



**INDIANA DEPARTMENT OF TRANSPORTATION  
DIVISION OF MATERIALS AND TESTS**

**ACCEPTANCE PROCEDURES FOR HMA SURFACE MIXTURE  
COARSE AGGREGATES FOR ESAL  $\geq$  10,000,000  
ITM No. 221-18**

**1.0 SCOPE.**

- 1.1 This method sets forth the acceptance procedures to be used when Aggregate Producers request that coarse aggregates be evaluated for use in HMA surface mixtures with ESAL  $\geq$  10,000,000.
- 1.2 HMA surface mixture aggregates are specified for use under certain traffic ESAL loading conditions to obtain skid-resistant HMA surface courses.
- 1.3 Coarse aggregates tested in accordance with this procedure shall be Polish Resistant Aggregates in accordance with ITM 214 or otherwise approved by the Department.
- 1.4 This method is a two part process. Part One requires a comparison of a HMA surface mixture with the proposed coarse aggregate to a HMA surface mixture with an approved steel furnace slag coarse aggregate or other coarse aggregate approved by the Department using the Circular Track Meter (CTM) in accordance with ASTM E2157 and the Dynamic Friction Tester (DFT) in accordance with ASTM E1911. The CTM and DFT values are used to determine the International Friction Index (IFI) in accordance with ASTM E1960. If the results of the comparison indicate that the HMA surface mixture with the proposed coarse aggregate has an IFI value equal to or greater than the IFI value of the HMA surface mixture with steel slag then Part Two may be initiated.

Part Two requires that a test section of HMA surface mixture using the proposed coarse aggregate and a control test section of HMA surface mixture using steel slag or an approved coarse aggregate be placed on a contract. Steel slag may be blended with an approved dolomite or polish resistant aggregate for the control test section. Acceptance of the coarse aggregate is made on the basis of an evaluation of friction test data obtained after two years of exposure to traffic; however, an aggregate may be accepted after one year of exposure to traffic at the discretion of the Department.

- 1.5 The Aggregate Producer will be required to maintain a warranty bond on the HMA surface course of the test section using the proposed coarse aggregate. The bond amount shall be sufficient to replace the test section with material satisfactory to the Department. Upon opening the test section to unrestricted traffic, the warranty bond will be in effect for a total of two years. The warranty bond is required to be properly executed by a surety company satisfactory to the

Department and be payable to the State of Indiana. Appendix A shall be used for the warranty bond.

- 1.6** If within two years of exposure to traffic, the average friction number of the proposed aggregate is less than the average friction number of the approved steel slag, the Department will evaluate the test section to determine if a problem exists. If remedial work is required, the Aggregate Producer shall conduct the work at no cost to the Department. If the Aggregate Producer cannot conduct the remedial work within a timely manner, the Department has the option to execute the warranty bond and have the remedial work conducted by other forces.
- 1.7** This procedure 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.**

- T 11 Materials Finer than 75  $\mu\text{m}$  (No. 200) Sieve in Mineral Aggregates by Washing  
 T 27 Sieve Analysis of Fine and Coarse Aggregates

### **2.2 ASTM Standards.**

- E274 Skid Resistance of Paved Surfaces Using a Full Scale Tire  
 E524 Smooth Tread Standard Tire for Special-Purpose Pavement Skid Resistance Tests  
 E1911 Measuring Paved Surface Frictional Properties Using the Dynamic Friction Tester  
 E1960 Calculating International Friction Index of a Pavement Surface  
 E2157 Measuring Pavement Macrotexture Properties Using the Circular Track Meter

### **2.3 ITM Standards.**

- 207 Sampling Stockpiled Aggregates  
 214 Acceptance Procedures for Polish Resistant Aggregates

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

**4.0 SIGNIFICANCE AND USE.** This ITM shall be used to evaluate coarse aggregates for use in HMA surface mixtures for ESAL  $\geq 10,000,000$  applications.

## 5.0 APPARATUS.

- 5.1 Dynamic Friction Tester in accordance with ASTM E1911
- 5.2 Circular Track Meter in accordance with ASTM E2157
- 5.3 Circular Track Polishing Machine. This device consists of three rubber tires attached to a rotating plate that travels at approximately 47 revolutions per minute resulting in approximately 141 wheel passes per minute. Water is sprayed on the mixture **test ring** surface to remove debris generated during polishing. A total load of 217 lbm is applied through the tires to the surface.
- 5.4 Friction vehicle and instrumentation in accordance with ASTM E274
- 5.5 Smooth Tread Standard Tire in accordance with ASTM E524

## 6.0 GENERAL REQUIREMENTS.

- 6.1 Each Aggregate Producer requesting to have a coarse aggregate tested in accordance with this procedure shall do so in writing to the State Materials Engineer, Division of Materials and Tests. Information concerning the type of material, and ledge numbers, if applicable, shall be included.
- 6.2 The steel slag or other approved **coarse** aggregate material used in the control test section shall be obtained from a Certified Aggregate Producer.
- 6.3 Testing shall be conducted by the North Central Superpave Center. The cost of shipping and testing of the coarse aggregate shall be the responsibility of the Aggregate Producer.
- 6.4 Friction testing of the test sections will be conducted by the Department at no expense to the Aggregate Producer.
- 6.5 Approval of the coarse aggregate for use in HMA surface mixtures for ESAL  $\geq$  10,000,000 will be based on results from both Part One and Part Two of this procedure.

## 7.0 SAMPLING.

- 7.1 Sampling of the coarse aggregate and steel slag (or other approved **coarse** aggregate) shall be in accordance with ITM 207 in the presence of the Department.
- 7.2 Each sample shall be sufficient in quantity to yield a minimum of **60** lbm of dry material that is passing the 1/2 in. sieve.

7.3 The samples shall be washed and decanted in accordance with AASHTO T 11.

## 8.0 PROCEDURE (PART ONE)

### 8.1 Mix Design

8.1.1 Mixtures shall be produced in the laboratory using a mix design designated by the Department. The mix design shall be in accordance with 401.04 for a 9.5mm HMA mixture. PG 64-22 asphalt and a mix design for ESAL Category 4 shall be used.

8.1.2 All other aggregates in the mix design shall be the same type and source for both the mixture using the proposed aggregate and the mixture using steel slag as the coarse aggregate. The design binder content and proportion of the aggregates may vary to account for the difference in absorption and specific gravities of the various aggregates.

### 8.2 Mixture Test Rings

8.2.1 Laboratory produced mixtures shall be reheated to  $300 \pm 9^{\circ}\text{F}$ .

8.2.2 Based on the volume of the gyrotory mold and the specific gravity of the mixture, the approximate weight of the mixture that would yield 7 to 8 % air voids ( $V_a$ ) shall be determined.

8.2.3 A minimum of seven gyrotory pills shall be compacted at the target air void content.

8.2.4 Once compacted, the gyrotory pills shall be thoroughly cooled.

8.2.5 The vertical sides of the gyrotory pills shall be cut at a slight angle to allow them to fit together to create a level test ring with a centerline diameter of 11.2 in. (i.e., to fit the footpath of the polishing machine, DFT and CTM). See Figure 1

8.2.6 The seven gyrotory pills shall be secured in the test ring with a metal ring clamp, placed in the center of a 20 x 20 x 1.5 in. wooden mold. See Figure 1

8.2.7 Self-leveling cement mix and water shall be thoroughly mixed according to the manufacturer's recommendations and carefully poured into the mold around the test ring and allowed to cure for a minimum of two days before testing.

8.2.8 The mixture test ring shall be polished a total of 300,000 wheel passes with the Circular Track Polishing Machine.



Figure 1: Completed Test Ring

### 8.3 Testing and Reporting

- 8.3.1** The mixture **test ring** shall be tested for the surface texture using the CTM in accordance with ASTM E2157 and the friction using the DFT in accordance with ASTM E1911 initially before polishing.
- 8.3.2** Polishing shall be stopped after 1500, 9000, 30000, 75000, 165000 and 300000 passes so that the surface texture and friction of the mixture **test ring** may be measured.
- 8.3.3** The CTM and DFT values are used to determine the International Friction Index (IFI) in accordance with ASTM E1960. If the IFI value of the mixture **test ring** using the proposed aggregate is equal to or greater than the IFI value for the mixture **test ring** using the steel slag, the Aggregate Producer may request to proceed to Part Two of this procedure.
- 8.3.4** Copies of the test information shall be sent to the Aggregate Producer and the Department and shall include the following:
- Coarse aggregate source identification
  - Type of material
  - Ledges of the aggregate, if applicable
  - Date sampled
  - Individual(s) obtaining the sample of coarse aggregate
  - The International Friction Index in accordance with ASTM E1960

### 9.0 TEST SECTIONS (PART TWO).

## **9.1 Test Section Selection**

**9.1.1** Upon evaluation and approval of the IFI data, a contract will be selected by the Department for placement of the proposed coarse aggregate test section and a control test section using steel slag from an approved source. The contract will have traffic ESAL's equal to or greater than 10,000,000 and have continuous uninterrupted traffic over the test sections.

**9.1.2** A 1 mi test section of HMA using the proposed coarse aggregate material shall be placed adjacent to a 1 mi test control section of HMA using steel slag. A mixture blend of Polish Resistant Aggregates or dolomite coarse aggregates with steel slag may be used. Both test sections shall be placed in the same driving lane. The two test sections shall be located between any major intersections on the contract.

## **9.2 Friction Testing**

**9.2.1** Each test section will be tested by the Department in accordance with ASTM E274. A smooth tire in accordance with ASTM E524 and a 40 mph test speed will be used.

**9.2.2** Friction testing will be performed after approximately six months, one year, eighteen months, and two years of exposure to traffic.

## **10.0 ACCEPTANCE CRITERIA.**

**10.1** If the proposed coarse aggregate HMA friction values are equal to or greater than the control section HMA friction values after two years of exposure to traffic, the proposed coarse aggregate will be approved for HMA surface mixtures for ESAL  $\geq 10,000,000$ .

**10.2** The Department will maintain a list of Approved Aggregates including aggregates meeting the requirements outlined herein. The list will include coarse aggregates that are approved for use when air-cooled blast furnace slag, steel furnace slag, or sandstone are required in HMA surface mixtures for contracts with traffic ESAL's equal to or greater than 10,000,000.

The aggregate source and ledge number(s), if applicable, will be placed on the Approved List in the ESAL  $\geq 10,000,000$  category.

**10.3** The aggregate will remain on the Department Approved List unless the material is not performing satisfactorily, as determined by the Department.

**AGGREGATE PRODUCER  
ITM 221-12P  
WARRANTY BOND**

Know all persons by these presents that we, \_\_\_\_\_ as principal and \_\_\_\_\_ as surety, are held and firmly bound unto the State of Indiana (hereinafter referred to as obligee) in the full and just sum of \$ \_\_\_\_\_, lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

The condition of the above obligation is that for two (2) years after the date the test section of HMA pavement located on \_\_\_\_\_, reference point \_\_\_\_\_ to reference point \_\_\_\_\_ is  
(Beginning Point) (Ending Point)  
completed and opened to unrestricted traffic; such warranty is to be in accordance with the Indiana Test Method 221 which is made a part of this bond for warranted test section of HMA pavement. If the principal satisfactorily fulfills the above condition, then this obligation shall be null and void; otherwise such obligation is to remain in full force and effect.

It is agreed that no modifications, omissions, or additions in or to the terms of the ITM 221 or the contract or in or to the plans or specifications shall affect the obligation of the surety on its bond.

In witness whereof, we hereunto set our hands and seal.

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Address: \_\_\_\_\_

By: \_\_\_\_\_  
Signature Surety Title

By: \_\_\_\_\_  
Signature Principle Title

\_\_\_\_\_  
(Print or Typed) Surety

\_\_\_\_\_  
(Print of Typed) Principal

State of Indiana, County of \_\_\_\_\_ SS:

State of Indiana, County of \_\_\_\_\_ SS:

Personally appeared before me,

Personally appeared before me,

\_\_\_\_\_  
as surety and acknowledge the executions of the  
above bond

\_\_\_\_\_  
as surety and acknowledge the executions of the  
above bond

this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_

this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_

By \_\_\_\_\_  
Signature Notary Public

By \_\_\_\_\_  
Signature Notary Public

\_\_\_\_\_  
(Print of Typed) Notary

\_\_\_\_\_  
(Print of Typed) Notary

My Commission Expires \_\_\_\_\_, 20 \_\_\_\_\_

My Commission Expires \_\_\_\_\_, 20 \_\_\_\_\_

\_\_\_\_\_  
(County of Residence)

\_\_\_\_\_  
(County of Residence)