

CHIP SEAL

GENERAL INFORMATION AND RESOURCES

SCOPE

A chip seal is a thin surfacing application used as an economical maintenance treatment. A chip seal should be placed on an existing road that is starting to show a limited amount of surface distress. Chip seals will help to seal minor cracks, improve skid resistance, and waterproof the existing surface. Chip seals are not meant to fix full-depth cracking, rutting, or base failures.

DEFINITIONS

SINGLE CHIP SEAL

Chip seals consist of a single, calibrated application of asphalt emulsion on an existing road surface followed by an application of a single-sized cover aggregate. This treatment is then rolled in order to embed the aggregate.

MULTIPLE CHIP SEAL

Multiple chip seals consist of two or more lifts of asphalt emulsion and cover aggregate. For each subsequent layer, the cover aggregate should be no more than half the size as the preceding layer of aggregate. Multiple chip seals can provide a wearing surface that is more durable than a single chip seal and more suitable to resist high traffic-related stresses.

GRADED SEAL

A graded seal is a special type of seal wherein the aggregate follows a continuous gradation curve instead of a single-size gradation. Graded seals, also known as Otta seals, are typically applied to low-volume roads.

SPECIALTY CHIP SEAL

Specialty chip seals refer to seals that address the distresses of a specific roadway being treated. Specialty seals are achieved by varying the types and layers of emulsion and aggregate. The most common specialty chip seals are sandwich seals, inverted seals, racked-in seals, and cape seals.

MATERIALS

ASPHALT EMULSIONS

A number of different types and grades of asphalt emulsions can be used in chip seals. The grade of emulsion required is based on a number of factors: environmental conditions (temperature and humidity, traffic type and volume, type of cover aggregate, and the existing road surface's physical characteristics such as slopes, shade, hills, and curves). Typically, the most common chip sealing emulsions used are CRS-2, CRS-2P, RS-2, RS-2P, HP-200, and HP-200P. Graded seals use HF-100S, HF-150S, and HF-250S emulsions.

COVER AGGREGATE

The type of cover aggregate used in chip seals must meet certain requirements for shape, size, cleanliness, and surface properties. The aggregate should be single-sized and cubical in shape. The number of flat and elongated particles should be kept to a minimum so that the required amount of asphalt emulsion can be applied to hold the stone in place. The aggregate should be as clean as possible to ensure a good adhesive bond between the aggregate and the asphalt residue. The asphalt emulsion and the aggregate must also be compatible in order to ensure the asphalt-aggregate bond is effective.



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DESIGN CRITERIA

When designing a chip seal, a number of factors have to be examined and assessed to ensure a high-quality treatment. Certain factors can have a tremendous effect on the performance of a chip seal: traffic, aggregate shape, specific gravity of the aggregate, aggregate wastage, residual asphalt content, and the texture of the existing surface.

TRAFFIC

The type and quantity of traffic the surface experiences will have a large effect on the type and quantity of asphalt emulsion required. A rough rule of thumb is that, as the traffic volume decreases from more than 2000 to less than 100 vehicles per day, the quantity of emulsion required increases by 40%. If the amount of heavy vehicles (heavy trucks) goes up, the quantity of emulsion required goes down. Heavy vehicles have the greatest impact on how much emulsion will be required for the chip seal.

AGGREGATE SHAPE

The overall shape of the cover aggregate can influence the quantity of aggregate required as well as the amount of asphalt emulsion required. The more cubical (the higher the average least dimension (ALD)) the aggregate, the more emulsion that is required. In addition, measuring the aggregate's air voids in its loose aggregate condition helps in determining the necessary quantity of both asphalt emulsion and aggregate.

SPECIFIC GRAVITY OF COVER AGGREGATE

The bulk specific gravity of the cover aggregate will affect the quantity of aggregate needed for an effective chip seal: the higher the specific gravity, the more aggregate is needed and vice versa.

AGGREGATE WASTAGE

In all chip seals, an excess of cover aggregate has to be applied to offset the unevenness of spread and whip-off as a result of traffic. Depending on the chip spreader equipment, this excess amount can range from 2 to 10% but is typically 5%. Wastage control is critical in multiple chip seal applications.

ASPHALT RESIDUAL IN THE EMULSION

The percentage of asphalt residue in the emulsion can affect the quantity of asphalt emulsion needed to hold the cover aggregate. The lower the percentage of residue, the more emulsion is needed.

SURFACE TEXTURE OF EXISTING PAVEMENT

The texture of the existing road surface can influence the quantity of asphalt emulsion needed. If the surface is rich in texture (indicating flushing or bleeding), a lower quantity of emulsion is needed. If the texture is dry and oxidized, then a higher quantity would be needed.

If there are steep hills or curves, adjustments may have to be made to the quantity of emulsion used in those areas, especially if there is significant heavy vehicle traffic. The types of industries nearby that are most likely to travel the road to be treated should be observed.

ADDITIONAL DESIGN ADJUSTMENTS

Further adjustments to the base spray and spread rates might be required to account for factors such as the time of the year, shade and exposure to sun, severity of snow ploughing operations, channelized traffic areas, and more.



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RECOMMENDED PERFORMANCE GUIDELINES

In order to construct a well-designed, high-quality chip seal, the following guidelines should be followed:

- Ensure that the existing pavement structure is adequate for supporting the expected traffic.
- Design a chip seal with the aggregate to be used on the job.
- Use clean and dust-free aggregate.
- Calibrate and inspect all equipment.
- Use a sufficient number of properly weighted rollers.
- Correctly execute all required design and construction techniques.
- Use traffic control to protect the fresh seal.
- Work only in weather suitable for the type and grade of emulsion being used.

RESOURCES AND REFERENCES

1. "Basic Asphalt Emulsion Manual", Fourth Edition, Asphalt Institute and Asphalt Emulsion Manufacturers Association, 2008
2. "Recommended Performance Guidelines", Second Edition, Asphalt Emulsion Manufacturers Association, Annapolis, Maryland, 2006
3. "Chip Seal Best Practices", NCHRP Synthesis 342, Transportation Research Board, Washington DC, 2005



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