

MIX DESIGN METHOD FOR CUTBACK ASPHALT MIXTURES

1.0 SCOPE

- 1.1 This Method of Mix Design is used to provide guidance in designing mixtures using MC-250 or MC-800 cutback asphalts intended to be produced by plant mixing at elevated temperatures. These design procedures are modifications of the Marshall Method of Design and are based on Asphalt Institute's Asphalt Cold-Mix Manual, MS-14.
- 1.2 These methods allow the designer a visual evaluation of the mix at various cutback asphalt contents, as well as determining density, stability and voids data.
- 1.3 It has been observed that typical MC-250 design contents range from 4.5 to 5.3%.

2.0 APPLICABLE DOCUMENTS

- 2.1 [TLT-301](#) Mix Design Method for Asphalt Concrete Pavement
- 2.2 [TLT-308](#) Empirical Mix Design Method for Cutback Asphalt Determination

3.0 TEST SPECIMENS

- 3.1 Aggregate Preparation
 - 3.1.1 Two (2) to three (3) bags (80-120 kg) of aggregate are required for the test method. The bags should contain materials representative of each component and should be in similar proportions to those estimated for the combined design gradation.
 - 3.1.2 The aggregate is recombined to give the desired gradation and three (3) 6000 g samples are taken for the Marshall stability specimens.
 - 3.1.3 Aggregate samples of the sizes specified in [TLT-301](#) are also obtained for the sieve analysis, bulk specific gravity and Atterberg limits.

4.0 APPARATUS AND PROCEDURE

- 4.1 The equipment and procedures are as per those in the above mentioned publications and design methods with the following modifications:
 - 4.1.1 Stability - use a water bath at 25°C - soak time is 35 minutes.
 - 4.1.2 Tests are based on 0.7% increments of cutback asphalt content with one above optimum, one near optimum and one below optimum. Generally, asphalt contents are 4.0%, 4.7% and 5.4%, for MC-250.

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- 4.1.3 Maximum Theoretical Density is performed on two (2) 1200 g samples of fresh loose mix (no ageing) with 50% solvent removed at the three asphalt contents.
- 4.1.4 The test specimens are mixed and compacted (75 blows/face) at $100 \pm 3^{\circ}\text{C}$.
- 4.1.5 During the mixing operation, care must be taken so that there is no loss of material in order to determine when 50% of the solvent has been lost.
- 4.1.6 To determine when 50% of the solvent has been removed, the weight of the mixing bowl, mixture, whip and spatula is monitored throughout the mixing operation.
- 4.1.7 If unable to remove 50% of the solvent after several minutes of mixing, it will be necessary to record the grams of solvent lost and return the mixture and the trowel to a large pan. Determine the total weight of mix component plus equipment. Place the pan of mixture plus trowel in a ventilated oven at the compaction temperature plus approximately 12°C to allow for solvent loss. Stir the mixture occasionally and check its weight. Continue this process until the predetermined solvent loss is achieved.
- 4.1.8 Transfer the material into a heated distribution pan and weigh out three (3) 1200 g samples into bread pans. Place the bread pans containing the mixture in a ventilated oven at 105°C and insert a dial thermometer into the mixture. Fill molds and compact at 75 blows/face as outlined in [TLT-301](#). Cool and extrude the specimens.

Note: The temperature of the mixture is generally at the compaction temperature ($100 \pm 3^{\circ}\text{C}$) after placing the mixture into the bread pans. It has been determined that after 50% of the solvent has been removed, the solvent loss is negligible during subsequent handling of the material at this temperature.

5.0 CALCULATION

5.1 EXAMPLE: MC-250 with 22.3% solvent by weight.

5.1.1 Determine the amount of MC-250 at 5.0% total asphalt content required for 6 000 grams of dry aggregate, and the weight (grams) of solvent to be removed.

5.1.2 MC-250:

$$5/100 \times 6\,000 = 300 \text{ g}$$

5.1.3 % Solvent:

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For this example the MC-250 has a solvent content of 22.3% by weight. Therefore, the amount of solvent to be removed is 11.15%.

$$11.15/100 \times 300 = 33.45 \text{ g}$$

6.0 REPORT

- 6.1 Design cutback asphalt and residual asphalt contents based on dry weight of aggregate.
- 6.2 Residual asphalt is determined at the design cutback asphalt content and is calculated based on the cutback asphalt asphalt/solvent ratio.
- 6.3 Void calculations are based upon the cutback content with 50% solvent removed.
- 6.4 Design gradings are provided highlighting any modification (e.g., blend sand addition).
- 6.5 Mix properties at the design cutback asphalt content.

7.0 DESIGN CRITERIA

- 7.1 The mix design shall meet the following criteria at the recommended design cutback asphalt content:

Blows/face	75
Marshall Stability (N) @ 25°C	6700+
Marshall Flow (mm) @ 25°C	2-4
Air Voids (%)	3-6
Visual Appearance *	normal (-)

* Cutback asphalt mixtures are designed slightly below optimum. This allows for a fog coat which is applied to the completed asphalt stabilized base course (normally 50% solution of SS-1 and water).