

VI STREETS

PART I – GENERAL

- Scope
- Related Work Specified Elsewhere
- Plan Submission and Approval
- Quality Assurance
 - Qualification of Asphalt Concrete Producer
 - Qualification of Testing Agency
 - Design Criteria

PART II – MATERIALS

- Selected Borrow Material
- Sub-Base
- Gradation
- Base Course
- Prime Coat
- Tack Coat
- Paving Materials
 - Aggregate
 - Paving Asphalt

PART III – EXECUTION

- Sub-Grade Preparation
 - Field Control
 - Grading
 - Excavation
 - Embankments
 - Select Borrow Materials
- Sub-Base Placement and Compaction
- Base Course
- Asphalt Paving
 - General
 - Job Conditions
 - Weather Limitations
 - Grade Control
 - Traffic Control
 - Prime Coat
 - Tack Coat
- Plant Mixed Asphalt Surfacing
 - Job Mixing Formula

- Mixing Plant
- Transporting Asphalt
- Equipment
 - Asphalt Distributor
 - Bituminous Pavers
 - Rolling Equipment
 - Hand Tools
- Placement
 - Allowable Tolerances
 - Density
 - Thickness
 - Surface Smoothness
- Placing the Mix
 - Continuity of Operation
 - Paver Placing
 - Hand Placing
 - Joints
- Compacting the Mix
- Testing
 - Density Control
 - Depth of Asphalt Control
- Drainage
- Cleaning and Protection
 - Cleaning
 - Protection
 - Patching
 - Adjusting Utility Grades
- Frame and Adjustments
 - Placing Frames
- Acceptance by the City

STREET DESIGN AND CONSTRUCTION

STANDARD SPECIFICATIONS

PART I - GENERAL

Scope

The work covered by this specification concerns the furnishing of all labor, equipment and materials and performing all operations in connection with the design and construction of streets in strict accordance with this specification and the applicable drawings.

Related Work Specified Elsewhere

Excavation, Backfill and Compaction Standard Specifications
Minimum Standards – Curb, Gutter, Sidewalks and Streets
Curb, Gutter and Sidewalk Standard Specifications

Plan Submission and Approval

Plan submission shall comply with the requirements of the General Specifications as well as the requirements in this section. Plans for proposed street construction shall be submitted on 24x36-inch sheets to the City for approval. An overall plan shall be submitted, along with individual plan and profile sheets. The plans shall show lots and blocks with topography, shall give centerline street grades, show vertical curves and the original ground profile. Grades shall be indicated for the curb and gutter for each side of the street; elevations of curb and gutter at the ends of each block shall be indicated. Cross pans including elevations shall be indicated on the street plan. The roadway width and type of curb, gutter and sidewalk shall be indicated for each street. Approval of the plans shall be per the General Specifications.

QUALITY ASSURANCE

Qualification of Asphalt Concrete Producer

Use only materials which are furnished by a bulk asphalt concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete.

Qualification of Testing Agency

A certified testing agency acceptable to the City shall establish job-mix formulas and perform the quality control sampling and testing required during excavation, sub-grade, sub-base, base and paving operations.

Design Criteria

Provide final surfaces of uniform texture, conforming to required grades and cross-sections and in compliance with the requirements for density, thickness and surface smoothness.

Maintain material within allowable tolerances of the governing standards as required under the sections for submittals and products.

PART II – MATERIALS

Select Borrow Material

Select sub-grade material shall be a well-graded mixture of sound mineral aggregate particles containing sufficient, proper quality bonding material to secure a firm, stable foundation when placed and compacted on the roadway.

When tested with laboratory sieves, the select sub-grade shall meet the following gradation requirements:

<u>Standard Size of Sieve</u>	<u>Percentage by Weight Passing Sieve</u>
3 inch	100
2 inch	90-100
No. 4	30-60
No. 200	5-15
Liquid Limit	35 maximum
Plasticity Index	6 maximum

The contractor will be required to provide a screen or other means to eliminate fines passing the No. 10 sieve if such fines prove to be objectionable at any time during the construction. If tests reveal that material being procured is not of suitable quality for which it is intended, the Contractor shall provide other material as approved by the City.

SUB-BASE

The bottom of the excavation for the pavement (or road surface) or top of the fill shall be known as the pavement sub-base and shall conform to the lines, grades and cross sections shown on the approved plans. This item shall consist of a foundation course composed of granular material, constructed on the prepared sub-grade in accordance with these specifications and to the grade indicated on the plans.

Gradation

This material need not be crushed, but can be of the pit run variety providing it is graded with the following limits:

<u>Standard Size of Sieve</u>	<u>Percentage by Weight Passing Sieve</u>
6 inch	100
No. 200	5-15
Liquid Limit	35 maximum
Plasticity Index	6 maximum
Resistance Value	75 minimum

The material supplied shall be a well-graded mixture, consisting of sound aggregate particles and sufficient filler or other proper quality binding material, which when placed and compacted will result in a firm, dense, unyielding foundation.

BASE COURSE

Crushed gravel or crushed stone base course material shall consist of hard, durable particles or fragments of stone or gravel crushed to required size and a filler of sand or other finely divided mineral matter. The portion of the material retained on a No. 4 sieve shall be known as coarse aggregate, and that portion passing a No. 4 sieve shall be known as filler. When produced from gravel, not less than 60% by weight of the coarse aggregate particles shall be particles having at least one fractured face, and if necessary to meet this requirement or to eliminate an excess of filler, the gravel shall be screened. The composite base course material shall be free from vegetable matter and lumps or balls of clay and shall meet the following grading requirements:

<u>Standard Size of Sieve</u>	<u>Percentage by Weight Passing Sieve</u>
3/4 inch	100%
No. 4	30-65
No. 8	25-55
No. 200	3-12
Liquid Limit	25 maximum*
Plasticity Index	6 maximum
Resistance Value	Minimum R=78

*30 maximum if non-plastic

Bearing value and/or stabilimeter tests may be required to properly evaluate the quality of the material.

Coarse aggregate shall show a loss of not more than 50% when tested in accordance with AASHTO standard method of test for abrasion of coarse aggregate by use of the Los Angeles machine, designation: T-96 (ASTM C131).

Prime Coat

The prime coat shall be a medium curing asphalt conforming to ASTM Specifications D598 or D2027. Cut-back A.C.-10 may be used in lieu of MC-70 when approved in writing by the City Public Works Director.

Tack Coat

The tack coat material shall be an asphalt of a grade approved by the City, typically conforming with the Standard Specifications of the Colorado Department of Transportation (Section 407) using SS-1 emulsion at a rate of 0.10 gallons or less per square yard on surface area. The solution shall be prepared by mixing one gallon of SS-1 emulsion to one gallon of clean water.

Paving Materials

The asphaltic surface course shall be composed of mineral aggregate and bituminous material, mixed in a central mixing plant, and shall be placed on the prepared base in conformity with the cross section and grades shown on the plans.

Aggregates

Aggregate shall be of uniform quality, crushed to size as necessary, and shall be composed of sound, tough, durable pebbles or fragments with or without natural or mineral fillers, as required. The aggregate shall be free from vegetable matter, lumps, or balls of clay, adherent films of clay or other matter that would prevent thorough coating with bituminous material and shall be free of an excess of flat or elongated pieces.

Coarse aggregate shall be crushed stone, crushed gravel, or crushed slag conforming to ASTM D692.

Fine aggregate shall be crushed stone, crushed gravel, natural sand, or slag screenings conforming to ASTM D1073.

Aggregate shall be composed of coarse and fine aggregate combined in the proper proportions to meet the Standard Specification, Grading C, of the Colorado Department of Transportation, as follows:

<u>Standard Size of Sieve</u>	<u>Percentage by Weight Passing Sieve</u>
3/4 inch	100
1/2 inch	70-95
No. 4	38-72
No. 8	25-58
No. 50	9-32
No. 200	3-12

When tested for abrasion, coarse aggregate shall show a loss of not more than 50% when tested in accordance with AASHTO standard method test for abrasion of coarse aggregate by use of the Los Angeles machine, designation: T-96 (ASTM C131).

At least 60% of all mineral aggregate not passing the No. 4 sieve shall have at least one fractured face. The mineral aggregate retained on the No. 8 sieve shall be clean, free from disintegrated stone, vegetable material, or other deleterious substances. Material passing the No. 200 sieve shall be less than one-half the material passing the No. 8 sieve. The material passing the No. 40 sieve shall have a liquid limit of not more than twenty-five (25) and a plasticity index of not more than six (6). Tests for liquid limit and plasticity index shall be made in accordance with AASHTO STANDARD METHODS T89 and T90. If sufficient fine material of satisfactory quality is not naturally present in the mineral aggregate, it shall be added. Material consisting of finely powdered limestone, Portland cement, hydrated lime, or other approved materials may be used for the filler.

Paving Asphalt

The paving asphalt shall be a homogenous product derived from asphaltic crudes and shall be free from water and any mineral matter other than naturally contained in the asphalt. The paving asphalt shall meet the requirements for AC-10 (or alternate if approved by City) and shall contain an anti-strip additive of a percentage as determined by a job mix formula. Sampling and testing of paving asphalt shall be in accordance with applicable AASHTO and ASTM Tests.

Determination of Percentage of Bituminous Material

The percentage of bituminous material, by weight, to be added to the aggregate will usually be between five and three-quarters (5 3/4) and seven (7) percent of the weight of the dry aggregate. The exact percentage to be used shall be fixed by the Contractor on the basis of preliminary laboratory tests and field sieve analysis of the aggregate furnished. The City and/or its Engineer reserves the right to review these tests and to order any changes in the percentage of bituminous material deemed necessary during the progress of the work.

PART III – EXECUTION

SUBGRADE PREPARATION

Field Control

Control stakes shall be set by field parties under the supervision of a professional engineer. Whenever necessary, the field parties shall be available to check field control and to provide assistance to the Contractor. A set of approved plans shall be kept on the job site at all times by the Contractor.

Grading

Excavation – Prior to the street being excavated or filled, compaction of cuts shall be checked to see if the backfill meets density requirements. If deficient, they shall be tamped and brought up to the proper density.

The following standards will be in effect: Soils meeting CDOT classifications shall be compacted to a minimum of 90% of Modified Proctor Density as determined by ASTM 1557. Other soils shall be compacted to a minimum of 95 % of Standard Proctor, and the minimum moisture content shall not be less than 2% below nor more than 2% above optimum.

No paving, sub-base or base material shall be placed upon a soft, spongy or frozen sub-grade or otherwise unsuitable sub-grade, the stability of which is unsuitable for the placement of sub-base or base.

Excavation shall be performed to the lines, grades and cross sections indicated on the approved drawings, except as otherwise permitted by the City, all excavated areas shall be excavated in such a manner that will permit adequate drainage. Suitable material removed from the excavations shall be used as far as practicable for embankments and backfilling. Unsuitable material shall be excavated below the grade shown on the drawings or indicated by grade stakes as directed by the City and replaced with select material. Excavated materials which are considered unsuitable and any surplus of excavated material not required for embankments or backfill shall be disposed of by the Contractor.

Embankments

Embankments shall be constructed by depositing, placing, and compacting materials of acceptable quality above the natural ground or other surface in accordance with lines, grades and cross sections shown on the plans and/or as required by the City. Before any embankment is placed, clearing, tree removal, and topsoil removal shall be performed as directed by the City Public Works Director. Clearing shall include removal and disposal of obstructions and rubbish to a minimum depth of twelve (12) inches below sub-grade elevation; sod will be removed to a minimum depth of six (6) inches, and trees and stumps to a minimum depth of eight (8) inches below sub-grade elevation. Each lift of embankment material, not to exceed six (6) inches of loose depth, shall be thoroughly and uniformly mixed and moistened to full depths and compacted by roller or vibratory equipment suitable for the

type of embankment material to be compacted to uniform minimum density of 90% of maximum density (ASTM D1557), and optimum moisture content of plus or minus 2%. Where required by the City Public Works Director or shown on the approved plans, select sub-grade material shall be furnished as fill material instead of using native materials.

Heavy construction equipment or loaded trucks shall be driven over the sub-grade and deflections noted. Soft and yielding material and portions of the sub-grade which show deflection shall be scarified and re-rolled or shall be removed and replaced with base course material, placed and compacted as specified herein. Sub-grade shall not be approved for base course construction until it is uniformly hard and unyielding.

Embankments shall be constructed to a width two (2) feet greater than the width of the section to be constructed.

Select Borrow Material

In the event sufficient material is not available for constructing sub-grade embankments or filling excavations from which unsuitable material is removed, the Contractor shall procure select sub-grade material for these purposes.

SUB-BASE PLACEMENT AND COMPACTION

Each layer of sub-base material shall be placed in layers not to exceed six (6) inches in loose depth. Each layer shall be wetted or aerated, if necessary, and compacted to 90% Modified Proctor density. No sub-base material shall be placed upon a soft, spongy or frozen sub-grade or other sub-grade, the stability of which is, in the opinion of the Engineer, unsuitable for the placement thereof.

BASE COURSE

Base course shall consist of a foundation course composed of crushed gravel or crushed stone and filler, constructed on the prepared sub-base in accordance with these specifications and to the grade indicated on the plans.

Placing and Spreading

The base course material shall be deposited and spread in a uniform layer and without segregation of size to such loose depth that, when compacted, the layer shall have a thickness not to exceed four (4) inches. The base course shall be rolled with a rubber-tired roller of minimum size of eight to twelve tons and a vibrated roller. Water may be added to produce a stable condition such that when heavy construction equipment or loaded trucks are driven over the base course, it is uniformly hard and unyielding. The material shall be compacted to a minimum density of 90% of Modified Proctor density.

No base course material shall be placed upon a soft, spongy or frozen sub-base or other sub-base, the stability of which is, in the opinion of the Engineer, unsuitable for the placement thereof.

ASPHALT PAVING

General

All asphalt paving shall conform and all work shall be done in accordance with the Standard Specifications of the Colorado Department of Transportation (Section 401).

Job Conditions

Weather Limitations – Apply bituminous prime and tack coats only when the ambient temperature in the shade is a minimum of 50 degrees Fahrenheit and when the temperature has not been below 35 degrees Fahrenheit for twelve hours immediately prior to application.

Do not apply when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.

Grade Control – Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

Traffic Control – Maintain vehicular and pedestrian traffic during paving operations as required for other construction activities.

Provide flagmen, barricades, warning signs, and warning lights for movement of traffic and safety to cause the least interruption to the work and inconvenience to the public.

Prime Coat – The grade of asphalt and the rate of application shall be approved by the Engineer and shall be determined by considering the condition of the base course, temperature, and other conditions affecting application. When, in the opinion of the City, the prepared base is thoroughly dry and satisfactory to receive the prime coat, the surface shall be cleaned by sweeping or other approved methods. The cleaning shall be continued until the embedded aggregates are uncovered but not dislodged, and dust, mud, and foreign matter removed. The equipment used to apply the prime coat shall be of the proper type and condition of maintenance to distribute the materials evenly and smoothly in the quantity specified. The material shall be heated to the proper temperature when applied, and shall only be applied when the outside temperature is above 50 degrees Fahrenheit. Apply enough material to penetrate and seal, but not flood, the surface. The prime coat shall be permitted to cure until thorough and proper penetration has been obtained, but at no time shall the curing period be less than twenty-four (24) hours. Pools of bituminous material occurring in depressions shall be removed from the surface before applying the asphalt surfacing. Blot with sand and remove loose sand before paving. Protect surfaces of curb and gutter, sidewalks and other structures to prevent any

asphaltic oil from being sprayed on them. Any surfaces inadvertently sprayed will be thoroughly cleaned at the expense of the contractor.

All spots unavoidably missed by the distributor or areas which are inaccessible to the distributor shall be hand-sprayed.

All vertical contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting asphalt concrete pavement shall be primed by brushing with hot asphaltic oil prior to placing the pavement.

At no time during the period of curing shall traffic be allowed upon the primed surface.

Tack Coat – Whenever new asphaltic pavement is placed on exiting pavement, a bituminous tack coat shall be applied to the exiting pavement prior to placing the new pavement.

The surface to receive the tack coat shall be dry and cleaned by an approved method until all dust, debris and foreign matter are removed. The tack coat material shall be applied at a rate and temperature approved by the Engineer which will provide a very thin coating uniformly distributed over the entire area to be covered, typically 0.05-0.15 gallons per square yard. The tack coat shall not be applied when the outside temperature is below 50 degrees Fahrenheit. Apply no more tack coat than necessary for the day's operation.

Apply tack coat to primed surfaces if "dusting" has occurred which will result in poor bonding between treated surface and bituminous pavement.

Plant-Mixed Asphalt Surfacing

Job Mixing Formula – No work shall be started on the project nor any mixture accepted until the Contractor has submitted for the approval of the Engineer a satisfactory job mix formula based upon tests of the materials to be furnished. The formula shall be submitted in writing by the Contractor to the City, indicating the definite percentage for each sieve fraction of aggregate and for asphalt. The intended temperature of completed mixture at the time it is discharged from the mixer must be between 235 degrees Fahrenheit and 300 degrees Fahrenheit. The material furnished shall conform to the approved job mix formula within the tolerances specified herein.

7.03.5 Job Mix Tolerances

Plus or Minus

Aggregate passing No. 4 sieve	8%
Aggregate passing No. 8 sieve	6%
Aggregate passing No. 200 sieve	3%
Mixture Temperature upon delivery at job site	20°F
Paving Asphalt (Bitumen)	0.5%

Should a change in sources of material be made, a new job mix formula shall be established before the new material is used. Prepared job mix formula for each course shall meet the following test criteria:

<u>Marshall Method</u>	<u>Minimum</u>	<u>Maximum</u>
Stability, lbs.	500	
Flow, units of 0.01 inch	8	18
% air voids – surface course	3	5
% air voids – base course	3	8
% voids in mineral aggregate – surface course	14	
Compaction blows	50	

Mixing Plant – The paving plant shall be of standard design and contain all the necessary components to ensure proper mixing of the materials. The plant shall be subject to approval by the City and/or Engineer. The City and/or its representatives shall have access at any reasonable time to all parts of the plant for the verification of weights and portions, character of materials, and determination of temperatures used in preparation of the mixture. All materials shall be mixed in accordance with standard procedures.

Transporting Asphalt – Transport asphalt concrete mixtures from mixing site in trucks having tight, clean, smooth, metal beds.

Coat hauling compartments with lime-water mixture to prevent asphalt concrete mixture from sticking. Elevate and drain compartment of excess solution before loading mix.

When the asphalt is subject to cooling during long haul, it shall be covered with a tarp in the truck to maintain proper temperature for laying. The asphalt shall not be hotter than 350 degrees Fahrenheit at the plant. During periods of cold weather or for long-distance deliveries, provide insulation around entire truck bed surfaces and provide covers securely fastened.

Equipment

Provide the size and quantity of equipment to insure a uniform continuity of operation and to complete the work specified within the project time schedule.

Asphalt Distributor

The distributor shall be in good mechanical condition and shall be capable of uniformly distributing the prime coat throughout a reasonable range of widths, pressures, temperatures, and application rates.

Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and thermometer for measuring temperatures of tank contents. They shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

Bituminous Pavers

Pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, that shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture and control pavement edges to true lines and grades without the use of stationary forms.

The pavers shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation and shall be equipped with a distributor system to place the mixture uniformly in front of the screed.

Rolling Equipment

Rollers shall be self-propelled, steel-wheeled rollers, pneumatic-tired rollers, or vibrating rollers, capable of reversing without backlash.

The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in workable condition.

Hand Tools

Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools to complete the work specified.

PLACEMENT

Prior to placement of the surface course, the base shall be cleaned of all dirt or other foreign matter. When the new pavement abuts the old paving, the Contractor shall, at his own expense, cut back the old pavement as directed by the Engineer and paint the edge of the old pavement with a coat of hot asphalt cement. The asphaltic pavement shall be placed only when the base is dry and weather conditions are suitable. The asphaltic pavement shall have a density of not less than 90% of the calculated density of a voidless mixture composed of the same material in like proportions. While the surface is being compacted and finished, the Contractor shall carefully trim the outside edges of the pavement to the proper alignment. No surfacing shall be placed unless the atmospheric temperature in the shade is at least 40 degrees Fahrenheit and rising, or 50 degrees Fahrenheit if falling, and other weather conditions are suitable. In no case shall pavement be laid on foundations in which frost is present.

Allowable Tolerances

Density – Compare density of in-place material against laboratory specimen of the same asphalt concrete mixture when subjected to 50 blows of standard marshall hammer on each side of the specimen. Minimum acceptable density of in-place materials shall be 95% of the recorded laboratory specimen density for any course.

Thickness – In-place compacted thicknesses will not be acceptable if exceeding the following allowable variations from thicknesses shown on the drawings:

1. Individual samples: 1/4 inch
Surface course: 1/4 inch, plus or minus
Base Course: 1/4 inch, plus or minus
2. Overall average of samples:
The compacted average thicknesses of both base course and surface course, computed by summing the individual sample thicknesses and dividing by the total number of samples, shall be no less than that specified on the drawings for each layer, respectively.

Surface Smoothness – Finished surfaces of each asphalt concrete course shall be checked for smoothness using a ten (10) foot straight edge applied parallel to and at right angles to the centerline of paved areas. Surfaces will not be acceptable if exceeding the following:

Surface Course: 3/16 inch in ten feet
Base Course: 1/4 inch in ten feet

PLACING THE MIX

The asphalt concrete mixture will be placed by a paving machine as specified, capable of spreading the mixture true to line, grade, and crown.

The mixture shall be spread at a temperature of not less than 250 degrees Fahrenheit. The desired temperature shall be set by the Engineer and shall be maintained within plus or minus 30 degrees Fahrenheit.

Hand-placing and spreading will be permitted in inaccessible and small areas.

Place each course in one or more lifts to provide a nominal compacted thickness conforming to the indicated grade, cross section, finish thickness, and density, as specified and shown on the drawings. No more than 3 1/2 inches compacted thickness shall be placed in one lift unless approved by the City based on available compaction equipment.

Continuity of Operations

It is essential to place the mixture in as continuous an operation as practicable to insure a good plant mix asphalt paving with good riding qualities and uniform density.

The paver speed will be maintained in balance with the plant production, and a sufficient number of trucks should be available to assure uniform capacity operation of the asphalt plant and pavers.

Defects caused by unnecessary stopping due to lack of coordination between mixing, hauling, and laydown shall be removed and replaced.

Paver Placing

Paving operations shall begin along the concrete gutter or low side of street and in direction of traffic flow and work toward crown from both sides of the street.

After the first truckload of the day has been spread, the loose and compacted depths shall be checked so that a ratio can be established for the correction of loose depth.

If segregation of materials should occur, the spreading operation will be stopped immediately and not resumed until the cause is determined and corrected.

Any asphalt mix which clings to the sides of the hopper shall be continually loosened and pushed into the active mix. No mix shall be retained in the hopper when there is a delay in the asphalt concrete supply.

Immediately after any course is screened, and before roller compaction is started, the surface shall be checked. Any area showing an excess or deficiency of bituminous material shall be removed and replaced, and all irregularities in alignment and grade shall be corrected by the addition or removal of mixture.

Complete base courses for a section before placing surface courses.

Hand Placing

Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperatures.

The mixture will be spread, tamped, and finished to a uniform density and to the correct depth. The surface will be checked as required under paver placing.

Joints

Carefully make joints between old and new pavements, or between successive days' work, to ensure a continuous bond between adjoining work. Saw cut existing old pavement so that an even vertical surface is exposed. Apply tack coat and butt new pavement up to saw cut edge of existing pavement.

Construct joints to have the same texture, density, and smoothness as the adjacent section of asphalt concrete course.

Clean contact surfaces, free of sand, dirt or other objectionable material and apply tack coat. Also apply tack coat to contact surfaces of old pavement joints before placing mixture against them.

Cut back edge of previously placed course to expose an even, vertical surface of full course thickness.

Offset longitudinal joints in succeeding courses not less than six (6) inches. Offset transverse joints in succeeding courses not less than twenty-four (24) inches.

When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface of full course thickness.

COMPACTING THE MIX

A minimum of two rollers will be required, and as many additional rollers as necessary shall be used to compact the asphalt mixture at the proper temperature to obtain the specified pavement density.

Begin rolling operations as soon after placing when the mixture will bear weight of roller without excessive displacement. Delays in rolling of fresh mixture shall not be tolerated.

The roller wheels shall be kept moist with only enough water to avoid picking up the material. A detergent may be added to the water, but no oil will be permitted for this purpose.

Do not permit heavy equipment, including rollers, to stand on finished surface before it has thoroughly cooled or set.

Compact mixture with hot sand tampers or vibrating plate compactors in areas inaccessible to rollers.

The lanes placed in the paving operation shall be rolled in the following order:

1. Transverse joints
2. Longitudinal joints
3. Outside edge
4. Breakdown rolling. Start rolling longitudinally at extreme lower side of sections and proceed toward the high side. Roll to slightly different lengths on alternate roller runs.
5. Intermediate rolling. Same as breakdown rolling.
6. Finish rolling.

The line of rolling should not be suddenly changed or the direction of rolling suddenly reversed, thereby displacing the mix.

If rolling causes displacement of materials, the affected areas shall be loosened at once with lutes or rakes and restored to the original grade with loose material before being re-rolled.

TESTING

Tests for conformity with the specified crown and grade shall be made by the Contractor immediately after initial compression, and any variation shall be corrected by removing or adding materials and continuing the rolling.

The finished surface shall not vary more than one-quarter (1/4) inch for the wearing course when tested with a sixteen (16) foot straight edge applied parallel with or at right angles to the centerline.

After completion of final rolling, the smoothness of the course shall again be tested, and the humps or depressions exceeding the specified tolerances or that retain water on the surface shall be immediately corrected by removing the defective work and replacing with new material or by adding additional material as directed by the City and at the expense of the Contractor.

Density Control

Conduct tests for density control during compaction operations in accordance with the requirements of ASTM D2950 – Tests for Density of Bituminous Concrete In-Place by Nuclear Methods.

Depth of Asphalt Control

Conduct tests of in-place compacted thickness to insure the required thicknesses are achieved as specified on the drawings and herein.

A minimum of one core sample for every 1200 square yards is required to measure thickness and Marshall stability and flow.

Conduct a minimum of one compaction test on bituminous pavement for every 1200 square yards at locations designated by the Engineer.

For the determination of composition, compaction and density of the pavement, the contractor shall remove suitable size samples of the completed pavement if directed by the Engineer. Samples for each day or fraction thereof when mixtures are placed may be taken by the Engineer. The Contractor shall replace the pavement where the samples are removed, and these replacements shall be installed by the contractor free of charge. After the samples have been removed from the completed pavement, they will be tested by the Engineer for density and composition. If the deficiency in composition of compaction exceeds the limits of toleration from the specified, satisfactory corrections shall be made.

DRAINAGE

Culverts shall be installed where V-ditches, gutters, and valley pans will not carry the necessary flow. Culverts shall be corrugated galvanized metal with metal end sections, unless otherwise authorized by the City. Diameter and scope shall be based on flows. Minimum diameter in roadways shall be eighteen (18) inches and minimum in driveways shall be twelve (12) inches.

CLEANING AND PROTECTION

Cleaning

After completion of paving operation, clean surface of spilled asphalt materials.

Protection

After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than six hours. Provide barricades and warning devices as required to protect pavement and the general public. Cover openings of structures in the area of paving until permanent coverings are placed.

Patching

Remove and replace defective areas. Cut out and fill with fresh, hot asphalt concrete. Compact by rolling to specified surface density and smoothness. Remove deficient areas for full depth of course. Cut sides perpendicular and parallel to direction of traffic with edges vertical. Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.

Adjusting Utility Grades

All existing manholes and valve boxes shall be adjusted to final grade by the Contractor. Where spacer rings are installed, they shall have a wide slotted flange for support and be equal to Clay Bailey #3100 or as approved by the City. If any existing manhole rings and covers or valve boxes are found to be defective, they shall be replaced as directed by the City.

FRAME ADJUSTMENTS

Set frames of subsurface structures to one-eighth (1/8) inch below final grade as a part of this work, including existing frames, and new frames furnished under other work of this project.

Placing Frames

The existing frames are to be stored while a temporary cover is used to support equipment while the paving operation is being completed to finish grade. The temporary frame is to be removed and the existing or new frames are then installed and adjusted to finish grade and slope.

The area between the frames and existing pavement is then filled with hot asphalt, concrete and compacted with the use of a hand tamper.

The same sequence is to be followed for water valve boxes, except that no temporary frames are required.

ACCEPTANCE

The Contractor shall guarantee all portions of street construction for a period of one year after completion against defective workmanship and materials and shall keep same in good order and repair. The determination of the necessity, during such guarantee period, for the Contractor to repair said street, or any portion thereof, shall rest entirely with the City's Engineer, whose decision upon the matter shall be final and obligatory upon the Contractor.