1. **SCOPE**

1.1 **Description Of Test**

This method determines the stripping potential of asphalt cement from aggregate in asphalt concrete mixtures compacted by the Marshall hammer. This method applies to both virgin and recycled asphalt concrete mixes.

The test procedure compares the tensile strength values of air cured specimens with the tensile strength values of duplicate specimens that have been cured in water. The result is an index of retained tensile strength. The results can be used as indicators of long term stripping susceptibility of asphalt concrete mixtures.

2. **DEFINITIONS**

Index of Retained Tensile Strength: the index of percent retained tensile strength is obtained by determining the tensile strength values of a set of three specimens that have been immersed in water and expressing it as a percentage of the tensile strength values of a duplicate set of air cured samples.

Stripping: is the breaking of the bond between the asphalt cement binder and the aggregate resulting in exposed aggregate surfaces with minimal or no asphalt cement coating. The stripping potential is evaluated on the specimens that have cured in a water bath to better simulate field conditions.

3. **APPARATUS AND MATERIALS**

3.1 **Equipment Required**

Refer to STP 204-8 and STP 204-10 for equipment needed for the compaction of Marshall briquettes.

Balance - sensitive to 0.1 g.

Thermometer for temperatures between 35°C and 150°C.
Water bath controlled at 25°C ± 1°C.

Oven preset at 60°C ± 1°C with thermostatic control.

Vacuum pump capable of producing 660.4 mm of vacuum or equivalent.

Yale pycnometer approximately 300 mm in diameter containing water for vacuuming the compacted Marshall briquettes.

Marshall stability machine equipped with steel loading strips. The strips shall have a concave surface and the length of the loading strip shall exceed the thickness of the specimen.

4. PROCEDURE

1.1 Sample Preparation

   1.1.1 Procedure For Obtaining Briquettes

      1.1.1.1 Lab Mixes

      Compact six specimens in accordance with STP 204-10 at optimum or near the asphalt content obtained from the Marshall mix design method for bituminous mixes. The specimen shall be compacted to the 50 blow Marshall in accordance with STP 204-8.

      1.1.1.2 Field Mixing

      When mixing commences on the job site, submit two Marshall specimens to Testing Services, compacted in accordance with STP 204-8.

1.2 Test Procedure

After cooling to room temperature extrude the test specimen using a mechanical extruder. Place compacted briquettes in 60°C ± 1 °C oven for 18 h ± 1 h.
At the end of the 18 h period remove the briquette from the oven and allow to cool to room temperature. Obtain the bulk density and air voids of each of the briquettes.

Group the six briquettes into two sets of three so the average bulk density of each set is essentially the same.

1.2.1 Procedure For The Air Cured Specimens

Place one set of briquette in the 25°C water bath for one hour. Remove and quickly dry with a damp towel, then test for tensile strength using the loading strips on the Marshall stability apparatus. The time from removal from the water shall not exceed 30 seconds. After testing, break open the briquettes immediately.

Using a magnifying glass examine the asphalt coating of the aggregate of the broken faces of the briquettes.

1.2.2 Procedure For The Water Cured Specimens

Submerge the other set of briquettes in Yale pycnometer containing water at 25°C ± 1°C. Apply a vacuum of approximately 660 mm Hg for a period of 1 h. At the end of the 1 h release the pressure slowly.

Remove the briquettes from the pycnometer and place in a covered water bath at 60°C ± 1°C for 24 h.

After 24 h, remove from the 60°C water bath and place in water bath at 25°C ± 1°C filled with water for 1 h. Remove from bath and quickly dry with a damp towel. Test for tensile strength using the loading strips on the Marshall stability apparatus. The time from removal from the water bath to completion of the tensile strength test shall not exceed 30 seconds. Break open the briquettes by hand immediately.

Using a magnifying glass examine the broken faces of the briquettes for percentage of stripping. Observe the asphalt coating on both the fine and coarse aggregate and the adherence of the fine aggregate to the coarse aggregate. Use Figure 1 to as a guide in visually estimating the percentage of particles stripped.
A COMPARISON CHART FOR VISUAL PERCENTAGE ESTIMATION

FIGURE 1
5. RESULTS AND CALCULATIONS

5.1 Percent Retained Tensile Strength (Index of Retained Tensile Strength)

Report the percent retained tensile strength as follows:

\[
\% \text{ Retained Tensile Strength} = \frac{Tensile \; Strength \; (water \; cured \; at \; 60^\circ C)}{Tensile \; Strength \; (air \; cured \; at \; 25^\circ C)} \times 100
\]

5.2 Percent Stripping

Report the percent stripped aggregate particles based on the visual evaluation.

6. ADDITIONAL INFORMATION

If the retained tensile strength is less than 70% or if the percent stripping in the water cured specimens is greater than 20%, repeat the water cured portion of the test, with an additive (if no additive is used) or an increased dosage of additive (if an additive is used already). This is required to recommend the best anti-stripping agent available for the particular asphalt and aggregate used.

If the test is repeated, compact 3 specimens with a know percentage of anti stripping agent and follow the water cured procedure described in section 1.2.2. Determine their average tensile strength and evaluate the stripping of the specimens. Determine the retained tensile strength by dividing the new average tensile strength value by the original tensile strength value obtained for the air cured samples.

The anti-stripping agent is added based on the optimum percent asphalt from the final Marshall mix design or based on the percent asphalt designated in the approved mix design. If liquid anti-stripping is added, the percentage of the additive will be a percentage by mass of the asphalt cement. If the anti-stripping agent is hydrated lime, the percentage of the additive will be a percentage by mass of the dry weight of the aggregate.

This method can be used to predetermine the stripping potential of an aggregate before the contract is tendered provided the crushed aggregate is obtained from the same portion of the gravel pit proposed to be used.
Once mixing commences in the field, testing should be completed on field mixes to see how mixing effects the stripping agent used.

Field cores can also be very helpful in determining whether an anti-stripping agent is required as they can be visually inspected for stripping potential. Cores can also be taken as a follow up on jobs where anti-stripping agents have been used to determine stripping behaviour.

7. REFERENCES

Ministry of Transportation, Ontario LS–283
AASHTO T 283
ASTM D 4867