Colorado Procedure 82-08

Standard Method of Test for

Field Correction of the In-Place Measurement of Density of Bituminous Pavement by the Nuclear Method

INTRODUCTION

This method covers the determination of a correction factor which is used to adjust the density readings of in-place bituminous pavement generated by a nuclear surface gauge to core sample densities. A common misconception exists that a calibrated nuclear gauge can and will provide the correct in-place density of a bituminous pavement. However, no two design mixes are identical when placed on a project because the environment and roadway structure are unique; therefore, a standard calibration for bituminous pavements is impossible. Correlating the in-place nuclear density to the in-place core sample density allows for the development of a correction factor that should be valid until the ingredients in the bituminous pavement change or the underlying material changes. Principles of the nuclear test are discussed in the AASHTO T 310 Appendix, as are some of the advantages and disadvantages of the test. Surface nuclear gauges utilize radioactive materials, which may be hazardous to the health of users unless proper precautions are taken.

1. SCOPE

1.1   This method describes the procedures for determining a correction factor to be applied to the in-place measurement, by nuclear methods, of pavement densities. This factor corrects for the varying effects of materials, roadway structure, and environment.

1.2   This procedure should be used on each project as specified in the contract. This procedure may also be used whenever variations in conditions bring the Moisture/Density Gauge or Thin Layer Density Gauge readings into question.

1.3   The values stated in English units are to be regarded as the standard.

2. REFERENCED DOCUMENTS

2.1   *Colorado Procedures*

CP 44	Bulk Specific Gravity and Percent Relative Compaction of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens	
CP 51	Determining the Maximum Specific Gravity of Bituminous Mixtures	
CP 75	Stratified Random Sampling of Materials	
CP 81	Density of In-Place Bituminous Pavement by Nuclear Method	

3. APPARATUS

3.1   Any tool suitable for removing intact a core of compacted pavement for the full depth of the course or courses. A diamond bit core drill is suitable for this purpose. The core drill must have a diameter of greater than 4 in. (100 mm) and should be equipped to core and retrieve specimens approximately 4 or 6 in. (100 to 150 mm) in diameter.

3.2   A rigid plate or suitable container large enough to hold the sample without distortion after it is removed from the pavement.

3.3   Surface Moisture/Density Gauge or Thin Layer Density Gauge as specified in CP 81.

3.4   Apparatus as specified in CP 51 (Determining the Maximum Specific Gravity of Bituminous Mixtures) and CP 44 (Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens).

4. PROCEDURE

4.1   Using CP 75, select and record seven longitudinal and transverse test locations where the gauge in test position will be at least 6 in. away from any vertical projection. Mark these test locations using a pavement marking pen. The gauge test site shall be an area 8 in. by 13 in. centered over the marked test location. The long

axis of the test site must be parallel to the direction of the paver and rollers.

NOTE 1: When selecting a test location, include all areas 1 foot or more away from confined or unconfined longitudinal joints. Do not include locations closer than 1 foot to longitudinal joints.

NOTE 2: If the existing pavement depth plus the depth of the planned first lift will be less than 4 in., the nuclear gauge may be affected by variations in the density of the subbase. Thin layer density gauges and cores are not affected by these variations in subbase densities.

NOTE 3: A visual examination of the existing pavement should be conducted before paving begins so that heavily distressed areas may be avoided when selecting test locations in Subsection 4.1. These areas may affect gauge readings, may not be representative of the roadway in general, or may lose their continuity once extracted.

4.2   Obtain nuclear gauge density readings at each test location according to CP 81 for either the nuclear gauge #1 or #2 values.

NOTE 4: CP 81 contains essential details concerning the safety, calibration, and standardization of nuclear gauges.

4.3   Take a core sample from the center of the gauge test site at each test location. This core shall be provided to CDOT for the determination of the nuclear asphalt density correction.

4.3.1   Any additional cores should be taken along the longitudinal axis as close as possible to the original core location.

NOTE 5: The Contractor shall provide cores from each location to CDOT as witnessed by the CDOT tester. If the core is damaged during the coring process, a new gauge test site as close as possible to the original test site along the longitudinal centerline axis of the original test site shall be chosen. The direction of the new test site shall be randomly selected by the CDOT tester. Repeat Subsections 4.1 to 4.3 at the new test site. Once the bulk specific gravity test (CP 44) has been started on a core, the contractor shall no longer have the option of requesting a new test site at that location.

4.4   When the nominal maximum size aggregate in the pavement is 1 in. or less, a 4 in. diameter bit or larger shall be used. When the nominal maximum size aggregate is over 1 in., a 6

inch diameter bit shall be used. When the coring operation has been completed, carefully remove sample by use of the core retriever. Mark each core to allow identification of the test site. Care should be exercised that the sample is not distorted, bent, cracked, or in any way changed from its physical condition as it was before removal from the pavement.

4.5   Separate the core below the layer for which the correction factor is being determined.

4.6   Determine the specific gravity of the core samples in accordance with CP 44.

5.   DETERMINATION OF CORRECTION FACTOR

5.1   Calculate the average specific gravity of the seven pavement cores taken from the roadway. Convert the average specific gravity to density by multiplying the specific gravity by 62.4.

5.2   Using CP 81, calculate the average in-place density from the seven sites using the nuclear gauge.

5.3   Calculate the correction factor to be used for measurements of density readings from the same project as follows:

$$A = B - C$$

Where:

A =   Correction factor determined for a specific gauge and pavement,
B =   Average density of pavement cores,
C =   Average density reading from nuclear gauge.

NOTE 6: This correction factor is added to the nuclear gauge density determined on the same pavement using the same nuclear density gauge.

6. REPORT

6.1   The results are reported on the following CDOT forms:

6.1.1   CDOT Form #746 - Nuclear Moisture/ Density Gauge Log (Example in Chapter 800).

6.1.2   CDOT Form #428 - Nuclear Asphalt-Density Test (Example in Chapter 800).

6.1.3   CDOT Form #469 - Nuclear Asphalt-Density Correction (Example in Chapter 800).