Standard Test Method for Workability of Cold Mix Patching Materials

AASHTO DESIGNATION: TP43-94[1,2] (Reapproved 1996)

1. Scope

1.1 This standard provides a test for determination of the workability of cold mix patching materials.

1.2 This standard is applicable to cold mix patching materials that will be stockpiled, subjected to various climatic conditions, and later retrieved for use in roadway patching operations.

1.3 This test may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 AASHTO Standards

T2 Sampling Aggregates
T40 Sampling Bituminous Materials
T168 Sampling Bituminous Paving Mixtures
T195 Degree of Particle Coating of Bituminous Aggregate Mixtures
T248 Reducing Field Samples of Aggregate to Testing Size
PP21 Testing and Evaluating Cold Mix Patching Materials

2.2 ASTM Standards

D8 Standard Definition of Terms Relating to Materials for Roads and Pavements

D3665 Random Sampling of Construction Materials

3. Terminology

3.1 Workability - The average maximum resistance to penetration by a designated penetrometer into an uncompacted cold mix that is confined in a designated box.

3.2 Definitions for other terms used in this standard may be found in ASTM D8 or a standard unabridged dictionary.

4. Summary of Method

4.1 This standard contains a workability test that determines a quantitative value for the workability of cold mix patching materials intended for winter and spring roadway patching.

4.2 Alternate 1 - Samples are obtained from cold mix production, cured, cooled to a specified temperature, and tested for workability.

4.3 Alternate 2 - Samples of the aggregate proposed for use are dried, mixed with the percentage of the asphalt binder proposed for use, cured, percent residual asphalt coating determined, cooled to a specified temperature, and tested for workability.

5. Significance and Use

5.1 Use the workability test, contained in this standard, to determine whether a cold mix product complies with specification requirements. The test may also be used to generate information concerning the potential workability of a cold mix design scheduled for production.

5.2 The workability test is one factor for determining cold mix suitability for use as a highway patching material.

5.3 This standard is applicable to cold mixes manufactured with modified or unmodified asphalt emulsions, cutback asphalts, or combinations.

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[1] This standard is based on SHRP Product H-348.

[2] Approved in October 1994, this provisional standard was first published in March 1995.

6. Interferences

6.1 Differences in the aggregate gradation, geometry, and surface properties, and the residual asphalt binder can affect the workability test values.

6.2 Test procedure variances can affect the values obtained. Careful adherence to the standard procedure will decrease the likelihood of differences caused by departures from test parameters.

7. Apparatus

7.1 (Required for alternate 2 only) Mixing bowl and mixing utensils suitable for mixing 2.5 kg aggregate samples with asphalt binder materials.

7.2 (Used for alternate 2 and for alternate 1 unless materials are cured prior to sampling) Oven capable of maintaining a temperature of 96 ± 2°C.

7.3 (For alternate 2 only) Oven capable of maintaining a temperature of 60 ± 2°C.

7.4 A refrigerator capable of maintaining a temperature of 4 ± 1°C.

7.5 Balance having a capacity of 3 kg or more and sensitive to 1.0 g.

7.6 Pocket penetrometer with an end diameter equal to 6.5 ± 1 mm and a scale range 0-430 kPa or greater.

7.7 Penetrometer adapter that will increase the end diameter of the penetrometer to 9.5 ± 0.1 mm (Figure 1).

> Note 1 -- Research has shown that the Soiltest CL 700-A penetrometer or equivalent, with the appropriate adapter, is one acceptable penetrometer for use in this standard.

7.8 A workability testing box constructed as a 102 mm cube with 10 mm diameter holes at the center of 2 opposite sides (Figure 1).

7.9 (Used for alternate 2 and for alternate 1 unless materials are cured prior to sampling) Containers for drying laboratory samples of aggregate.

7.10 (Used for alternate 2 and for alternate 1 unless materials are cured prior to sampling) Containers for curing mixture samples.

7.11 Containers for cooling mixture samples.

7.12 Utensils for handling and transferring mixture samples.

8. Materials - A supply of absorbent paper.

9. Standardization

9.1 Verify calibration of the oven. A standard ASTM thermometer with 0.1°C markings is suitable for verification.

9.2 Verify calibration of the refrigerator. A standard ASTM thermometer with 0.1°C markings is suitable for verification.

9.3 Verify calibration of the balance. Standardized masses are suitable for verification.

9.4 Verify calibration of the penetrometer.

10. Hazards

10.1 Observe standard laboratory safety precautions when preparing and testing cold mix asphalt test specimens.

10.2 Cutback asphalt having a flash point of less than 100°C (212°F) when used in mixtures, shall not be subjected to accelerated curing in the oven with a temperature setting of 100°C (212°F). Use of gas ovens with open flame is prohibited. Any deviation from this requirement will cause a fire or explosion. These requirements are specially applicable to 12.3.2.2.

11. Sampling, Test Specimens, and Test Units

11.1 Obtain field samples in accordance with ASTM D3665.

11.2 Alternate 1.

11.2.1 Obtain 3 samples, in accordance with T168, of cold mix from the material proposed for use.

11.2.2 Use standard quartering procedures to obtain

a 2500 ± 100 g laboratory test sample from each of the 3 field samples.

11.2.2 When alternate 1 is used, proceed directly to Section 12.

11.3 Alternate 2.

11.3.1 Aggregates.

11.3.2.1 Sample the proposed aggregate source, with the specified gradation, which is intended for production use, in accordance with T2.

11.3.2.2 Assure that the field sample complies with the gradation required for cold mix production. Obtain laboratory samples from the field sample by reducing the field sample of aggregate to a series of laboratory test samples (a minimum of 3) massing 2500 ± 100 g each in accordance with T248.

11.3.2 Asphalt Binder - Sample Asphalt Binder materials in accordance with T40.

12. Procedure - Alternate 1.

12.1 Line a curing container with absorbent paper and spread one of the sample mixtures into the lined container.

12.2 Proceed directly to Section 13.3

13. Procedure - Alternate 2.

13.1 Aggregate.

13.1.1 Place each of the 2500 ± 100 g laboratory samples of aggregate into a container suitable for drying.

13.1.2 Place the containers of aggregate in an oven preheated to 60 ± 2°C for drying.

13.1.3 Stir the samples occasionally to prevent formation of lumps.

13.1.4 Dry the samples to a constant mass.

13.1.5 Determine the mass, to the nearest 1 g, of each of the aggregate samples after drying is completed. Enter the mass in grams of each aggregate sample used for the workability test in Table 2, Column 1.

13.2 Mixing

13.2.1 Place the aggregate sample (which has it's mass recorded in Column 1, line 1 of Table 2 into the mixing container and pour a measured quantity of the asphalt binder material (which would contain approximately the percent asphalt residue by mass of the total mix entered in line 1, Column 2, of Table 1, into the container with the aggregate. Determine the quantity of binder material from line 1, Column 3, of Table 2.

13.2.2 Mix the aggregate and binder until the binder is thoroughly dispersed throughout the mixture.

13.2.3 Line a curing container with absorbent paper and spread the mixture into the lined container.
12.2.3 Curing (both alternates).

> Note 2 -- If inspection of an alternate 1 sample reveals that the mixture has already been cured as a result of stockpile aging, the sample processing may proceed directly to Section 14.

13.3.1 Emulsions

13.3.1.1 Place the lined container and mixture in an oven which has been preheated to 96 ± 2°C. Cure the mix in the oven until the water (and cutback solvents, if present) have evaporated.

13.3.1.2 Alternatively, the lined container and mixture may be cured at room temperature. When this option is used, cure the mix until the water (and cutback solvents, if present) have evaporated.

13.3.2 Cutbacks.

13.3.2.1 Place the lined container and mixture under a fume hood and cure at room temperature. Cure the mix until cutback solvents (and water if present) have evaporated.

13.3.2.2 Alternatively, if the flashpoint of the cutback allows, the curing process may be accelerated by placing the lined container and mixture in an oven which has been preheated to 96 ± 2°C. Cure the mix in the oven until cutback solvents (and water, if present) have evaporated, when the cutback flashpoint is 100°C or less, do not use this alternate because of the hazard noted in 10.2.

13.4 (For alternate 2 samples only) Coating percent before workability test.

13.4.1 When the mixture sample is cured, determine and record the percentage of aggregate coated with residual asphalt in accordance with the applicable Sections of T195 (the mass of the sample is the total mass, approximately 2500 g, of the particular cured mixture sample that is in process in lieu of that specified by T195).

13.5 (Both alternates) Processing remaining mixture samples.

13.5.1 Process each of the remaining samples as indicated in Sections 13 through 13.4.1.

14. Procedure - Workability (both alternates).

14.1 Processing first sample.

14.1.1 Line a cooling container with absorbent paper and spread the mixture into the lined container.

14.1.2 Place the container and sample mixture into the refrigerator and allow the sample mixture to stabilize at a temperature of 4 ± 1°C.

14.1.3 Remove the cooled mixture from the refrigerator and place it into the workability box. Drop the mixture loosely into the box. Make no effort to compact the sample mixture into the box.

14.1.4 Place the adapter on the penetrometer.

14.1.5 Using a penetration rate of 12 ± 5 mm/s, push the penetrometer with adapter installed through the hole in one side of the box into the sample mixture. Record the maximum resistance.

14.1.6 Using a penetration rate of 12 ± 5 mm/s, push the penetrometer with adapter installed through the hole in the opposite side of the box into the sample mixture. Record the maximum resistance.

14.2 Processing the remaining samples in accordance with Section 14.1 through 14.1.6.

15. Calculations and Worksheets

15.1 Residual asphalt content.

15.1.1 Enter the percent residual asphalt by mass of the total mix as produced (or as scheduled for production) in line F of Table 1.

15.1.2 Enter the residual asphalt binder factor from specification tests performed on the material used in production (or scheduled for use) in line R of Table 1.

15.1.3 Enter the value from line F, Table 1, into line 1, Table 1 for alternate 1 samples. For alternate 2 samples see Section 15.2.5.

15.1.4 Enter the mass of each sample mixture in line 2, Table 1.

15.1.5 Enter the maximum penetrometer resistance value for side one of the sample mixture in line 3, Table 1.

15.1.6 Enter the maximum penetrometer resistance value for side two of the sample mixture in line 4, Table 1.

15.1.7 Calculate the average of the penetrometer resistance values entered in line 3 and 4. Enter the average for each sample in line 5, Table 1.

15.1.8 Calculate the grand average penetration resistance value by averaging the values entered in line 5, Columns 2, 3, and 4, of Table 1. Enter this value, to the nearest kiloPascal, in line W under Table 1. This is the designated Workability value for the mixture.

15.1.9 Determine the percent (by total mass of mix) binder material used (or scheduled for use) in production. Enter in line I, at the end of Table 1.

15.2 Alternate 2.

15.2.1 Enter the total mass of the dry aggregate for each sample in Column 1 of Table 2.

15.2.2 Calculate the total binder mass in grams to be added to each sample mix in accordance with the equations in Table 2, Column 2, and enter in Table 2, Column 3.

15.2.3 Use the following equation to calculate the residual asphalt percent by mass of final mix (aggregate + residual asphalt), and enter in Table 2, Column 4.

$$J = 100\,[(IR)/100] \,/\, [G+((IR)/100]$$

where:

I = G(F/R) = total binder material mass in g.
R = residual asphalt factor in percent.
G = aggregate mass in g.
J = percent residual asphalt by mass of final mix.

15.2.4 Enter the percent coating values for each mix sample before the workability test, as determined in Section 13.4, into Table 2, Column 5.

15.2.5 Enter the values from Table 2, Column 4 for each sample processed to completion into Table 1, line 1 (in lieu of the value in line F).

16. Report

16.1 Report the following information as a minimum.

16.1.1 Source of aggregate.

16.1.2 Aggregate gradation.

16.1.3 Source of binder material.

16.1.4 Type of binder (emulsion, cutback, etc.)

16.1.5 Source of mixture.

16.1.6 Percent residual asphalt in mix.

16.1.7 Total percent binder material corresponding to the value reported in Section 16.1.6.

16.1.8 Workability of mix (from line W, Table 1).

16.1.9 (Required for alternate 2 specimens only) Percent residual asphalt coating value before the workability test is performed for each specimen (from Column 5, Table 2).

17. Precision and Bias

17.1 Precision - The research required to develop precision values has not been conducted.

17.2 Bias - The research required to establish the bias of this method has not been conducted.

18. Keywords - Cold mix asphalt; workability; cold mix workability test; cold mix evaluation test.

Table 1.
Laboratory Workability Test Worksheet

Residual asphalt content used (or scheduled for use) in production: _____(F)

Binder material residual factor from specification tests on material used (or scheduled for use) in production: _____(R)

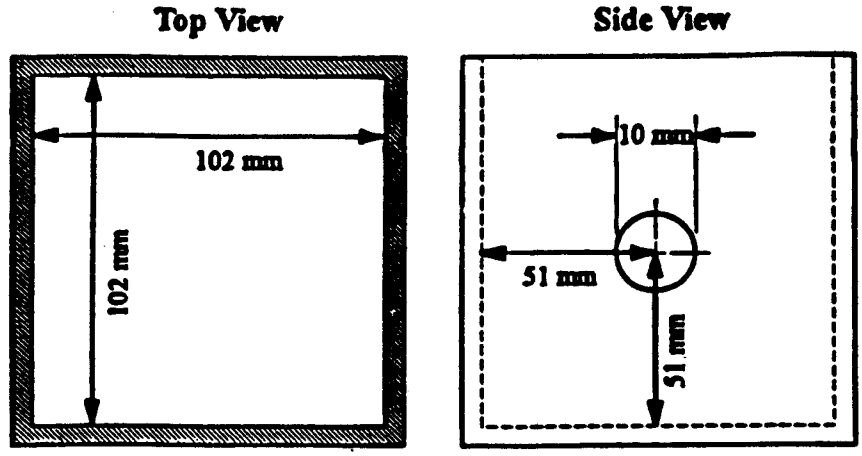
Residual Asphalt Content of Sample Percent	F	F	F
Mass of Sample g			
Penetrometer resistance reading #1, kPa			
Penetrometer resistance reading #2, kPa			
Average Penetrometer resistance reading, kPa			

Maximum grand average penetrometer resistance, the Workability value: _____(W)

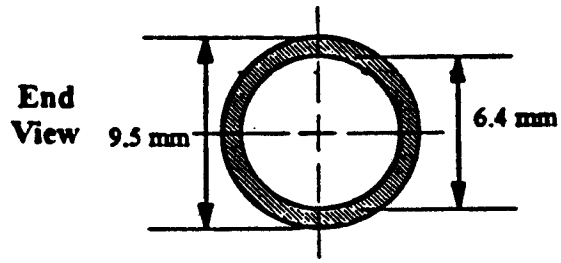
Total percent asphalt binder content used (or scheduled for use) in production:_____(I percent)

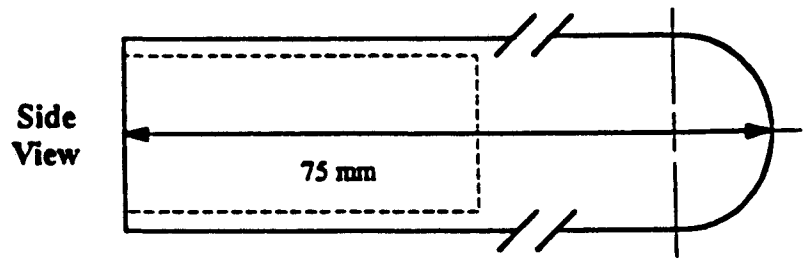
Table 2. Laboratory Worksheet for Sample Preparation (use with alternate 2 only).

Aggr. Mass, g (G)	Target Binder Mass Formulae, g	Total Binder Mass, g	Residual Asphalt Content Percent by Mass of Final mix	Percent Coated
				Initial
	G×[F/(R)]			
	G×[F)/(R)]			
	G×[F/(R)]			



Workability Testing Box





Penetrometer Adapter

Figure 1. Workability testing box and penetrometer adapter.