



Test method T646

Mix volume ratio (Dry mix)

NOVEMBER 2012



Revision Summary

Ed/Rev Number	Clause Number	Description of Revision	Authorisation	Date
		New Issue (David Bligh)	D.Dash	Aug 1999
Ed 2/Rev 0	All	Revised & reformatted. Reference to AS where appropriate. Formula corrected and based on coarse aggregate in the mix. Symbols revised. Title Revised	P Walter	June 2010
Ed 3/ Rev 0	All	Reformatted RMS template	J. Friedrich	November 2012

Note that Roads and Maritime Services is hereafter referred to as 'RMS'.

The most recent revision to Test method T646 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

Test method T646

Mix volume ratio (Dry mix)

1. Scope

This test method sets out the procedure to determine the mix volume ratio of a stone mastic asphalt mix.

NOTE: The method is based on the Main Roads Department, Queensland - Test Method Q318-2008.

2. General

- (a) This test is applicable to SMA14 and SMA10 stone mastic asphalt produced in an asphalt manufacturing plant.
- (b) The method allows results from an Australian Standard as an alternative to test results. Where an equivalent test method is already specified, the results from that test method are to be used in the relevant calculations.
- (c) The following terms and definitions are used in this Test Method.

Term	Definition
Mix volume ratio	The volume of the components other than the coarse aggregate within a compacted mix expressed as a proportion of the volume of air voids contained within the coarse aggregate in a dry rodded condition.
coarse aggregate	(a) For SMA14, the fraction retained on a 4.75 mm AS sieve. (b) For SMA10, the fraction retained on a 2.36 mm AS sieve.

- (d) The following documents are referred to in this Test Method:
 - (i) T209 - Density and Water Absorption of Coarse Aggregate.
 - (ii) T212 - Compacted Unit Mass of Aggregate.
 - (iii) T607 - Bitumen Content and Aggregate Grading of Bituminous Mixtures - Reflux Method.
 - (iv) AS 1141 Methods for sampling and testing aggregates
 - AS 1141.4 Bulk density of aggregate (alternative to T212).
 - AS 1141.6.1 Particle density and water absorption of coarse aggregate - Weighing-in-water method (alternative to T209).
 - (v) AS 2891 Methods of sampling and testing asphalt:
 - AS 2891.1.1 Sampling of loose asphalt.
 - AS 2891.2.1 Sample preparation - mixing, quartering and conditioning of asphalt in the laboratory.
 - AS 2891.2.2 Sample preparation - compaction of asphalt test specimens using a gyratory compactor.
 - AS 2891.3.1 Bitumen content and aggregate grading - Reflux method (alternative to T607).
 - AS 2891.9.2 Determination of bulk density of compacted asphalt - Presaturation method.
 - (vi) Austroads Test Method AG:PT/T234 - Asphalt binder content (Ignition oven method).

3. Apparatus

The apparatus is specified in the relevant test method.

4. Sampling and Preparation

Sample loose asphalt produced in an asphalt manufacturing plant as required either at the plant or on site in accordance with AS 2891.1.1.

5. Procedure

NOTE: The method requires determination of the binder content and particle distribution of the mix, the particle density on a dry basis of the coarse aggregate, the compacted bulk density of the coarse aggregate and the compacted density of the mix.

- (a) Determine the compacted density of the mix:
- (i) Prepare the sample in accordance with AS 2891.2.1.
 - (ii) Compact the mix according to AS 2891.2.2. Unless otherwise specified, use 120 gyratory cycles (N) and temperature of $150 \pm 5^\circ\text{C}$ (T).

NOTE: These parameters will depend on the binder type and incorporation of WMA technology.

- (iii) Determine the compacted density (D_C) of the mix according to AS 2891.9.2 to the nearest 0.001 t/m^3 .
- (b) Determine the total binder content (B) and aggregate particle distribution of the mix in accordance with T607 or AS 2891.3.1. For aggregate that will not break down under heating another alternative is AG:PT/T234.

NOTE: Do not use AG:PT/T234 where aggregates break down under heating as the grading will be affected.

- (c) Determine the particle density on a dry basis of the coarse aggregate fraction (ρ_D) to the nearest 0.001 t/m^3 in accordance with T209 or AS 1141.6.1.
- (d) Determine the compacted bulk density of the coarse fraction in accordance with T212 or AS 1141.4. Repeat the test to give 3 determinations and calculate the average compacted bulk density ($\rho_{C,bulk}$) to the nearest 0.001 t/m^3 .

6. Calculations

- (a) Calculate the proportion of coarse aggregate in the total aggregate (P_C) to the nearest 0.1% as follows:

$$P_C = \frac{M_C}{M_S} \times 100\%$$

- Where
- P_C = Proportion of coarse aggregate in the total aggregate (%)
 - M_C = Mass of aggregate retained by the coarse sieve (g):
i.e. SMA14 +4.75 mm and SMA10 +2.36 mm
 - M_S = Total mass of aggregate sample (g)

- (b) Calculate the Proportion of Coarse Aggregate (P_{CM}) in the mix to the nearest 0.1% as follows:

$$P_{CM} = \frac{P_C D_C}{\rho_D} \times \frac{(100 - B)}{100}$$

- Where
- P_{CM} = Proportion by volume of coarse aggregate in the mix (%)
 - P_C = Proportion of coarse aggregate in the total aggregate (%)
 - D_C = Compacted density of the mix (t/m^3)
 - B = Total binder content of the mix (%)
 - ρ_D = Particle density on a dry basis of the coarse aggregate (t/m^3)

- (c) Calculate the Voids in Coarse Aggregate (VCA) to the nearest 0.1% as follows:

$$VCA = \left(1 - \frac{\rho_{Cbulk}}{\rho_D} \right) \times 100\%$$

- Where VCA = Voids in Coarse Aggregate (%)
 ρ_{Cbulk} = Average compacted bulk density of dry rodded coarse aggregate (t/m^3)
 ρ_D = Particle density on a dry basis of coarse aggregate (t/m^3)

- (d) Calculate the Mix Volume Ratio (MVR) for the mix to the nearest 0.01 as follows:

$$MVR = \frac{(100 - P_{CM})}{VCA}$$

- Where MVR = Mix Volume Ratio
 P_{CM} = Proportion of coarse aggregate in the mix (%)
 VCA = Voids in Coarse Aggregate (%)

7. Reporting

Include the following results in the report:

- The product or mix identification.
- Source of material: the batch number, date of production and sampling point.
- The number of compaction cycles (N) and temperature (T) used in Step 5(a).
- The Mix Volume Ratio (MVR) of the mix to the nearest 0.01.
- Reference to this test method.