## 4.3 PIPE MATERIAL

4.3.1 The pipe and fittings on Lakehaven Utility District projects are indicated by a pipe type. Pipe types refer to the Engineer's pipe type designations. All pipe and fittings shall be new and shall conform to the specifications contained herein. Pipe class shall be as specified or as required by test requirements, whichever is greater. The Contractor will submit a certificate on each type of pipe, certifying that the pipe meets or exceeds contract specification requirements.

4.3.2 Where pipe types are specifically shown on the Contract Drawings, only those pipe types shall be installed. Where pipe types are not shown on the Contract Drawings, any of the pipe types listed below may be used at the Contractor's discretion. Bedding classifications for the alternative pipe types are shown on the standard plans or on the Contract Drawings. Only one type of pipe shall be installed between adjacent manholes or other pipeline terminal points. Alternative pipe types for side sewers and manhole drop structures are shown on the Contract Drawings.

| PIPELINE | SIZE-INCHES | ALTERNATIVE PIPE TYPES |
|---|---|---|
| Gravity Sewer | 6, 8 & 10 | GPVC; PPVC; DIP (epoxy-lined); HDPE |
| Gravity Sewer | 12 | GPVC; DIP (epoxy-lined); HDPE |
| Gravity Sewer | 15, 18 | GPVC; DIP (epoxy-lined); HDPE |
| Gravity Sewer | 21 and larger | GPVC; DIP (epoxy-lined); HDPE |

Pressure pipe for force main, 14 inches or larger in size shall be epoxy-lined ductile iron or HDPE, unless otherwise noted on the Contract Drawings or as directed by the Engineer. Pressure pipes of four (4) to twelve (12) inches in size shall be PVC pressure pipe, HDPE or polyethylene pressure pipe, unless noted otherwise on the Contract Drawings. Pressure sewer pipes of two (2) to four (4) inches shall be polyethylene, unless noted otherwise on the Contract Drawings.

4.3.3 Alternative Pipe Types

4.3.3.1 Ductile Iron Pipe (DIP)

4.3.3.1.1 Ductile iron pipe shall conform to the requirements of ANSI A21.51, thickness Class 52. Pipe shall have a standard thickness epoxy lining. Pipe and fittings shall receive a factory-applied, standard bituminous exterior coating, one (1) mil minimum thickness.

4.3.3.1.2 Joints shall be of the bell and spigot, compression ring, push-on type, utilizing a special bell designed to make a complete watertight joint using a single sewage-resistant synthetic rubber gasket. Joints, gaskets and gasket lubricant shall conform to the requirements of ANSI Standard A21.11. All ductile iron pipe shall be provided with nitrile rubber gaskets.

4.3.3.2.2.1 Joints shall meet the requirements of ASTM D-3139, using a restrained rubber gasket conforming to ASTM F-477.

4.3.3.2.2.2 Pipe manufactured greater than ten (10) months prior to actual installation will not be permitted. Pipe older than six (6) months shall be protected from exposure to ultraviolet light.

4.3.3.3 Pressure Polyvinyl Chloride Pipe (PPVC)

4.3.3.3.1 Pressure polyvinyl chloride pipe shall be rigid plasticized polyvinyl chloride pipe suitable for use as a pressure conduit for the conveyance of domestic sewage. The pipe shall be suitable for use at a maximum hydrostatic pressure of 200 psi at 73 degrees Fahrenheit. Pipe shall conform to the requirements of ASTM Designation D-2241-96, except as modified herein or as shown on the plans.

4.3.3.3.2 All pressure polyvinyl chloride pipe shall be Schedule 40 or greater.

4.3.3.3.3 The material used to produce the pipe and fittings shall be clean, virgin material conforming to the requirements of ASTM Designation D-1784, Class 12453-B.

4.3.3.3.4 Joints for pipe and fittings shall utilize sewage-resistant synthetic rubber gaskets conforming to the requirements of ASTM Designation F-477. The gaskets shall be the sole element depended upon to make the joint flexible and watertight. Provisions for expansion and contraction shall be made at each joint.

4.3.3.3.5 Pipe manufactured greater than ten (10) months prior to actual installation will not be permitted. Pipe older than six (6) months shall be protected from exposure to ultraviolet light.

4.3.3.3.6 Pipe and fittings shall be as manufactured by Johns Mansville, Certain-Teed or approved equal.

4.3.3.4 High Density Polyethylene Pipe (HDPE)

4.3.3.4.1 High Density Polyethylene gravity sewer pipe shall conform to ASTM Designation F894-85, or later revision, for polyethylene large-diameter profile wall sewer and drain pipe. Joints shall be gasketted type. The pipe resin shall conform to all requirements of ASTM D1248, Type III, Class C, Grade P34, with a PPI rating of 3408. The long-term hydrostatic strength shall be 1250 psi, and the hydrostatic design stress shall be 650 psi, as determined by ASTM D2837. Material strength and modules of elasticity shall meet the requirements of cell classification PE 345434C or higher, ASTM D3350. Minimum ring stiffness constants for various pipe diameters are shown on the "pipe schedule" provided in the Contract Drawings.

4.3.3.4.2 Prior to installation, the manufacturer shall provide written certification that the material was manufactured, sampled, tested, and inspected in accordance with ASTM F894 and found to meet all requirements. Copies of all test results shall be provided with the certification. The Engineer shall have free access to the testing and inspection areas of the manufacturer's plant.

4.3.3.4.3 Gaskets shall be rubber and molded or, if approved by the Owner, produced from an extruded shape approved by the pipe manufacturer and spliced into circular form. The gaskets shall comply with the physical requirements specified in the non-pressure requirements of ASTM Specification F-477. The lubricant used for assembly shall have no detrimental effect on the gasket or the pipe.

4.3.3.4.4 The average nominal inside diameter shall be true to the specified pipe size within ± 1/4-inch. Standard laying lengths shall be 20 feet (±2").

4.3.3.4.5 Each piece of pipe shall be clearly marked with the pipe size, class, profile number and production code.

4.3.3.4.6 The pipe shall be stored, loaded, unloaded, installed, bedded, compacted, and backfilled in complete accordance with the manufacturer's recommendations, unless otherwise specifically directed or authorized, in writing, by the Engineer.

4.3.3.4.7 A manufacturer's representative shall be on site during start-up construction for a minimum of 8 hours, for each crew utilized, to instruct work crews and ensure compliance with his/her company's installation regulations. Additionally, he/she shall remain on site for this purpose until such time that he/she feels the Contractor has demonstrated his competence in the method employed by the Contractor for this type of pipe installation.

4.3.3.4.8 The bedding material shall be compacted to a minimum 90% of the Standard Proctor Density per ASTM D-698. Mechanical compaction will be required.

4.3.3.4.9 HDPE pipe shall be white or near white in color.

4.3.3.5 Polyethylene Pressure Pipe

4.3.3.5.1 Polyethylene pressure pipe shall be high density polyethylene (HDPE) plastic pipe with fittings suitable for use as a pressure conduit. The pipe shall conform to all requirements of ASTM D148, Type III, Class C, Category 5, Grade P34, with a PPI rating of PE 3406. The pipe shall have a working pressure rating of 145 psi, SDR11 and withstand without failure a minimum burst pressure of 560 psi when applied in 60 to 70 seconds with water at 73 degrees Fahrenheit, in accordance with ASTM D1599. The long-term hydrostatic strength shall be 1450 psi and hydrostatic design stress of 730 psi, as determined by ASTM D2837. The melt index shall be less than 0.25 as determined by ASTM D1238. The environmental stress crack resistance shall allow no cracks after 1,000 hours as determined by ASTM D1693.

4.3.3.5.2 Polyethylene pressure pipe joints shall be joined by a thermal butt fusion system in accordance with the manufacturer's requirements.

## 4.4 PIPING ACCESSORIES

### 4.4.1 Flexible Couplings

Couplings for joining different pipe types shall consist of a cast iron coupling system; or of a sewage-resistant synthetic rubber or polyvinyl chloride sleeve, Type 301 or better, with stainless steel bands and a tightening mechanism designed to compress the sleeve to form a watertight and airtight seal when the joint is assembled as approved by the Engineer. Joints made using couplings shall pass the tests specified for gravity pipelines in Section 6 of these specifications. Couplings shall be as manufactured by Rockwell International, or approved equal. Couplings may only be used where proposed pipelines connect to existing pipeline stub-outs. No Fernco-type couplings shall be used on mainline pipe construction.

## 4.5 PIPE LAYING

4.5.1 All pipe utilizing bell and spigot-type joints shall be laid continuously upgrade with the bell of the pipe forward, unless specifically shown otherwise on the Contract Drawings. Each length of pipe shall be bedded firmly into granular bedding material as specified in Section 3.4 of these specifications. Each length of pipe shall have a true bearing for its entire length. A depression in the bedding material no larger than necessary to accommodate the pipe shall be excavated at each joint location. Adjustment to line and grade shall be made by scraping away, filling in and tamping the bedding material to provide true grade to fit the barrel of the pipe. No wedging or blocking up of pipe shall be permitted.

4.5.2 Both bell and spigot shall be clean before the joint is made, and care shall be taken that nothing but the joint material and lubricant enters the joint. Joints shall be made in accordance with the manufacturer's recommendations. Care shall be exercised to insure that the gasket is fully seated and that the insertion of the spigot end is complete and complies fully with the manufacturers recommendations for installation. Particular attention is called to the high coefficient of expansion of polyvinyl chloride pipe and the need to carefully observe necessary joint clearances as indicated by pipe markings.

4.5.3 After making the joint, the pipe shall be rigidly secured in place by backfilling to the top of the pipe, on each side of the pipe, at the center of the section, using bedding material or initial backfill material in accordance with the designated bedding condition. Due to the light weight of polyvinyl chloride pipe, additional care shall be taken during the initial backfilling, so as not to disturb, raise, lower or laterally move the pipe.

4.5.4 Caps for stubs shall be air-tight, compatible to the pipe joint and shall be in accordance with the pipe manufacturer's recommendation. Wood caps will not be permitted. Blocking of caps shall be

provided as required.

4.5.5. When pipe laying is not in progress, the forward end of the pipe shall be kept effectively closed with a temporary plug. Care shall be taken to prevent damage to pipe or pipe ends. Any pipe or pipe ends damaged shall be removed and discarded.

4.5.6 All pipelines shall be laid to the line and grade shown on the Contract Drawings, unless otherwise directed by the Engineer. Variance from established line and grade for gravity sewer lines shall not be greater than 1/32 of an inch per inch of pipe diameter and shall not exceed 1/2 inch; provided that such a variation does not result in a level or reverse sloping pipe invert. Variance in the invert elevation between adjoining pipe ends due to non-concentricity of joining and pipe interior surfaces shall not exceed 1/64 of an inch per inch of pipe diameter or 1/2 inch maximum; provided that such a variation does not result in a level or reverse sloping pipe invert.

4.5.7 Survey line and grade-control hubs will be provided by the Contractor for his/her use in constructing all pipelines to the proper grade and alignment as shown on the Contract Drawings. The Contractor shall transfer line and grade and control his/her work. In case the referenced methods are impractical, the Contractor may control his/her line and grade by the use of approved surveying instruments operated by qualified personnel. The Contractor shall constantly check line and grade of the pipe and, in the event they do not meet specified limits, the work shall be immediately stopped and the cause remedied before proceeding with the work.

4.5.8 Pressure sewer pipe shall be laid in accordance with the manufacturer's requirements and the line and grade shown on the Contract Drawings, unless otherwise directed by the Engineer. Mud, silt, gravel and other foreign material shall be kept out of the pipe and joining surfaces. The pipe shall be laid at uniform grade with no sag or overbends between high and low points.

4.5.8.1 The Contractor shall install a continuous ribbon of warning tape one (1) foot below the finished grade directly above the sewer force main. The warning tape used shall conform to the requirements for marker tape under Section 4.6.3. of these specifications.

4.5.8.2 Concrete thrust blocks shall be required at all force main bends, as detailed on the Contract Drawings and/or as directed by the Engineer.

## 4.6 SERVICE FITTINGS AND SIDE SEWER STUBS

4.6.1 Regardless of the locations shown on the Contract Drawings, all service fittings and side sewer stubs shall be installed at the locations directed by the Engineer. The Engineer will furnish to the Contractor the station of the service fittings and calculate the cut to the invert of the side sewer stubs at the right-of-way or easement line.

4.6.2 The known existing basement locations are indicated on the Contract Drawings. There is no guarantee that all basements are shown or that the locations shown are accurate. Where required by

the Engineer, the Contractor shall construct side sewer stubs to serve basements, whether or not their locations are shown on the Contract Drawings. Where basements are not a factor, the side sewer stubs shall be placed at a depth adequate to serve the property in question, with a preferred depth of five (5) to eight (8) feet for enhanced access. Minimum grade for side sewer stubs is 2%. Maximum grade for side sewer stubs is 200%. 4.6.3 Side sewer stubs shall be marked with plastic film marking tape. Tape shall be an inert plastic film highly resistant to alkalis, acids, or other destructive chemicals likely to be encountered in soils. Tape shall be a minimum of two (2) inches in width, brightly colored and shall bear an imprint to the effect that a sewer pipeline lies below. Tape shall have a metalized foil core to enable detection with electronic instruments.

4.6.4 Plastic marking tape shall be buried in the pipe trench, directly over the pipe, at a depth of 1-1/2 to two (2) feet. Tape shall extend the full length of the side sewer stub from the sewer main to the plugged end at the right-of-way or easement line.

4.6.5 All side sewer stubs shall be marked with a 2"X 4" wood, plastic or metal stake placed at the end of the side sewer stub. The 2"X 4" stake shall be painted with a white oil-based enamel base coat. The label "Sanitary Side Sewer" and depth to invert shall be clearly marked with black enamel paint.

## 4.7 JACKING OR AUGERING CONSTRUCTION

4.7.1 Jacking or augering beneath existing structures, across railroad rights-of-way, across highway rights of way, under stream channels or other locations indicated on the Contract Drawings or as directed by the Engineer shall be of sufficient size, height and width to permit the installation of the pipe and/or conduits, and to permit ample room for the work and safety of the workmen. The Contractor shall make his/her own determination of site conditions, local jurisdiction requirements, and shall select a construction method compatible with these conditions. Details of the methods to be employed shall be submitted to the Engineer for approval.

4.7.2 All work performed beneath existing structures, rights-of-way or stream channels shall be performed in accordance with the requirements and/or regulations of the parties or agencies having jurisdiction over these locations. The Contractor shall contact the parties or agencies prior to starting work and shall meet all requirements of the parties or agencies with regard to insurance, methods of construction, and the safety precautions to be taken in performing the jacking or augering work, and written confirmation shall be submitted to the Engineer. All costs involved in meeting these requirements shall be included in the pipeline unit price and no additional compensation will be allowed.

4.7.3 The steel casing pipe shall be of sufficient strength to meet the loading conditions. Loading for highway and pavement tunnels shall be based upon continuous load carrying structures for the height of cover under H-20 loading. Loading for railroad tunnels shall be based on continuous load carrying structures for the height of cover under Cooper E-80 loading. Voids between the ground and the casing pipe shall be pressure grouted.

# SECTION 7

# RESTORATION

## 7.1 GENERAL

This section includes provisions for the restoration of the various surfaces, which will or may be encountered during construction of a project. All surfaces disturbed in the process of executing a contract shall be restored as near as physically possible to those conditions existing prior to commencement of work, or better. For clearing of sod and other plant material and removal of pavement, refer to Section 1 of these specifications.

## 7.2 TEMPORARY SURFACING AND MAINTENANCE

The Contractor shall provide temporary surfacing for trenches in roadways that will carry traffic before the pavement is restored. Temporary surfacing shall consist of installing crushed surfacing top course material to the elevation of the top of the adjacent pavement. Crushed surfacing top course material and installation shall be as specified in Section 7.3.5 of the specifications herein. The Contractor shall be responsible for maintaining that temporary surfacing in a safe and passable condition and for dust control as specified in the Special Provisions of the Contract and as required by the Engineer.

### 7.2.1 Temporary Pavement Patching

During construction of the sewer system, the Contractor shall complete the trench backfill through intersections, as specified elsewhere within the Special Provisions, to within 0.2 of a foot below the existing pavement surface. The area(s) shall then be patched with asphalt cold-mix or asphalt concrete pavement approved by the Engineer. The Contractor shall maintain the temporary patch until such time as the pavement is restored, as defined in these specifications. The Contractor shall have adequate patching material available to insure the patch will be completed before the end of a work shift.

After the sewer pipe has been accepted, or when directed by the Engineer, the patched area(s) shall be excavated and prepared for pavement restoration. The pavement restoration shall be completed within the same day the temporary patch is removed.

"Temporary Pavement Patching" shall be used only when directed by the Engineer and for the convenience of the traveling public.

7.2.2 Dust Control. The Contractor shall provide water and/or a dust palliative and apply, as ordered by the Engineer, for the alleviation or prevention of dust nuisances. A water truck shall be assigned to the Project for full-time use; all costs of which shall be merged in the various lump sum and unit prices bid. Should the Contractor elect to utilize gravel, or any bituminous

product, as a means of providing and/or maintaining dust control, it shall be at his/her expense. Rock and bituminous products, as shown in the proposal, are intended to be utilized for roadway restoration, not for dust control.

## 7.3 PAVEMENT RESTORATION

7.3.1 All street, roadway and driveway surfacing that is removed or damaged by the Contractor's operations shall be restored by repairing or replacing the surfacing as specified herein. Unless otherwise noted in these Specifications, on the Contract Drawings, or as directed by the Engineer, bituminous, asphalt and cement concrete pavement shall be restored using the same type of material as the existing pavement, and the existing surfacing on unimproved public streets and roadways shall be replaced with gravel surfacing as specified herein. Minimum pavement thickness (net after compaction) shall be established by the agency having jurisdiction. Where such agency does not specify minimum thickness, the minimum thickness shall be two (2) inches, net after compaction. Other roadway surfaces shall be restored in a manner approved by the Engineer, using the same type of material as the existing surfacing. Particular care shall be taken to minimize damage to pavement adjacent to construction areas. During pavement restoration and after gravel base has been placed and unsuitable material removed, if subgrade surfaces are not suitable due to wet conditions or existing materials, the Contractor shall at his expense remove all unsuitable materials and fill with Gravel Base, Class B, to provide a firm and stable base just prior to placement of crushed stone and asphalt.

7.3.2 Unless otherwise noted, all valve boxes, manhole frames, catch basin gratings and other utility appurtenances located within paved areas shall be set or raised to finish grade. Utility appurtenances located in asphalt concrete pavement shall be raised to finish grade after the surfacing is completed. Cutouts shall be concentric with the appurtenance and the patch shall be as specified in Sections 7.3.4, 7.3.5, and 7.3.6 of the specifications herein. Pavement restoration details are shown on the Contract Drawings.

7.3.3 Construction surveying and staking are the responsibility of the Contractor.

7.3.4 Gravel Base

7.3.4.1 Gravel base shall consist of naturally occurring or screened gravel. It shall be essentially free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily and shall meet the following test requirements:

Stabilometer "R" Value . . . . . 72 min.
Swell pressure . . . . . 0.3 psi max.

The maximum particle size shall not exceed 2/3 of the depth of the layer being placed.

Gravel base shall meet the following requirements for gradation and quality when placed in hauling vehicles for delivery to the roadway or during manufacture and placement into a temporary stockpile. The Engineer will determine the exact point of acceptance.

| | |
|---|---|
| % Passing 1/4" square opening | 25 min. |
| % Passing No. 200 sieve | 10.0 max. |
| All percentages are by weight. | |
| Dust Ratio: $\frac{\%\text{ Passing U.S. No. 200}}{\%\text{ Passing No. 40 Sieve}}$ | 2/3 max. |
| % Sand Equivalent | 30 min. |

Gravel base material retained on a 1/4 inch square sieve shall contain not more than 0.20 percent by weight of wood waste.

7.3.4.2 Before placement of gravel base, all depressions shall be drained and filled and the fill shall be compacted as specified for trench backfill. The entire subgrade shall then be shaped to a smooth, uniform surface, reasonably true to line, grade and cross-section as approved by the Engineer.

7.3.4.3 Placement of Gravel Base

7.3.4.3.1 All equipment necessary for the satisfactory performance of this construction shall be on the project and approved by the Engineer prior to beginning work. If central mix plant methods are used, the central mixing plant shall comply with the following requirements:

The cold aggregate feeder shall be mechanically operated and adjustable to the extent necessary to provide a uniform and continuous flow of materials. These materials shall be deposited in an approved mixer, with a sufficient amount of water being added to obtain the required density when spread and compacted. The water shall be weighed or metered and dispensed through a device providing uniform dispersion across the mixer. The mixing plant shall be provided with weighting or calibrating devices, feeders, provisions for sampling and other devices and equipment so designed, coordinated, and operated as to produce a uniform mixture and to permit the sampling of the materials before and after mixing. The mixer shall be kept in good condition and mixing blades or paddles shall be of proper size, adjustment, and clearance to provide positive and uniform mixing of the entire components of the mixture at all times. The capacity of the plant and equipment furnished on the work shall be adequate at all times to provide for efficient and continuous operations insofar as practicable.

7.3.4.3.2 Mixing

Unless otherwise specified, the Contractor may use either, or both, of the following described methods:

7.3.4.3.2.1 Central Plant Mix Method.

The surfacing material and water shall be mixed in an approved mixing plant as described in Section 7.3.4.3 of these specifications. The completed mixture shall be a thoroughly mixed combination of proportioned materials and water, uniform in distribution of particle sizes and moisture content. Mixture containing water in excess of the proportion established by the Engineer will not be accepted.

7.3.4.3.2.2 Road Mix Method.

After material for each layer of surfacing has been placed, the material shall be mixed until uniform throughout by motor graders or other equipment approved by the Engineer. Water to facilitate mixing and compacting shall be added in amounts approved by the Engineer.

7.3.4.3.3 Placing and Spreading

7.3.4.3.3.1 Central Plant Mix Method.

After mixing, material for each layer of surfacing shall be transported to the roadway in approved vehicles. Vehicles for hauling the mixture shall be capable of being accurately weighed, and capable of depositing the mixture within the receiving hopper of the spreading equipment, or in windrows of reasonably uniform size in front of the spreading equipment, with a practicable minimum of segregation of the mix. A motor grader may be used as the spreading machine and shall be capable of receiving the material by direct deposit in its hopper from the hauling vehicle or from a uniform windrow, and be capable of spreading and screeding the material to a depth and surface uniformity so that when compacted it will be reasonably true to line, grade, depth of course, and cross-section without further shaping. The following nominal depth of compacted material shall not be exceeded in any one course without the approval of the Engineer.

Ballast . . . . . 0.50 foot
Gravel Base . . . . . 0.75 foot
Crushed Surfacing . . . . . 0.35 foot

7.3.4.3.3.2 Road Mix Method.

Each layer of surfacing material shall be spread by means of approved spreading equipment. Such equipment may be bottom-dump hauling equipment with either longitudinal or transverse spreading facilities; self-propelled spreading and leveling machines; or spreader boxes equipped with wheels or so constructed to preclude any damage to the subgrade or underlying courses. The combination of longitudinal and transverse spreading equipment shall not be permitted in any specific sections of a

project. The Engineer will determine the limits of a specific section. Spreading on small areas of less than 2,000 square yards or on areas irregular in shape may be accomplished by other means as approved by the Engineer. The depth of material in any course shall be as specified in Section 7.3.4.3.3.1 herein.

7.3.4.3.4 Shaping and Compaction

Except as provided in Section 7.3.4.3.3.1, final shaping of each layer prior to compaction shall be accomplished by approved equipment. Immediately following spreading and final shaping, each layer of surfacing shall be compacted to at least 95 percent of the standard density determined by WSDOT Test Method No. 606 before the next succeeding layer of surfacing or pavement is placed thereon. The determination of field in-place density shall be made by the Nuclear gauge or the Washington Densometer. When the thickness of surfacing is less than 0.15 foot, density testing will not be required and the Engineer will determine the number of coverages required for the particular compaction equipment available. Vibratory compactors and rollers shall be adequate in design and number to provide compaction and obtain the specified density for each layer while still moist. A mist spray of water shall be applied as needed to replace moisture lost by evaporation. The completed layer shall have a smooth, tight, uniform surface, reasonably true to the line, grade, and cross-section shown in the plans, or as staked by the Engineer.

7.3.4.3.5 Miscellaneous Requirements

The surface of each layer of surfacing material shall be maintained reasonably true to line, grade and cross-section by blading, watering and rolling until placing the next succeeding course. The first course of surfacing material shall be placed on all available subgrade before placing the succeeding course, unless otherwise authorized by the Engineer. Unless otherwise approved, there shall be a distance of not less than one (1) station between the construction of any two (2) courses of surfacing or ballast. When keystone is required, it shall be placed in accordance with Section 7.3.4.3.5.1 before terminating each day's operation. Should irregularities develop in any surface during or after compaction, they shall be remedied by loosening the surface and correcting the defects, after which the entire area, including the surrounding surface, shall be thoroughly recompacted. Any additional materials necessary to make the repairs shall be furnished by the Contractor at the unit contract price.

7.3.4.3.5.1 Keystone

When necessary, as determined by the Engineer, crushed surfacing top course shall be used for keystone to key the top surface of ballast, gravel base, crushed surfacing base course or any other surfacing course which requires keying. The keystone shall be spread evenly on top of the surfacing course requiring it, in the amount ordered by the Engineer, by means of approved spreading equipment. The surface shall be watered and, if necessary, bladed lightly until the keystone is worked into the interstices of the surfacing course, without excessive displacement, and shall be compacted. The operations of adding keystone, wetting, blading and compacting shall be continued until the course has become thoroughly keyed and compacted.

7.3.4.3.6 Weather Limitations

When, in the opinion of the Engineer, the weather is such that satisfactory results cannot be obtained, the Contractor shall suspend operations until the weather is favorable. No surfacing materials shall be placed in snow or on a soft, muddy or frozen subgrade.

7.3.4.3.7 Hauling

Hauling equipment shall be routed over the roadway in such a manner as to be most effective in the compacting of the surfacing. Hauling over any of the surfacing in the process of construction will not be permitted when, in the opinion of the Engineer, the effect will be detrimental. All loads shall be of uniform capacity, unless deviation is expressly authorized by the Engineer, and shall comply with the permissible weight hauling requirements of the affected public agencies.

7.3.4.3.8 Hours of Work

Normally, the Contractor shall so arrange his/her surfacing operations that the placing of materials will be accomplished during daylight hours. However, when necessary to complete the project within the time specified, or to avoid peak periods of public traffic, work may be undertaken during the hours of darkness, provided the Contractor furnishes and operates adequate lighting apparatus to ensure that all work undertaken can be carried on satisfactorily in the manner contemplated by these specifications. Normal hours of operation shall be in accordance with the requirements of the local jurisdiction, unless otherwise approved by the Engineer. Inability to demonstrate reliable and satisfactory results will be reason to order termination of night operations, and the Contractor shall procure additional equipment and personnel as may be necessary to satisfactorily complete the work as specified while operating during daylight hours only.

7.3.4.3.9 Moisture Content

All gravel base material shall be placed at the moisture content required to produce the specified density and shall be compacted to a relative density of 95 percent of the optimum density determined by AASHTO Designation T-180.

7.3.5 Crushed Surfacing Top Course

7.3.5.1 Crushed surfacing shall be manufactured from ledge rock, talus, or gravel. The materials shall be uniform in quality and substantially free from wood, roots, bark, and other extraneous material and shall meet the following test requirements:

| | |
|---|---|
| Los Angeles Wear, 500 Rev. | 35% Maximum |
| | |

| FINE AGGREGATE | |
|---|---|
| **Class of Asphalt Concrete** | **" B "** |
| **Size Designation** | **1/4"-0** |
| % Passing 1/2" Square opening | - |
| % Passing 3/8" Square opening | 100 |
| % Passing 1/4" Square opening | 85-100 |
| % Passing U.S. No. 4 Sieve | - |
| % Passing U.S. No. 8 Sieve | - |
| % Passing U.S. No. 10 Sieve | 50-70 |
| % Passing U.S. No. 40 Sieve | 18-36 |
| % Passing U.S. No. 80 Sieve | 10-22 |
| % Passing U.S. No. 200 Sieve | 5.0-9.0 |

Coarse and fine aggregate shall be proportioned in the following approximate ratios for Class B asphalt concrete:

| CLASS OF ASPHALT CONCRETE "B" | |
|---|---|
| % Coarse Aggregate | Min. 35 |
| % Fine Aggregate | Min. 65 |
| All percentages by weight | |

7.3.6.2.5 Gradation-Immediate Use

The Contractor may furnish aggregates for use on the same Contract from a single stockpile or from multiple stockpiles. The gradation of the aggregates may differ from the sizes specified in Section 7.3.6.2.4 of these specifications, provided that the completed mixture complies in all respects with the pertinent requirements of 7.3.6.2.3 of these specifications. Acceptance of the aggregate gradation shall be based on samples taken from the final mix.

Aggregate grading within the above ranges shall be such that there will be a minimum of two (2) percent of the total aggregate retained between any successive pair of sieves finer than the U.S. No. 10. The grading shall be of such uniformity that the fractions of aggregate passing the 1/4 inch and U.S. No. 10 sieves during the day's run will conform to the following limitations:

| | |
|---|---|
| Maximum variation in percentage of material passing 1/4" sieve | 10 |
| Maximum variation in percentage of material passing U.S. No. 10 sieve | 8 |

7.3.6.2.4 Gradation - Future Use

When produced for future work on other contracts, aggregate for Class B asphalt concrete, shall be furnished and stockpiled separately in the following applicable sizes: 1 1/4 inch to 1/4 inch, 3/4 inch to 1/4 inch, 5/8 inch to 1/4 inch, and 1/4 inch to 0. The aggregates produced shall meet the grading requirements set forth in the table below. Acceptance of the aggregate shall be based on gradation tests at the time of stockpiling.

| **COARSE AGGREGATE** | |
|---|---|
| **Class of Asphalt Concrete** | **" B "** |
| **Size Designation** | **5/8"-1/4"** |
| % Passing 1 1/4" Square opening | - |
| % Passing 1" Square opening | - |
| % Passing 3/4" Square opening | - |
| % Passing 5/8" Square opening | 100 |
| % Passing 1/2 Square opening | 72-100 |
| % Passing 3/8" Square opening | 28-72 |
| % Passing 1/4" Square opening | 0-28 |
| % Passing U.S. No. 10 sieve | 0-2 |
| All percentages by weight | |

7.3.6.2.3 Proportions of Materials

The materials of which asphalt concrete is composed shall be of such sizes, grading, and quantities that, when proportioned and mixed together, they will produce a well graded mixture within the requirements listed in the table that follows.

For the determination of a Project Mix Design, the Contractor shall submit, to the Engineer, representative samples of the various aggregates to be used, along with gradation data showing the stockpile averages and variation of the aggregates as produced together with proposed combining ratios and average gradation of the completed mix. The initial asphalt content shall be determined by the Engineer from the aggregates and data provided.

The percentages of aggregate include mineral filler, when used, refer to the completed dry mix. The percentage of asphalt refers to the complete asphalt concrete mixture. All percentages are by weight.

| **GRADING AND ASPHALT REQUIREMENTS Percentages by Weight Passing Sieves** | |
|---|---|
| **CLASS B** | |
| 1-1/4" sieve (square opening) | - |
| 1" sieve (square opening) | - |
| 3/4" sieve (square opening) | - |
| 5/8" sieve (square opening) | 100 |
| 1/2" sieve (square opening) | 90-100 |
| 3/8" sieve (square opening) | 75-90 |
| 1/" sieve (square opening) | 55-75 |
| U.S. No. 4 sieve | - |
| U.S. No. 8 sieve | - |
| U.S No. 10 sieve | 32-48 |
| U.S. No. 40 sieve | 11-24 |
| U.S. No. 80 sieve | 6-15 |
| U.S. No. 200 sieve | 3.0-7.0 |
| Mineral Filler | 0.2 |
| Asphalt % of total mixture | 4.0-7.5 |
| Sand-Silt Ratio | 5.5-10.5 |

| | | |
|---|---|---|
| Modified Lottman Stripping Test | | Pass |

following test requirements:

| | |
|---|---|
| Los Angeles Wear, 500 Rev. | 30% Max. |
| Degradation Factor - Wearing Course | 30% Min. |
| Degradation Factor - Other Courses | 20% Min. |

It shall be uniform in quality, substantially free from wood, roots, bark, extraneous materials, and adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be considered as coating, unless it exists on more than 50 percent of the surface area of any size between consecutive laboratory sieves. Mineral aggregate removed from deposits contaminated with various types of wood waste shall be washed, processed, selected, or otherwise treated to remove sufficient wood waste so that the oven-dried material retained on a 1/4-inch square sieve shall not contain more than 0.1 percent by weight of material with a specific gravity less than 1.0.

7.3.6.2.2 Test Requirements

Aggregate for asphalt concrete shall meet the following test requirements:

| **CLASS OF ASPHALT CONCRETE "B"** | | |
|---|---|---|
| Fracture, by weight | % Min. | 75 |
| Sand Equivalent | Min. | 45 |

When material is being produced and stockpiled for use on a specific contract or for a future contract, the fracture and sand equivalent requirements shall apply at the time of stockpiling. When material is used from a stockpile that has not been tested as provided above, the requirements for fracture and sand equivalents shall apply at the time of its introduction to the cold feed of the mixing plant. The properties of the aggregate in a preliminary mix design for asphalt concrete shall be such that when it is combined within the limits set forth in Section 7.3.6.2.3 of these specifications and mixed in the laboratory with the designated grade of asphalt, mixtures with the following test values can be produced:

| **CLASS OF ASPHALT CONCRETE "B"** | | |
|---|---|---|
| Stabilometer Value | Min. | 35 |
| Cohesiometer Value | Min. | 100 |
| % Air Voids | | 2-4.5 |
| | | |

Crushed surfacing of the various classes shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The Engineer will determine the exact point of acceptance.

| | **BASE COURSE** | **TOP COURSE AND KEYSTONE** |
|---|---|---|
| % Passing 1 1/4" square sieve | 100 | |
| % Passing 5/8" square sieve | 50 to 80 | 95 to 100 |
| % Passing 1/4" square sieve | 30 to 50 | 30 to 65 |
| % Passing U.S. No. 40 sieve | 3 to 18 | 8 to 24 |
| % Passing U.S. No. 200 sieve | 7.5 max | 7.5 max. |
| % Fracture | 50 min. | 50 min. |
| All percentages are by weight | | |
| % Sand equivalent | 40 min. | 40 min. |

The fracture requirement shall be at least one mechanically fractured face and will apply to material retained on each sieve size No. 10 and above, if that sieve retains more than five (5) percent of the total sample. The portion of crushed surfacing retained on a 1/4-inch square sieve shall not contain more than 0.15 percent wood waste.

7.3.5.2 Placement of crushed surfacing top course shall be as specified in Section 7.3.4 herein for the placement of gravel base.

7.3.6 Asphalt Concrete Pavement

7.3.6.1 The restoration of asphalt concrete pavement shall be accomplished by patching the trench area as shown on the Contract Drawings for pavement restoration sections for asphalt concrete. The patch shall conform to the grade existing prior to construction and shall provide a smooth, continuous restoration of the pavement surface.

7.3.6.2 Aggregates for Asphalt Concrete

7.3.6.2.1 General Requirements

Aggregates for asphalt concrete shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of these specifications. The material from which they are produced shall meet the

| | |
|---|---|
| Degradation Factor - Top Course | 25% Minimum |
| Degradation Factor - Base Course | 15% Minimum |