 71.9	31.2 83.9	35.7 95.9	37.9 101.9	40.2 107.9	44.6 119.8	53.6 143.8
18 %	A B	28.4 76.1	33.1 88.8	37.8 101.5	40.2 107.9	42.5 114.2	47.2 126.9	56.7 152.3
19 %	A B	29.9 80.4	34.9 93.8	39.9 107.2	42.4 113.9	44.9 120.6	49.9 134.0	59.8 60.7
20 %	A B	31.5 84.6	36.8 98.7	42.0 112.8	44.6 119.8	47.2 126.9	52.5 141.0	63.0 169.2

Note: *This chart is not suitable for use when Type IP Portland-Pozzolan Cement or Fly Ash is being used.*

Additive Spread Rate (lb/yd^2) - ENGLISH
Figure A - 4

DOTD Designation: TR 436M/436-99

Method B - Central Plant Mixing

I. Scope

A. This procedure is designed to determine the distribution of dry additives, including cement, lime or fly ash, when they are being mixed by a central mix process with soil, aggregates or soil-aggregate mixtures for stabilization or treatment, and to make adjustments to the feed rate to meet the design requirements.

B. Reference Documents
   1. DOTD TR 403 - Determination of Moisture Content.
   2. DOTD S 101 - Aggregates and Aggregate Mixtures.

II. Apparatus

A. **Central mix plant** - approved in accordance with the Department's procedure, with a laboratory containing the following equipment:
   1. **Scales**
      a. **Additive** - accurate to 0.1% of mass of sample tested and of adequate capacity to determine the mass of sample.
      b. **Soil or soil-aggregate mixture** - platform scale, certified in accordance with department policy.
   2. **Standardized sampling container**
      a. **Additive** - sufficient size and strength for catching the additive sample and holding it during the weighing process.
      b. **Soil or soil-aggregate mixture** - haul truck
   3. **Apparatus required for drying material in accordance with DOTD TR 403.**

B. **Field book**.

C. **Stopwatch**.

D. **Worksheet** - Daily Central Mix Plant Report Form No. 03-22-0754 (Figure B-1)

E. **Worksheet** - Moisture Content, Form No. 03-22-0756 (Figure B-2)

III. Health Precautions

Do not breathe cement or lime dust extensively. Exercise caution when working with quick lime, because it is hazardous and can cause hydration burns. Wearing long sleeves and long pants is advised.

IV. Sample

A. **Additive** - quantity obtained during a time period adequate to represent plant operations and ensure uniformity of flow, but not less than 45 kg (100 lb).

Note B-1: *For high production plants, the minimum sample mass of cement or other additive must be increased to ensure uniformity of flow.*

B. **Soil, aggregate or soil-aggregate mixture** - quantity obtained during the time period to represent plant operations and ensure uniformity of flow.

V. Procedure

A. Establish the sampling time period which will result in a sample size which meets the requirements of Step III. A. Record this time period in minutes or seconds on the worksheet.

Note B-2: *The sampling time period must be established for each production rate at each percent by mass of cement, lime or other additive.*

B. Determination of Dry Mass of Soil, Aggregate or Soil-Aggregate Mixture
   1. Obtain the tare mass of the haul truck, using the platform scale and record in the field book.

Note B-3: *The tare mass of the haul truck shall be obtained immediately before each test and the condition of the truck shall be the same at the time of determining the mass of sample and truck as when the tare mass is obtained.*

   2. After allowing the plant to operate until flow is uniform, divert the feed for the first material into the haul truck, simultaneously starting the stop watch. Allow the material to flow into the haul truck for the time period determined in step A., discontinuing the flow when the stop watch indicates the period is completed.
   3. Determine the wet mass of the material to the nearest 10 kg (0.01 ton or 20 lb) by subtracting the haul truck tare mass from the mass of the haul truck and sample.
   4. Record the wet mass of the material sample on the worksheet.
   5. Determine the percent moisture and total dry mass of the material in accordance with TR 403. Record on the worksheet.
   6. Repeat Steps 1-5 for each material.

C. Determination of Dry Mass of Cement, Lime or Other Additive .

1. Obtain the tare mass of the sampling container and record in the field book to the nearest 0.5 kg (0.1 lb).
2. After allowing the plant to operate until flow is uniform, divert the feed of the cement, lime, or other additive into the sampling container, simultaneously starting the stop watch. Allow the material to flow into the container for the time period determined in step A, discontinuing the flow when the stop watch indicates the period is completed.
3. Determine the mass of material sampled by subtracting the container tare mass from the mass of the container and the material.
4. Repeat steps 1 - 3 with each additive.
5. Record the mass of the cement, lime, or other additive sample on the worksheet to the nearest 0.5 kg (1lb). Record as Dry Mass of Material under cement or additive/lime, as appropriate.

VI. Calculations

A. Calculate the total dry mass of the component materials to the nearest 0.1 kg (1 lb) using the following formula: Record on the worksheet.

Total Dry Mass =

Dry Mass of Material (cement) + Dry Mass of Material (Soil)

example:

dry mass of matl. (cement) = 290.5 kg (640 lb)
dry mass of matl. (soil) = 2975 kg (6567 lb)

Total Dry Mass:

Metric = 290.5 + 2975 = 3265.5 kg
English = 640 + 6567 = 7207 lb

B. Determine the percent by mass of each material using the following formula:

$$\% \text{ by mass} = \frac{\text{dry mass of material}}{\text{total dry mass}} \times 100$$

1. Metric Example:

$$\% \text{ by mass (soil)} = \frac{2975}{3265.5} \times 100$$

$$= 0.91103 \times 100$$

$$= 91.103$$

$$\% \text{ by mass (soil)} = 91.1$$

$$\% \text{ by mass (cement)} = \frac{290.5}{3265.5} \times 100$$

$$= 0.08896 \times 100$$

$$= 8.896$$

$$\% \text{ by mass (cement)} = 8.9$$

2. English Example:

$$\% \text{ by mass (soil)} = \frac{6567}{7207} \times 100$$

$$= 0.91119 \times 100$$

$$= 91.119$$

$$\% \text{ by mass (soil)} = 91.1$$

$$\% \text{ by mass (cement)} = \frac{640}{7207} \times 100$$

$$= 0.08880 \times 100$$

$$= 8.880$$

$$\% \text{ by mass (cement)} = 8.9$$

VII. Report

Report the values for the Proportion Check section on the plant report.

VIII. Normal Test Reporting Time

The normal test reporting time is 1 hour.

DOTD 03-22-0754
Metric/English
Rev. 5/99

Louisiana Department of Transportation and Development

DAILY CENTRAL MIX PLANT REPORT

Project No. 999-99-9999 **Plant Code** B999 **Mat Code** 421 **Seq. No.** 001

Project No. **Lot No.** 005 **Date** 03-10-99

Project No. **Purp. Code** 3 Class 1

1 = Class 1
2 = Class 2
3 = In-Place Stabilized

Base Course Type Soil Cement Weather: High ________ Low ________

Mix Design			
	Material	Source	Proportions By Mass (Wt)
Material #1	Sandy Clay Loam	LC Enterprises	91.0
Material #2			
Material #3			
Lime/Additive			
Cement	Type 1	Blue Circle	9.0
Total			100 %

Proportion Check (TR 436)

Material	No. 1	No. 2	No. 3	Additive/Lime	Cement	Total
Test No. 1 Sampling Time Period: 1 minute						
Wet Mass (Wt) of Material	3190					
% Moisture	7.2					
Dry Mass (Wt) of Material	2976				289.5	3265.5
Percent By Mass (Wt.)	91.1				8.9	100 %
Test No. 2 Sampling Time Period:						
Wet Mass (Wt) of Material						
% Moisture						
Dry Mass (Wt) of Material						
Percent By Mass (Wt)						100 %
Test No. 3 Sampling Time Period:						
Wet Mass (Wt) of Material						
% Moisture						
Dry Mass (Wt) of Material						
Percent By Mass (Wt)						100 %
Test No. 4 Sampling Time Period:						
Wet Mass (Wt) of Material						
% Moisture						
Dry Mass (Wt) of Material						
Percent By Mass (Wt)						

-- OVER --

Figure B - 1 (METRIC)

Daily Central Mix Plant Report

DOTD 03-22-0754
Metric/English
Rev. 5/99

Louisiana Department of Transportation and Development

DAILY CENTRAL MIX PLANT REPORT

Project No. 999-99-9999 **Plant Code** B999 **Mat Code** 421 **Seq. No.** 001

Project No. ______ **Lot No.** 005 **Date** 03-10-99

Project No. ______ **Purp. Code** 3 Class 1

1 = Class 1
2 = Class 2
3 = In-Place Stabilized

Base Course Type Soil Cement Weather: High 75°F Low 68°F

Mix Design			
	Material	Source	Proportions By Mass (Wt)
Material #1	Sandy Clay Loam	LC Enterprises	91.0
Material #2			
Material #3			
Lime/Additive			
Cement	Type I	Blue Circle	9.0
Total			100 %

Proportion Check (TR 436)						
Material	No. 1	No. 2	No. 3	Additive/Lime	Cement	Total
Test No. 1 Sampling Time Period: 1 minute						
Wet Mass (Wt) of Material	7040					
% Moisture	7.2					
Dry Mass (Wt) of Material	6567				640	7207
Percent By Mass (Wt.)	91.1				8.9	100 %
Test No. 2 Sampling Time Period:						
Wet Mass (Wt) of Material						
% Moisture						
Dry Mass (Wt) of Material						
Percent By Mass (Wt)						100 %
Test No. 3 Sampling Time Period:						
Wet Mass (Wt) of Material						
% Moisture						
Dry Mass (Wt) of Material						
Percent By Mass (Wt)						100 %
Test No. 4 Sampling Time Period:						
Wet Mass (Wt) of Material						
% Moisture						
Dry Mass (Wt) of Material						
Percent By Mass (Wt)						

-- OVER --

Figure B - 1 (ENGLISH)

Daily Central Mix Plant Report

Metric/English
Rev. 5/99

Louisiana Department of Transportation and Development

MOISTURE CONTENT WORKSHEET

(DOTD Designation TR 403)

Project No: 999-99-9999 Plant Code: B999 Tested By: ____

Project No: ____ Lot No: 005 Checked By: ____

Project No: ____ Date: 3/10/99

Material	No. 1	No. 2	No. 3	Additive/ Lime	Cement
Test No. ____					
Mass (Wt) of Material + Container (A)	19650				305.5
Tare Mass (Wt) of Container (B)	16460				15
Wet Mass (Wt) of Material (TWW) = (A - B)	3190				
Wet Mass (Wt) Sample & Pan (a)	3073				
Dry Mass (Wt) Sample & Pan (b)	3038				
Mass (Wt) of Water (w) = (a - b)	35				
Pan Mass (Wt) (c)	2550				
DryMass (Wt) Sample (d) = (b - c)	488				
% Moisture (MC) = $(\frac{w \times 100}{d})$	7.2				
Dry Mass (Wt) of Material (TDW) = $(\frac{TWW \times 100}{100 + MC})$ -->	2976				
(TDW) = (A - B) -->					290.5
Test No. ____					
Mass (Wt) of Material + Container (A)					
Tare Mass (Wt) of Container (B)					
Wet Mass (Wt) of Material (TWW) = (A - B)					
Wet Mass (Wt) Sample & Pan (a)					
Dry Mass (Wt) Sample & Pan (b)					
Mass (Wt) of Water (w) = (a - b)					
Pan Mass (Wt) (c)					
Dry Mass (Wt) Sample (d) = (b - c)					
% Moisture (MC) = $(\frac{w \times 100}{d})$					
Dry Mass (Wt) of Material TDW) = $(\frac{TWW \times 100}{100 + MC}$ --->					
(TDW) = (A - B) --->					

Figure B - 2 (METRIC)

Moisture Content Worksheet

DOTD 03-22-0756
Metric/English
Rev. 5/99

Louisiana Department of Transportation and Development

MOISTURE CONTENT WORKSHEET

(DOTD Designation TR 403)

Project No: 999-99-9999 Plant Code: B999 Tested By: ________

Project No: ________ Lot No: 005 Checked By: ________

Project No: ________ Date: 3/10/99

Material	No. 1	No. 2	No. 3	Additive/ Lime	Cement
Test No. 1					
Mass (Wt) of Material + Container (A)	43320				673
Tare Mass (Wt) of Container (B)	36280				33
Wet Mass (Wt) of Material (TWW) = (A - B)	7040				
Wet Mass (Wt) Sample & Pan (a)	3073				
Dry Mass (Wt) Sample & Pan (b)	3038				
Mass (Wt) of Water (w) = (a - b)	35				
Pan Mass (Wt) (c)	2550				
DryMass (Wt) Sample (d) = (b - c)	488				
% Moisture (MC) = $(\frac{w \times 100}{d})$	7.2				
Dry Mass (Wt) of Material (TDW) = $(\frac{TWW \times 100}{100 + MC})$ -->	6567				
(TDW) = (A - B) -->					640
Test No. ____					
Mass (Wt) of Material + Container (A)					
Tare Mass (Wt) of Container (B)					
Wet Mass (Wt) of Material (TWW) = (A - B)					
Wet Mass (Wt) Sample & Pan (a)					
Dry Mass (Wt) Sample & Pan (b)					
Mass (Wt) of Water (w) = (a - b)					
Pan Mass (Wt) (c)					
Dry Mass (Wt) Sample (d) = (b - c)					
% Moisture (MC) = $(\frac{w \times 100}{d})$					
Dry Mass (Wt) of Material (TDW) = $(\frac{TWW \times 100}{100 + MC})$ --->					
(TDW) = (A - B) --->					

Figure B - 2 (ENGLISH)

Moisture Content Worksheet

DOTD Designation: TR 436M/436-99

Method C - Lime Slurry

I. Scope

This procedure is designed to determine the quantity of lime in a slurry when it is being mixed in-place with soil or soil-aggregate mixtures for treatment and to adjust the distribution of the slurry to meet the required percent of lime.

II. Apparatus

A. **Scale** - readable to 0.1 g (0.01 lb), with the capacity to weigh the required sample.
B. **4-L (1-gal) friction top can**
C. **Distributor** - designed to distribute lime slurry and capable of being calibrated to distribute slurry in the required quantity at the proper distribution rate
D. **Graduated cylinder** - capable of measuring a minimum of 1000 mL
E. **Tape** - a minimum of 30 m, readable to 0.1 m (100 ft, readable to 0.1 ft.)
F. **Squeeze bottle**
G. **Stirrer**
H. **Fieldwork** - for recording measurements and results of calculations not documented on specific forms. (Figure C-1)

III. Sample

Obtain approximately 3 L (3/4 gal) of slurry from the transport.

IV. Procedure

Note C-1: *Record all values and results of calculations in the fieldwork.*

A. Determine the specific gravity of the slurry as follows.
   1. Obtain the tare weight of a clean, dry graduated cylinder and record.
   2. Agitate the sample by stirring until the mixture is homogenous.
   3. Pour the sample into the graduated cylinder to just below the 1000-mL mark.
   4. Fill the squeeze bottle with material from the agitated sample and complete fillingthe graduated cylinder with the sample to 1000 mL, with the bottom of the meniscus at the 1000-mL line. If you overfill the graduated cylinder, use the squeeze bottle to remove excess slurry and return it to the original sample.
   5. Weigh the graduated cylinder with the 1000 mL of slurry and record.
   6. Determine the weight of the 1000 mL of slurry by subtracting the tare weight of the graduated cylinder from the filled weight and record.
   7. Calculate the specific gravity in accordance with step V.B.

B. Determine and record the weight of lime per unit volume of slurry as shown in step V.C.
C. Determine and record the minimum spread rate in kg/m^2 (lb/yd^2) of dry lime in accordance with step V.A. and in L/m^2 (gal/yd^2) of slurry in accordance with step V.D.
D. Determine and record the maximum length of spread in meters (feet), in accordance with step V.E.
E. Measure and record the length and width of spread in meters (feet) to the nearest 0.1 m (nearest foot).
F. Determine and record the volume of slurry dispensed.
G. Determine and record the actual spread rate of slurry in L/m^2 (gal/yd^2) in accordance with step V.F.
H. Determine and record the actual spread rate of dry lime (% lime by volume) in accordance with step V.G.

V. Calculations

A. Calculate the minimum spread rate (M) of dry lime to the nearest 0.01 kg/m^2 (0.1 lb/yd^2) by using the following formula:

Note C-2: *The unit weight of lime will be 560 kg/m^3 (35 lb/ft^3). For the purpose of slurry calculations, quicklime is assumed to become hydrated lime when incorporated into water.*

1. Metric Example:

$$M = \frac{tVU}{100\ 000}$$

where:

M = minimum spread rate, kg/m^2
t = plan thick. of compacted course, mm
V = specified additive by volume, %
U = unit wt. of additive, kg/m^3
100 000 = constant, converts mm to m and % to decimal

example:

t = 150 mm
V = 6.0 %
U = 560 kg/m^3

$$M = \frac{tVU}{100\ 000}$$

$$= \frac{150 \times 6.0 \times 560}{100\ 000}$$

$$= \frac{504\ 000}{100\ 000}$$

$$= 5.0400$$

$$M = 5.04\ kg/m^2$$

2. English Example:

$$M = 9\left(\frac{t}{12}\right)\left(\frac{V}{100}\right) U$$

where:

M = minimum spread rate, lb/yd^2
9 = constant (ft^2/yd^2)
t = plan thickness of compacted course, in
12 = constant (in/ft)
V = specified additive by volume, %
100 = a constant (to convert % to decimal)
U = unit wt. of additive, lb/ft^3

example:

t = 6 in.
V = 6.0 %
U = 35 lb/ft^3

$$M = 9\left(\frac{6}{12}\right)\left(\frac{6.0}{100}\right) 35$$

$$= 9 \times 0.5 \times 0.060 \times 35$$

$$= 9.450$$

$$M = 9.4\ lb/yd^2$$

B. Calculate the specific gravity of the slurry (g), to the nearest 0.0001, by dividing the mass of 1000 mL of slurry by 1000.

example:

tare mass of graduated cylinder	=	571.6 g
mass of grad. cyl. & 1000 mL of slurry	=	1775.1 g
Mass of 1000 mL of slurry	=	1203.5 g

$$g = \frac{1775.1 - 571.6}{1000}$$

$$= \frac{1203.5}{1000}$$

$$g = 1.2035$$

C. Calculate the mass of lime per unit volume of slurry (S) to the nearest 0.001 kg/L (0.01 lg/gal) by using the following formula:

1. Metric Example:

$$S = 1.77(g - 1)$$

where:

g = specific gravity of the slurry
1.77 = constant (based on sp.gr. lime = 2.3)

example:

g = 1.2035

$$S = 1.77(1.2035 - 1)$$

$$= 1.77(0.2035)$$

$$= 0.36019$$

$$S = 0.360\ kg/L$$

2. English Example:

$$S = 14.8(g - 1)$$

where:

g = specific gravity of the slurry
14.8 = constant (based on sp.gr. lime = 2.3 and weight of lime equals 19.2 lb/gal)

example:

g = 1.2035

$$S = 14.8(g - 1)$$

$$= 14.8(1.2035 - 1)$$

$$= 14.8(0.2035)$$

$$= 3.0118$$

$$S = 3.01\ lb/gal$$

D. Calculate the minimum spread rate of slurry (R) to the nearest 0.1 L, in L/m^2 (0.1 gal, in gal/yd^2) by using the following formula:

1. Metric Example:

$$R = \frac{M}{S}$$

where:

M = minimum spread rate of dry lime, kg/m^2
S = mass of lime per unit volume, kg/L

example:

M = 5.04 kg/m^2
S = 0.360 kg/L

$$R = \frac{5.04}{0.360}$$

$$= 14.000$$

$$R = 14.0\ L/m^2$$

2. English Example:

$$R = \frac{M}{S}$$

where:

M = minimum spread rate of dry lime, lb/yd^2
S = weight of lime per unit volume, lb/gal

example:

M = 9.4 lb/yd^2
S = 3.01 lb/gal

$$R = \frac{9.4}{3.01}$$

$$= 3.122$$

$$R = 3.1\ gal/yd^2$$

E. Calculate maximum length of spread (L_m), to the nearest 0.1 m (1 ft), for a slurry transport by using the following formula:

1. Metric Example:

$$L_m = \frac{G}{R \times W_m}$$

where:

G = volume of slurry in transport, L
R = minimum spread rate of slurry, L/m^2
W_m = width of spread, m

example:

G = 18 845 L
R = 14.0 L/m^2
W_m = 7.6 m

$$L_m = \frac{18\ 845}{14.0 \times 7.6}$$

$$= \frac{18\ 845}{106.400}$$

$$= 177.114$$

$$L_m = 177.1\ m$$

2. English Example:

$$L_m = \frac{9 \times G}{R \times W_m}$$

where:

G = volume of slurry in transport, gal
R = minimum spread rate of slurry, gal/yd^2
W_m = width of spread, ft
9 = constant, ft^2/yd^2

example:

G = 4,980 gal
R = 2.90 gal/yd^2
W_m = 25 ft

$$L = \frac{9 \times 4980}{3.1 \times 25}$$

$$= \frac{44,820}{77.5}$$

$$= 578.32$$

$$L = 578\ ft$$

F. Calculate the actual spread rate (A) to the nearest 0.1 L/m^2 (0.1 gal/yd^2) by using the following formula:

1. Metric Example:

$$A = \frac{G}{L_a \times W_a}$$

where:

G = volume of slurry dispensed, L
L_a = actual length of spread, m
W_a = actual width of spread, m

example:

G = 18 845 L
L_a = 168.7 m
W_a = 7.6 m

$$A = \frac{18\ 845}{168.7 \times 7.6}$$

$$= \frac{18\ 845}{1282.120}$$

$$= 14.698$$

$$A = 14.7\ L/m^2$$

2. English Example:

$$A = \frac{9 \times G}{L_a \times W_a}$$

where:

G = volume of slurry dispensed, gal
L_a = actual length of spread, ft
W_a = actual width of spread, ft
9 = constant, ft^2/yd^2

example:

G = 4,980 gal
L_a = 543 ft
W_a = 25 ft

$$A = \frac{9 \times 4980}{543 \times 25}$$

$$= \frac{44{,}820}{13{,}575}$$

$$= 3.301$$

$$A = 3.3\ gal/yd^2$$

G. Calculate the actual spread rate in percent of dry lime by volume (V) to the nearest 0.1% by using the following formula:

1. Metric Example:

$$V = \frac{A \times S}{U \times t} \times 100\ 000$$

where:

A = actual spread rate of slurry, L/m^2
S = mass of lime per unit vol. of slurry, kg/L
t = plan thickness of compacted course, mm
U = unit mass of lime, kg/m^3

example:

A = 14.7 L/m^2
S = 0.360 kg/L
t = 150 mm
U = 560 kg/m^3

$$V = \frac{14.7 \times 0.360}{560 \times 150} \times 100\ 000$$

$$= \frac{5.292}{84\ 000} \times 100\ 000$$

$$= 0.000\ 063\ 00 \times 100\ 000$$

$$= 6.300$$

$$V = 6.3\ \%$$

2. English Example:

$$V = \frac{400 \times A \times S}{3 \times U \times t}$$

where:

A = actual spread rate of slurry, gal/yd^2
S = wt. of lime per unit volume of slurry, lb/gal
t = plan thickness of compacted course, in.
U = unit weight of lime, lb/ft^3
3 = constant
400 = constant

example:

A = 3.3 gal/yd^2
S = 3.01 lb/gal
t = 6 in.
U = 35 lb/ft^3

$$V = \frac{3.3 \times 3.01 \times 400}{3 \times 35 \times 6}$$

$$= \frac{9.933 \times 400}{630}$$

$$= \frac{3973.200}{630}$$

$$= 6.306$$

$$V = 6.3\ \%$$

VI. Report

A Report the minimum spread rate of slurry to the nearest 0.1 L/m^2 (0.1 gal/yd^2)

B. Report the maximum length of spread to the nearest 0.1 m (1 ft)

C. Report the actual spread rate of dry lime to the nearest 0.1% in percent by vol.

4. Report the percent of lime required.

VII. Normal Test Reporting Time

The normal test reporting time is 30 minutes.

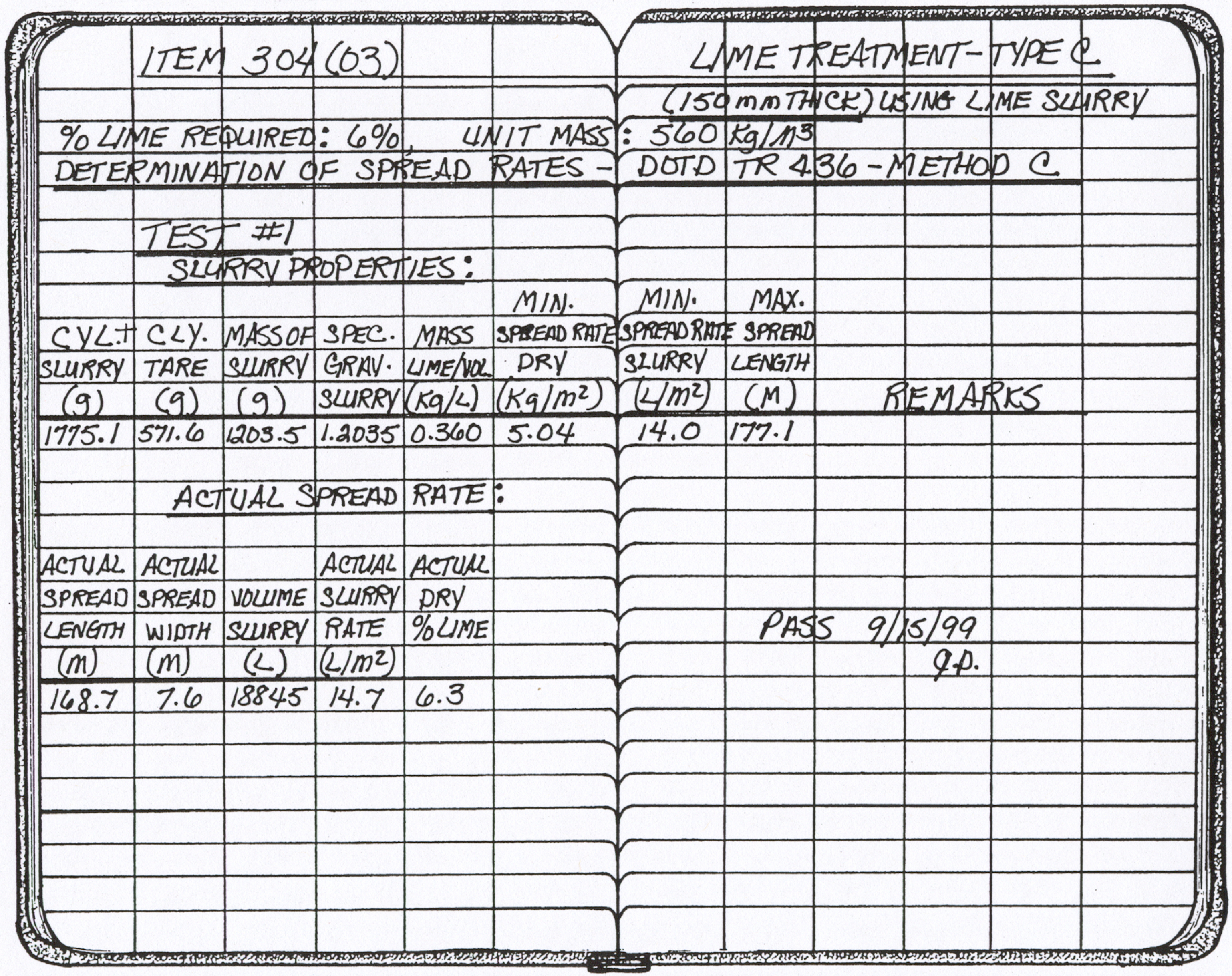


Figure C - 1 (METRIC)

Field Book