SECTION 304
PORTLAND CEMENT TREATED BASE

304.01 DESCRIPTION. This work is the construction of one or more courses of an aggregate, water, and portland cement mixture on a prepared surface.

304.02 MATERIALS.

304.02.1 Portland Cement. Use portland cement meeting AASHTO M 85, Type I or Type II requirements.

304.02.2 Water. Use water meeting Subsection 713.01 requirements.

304.02.3 Aggregate. Use aggregate source(s) meeting Section 106 requirements.

Produce aggregates meeting Subsection 701.02.9 requirements.

Assure aggregate is available for sampling at least 60 days before mixing is to begin.

Stockpile the aggregates under Subsection 303.03.

304.02.4 Blending Material. Blending material, consisting of selected natural or crushed mineral aggregate may be combined with the produced aggregate and added to meet gradation requirements. Blending material is by and at Contractor expense. The liquid limit for that portion of the fine aggregate passing the No. 40 (0.425) sieve cannot exceed 30, and the plasticity index cannot exceed 7, tested under MT-208.

304.03 CONSTRUCTION REQUIREMENTS.

304.03.1 Composition and Proportioning.

A. **Cement.** Add portland cement at the job mix target rate set by the Engineer. The initial job mix target rate is the laboratory mix design value.

B. **Water.** Provide the water to reach plus or minus two percent of the optimum moisture content of the compacted mixture.

C. **Aggregate.** Establish a single value for each specified aggregate size within the job-mix target limits in Table 701-13 in Subsection 701.02.9 as the target aggregate gradations. Submit it to the Engineer for approval. The job mix tolerances will be applied to the approved target values for final acceptance.

   Produce aggregates meeting the approved job-mix aggregate gradation.

304.03.2 Aggregate Production, Testing, and Acceptance.

A. **General.** Perform all work to meet the approved job-mix target values within the specified tolerances.

   Sample and test aggregates during production to control gradations.

B. **Acceptance Sampling and Testing.** The Department will sample the stockpiles for acceptance of the aggregates physical properties, excluding combined gradations. Aggregate gradation samples for acceptance testing are randomly taken at the last practical point before portland cement and water are added to the mixture.

The approximate quantity represented by each sample is 1500 tons (1350 t).

Additional samples will be taken as necessary.

Five samples will represent approximately 7500 tons (6750 t) which constitutes a lot whenever production schedules and material continuity permit. The Project Manager may establish a lot of the quantity represented by any number of consecutive random samples from 3 to 7 inclusive when there are short production runs, significant material changes, or other unusual characteristics of the work.

C. **Acceptance.** Cement-treated base is evaluated for gradation requirements on a lot-by-lot basis. Acceptance is made under Subsection 105.03.2

304.03.3 Weather Limitations. Do not mix or place cement-treated base when the ambient temperature is below 40 °F (4 °C) or when the local weather forecast predicts the temperature to fall below 35 °F (2 °C) within 24 hours. The Project Manager will determine which forecast applies to the project.

Do not incorporate frozen aggregate in the cement treated base or place it on a frozen subgrade.

304.03.4 Subgrade Preparation. Prepare the subgrade meeting the applicable requirements of Section 203. Do not place the cement treated base on a soft or yielding subgrade.

Place cement-treated bases on constructed subgrades with the existing surface preparation meeting Section 204 requirements.

Trim the subgrade to the thickness tolerances for cement-treated base specified in Subsection 304.03.13.

304.03.5 Mixing. Mix the Portland cement-treated base in a central plant.

Proportion the aggregate and cement by weight. Water may be proportioned by weight or by volume.

Assure weigh systems and meters are accurate to within plus or minus 0.5 % of the total quantity batched and are equipped to indicate the total quantity of each ingredient batched between one half to ten hours.

Calibrate the feed system before production mixing begins.

Mix ingredient proportions will be periodically verified from the weigh indicators.

Maintain the cement content to within plus or minus 1.0% of the job mix target at any periodic check and within plus or minus 0.3 % for each day's production. Mixing will be suspended if the Contractor fails to maintain cement content within the above tolerances until corrections are made.

Uniformly mix aggregate, cement, and water. Modify mix procedures when evidence of a non-uniform mix is identified.

304.03.6 Moisture-Density Test. The moisture and density relationship is determined by Montana Test Method MT-211 using samples taken from the aggregate stockpiles before starting mixing operations.

Once cement-treated base production has begun, subsequent moisture-density tests will be made on samples taken from the roadway to verify the moisture-density relationship obtained from the stockpile samples.

The compacted minimum density is 96% of the maximum dry density as determined above.

304.03.7 Compaction. Select the compaction method and complete compaction within two hours after mixing.

Field density values are determined under MT-212. One density test is taken at a randomly selected site within a 500 foot (152 m) section being constructed. If the density is below that specified, two additional tests will be taken in that section and the results averaged. The average density for the 3 tests must be at least the specified density, with none of the 3 tests less than 93% of the maximum dry density.

If the densities do not meet the specified requirements, remove the mix and reconstruct the section at Contractor expense.

The removed mix may be re-processed as aggregate for producing cement-treated base.

Remove and re-process any un-compacted sections where the weather has increased the average moisture content above optimum by more than 2%.

304.03.8 Finishing. Shape the compacted surface to the specified lines, grades, and cross sections.

Finish and compact to produce a smooth, dense surface free of compaction planes, cracks, irregularities, or loose material.

Complete the surface finishing within two hours of compaction.

Scarify and re-compact surface deformations in the base caused by equipment.

Do not permit the moisture content to fall below the specified optimum during finishing. Apply water in a uniform fog spray.

304.03.9 Construction Joints. Construct straight vertical-faced transverse joints at the end of each day's work by cutting back into the completed base. Assure the vertical face is free of loose material.

Repair all construction related damage to finished sections of the cement-treated base at Contractor expense.

304.03.10 Protection and Curing. Once the cement-treated base is finished, apply the specified bituminous curing seal at approximately 0.2 gallon per square yard (0.91 L per m^2).

Keep the cement-treated base surface moist between the final compaction and application of the curing seal.

Before applying the curing seal, assure the base surface is tightly knit, free of all loose material, and has sufficient moisture to prevent asphalt penetration.

Apply the specified blotter material at approximately 15 pounds per square yard (8.2 kg per m^2) when directed.

The actual application rate of curing seal and blotter may be adjusted by the Project Manager.

Remove base areas that have absorbed the curing seal down to hard, clean base, within 24 hours of application. Re-moisten if requested and re-apply the curing seal as specified.

Apply the curing seal and blotter material meeting the applicable requirements of Section 409.

304.03.11 Curing Period. Allow the cement-treated base to cure for at least 7 days after the curing seal is applied before applying the wearing course.

Immediately repair all curing seal damage during the cure period at Contractor expense.

304.03.12 Maintenance. Maintain the finished surface and seal before placing the wearing course. Make all repairs or patches the full depth of the base.

304.03.13 Surface Smoothness and Thickness Requirements.

A. Surface Smoothness. Assure the final surface does not vary from the mean constructed grade by more than nor diverge from the mean constructed grade at a rate exceeding the following:

Total Variation	Rate
0.04 foot (12 mm)	0.40%

Mean constructed grade for each section is the planned grade or a grade approximately parallel to plan grade, as determined by the Project Manager.

Correct all out of tolerance surface irregularities within 12 hours of compaction and finishing using a motor patrol.

B. Thickness. The finished cement-treated base thickness is determined by drilling test holes at random locations within 500 feet (152 m) sections. The average thickness constructed in one day must be more than plan thickness minus 5%, with no individual measurement less than plan thickness minus 10 percent.

Re-construct areas at Contractor expense where:

1. The average thickness represented by one day's construction is outside the specified tolerance; or
2. In limited areas that vary in thickness in excess of 10% from the plan thickness.

304.03.14 Use of Trimmed Material. Cement-treated base trimmings may be used for shoulder construction in lieu of aggregate, subject to the following:

1. The shoulder subgrade is prepared as specified in Subsection 304.03.4;
2. Hardened material is reworked to the maximum size specified for shoulder aggregate before spreading additional shoulder aggregate;
3. The trim material used cannot exceed 25% of the contract aggregate shoulder depth per linear foot (305 mm) of shoulder. When trimmings

exceed this limit, remove or place the excess in other shoulder areas, subject to the 25% limit;

4. Uniformly distribute the trim material in the shoulder area before spreading additional shoulder aggregate.

304.04 METHOD OF MEASUREMENT.

304.04.1 Cement-Treated Base. Cement-treated base is measured by the square yard (square meter) of completed surface.

Cement-treated base placed outside the lines shown in the Contract or established by the Project Manager is not measured for payment.

No measurement is made of the width required for forms or equipment operations.

Gravel used in trimmings and lateral support sections outside the planned typical section dimensions are not measured for payment.

304.04.2 Portland Cement. Portland cement is measured by the short ton (metric ton) or by the hundredweight (kilogram) under Subsection 109.01.

Measurement includes the cement in trimmings used as shoulder gravel.

Additional cement required for the re-processing specified in Subsection 304.03.7 is not measured for payment.

The payment weight is the invoice weight, up to the job mix target quantity, plus 0.3 percent. Furnish copies of invoices showing weights from certified scales.

Deductions are made for waste and non-project use.

304.04.3 Curing Seal. Curing Seal is measured by the gallon (liter) or by the ton (metric ton) under Subsection 409.04.1.

304.04.4 Blotter Material. Blotter material is measured by the ton (metric ton) or by the cubic yard (cubic meter) for the quantity applied and accepted in place.

304.05 BASIS OF PAYMENT. Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Cement-Treated Base	Square Yard (square meter)
Portland Cement	Short Ton (metric ton) or Hundred-weight (kilogram)
Curing Seal	Gallon (liter) or Ton (metric ton)
Blotter Material	Ton (metric ton) or Cubic Yard (cubic meter)

Existing Surface Preparation is measured and paid for under Subsections 204.04 and 204.05.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the Contract.