

SECTION 461 Compaction and Density of Asphalt Pavement

461.1 General

Compaction of the asphaltic pavement or surface is geared to achieving the required density and ride qualities. The contractor is responsible for mixture design, quality control of the production of the mix, and attainment of required pavement density. Specific rolling patterns and compaction equipment specifications have mostly been removed from the standard specifications. The one exception requires a minimum number of rollers for mixture compacted by the ordinary compaction procedure.

[Standard spec 460](#) sets forth the specifications for required densities and establishes reduced payment schedules for pavements deficient in density. Regardless of reduced payments the intent is to achieve the required density. Section 460 requires that the contractor not operate below the specified minimum density on a continuing basis. If the minimum required density cannot be obtained production must be stopped until the source of the problem is determined and corrective action taken to bring the work into compliance with the specifications.

461.2 Initial Rolling

Initial or breakdown rolling should be accomplished as soon as possible after the material has been spread. Vibratory three-wheel or tandem steel wheel rollers are generally used. Pneumatic-tire rollers may be used for breakdown rolling provided detrimental pick-up does not occur and the rutting can be removed in subsequent rolling operations. Use of pneumatic-tire rollers may be particularly effective when overlaying rutted or irregular pavements, since bridging over the uneven surface will be minimized.

The lead wheel of a roller should be driven so the mix is drawn under the roller and not pushed ahead in a wave. Usually, each drum of a vibratory roller is driven. The roller should be operated very slowly to minimize displacement and promote particle orientation for increased density.

Vibratory rollers are usually not operated in the dynamic mode at speeds in excess of 2-1/2 miles per hour. Vibratory rollers are equipped with variable amplitude and frequency controls. Amplitude is the total vertical motion of the drum. Frequency is the speed of rotation of the eccentric mass and is measured in vibrations per minute. To be effective, the settings for amplitude and frequency must be selected to satisfy job conditions. The total applied force must be great enough to attain the specified density but low enough to avoid decompaction or a reduction in density. For thick lifts over 2 inches in thickness, a high amplitude and low frequency is best. For thin lifts under 2 inches in thickness, a low amplitude and high frequency is best.

Rolling of the first lane paved should begin on the outside or low edge of the lane and progress toward the inside or high side, each pass overlapping the previous one. In general, to avoid stress cracks near the unconfined pavement edge, the roller should overhang the unconfined edge of the pavement by approximately 6 inches on the first pass. If stress cracks result from overhanging the roller over the unconfined edge on the first pass, an alternative method is to make the first pass 6 inches back from the unconfined edge. The best rolling method may be mix and lift thickness dependent. The roller should roll up as close to the paver as possible on each pass. Stopping and reversing the roller at the same transverse location in adjacent passes should be avoided.

The same roller procedure is followed on successive lanes, except the longitudinal joint is rolled first, with the roller riding on the hot mat leaving a gap of 6 to 8 inches at the joint which is not rolled on the inward pass, and then on the reverse pass riding on the hot mat and overlapping 6 to 8 inches onto the cold mat. The pavement outside of the roller edge should be closely monitored to ensure that stress cracks are not forming in the hot mat on the first pass. If stress cracks are observed, an alternate method such as overlapping 2 to 5 inches onto the cold mat on the first pass may be considered.

Rolling of "tender mixes" (slow-setting mixes) may need experimentation to achieve uniform, required density. Delaying the initial rolling until the mixture cools and gains internal viscosity may be one approach. Initial rolling by a vibratory roller with the vibrating system shut off on the forward pass may be helpful. Frequency and amplitude should be adjusted on the return pass to avoid decompaction. Immediate testing by nuclear meter after each pass can serve as a check on the effectiveness of the rolling procedure. Results may allow the roller operator to avoid unneeded passes, incorrect vibrator settings or correct other detrimental techniques.

461.3 Intermediate Rolling

Pneumatic-tire rollers may be used for intermediate rolling while the mat is still warm. Rollers should be operated continuously between the hot and cold roller. Rolling patterns should be the same as for initial rolling, but higher speeds are normally permissible and desirable to obtain more coverage.

One problem with pneumatic-tire rollers is the hot mixture sometimes sticks to the tires. This is often used as an excuse for not rolling the mat when it is hot enough for the rolling to be effective. However, a slight

amount of pick-up can be tolerated, and one or more of the following measures may be used to minimize or prevent pick-up. First, the tires must be cleaned of any clinging asphalt. The tires should then be allowed to warm up uniformly over the tire surface, using as little water on the wheels as possible. A small amount of nonfoaming household detergent or soluble oil added to the roller water at the rate of one part of oil to 50 parts of water helps to prevent pick-up. Use of frame-mounted skirts or scrapers may be effective in removing picked-up asphaltic mix from the tires.

461.4 Final Rolling

Final rolling is performed when the mat has cooled to the degree that few or no roller marks are left by the roller, and densification can be accomplished without shoving the mix excessively or causing the surface to "check." Rolling should be continued until all evidence of increased compaction disappears; checks, creases, ruts, and ridges from previous rollings are eliminated; and all bumps are ironed out.

461.5 Reporting

It will be necessary for the inspector to record in the inspector's diary all the particulars that will give a clear and complete picture of the compaction train. This includes the following:

- Number of rollers.
- Make and model of the roller(s).
- Actual compactive weight.
- Rolling pattern and number of passes.
- Tire pressure (pneumatic-type only).
- Frequency and amplitude (vibratory-type only).
- Beginning and ending stations.
- Ambient conditions. - Tons placed.
- Time elapsed.
- Problems encountered and changes made to resolve problems.

461.6 Compaction Procedures

461.6.1 Ordinary Compaction Procedure

[Standard spec 450.3.2.6](#) provides that all asphaltic patching, leveling, or wedging layers and base courses be compacted to the degree no further appreciable consolidation is observed under the compaction equipment. All asphaltic surface courses, except safety islands, should be compacted under this procedure.

Determination of adequate compaction by this procedure is based on the observer's judgment. At least two passes of the roller will be necessary to determine if additional consolidation is occurring.

461.6.2 Specified Density Procedure

All layers or courses not compacted by the ordinary compaction procedure will be compacted by the specified density procedure, in which compactive effort is applied until a pre-determined density has been achieved.

461.7 Field Densities

Field densities are usually taken by nuclear methods in accordance with established procedures in chapter 4. When nuclear methods are not used, the immersion method must be used. Once a method has been selected for determining mat density, that method should be followed throughout the work.

When the immersion method is used, a field density determination should be made on pavement samples before they are submitted to the laboratory. This density should be noted on the shipping tag or letter of transmittal (when used). Both the density obtained in the field and in the laboratory, will be indicated on the test report.