

Chapter 12 - Roadway Construction and Inspection Procedures

12.1 General

All earthwork and right-of-way construction shall be performed in accordance with the City of Castle Pines Roadway Design and Construction Standards. In these Roadway Standards, asphalt refers to hot bituminous pavement, existing bituminous pavement, or asphalt paving material. In case of discrepancy, the most stringent criteria shall take precedence as determined by the City.

Refer to Chapter 8 for Inspection and Testing Requirements related to bridges and structures.

12.1.1 Third-Party Testing

Results of tests and inspections performed by the testing firm in the employment of the Owners, Developers, or Contractors shall be submitted directly from the testing agency to the City Public Works Department within 10 working days after the testing or retesting date of field and laboratory tests. Failure to meet the above requirements may result in a Stop Work Order being issued along with penalties in accordance with these Roadway Standards. It is the responsibility of the third-party testing agency and the Owner/Developer to review test data and assure conformance to testing frequencies outlined in these Standards. Failure to conform to Standards may result in non-acceptance of public infrastructure.

12.1.2 Rights-of-Way, Easements, and Storm Water Facilities

Any work performed inside a City right-of-way, associated easements, and all storm water facilities shall be tested by approved materials testing firms accredited by American Association of State Highway and Transportation Officials (AASHTO) on an annual basis. They must employ a full-time, registered Professional Engineer (PE) licensed in the State of Colorado who directly supervises the work of the firm. The costs of testing, retests, and associated reporting will be paid by the Owner/Developer. All material testing reports must be from an AASHTO-accredited lab and must be certified by a PE.

12.2 Ancillary Structure Testing

12.2.1 Utility Trenches, Inlets, Manholes, and Junction Boxes Backfilling Materials, Placement, and Compaction

All utility trenches within the right-of-way, associated easements, and on all facilities shall be placed and compacted in accordance with these Roadway Standards.

12.2.2 Testing

Field moisture-density testing shall be performed during backfill operations from the bedding material up to the finished subgrade elevation. Minimum testing frequency shall be in accordance with the tables in this chapter. A sufficient number of tests shall be taken at various depths to confirm backfill compaction and moisture content specifications are met. The results of field density tests shall be submitted in packet form and reviewed by the City Public Works Department prior to paving surfaces and prior to preliminary acceptance of right-of-way features. Prior to receiving the test packet, it is the testing agency and Owner/Developer's responsibility to assure conformance with testing frequency. Testing shall be done in accordance with this manual. Within the roadway area, trench compaction shall be in accordance with AASHTO T-99 or T-180.

12.2.3 Curb, Gutter, Sidewalk, Cross Pans, and Minor Drainage Structures Subgrade Preparation

12.2.3.1 Subgrade

Subgrade shall be thoroughly compacted in accordance with the Specifications outlined in this chapter. The surface shall be smooth to the final grade on which the concrete or asphalt will be placed, with no humps or depressions.

12.2.3.2 Testing

Testing frequency for the subgrade shall be in accordance with the tables in this chapter. Once all testing is complete, the subgrade shall be proof rolled. All costs associated with testing, retests, and associated reporting will be paid by the Owner/Developer. These test results shall be submitted to City Public Works Department for compliance review prior to paving and before initial acceptance.

12.2.4 Concrete

12.2.4.1 Materials

Concrete material, curing, and placement shall conform with the requirements of these Roadway Standards. Curing methods shall conform to ACI 301 standard specifications.

12.2.4.2 Placement

Concrete placement and finishing shall include methods per ACI, which will not reduce the strength or integrity of the final product.

12.2.4.3 Testing

Daily placement of concrete will require testing in accordance with this chapter, plus properties testing on the first three consecutive passing truck loads. If placement is by means of a pump truck, sampling will be from the point of placement (the end of the discharge hose). One set of five cylinders shall be made and used for compressive strength testing from one of the first three passing truck loads and every 50 subsequent cubic yards or portion thereof. In the event of there being only one or two truck load(s) placed, then all of the tests described previously will be required to pass, with one set of cylinders made for compressive strength testing.

12.2.4.4 Cold Weather Concrete Protection

From November 1st through April 15th when the mean daily temperature is less than 40°F or when concrete is placed with ambient temperatures below 40°F, cold weather protection shall be provided in accordance with these Roadway Standards.

All protection for the job must be onsite and reviewed by a City Inspector prior to beginning the concrete placement. After the concrete has been placed, the Contractor shall provide sufficient protection, such as cover, straw, thermal blankets, canvas, framework, or heating apparatus, to enclose and protect the structure and maintain the temperature of the concrete at not less than 50°F for a minimum of 5 days or until at least 60% of the design strength has been attained. It shall be the Permittee's responsibility to provide proof of temperature compliance through the use of maturity meters or with surface temperature recording devices, as certified (by a PE) by a testing laboratory. The maximum frequency for recording temperatures shall be 1-hour intervals. If surface temperature compliance data are not provided, the permittee may be required to provide the City with petrographic tests for every 50 cubic yards of concrete

placed. Except as provided previously, cold weather placement of concrete shall be in accordance with ACI-306. If in the opinion of the City Inspector, the protection provided is not in accordance with the specifications herein, placement of concrete shall cease until conditions or procedures are satisfactory to the City Inspector.

Note: Dates for Mean Daily Temperature as determined over the last 25 years by the Colorado Climate Center, Department of Atmospheric Science by: (min. temp. + max. temp)/2 (which is accurate to within plus or minus 1 degree).

12.3 Roadway Subgrade Preparation

12.3.1 Swell Mitigation Procedure

If swell mitigation is required in accordance with the approved Pavement Design Report, the swelling material shall be mitigated based on the approved measures. Field density tests and a proof roll shall be performed and accepted.

12.3.2 Compaction

Subgrade shall be prepared in accordance with these Roadway Standards. Certified compaction reports shall be required in accordance with these Roadway Standards prior to initial acceptance by the City.

To determine soil temperature, the subgrade will be checked at various depths below the surface as determined by the City Inspector. If there is the presence of ice crystals in the subgrade, or temperatures are recorded at or below 32°F, as determined by a City Inspector, it shall be considered frozen material.

12.3.3 Testing

Subgrade shall be tested in accordance with these Roadway Standards.

12.3.4 Final Proof Rolling

Subgrade, which is pumping, or deforming as determined by the City Inspector, must be reworked, replaced, or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. The proof roll shall be scheduled with the City Public Works Department at least 24 hours in advance, and the City Inspector shall be present at the time of the proof roll.

Table 12-1. Soil Characteristics

Soil Type	Compaction	Moisture
A-1, A-2, A-3	95% Min. of AASHTO T 180	-2 to +2
A-4, A-5, A-6, A-7	95% Min. of AASHTO T 99	0 to +4

12.3.5 Acceptance

The results of field moisture and density tests shall be submitted and reviewed by the City Public Works Department. Provided all tests are acceptable and the proof roll is approved, placement of the first paving course may proceed. Should testing and proof rolling indicate unsatisfactory work, the necessary reworking, compaction, replacement, retesting, and new proof roll will be required prior to continuation of the paving process. The testing and proof rolling are valid for 24 hours. Changes in weather, such as freezing or precipitation, will require retesting and proof rolling the subgrade. The City will review all testing prior to acceptance.

12.4 Lime- and Cement-Treated Subgrade

12.4.1 Materials

Construction of lime- and cement-treated subgrade shall not be allowed from October 1st through April 15th. Lime- and cement-treated subgrade shall be used only where a mix design has been previously submitted to and approved by the City Public Works Director or their representative.

12.4.2 Construction

Subgrade shall be in accordance with the proof roll standards. Acceptable compressive strength test results shall be in a range determined by the City. If cement treatment subgrade is used under concrete pavement, a bond breaker shall be used.

Note: If lime- or cement-treated subgrade is used for swell mitigation in accordance with Chapter 10 of these Roadway Standards, the lime- or cement-treated subgrade cannot be used to improve the R-value or the structural number.

12.4.3 Testing

Lime- and cement-treated subgrade shall be observed and tested on a full-time basis. Minimum sampling and testing shall be in accordance with the more stringent of current AASHTO and Colorado Department of Transportation (CDOT) specifications. Compaction curves (AASHTO T 220) will be required for each soil type, and field density shall be compared with the appropriate curve for percentage compaction determinations.

12.4.4 Acceptance

Test results shall be submitted and reviewed by the City Public Works Department. Provided all tests, including a proof roll, are acceptable, the subgrade will be approved, and the next paving course can be placed. The City will review all testing prior to acceptance.

12.5 Aggregate Base Course and Recycled Concrete Base Course

12.5.1 Materials

Aggregate base course materials must be from a currently approved source and conform to the requirements found in these Roadway Standards.

12.5.2 Placement and Compaction

Materials shall be placed on an approved subgrade that has been tested and proof-rolled within the past 24 hours and found to be stable and non-yielding. Should weather conditions change, such as freezing or precipitation, aggregate base materials shall not be placed until the subgrade is retested and proof rolled.

Aggregate base materials shall be moisture treated and compacted to 95% modified proctor and within 2% of optimum.

12.5.3 Testing

Testing shall be done in accordance with these Roadway Standards. Should the tests indicate the material does not meet specifications, the material shall be removed and replaced.

During placement and compaction, compaction curves will be required for each material used. Field moisture-density tests shall be taken on each lift of material at random locations at approximate intervals of 200 linear feet in each travel lane.

12.5.4 Proof Rolling

After the base course has been compacted, tested, and found to meet specifications, base course, which is pumping or deforming, must be reworked, replaced, or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. The proof roll shall be scheduled 24 hours in advance with the City, and a City representative shall be present at the time of the proof roll.

12.5.5 Acceptance

The results of field moisture/density tests and proof rolling shall be submitted and reviewed by the City Public Works Department. Provided all tests are acceptable, and the proof roll is approved, placement of the first paving course may proceed. Should testing and proof rolling indicate unsatisfactory work, the necessary reworking, compaction, replacement, retesting and new proof roll will be required prior to continuation of the paving process. Approval testing and proof rolling are valid for 24 hours. Changes in weather, such as freezing or precipitation, will require reapproval, re-testing, and proof rolling of the base course.

12.6 Asphalt

12.6.1 Materials

All asphalt, aggregate, fillers, and additives shall be combined to form a mix design in accordance with Chapter 10 of these Roadway Standards. The mix design must be submitted to and approved by the City Public Works Department every 2 years. If any element of a mix design changes, a new mix design submittal is required.

12.6.2 Placement and Compaction

Materials shall be placed on an approved subgrade, base course, or previous paving course in accordance with these Roadway Standards.

If more than one theoretical maximum specific gravity test is taken in a day, the average of the theoretical maximum specific gravity results will be used to determine the percentage of compaction.

Self-propelled pavers shall be provided that are capable of spreading and finishing the asphalt paving material in full lane widths applicable to the typical section and thicknesses as discussed at the pre-paving conference or shown in the Contract documents and shall be equipped with the following:

- Anti-segregation devices
- A vibratory screed assembly capable of being heated

Pavers used for shoulders, patching, and similar construction not requiring fine-grade control shall be capable of spreading and finishing courses of asphalt to the required widths and depths as shown in the Contract without segregation.

The paver's receiving hopper shall have sufficient capacity for a uniform spreading operation and shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.

The paver shall be capable of operation at forward speeds consistent with uniform and continuous placement of the mixture. Stop-and-go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, segregating, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of detecting grade provided by a source of reference line and maintaining the screed at the specified longitudinal grade and transverse slope. The sensors may be contact or non-contact-type devices. The sensor shall be constructed to operate from either or both sides of the paver and shall be capable of working with the following devices when they are required for the situation:

- Grade control device at least 30 feet in length
- Joint matching device
- Adequate length of control line and stakes if no other type of geometric control is present
- A straight edge at least 10 feet in length that will be available to verify the crown on the screed, at the City's request

The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1%. Automatic mode should be used where possible. If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.

If the Contractor fails to obtain and maintain the specified thickness or surface tolerances, the paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made. Placement of asphalt paving material on a waterproofed bridge deck shall be accomplished with equipment that will not damage the membrane or protective covering. Material placed that does not meet thickness requirements shall be removed and replaced. Material placed that does not meet smoothness requirements shall be removed and replaced or diamond ground so long as thickness requirements are still met after grinding.

Redistribution of the mixture using hand tools is only permitted when necessary around utilities and in areas inaccessible to equipment. Casting or raking will not be allowed.

Asphalt shall be placed only on properly prepared, unfrozen surfaces that are free of water, snow, and ice. The asphalt shall be placed only when both the air and surface temperatures equal or exceed the temperatures specified in Table 12-2 and the City Inspector determines that the weather conditions Permit the pavement to be properly placed and compacted.

Table 12-2. Placement Temperature Limitations in °F

Compacted Layer Thickness (inches)	Minimum Surface and Air Temperature °F	
	Top Layer	Layers Below Top Layer
< 1.5	60	50
1.5 to 3	50	40
> 3 ^a	45	35

Note: Air temperature is taken in the shade. Surface is defined as the approved subgrade, base course, or previous paving course on which the new pavement is to be placed.

^a Requires Preapproval from the City Public Works Department.

The minimum temperature of the mixture when discharged from the mixer and when delivered for use shall be as shown in Table 12-3. Mix temperatures will be checked on each load behind the paver screed. Where the temperature does not meet specifications, the material shall be rejected.

Table 12-3. Mix Temperatures

Asphalt Grade	Minimum Mix Discharge Temperature (°F) ^a	Minimum Delivered Mix Temperature (°F) ^b
PG 58-28	275	235
PG 64-22	290	235

^a The maximum mix discharge temperature shall not exceed the minimum discharge temperature by more than 30°F.

^b Delivered mix temperature shall be measured behind the paver screed.

12.6.3 Testing

Asphalt pavement testing shall be performed in accordance with these Roadway Standards. The tests shall be performed under the general supervision of a PE licensed in the State of Colorado. Laboratories shall be accredited by AASHTO for tests being performed to an AASHTO standard or an equivalent test method. Technicians taking samples and conducting compaction tests must have LabCAT Level A certification. Technicians conducting tests of asphalt content and gradation must have LabCAT Level B certification. Technicians performing volumetric testing must have LabCAT Level C certification.

If any materials furnished or work performed fails to fulfill the specification requirements, such deficiencies shall be reported to the City Public Works Department or City Inspector on the day of paving. Written field reports of all tests taken, and observation results shall be given to the Contractor, City Inspector, City, and Developer within 10 business days after samples were obtained or density testing performed. Failures should be reported to the City within this time duration.

Nuclear density test results shall be corrected using Colorado Procedure 82 Field Correction of the In-Place Measurement of Density of Bituminous Pavement by the Nuclear Method. A new calibration should be developed for each change in mix design, pavement lift, or underlying surface. Results of nuclear density test results shall be reported to the Inspector/project superintendent at the time the testing occurs. **Nuclear density test results are for information only and are not to be considered for acceptance.**

If the Contractor chooses to cover a lower asphalt lift before that material has been accepted, and it is determined that the lower lift is not within the tolerance variance, then both the lower lift(s) and upper lift will be removed and replaced.

Mix temperatures will be checked on each load behind the paver screed. Where the temperature does not meet specifications, the material shall be rejected and removed immediately.

If requested by the City, upon completion of the paving, the final pavement thickness and density may be determined by taking cores. Core density shall be determined by coring after each lift of asphalt is placed. The cores shall be taken at random locations at intervals of approximately 500 feet in each travel lane as determined and marked by the City Inspector. The City Inspector must be present during actual core drilling, or cores will not be accepted. The core holes shall be repaired with asphalt paving material or other approved products.

Profilograph tests may be required prior to initial and Final Acceptance on collector and arterial roadways. Profilographs shall be performed by a certified independent testing consultant with data supplied to the City within 5 working days. Profilographs shall be performed according to CDOT specifications.

Table 12-4. Job Mix Formula Production Tolerance Zones

Element	Reference Conditions		
	Within Tolerance (GREEN)	Tolerance Variance (YELLOW)	Out of Tolerance (RED)
Asphalt Content	±0.3%	+0.5/-0.4%	+0.51/-0.41%
Air Voids	±1.2%	±2.4%	±2.5%
VMA	±1.2%	±2.4%	±2.5%
Percent Relative Compaction – Mat	94 ±2%	N/A	N/A
Percent Relative Compaction – Joint	92 ±4%	N/A	N/A
Passing the 3/8-inch and Larger Sieves	±6%	±9%	±10%
Passing the No. 4 and No. 8 Sieves	±5%	±8%	±9%
Passing the No. 30 Sieve	±4%	±6%	±7%
Passing the No. 200 Sieve	±2%	±3%	±4%

Note:

VMA = Voids in Mineral Aggregate

Condition Green will exist when all elements are within Tolerance. Condition Yellow will exist when any Element falls outside of the Within Tolerance Zone (Green) and has not exceeded the Tolerance Variance Zone (Yellow). If any of the elements fall in the Tolerance Variance Zone (Yellow), the Contractor shall notify the Supplier and corrections shall be made. While elements are in the Tolerance Variance Zone (Yellow), paving operations may continue while corrections are made, provided in-place densities meet the specifications. While elements are in the Tolerance Variance Zone (Yellow), samples will be taken daily until the mix is back in the Within Tolerance Zone (Green). In the event the mix has not been brought back to Within Tolerance (Green) by the end of the third day's paving operations, or at any time the tests move into the Out of Tolerance Zone (Red), production or paving operations will be suspended until corrections are made and the mix is verified against CDOT Standard Specifications.

12.6.4 Acceptance

The results of field density and laboratory tests shall be submitted to, and reviewed by, the City. Provided all tests are acceptable, the asphalt concrete materials, placement, and compaction will be approved. Acceptable results shall be in compliance with specified tolerances.

Should testing indicate unsatisfactory work, removal and replacement or overlay work will be required as determined by the City Public Works Director.

Requirements:

- All (100%) mat cores must pass 94% (plus or minus 2.0%) of the theoretical maximum specific gravity (Rice Value).
- All (100%) longitudinal joint cores must pass 92% (plus or minus 4.0%) of the theoretical maximum specific gravity (Rice Value).
- All Lottman (Tensile Strength Ratio, % Retained, CP-L 5109) shall be equal to or greater than 70%.

12.6.5 Hot Mix Asphalt Test Result Dispute Resolution

If the Contractor wishes to dispute the results of a failing test, then a split sample (in accordance with CDOT Field Materials Manual) shall be provided to a certified third-party laboratory within 10 working days after the testing date of the original laboratory test. The results of the retest shall replace those of the original test. The Contractor shall be responsible for paying for the retesting.

12.7 Portland Cement Concrete

12.7.1 Materials

All aggregate, Portland cement, fly ash, water, admixtures, curing materials and reinforcing steel shall meet the requirements of these Roadway Standards. All materials shall be combined in accordance with the mix design, submitted to, and approved every 2 years by the City.

12.7.2 Construction Requirements

Materials shall be proportioned, handled, measured, batched, placed, and cured in accordance with these Roadway Standards.

12.7.3 Cold Weather Concrete Protection

From November 1st through April 15th when the mean daily temperature is less than 40°F or when concrete is placed with ambient temperatures below 40°F, cold weather protection shall be provided in accordance with these Roadway Standards.

All protection for the job must be onsite and reviewed by the City Inspector prior to beginning the concrete placement. After the concrete has been placed, the Contractor shall provide sufficient protection, such as cover, straw (as determined by R-factor per ACI specifications), thermal blankets, canvas, framework, or heating apparatus, to enclose and protect the structure and maintain the temperature of the concrete at not less than 50°F for a minimum of 5 days or until at least 60% of the design strength has been attained. It shall be the Permittee's responsibility to provide proof of temperature compliance through the use of maturity meters or with surface temperature recording devices, as certified (by a PE) by a testing laboratory. The maximum frequency for recording temperatures shall be 1-hour intervals. If surface temperature compliance data are not provided, the permittee shall be required to provide the City with petrographic tests for every 50 cubic yards of concrete placed. Except as provided previously, cold weather placement of concrete shall be in accordance with ACI-306. If in the opinion of the City Inspector, the protection provided is not in accordance with the specifications noted previously, placement of concrete shall cease until conditions or procedures are satisfactory to the City Inspector.

Note: Dates for Mean Daily Temperature as determined over the last 25 years by the Colorado Climate Center, Department of Atmospheric Science by: $(\text{min. temp.} + \text{max. temp.})/2$ (which is accurate to within plus or minus 1 degree).

12.7.4 Testing

During placement of Portland cement concrete pavement, observation and testing shall be on a full-time basis. For each day of production, change in source or supplier, or every 400 cubic yards placed (or portion thereof), aggregate samples shall be obtained at the batch plant for gradation of both the coarse and fine aggregates.

Slump, air content, unit weight and mix temperature shall be tested every 50 cubic yards of pavement placed. Daily placement of concrete will require testing of slump, air content, unit weight, and mix temperature on the first three consecutive passing loads. Sampling will be from the point of placement. If any one test fails to meet the requirements, testing shall continue until loads meet requirements. Thereafter, slump, air content, unit weight, and mix temperature shall be tested at least every 50 subsequent cubic yards or portion thereof.

A minimum of five compressive-strength cylinders shall be fabricated for each 50 cubic yards placed. Cylinders shall be tested as follows: one at 7 days, three at 28 days and one for backup, as required by the City. Testing intervals may be increased at the discretion of the City Inspector.

Portland cement and fly ash will be accepted on the basis of current certificates of compliance and pre-testing by CDOT. Reinforcing steel, dowels, and tie bars will be accepted by certificate of compliance and mill reports. Water, if not potable, shall be sampled and tested before use. Only CDOT-approved brands of air entraining agents, chemical admixtures, and curing materials may be used and must be documented.

Surface smoothness shall be tested and corrected as necessary. Acceptance profiles shall be performed per CDOT specifications. Hand-placed concrete tested with a 10-foot straightedge shall have a deviation of no more than 3/16-inch in 10 feet. This requirement is for all concrete mainline pavement. Defective concrete pavement shall be corrected as necessary.

Concrete thickness shall be verified by coring after construction at random locations at intervals of approximately 500 feet in each travel lane as determined and marked by the City Inspector. The City Inspector must be present during actual core drilling, or cores will not be accepted. Core holes shall be repaired with an approved high-strength epoxy grout or other approved material.

A Final Acceptance profile test shall be conducted after all corrections and repairs are made. Acceptance profiles shall be performed by a certified profiler with data supplied to the City within 5 working days following the test.

Curing methods shall conform to ACI 301 standard specifications.

12.7.5 Acceptance

All test results shall be submitted to and reviewed by City Public Works Department or their representative. The pavement will be accepted once all tests are approved and applicable repairs or corrections have been made. Should testing indicate unsatisfactory work, removal and replacement or grinding will be required.

12.8 Other Materials

12.8.1 Asphalt Prime and Tack Coats General

Prime coat is the application of a diluted, emulsified asphalt or cutback asphalt (as allowed by federal or state law) to previously prepared aggregate base course or granular soil subgrade prior to placing asphalt concrete. The prime penetrates into the base or subgrade, plugs the voids, binds the fine aggregate at the surface, waterproofs the surface until the asphalt concrete surfacing is placed, and helps prevent the surfacing from shoving following construction.

Tack coat is a very light application of asphalt (usually diluted emulsified asphalt) to create a bond between the asphalt concrete being placed and underlying pavement or adjacent features, such as gutter faces, valve boxes, manholes, and rings. A tack coat prevents a slip plane in overlays and seals joints

between the paving and other appurtenances. It must be applied uniformly and lightly. Too heavy a tack coat is less desirable than none at all. A tack coat is used when the surface to be overlaid is old, glazed, dried out or subjected to dust or traffic film. Tack coats are sometimes omitted between asphalt courses of new pavements if the succeeding course is placed within 24 hours. If the surface of the underlying course is contaminated by sand, dust, or foreign material deposited by traffic or wind, merely brooming is not completely effective. A very light tack coat should be applied after brooming.

12.8.2 Materials

Emulsified asphalt shall meet the requirements of these Roadway Standards.

12.8.3 Application

Before prime coat application, the surface should be allowed to dry to approximately 80% of optimum moisture. Application shall be made with a self-propelled pressure distributor capable of uniform distribution at the rate specified. The distributor should be calibrated and equipped hydraulically, or with tie downs, so the spray bar will maintain a uniform height above the surface being primed. The asphalt material shall be applied in the range of 0.20 to 0.40 gallon/square yard. If the surface being primed is very tight textured and appears fairly non-absorbent, use the lower end of the range. If the surface is more open textured and appears more absorbent, use the higher end of the range. Apply as much material as the surface will absorb in a reasonable period of time. If an excess is applied, use a blotter material (sand or aggregate base material) to absorb the excess.

Tack coat is applied with a self-propelled pressure distributor that is in good condition, clean, and has been calibrated with nozzles set properly for fan overlap and not plugged. The spray bar should be capable of being set hydraulically, or tied down, so the bar is maintained at a uniform height from the application surface. A 1:1 dilution should be applied at 0.10 gallon/square yard. Greater dilutions should be applied at heavier rates. A wand or hand-spray nozzle attached to the spray bar can be used for applying tack to gutter faces, valve boxes, manholes, and rings. In lieu of the wand, a hand sprayer, or as a last resort, a mop and bucket, may be used. Care must be taken with the wand, sprayer, and especially a mop so that a very light coating is applied, and the emulsion is not sprayed on the surfaces where paving will not be used. Sloppy workmanship shall not be tolerated. The tack coat must be evenly distributed over the entire surface.

12.8.4 Curing

When applied, emulsified asphalt will be brown in color. When the emulsion breaks (dehydrates), it will separate into its two components, asphalt cement and water, and turn black in color. Following the break, the water must evaporate before placing asphalt concrete. The prime or tack coat will be sticky or tacky when cured. The length of time required for curing will depend on the surface temperature, air temperature, humidity, and wind conditions. On a hot, dry, windy day, the prime or tack coat will cure in an hour or so. Cooler, more humid, cloudy, and still conditions will extend this time period.

12.8.5 Acceptance

Prime or tack coat will be approved by the City upon acceptance of mill certifications, visual approval, and verification of application rate. Dust or contamination of prime or tack coats will require brooming and reapplication.

12.8.6 Joint/Crack Sealant

12.8.6.1 Hot Poured Joint and Crack Sealant

This item shall consist of furnishing all materials, equipment, labor, cleaning and clean up, traffic control, and incidental items necessary for sealing or filling cracks of asphalt pavements. The purpose of crack sealing and crack filling is to prevent the intrusion of water and incompressibles. Crack sealing shall be applicable for cracks determined by the City Public Works Department. Crack filler is recommended for cracks that are 1 inch or wider or exhibit edge deterioration. Crack sealer is used for working cracks, and for cracks that have more than a quarter-inch seasonal movement. Both hot and cold materials are currently available for crack sealing; however, this specification is meant to only apply to hot applied materials. Crack filler should be used for nonworking cracks. Nonworking cracks are cracks that have annual movement of less than one-quarter inch. Nonworking crack types may include wide transverse cracks. If a crack exhibits edge deterioration, it should be filled not sealed.

12.8.6.2 Concrete Joint Fillers

The joint sealant for all sawed longitudinal and transverse joints shall be a silicone joint sealant meeting ASTM D5893. ASTM C1193 provides guidance for use of joint sealants. Blocking medium shall be an expanded, closed-cell polyethylene foam-backer rod or nonplastic rope that is compatible with the joint sealant material and meets ASTM C1330, Type C, or ASTM D5249. Polyethylene expansion joint materials shall be flexible, low-density, expanded-extruded polyethylene plank formed by the expansion of polyethylene base resin, extruded as a multicellular, closed-cell, homogeneous foamed polyethylene. Laminations shall not be permitted. The joint material shall conform to ASTM D1751, ASTM D1752, or ASTM D8139.

12.9 Road Cuts

12.9.1 Small Trench Cut in an Existing Roadway

This section is generally reserved for small road cuts from utility locates, water line repairs, sewer line repairs, electrical line repairs, gas main, phone lines, fiber-optic lines, cable lines, or service line repairs with damage to pavement areas. Unless preapproved, small trenches must be closed and temporarily resurfaced by the end of the workday. Trenches in existing roadways shall be backfilled with a preapproved material and the surface restored to use by the end of the workday through the use of accepted materials.

Final surface restoration shall be completed within 24 hours of temporary surface placement, excluding concrete curing. For roadways where concrete is involved, high, early-strength concrete may be required. For damaged or disturbed concrete pavements, sidewalks, curbs, gutters, cross pans, fillets, and curb ramps, the entire panel or section must be removed and replaced.

If more than 225 square feet of existing roadway is disturbed (from single street cuts on Arterial or Collector streets to multiple street cuts on Local streets) within a single block, the construction area shall be milled and overlaid per the direction of the City Public Works Department. The mill and overlay shall encompass all of the disturbed asphalt areas in a rectangular shape. Refer to Castle Pines Municipal Code for additional street cut regulations. Standard trench patching shall be required immediately following the initial road cut(s). T patching and infrared repair is required on all asphalt repair or replacement.

12.9.2 Trenches Crossing a Roadway

Unless otherwise approved in writing by the City Public Works Department, all trenches crossing a roadway shall be perpendicular to the direction of travel. The sides of the trench shall be saw cut smooth a minimum of 1 foot from the edge of the trench. The road surface shall be replaced in accordance with Standard Detail SD. 47, matching the existing pavement grade and maintaining proper drainage. In concrete roads, the pavement thickness shall be the same as existing, but the panel must be doweled in the existing pavement as shown in the Standard Details. Unless otherwise approved, all trenches crossing in asphalt road surface that are less than 5 years old shall be milled and overlaid with approved materials a minimum of 10 feet on both sides of the trench for Local roadways and a minimum of 50 feet on both sides of the trench for Collector and Arterial roadways.

12.9.3 Longitudinal Trenches within a Roadway

Longitudinal trenches within a roadway shall be straight and will generally be a consistent distance from either the centerline of the road or flow line, as specified. Meandering will not be allowed. All pavements shall be saw cut a minimum of 1 foot beyond the edge of the trench before patching. If the distance between the edge of the trench and the lip of gutter, cross pan, or edge of pavement is less than 6 feet, all pavement to the lip of gutter, cross pan, or edge of pavement shall be removed and replaced. At a minimum, removed asphalt pavements shall be in accordance with Standard Detail SD. 47.

Pavements within arterials and collectors shall have the final repairs completed within 24 hours of the completion of the work requiring a road cut. All permanent repairs and temporary patches shall restore the pavements to existing or better conditions than existed before construction. Temporary patches in roadways shall be completed by the end of each working day.

Final repairs of pavement within local streets shall be completed within 5 days of the completion of the work requiring a road cut. At no time will more than 800 feet of trench be allowed to be unrestored or temporarily patched. All patches shall restore the pavement to existing or better condition than existed prior to construction.

In roadways whose surface is more than 5 years old, a minimum 12-foot-wide mill and overlay to a depth of 2 inches is required for the length of the trench before the end of construction. The edge of trench should not be in the wheel path. Where the trench straddles two or more traffic lanes, both lanes shall be milled and overlaid to a depth of 2 inches for the length of the trench before the end of construction.

Local streets shall be patched in accordance with Standard Detail SD. 47. Where multiple trench cuts occur in the street, the construction area shall be milled and overlaid by the end of the project. The mill and overlay shall encompass all of the disturbed asphalt areas in a rectangular shape.

In roadways whose surface is less than 5 years old, the half of the roadway disturbed by construction shall be milled and overlaid to a depth of 2 inches for the length of the trench before the end of construction. This restoration section shall extend from the centerline of the roadway to the lip of the gutter or pan. Should the road surface on both sides of the centerline be damaged as a result of construction activities, the entire surface of the roadway shall be milled and overlaid.

At no time will more than 800 feet of road be disturbed and unavailable for the public use, unless approved in writing by the City Public Works Department.

All final road restoration shall be completed within 24 hours of the temporary patch for unless otherwise approved by City Public Works Department or their representative. Failure by the Contractor to perform the required restoration may result in the work being done though the City, with all costs charged to the

project Owner or Contractor. Failure to remit payment for all incurred costs within 30 days of written notice may incur additional finance charges, project acceptance delays, and collection fees.

12.9.4 Potholes for Locates or Subsurface Investigations in Asphalt Pavements

Potholes for utility locates shall be done by means of a 3- to 6-inch-diameter core drill through the existing roadway surface. Potholes in asphalt roadways with a surface disturbance less than 1 square foot shall be repaired using preapproved pavement materials with an infrared surface treatment.

12.9.5 Potholes for Locates or Subsurface Investigations in Concrete Pavements

Potholes for utility locates shall be done by means of a 3- to 6-inch-diameter core drill through the concrete surface. Potholes in concrete pavement shall be plugged using a preapproved, fast-setting pavement concrete. More than two cores in a concrete pavement, including any previous core, or single disturbed area greater than 1 square foot, shall require the entire panel to be removed and replaced.

For potholes in sidewalks, curbs, gutters, fillets, curb ramps, cross pans, and other small concrete placements, the entire concrete section shall be removed and replaced.

12.9.6 Amount of Unpaved Roadway Trench

At no time shall more than 800-feet of a trench or trenches be without final restoration and useable by the public. Situations other than a temporary surface patch, approved by the City Inspector because of weather or the need to gain access for final tie-in work, must be approved in writing by the City Public Works Department or its assignee prior to the road surface being cut. Before paving, the Contractor or the project Owner shall verify passing compaction density tests and pass a proof roll. The City Public Works Department verifies test results prior to acceptance or Permit close out.

12.9.7 Trenchless Technology – Bores and Missiles

Trenchless construction for dry utilities using missiles, rams, unguided bores, or any other type of limited control devices is not allowed in the right-of-way. Only machines with fully controlled boring heads are permitted.

The individual Contractor shall warranty the work for a period of 5 years for heave or settlement. In areas where the exact depth and location of sewer mains or services is not known, the Contractor shall pothole to determine the depth or shall have a TV video survey done of the sewer line or service, prior to construction. The Contractor shall again video survey the sewer line or service after construction is complete to demonstrate the lines have not been damaged. A videotape of the before and after conditions shall be submitted to the City Public Works Department within 30 days of completing boring operations.

12.10 Quick Reference

Table 12-5. Castle Pines minimum Testing Requirements

Item	Type of Test	Minimum Frequency
Dry Utilities; Gas, Electric, Phone and Cable TV Trenches (Backfill)	Moisture/Density	1 per 200 lane feet Every 1 foot in elevation and 1 foot from all structures every 1 foot in elevation

Table 12-5. Castle Pines minimum Testing Requirements

Item	Type of Test	Minimum Frequency
Wet Utilities: Sanitary & Storm Sewer, Water Line Trenches, Services (Backfill) (Full-Time Tester)	Moisture/Density	1 per 200 lane feet every 1 foot in elevation, and 1 foot from all structures, manholes, valves, and other obstacles every 1 foot in elevation
Inlets (Concrete)	Air, Slump, Unit Weight, Temperature	First three consecutive passing loads, every 50 cubic yards thereafter
	Cylinders	1 set per 50 cubic yards
	Steel	Visual documentation
Inlets (Backfill)	Density	1 foot in elevation around structure every 1 foot in elevation
Sidewalk, Curb and Gutter (Subgrade)	Moisture/Density	1 per 200 lane feet every 1 foot in elevation
	Proof-roll	All subgrade
Sidewalk, Curb and Gutter (Concrete)	Air, Slump, Unit Weight, Temperature	First three consecutive passing loads, every 50 cubic yards thereafter
	Cylinders	1 set per 50 cubic yards
Roadway (Subgrade)	Moisture/Density	1 per 200 lane feet every 1 foot in elevation
	Proof-roll	All subgrade
Roadway (Base Course)	Gradation and Atterberg Limits	1 per 2,000 tons
	Moisture/Density	1 per 200 lane feet
	Proof-roll	All base course
Roadway (Concrete) (Full-time Tester)	Air, Slump, Unit Weight, Temperature	First three consecutive passing loads, every 50 cubic yards thereafter
	Cylinders	1 set per 50 cubic yards
Roadway (Asphalt) (Full-time Tester)	Density by Nuclear Gauge	1 per 200 lane feet
	Asphalt Content, Gradation, Air Voids, VMA	1 per 1,000 tons or minimum 1 per each days' production sampled at paver
	Lottman Striping TSR and Dry Density	One per project per mix used
Roadway (Asphalt and Concrete)	Cores (Thickness and Density Verification) per Request	1 per 500 lane feet
Roadway	Smoothness Profile	Arterials and Collectors