INDIANA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS MANAGEMENT

ACCEPTANCE PROCEDURES OF STEEL FURNACE SLAG FOR DELETERIOUS MATERIALS
ITM No. 219-15T

1.0 SCOPE.

1.1 This method sets forth the procedure for sampling and testing SF slag for determination of deleterious materials in the aggregate.

1.2 Unaged SF slag may contain an excessive amount of unstable compounds such as calcium oxide and magnesium oxide which when hydrated will expand.

1.3 This procedure will apply to the use of coarse aggregate SF slag in HMA Base and Intermediate mixtures.

1.4 This ITM may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the ITM is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 REFERENCES.

2.1 AASHTO Standards.

M 92 Wire-Cloth Sieves for Testing Purposes
M 231 Weighing Devices Used in the Testing of Materials
T 11 Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
T 27 Sieve Analysis of Fine and Coarse Aggregates
T 107 Autoclave Expansion of Hydraulic Cement
T 245 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
T 248 Reducing Samples of Aggregate to Testing Size

2.2 ITM Standards.

207 Sampling Stockpiled Aggregates

3.0 TERMINOLOGY. Definitions for terms and abbreviations will be in accordance with the Department's Standard Specification, Section 101.

4.0 SIGNIFICANCE AND USE. This ITM shall be used to evaluate SF slag for determination of the potential for expansion of deleterious materials in the aggregate. Expansion of steel slag in encapsulated uses such as HMA Base and Intermediate mixtures may cause heaving of the HMA and eventual failure of the pavement by raveling. This test procedure is conducted by the Certified Aggregate Producer and the amount of deleterious material of the stockpiled steel slag is required to be determined prior to use.

5.0 APPARATUS.

5.1 Balance, Class G2, in accordance with AASHTO M 231

5.2 Sieves, in accordance with AASHTO M 92

5.3 Autoclave, in accordance with AASHTO T 107

5.3 Rupture disk, in accordance with AASHTO T 107

5.4 Mold assembly, 4 in., in accordance with AASHTO T 245, with the collar, compaction mold, and base plate welded together

6.0 SAFETY PRECAUTIONS.

6.1 The pressure gage shall have a capacity of 600 psi. A gage with too small or too large a capacity may be a hazard. For pressure above the specified maximum working pressure, with a smaller capacity gage, the pressure may not be measured by the scale. With a larger capacity gage, the arc of movement may be too small to be noticed. The operator shall assure that the gage hand has not passed the maximum graduation on the scale.

6.2 The pressure gage should be tested for proper operation. A thermometer is used together with the pressure gage to provide a means of detecting any failure of the pressure gage to operate properly and to indicate any unusual condition.

6.3 The automatic control should be maintained in proper working order at all times.

6.4 The safety valve is set to relieve the pressure at approximately 6 to 10 % above the maximum of 305 psi specified in this test method, which is approximately 330 psi. Unless the manufacturer has given specific maintenance instructions for the safety valve, the valve should be tested twice each year. A gage testing device is used for the testing, or the automatic controls are adjusted to allow the autoclave to reach a pressure of approximately 330 psi, at which pressure the safety valve

6.5 will either open or be adjusted to open. The safety valve discharge should be directed away from the operator. (Note 1)

Note 1 - Unexpected combinations of conditions may occur. For example, in one case the automatic control had failed, the safety valve had become stuck, and the gage hand, which at first glance appeared to be at about zero, had passed the maximum graduation and had come to stop on the wrong side of the pin. This condition of the gage was finally detected and the pressure, then of an unknown magnitude, was released before failure could occur in the apparatus.

6.6 Heavy leather work gloves should be worn to prevent burning of the hands when removing the top of the autoclave at the completion of the test. The vent valve is directed away from the operator. When removing the autoclave lid, the lid is tilted so that any steam escaping from beneath the lid will be discharged away from the operator. Care shall be taken to avoid scalding by any liquid that may have been used in the autoclave well.

6.7 The operator shall be made aware that for many autoclave pressure gages the return of the gage hand to the initial rest or starting point does not necessarily indicate zero pressure within the autoclave. An appreciable dangerous pressure may still be present.

7.0 GENERAL REQUIREMENTS.

7.1 Each Aggregate Producer requesting to have SF slag approved in accordance with this procedure shall contact the appropriate District Testing Engineer to initiate the testing process.

7.2 Sampling and testing shall be conducted by the Aggregate Producer.

7.3 SF slag shall be sampled as the stockpiles are being constructed. Existing stockpiles shall be sampled randomly from the exterior and interior of the stockpile.

7.4 Acceptance for use of SF slag will be given on each stockpile of approximately 2000 t. Stockpiles that do not meet the acceptance criteria of this test method may be tested again after 30 days from the test date.

7.5 Stockpile location, stockpile identification, and test results shall be maintained at the SF slag source and shall be available for inspection.

8.0 SAMPLING.

8.1 Sampling of aggregates shall be done in accordance with ITM 207.

8.2 Each sample shall consist of 25 to 110 lbm of material, depending on the size of the coarse aggregate tested.

9.0 SAMPLE PREPARATION.

9.1 Reduce the sample in accordance with AASHTO T 248 to a sample size of 1500 ± 50g and decant the sample in accordance with AASHTO T 11.

9.2 Sieve the sample in accordance with AASHTO T 27 and retain the + No. 4 sieve material. The sample shall be 100 % passing the 1 1/2 in. sieve and a maximum of 2 % passing the No. 4 sieve

9.3 Record the initial weight of the + No. 4 sieve material (A) and the gradation

9.4 Place the sample in the mold assembly in three approximately equal layers. Each layer should be leveled by raising the opposite sides of the mold alternately and dropping the mold on a firm base.

10.0 PROCEDURE.

10.1 Place the mold in the autoclave

10.2 Following the manufacturer's instructions, bring the autoclave to 295 ± 10 psi

10.3 Maintain the autoclave at 295 ± 10 psi for three hours

10.4 Remove the mold after the autoclave has cooled

10.5 Allow the mold to cool to room temperature

10.6 Remove the material from the mold and sieve the material in accordance with AASHTO T 27

10.7 Weigh the material passing the No. 4 sieve (B)

11.0 CALCULATIONS. The deleterious content is calculated as follows:

$$\% \text{ Deleterious} = \frac{B}{A} x100$$

where:

A = initial weight of the sample retained on the No. 4 sieve, g
B = final weight of the sample passing the No. 4 sieve, g

12.0 REPORT.

12.1 The gradation of the sample is reported to the nearest 0.1 %.

12.2 The deleterious content is reported to the nearest 0.1 %.