

#### 17-6.4.4 Channels and Conduits

- a) General — Except as otherwise specified, the periods of time set forth herein are based on the use of Types II, III, IV or V portland cement.
- b) Forms Removal — Forms for open channels and forms and shoring for box sections and arch sections of sewers and storm drains may be removed as follows:
  - 1) Forms for open channel walls—16 hours.
  - 2) Outside forms of box sections and inside wall forms of box sections which do not support the slab forms—16 hours.
  - 3) Arch sections in open cut—12 hours.
  - 4) Slab forms for box sections—
    - (a) Type II cement—48 hours or 6 hours per foot (20 hours/m) of span between supports, whichever is greater.
    - (b) Type III cement—24 hours or 3 hours per foot (10 hours/m) of span between supports, whichever is greater.
    - (c) Type V cement—56 hours or 7 hours per foot (23 hours/m) of span between supports, whichever is greater.

#### 17-6.5 Falsework

17-6.5.1 General — The Contractor shall submit detailed plans of the falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, and typical soil conditions.

Falsework may be bolted or spiked at the option of the Contractor, but the use of bolts and spikes shall not be combined in the same connection. The allowable spacings and connection values of bolts and spikes shall be in accordance with the National Design Specifications for Stress-Grade Lumber and its Fastenings as recommended by National Lumber Manufacturers Association, except that an additional allowance of 25 percent for temporary use shall be added to the connection values for bolts and spikes.

Ends of columns bearing on wedges shall be tied in both directions by girts.

## **17-6.6 Placing Reinforcement**

**17-6.6.1 General** — Except for minor structures, driveways and sidewalk construction, the Contractor shall submit a reinforcing steel placing plan for approval.

Reinforcing bars shall be placed in accordance with the size and spacing shown on the plans. Reinforcing bars shall be firmly and securely held in position in accordance with the “*Manual of Standard Practice*” of the Concrete Reinforcing Steel Institute, using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Metal chairs which extend to the surface of the concrete (except where shown on the Plans) and wooden supports, shall not be used. Tack welding on reinforcing bars will not be permitted.

Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing in the form, all reinforcing steel shall be cleaned thoroughly of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

Bar spacing is center to center of bars. Bar cover is clear distance between surface of bar and face of concrete and shall be 2 inches (50mm) unless otherwise noted on the Plans. Reinforcement shall terminate 2 inches (50mm) from concrete surfaces and expansion joints, unless otherwise noted on the Plans.

Reinforcement used in post-tensioned concrete shall be adjusted or relocated during the installation of prestressing products or tendons, as required to provide planned clearances to the prestressing tendons, anchorages, jacks and equipment, as approved by the Engineer.

**17-6.6.2 Splicing** — Splices of bars shall be made only where shown on the Plans or as approved by the Engineer. Where bars are spliced, they shall be lapped at least 30 diameters, unless otherwise shown on the Plans.

Splicing shall be accomplished by placing the bars in contact with each other and wiring them together.

Welding of reinforcing steel will not be permitted unless specifically authorized by the Engineer.

**17-6.6.3 Bending Reinforcement** — Bends and hooks in bars shall be made in the manner prescribed in the “*Manual of Standard Practice*” of the Concrete

Reinforcing Steel Institute.

Bars shall not be bent or straightened in a manner which will injure the material. Bars with kinds or unspecified bends shall not be used.

17-6.6.4 Welded Wire Fabric — Welded wire fabric shall be spliced not less than two meshes. It shall be lifted carefully into its specified position after the concrete is placed but still plastic.

### 17-6.7 Placing Concrete

17-6.7.1 General — Concrete shall be conveyed, deposited, and consolidated by any method which will preclude the segregation or loss of ingredients. Equipment used in conveying and depositing concrete shall not have any aluminum component in direct contact with the concrete.

All surfaces against which concrete is to be placed shall be thoroughly moistened with water immediately before placing concrete. All ponded and excess water shall be removed to leave surfaces moist but not flooded.

Chute used in conveying concrete shall be sloped to permit concrete of the consistency required to flow without segregation. Where necessary to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

Where a sequence for placing concrete is shown on the Plans, no deviation will be permitted unless approved in writing by the Engineer.

17-6.7.2 Grouting — Where concrete is to be deposited against hardened concrete at horizontal construction joints, placing operations shall begin by conveying a grout mixture through the placing system and equipment and depositing the mixture on the joint. The grout mixture shall consist of a modification of the concrete specified to reduce the quantity of coarse aggregate in the mix larger than pea-gravel size to one-half the quantity specified.

17-6.7.3 Depositing — To avoid segregation, concrete shall be deposited as near to its final position as is practicable. The use of vibrators for extensive shifting of the mass of concrete will not be permitted. Concrete that has partially hardened, has been retempered, or is contaminated by foreign materials shall not be deposited in the structure.

Concrete shall be placed in horizontal layers insofar as practical. Placing shall start at the low point and proceed up grade unless otherwise permitted by the Engineer. Concrete shall be placed in a continuous operation between

construction joints and shall be terminated with square ends and level tops unless otherwise shown on the Plans.

Concrete shall not be permitted to fall more than 6 feet (1.8m) without the use of pipes or tremies. Pipes and tremies shall be at least 6 inches (150mm) in diameter, or the equivalent cross-sectional area for rectangular sections. Concrete shall not be placed in horizontal members or sections until the concrete in the supporting vertical members of sections has been consolidated and a 2-hour period has elapsed to permit shrinkage to occur.

17-6.7.4 Consolidating — Concrete shall be thoroughly consolidated in a manner that will encase the reinforcement and inserts, fill the forms, and produce a surface of uniform texture free of rock pockets and excessive voids.

Structural concrete, except slope paving such as spillway aprons and channel lining, and concrete placed under water, shall be consolidated by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The location, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without separation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Internal vibrators shall not be held against the forms or reinforcing steel.

The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it has been deposited in the forms. At least two vibrators in good operating condition shall be available at the site of the structure in which more than 25 cubic yards (19m<sup>3</sup>) of concrete is to be placed.

Approved external vibrators for consolidating concrete will be permitted when the concrete is not accessible to internal vibration. Forms and falsework shall be designed and constructed to resist displacement or damage from external vibration.

17-6.7.5 Walkways — Walkways and platforms shall be provided for personnel and equipment at a level convenient for the concrete placement and to permit the performance of all operations necessary for the completion of such work including finishing.

Where bridge decks are to be constructed to final roadway grade, walkways shall be provided outside the deck area along each side and for the full length of the structure. These walkways shall be of sufficient width and so constructed as to provide for the support of the bridges from which the longitudinal floats specified are to be operated.

17-6.7.6 Joints — The work shall be so prosecuted that construction joints will occur at designated places shown on the Plans unless otherwise authorized by the Engineer. The Contractor shall construct, in one continuous concrete placing operation, all work comprised between such joints. Joints shall be kept moist until adjacent concrete is placed.

All construction joints having a keyed, stepped, or roughened surface shall be cleaned by sandblasting prior to placement of the adjacent concrete, unless otherwise directed by the Engineer. Any quality of sand may be used which will accomplish the desired results.

The sandblasting operations shall be continued until all unsatisfactory concrete, laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed thoroughly to remove all loose material. The method used in disposing of wastewater employed in washing the concrete surfaces shall be such that the wastewater will not stain, discolor, or affect exposed surfaces of the structures, and will be subject to the approval of the Engineer.

Expansion and contraction joints in concrete structures shall be formed where shown on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the Plans.

No direct payment will be made for furnishing and placing asphalt paint, premolded asphalt filler, or other types of joint separators. The cost therefor shall be included in the price bid for the item of work of which they are a part.

#### 17-6.7.7 Application of Joint Sealants

- a) General — All joint sealants shall conform to the general requirements for application and special requirements for each specific material shown below. Prior to sealing joints containing waterstops, the expansion joint filler, hardboard, concrete spillage, and all foreign material shall be removed from the deck joint down to a depth of the waterstops. All such material shall be removed from the entire depth of joints in curbs, sidewalks, railings, and the overhanging portion of deck slabs. Immediately before applying the joint sealant, the joint shall be thoroughly cleaned by abrasive blasting or other approved means to remove all mortar, laitance, scale, dirt, dust, oil, curing compounds and other foreign material. The joints shall be blown out with high pressure compressed air to remove all residue.

If sealant is shown in the sidewalk, saw-cutting of grooves at concrete railing locations shall be completed prior to constructing the railings. Joint

seal material shall be protected during the construction of the railing.

At the time of applying the joint sealant, the joint shall be surface dry, and acceptable to the Engineer. No sealant shall be placed during unsuitable weather or when the atmospheric temperature is below 50°F (10°C), or when weather conditions indicate that the temperature may fall below 32°F (0°C) within 24 hours.

The joint shall be filled from the bottom to the top without formation of voids. The top of the finished joint seal shall be between ¼ inch and ¾ inch (6 and 10mm) below the finished surface.

All adjoining surfaces shall be carefully protected during the joint sealing operations, and any stains, marks or damage thereto, as a result of the Contractor's operations, shall be corrected in a manner satisfactory to the Engineer.

17-6.7.8 Placing Concrete Under Adverse Weather Conditions — Concrete for structures shall not be placed on frozen ground nor shall it be mixed or placed while the atmospheric temperature is below 35°F (2°C), unless adequate means are employed to heat the aggregates and water, and satisfactory provisions have been made for protecting the work.

Concrete slabs shall not be placed on frozen ground, nor shall concrete be mixed or placed when the atmospheric temperature is below 35°F (2°C), or when conditions indicate that the temperature may fall to 35°F (2°C) within 24 hours, except with the written permission of the Engineer and only after such precautionary measures for the protection of the pavement have been taken as the Engineer may direct.

Concrete shall be effectively protected from freezing or frost for a period of 5 days after placing.

Concrete for structures shall not be mixed or placed while the atmospheric temperature is above 115°F (46°C) unless adequate means are employed to cool the aggregate and water and satisfactory provisions have been made for protecting the work. In any case, the temperature of the concrete as placed shall not exceed 90°F (32°C).

Concrete placement shall be stopped when rainfall is sufficient to cause damage to the work.

#### 17-6.8 Surface Finishes

(a) General — The classes of surface finish described herein shall be applied

to various parts of concrete structures as specific in the Special Provisions, and herein.

The invert of cast-in-place sewers and sewer structures shall be given a steel trowel finish. The invert in circular conduit is defined as the unlined portion of lined conduit or the bottom 60 degrees of circumference of the inside of unlined conduit. Unless otherwise specified, the invert of cast-in-place storm drains shall be given a wood-float finish.

**(b) Ordinary Surface Finish** — Immediately after the forms have been removed, all exterior form bolts shall be removed to a depth of at least 1 inch (25mm) inside the surface of the concrete and the resulting holes or depressions cleaned and filled with mortar, except on the interior surfaces of box girders the bolts may be removed flush with the surface of the concrete. Mortar shall be Class “C.” White cement shall be added to the mortar in an amount sufficient to tint the mortar a shade lighter than the concrete to be repaired. Mortar shall be mixed approximately 45 minutes in advance of use. Care shall be exercised to obtain a good bond with the concrete. After the mortar has thoroughly hardened, the surface shall be rubbed with a carborundum stone in order to obtain the same color in the mortar as in the surrounding concrete. All fins caused by form joints, and other projections shall be removed and all pockets cleaned and filled. Mortar for filling pockets shall be treated as specified for bolt holes.

Ordinary surface finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher-class finish. On surfaces which are to be buried underground or surfaces which are completely enclosed (such as the cells of box girders), the removal of fins and form marks and the rubbing of a mortared surface to a uniform color will not be required. Ordinary surface finish, unless otherwise specified, shall be considered as a final finish on the following surfaces:

- 1) The undersurface of slab spans, box girders, filled-spandrel arch spans and floor slabs between T-girders of superstructures except for grade-separation structures.
- 2) The exposed surfaces of channel walls and the inside vertical surface of T-girders of superstructures except for grade-separation structures.
- 3) Surfaces which are to be buried underground, covered with fill, or for surfaces of culverts above finish grade which are not visible from the traveled way.
- 4) Top surfaces which are to be buried underground shall be struck off and given a float finish.

**17-6.9 Curing** — As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall either be sprinkled with water, covered with plastic sheet, or covered with earth, sand or burlap, or when not required to be painted, sprayed with Type 1 curing compound conforming with Subsection 17-4.1.

When an impervious membrane (curing compound) is used, it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely cover and seal all exposed surfaces of the concrete with a uniform film. The membrane shall not be applied to any surface until all of the finishing operations have been completed; such surface being kept damp, until the membrane is applied. All surfaces on which a bond is required, such as construction joint, shear planes, reinforcing steel, and the like, shall be adequately covered and protected before starting the application of the curing compound in order to prevent any of the compound from being deposited thereon; and any such surface with which the compound may have come in contact shall immediately thereafter be cleaned. Care shall be exercised to prevent any damage to the membrane seal during the curing period. Should the seal be damaged before the expiration of 10 days after the placing of the concrete, additional impervious membrane shall be immediately applied over the damaged area.

Should any forms be removed sooner than 10 days after the placing of the concrete, the surface so exposed shall either be immediately sprayed with a coating of the curing compound, or kept continuously wet by the use of burlap or other suitable means until such concrete has cured for at least 10 days.

When tops of walls are cured by the curing compound method, the side forms, except for metal forms, must be kept continuously wet for the 10 days following the placing of the concrete.

If there is any likelihood of the fresh concrete checking or cracking prior to the commencement of the curing operations (due to weather conditions, materials used, or for any other reason), it shall be kept damp, but not wet, by means of an indirect fine spray of water until it is not likely that checking or cracking will occur, or until the curing operations are started in the area affected.

**17-6.10 Payment** — Payment for concrete structures will be made in conformity with the terms of the Contract and will be based on unit prices or lump sums as set forth in the Bid. When payment is provided for on a lump sum basis, such payment shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work required to construct the structure in conformity with the Plans and Specifications.

Where concrete is scheduled for payment on the basis of cubic yards ( $m^3$ ), the



calculation of the quantity of concrete for payment will be made only to the neat line of the structures as shown on the Plans and on the basis of the concrete having the specified dimensions. However, all concrete shall be placed to line and grade within such tolerances, as determined by the Engineer, are reasonable and acceptable for the type of work involved. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, or metal inserts or openings 6 square feet (0.5m<sup>2</sup>) or less in area. The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be included in the item of work of which said mortar is a part.

The quantity of reinforcing steel, when scheduled as a separate item, will be calculated for payment on the basis of the number of each type bar actually placed in accordance with the Plans and approved changes. The weight will be calculated using the actual lengths of bars placed and the unit weights per linear foot (m) specified in ASTM A 615, A 616, and A 617.

Steel for laps indicated on the Plans, or required by the Engineer, will be paid for at the Contract Unit Price. No payment will be made for reinforcing steel in laps (whether specified or optional) which are not used, and payment will not be made for additional steel in laps which are requested by the Contractor for its convenience, or for steel used in chairs or other devices for supporting the required reinforcement. The cost of tie wire shall be included in the unit price bid.

Payment for longitudinal steel reinforcement will be made on the basis that the longest standard mill lengths will be placed; and not more than one lap will be paid for between two consecutive construction joints, unless otherwise authorized by the Engineer. The standard mill length for bar sizes No. 4 and larger is specified as 60 feet (18m).

when optional longitudinal construction joints are indicated on the Plans or specified, the Contractor will be permitted to lap the transverse reinforcing steel at said joints and the reinforcing steel used in such laps will be paid for at the Contract Unit Price.

## **17-7 Concrete Curbs, Walks, Gutters, Cross Gutters, Access Ramps and Driveways**

**17-7.1 General** — Concrete curbs, walks, gutters, cross gutters, access ramps and driveways shall be constructed of portland cement concrete of the class and other requirements prescribed in Subsection 17-1.1.2. The finish coat to be applied to

curbs shall consist of Class “B” mortar prepared as prescribed in Subsection 17-5.

Unless otherwise specified on the Plans, the minimum thickness of walks shall be 4 inches. The minimum thickness of gutters, cross gutters, alley intersections, access ramps and driveway aprons shall be 6 inches (150mm).

**17-7.2 Drainage Outlets Through Curb** — Where existing building drains occur along the line of work, the new curb shall be suitably sleeved to provide for such drains. Similar sleeves shall be installed to serve low areas on adjacent property where drainage has been affected by the work.

The location and size of the sleeves and construction of connecting sidewalk drains shall be in accordance with the Plans.

**17-7.3 Driveway Entrances** — Driveway entrances shall be provided in new curb at all existing driveways along the line of the work, at locations shown on the plans, and at such other locations as may be designated by the Engineer.

The fully depressed curb opening at driveway entrances shall be 1 inch (25mm) above gutter flowline at the curb face. The top of the fully depressed portion of the curb shall be finished to a transverse slope toward the gutter of  $\frac{3}{4}$  inch (20mm).

Where walk is to be constructed across driveways to commercial establishments, the thickness thereof shall be 6 inches (150mm) unless otherwise specified or indicated on the plans. At residential driveways, the thickness of the walk will be 6 inches (150mm) unless otherwise specified.

**17-7.4 Forms** — Form material shall be free from warp, with smooth and straight upper edges, and if used for the face of curb, shall be surfaced on the side against which the concrete is to be placed. Wooden forms for straight work shall have a net thickness of at least  $1\frac{1}{2}$  inches (40mm). Metal forms for such a work shall be of a gage that will provide equivalent rigidity and strength. Curb face forms used on monolithic curb and gutter construction shall be of a single plank width when the curb face is 10 inches (250mm) or less, except for those used on curb returns. All forms used on curb returns shall be not less than  $\frac{3}{4}$  inch (20mm) in thickness, cut in the length and radius as shown on the plans, and held rigidly in place by the use of metal stakes and clamps. The curb face form shall be cut to conform exactly with the curb face batter as well as being cut to the required length and radius. Forms shall be of sufficient rigidity and strength, and shall be so supported, as to adequately resist springing or deflection from placing and tamping the concrete.

Form material shall be clean at the time it is used; and shall be given a coating of light oil, or other equally suitable material, immediately prior to the placing of

the concrete.

All forms except back planks of curb shall be set with the upper edges flush with the specified grade of the finished surface of the improvement to be constructed, and all forms shall be not less than a depth equivalent to the full specified thickness of the concrete to be placed.

Back forms shall be held securely in place by means of stakes driven in pairs at intervals not to exceed 4 feet (1.2m), one at the front form and one at the back. Clamps, spreaders, and braces shall be used to such extent as may be necessary to ensure proper form rigidity. Forms for walk, gutter, and similar work shall be firmly secured by means of stakes driven flush with the upper edge of the form at intervals not to exceed 5 feet (1.5m). Form stakes shall be of sufficient size and be driven so as to adequately resist lateral displacement.

Commercial form clamps for the curb and gutter may be used provided they fulfill the requirements specified herein.

**17-7.5 Placing Concrete** — Concrete shall be placed on a subgrade sufficiently dampened to ensure that no moisture will be absorbed from the fresh concrete.

Concrete shall be placed in curb, gutter, and curb and gutter forms in horizontal layers not exceeding 6 inches (150mm) in thickness, each layer being spaded along the forms and thoroughly tamped. Concrete may be placed in layers of more than 6 inches (150mm) in thickness only when authorized by the Engineer and the spading and tamping is sufficient to consolidate the concrete for its entire depth.

After the concrete for walk has been placed, a strikeoff shall be used to bring the surface to the proper elevation when compacted. It shall be spaded along the form faces and tamped to assure a dense and compact mass, and to force the larger aggregate down while bringing to the surface not less than  $\frac{3}{8}$  inch (10mm) of the free mortar for finishing purposes.

Concrete shall be placed in cross gutters in horizontal layers of not more than 4 inches (100mm) in thickness, each layer being spaded along the form faces and thoroughly tamped into a dense and compact mass. If internal vibrators are used, the full specified thickness may be placed in one operation.

After the concrete has been placed and tamped, the upper surface shall be struck off to the specified grade.

#### **17-7.6 Joints**

(a) **General** — Joints in concrete curb, gutter, and walk shall be designated as expansion joints and weakened plane joints. When replacing sidewalk

adjacent to existing sidewalk with varying joints and score lines, new joints and score line shall be placed to provide a reasonable resemblance to the existing patterns. A weakened plane joint shall be placed at all locations where utility boxes and other similar structures are located.

(b) Expansion Joints — Expansion and weakened plane joints shall be constructed in curb, walk and gutter as shown on the Plans or as specified herein. No such joints shall be constructed in cross gutters, alley intersections, access ramps or driveways except as may be approved by the Engineer.

One-quarter-inch (6mm) joints shall be constructed in curb and gutter at the end of all returns except where cross gutter transitions extend beyond the curb return, in which case they shall be placed at the ends of the cross gutter transition. No joints shall be constructed in returns. Where monolithic curb and gutter is constructed adjacent to concrete pavement, no expansion joints will be required except at EC and BC of curb returns.

One-quarter-inch (6mm) joints shall be constructed in walk returns between the walk and the back of curb returns when required by the Engineer. At the EC and BC and around utility poles, the joint filler-strips shall extend the full depth of the concrete being placed. Joint filler-strips between walk and curb shall be the depth of the walk plus 1 inch (25mm) with the top set flush with the specified grade of the top of curb.

All expansion joint filler strips shall be installed vertically, and shall extend to the full depth and width of the work in which they are installed, and be constructed perpendicular to straight curb or radially to the line of the curb constructed on a curve. Expansion joint filler materials shall completely fill the joints to within  $\frac{1}{4}$  inch (6mm) of any surface of the concrete. Excess filler material shall be trimmed off to the specified dimension in a neat and workmanlike manner. During the placing and tamping of the concrete, the filler strip shall be held rigidly and securely in proper position.

(c) Weakened Plane Joints

(1) General — Weakened plane joints shall be straight and constructed in accordance with Subsections (2) or (3) below, unless otherwise shown on the Plans.

In walk, joints shall be transverse to the line of work and at regular intervals not exceeding 10 feet (3m). At curves and walk returns, the joints shall be radial.

In gutter, including gutter integral with curb, joints shall be at regular intervals not exceeding 20 feet (6m). Where integral curb and gutter is

adjacent to concrete pavement, the joints shall be aligned with the pavement joints where practical.

(2) Control Joint — After preliminary trowelling, the concrete shall be parted to a depth of 2 inches (50mm) with a straightedge to create a division in the coarse aggregate. The concrete shall then be refloated to fill the parted joint with mortar. Headers shall be marked to locate the weakened plane for final joint finishing, which shall be accomplished with a jointer tool having a depth of ½ inch (13mm) and a radius of ⅛ inch (3mm). The finished joint opening shall not be wider than ⅛ inch (3mm).

(3) Plastic Control Joint (Score Line) — The joint material shall be a T-shaped plastic strip at least 1-inch (25mm) deep, having suitable anchorage to prevent vertical movement, and having a removable stiffener with a width of at least ¾ inch (20mm). After preliminary trowelling, the concrete shall be parted to a depth of 2 inches (50mm) with a straightedge. The plastic strip shall be inserted in the impression so that the upper surface of the removable stiffener is flush with the concrete. After floating the concrete to fill all adjacent voids, the removable stiffener shall be stripped. During final trowelling, the edges shall be finished to a radius of ⅛ inch (3mm), using a slit jointer tool.

#### 17-7.7 Finishing

(a) General — Finishing shall be completed as specified herein for the type work being performed.

(b) Curb — The front forms may be stripped as soon as the concrete has set sufficient. Class “B” mortar, as prescribed in Subsection 17-5 and thinned to the consistency of grout, shall be immediately applied to the top and face of the curb if needed. If monolithic curb and gutter is being constructed, this mortar shall be applied to the full exposed curb face; otherwise, it shall extend 2 inches (50mm) below the gutter surface.

The face and top of the curb shall then be carefully trowelled to a smooth and even finish; the top being finished to a transverse slope of ¼ inch (6mm) toward the gutter, with both edges rounded to a radius of ½ inch (13mm). The trowelled surface shall be finished with a fine-hair broom applied parallel with the line of the work. The edge of the concrete at all expansion joints shall be rounded to a ¼-inch (6mm) radius. The surface of the work shall be finished as prescribed; after which the name of the Contractor, together with the year in which the improvement is constructed, shall be stamped therein to a depth of ¼ inch (6mm) in letters not less than ¾ inch (20mm) high, at BC and EC of curb returns.

Joints shall conform to Subsection 17-7.6.

(c) Walk — The forms shall be set to place the finished surface in a plane sloping up from the top of curb 2 percent when measured at right angles to the curb.

Following placing, the concrete shall be screened to the required grade, tamped to consolidate the concrete and to bring a thin layer of mortar to the surface, and floated to a smooth, flat uniform surface. The concrete shall then be edged at all headers, given a preliminary trowelling and provided with weakened plane joints.

Walk shall be steel trowelled to a smooth and even finish. All formed edges shall be rounded to a radius of ½ inch (13mm). Edges at expansion joints shall be rounded to a radius of ⅛ inch (3mm). Preliminary trowelling may be done with a longhandled trowel or “Fresno,” but the finish trowelling shall be done with a hand trowel. After final trowelling, walk on grades of less than 6 percent shall be given a fine hair-broom finish applied transverse to the center line. On grades exceeding 6 percent, walk shall be finished by hand with a wood float. Walk shall be remarked as necessary after final finish, to assure neat uniform edges, joints, and score lines.

Scoring lines, where required, shall have a minimum depth of ¼ inch (6mm) and a radius of ⅛ inch (3mm). When longitudinal scoring lines are required, they shall be parallel to, or concentric with, the lines of the work. Walk 20 feet (6m) or more in width shall have a longitudinal center scoring line. In walk returns, one scoring line shall be made radially midway between the BCR and ECR. When directed by the Engineer, longitudinal and transverse scoring lines shall match the adjacent walk. The Contractor shall have sufficient metal bards, straightedges, and joint tools on the project.

Headers shall remain in place for at least 16 hours after completion of the walk but must be removed before the Work is accepted.

(d) Gutter — After the concrete has been thoroughly tamped in such manner as to force the larger aggregate into the concrete and bring to the top sufficient free mortar for finishing the surface shall be worked to a true and even grade by means of a float, trowelled with a long-handled trowel or “Fresno” and wood float-finished. The flowline of the gutter shall be trowelled smooth for a width of approximately 4 inches (100mm) for integral curb and gutter and 4 inches (100mm) on either side of the flowline on cross gutters and longitudinal gutters. The outer edges of the gutter shall be rounded to a radius of ½ inch (3mm).

Side forms shall remain in place for at least 24 hours after completion of the

gutter, but must be removed before the work will be accepted.

Joints shall conform to Subsection 17-7.6.

(e) Access Ramps and Driveways — Alley intersections, access ramps and driveways shall be constructed as specified for concrete pavement in Subsection 17-7.5 except final finishing for access ramps and the sloping portion of driveways shall be done by hand with a wood float and the remaining portion of the driveway finished as specified for walks in accordance with Subsection 17-7.7(c).

**17-7.8 Curing** — Immediately after finishing operations are completed, Type 1 concrete-curing compound shall be applied.

The curing compound shall be applied under pressure, by means of a spray nozzle, in such manner and quantity as to entirely cover all exposed surfaces of the concrete with a uniform film. Curing compounds shall be as specified in Subsection 17-4.

No power equipment used for the preparation of subgrade will be permitted adjacent to concrete curb, gutter, or alley intersections until the fourth day following placement of the concrete. The placement of bituminous pavement adjacent to concrete curb, gutter, or alley intersections will not be permitted until the seventh day following the placement of concrete nor will concrete paving operations be permitted until the seventh day where placing or finishing equipment will ride on the previously placed concrete. If admixtures, additional cement or Type III cement is used to obtain high early strength concrete in accordance with Subsection 17-1.1.1, grading operations will be permitted on the second day following the placement of the concrete and paving operations on the third day.

**17-7.9 Repairs and Replacements** — Any new work found to be defective or damaged prior to its acceptance shall be repaired or replaced by the Contractor at no expense to the Agency.

**17-7.10 Backfilling and Cleanup** — Backfilling to the finished surface of the newly constructed improvement must be completed before acceptance of the Work.

Upon completion of the work the surface of the concrete shall be thoroughly cleaned and the site left in a neat and orderly condition.

**17-7.11 Measurement and Payment** — Payment for concrete curbs, walks, gutters, cross gutters, access ramps and driveways will be made as shown in the Bid.

Measurements to determine the pay quantities will be made in horizontal planes,

including but not limited to removal of existing concrete, disposal, subgrade preparation backfilling and cleanup.

The price bid shall be considered to include full payment for all materials, labor, equipment and incidentals require to construct the concrete improvements in accordance with the plans and Specifications.



# CITY OF ALBANY

## Standard Specifications Technical Provisions

### Section 18

#### Sanitary Sewers & Storm Drains

##### **18-1 Trenching**

**18-1.1 General** — For the purpose of shoring or bracing, a trench is defined as an excavation in which the depth is greater than the width of the bottom of the excavation.

Excavations for appurtenant structures, such as but not limited to manholes, transition structures, junction structures, vaults, valve boxes, catch basins, thrust blocks, and boring pits shall, for the purpose of shoring and bracing, be deemed to be in the category of trench excavation.

Excavation shall include the removal of all water and materials of any nature which interfere with the construction work. Removal of groundwater to a level below the structure subgrade will be necessary only when required by the plans or specifications.

Excavation for conduits shall be by open trench unless otherwise specified or shown on the plans. However, should the Contractor elect to tunnel or jack any portion not so specified, they shall first obtain approval from the Engineer. Payment for such work will be made as though the specified methods of construction had been used.

**18-1.2 Maximum Length of Open Trench** — Except by permission of the Engineer, the maximum length of open trench where prefabricated pipe is used shall be 500 feet (150m) but no more than the amount of pipe installed and backfilled in a single day. The distance is the collective length at any location, including open excavation, pipe laying and appurtenant construction.

Except by permission of the Engineer, the maximum length of open trench in any one location where concrete structures are cast in place will be that which is necessary to permit uninterrupted progress. Construction shall be pursued as follows: excavation, setting of reinforcing steel, placing of floor slab, walls, and

cover slab or arch. Each shall follow the other without any one operation preceding the next nearest operation by more than 200 feet (60m).

Failure by the Contractor to comply with the limitations specified herein may result in an order to halt the work until such time as compliance has been achieved.

**18-1.3 Maximum and Minimum Width of Trench** — For pipe (except corrugated steel pipe), the minimum and maximum width of trench permitted shall be as indicated on the Plans or Standard Drawings.

For corrugated steel pipe, the trench shall be at least 16 inches (400mm) wider than the diameter of the pipe to be installed.

If the maximum trench width is exceeded, the Contractor shall provide additional bedding, another type of bedding, or a higher strength of pipe, as shown on Plans or approved by the Engineer, at no additional cost to the City.

**18-1.4 Access to Trenches** — Safe and suitable ladders which project 2 feet (0.6m) above the top of the trench shall be provided for all trenches over 4 feet (1.2m) in depth. One ladder shall be provided for each 50 feet (15.6m) of open trench, or fraction thereof, and be so located that workers in the trench need not move more than 25 feet (7.5m) to a ladder.

**18-1.5 Removal and Replacement of Surface Improvements** — Bituminous pavement, concrete pavement, curbs, sidewalks or driveways removed in connection with construction shall be removed and replaced in accordance with the other provisions of these Standard Specifications.

**18-1.6 Bracing Excavations** — The manner of bracing excavations shall be as set forth in the rules, orders, and regulations of the Division of Industrial safety of the State of California.

Prior to commencing the excavation of a trench 5 feet (1.5m) in depth or greater and into which a person will be required to descend, the Contractor shall first obtain a permit to do so from the Division of Industrial Safety.

Should the bracing system utilize steel H-beams or piles or other similar vertical supports, driving of said vertical supports will not be permitted except for the last 4 feet (1.2m). The vertical supports shall be placed in holes drilled to a depth of 4 feet (1.2m) above the proposed bottom of pile, except where this procedure is impracticable. The vertical support may then be driven to the required depth, not to exceed 4 feet (1.2m). During the drilling and driving operations the Contractor shall take care to avoid damage to utilities.

At locations where the drilling of such holes is impracticable because of the existence of rocks, running sand, or other similar conditions, and provided said impracticability is demonstrated to the satisfaction of the Engineer by actual drilling operations by the Contractor, the Engineer may, upon request of the Contractor, approve the use of means other than drilling for the purpose of placing the vertical support. Such other means, however, must be of a nature which will accomplish, as nearly as possible, the purpose of the drilling, namely, the prevention of damage to existing surface or sub surface improvements, both public and private. All costs for this work shall be included in the prices bid for the items involved.

If sheeting is used to support the excavated trench, the sheeting shall be removed by the Contractor, and no such sheeting will be permitted to remain in the trench. When field conditions, the type of sheeting, or methods of construction used by the Contractor are such as to make the removal of sheeting impracticable, the Engineer may permit portions of the sheeting to be cut off to a specified depth and remain in the trench.

**18-2 Bedding** — Bedding shall be defined as that material supporting, surrounding and extending to between six inches and one foot above the top of the pipe, as shown in the details. Where it becomes necessary to remove boulders or other interfering objects at subgrade for bedding, any void below such subgrade shall be filled with the bedding material designated on the Plans. Where concrete is specified to cover the pipe, the top of the concrete shall be considered as the top of the bedding.

If soft, spongy, unstable, or other similar material is encountered upon which the bedding material or pipe is to be placed, this unsuitable material shall be removed to a minimum depth of 18 inches beneath the bottom of the pipe or as ordered by the Engineer and replaced with bedding material suitably densified. Additional bedding so ordered, over the amount required by the Plans or Specifications, will be paid for as provided in the Bid Schedule. If the necessity for such additional bedding material has been caused by an act or failure to act on the part of the Contractor, or is required for the control of groundwater, the Contractor shall bear the expense of the additional excavation and bedding.

Bedding material for pipe shall first be placed to a depth of 4 inches below the pipe. If the pipe is to be laid in a rock cut, there shall be at least 6 inches of bedding below the pipe. Then the remainder of the bedding shall be placed. Bedding shall be compacted by hand or mechanical tampers prior to backfilling. All bedding material shall be placed carefully to achieve uniform contact with the pipe and a minimum relative compaction of 90 percent, as determined by ASTM D-1557 (AASHTO T-180) laboratory density. Unless the sheeting or shoring is to be cut off and left in place, densification of bedding for pipe shall be accomplished after the sheeting or shoring has been removed from the bedding zone.

In dry trench conditions or where otherwise specified, bedding material for pipe shall be sand, Class II Aggregate Base, native free-draining granular material having a sand equivalent of not less than 30. Where water is encountered, or where trench dewatering is used, Wet Condition Material, meeting the requirements presented in Table 1, shall be used.

<b>TABLE 1</b>	
<b>PIPE BEDDING GRADATION REQUIREMENTS FOR WET TRENCH CONDITION</b>	
<b>Sieve Size</b>	<b>Percent Passing</b>
1½ inches	100
¾ inches	55 to 100
⅜ inches	8 to 50
No. 4	0 to 8
No. 200	0 to 2

Crushed stone or gravel meeting these requirements include No. 3 concrete aggregate, as specified in the Public Works Specifications, and concrete gravel designated ASTM C33, Gradation 67.

Concrete used for bedding shall be one of the classes of concrete specified herein for the indicated time periods before backfill.

Continuity of bedding material shall be interrupted by low permeability groundwater barriers to impede passage of water through the embedment. Barrier material shall be low permeability clay material and shall be compacted to 95 percent of maximum density. Material may be finely divided suitable job excavated material, free from stones, organic matter, and debris. A groundwater barrier of compacted soil shall be placed at or near each manhole or special structure along the sewer line. The groundwater barrier shall be keyed a minimum of 6 inches into undisturbed material on the trench sides and trench bottom and shall extend vertically to the top of the pipe embedment. The barrier shall be 18 inches thick.

### **18-3 Pipe Materials & Installation (New or Replacement)**

#### **18-3.1 General**

**18-3.1.1 General** — Pipe will be inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection. Any corrective work shall be approved by the Engineer and shall be at no cost to the City.

When connections are to be made to any existing pipe, conduit, or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for, and expose, the existing improvement before laying any pipe or conduit. The Engineer shall be given the opportunity to inspect the existing pipe or conduit before connection is made.

Pipe shall be laid up-grade with the socket or collar ends of the pipe upgrade unless otherwise authorized by the Engineer.

Pipe shall be laid to Plan line and grade, with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the socket or collar, which shall not bear upon the sub grade or bedding. Any pipe which is not in true alignment or shows any undue settlement after laying shall be taken up and relaid at the Contractor's expense.

Pipe sections shall be laid and jointed in such a manner that the offset of the inside of the pipe at any joint will be held to a minimum at the invert. The maximum offset at the invert of pipe shall be 1 percent of the inside diameter of the pipe or  $\frac{3}{8}$ -inch (10mm), whichever is smaller.

In joining socket and spigot pipe, the spigot of each pipe shall be so seated in the socket of the adjacent pipe as to give a minimum of  $\frac{3}{8}$ -inch (10mm) annular space all around the pipe in the socket. Unavailable offsets shall be distributed around the circumference of the pipe in such a manner that the minimum offset occurs at the invert.

When pipe is laid in a sheeted trench, all sheeting against which concrete cradle is to be placed shall be faced with at least one thickness of building paper and the sheeting shall be withdrawn without displacing or damaging the cradle.

After the joints have been made, the pipe shall not be disturbed in any manner.

At the close of work each day, or whenever the work ceases for any reason, the end of the pipe shall be securely closed.

18-3.1.2 Marking — Each length of pipe shall be marked by the manufacturer with the trade name, nominal size, D-load, date of manufacture and lot number. The D-load and lot number designations shall be marked on the inside of the pipe.

A lot is defined as 100 lengths of pipe, or a fraction thereof, of one

diameter and D-load manufactured within a 24-hour period.

Each coupling shall be marked with the nominal size and D-load for the pipe with which it shall be used.

- 18-3.1.3 Basis for Acceptance — The basis for acceptance of lots shall be: D-load strength test, compliance with Specifications, inspection of pipe manufacture, and inspection of completed pipe.

the Engineer may accept a certification indicating compliance with these specifications in lieu of City inspection.

18-3.1.4 Causes for Rejection — The following defects are cause for rejection of individual pipe lengths:

- 1) Any crack, any piece broken from the pipe, or other irregularities.
- 2) Deficiencies or irregularities in wall thickness. Wall thickness shall be at least 95 percent of the manufacturer's specified nominal wall thickness.
- 3) Improper machining of ends of pipe lengths. When plastic couplings are used, pipe ends shall be machined at least 1/16-inch deep (1.5mm) for a minimum of two-thirds of the full circumference. Unmachined portions of the ends shall be sanded smooth to provide a close-fitting joint.

When a pipe contains localized defects but is otherwise acceptable, the pipe will be accepted when the defective portion is cut off and the end or ends satisfactorily remachined.

## 18-3.2 PVC Plastic Pipe

18-3.2.1 General — This subsection applies to the requirements for unplasticized polyvinyl chloride (PVC) plastic pipe for gravity flow sewers and house connection sewers. Pipe, fittings, couplings and joints shall be in conformance with the requirements of ASTM D 3033 or D 3034, except as modified herein.

The ASTM designation, SDR, and type of joint shall be as shown on the Plans or in the Specifications. When PVC sewer pipe is specified without further qualification, the pipe shall conform to the requirements of ASTM D 3034, SDR 35, and shall have gasketed joints. All pipe, fittings and couplings shall be clearly marked at an interval not to exceed 5 feet

(1.5m) as follows:

- 1) Nominal pipe diameter.
- 2) PVC cell classification.
- 3) Company, plant, shift, ASTM, SDR, and date designation.
- 4) Service designation or legend.

For fittings and couplings, the SDR designation is not required.

18-3.2.2 Cell Classification — Pipe shall be made of PVC plastic having a cell classification of 12454-B, 13364-A, or 13364-B as defined in ASTM D 1784. The fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, or 13343-C. PVC compounds of other cell classifications shall be prequalified.

18-3.2.3 Joining Systems — All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

the socket and spigot configurations for the fittings and couplings shall be compatible to those used for the pipe.

18-3.2.4 Elastomeric Gasket Joints — Pipe with gasketed joints shall be manufactured with a socket configuration which will prevent improper installation of the gasket and will ensure the gasket remains in place during the joining operation. The gasket shall be manufactured from a synthetic elastomer.

18-3.2.5 Solvent Cement Joints — Pipe with solvent cement joints shall be joined with a PVC cement conforming to ASTM D 2564.

18-3.2.6 Injection Sealed Joints — Pipe with injection sealed joints shall be sealed with a PVC adhesive compound. The compound shall conform to the requirements of ASTM D 2564 and shall have a minimum viscosity of 50,000 centipoise (50Pa.s). The internal diameter of the socket shall be uniform with a locking taper at the base and an outer seal ring attached to the end. The socket shall have an injection port to inject the adhesive and an exhaust port on the opposite side to allow air to escape from the annular space.

18-3.2.7 Test Requirements — General. Pipe, fittings and couplings shall meet the requirements of the section titled “Requirements” of ASTM D 3033 or D 3034. During production of the pipe, the

manufacturer shall perform the specified tests for each pipe marking. A certification by the manufacturer indicating compliance with specification requirements shall be delivered with the pipe. The certification shall include the test result data. The PVC compound shall also meet the chemical resistance requirements.

18-3.2.8 Acceptance — The basis for acceptance shall be the inspection of pipe, fittings and couplings; the tests specified in Subsection 18-3.2.7; and compliance with the specifications. When the pipe is delivered to the work site, the Engineer may require additional testing to determine conformance with the requirements of pipe flattening, impact resistance, pipe stiffness and extrusion quality. Also, pipe which is not installed within 120 days of the latest test shall not be used without prior approval of the Engineer.

18-3.2.9 Selection of Test Pipe — When testing is required by the Engineer, one test pipe shall be selected at random by the Engineer from each 1200 feet (360m) or fraction thereof of each size of pipe delivered to the Work site but no less than one test pipe per lot. A lot shall be defined as pipe having the same identification marking. The length of specimen for each selected pipe shall be a minimum of 8 feet (2.4m).

A pipe lot shall consist of all pipe having the same marking number. The lot test specimen shall have a minimum length of 4 feet (1.2m).

18-3.2.10 Chemical Resistance — The PVC compound for cell classifications not specifically identified herein shall be pre-qualified by the pipe manufacturer by meeting the chemical resistance tests which follow. Compound samples and molded test specimens shall be prepared in accordance with ASTM D 53.

Tensile and Izod impact exposure specimens shall be immersed in the solutions for a period of 112 days. At 4-week intervals, selected specimens shall be removed, washed, surface dried and tested.

Weight change specimens shall be 2 inches (50mm) in diameter and may be molded discs or discs cut from the pipe wall. They shall be conditioned for 7 days at  $110^{\circ} \pm 5^{\circ}\text{F}$  ( $43^{\circ} \pm 3^{\circ}\text{C}$ ), cooled in a desiccator for three hours at  $75^{\circ} \pm 5^{\circ}\text{F}$  ( $24^{\circ} \pm 3^{\circ}\text{C}$ ), weighed, and then immersed in the solutions specified in Subsection 2.0-2.3.3 of the Standard Specifications for Public Works Construction. At 4-week intervals, selected specimens shall be removed, washed, surface dried and weighed. These same specimens shall then be reconditioned for 7 days at  $110^{\circ} \pm 5^{\circ}\text{F}$  ( $43^{\circ} \pm 3^{\circ}\text{C}$ ), cooled in a desiccator for 3 hours at  $75^{\circ} \pm 5^{\circ}\text{F}$  ( $24^{\circ} \pm 3^{\circ}\text{C}$ ) and again weighed.



Initial and post-exposure specimens shall meet the following requirements when tested at  $75^{\circ} \pm 5^{\circ}$  ( $23^{\circ} \pm 2^{\circ}\text{C}$ ):

Property	ASTM Test Method	Cell Class Min. Values		
		12454	13343	13364
Tensile Strength (Yield), psi (MPa)	D 638	7000 (41)	6000 (41)	6000 (48)
Impact Strength, ft-lbs/in. (J/m)	D 256 Method A	0.65 (80)	1.5 (80)	1.5 (35)
Weight Change, %	D 543	1.5	1.5	1.5

If any specimen fails to meet the requirements at any time during the 112 days exposure period, the material will be subject to rejection.

18-3.2.11 Pipe Acceptance — At the time of manufacture, each lot of pipe and fittings shall be inspected for defects, and tested for impact, stiffness and flattening in accordance with ASTM D 2751.

When testing subsequent to manufacture the impact requirement shall be excluded. For the flattening requirement, the percentage reduction in pipe diameter shall be not less than 15 percent for pipe marked SDR 23.5 or lower, and not less than 25 percent for pipe marked with higher SDR numbers. The stiffness requirement is unchanged.

The Engineer may require certification by the manufacturer that the test results comply with specification requirements.

18-3.2.12 Marking — Pipe shall have a home mark to indicate full penetration of the spigot when the joint is made. Pipe shall be marked at 5-foot (1.5m) intervals or less with a marking number which identifies the manufacturer, SDR, size, machine, date and shift on which the pipe was produced.

### **18-3.3 Reinforced Concrete Pipe**

**18-3.3.1 General** — These specifications apply to reinforced concrete pipe intended to be used for the construction of storm drains, sewers, and related structures.

The size, type, and D-load of the concrete pipe to be furnished shall be as shown on the Plans, or as specified under the item of work for the project.

Prior to the manufacture of the pipe, three sets of prints of the pipe line layout diagrams, prepared in accordance with good industry practice, shall be furnished to the Engineer. Catch basin connector pipe need not be included in the pipe line layout; in lieu thereof, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall include size and D-load of pipe, station at which pipe joins mainline, number of sections of pipe, length of sections, type of sections (straight, horizontal bevel, vertical, bevel, etc.). The diagrams and lists submitted will be used by the Agency for reference only, and their use shall in no way relieve the Contractor of its responsibility for correctness. The Engineer may waive the pipeline layout and connector pipe list requirement.

Cast reinforced concrete pipe shall be manufactured by placing the concrete into stationary, vertical, cylindrical metal forms.

Spun reinforce concrete pipe shall be manufactured by introducing the concrete into a rotating, horizontal, cylindrical metal form.

The interior surface of the pipe shall be smooth and well-finished. Joints shall be of such type and design and so constructed as to be adequate for the purpose intended so that when laid, the pipe will form a continuous conduit with a smooth and uniform interior surface.

Sockets and spigots shall be free from any deleterious substance or condition which might prevent a satisfactory mortar bond at the joints.

If the Engineer determines that the forms, end rings or form gaskets used in the manufacture of the pipe are inadequate for the purpose intended, the Contractor shall replace or repair said equipment to the satisfaction of the Engineer.

Pipe stronger than that specified maybe furnished at the Contractor's option, and at its expense, provided such pipe conforms in all other respects to the applicable provisions of these specifications.

The Contractor shall furnish, install and maintain stulls or other devices in the pipe as may be necessary to meet the limitation on cracks as specified herein, throughout pipe handling, transportation, and field installation.

18-3.3.2 Materials — Pipe greater than 24 inches shall be reinforced concrete pipe in accordance with ASTM C 76 Class IV. Cement used in the manufacture of pipe shall be in accordance with ASTM C 150, Type II, low alkali. At least two 3-edge bearing tests shall be made on each size of pipe. No hydrostatic nor absorption tests will be required except as stated hereinafter.

Joints shall be the rubber gasket type with the gaskets in accordance with ASTM C 361. Connections of reinforced concrete pipe to structures shall be with steel manufacturer's bell ring as detailed on the Plans. Plastic or fiberglass bell rings or collars shall not be used. Rubber gaskets shall be of the O-ring type. The spigot shall be formed with a groove for the gasket.

Fittings required as indicated on the Plan shall be constructed to the standards of the pipe manufacturer. Details of fittings shall be submitted for Engineer's acceptance before fabrication.

18-3.3.3 Installation - The ends of the pipe shall be so formed that, when the pipes are laid together and joined, they shall make a continuous and uniform line of pipe with a smooth and regular surface.

This gasket shall be of circular cross section unless otherwise approved by the Engineer. The length and cross sectional diameter of the gasket, the annular space provided for the gasket, and all other joint details shall be such as to produce a watertight joint. The slope of the longitudinal gasket contact surfaces of the joint with respect to the longitudinal axis of the pipe shall not exceed 2 degrees.

Under ordinary laying conditions, the work shall be scheduled so that the socket end of the pipe faces in the direction of laying. Prior to placing the spigot into the socket of the pipe previously laid, the spigot groove, the gasket and the inside of the socket shall be thoroughly cleaned. Then the spigot groove, the gasket and the first 2 inches (50mm) of the inside surface of the socket shall be lubricated with a soft vegetable soap compound.

The gasket after lubrication shall be uniformly stretched when placing it in the spigot groove so that the gasket is distributed evenly around the circumference.

For pipe in which the inside joints are to be pointed, suitable spacers shall be placed against the inside shoulder of the socket to provide the proper space between abutting ends of the pipe.

After the joint is assembled, a thin metal feeler gage shall be inserted between the socket and the spigot and the position of the gasket checked around the complete circumference of the pipe. If the gasket is not in the proper position, the pipe shall be withdrawn, the gasket checked to see that it is not cut or damaged, the pipe relaid, and the gasket position again checked.

Concrete pipe with elliptical reinforcement shall be laid with the minor axis of the reinforcement cage in a vertical position.

In general, horizontal or vertical curves shall be made by using pipe with beveled ends or by slight deflections in the joints of straight pipe. If necessary, short length pipe shall be made for curve of shorter radius than can be made with beveled pipe of usual length. Detailed layouts of curves shall be submitted to the Engineer by the pipe manufacturer for review and acceptance before fabrication of the beveled pipe. Curves may be made by use of angle bands at joints in lieu of beveled ends. Not more than 15 degrees of deflection angle shall be made in any one joint. Each angle joint shall fall upon the curve of the radius as indicated on the Plan.

**18-3.4 Reinforced Thermosetting Resin (RTR) and Reinforced Plastic Mortar (RPM) Pipe and Fittings**

18-3.4.1 General — This subsection applies to RTR and RPM pipe and fittings.

18-3.4.2 Type of Service — Types of service shall be as follows:

Types of Service	Uses	ASTM Requirements <sup>1</sup>
I	Storm drains Sanitary sewers	ASTM D3517 for pressure and nonpressure
II		ASTM D3262 for nonpressure ASTM D3754 for pressure

1. Pipe shall comply with ASTM requirements except as modified herein.

18-3.4.3 Material Composition — The RTR and RPM material shall conform to Section 213 of the Standard Specifications for Public Works

## Construction.

18-3.4.4 Joints for RTR and RPM Pipe and Fittings — Joints shall be socket (bell) and spigot connections with elastomeric gaskets conforming to ASTM F477. Gaskets shall be new.

18-3.4.5 Joint Adapters for RTR and RPM Pipe and Fittings — Where adapters are required, adapters shall be approved by the Engineer. Fittings shall be manufactured from pipe that has been accepted and hydrotested.

18-3.4.6 Pipe Acceptance — Inspection, testing and acceptance shall conform to Subsection 18-3.1. The Engineer may require certification by the manufacturer that the test results comply with specification requirements. Each length of pipe shall be hydrostatically tested to 150 percent of design pressure.

18-3.4.7 Marking — Each length of pipe and each fitting shall be marked with the type, size, pressure class, lot or serial number, the name or mark of the manufacturer and the hydrostatic test pressure. Identification shall be traceable to location, date and shift of manufacture.

## 18-3.5 Polyethylene (PE) Solid Wall Pipe and Liner

18-3.5.1 General — Polyethylene (PE) plastic solid wall pipe and liner for use in gravity flow sanitary sewers, storm drains and water systems shall comply with ASTM D 2239 and D 3035. Fittings shall comply with ASTM D 2683, D 3797 and D 3261.

18-3.5.2 Material Composition — Pipe and fittings shall be made from PE resins in accordance with ASTM D 1248, and shall consist of a high-density, high-modulus resin which meets or exceeds the requirements listed below, and shall also meet requirements of ASTM D 3350.

Property	Value	ASTM Test
Density (g/cm <sup>3</sup> )	0.941 min.	D 1505
Melt Index	0.41 max.	D 1238
Flexural Modulus (psi)	120,000 min.	D 790
Tensile Strength (psi)	3,000 min.	D 638
Environmental Stress Crack Resistance		D 1693
a. Test Condition	C	
b. Test Duration (hrs.)	192	
c. Failure, max. %	20	
Hydrostatic Design Basic (psi) at 73°F (23°C)	1,250 min.	D 2387
Color	2% Carbon Black min.	

The Engineer may at any time direct the manufacturer to obtain compound samples and to prepare compression molded test specimens in accordance with ASTM D 1928. These specimens shall comply with the minimum property values shown above and ASTM D 3350. The materials shall meet the chemical resistance tests in Subsection 18-3.2.10.

18-3.5.3 Pipe or Liner Acceptance Group — At the time of manufacture, each lot of pipe liner, and fittings shall be inspected for defects and tested for impact, stiffness and flattening in accordance with National Sanitation Foundation (NSF) Standard Number 14.

The liner or pipe shall be homogeneous throughout, uniform in color, free of cracks holes, foreign materials, blisters or deleterious faults.

When testing subsequent to manufacture, the impact requirements shall be excluded. For the flattening requirement, the percentage reduction in pipe or liner diameter shall be not less than 15 percent for SDR 21 or lower, and not less than 25 percent for SDR 22 and above. All of the above requirements shall comply with NSF Standard Number 14.

The Engineer may require certification by the manufacturer that the test results comply with specification requirements.

For testing purposes, a production lot shall consist of all pipe or liner having the same marking number. It shall include any and all items produced during any given work shift and must be so identified as opposed to previous or ensuing production.

The test specimen shall have a minimum length of 4 feet (1.2m).

**18-3.5.4 Marking Group** — Pipe and liner shall be marked at 5-foot (1.5m) intervals or less with a coded number which identifies the manufacturer, SDR, size, material, machine, date and shift on which the pipe and liner were extruded.

At the end of the production shift, during which a production lot has been extruded, the marking code on the pipe and liner shall be changed to indicate that said time intervals have elapsed and that a new production shift has begun.

Fittings shall be marked with the name of the manufacturer or its logo, size and material from which they were molded or fabricated.

**18-3.5.5 Dimensions** — Unless otherwise indicated, liner for pipe shall be SDR 32.5. Pipe for direct burial shall have an SDR as shown on the Plans.

**18-3.6 Vitrified Clay Pipe** — Vitrified clay pipe shall be used only when specified on the contract plans for minor repairs to existing vitrified clay pipe sewers.

Except as modified in this subsection, vitrified clay pipe and fittings, including perforated pipe, shall be extra strength manufactured in accordance with ASTM C 700.

All pipe and fittings shall be clearly marked with the name or trademark of the manufacturer's date code. All fabricated bends and/or bevels shall be all standard length straight pipe and shall, in addition to the above, be marked with a manufacturer's date. All fabricated bends and/or bevels shall be manufactured from pipe meeting all requirements of the pipe specifications for the project.

## **18-4 Pipe Liners (or Pipe Rehabilitation Lines)**

**18-4.1 General** — At the time of manufacture, each lot of pipe, liner, and fittings shall be inspected for defects and tested in accordance with ASTM D 3350.

The liner or pipe shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters or deleterious faults.

The Contractor shall supply certification by the manufacturer that materials used in the manufacture of the pipe and pipe fittings conform to the requirements of these Specifications.

**18-4.2 Installer Qualifications** — Applicators and welders shall be qualified in

accordance with the Standard Specifications for Public Works Construction.

**18-4.3 Preparation of Existing Pipe for Installation of Plastic Liner —**

Obstructions such as roots, joint offsets, rocks, or other debris that would prevent passage or damage to the liner pipe sections shall be removed or repaired prior to installing the liner pipe(s).

**4.4 Installation —**

The existing sewer shall be maintained in operation during the relining process. Liner pipes shall be inserted one section at a time through an access pit constructed above the existing sewer. The top of the existing sewer exposed in the pit should be removed down to springline level (halfway). Liner pipes shall be inserted spigot end first with the bell end trailing. The pushing force shall be applied to the pipe walls end inside of the bell. Maximum jacking load shall not exceed the following:

Nominal Diameter (Inches)	Safe Compressive Load (Tons) <sup>1</sup>	
	18 PSI Pipe Stiffness	36 PSI Pipe Stiffness
18	—	17
20	—	19
24	23	31
30	36	52
36	52	66
42	71	95
48	93	130
54	123	171
60	155	212
66	175	240
72	209	292
78	252	351
84	307	422
90	357	485
96	411	560

1. Factor of Safety of 4 is included for longitudinal compressive load.

**18-4.5 Reinforced Plastic Mortar Liner Pipe**

**18-4.5.1 General —** Fiberglass Reinforced Plastic Mortar (RPM) Liner pipe for use in lining sanitary sewers shall comply with ASTM D 3262. Unless otherwise indicated, the minimum pipe stiffness shall be 18 psi as measured by testing in accordance with ASTM D 2412.



Pipe Stiffness (psi)	Maximum Hydrostatic Head (ft.) <sup>1</sup> for UngROUTed Installation <sup>2</sup>
18	10
36	21
46	27
72	43
(Any pipe stiffness)	(0.6 x pipe stiffness)

1. Groundwater surface to bottom of liner pipe.
2. Safety factor and grout support factor not included.

**18-4.5.2 Material Composition** — Pipes, joints, and fittings shall be made from thermosetting resin, glass fiber reinforcements, and silica sand in combinations meeting all requirements of this subsection. Designation per ASTM D 3262 shall be Type 1, Liner 2, Grade 3, and Pipe Stiffness B, C, D, or as indicate din the Specifications. Rubber gaskets shall conform to the requirements of ASTM F 477.

**18-4.5.3 Liner Pipe Acceptance** — The liner pipe shall be free of cracks, holes, delaminations, foreign inclusions, blisters, or other defects that would, due to their nature, degree, or extent, have a deleterious effect of the pipe performance as determined by the Engineer.

For testing purposes, a production lot shall consist of all liner pipe having the same lot marking number, but shall not exceed a total of 100 pipes per ASTM D 3262. Pipe length, wall thickness, joint dimensions, pipe stiffness, and deflection characteristics shall be verified by testing for each lot per ASTM D 3262 requirements.

#### **18-4.6 Folded PVC Pipe Rehabilitation System**

**18-4.6.1 General** — Folded PVC extrusion material shall be introduced into sanitary sewers and storm drains in order to rehabilitate the existing pipelines system without excavation. This method applies to the rehabilitation of 4-inch through 12-inch diameter pipe in terms of materials and installation. The standard dimension ratio shall be SDR 35 in relation to the nominal pipe diameter.

**18-4.6.2 Material Composition** — The folded pipe shall be made from unplasticized PVC compounds having a cell classification of 12334-B or 12454-B, as defined in ASTM D 1784. Additives and fillers, including but not limited to stabilizers, anti-oxidants, lubricants, colorants, etc., shall not exceed 10 parts per 100 by weight or PVC resin in the compound.

**18-4.6.3 Material and Equipment Acceptance** — At the time of manufacture, the extruded material shall be inspected for defects and physical properties in accordance to the ASTM D 1784, or as indicated in the Specifications.

At the time of installation, the material shall be homogeneous, free of defects, cracks, holes, blisters, foreign materials, or other deleterious faults. Pipes with the aforementioned defects will be rejected.

The Contractor shall furnish and maintain, in good condition, all equipment necessary for proper execution and inspection of the work.

**18-4.6.4 Marking** — Markings shall conform to the requirements of Subsection 18-3.1.2.

**18-4.6.5 Chemical Resistance and Physical Testing** — The PVC material shall be tested in accordance with Sections 18-3.2.7 and 18-3.2.10. The various requirements shall be met with samples taken from pipe that had experienced the folding and rerounding process.

**18-4.6.6 Installation and Field Inspection:**

- 1) The existing pipeline shall be cleaned of any obstacles, televised and the condition approved by the Engineer prior to the insertion of the folded pipe.
- 2) A flexible heat containment tube shall be permanently placed inside the existing pipe for the retention of heat necessary to soften the folded pipe. A cable shall be strung through the heat containment tube.
- 3) Steam at 212°F shall be applied to the folded pipe while in the spool trailer for a minimum of 45 minutes prior to insertion into the existing pipe. Once the material has become pliable, the cable shall be attached to the folded pipe. Using a winch at the termination point, the folded pipe shall then be inserted into the existing pipe through an existing manhole or access point. Pulling force shall not exceed 2,000 pounds.
- 4) After the folded PVC pipe is inserted into the existing pipe, it shall be cut off at the starting point and restrained at the terminating point. Steam shall be introduced at the insertion end both inside and outside of the folded pipe until a minimum temperature of 200°F is attained at the

terminating end. This temperature shall be held for a minimum of 20 minutes and shall not exceed 240°F.

- 5) After the material has reached the required temperature, a specifically designed pressure driven rounding device shall be used to progressively round the folded PVC at a maximum rate of 3 feet per second using steam at 5 to 8 psi. The rounding process shall not cause any scraping, tearing, abrasion, movement, or other damage to the liner.
- 6) When the rounding process is complete, the steam shall be converted to air, maintaining an internal pressure of 5 to 10 psi. After the conversion to air pressure, water shall be introduced until the system is completely filled. The air pressure shall then be turned off and a minimum of 8 psi water pressure shall be maintained until the system is cooled to at least 120°F on both ends. At this point, the water pressure shall be relieved and both ends shall be cut off in the manholes.

#### **18-4.7 PVC Manhole and Wet Well Lining Systems**

**18-4.7.1 General** — This subsection describes the installation of the PVC liner by placing the liner strips so that an annular space is created between the PVC liner and the existing manhole/wet well. This annular space is then filled with cementitious grout or other approved materials that will result in a monolithic manhole/wet well within the existing manhole/wet well.

#### **18-4.7.2 Materials**

- (a) PVC Liner. The PVC liner shall comply with the applicable requirement in Subsection 18-4.
- (b) Grout. Cementitious grout or other approved materials shall conform to applicable provision of these specifications and as indicated on the Plans.
- (c) Sealant/Adhesive. Sealant/adhesive shall be as indicated on the Plans or in the Specifications.

**18-4.7.3 Chemical Resistance** — The PVC material and sealant/adhesive shall conform to Sections 18-03.2.7 and 18-3.2.10.

**18-4.7.4 Installation and Field Inspection** — Surface preparation shall

consist of thorough cleaning to remove all loose material and surface contaminants. Any protrusions on the wall surface which interfere with the installation of the liner shall be removed. The Contractor, when required, shall provide for the flow of sewage around the manhole/wet well designated for lining. Installation shall be accomplished by either manually spirally winding the PVC strip or manually placing the PVC panels and by engaging the complimentary locks (male/female) at the edges of the strips/panels in a manner which creates the annular space, as specified and approved by the Engineer.

**18-4.8 End Seals** — When required by the Engineer, the beginning and end of the new PVC pipe shall be sealed to the existing pipeline structure in order to prevent water movement between the two systems. The end seal material shall be an approved epoxy material and shall provide a watertight seal.

**18-4.9 Service Connections** — Existing service connections shall be reinstated through the use of a remote controlled unit or excavation.

## **18-5 Backfill**

**18-5.1 General** — Backfill shall be considered as starting 1 foot (0.3m) above the pipe or conduit, or at the top of concrete bedding over the pipe or conduit. All materials below this point shall be considered as bedding.

Backfill, or fill, as the case may be, for cast-in-place structures such as, but not limited to, manholes, transition structures, junction structures, vaults, valve boxes and reinforced concrete box conduits, shall start at the subgrade for the structure.

All backfill shall be placed as specified herein.

Except where the pipe must remain exposed for force main leakage tests and subject to the provisions herein, the Contractor shall proceed as soon as possible with backfilling operations. Care shall be exercised so that the conduit will not be damaged or displaced. If the pipe is supported by concrete bedding placed between the trench wall and the pipe, the remainder of any bedding material shall be placed to 1 foot (0.3m) over the top of the conduit. The backfill above the concrete bedding shall not be placed nor sheeting pulled until at least the minimum time after the placement provided by the optional classes of concrete designated in Section 17 for such concrete bedding.

Unless otherwise specified, the periods of time set forth in the following table after which the Contractor may place fill or backfill against or over the top of any cast-in-place structures are predicated on the use of concrete to which no admixture has been added for the purpose of obtaining a high early strength:

OPERATION	LOCATION	
	Against Sides of Structures (Days)	Over Top of Structure (Days)
Placement of Loose Backfill	5	21
Densification of Backfill	7	28

The Engineer may permit the use of admixtures or the use of additional cement in various parts of the structure in accordance with Section 17.

Rocks greater than 6 inches (150mm) in any dimension will not be permitted in backfill placed between 1 foot (0.3m) above the top of any pipe or box and 1 foot (0.3m) below pavement subgrade.

When the trench is wider than 3 feet (0.9m), rocks not exceeding 12 inches (0.3m) in greatest dimension, which originate from the trench, will be permitted in the backfill from 1 foot (0.3m) above the top of any pipe or box to 5 feet (1.5m) below the finished surface.

Rocks greater than 2½ inches (63mm) in any dimension will not be permitted in backfill placed within 1 foot (0.3m) of pavement subgrade.

Where rocks are included in the backfill, they shall be mixed with suitable excavated materials so as to eliminate voids.

Subject to the provisions specified herein, the material obtained from project excavations may be used as backfill provided that all organic material, rubbish, debris, and other objectionable materials are first removed. Broken portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the backfill subject to the same limitations as rocks, or provided they are processed to meet all requirements of backfill materials.

Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, the voids remaining after the removal of the boulders shall be backfilled with suitable material and densified as approved by the Engineer.

The removal of all boulders or other interfering objects and the backfilling of voids left by such removals shall be at the expense of the Contractor and no

direct payment for the cost of such work will be made. The costs of such work shall be included in the prices bid for the various items of work.

Voids left by the removal of sheeting, piles and similar sheeting supports shall be immediately backfilled with clean sand which shall be jetted into place to ensure dense and complete filling of the voids.

After the placing of backfill has been started, the Contractor shall proceed as soon as practicable with densification.

**18-5.2 Mechanically Compacted Backfill** — Backfill shall be mechanically compacted by means of tamping rollers, sheepsfoot rollers, pneumatic tire roller, vibrating rollers, or other mechanical tampers. All such equipment shall be of a size and type approved by the Engineer. Impact-type pavement breakers (stompers) will not be permitted over clay, asbestos, cement, plastic, cast iron, or nonreinforced concrete pipe.

Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or improvements installed under the Contract. The Contractor shall make its own determination in this regard.

Material for mechanically compacted backfill shall be placed in lifts which, prior to compaction, shall not exceed the thickness specified below for the various type of equipment:

- 1) Impact, free-fall, or “stomping” equipment — maximum lift thickness of 3 feet (0.9m).
- 2) Vibratory equipment, including vibratory plate, vibratory smooth-wheel rollers, and vibratory pneumatic-tired rollers — maximum lift thickness of 2 feet (0.6m).
- 3) Rolling equipment, including sheepsfoot (both vibratory and nonvibratory), grid, smooth-wheel (nonvibratory), pneumatic-tired (nonvibratory), and segmented wheels — maximum lift thickness of 1 foot (0.3m).
- 4) Hand-directed mechanical tampers — maximum lift thickness of 4 inches (100mm).

Mechanically compacted backfill shall be placed in horizontal layers of thickness (not exceeding those specified above) compatible to the material being placed and the type of equipment being used. Each layer shall be evenly spread, moistened (or dried, if necessary), and then tamped or rolled until the specified relative

compaction has been attained.

**18-5.3 Water Densified Backfill** — As used in these specifications, flooding shall mean the inundation of backfill with water, puddled with poles or bars to ensure saturation of the backfill material for its full depth. Jetting shall be accomplished by the use of a jet pipe to which a hose is attached, carrying a continuous supply of water under pressure. Jetting will not be permitted in roadways.

All backfill to be densified by water shall be jetted.

The backfill shall be jetted in accordance with the following requirements:

- 1) The jet pipe shall consist of a minimum 1½-inch (38mm) diameter pipe to which a minimum 2-inch (50mm) diameter hose is attached at the upper end. The jet shall be of sufficient length to project to within 2 feet (0.6m) of the bottom of the lift being densified.
- 2) The Contractor shall jet to within 2 feet (0.6m) of the bottom of the lift and apply water in a manner, quantity and at a rate sufficient to thoroughly saturate the thickness of the lift being densified. The jet pipe shall not be moved until the backfill has collapsed and the water has been forced to the surface.
- 3) The lift of backfill shall not exceed that which can be readily densified by jetting, but in no case shall the undensified lift exceed 15 feet (4.5m).
- 4) Where the nature of the material excavated from the trench is generally unsuitable for densification with water, the Contractor may, at not cost to the Agency, import suitable material for jetting or densify the excavated material by other methods. The backfill shall be allowed to thoroughly drain until the surface of the backfill is in a firm and unyielding condition prior to commencement of any subsequent improvements. The Engineer may require the Contractor, at the contractor's expense, to provide a sump and pump to remove any accumulated water.
- 5) The Contractor shall make its own determination that jetting will not result in damage and any resulting damage shall be repaired at the Contractor's expense.

**18-5.4 Compaction Requirements** — Except as specified otherwise, trench backfill shall be densified to the following minimum relative compaction:

- 1) 90 percent Relative Compaction:

- a) Between the pipe zone and the upper 3 feet (0.9m), measured from the pavement surface (or finish grade where there is no pavement) within native material.
  - b) Outside the traveled way, shoulders and other paved areas (or areas to receive pavement).
  - c) Under sidewalks.
- 2) 95 percent Relative Compaction:
- a) In the upper 3 feet (0.9m), measured from the pavement surface (or finish grade where there is no pavement), within the existing or future traveled way, shoulders, and other paved areas (or areas to receive pavement).
  - b) Within engineered fill.
  - c) Where lateral support is required for existing or proposed structures.

**18-5.5 Imported Backfill** — If the Contractor is permitted to import material from a source outside the project limits for use as backfill, said materials shall be clean soil, free from organic material, trash, debris, rubbish, or other objectionable substances.

Whenever the specifications or plans permit the use of imported material for backfill, the Contractor shall deliver, not less than 10 days prior to intended use, a sample of the material to the Engineer. The sample shall have a minimum dry weight of 100 pounds (45 kg) and shall be clearly identified as to source, including street address and community of origin. The Engineer will determine the suitability, the minimum relative compaction to be attained, and the placement method.

Should the imported material not be substantially the same as the approved sample, it shall not be used for backfill and shall be removed from the Work site at the Contractor's expense.

The densification method for imported material authorized by the Engineer will be dependent upon its composition, the composition of the in-place soil at the point of placement, and the relative compaction to be obtained.

Testing of import material shall be at the Contractor's expense.

**18-5.6 Transported Backfill** — The Contractor may transport or back=haul



material to be used as backfill material from any portion or line of a project to any other portion or line of the same project, or from any project being constructed under one contract to any other project being constructed under that same contract. Such transported material shall be clean soil, free from organic material, trash, debris, rubbish, or other objectionable substances except that broken portland cement concrete or bituminous type paving may be recycled as backfill as specified.

**18-5.7 Compaction Tests**

**Laboratory Maximum Density** — The following method shall be used for compaction tests unless otherwise specified;

Compaction tests will be performed in accordance with ASTM D 1557 method “C” modified to use a 4-inch (100mm) diameter mold. If the material contains more than 10 percent of particles which are retained on a 3/4-inch (19mm) sieve, use ASTM D 1557 method “D” modified to use a 40 inch (100mm) diameter mold.

The Engineer may modify ASTM D 1557 at his option to calculate relative compaction based on adjusted laboratory maximum wet density calculated as follows:

$$DA = \frac{100 Dm}{100 \pm Wa}$$

Da            Adjusted laboratory maximum wet density  
Dm            Maximum wet density per ASTM D 1557  
± Wa           Percent change in moisture content from field moisture to laboratory optimum moisture. Use minus when field moisture content is higher than laboratory optimum moisture content. Use plus when field moisture content is lower than laboratory optimum moisture content.

**Field Density** — Field density of soil shall be determined by any method, approved by the Engineer, which will accurately and consistently determine the density and moisture content of the soil.

**18-5.8 Relative Compaction** — The words Relative Compaction (Relative Density) shall mean the ratio of the field dry or wet density to the laboratory maximum dry or adjusted wet density, respectively, expressed as a percentage.

**18-5.9 Sand Equivalent Test** — This test is intended to serve as a field test to indicate the presence or absence of plastic fine material. The test shall be run in accordance with Calif. Test 217 or ASTM D 2419. When testing material containing asphalt, this test method shall be modified by drying the sample at a

temperature not exceeding 100°F (38°C).

**18-5.10 Permeability Test** — Permeability tests for granular soils will be performed in accordance with ASTM D 2434, using samples compacted to the specified field density.

## **18-6 Testing Pipelines**

**18-6.1 General** — All leakage tests shall be completed and approved prior to placing of final asphalt surfacing or concrete surface improvements.

When leakage or infiltration exceeds the amount allowed by the specifications, the Contractor at its expense shall locate the leaks and make the necessary repairs or replacements in accordance with the Specifications to reduce the leakage or infiltration to the specified limits. Any individually detectable leaks shall be repaired, regardless of the results of the tests. Leakage tests shall be made on completed pipelines as follows:

- 1) Storm Drains — Not required unless called for on Plans or in Specifications.
- 2) Gravity Sanitary Sewers [24 inches (600mm) or less in diameter where difference in elevation between inverts of adjacent manholes is 10 feet (3m) or less] — Water exfiltration test or water infiltration test as directed. The Engineer may allow substitution of an air pressure test for the water exfiltration test.
- 3) Gravity Sewers [24 inches (600mm) or less in diameter where difference in elevation between inverts of adjacent manholes if greater than 10 feet (3m) — Air pressure test or water infiltration test as directed.
- 4) Gravity Sewers [greater than 24 inches (600mm) in diameter] — Air pressure test or water infiltration test as directed.
- 5) Pressure Sewers (force mains) — Water pressure test at 120 percent of maximum operating pressure.

**18-6.2 Water Exfiltration Test** — Each section of sewer shall be tested between successive manholes by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers. The pipe and manhole shall be filled with water to a point 4 feet (1.2m) above the invert of the sewer at the center of the upper manhole; or if groundwater is present, 4 feet (1.2m) above the average adjacent groundwater level.

If, in the opinion of the Engineer, excessive groundwater is encountered in the

construction of a section of the sewer, the exfiltration test for leakage shall not be used.

The allowable leakage will be computed by the formulae:

$$\begin{aligned} E &= 0.0001 LD \sqrt{H} \text{ for mortared joints.} \\ E &= 0.00002 LD \sqrt{H} \text{ for all other joints.} \end{aligned}$$

Where:

L is length of sewer and house connections tested, in feet.

E is the allowable leakage in gallons per minute of sewer tested.

D is the difference in elevation between the water surface in the upper manhole and the invert of the pipe at the lower manhole; or if groundwater is present above the invert of the pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the groundwater at the lower manhole.

The contractor shall, at its expense, furnish all water, materials and labor for making the required test. All tests shall be made in the presence of the Engineer.

**18-6.3 Water Infiltration Test** — The end of the sewer at the upper structure shall be closed sufficiently to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least 3 days, after which the section shall be tested for infiltration.

The infiltration into each individual reach of sewer between adjoining manholes shall not exceed that allowed by the formula in Subsection 18-6.2 where H is the difference in the elevation between the groundwater surface and the invert of the sewer at the downstream manhole.

Unless otherwise specified, infiltration will be measured by the Engineer using measuring devices furnished by the City.

**18-6.4 Air Pressure Test** — The Contractor shall furnish all materials, equipment and labor for making an air test. Air test equipment shall be approved by the Engineer unless otherwise provided on the plans or in the Specifications.

The Contractor may conduct an initial air test of the sewer mainline after densification of the backfill but prior to installation of the house connection sewers. Such tests will be considered to be for the Contractor's convenience and need not be performed in the presence of the Engineer.

Each section of sewer shall be tested between successive manholes by plugging and bracing all openings in the sewer mainline and the upper ends of all lower

lateral sewers. Prior to any air pressure testing, all pipe plugs shall be checked with a soap solution to detect any air leakage. If any leaks are found, the air pressure shall be released, the leaks eliminated, and the test procedure started over again. The Contractor has the option of wetting the interior of the pipe prior to the test.

The final leakage test of the sewer mainline and lower lateral sewers, shall be conducted in the presence of the Engineer in the following manner:

Air shall be introduced into the pipeline until 3.09 psi (20kPa) gage pressure has been reached, at which time the flow of air shall be reduced and the internal air pressure shall be maintained between 2.5 and 3.5 psi (17 and 24kPa) gage pressure for at least 2 minutes to allow the air temperature to come to equilibrium with the temperature of the pipe walls. Pressure in the pipeline shall be constantly monitored by a gage and hose arrangement separate from hose used to introduce air into the line. Pressure in the pipeline shall not be allowed to exceed 5 psi (34kPa) gage pressure.

After the temperature has stabilized and no air leaks at the plugs have been found, the air pressure shall be permitted to drop and, when the internal pressure has reached 2.5 psi (17kPa) gage pressure, a stopwatch or sweep-second-hand watch shall be used to determine the time lapse required for the air pressure to drop to 1.5 psi (10kPa) gage pressure.

If the time lapse (in seconds) required for the air pressure to decrease from 2.5 to 1.5 psi (17 to 10kPa) gage pressure exceeds that shown in the following table, the pipe shall be presumed to be within acceptance limits for leakage.

If the time lapse is less than that shown in the table, the Contractor shall make the necessary corrections to reduce the leakage to acceptance limits.

- |   |   |
|---|---|
| T | time in seconds for pressure to drop from 2.5 to 1.5 psi (17 to 10kPa) gage pressure. |
| D | inside diameter of pipe in inches (mm).   |

# LOW PRESSURE AIR TEST FOR SEWERS

Time (T) in Seconds

Main Line				4" (100mm) House Connection					Main Line				6" (150mm) House Connection						
Dia.		Length		House Connection Length					Dia.		Length		House Connection Length						
In.	(mm)	(ft)	(m)	0 ft. (0m)	100 ft. (30m)	200 ft. (60m)	300 ft. (90m)	400 ft. (120m)	In.	(mm)	ft.	(m)	0 ft. (0m)	100 ft. (30m)	200 ft. (60m)	300 ft. (90m)	400 ft. (120m)		
7.5)	0	(0)	0	0	20	40	50	70	8	(200)	0	(0)	0	40	80	100	110		
	50	(15)	40	50	70	90	80	110			50	(15)	40	70	110	110	110	110	110
	100	(30)	70	90	100	100	90	100			100	(30)	70	110	120	120	120	120	120
	150	(45)	110	120	110	100	100	100			100	(45)	110	120	120	120	120	120	120
	200	(60)	140	120	110	110	100	100			100	(60)	140	130	120	120	120	120	120
10)	300	(90)	140	130	120	110	110	110	10	(250)	300	(90)	140	130	120	120	120		
	400	(120)	140	130	120	120	110	110			400	(120)	140	130	130	120	120	120	
	50	(15)	50	70	90	100	90	110			50	(15)	50	90	120	120	120	120	
	100	(30)	110	130	120	110	110	110			100	(30)	110	140	130	130	130	130	
	200	(60)	170	150	140	130	120	120			200	(60)	170	150	140	140	140	140	
12.5)	300	(90)	170	160	150	140	130	130	12	(300)	300	(90)	170	160	150	140	140		
	400	(120)	170	160	150	150	140	140			400	(120)	170	160	150	150	150	150	
	50	(15)	80	100	110	110	110	110			50	(15)	80	120	140	130	130	130	
	100	(30)	160	170	150	140	130	130			100	(30)	160	170	150	150	140	140	
	200	(60)	200	180	170	160	150	150			200	(60)	200	180	170	160	160	160	
15)	300	(90)	200	190	180	170	160	160	15	(375)	300	(90)	200	190	180	170	170		
	400	(120)	200	190	180	180	170	170			400	(120)	200	190	180	180	180	180	
	50	(15)	120	140	160	140	130	130			50	(15)	120	160	160	160	150	150	
	100	(30)	250	220	190	170	160	160			100	(30)	250	210	190	170	170		
	200	(60)	260	230	220	200	190	190			200	(60)	260	230	210	200	200		
17.5)	300	(90)	260	240	230	220	210	210	18	(450)	300	(90)	260	240	220	210	210		
	400	(120)	260	240	230	220	220	220			400	(120)	260	240	230	220	220	220	
	50	(15)	180	200	190	170	150	150			50	(15)	180	220	190	170	170		
	100	(30)	310	260	230	210	190	190			100	(30)	310	260	220	200	200		
	200	(60)	310	280	260	250	230	230			200	(60)	310	280	260	240	240		
20)	300	(90)	310	290	280	260	250	250	21	(525)	300	(90)	310	290	270	260	260		
	400	(120)	310	290	280	270	260	260			400	(120)	310	290	280	270	270	270	
	50	(15)	240	260	230	200	180	180			50	(15)	240	260	220	200	200		
	100	(30)	360	310	280	250	230	230			100	(30)	360	300	260	240	240		
	200	(60)	360	330	310	290	280	280			200	(60)	360	330	300	280	280		
22.5)	300	(90)	360	340	320	310	300	300	24	(600)	300	(90)	360	330	320	300	290		
	400	(120)	360	340	330	320	310	310			400	(120)	360	340	330	310	310		
	50	(15)	320	320	270	240	210	210			50	(15)	320	310	260	220	220		
	100	(30)	410	360	320	290	270	270			100	(30)	410	350	310	280	280		
	200	(60)	410	380	360	340	320	320			200	(60)	410	370	350	320	310		
25)	300	(90)	410	390	370	360	350	350	27	(675)	300	(90)	410	380	360	350	330		
	400	(120)	410	390	380	370	360	360			400	(120)	410	390	370	360	350		
	50	(15)	400	370	310	280	250	250			50	(15)	400	350	290	260	260		
	100	(30)	460	410	370	340	310	310			100	(30)	460	390	350	320	290		
	200	(60)	460	430	410	390	370	370			200	(60)	460	420	390	370	350		
27.5)	300	(90)	460	440	420	410	390	390	30	(750)	300	(90)	460	430	410	390	380		
	400	(120)	460	450	430	420	410	410			400	(120)	460	440	420	410	390		
	50	(15)	490	420	360	310	280	280			50	(15)	480	390	330	290	260		
	100	(30)	510	460	420	380	360	360			100	(30)	510	440	390	360	330		
	200	(60)	510	480	460	440	420	420			200	(60)	510	470	440	420	390		
30)	300	(90)	510	490	470	460	440	440	33	(825)	300	(90)	510	480	460	440	420		
	400	(120)	510	500	480	470	460	460			400	(120)	510	490	470	460	440		
	50	(15)	560	460	400	350	320	320			50	(15)	560	440	370	320	290		
	100	(30)	560	510	460	430	400	400			100	(30)	560	490	440	400	370		
	200	(60)	560	530	510	490	460	460			200	(60)	560	520	490	460	440		
32.5)	300	(90)	560	540	520	510	490	490	36	(900)	300	(90)	560	530	510	490	470		
	400	(120)	560	550	530	520	510	510			400	(120)	560	540	520	510	490		
	50	(15)	610	510	440	390	360	360			50	(15)	610	480	410	360	320		
	100	(30)	610	560	510	480	440	440			100	(30)	610	540	480	440	410		
	200	(60)	610	580	560	530	510	510			200	(60)	610	570	540	510	480		
35)	300	(90)	610	600	580	560	540	540	39	(975)	300	(90)	610	590	560	540	520		
	400	(120)	610	600	580	570	560	560			400	(120)	610	590	570	560	540		
	50	(15)	660	560	490	440	390	390			50	(15)	660	530	460	410	380		
	100	(30)	660	610	560	520	490	490			100	(30)	660	590	530	480	450		
	200	(60)	660	630	610	580	560	560			200	(60)	660	620	590	560	530		
37.5)	300	(90)	660	640	620	610	590	590	42	(1050)	300	(90)	660	640	610	590	570		
	400	(120)	660	650	630	620	610	610			400	(120)	660	640	620	610	590		
	50	(15)	710	610	540	480	430	430			50	(15)	710	580	490	430	390		
	100	(30)	710	660	610	570	540	540			100	(30)	710	640	580	530	490		
	200	(60)	710	680	660	630	610	610			200	(60)	710	670	640	610	580		
40)	300	(90)	710	690	680	660	640	640	42	(1050)	300	(90)	710	690	660	640	620		
	400	(120)	710	700	680	670	660	660			400	(120)	710	690	670	650	640		

**18-6.5 Water Pressure Test** — Preparatory to testing, the section of the pipeline to be tested shall be filled with water and placed under a slight pressure for at least 48 hours. The pipeline shall then be brought up to the test pressure specified and maintained on the section under test for a period of not less than 4 hours.

Accurate means shall be provided for measuring the quantity of water required to maintain full pressure on the line for the test period, which volume shall not exceed:

$$L = \frac{CN D^3 P}{1850}$$

Where:

- L = Maximum allowable leakage in gallons per hour for section of pipeline tested.
- N = Number of joints in length tests.
- D = Diameter of pipe in inches.
- P = Test pressure in psi.
- C = 1.0 for reinforced concrete pressure pipe with rubber joints, cylinder type.
- C = 3.0 for reinforced concrete pressure pipe with rubber joints, non-cylinder type.
- C = 0.50 for cast iron pipe with mechanical or rubber gasket joints and asbestos-cement pipe.
- C = 1.0 for other type of cast iron joints (caulked) and other types of pipe.

No leakage is allowed for welded steel pipe with welded joints.

**18-6.6 Mandrel Test of ABS and PVC Pipe** — Following the placement and densification of backfill and prior to the placing of final pavement, all mainline pipe shall be cleaned and then mandrelled to measure for obstructions (deflections, joint offsets and lateral pipe intrusions). A rigid mandrel, with a circular cross section having a diameter of at least 95 percent of the specified average inside diameter, shall be pulled through the pipe by hand. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe.

All material, equipment and labor to perform the test shall be provided by the Contractor at no cost to the City.

**18-6.7 Field Inspection for RTR and RPM Pipe Deflections** — Installed pipe shall be inspected during construction to ensure that vertical deflections do not exceed

5 percent of the nominal ID. After the pipe had been joined and backfilled, inspection shall be as follows:

The first section of the pipeline that has been installed shall be inspected to ensure that the Contractor's installation procedures result in acceptable vertical deflections. Additional sections shall be inspected to ensure that the specified maximum deflection is not exceeded. If excessive deflections are encountered, the affected pipes shall be re-installed properly. For pipelines with ID's less than 24 inches (600mm), a mandrel shall be used to check deflections. For pipelines 24 inches (600mm) or greater, a method approved by the Engineer shall be used to test vertical deflections, provided the accuracy of the test procedure is  $\pm 1/16$  of an inch (2mm).

## **18-7 Manholes, Cleanouts and Appurtenances**

**18-7.1 General** — These specifications apply to manholes, cleanouts and appurtenance materials.

The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, or on the job site after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Materials rejected after delivery to the job site shall be marked for identification and shall be removed from the job site at once. All materials which have been damaged after delivery, and prior to project acceptance by the Agency, shall be rejected, even if installed. The Engineer's judgement shall be final on the condition of the material. Contractor may attempt to make acceptable repairs on installed material(s), if the Engineer so agrees; however, Engineer's judgment on the acceptability of the repairs will be final, and if not satisfactory, the material shall be removed and replaced with satisfactory material entirely at the Contractor's expense. The Engineer may accept a certification indicating compliance with the specifications in lieu of inspection.

### **18-7.2 Manholes**

**18-7.2.1 Precast Manhole Sections** — Precast manhole sections, where not otherwise modified in the Plans, shall conform to ASTM C478 and meet the following requirements:

- 1) The wall thickness shall not be less than 5 inches for 48-inch diameter barrel sections and 6 inches for 60-inch diameter barrel sections

- 2) All sections shall be fully cured and shall not be shipped nor subjected to loading until the design compressive strength has been reached.
- 3) Precast base sections shall have the base slab integral with the sidewalls. Precast base sections shall be used only if the invert plan and alignment of the sewer connections in the base exactly match the field measured angles between the connecting sewers.

18-7.2.2 Manhole Bases — Materials used in cast-in-place concrete manhole bases shall be in accordance with the applicable requirements of Section 17. At the option of the Contractor and with the approval of the Engineer, precast base sections with integral floor conforming to ATM C 478 may be used.

18-7.2.3 Manhole Extensions — Concrete grade rings for extensions shall be a maximum of 6 inches thick.

In general, manhole extensions will be used on all manholes in roads or streets or in other locations where a subsequent change in existing grade may be likely. Extensions will be limited to a maximum height of 12 inches.

18-7.2.4 Jointing Manhole Sections — Male and female joints of manhole sections shall be sealed with either a round rubber “O”-ring gasket or a preformed flexible joint sealant. The “O”-ring shall conform to ASTM C-443. The preforming flexible joint sealant shall conform with Federal Specification SS-S-00210, and be Kent Seal No. 2 as manufactured by Hamilton-Kent, Ram-Nek as manufactured by K.T. Snyder Company, or equal. The size of the preformed joint sealant shall be as recommended by the manufacturer of the precast manhole sections.

18-7.2.5 Placing Precast Manhole Sections — Precast manhole sections shall be carefully inspected prior to installation. Sections with chips or cracks in the tongue shall not be used. Ends of precast manhole sections shall be cleared of foreign materials.

The precast sections shall be installed in a manner that will result in a watertight joint. Rubber “O”-Ring gaskets or preformed flexible joint sealant shall be installed in strict conformance with the manufacturer’s recommendations. Only pipe primer furnished by the gasket manufacturer will be approved. IF leaks appear in the manholes, the inside joint shall be caulked with non-shrink epoxy mortar to the satisfaction of the Engineer.



**18-7.2.6 Manhole Channels** — Manhole channels shall be constructed as shown on the Plans and with smooth transitions to ensure an unobstructed flow through manhole. All sharp edges or rough sections which tend to obstruct flow shall be removed. Where a full section of pipe is laid through a manhole, a neatly cut half pipe shall be laid to form the channel. The exposed edge of the pipe shall be completely covered with mortar. All mortar surfaces shall be troweled smooth. Breaking out the top half section after installation is not acceptable.

**18-7.2.7 Flexible Joints** — Flexible joints shall be provided not more than two feet from manhole walls. Pipes entering manholes shall be laid on firmly compacted base rock or bedding material as specified.

**18-7.2.8 Covers** — Castings shall conform to ASTM A 48, Class 35. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. The frames and covers shall be asphalt coated. Frames and covers shall be installed on top of manholes to positively prevent all infiltration of surface or groundwater into manholes. Frames shall be set in a bed of mortar with the mortar carried over the flange of the ring as shown on the Plans. Set frames so tops of covers are flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed. Provide a concrete manhole collar as shown on the Plans. Manhole covers shall be stamped with “Storm Drain” or “Sewer” as appropriate.

**18-7.2.9 Manhole Over Existing Sewers** — Manholes shall be constructed over existing operating sewer lines at locations shown. Excavation shall be as specified hereinbefore.

Flow through existing sewer lines shall be maintained at all times and shall be controlled. New concrete and mortar work shall be protected for a period of one day after concrete has been placed.

The new base shall be constructed under and around the existing sewer as specified herein.

The top half of the existing pipe shall be neatly removed within the new manhole, the edges covered with mortar, and troweled smooth.

**18-7.2.10 Connection to Existing Manholes** — Sewers shall be connected to existing manholes. Provide all diversion facilities and perform all work necessary to maintain sewage flow in existing sewers during connection to the manhole such that overflows or backup into house laterals do not occur. Break through existing manhole bases and grout as necessary to provide smooth flow into and through existing manholes. The connection

procedure shall be as follows:

- 1) Break through an opening approximately 6 inches in diameter greater than the outside diameter of the pipe.
- 2) Roughen the surface of the pipe to be encased in the wall by sandblasting or other means. Plastic pipes shall be provided with a waterstop gasket.
- 3) Coat the surface of the existing wall edge and the area of the pipe to be encased with an epoxy bonding agent such as Sikadur Hi-Mod Epoxy Adhesive, as manufactured by the Sika Chemical Corporation, Concessive 1001-LPL, as manufactured by Adhesive Engineering Co., or equal. The grout must be placed while the bonding agent is still tacky.
- 4) Fill the space between the pipe and the existing wall with a non-shrink, non-metallic grout as manufactured by Master Builders, U.S. Grout Corp. (5 Star), or equal. The grout shall have 0.00 percent shrinkage when tested according to the requirements of ASTM C-827 and Fed. Spec. CRD-C 621.
- 5) The pipe shall be shored in place so that there is not possibility of movement during and after the grouting operation. The shoring shall not be removed until the grout has attained a compressive strength of 3,000 psi or higher.

18-7.2.11 Vacuum Testing — All project manholes shall be vacuum tested. Vacuum test procedures and requirements shall be as follows:

- 1) After completion of the manhole barrels but prior to backfilling and grade ring installation, all openings in the manhole are sealed with plugs and a rubber ring “donut” type plug inserted inside the opening of the cone.
- 2) A small vacuum pump is attached to a hose connected to the plug and 4 psi of vacuum applied.
- 3) The vacuum is permitted to stabilize at 3.5 psi for one minute, then the test is begun.
- 4) The manhole must maintain vacuum such that no greater than 0.5 psi of vacuum is lost during the specified test period.
- 5) The specified test period is as follows:

Manhole Depth (Ft.)	Test Period (Min.)
0-5	4.5
5-10	5.5
10-15	6.0
Greater than 15	6.5

- 6) Manholes that fail the test shall be patched as required and re-tested.
- 7) A vacuum regulator shall be provided on the vacuum pump such that no greater than 10 psi can be applied to the manhole during the test. All manholes that do not meet the leakage test, or are unsatisfactory from visual inspection shall be repaired to the satisfaction of the Engineer.

18-7.2.12 Hydrostatic Testing — At the option of the Contractor and with the approval of the Engineer, hydrostatic testing may be substituted for vacuum testing. The test shall consist of plugging all inlets and outlets and filling the manhole near the top with water. Leakage in each manhole shall not exceed 0.1 gallon per hour per foot of head above the invert. All manholes that do not meet the leakage test, or are unsatisfactory from visual inspection, shall be repaired to the satisfaction of the Engineer.

### 18-7.3 Sewer Cleanouts

18-7.3.1 General — Cleanout construction shall be as shown on the Plans. The cleanout shall be the same material as the mainline sewer.

18-7.3.2 Pipe and Fittings — Pipe fittings, including material for drop connections at the manhole, shall be the type and dimensions as shown on the Plans or as specified in the Special Provisions for the Project.

18-7.3.3 Cleanout Frames and Covers — Cleanouts shall be as shown on the plans or the Standard Details and shall be the same type of material as approved for use in main sewer or house connection sewer construction. Castings shall conform to ASTM A48, Class 30B. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. The frames and covers shall be asphalt coated.

## **18-8 Sewer Lateral Rehabilitation**

**18-8.1 General** — Construction shall conform to the following subsections and modifications of the Public Works Specifications:

Active lower lateral sewers, as indicated on the contract drawings, shall be replaced, sliplined, or otherwise rehabilitated. Lateral work shall include installation of a two-way cleanout between the sidewalk and the curb.

**18-8.2 Abandoned House Connection Sewers** — The Contractor shall be responsible for determining if a house connection sewer is abandoned. An abandoned house connection sewer shall be defined as a house connection sewer that does not connect to a house sewer (upper lateral). Abandoned house connection sewers shall be disconnected from the sewer main and the sewer main connection fitting shall be replaced with a straight piece of pipe similar to the existing sewer and approved fittings to make a watertight and airtight replacement. The abandoned house connection sewer shall be removed completely at least 2 feet from the sewer main and the removed pipe shall be disposed of by the Contractor. The remaining house connection sewer shall be plugged with the Class C grout.

**18-8.3 Initial Lateral Inspection** — The initial work of the lateral rehabilitation program shall include televising the entire building lateral (upper and lower) and pulling a sizing pig through the lateral. The results of the initial work shall be provided to the Engineer who will determine if the lateral will be:

- 1) Replaced.
- 2) Sliplined.
- 3) Combination of replacement and sliplining.
- 4) No rehabilitation required. As a minimum, two-way cleanouts near the property line will be installed if not present.

The Engineer reserves all rights and will make the final determination of the rehabilitation method of the lateral. Payment for lateral rehabilitation shall be based on the unit prices provided for lateral inspection, lateral replacement, lateral sliplining, and installation of two-way cleanouts and standard cleanouts.

## **18-8.4 Television Inspection**

**18-8.4.1 General** — Video recordings shall be made of the television inspections and one copy each shall be submitted to the Engineer. One copy of the printed inspection log shall also be submitted to the Engineer.

Television equipment shall include a color television camera, television monitor, cables, power source, lights and other equipment. The television camera shall be specifically designed and constructed for operation in

connection with sewer inspection. The camera shall be operative in 100 percent humidity conditions. Lighting for the camera shall minimize reflective glare. Lighting and camera quality shall be suitable to provide a clear, in-focus picture of the entire inside periphery of the sewer pipe for all conditions encountered during the work. Focal distance shall be adjustable through a range of from 6 inches to infinity. The remote reading footage counter shall be accurate to two-tenths of a foot over the length of the particular section being inspected and shall be mounted over the television monitor. The camera, television monitor and other components of the video system shall be capable of producing a minimum 350 line resolution color video picture. The camera shall be mounted on skids suitably sized for each pipe diameter to be investigated.

18-8.4.2 Installation — The camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition but in no case shall the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall reset up his equipment in a manner so that the inspection can be performed from the new manhole. If, again, the camera fails to pass through the entire section, the Contractor shall, with Engineer's approval, remove the obstruction by excavation and proceed with the television inspection. The Engineer shall determine based on the method of rehabilitation identified for the sewer reach, how and if the exposed line shall be fixed.

#### 18-8.4.3 Documentation of the Television Results

- 1) Television inspection logs shall be typed or printed location reports acceptable to the Engineer. One copy shall be maintained on-site by the Contractor throughout the project. Printed location reports shall clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. In addition, other data of significance including the locations of buildings, suspected sump pump flows and house service connections, joints, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion and other discernible features shall be recorded and a copy of such records shall be submitted to both the agency and the Engineer. Voice recordings on the videotapes shall make brief and informative comments on the sewer conditions.

- 2) The measurement of distance to defects is critical in confirming the locations of areas to be excavated shown on the Plans. The Contractor shall use the following procedure in performing the television inspections:
  - a. A marker or flag shall be attached to the top of the camera yoke.
  - b. The measurements recorded in the log shall be zeroed in alignment with the marker rather than the camera itself, as is the usual practice.
- 3) Color videotape recordings of the internal sewer inspection shall be made by the Contractor. One copy of the videotape in a format approved by the City shall be submitted. The tab to prevent accidental erasure shall be removed from the cassette before submittal.

Videotape recording playback shall be the same speed that it was recorded. Slow motion or stop motion playback features may be supplied at the option of the Contractor. Title to the tape will remain with the Agency. The Contractor shall have all videotapes and necessary playback equipment readily accessible for on-site review by the Engineer during the project.

Tapes shall include the following information:

- a. Data view:

- Report No.
- Date of TV inspection
- Upstream and downstream manhole numbers
- Current distance along reach (tape counter footage)
- Printed labels on tape container and tape cartridge with location information, date, format information, and other descriptive information

- b. Audio:

- Date of TV inspection
- Verbal confirmation of upstream and downstream manhole numbers
- Verbal description and location of each defect
- Verbal description and location of each service connection

**18-8.4.5 Payment** — Payment for preconstruction video-inspection of reaches which have been previously video-inspected is included in the unit cost for the rehabilitation method performed. Payment for preconstruction video-inspection of reaches not previously televised will be based on the unit bid price per linear foot of sewer. Payment for post-construction video-inspection of reaches is included in the unit cost for the rehabilitation method performed.

**18-8.5 Determination of Suitability of Sliplining** — A sizing pig shall be pulled through the existing sewer to ensure that there are no obstructions. The minimum size of pipe for sliplining shall be three inch inside diameter.

The sizing pig shall comprise a pulling head made of steel, attached to a piece of pipe of the same size and material as the liner. A flexible pulling head is not acceptable. A cable shall be attached to the tail of the pig to allow withdrawal if necessary.

If the size pig is scored to a depth equal to or greater than 10 percent of the liner thickness, insertion of the liner shall not be permitted.

#### **18-8.6 Lateral Replacement**

**Lateral Materials** — Lateral materials shall be Polyvinyl Chloride Pipe (PVC) SDR 21 in accordance with ASTM D2241; or Polyethylene Pipe (PE) SDR 21 in accordance with Section 18.3.6 of the Standard Specifications or Vitrified Clay Pipe (VCP), extra strength, bell and spigot rubber gasket joint, in accordance with ASTM C700.

Laterals shall be 4 inch minimum diameter or shall match the size of the existing lateral, whichever is larger.

After replacement, the laterals shall be reconnected to the main sewer line and connected to new cleanouts. Connections to new cleanouts shall be made with mechanical joints or as otherwise directed by the Engineer

Construction of laterals shall conform to Section 18 of the Standard Specifications. Maximum deflection with one fitting shall not exceed 22-1/2 degrees. Long-radius bends shall be used for changes in direction except as otherwise allowed by the Engineer.

The Engineer shall determine the line and grade of replacement laterals. Replacement laterals shall be constructed with a minimum number of changes in grade and direction as possible, regardless of the alignment of the existing lateral. Unless otherwise directed, Contractor shall lay the pipe on a uniform grade between the sewer main and the upstream end of the lateral. Minimum slope

shall be 1/4 inch per foot unless otherwise permitted by the Engineer.

### **18-8.7 Sliplining**

**18-8.7.1 General** — The installation of the polyethylene solid wall sewer pipe liner shall conform to this Standard Specification and to ASTM Specifications F585, D2657, and D2321.

**18-8.7.2 Liner Handling** — The liner shall be handled with care to minimize the possibility of it being cut, kinked, gouged or otherwise damaged. Damage will be assessed in accordance with ASTM F585. Ropes, fabric, rollers, or rubber-protected slings and straps may be used when handling the liner. The use of cables, chains or hooks will not be permitted. Liner shall be stored on level ground or surface, free of sharp objects which could cause damage. The liner shall be pulled on rollers, or otherwise protected from damage during the pulling operation. Sections of the liner damaged, cut, or gouged shall be repaired by cutting out the section of pipe containing the damaged areas and then rejoining the liner sections as specified herein.

**18-8.7.3 Liner Installation** — The Contractor shall insert the liner into the pipe in accordance with ASTM F585, the manufacturer's recommendations, and the shop drawings. A thermal crayon shall be used for providing a fail-safe mechanism for the thermometer to assure proper fusion temperature.

### **18-8.7.4 Joining Systems**

- a. **Butt Fusion.** Sections of the liner shall be joined into continuous lengths on the job site at ground level above the trench. Joining shall be accomplished by butt fusion performed in accordance with the liner manufacturer's recommendations and pertinent sections of ASTM D2657.

Butt fusion shall be accomplished by aligning the sections to be joined in a fixture, softening the ends by heat and then joining them together under controlled pressure. All fusion must be done by personnel trained by the pipe supplier and using tools recommended by the pipe supplier and approved by the Engineer. Joints between pipe sections shall be smooth and internal fusion beads in no case shall be greater than 0.10 inch.

Two joints, selected at random by the Engineer shall be tested in compliance with ASTM D638 to assure that the tensile strength of



the joints equals or exceeds that of the material joined. The specimens to be tested shall be obtained by cutting the liner pipe at least 12 inches on each side of the field-made joint. The ends may then be rejoined and work may proceed.

- b. Mechanical Joints. Where the polyethylene liner is reconnected to the sewer main stubout and to the cleanout, and where the liner must be joined in the trench as approved by the Engineer, the polyethylene pipe shall be joined together with a stainless steel full encirclement clamp.

Clamps shall be 316 stainless steel with a rubber sleeve and shall be of adequate length to protect against pull out. Minimum lengths of clamps are listed below.

Approximate Outside Diameter of the Liner Pipe (inches)	Minimum Length of Clamp (inches)
3.5	7.5
4.5	10
5.5	10

18-8.7.5 Insertion of Liner Pipe — The top of the lateral shall be exposed to the springline for the full length of the access pit prior to the removal of the crown portion. All sharp edges shall be removed from the exposed pipe opening.

18-8.7.6 Stress and Strain Relief of Polyethylene Liner Pipe — Stress and strain relief shall be provided for as part of lateral sliplining.

18-8.7.7 Sealing Entire Annular Space Between Liner and Pipe Wall — The Contractor shall grout the entire annular space between the liner and pipe wall with Class “E” mortar specified in Subsection 201-5 of the Public Works Specifications. The grout shall have a water/solids ratio of 0.35 to 0.40. The workability shall be measured by the Corps of Engineers test method C 611; and shall satisfy a range of 10 to 30 seconds.

Grouting procedure shall conform to Subsection 306-3.8 of the Public Works Specifications. The grout shall be supplied to the pump continuously and shall be placed in such a manner that it will not place any undue stresses on the polyethylene liner.

The Contractor shall utilize special procedures including pressure relief

valves on the grout pumping apparatus, as necessary, to ensure that the liner does not rise off the existing sewer invert nor is deflected out-of-round during placement and curing of the grout. The use of water to fill the liner prior to grouting is an acceptable method to prevent flotation. If the liner is not filled with water, the grout pressure at the point of injection shall not exceed 7 psi.

Grouting shall be considered complete when the quantity of grout pumped is between 90 and 120 percent of the annular space volume.

**18-8.7.8 Cleanout Installation** — All upper laterals that are rehabilitated and all lower laterals that are replaced shall have two-way cleanouts as shown on the Plans. Existing cleanouts shall be removed and shall be replaced with new cleanouts.

Temporary reconnection or pumping shall be done as necessary to maintain service during rehabilitation of laterals. Cleanouts shall not be installed until laterals have been rehabilitated.

If the lateral is sliplined, the clean out shall be either PVC pipe or polyethylene liner pipe as approved by the Engineer. All cleanout plumbing shall have an inside diameter within 15 percent of the liner inside diameter. Transition from house plumbing to the cleanout fitting shall be made with a ductile iron or polyethylene fabricated reducer.

Cleanouts shall be constructed as shown in the Standard Details. If the lateral is replaced, the cleanout shall be the same dimension and material as the replacement sewer pipe. All joints shall be made watertight and airtight. The Contractor shall submit to the Engineer shop drawings of all materials used in constructing cleanouts.

## **18-9 Control of Existing Flows**

**18-9.1 Sewer Flow Control** — Flow in the existing sewers shall not be restricted or dammed for any period of time without the approval of the Public Works Director. All manhole connections shall be constructed while sewage is flowing in the existing pipe. All rerouting and/or bypass pumping of existing flows necessary to make the required modifications shall be made at the Contractor's expense. The Contractor must advise the Engineer of plans for diverting sewage flow and obtain Engineer's approval before starting. Engineer's approval shall not relieve Contractor of the responsibility for maintaining adequate capacity for flow at all times and adequately protecting new and existing work.

Bypassing of untreated wastewaters to surface water or drainage courses will not be permitted. All wastewater facilities will remain in continuous and full

operation during construction.

Where temporary pumps are required to bypass any sewage across traffic lanes, the discharge lines crossing the traffic lanes shall be buried a minimum of 4 inches below the pavement surface and backfilled with temporary asphalt concrete surfacing.

### **18-10 Trench Resurfacing**

**18-10.1 Temporary Resurfacing** — Unless permanent pavement is placed immediately, temporary bituminous resurfacing 2 inches (50mm) thick shall be placed and maintained at locations determined by the Engineer wherever excavation is made through pavement, sidewalk or driveways. In sidewalk areas the temporary bituminous resurfacing shall be at least 1 inch (25mm) thick; in all other areas it shall be at least 2 inches (50mm) thick. At major intersections and other critical locations, a greater thickness may be ordered. Temporary resurfacing shall be placed as soon as the condition of the backfill is suitable to receive it and shall remain in place until the condition of the backfill is suitable for permanent resurfacing.

The bituminous mixture used for temporary trench resurfacing shall conform to Class D, Fine, Type #, Asphalt Concrete, and of bitumen conforming to grade SC-800 liquid asphalt.

The mixture may be furnished from stockpiles or directly from the plan mixer and may be laid cold, at the option of the Contractor. The resurfacing shall be placed, rolled, maintained, and removed and disposed of by the Contractor.

**18-10.2 Permanent Resurfacing** — Unless otherwise shown on the Plan or in the Specifications, all surface improvements damaged or removed as a result of the Contractor's operations shall be reconstructed by the Contractor to the same dimensions, except for pavement thickness, and with the same type materials used in the original work. Trench resurfacing shall be 1 inch (25mm) greater in thickness than existing pavement, or 3 inches, whichever is greater.

**18-11 Measurement & Payment** — Pipe and conduit shall be measured along the longitudinal axis between the ends as laid and shall include the actual pipe in place and shall not include the inside dimensions of structures. House connection sewers shall be measured from the inside face of the "Y" of the main to the inside face of conduit or structure to which connection is being made.

The price per linear foot (m) for pipe and conduit in place shall be considered full compensation for all wyes, tees, bends, monolithic catch basins, and special appurtenances as shown on the Plans; the removal of interfering portions of existing sewers, storm drains, and improvements; the closing or removing of abandoned conduit

and structures; the excavations of the trench; the control of ground and surface waters; the preparation of subgrade; placing and joining pipe; backfilling the trench; permanent resurfacing; and all other work (excluding temporary resurfacing) necessary to install the pipe or conduit, complete in place.

Payment for structures such as manholes, clean outs, junction structures, lamp holes, and catch basins shall be made at the price bid for each structure and shall be full payment for each structure complete in place, including excavation, backfill, constructing inverts, furnishing and installing castings, restoration of the street surface and all other work, excluding temporary resurfacing, necessary to complete the Work.

# CITY OF ALBANY

## Standard Specifications Technical Provisions

### Section 19

#### Landscape Irrigation

##### **19-1 General**

###### **19.1.1 Scope**

Furnish all labor, tools, equipment, materials, transportation, and perform all operations necessary for the proper execution and completion of all irrigation work in accordance with the Drawings and Specifications. The work shall include, but not necessarily be limited to, trenching and backfill, water and electrical points of connection, backflow preventers, controllers, sleeves, conduits, main lines, lateral lines, remote control valves, pressure reducing valves, hose bibs, quick couplervalves, gate valves, risers, heads, emitter flush valves, emitters, emitter line and tubing, testing, adjustment of heads, maintenance and providing as-built drawings.

Coordinate installation of irrigation system with layout and installation of the plant materials to insure that there will be complete and full irrigation coverage of planting in accordance with these drawings, specifications and contract documents. Irrigation system shall be installed and tested prior to installation of plant material.

The “Model Water Efficient Landscape Ordinance” by the State Department of Water Resources shall apply.

###### **19-1.2 Related Work**

Section 020: Landscaping

**19-1.3 Applicable Publications** — The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. Federal Specification (Fed. Spec.):

- WW-H-001220      Head, Sprinkler, (Underground Connection)
- WW-V-51F          Valve, Angle, Check and Globe, Bronze; 125-, 150-, and 200-pound, Threaded End, Flange Ends, Solder Ends, and Brazed End, for Land Use.
- WW-V-54D          Valve, Gate, Bronze (125-, 150-, and 200 pound, Int Am 3 Screwed, Flanged, Solder End, for Land Use)
- B.      American National Standards Institute (ANSI) Publications:
- B2.1-68              Pipe Threads (Except Dryseal) Specifications, Dimensions and Gauging for Taper and Straight Pipe Threads, Including Certain Special Application
- B16.3-77             Malleable Iron Threaded Fittings, Class 150 and 300.
- C.      American Society for Testing and Materials (ASTM) Publications:
- A53-81A             Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- A120-81             Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses.
- B61-80               Steam or Valve Bronze Castings
- B62-80               Composition Bronze or Ounce Metal Castings
- D1785-76            (Poly Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2241-80            (Poly Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
- D2287-81            Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- D2464-76            Threaded (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- D2466-78            (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

- |           |  |
|-----------|--|
| D2467-76A | Socket-Type (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80         |
| D2564-80  | Solvent Cements for (Poly Vinyl Chloride) (PVC) Plastic Pipe and Fittings.         |
| D2774-72  | Underground Installation of Thermoplastic (R1978) Pressure Piping                  |
| D2855-81  | Making Solvent-Cemented Joints with (Poly Vinyl Chloride) (PVC) Pipe and Fittings. |
- D. American Society of Sanitary Engineering (ASSE) Publications:
- |         |                                      |
|---------|--------------------------------------|
| 1013-80 | Reduced Pressure Backflow Preventers |
| 1003-1  | Pressure Reducing Valve              |
- E. American Water Works Association (AWWA) Publications:
- |         |   |
|---------|---|
| C506-78 | Standard for Backflow Prevention Devices-Reduced Pressure Principle and Double Check Valve Types                              |
| C601-81 | Standard for Disinfecting Water Mains   |
| C800-66 | Standard for Threads for Underground Service Line Fittings - with Appendix on Collected Standards for Service Line Materials. |
- F. International Association of Plumbing and Mechanical Officials:  
Uniform Plumbing Code - 1979 (UPC)
- G. National Fire Protection Association (NFPA) Publications:
- |         |  |
|---------|--|
| NFPA 24 | Standard for Outside Protection - 1977 |
| NFPA 70 | National Electrical Code - 1981        |
- H. National Sanitation Foundation (NSF) Publications:
- |               |   |
|---------------|---|
| STD No. 14-78 | Plastic Piping System Components and Related Material |
|---------------|---|
- I. Plastic Pipe Institute (PPI) Publication:

**19-1.4 Submittals**

- A. The following items shall be submitted to the City for review:
1. Materials List
  2. Shop Drawings
  3. Manuals
  4. As-built Drawings
  5. Controller Charts
- B. Controller Charts
1. As-built drawings shall be approved by the City before controller charts are prepared.
  2. Provide one controller chart for each controller controlling this area.
  3. The chart shall show the area controlled by the automatic controller and shall be the maximum size which the controller door will allow.
  4. The chart is to be a reduced drawing of the actual as-built system. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable when reduced.
  5. The chart shall be a blackline or blue line ozalid print and a different color shall be used to indicate the area of coverage for each station.
  6. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum of 10 mils.
  7. These charts shall be completed and approved prior to final inspection of the irrigation system.

**19-1.5 Explanation of Drawings**

- A. Due to the scale of the drawings, it is not possible to indicate all off-sets, fittings, sleeves, etc. which may be required. The Contractor shall carefully



investigate the structural and finished conditions affecting all of this work and plan his work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between existing and contract installation of irrigation systems, planting including existing trees and shrubs, architectural features, above and below grade utilities, hydrants, and drainage system.

The Contractor shall be responsible for modifications to the irrigation system to prevent blockage of sprinkler irrigation patterns; to prevent overspray and excessive runoff onto walkway and parking areas; and to provide full irrigation coverage to the planted areas.

Modifications shall be reviewed by the City prior to installation. All costs associated with modifications to the irrigation system and verification of utility and underground structure locations including potholing shall be considered as included in the Contract Prices paid for the various items of work and no additional compensation will be made therefor. Damage to utility lines, underground structures, etc., shall be repaired at the Contractor's expense to the satisfaction of the City.

- B. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.
- C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering or that will affect layout of the planting. Such obstructions or differences should be brought to the attention of the City. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.

#### **19-1.6 Equipment to be Furnished**

- A. Supply as a part of this contract the following tools:
  - 1. Two (2) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
  - 2. Two (2) keys for each automatic controller.
  - 3. Two (2) keys for each controller enclosure.

4. Six (6) quick coupler keys and matching hose swivels for each type of quick coupling valve installed.
5. Two (2) keys for the hose bib.
6. The above mentioned equipment shall be turned over to the City at the conclusion of the project. Before final inspection can occur, evidence that the City has received material must be shown by the Contractor.

**19-1.7 Handling of PVC Pipe and Fittings** — The Contractor is cautioned to exercise care in handling, loading, unloading, and storing of PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping.

**19-1.8 Verification of Site Conditions & Surveys**

Contractor shall, to the satisfaction of the City, lay out the work from the plans and shall establish all bench marks, monuments, lines and levels necessary for the construction covered by this contract unless otherwise specified herein. The Contractor shall employ a qualified land surveyor registered in the State of California, to lay out the work and to verify the lines and elevations as the work progresses. All dimensions shall be checked against existing conditions and discrepancies reported immediately to the City. Contractor shall be responsible for establishment of basic layout of entire area to the satisfaction of the City prior to beginning any portion of construction. Any discrepancies arising from preliminary layout shall be resolved prior to construction. During the progress of construction, the Contractor shall provide surveying service as necessary, or upon request of the City, to assure that the construction complies with the plans and specifications.

Prior to installation, Contractor shall carefully check all grades to satisfy himself that the work may proceed.

**19-2 Materials**

**19-2.1 General** — Use only new materials of brands and types noted on the drawings, specified herein, or approved equals.

**19-2.2 PVC Pressure Main Line Pipe, Fittings and Fabrication Materials**

- A. Pressure main line piping for sizes 1-1/2" and larger, shall be Ring-Tite PVC Class 200.

Ring Tite Pipe: Pipe shall be made from an NSF approved Type I, Grade I, PVC compound conforming to ASTM specification D1784. All pipe must meet requirements as set forth in Federal Specifications PS-22-70, with an appropriate standard dimension (S.D.R.).

- C. Field fabrication of ring-tite fittings will not be allowed. Use molded ring-tite type fittings for PVC as manufactured by Flo Control or approved equal.
- D. Pressure main line piping for sizes 2" and smaller shall be PVC Schedule 40 with solvent-weld joints.
- E. Solvent Weld Pipe: Pipe shall be made from NSF approved Type I, Grade PVC compound conforming to ASTM specification D1785. All pipe must meet requirements as set forth in Federal Specification PS-21-70.
- F. PVC solvent-weld fittings shall be Schedule 40, 1-2, II-I NSF approved conforming to ASTM test procedure D2466.
- G. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer.
- H. All PVC pipe must bear the following markings:
  - 1. Manufacturer's name
  - 2. Nominal pipe size
  - 3. Schedule of class
  - 4. Pressure rating in P.S.I.
  - 5. NSF (National Sanitation Foundation) approval.
  - 6. Date of extrusion
- I. All fittings shall bear the manufacturer's name or trademark, material designation, size applicable I.P.S. schedule and NSF seal of approval.

### **19-2.3 PVC Non-Pressure Lateral Line Piping**

- A. Non-pressure buried lateral line piping shall be PVC Type 1120 - Class 315 for 1/2 inch and Class 200 for 3/4 inch and larger. Joints to be solvent welded.
- B. Pipe shall be made from NSF approved, Type I, Grade II PVC compound conforming to ASTM specification D1784. All pipe must meet requirements set forth in Federal Specification PS-22-70 with an appropriate standard dimension ratio.

- C. Except as noted in 19-2.2 A and B this section, all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure main line pipe and fittings as set forth in section 19-2.2 of this section.

#### **19-2.4 Quick Coupling Valves**

- A. Quick coupling valves shall have a brass, two piece body, designed for working pressure of 150 P.S.I. operable with quick coupler. Key size and type shall be as shown on the plans.
- B. Quick coupling valves shall be installed from 6" to 12" from nearest adjacent paved area.

#### **19-2.5 Hose Bibs**

- A. Hose bibs shall be brass construction with removable key handle as indicated on plans.

#### **19-2.6 Gate Valves**

- A. Gate valves 3" and larger shall be iron body, bronze mounted, double discs, parallel seats with pin disc spreader mechanism and shall conform to the specification of the American Water Works Association.
- B. Gate valves 3" and larger shall have 2" square operating nut, with arrow cast in metal indicating direction of opening.
- C. Gate valves 3" and larger shall have ends compatible with pipe in which they are being installed.
- D. Gate valves 3" and larger shall be similar to those manufactured by Kennedy Valve Mfg. Co., or approved equal.
- E. Gate valves 2-1/2" and smaller shall be bronze construction, screwed connections, equipped with operating wheel, and similar to those manufactured by Stockham Valve Co., or equal.
- F. All gate valves shall be installed per installation detail.

#### **19-2.7 Control Wiring**

- A. Connections between the automatic controllers and the electrical control valves shall be made with single strand, direct burial solid copper wire AWG-U.F., 600 volt. Install in accordance with the valve manufacturer's

specifications and wire chart. In no case shall wire size be less than #14 gauge.

- B. Control wires shall have an insulating jacket with a color that is unique for each controller. The common wire shall have a white insulating jacket with a stripe of color to match the control wire it serves. The spare wire shall have an insulating jacket with a color that is different from all control or common wires.
- C. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible.
- D. All wiring shall be run inside a conduit. Conduit for conductor wire shall be as specified by Section 19-2.13.
- E. An expansion curl shall be provided within three (3) feet of each wire connection and at least every 100 feet in length. Expansion curls shall be formed by wrapping at least five turns of wire around a one inch diameter pipe, then withdrawing pipe. Expansion curl shall be of sufficient length at each splice connection at each electric control valve, so that in case of repair, the valve bonnet may be brought to the surface without disconnection of the control wires.
- F. All splices shall be made in a valve or splice box with 3M-DBY wire splice pack, DS-400 Dri-Splice Wire, or approved equal. Use one splice per connector sealing pack.
- G. Field splices between the automatic controller and electrical control valves will not be allowed without prior approval of the City.

#### **19-2.8 Automatic Controllers**

- A. Automatic controllers shall be of size and type shown on the plans, Rainbird, or approved equal.
- B. Final location of automatic controllers shall be approved by the City.
- C. Unless otherwise noted on the plans, the 120 volt electrical power to the automatic controller location is to be furnished by a licensed electrical subcontractor and not by the irrigation subcontractor. The final electrical hook-up shall be the responsibility of the irrigation contractor.
- D. Label each new control line wire at controller. See installation section of these specifications.

- E. All controllers shall be equipped with a rain sensing override device.

#### **19-2.9 Electrical Control Valves**

- A. All electrical control valves shall be as listed on the drawings.
- B. All electrical control valves shall have a manual flow adjustment.
- C. Provide and install one control valve box for each electric control valve. Box to be lockable.
- D. Label control line wire at each valve. See installation section of these specifications.

#### **19-2.10 Control Valve Boxes**

- A. Use 10" round valve box with extension and bolt down cover for all gate valves and quick coupling valves, Carson Industries 910-12B or approved equal. Box to be bolt lockable.
- B. Use 11 3/4" x 17" x 12" rectangular box and bolt down cover for all electrical control valves, Carson Industries 1419-12B or approved equal. Box to be bolt lockable.

#### **19-2.11 Sprinkler Heads**

- A. All sprinkler heads shall be Champion, approved equal, or as listed on the drawings.
- B. Spray heads shall have a manual screw flow adjustment.
- C. Riser units shall be fabricated in accordance with the details shown on the plans.
- D. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.
- E. All sprinkler heads shall be brass and of the same type shall be by the same manufacturer.

#### **19-2.12 Sleeves**

- A. All water lines installed under paving or through architectural features shall be installed in Class 200 PVC pipe. Size as required, unless specified otherwise on Drawings.

- B. Sleeves shall extend 12" beyond edges of pavement.
- C. There shall be no ring tite couplings inside of sleeves.
- D. Where length of sleeve exceeds 15' in length and where ring tite pipe is designated to be installed at sleeve location, substitute class 315 solvent weld pipe and Schedule 40 solvent weld fittings inside sleeve.
- E. Coordinate sleeve and pipe locations with other trench work and paving installations prior to construction.

#### **19-2.13 Conduit**

- A. All low voltage electrical wire shall be installed in schedule 40 PVC gray conduit. Size as required unless specified otherwise on the drawings. 120 volt electrical wires shall be installed in conduit in accordance with applicable codes and regulations.
- B. Conduit shall extend into splice boxes, or other enclosures. Where splice box is located in paved area, provide capped stub-out conduit piece extending out from box at least 12" into planting bed area.
- C. Splice boxes which must be installed in paved areas are to be concrete valve boxes approved by the City. Boxes shall not be installed in streets, driveways, or in locations where there is vehicular traffic.
- D. Coordinate conduit locations with other trench work and paving installations prior to construction.

#### **19-2.14 Backflow Prevention Device**

19-2.14.1 Reduced Pressure Type Backflow Preventer — ASSE 1013, backflow preventer shall be of the reduced pressure principle type conforming to the applicable requirements of AWWA C506. A certificate of Full Approval or a current Certificate of Approval shall be furnished for each design, size, and make of backflow preventer being provided for the project. The certificate shall be from the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, and shall attest that this design, size and make of backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. A Certificate of Provisional Approval will not be acceptable in lieu of the above.

Reduced pressure type backflow preventer shall be Febco 825Y, Wilkins Model 575R, or approved equal in accordance with the Details.

The backflow preventer shall be installed in an enclosure as detailed on the plans.

19-2.14.2 Double Check Valve Assembly — Double check valve assembly shall be a Febco No. 805, Hershey No. 1 or approved equal, in accordance with the Details. Install check valve in a concrete box with lockable reinforced concrete lid.

**19-2.15 Flushing End Plug**

- A. Provide and install one flushing end plug at the end of each lateral in the drip irrigation system shown on the plans.
- B. Install flushing end plug in a Carson Box No. 910-12B.

**19-2.16 Pressure Reducing Valve**

- A. Pressure reducing valve shall be Wilkins Model 90 - 3/4", or approved equal. Discharge pressure is to be set at 30 PSI.

**19-2.17 Filter**

- A. Filter shall be installed on emitter manifold and shall be Irri-Delco 3/4"-39-0 filter with 155 mesh stainless steel screen and flush valve, or approved equal. Install emitter manifold assembly in a lockable box.

**19-2.18 Pressure Gauge**

- A. Pressure gauge shall be Irrrometer model 7-100 (0-100 PSI), or approved equal.

**19-2.19 Emitter Riser**

- A. Emitter riser shall be 1/2" IPS Flexible Hose (.840 O.D.) Use only IPS Weld-on #795 solvent weld cement on this hose.

**19-2.20 Emitter Assembly**

- A. Single Outlet Emitter: Emitter assembly shall consist of a 1/2" Sch. 80 PVC Male adapter (gray), a Salco RA 125T Adapter or approved equal, and a Salco emitter or approved equal.
- B. Multiple Outlet Emitter: Emitter assembly shall consist of a 1/2" Sch. 40 PVC Male Adapter, a RA 125T, 1/2" adapter, a Salco PC6-1 Multi-Outlet Emitter, Salco Distribution Tubing #CT-125 PVC, Salco EOCV Emitter



Outlet Check Valves on Tips of Distribution Tubing and a Salco DAS-8 Emitter Access Sleeve, all products as specified or approved equal.

### **19-3 Preparation**

#### **19-3.1 Physical Layout**

- A. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads.
- B. Coordinate drip, bubbler and spray system with approved plant layout prior to installation of any irrigation piping.
- C. All layout shall be approved by City prior to installation.

#### **19-3.2 Water Supply**

- A. Sprinkler irrigation system shall be connected to water supply points of connection as indicated on the drawings.
- B. Connections shall be made at approximate locations as shown on drawings. Contractor is responsible for minor changes caused by actual site conditions.

#### **19-3.3 Electrical Supply**

- A. Electrical connections for automatic controller wiring shall be made to electrical service points as indicated on the drawings.
- B. Connections shall be made at approximate locations as shown on drawings. Contractor is responsible for minor changes caused by actual site conditions.

### **19-4 Execution**

**19-4.1 General** — Contractor is responsible for coordinating work with paving installations and/or removal and repair of all asphalt and/or concrete paving necessary to install the irrigation system as shown on the plans which are a part of these contract documents. Contractor shall coordinate all work within public right-of-ways with the appropriate agencies and City. Removal and repair of paving shall be completed under the direction and approval of the City and appropriate agencies and shall be installed in accordance with City/County Specifications and applicable codes.

**19-4.2 Trenching** — Trenching shall be in accordance with Section 18-1 of these Technical Provisions and as specified herein.

- A. Dig trenches straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow layout indicated on drawings and as noted.
- B. Where it is necessary to excavate adjacent to existing trees, the Contractor shall use all possible care to avoid injury to trees and tree roots. Excavation in areas where two (2) inch and larger roots occur shall be done by hand. All roots two (2) inches and larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and heavily wrapped with burlap and kept damp, to prevent scarring or excessive drying. Where a ditching machine is run close to trees having roots smaller than two (2) inches in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making clean cuts through. Roots one (1) inch and larger in diameter shall be painted with two coats of Tree Seal, or equal. Trenches adjacent to trees should be closed within twenty four (24) hours; and where this is not possible, the side of the trench adjacent to the tree shall be kept shaded with damp burlap or canvas.
- C. Subgrade of all trenches shall be flush with the adjoining subgrade. The sprinkler irrigation contractor shall set in place, cap and pressure test all piping to be under paving prior to the paving work.
- D. Generally, piping under existing walks is to be done by jacking, boring or hydraulic driving, but where any cutting or breaking of sidewalks and/or concrete is necessary, it shall be done and replaced by the Contractor as part of the contract cost. Permission to cut or break sidewalks and/or concrete shall be obtained from the City. No hydraulic driving will be permitted under concrete paving. When pavement removal is approved by the City, removal and replacement shall be in accordance with other applicable provisions of these Technical Provisions.

Minimum cover requirements over:

- 1. Non pressure lines: 18"
- 2. Pressure main lines: 24"
- 3. Control wiring: 24"
- 4. All pipe and conduit under asphalt roadways: 36"
- 5. All pipe and conduit under concrete roadways or asphalt pedestrian or bike paths 24"

**19-4.3 Backfilling** — Backfilling shall conform to Section 18-2 and 18-5 of these Technical Provisions and as specified herein.

- A. The trenches shall not be backfilled until all required tests are performed.
- B. A 6" layer fine granular material backfill will be initially placed on all lines. No foreign matter larger than one-half (1/2) inch in size will be permitted in the initial backfill. Remainder of backfill shall be excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, or other approved materials, free from large clods of earth or stones. Backfill shall be mechanically compacted according to Section 18. Backfill will conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.
- C. Flooding of trenches will be permitted only with approval of the City.
- D. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the City.

**19-4.4 Assemblies**

- A. Routing of sprinkler irrigation lines as indicated on the drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform with the details and plans.
- B. Install NO multiple assemblies from PVC mainlines. Provide each assembly with its own outlet.
- C. Install all assemblies specified herein in accordance with the respective details. In absence of details or specs pertaining to specific items required to complete work, perform such work in accordance with best standard practice and with prior approval of the City.
- D. On PVC to metal connections, the Contractor shall work the metal connections first. Permatex 51 pipe joint compound or approved equal, shall be used on all threaded PVC to PVC, and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Use no pipe joint compound on threaded connections at sprinkler inlets.

**19-4.5 Line Clearance** — All lines shall have a minimum clearance of six (6) inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.

## **19-4.6 Pipe**

### **A. PVC:**

1. Pipe shall be cut with a fine tooth hacksaw or approved PVC cutting tool and any burrs shall be removed. The outside surface of the pipe and the inside surface of the fittings shall be wiped with a clean cloth saturated with methyl isobutyl ketone (MIBK) to remove all dirt and moisture before the cement solution is applied. The cement solution shall be applied to the pipe and fitting socket with a brush having a width approximately three-quarters the depth of the socket. The cement solution shall be applied freely with a light wiping action to spread the cement uniformly over the surfaces. The pipe surface of fitting socket shall not be rubbed with a brush any more than is necessary to spread the cement. If the cement thickens, it shall be discarded.
2. Immediately after the cement has been applied to the surface to be joined, the pipe shall be inserted into the fitting with a twisting motion to the full depth of the fitting socket. Immediately after joining is completed, any excess cement shall be thoroughly wiped from the pipe and fitting. The joined members shall be allowed to cure for at least 5 minutes before they are handled. In cold or damp weather, the curing period shall be increased due to slower evaporation of the solvent. An additional fitting or pipe section may be added to the completed joint within 3 minutes if care is exercised in handling so that a strain is not placed on the previous joint. The male pipe threads of all threaded connections on PVC plastic pipe shall be coated with Permatex #51 pipe joint compound or a joint compound suitable for use with plastic pipe.
3. Except as shown on the plans, PVC plastic pipe placed in a trench shall be laid on level, undisturbed, or well-compacted earth and solvent-weld pipe shall be snaked from side to side in the trench at intervals of approximately 50 feet. Pipe shall be held down between joints with small mounds of earth to prevent movement. After completing the pressure tests on the pipelines and before any backfill is placed, water shall be run through the entire line until the pipe has been cooled to the supply water temperature. The trench shall be immediately backfilled, covering the pipe with soft earth to prevent damage to the pipe from rocks or clods.
4. There shall be no ring tite couplings inside of sleeves.
5. Where length of sleeve exceeds 15' in length and where ring tite

pipe is designated to be installed at sleeve location, substitute class 315 solvent weld pipe and Schedule 40 solvent weld fittings inside sleeve.

**B. Thrust Blocks:**

1. Thrust blocks shall be provided where necessary to resist system pressure on ring-tite gasketed pipe and fittings. Blocks shall be concrete and the size shall be based on an average soil safe bearing load of 2,000 lbs/s.f.
2. Form thrust blocks in such a manner that concrete comes in contact only with the fittings. Thrust blocks shall be between solid undisturbed soil and the fittings.

**19-4.7 Remote Control Valves**

- A. Install where shown on drawings and details and in accordance with manufacturer's specifications. When grouped together, allow at least eighteen (18) inches between valves. Install each remote control valve in a separate valve box.
- B. Provide each assembly with its own outlet; no multiple assemblies will be allowed.
- C. Remote control valves shall be adjusted so the sprinkler heads operate at the pressure recommended by the head manufacturer and so a uniform distribution of water is applied by the sprinkler heads to the planting area for each individual valve system.
- D. Label control line wire at each valve with a 2-1/4" X 2-3/4" polyurethane I.D. tag, indicating identification number of valve (controller and station number). Attach label to control wire.

**19-4.8 Quick Coupling Valves**

- A. Install as detailed on the drawings.

**19-4.9 Hose Bib**

- A. Install as detailed on the drawings.

#### **19-4.10 Valve Boxes**

- A. All valve boxes shall be set to finish grade in lawn areas and 2 inches above finish grade in ground cover areas.
- B. Valve boxes located near walks, curbs, and header boards, shall be installed in such a way as to align with those items, squarely if rectangular in shape, and with top surface matching plane as items listed above.
- C. Install boxes 12" away from and perpendicular to adjacent improvements. At multiple valve box groups, install boxes 6" apart, measured at finish grade surface. Short side of box shall be parallel to adjacent improvement.

#### **19-4.11 Flushing of System**

- A. After all new sprinkler pipe lines and risers are in place and connected, all necessary diversion work has been completed, and prior to installation of sprinkler heads, the control valves shall be opened and a full head of water used to flush out the system.
- B. Sprinkler heads shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the City.

#### **19-4.12 Automatic Controller**

- A. Install as per the plans and details and manufacturer's instructions. Remote control valves shall be connected to controller in numerical sequence as shown on the drawings.
- B. Label each new control line wire at controller with a permanent non-fading label indicating station number of valve controlled. Attach label to control wire.

#### **19-4.13 Low Voltage Control Wiring**

- A. A single common wire as previously described in these specifications, shall be installed from the controller to the control valves in series.
- B. For each control valve, install separate control wires as previously described in these specifications, from the Controller to each control valve serviced by the controller.
- C. A single spare wire as previously described in these specifications, shall be installed from the controller and stubbed into each valve box in series. The spare wire is not to be connected to any equipment at the time of

installation.

**19-4.14 High Voltage Wiring for Automatic Controller**

- A. A 120 volt power source and service switch for the automatic controller shall be provided by the electrical subcontractor. The irrigation subcontractor shall install the wires from the 120 volt power service switch to the controller.
- B. All electrical work shall conform to local codes, ordinances and union authorities having jurisdiction.
- C. The Contractor shall provide and install the service unit and meter socket and make the connection between the power source and the controller.
- D. Adequate coverage and protection of the 24 volt service wire leading from the controller shall be maintained from the bottom of the controller.

**19-4.15 Testing** — After the entire sprinkler system has been completely installed, a complete test of the entire installation shall be made by the Contractor in the presence of the City before final acceptance of the system by the City.

- A. Testing of Service Lines:
  - 1. After the pipe has been backfilled to 12 inches over the top, each section of the pipe to be tested shall be slowly filled with water and all air shall be expelled from the pipe. The valves controlling the admission of water into the section of pipe to be tested should be opened wide before shutting hydrants or blow-offs. After the system has been filled with water and all air expelled, all valves controlling the section to be tested shall be closed and the line be allowed to set for a period of not less than 24 hours.
  - 2. The pipe shall then be refilled, if necessary, and subjected to a pressure of not less than 150 lbs per square inch or the service pressure plus 50 pounds, whichever is greater for a period of four hours.
  - 3. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test. Any cracked or defective pipe, fittings, or valves discovered during the test shall be removed and replaced with sound material and the test repeated until the system is proved satisfactory by the City.
  - 4. For a 4 hour hydrostatic test, the allowable leakage in gallons is

equal to diameter (inches) x length (feet) x 0.00158.

5. The test water shall be left in the mains until backfilling operations are completed.
6. After backfilling is completed, and before pavement sections are installed, the test shall be run again and no section shall be allowed a leakage greater than that of the 4 hour hydrostatic test.

**B. Testing Plastic Pipe:**

After all new sprinkler piping and risers are in place and connected, and all necessary division work has been completed and prior to the installation of sprinkler heads, control valves shall be opened and a full head of water used to flush out the system. After the system is thoroughly flushed, risers shall be capped off and the system pressure tested. At drip system, cap tees before flexible riser is installed. Request the presence of the City in writing at least 72 hours in advance of testing. All testing shall be done in the presence of the City or the City's authorized representative. Apply a continuous static water pressure of 120 p.s.i. on main lines and 60 p.s.i. on lateral lines when welded plastic joints have cured at least 24 hours and with the risers capped as follows:

1. Test main lines and submains for 4 hours.
2. Test lateral lines for 2 hours.
3. Repair leaks resulting from tests. Pressure testing shall continue until no leakage or loss of pressure is shown over the entire prescribed test period. At the conclusion of the pressure test, the heads, flexible risers and emitters shall be installed and tested for operation in accordance with design requirements under normal operating pressure.

**19-4.16 Testing of Electrical System** — Prior to acceptance of the work, the Contractor shall cause the following tests to be made:

- A. For continuity of each circuit.
- B. For grounds in each circuit.
- C. A megger test on each circuit.
- D. A functional test in which it is demonstrated that each and every part of the system functions as specified or intended herein.



#### **19-4.17 Sprinkler Heads**

- A. Install the sprinkler heads as designated on the drawings. Sprinkler heads to be installed in this work shall be equivalent in all respects to those itemized.
- B. Spacing of heads shall not exceed the maximum indicated on the drawings. In no case shall the spacing exceed the maximum recommended by the manufacturer.
- C. Nozzles on stationary sprinklers shall be tightened after installation and sprinklers having an adjustment stem shall be adjusted on a lateral line for the proper radius, diameter and/or gallonage. They shall be set perpendicular to finish grade.
- D. Trim sprinkler heads around existing utility company boxes and other obstructions.

#### **19-4.18 Adjustment of the System**

- A. The Contractor shall flush and adjust all sprinkler heads for optimum performance and to prevent over-spray onto walks, roadways, and buildings as much as possible.
- B. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments after approval by the City, prior to planting. Adjustments may also include changes in nozzle or screen sizes and degrees of arc as required. Contractor is responsible for providing full coverage of all planted areas, with no flooding or dry spots.
- C. Lowering raised sprinkler heads by the Contractor shall be accomplished within ten (10) days after notification by the City.
- D. The irrigation system shall also be tested at the time of final inspection for planting. If in the opinion of the City, any portion of the irrigation system is found to be defective or damaged the Contractor shall make all required repairs or replacement to meet the requirements of the irrigation specifications at no additional cost to the City. The Contractor shall make repairs within two weeks after planting final inspection.

#### **19-5 Maintenance**

- A. Plant maintenance following project installation is included in the contract and it shall begin on the date the work is accepted by the Director of

Public Works as complete.

- B. The plant maintenance period shall be as specified in the Special Provisions. If not specified, the minimum period shall be 180 days.
- C. The irrigation system shall be maintained, repaired and adjusted as required by the Contractor during the plant maintenance period. Soil moisture at the plant root balls in each watering zone shall be checked prior to watering. The Contractor shall be responsible for adjusting watering cycles so that plants receive sufficient water to ensure vigorous growth without allowing soil to become oversaturated with water.

**19-6 Measurement** — The work performed under these specifications will be measured by the unit or lump sum as designated in the contract items of work.

**19-7 Payment** — Payment will be made at the lump sum or unit price for sprinklers, sprinkler heads, bubbler heads, quick coupling valves, backflow preventers, control valves, control assemblies, turning unions, or garden valves; and the contract prices per linear foot for the various sizes and types of pipe.

Full compensation for furnishing and installing swing joints and pipe used for risers shall be considered as included in the price paid for the contract item requiring the swing joint and riser and no additional payment will be made therefore.

When there are no separate contract items for materials necessary to complete the irrigation system, such materials shall be furnished and installed. Full compensation for this work and materials shall be considered as included in the prices paid for the various contract items of the irrigation system and no additional payment will be made therefore.

The contract prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals; and for doing all the work involved in installing the irrigation systems, complete in place, as shown on the plans, and specified in these specifications and the special conditions and as directed by the City, including any excavation, backfill, testing and water involved.

**CITY OF ALBANY**  
**Standard Specifications**  
**Technical Provisions**

**Section 20**

**Landscaping**

**20.1 General**

**20-1.1 Scope**

This work shall consist of, but not necessarily limited to, furnishing all labor, materials, plant materials, tools and equipment required to grade, prepare soil, fertilize, plant, grass from seed, and otherwise complete the landscaping as shown on the approved plans, these specifications and the details.

The Contractor shall coordinate layout and installation of plant material with installation of the irrigation system to insure that there will be complete and full irrigation coverage of planting in accordance with these drawings, specifications and contract documents. Irrigation system shall be installed and tested prior to installation of plant material.

The “Model Water Efficient Landscape Ordinance” by the State Department of Water Resources shall apply.

**20-1.2 Related Work**

Section 18-1 — Trenching

Section 18-5 — Backfill

Section 19 — Irrigation System

**20-1.3 Planting Conditions** — No planting or seeding shall occur during weather conditions which will adversely affect materials or when soil is in a muddy condition. Contractor shall not plant at the end of the day, on Fridays or before holidays unless a special crew has been assigned to care for plants on next calendar day, and on weekends and holidays.

#### **20-1.4 Preservation of Property**

The planting and seeding operations shall be conducted in such a manner that no damage shall result to existing site improvements and plantings. The Contractor shall be responsible for any damage resulting from his operations, and shall repair or replace such damage at his own expense and to the satisfaction of the City. Vehicles of any kind shall not be allowed to pass over curbs, sidewalk, planting areas, etc., unless proper protection is provided.

Prior to excavating for plant pits and beds, the location of any underground utilities shall be verified and staked by the Contractor. All costs associated with verification of utility and underground structure locations including potholing shall be considered as included in the Contract Prices paid for the various items of work and no additional compensation will be made therefor. Damage to utility lines, underground structures, etc., shall be repaired at the Contractor's expense to the satisfaction of the City or owner of the utility involved.

**20-1.5 Underground Obstructions** — Rocks and other obstructions shall be removed to a depth necessary to permit proper planting according to drawings and specifications. If underground utilities, construction or solid rock ledges are encountered, City shall be contacted immediately for determination of extent of obstruction. Direction for selection of alternate locations shall be made by the City.

**20-1.6 Protection of Existing Trees to Remain** — Contractor shall erect barricades around trees to remain. They shall be constructed of wood. Place barricades minimum 5' away from trunk or at drip line if located greater than 5' from trunk. Under no circumstances shall earth, debris and materials be piled against trees or stored within drip line of trees.

**20-1.7 Personnel** — Planting shall be performed by personnel familiar with the procedures required of their trade and shall be supervised by a qualified planting foreman.

**20-1.8 Sequence of Work** — Landscaping shall not begin until all other improvements have been installed and inspected by the City. Contractor must receive approval to proceed from City prior to starting landscaping work.

#### **20-1.9 Inspections**

- A. Right of inspection by the City for approval or rejection is reserved at the place of growth and/or on the project site at any time upon delivery or during the work.
- B. Contractor shall notify City of inspections a minimum of 48 hours in

advance of inspection required.

**20-1.10 Quality** — All work shall be of the highest quality and shall be subject to the approval of the City. Any work that is deemed unacceptable by the City shall be removed by the Contractor immediately and replaced with work that is acceptable to the City. Such removal of defective work and replacement shall be at the expense of the Contractor. Defective work shall be replaced immediately.

All plant materials shall be of standard, approved first grade quality and shall be in prime condition when installed and accepted.

Any commercially processed or packaged materials shall be delivered to the site in the original unopened containers bearing the manufacturer's guaranteed analysis.

**20-1.11 Storage of Materials**

- A. Plants not installed on the day of arrival at the site shall be stored and protected as follows:
  - 1. Outside storage shall be shaded and protected from wind and sun.
  - 2. Plants shall be kept in a moist condition until planted, by watering.
- B. Fertilizer and lime shall not be stored with any other landscape materials.
- C. Soil sterilant shall not be stored with any other landscape materials.
- D. Storage of materials shall be only in areas designated or as approved by the City.
- E. The seed containers shall be stored immediately in a dry, weather and damp proof structure. Any seed which has become wet, moldy or is otherwise damaged in transit or storage will not be acceptable.

**20-1.12 Submittals**

- A. The Contractor shall submit to the City within 14 days of notice to proceed, all descriptive data and samples for the work as required by the specifications, and offers of alternatives, if any. Such submittals shall be checked and coordinated by the Contractor with the work of other trades involved before they are submitted to the City for examination.

Submittals shall be made by a letter of transmittal which shall contain a list of all materials submitted and identification of all deviations from the

plans and specifications contained in the submittal. The letter and all accompanying items shall be fully identified as to project name and location, Contractor's name, with ample cross-references to the contract documents, to facilitate identification of items and their location in the work.

- B. Six copies of submittals shall be presented to the City.
- C. Contractor shall supply the City with a list of all products, e.g. fertilizer, soil amendments, and plant materials, including name of nursery or supplier.
- D. Contractor shall supply the City with a sample of all supplied materials accompanied by analytical data from an approved laboratory source illustrating compliance or bearing the manufacturer's guaranteed analysis.

**20-1.13 Determination of the Use of Chemicals** — The City shall make the final determination of the use of chemicals on the site. Submit letters from the manufacturers on the levels of toxicity to the City for review and direction.

**20-1.14 Site Safety** — Contractor shall comply with all City/County, State and National regulations and requirements regarding site safety. Contractor shall assure that no unsafe conditions are allowed to remain overnight, over weekends, or unguarded during the work day. Material safety data sheets shall be kept on the job site at all times.

## **20-2 Materials**

### **20-2.1 Plant Stock**

- A. Plant Stock and Ground Cover:
  - 1. Plants shall be the variety, quantity and size indicated. When total quantities are shown tabulated on the drawings, they shall be considered approximate and are furnished for convenience only. Contractor is responsible for installing all of the plants shown on the planting plan and for computing the quantity of ground cover required within the area specified and planted at the specified spacing. Quality and size shall conform to the State of California Grading Code of Nursery Stock, No. 1 grade. Nursery-grown stock only shall be used, and shall be free from insect pests and diseases.
  - 2. All plants shall comply with Federal and State laws requiring inspection for plant diseases and infestations. Inspection certificates required by law shall accompany each shipment of

plants, and certificates shall be delivered to the City. All plants shall be true to species and size indicated, and shall be tagged in accordance with the standard practice recommended by the American Association of Nurserymen; however, determination of plant species or variety will be made by the City's decision will be final.

3. Plants shall be healthy, shapely, and well-rooted. Roots shall show no evidence of having been root bound, restricted or deformed. Plant material that has just been upgraded in container size shall be rejected. Root condition of plants in containers will be inspected by the City and determined by removal of earth from the roots of not less than two plants of each species or variety from each source. All plant materials requiring inspection by the City shall be assembled and available for such inspections. In case the sample plants inspected are found to be defective, the City reserves the right to reject the entire lot or lots of plants represented by the defective samples.
4. Each plant shall be handled and packed carefully to avoid damage. All necessary precautions shall be taken to insure that the plants will arrive at the site of work in proper condition for successful growth.
5. Plants shall be transported in enclosed trucks. If trees are too large for enclosed trucks and are transported in open trucks, they shall be wrapped to prevent damage and windburn. Trees in transport or prior to shipping shall not be tipped so that the container of the adjacent plant is leaning on the trunk of the next tree. Adequate protection shall be placed between trees so that trunks are not scarred in transport and branches are not broken. All tree trunks shall be wrapped with protective covering at growing grounds prior to handling and loading. Covering shall be removed at time of plant materials inspection at job site to inspect each tree. Trunks showing signs of damage due to improper handling shall be rejected. Plant materials showing damage from transport and loading, showing signs of ill health and plants that are not true to size and species specified and in conformance to the specifications stated in these contract documents shall be rejected. Rejected materials shall be removed from the site and replaced with materials that meet the satisfaction of the City and at no additional cost to the City.
6. Substitutions will not be permitted, unless proof is submitted to the City that any plant specified is not obtainable. The City will

consider use of the nearest equivalent size or variety. Such proof shall be substantiated and submitted in writing by the Contractor within 14 days after the effective date of Notice to Proceed. The City will make appropriate deductive adjustments to the contract bid items for substitute materials; there will be no additional compensation for approved substitution.

7. Plants shall have straight trunks with the leader intact, undamaged and uncut. All old abrasions and cuts shall be completely calloused over. All plants shall be measured when their branches are in their normal position. Height of plant is measured from root crown to top of plant. Width of plant is measured at branching at the widest point. Indicated sizes shown are before pruning. Plants shall not be pruned prior to delivery.
8. Trees shall be well tapered in the trunk so that when the nursery stake is removed, the tree supports itself upright without further staking. Trees shall have a main leader. The main branches shall be spaced vertically and alternately along the trunk. Branching shall not be concentrated in one location nor shall there be severe crossing of branches. Branches shall be smaller in diameter than the trunk. Branch attachments shall be free of embedded bark. At least one half of the foliage on the branches shall be located along the lower two thirds of the trunk.
9. All plants declared unsuitable for planting as a result of inspection of materials shall be removed from the site immediately. They shall be replaced with specimens that conform to the contract documents and that are acceptable to the City. Cost of return to grower and cost of replacement of plant materials shall be borne by Contractor and at no additional cost to the City.
10. Contractor shall facilitate inspection and identification by labeling trees and bundles or containers of the same shrub, groundcover or vine with a durable waterproof label and weather resistant ink. Labels shall state the correct plant name and size as specified in the project plant list and shall be legible for 60 days after delivery to the planting site. Plant material which is not labeled shall be rejected.
11. Plant material shall be grown under similar climatic conditions to those found in project site.
12. Ground cover shall be rooted plants, grown in flats unless otherwise noted on the plans or as approved by the City.



**20-2.2 Seed**

- A. Seed mixture shall be 98 percent pure, and noxious weed free, with a minimum of 88 percent germination. All seed shall be re-cleaned Grade A "new crop" seed, delivered in the original unopened containers, and shall bear a guaranteed analysis and dealer's label. The dealer may mix the seed provided a guaranteed statement of composition of mixture and percentages of purity and germination of each variety is attached to the sealed container. The seed shall be pretreated with a pre-emergence fungus preventative such as "Thiram", or approved equal, in accordance with manufacturer's specifications.
- B. Seed shall be as specified on plans.

**20-2.3 Topsoil**

- A. Source: On site stockpile

**20-2.4 Soil Conditioner**

**20-2.4.1. Nitrogen Stabilized Organic Amendment**

Amendment shall be nitrogen-stabilized sawdust. Source shall be derived from a combination of fir and pine or cedar wood, free from weed seed, dust, and objectionable material and containing the following physical properties:

Percent Passing	Sieve Size
95-100%	9.51mm (3/8")
90-95%	6.35mm (1/4")
85-90%	2.38mm (No. 8, 8 mesh)
15-20%	500 Micron (No. 35, 32 mesh)

Chemistry shall be:

Nitrogen Content  
(dry weight): 0.56% - 0.84%

Iron Content: Minimum 0.08% diluted acid soluble  
Fe on dry weight basis.

Soluble Salts: Maximum 4.0 millimhos centimeter @ 25 degrees C. as determined by saturation extract method.

Ash (dry weight): 0 - 8.0%

**20-2.5 Fertilizer** — Fertilizer shall be a commercial inorganic fertilizer in the granular and pelleted form. Fertilizer shall be delivered to the site in containers labeled in accordance with the applicable State of California regulations, bearing the warranty of the producer for the grade furnished. It shall be uniform in composition, dry and free-flowing.

A. Planted and Seeded Areas:

Pelleted type with analysis of 6-20-20 (N-P-K) and granular type 16-6-8 (N-P-K).

B. Planting Holes:

Tablets, 21 gram size, or approved equal, with an analysis of 20-10-5 (N-P-K).

**20-2.6 Herbicide**

A. Submit written chemical weed control program prepared by a licensed pest control advisor for approval by the City.

B. Herbicide shall be compatible with plant materials used in this contract. Proof of such compatibility shall be included in weed program submitted.

C. Program shall specify waiting period between spraying and planting.

**20-2.7 Mulch** — Mulch shall be 1/4"-3/8" dia. fir bark.

**20-2.8 Backfill** — Backfill to be used in planting holes shall be 100% topsoil obtained from on site top soil stripped and stockpiled.

**20-2.9 Tree Stakes and Ties**

A. Tree stakes shall be 3" dia. x 8' straight, close grained, Lodge Pole Pine pointed at one end. Stakes shall be pointed prior to treatment with Copper Napthanate which shall penetrate stake surfaces to a minimum depth of 1/4".

- B. Tree straps: corded rubber tire strips - 1" wide by 1/4" to 1/2" thick by length as required. Strips shall not contain steel within or have wire tie ends.

**20-2.10 Water**

- A. Water at will be furnished by the City at existing available sources.

**20-3 Execution**

**20-3.1 Soil Preparation and Grading**

**A. ROUGH GRADE AND WATER:**

Prior to any planting bed preparation or planting, grade all planting areas, fill as needed or remove surplus dirt and float areas to a smooth uniform grade. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Rough grades shall be inspected and approved by the City before any amendments and fertilizers are installed. All planting areas shall be thoroughly wetted down. Allow soil to dry so as to be workable after which thoroughly cultivate to a depth of 6 inches using a rotary hoe and allow to dry out.

**B. SOIL AMENDMENTS, FERTILIZERS AND CULTIVATING:**

1. Spread soil amendment and fertilizer evenly over all areas, including grass from seed areas, at the following rates:
  - a. Soil Amendment - 6 cu. yds. per 1,000 sq. ft.
  - b. Fertilizer - 30 lbs. per 1,000 sq. ft. of 6-20-20.
2. After approval of amendment and fertilizer applications by the City, incorporate into top 6 inches of soil by repeated rotary-hoe cultivation.

**C. WATER:**

At completion of soil amendment, water soil in all areas, including grass from seed, for a full 14 days. Soil to be moist to a minimum depth of 24 inches and not be allowed to dry out at any time. In locations where irrigation is by drip or bubblers, the Contractor may, at his option and expense, install a temporary irrigation system to keep soil moist. The Contractor shall be responsible for insuring that the temporary irrigation

system does not create a safety hazard.

**D. SPRAY WITH CHEMICAL WEED KILLER:**

1. At the end of the watering period, spray area with an approved general chemical weed killer to eliminate all plant growth and roots including broadleaf and grass seedlings. Chemical shall be part of the chemical weed control program prepared by a licensed pest control advisor and approved by the City.
2. Chemical shall not sterilize soil and shall be applied as per manufacturer's directions. Alternate weeding methods can be used upon approval of the City.

**E. FINISH GRADE:**

1. When weeding and soil conditioning have been completed and soil has been thoroughly water settled, all planting areas shall be finish graded for placement of plant materials and seeding operation. Grading shall be done when soil is at optimum moisture content for working.
2. Finished grades shown on plans are given in feet and decimals of feet. Slope uniformly between given spot elevations. Planting areas including seeded areas shall be true to grade within one inch when tested in any direction with a 10 foot straightedge.
3. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch basins. Finish grades shall be smooth, even, and on a uniform plane with no abrupt change of surface and no erosion scars. Minor adjustments of finish grades shall be made at the direction of the City if required.
4. All grades shall provide for natural runoff of water without low spots or pockets. Flow line grades shall be accurately set and shall not be less than 2 percent gradient wherever possible unless otherwise indicated.
5. Finish grade of earth in planting beds shall be 1 inch below top of adjacent pavement, curbs or headers, unless otherwise indicated on the drawings. Finish grade of earth in grass areas shall be 1/2" below top of adjacent pavement, curbs or headers.
6. Tops and toes of all slopes shall be rounded to produce a gradual

and natural-appearing transition between relatively level areas and slopes.

7. Protect all areas against compaction by equipment.

### **20-3.2 Tree & Shurb Planting**

#### **A. STAKE PLANT LOCATIONS:**

Mark tree and shrub locations on site using stakes or similar means. Locations shall be approved by the City before plant holes are dug, and adjustments made as required.

#### **B. WATER-TEST SELECTED PLANT HOLES:**

1. Dig tree pit as per specifications below, paragraph C.
2. Tree pits to be water tested will be selected by City. Approximately one (1) location per 80 sq. ft. will be selected. If site requires more test holes, it will be specified on the drawings.
3. Fill tree pits with water. Check holes after 24 hours to determine if water has drained out. If not, bring to attention of the City.
4. Adjustment of pit size or location will be made if drainage problem exists. This will be determined by the City.

#### **C. PLANTING HOLES:**

1. Dig pits circular in outline with vertical sides as shown on the Planting Detail. Do not excavate deeper than the vertical dimension of the rootball. After pits are dug, break sides to open wall of pit for root penetration and loosen bottom of pit to a depth of 3 inches. Construct foot tamped mound in bottom of pit to support plant at proper level.

#### **D. PLACEMENT OF PLANTS:**

1. Do not handle container plants by the tops, stems, or trunks at any time. Lift all plants so that root ball is supported from the underside. Plants that do not have a satisfactory root system will be rejected.
2. Cut root ball vertically in a few places to encourage new feeder root development along perimeter of the root ball.

3. All plants shall be planted immediately after the containers are cut. Containers shall be removed immediately from the site.
4. Place plant in upright and plumb position.
5. Groundcovers shall be installed at spacings indicated on the drawings and shall be evenly spaced and staggered in rows. Place each plant in a pit so the root system lies free without doubling and so the roots are planted vertically. Firm the soil around each plant and water the area immediately to avoid drying out.

**E. FERTILIZING AND BACKFILL:**

1. Place fertilizer tablets in the following quantities around perimeter of plant hole:

1 gallon plant - 1 tablet  
5 gallon plant - 3 tablets  
15 gallon plant - 5 tablets  
24" box plant - 7 tablets

2. Backfill hole with stockpiled on site topsoil. Taper backfill around sides and up to top of rootball so that sides of rootball are not exposed.
3. Construct a 3" high berm outside the excavated area, and fill the watering basin with B-1 solution. Remove berm in areas to receive grass that will be mowed after third thorough watering, and prior to grass installation.
4. Backfill shall be watered until the backfill material is moist to the full depth of the hole.
5. Excess backfill shall be disposed of at direction of the City, and shall be included in the cost of planting.

**G. PRUNING:**

No pruning shall be done unless specifically requested by the City and under the City's direction.

**H. STAKING:**

1. Install stakes as specified along sides of root ball and one foot into undisturbed ground (or deeper in accordance with the Planting

Detail). Stakes are not to go through root ball. For 24" box trees wood cross pieces nailed to stakes shall be 30" long. Install ties as shown on the Planting Detail.

2. Ties shall be placed as low on the trunk as possible but high enough so the tree will return to upright position after deflection.
3. To find the proper height for tie locations, hold the trunk in one hand, pull the top to one side and release. The height at which the trunk will just return to the upright position when the top is released is the height at which to attach the ties.
4. Ties are to form a loose loop around the tree trunk and stakes so that the trunk cannot work towards the support stakes. Tree ties shall be nailed securely in position in accordance with the manufacturer's recommendations and planting details.
5. Support stakes are not to exceed 6" above the tie locations. A flexible auxiliary stake shall be attached to those trees needing extra trunk support as determined by the City.
6. One tree of each size shall be staked and approved by the City prior to continued staking.

#### I. PRE-EMERGENT HERBICIDE APPLICATION:

1. Pre-emergent herbicide shall be applied to all tree, shrub, ground cover and firbark areas including plant basins. Chemicals used are to be in written chemical weed control program prepared by a licensed pest control advisor and approved by the City. Apply prior to any mulching.
2. Pre-emergent shall be applied during a windless period. Areas to receive seed shall be protected from contamination by pre-emergent.
3. Any area to receive seed that is contaminated with pre-emergent shall have the soil stripped to a 6" depth and replaced with imported topsoil to the satisfaction of the City and at no additional cost to the City.

#### J. MULCHING:

Install a 2" layer of fir bark in all planted areas not planted with grass or

hydroseed. Fir bark shall be kept away from stems and trunks of plants, 4" at groundcovers and 8" for all other plants.

**K. ADJUSTMENT OF PLANTS:**

1. Plants that settle deeper than specified shall be raised to the correct level.
2. Plants that go out of plumb shall be straightened and restaked.

**20-3.3 Grass from Seed**

- A. Installation of plants shall be approved by the City before seeding operations begin. Just prior to seeding, areas to be seeded shall be loosened by harrow or rototiller to 2" depth, raked to remove rocks one inch or larger in size along with sticks and debris, floated level, rolled and floated again.
- B. Seed shall be sown evenly using a mechanical spreader at the rate of 10 pounds of mixture over each 1,000 square feet of area. One half of the seed shall be sown in one direction, and the remaining one half sown in a direction 90 degrees to the first during a windless period. Overseed any existing undisturbed lawn at junction with disturbed area being seeded to provide even grass coverage at this point. Apply fertilizer (16-6-8) at the rate of 6 lbs./1,000 sq. ft. uniformly over seeded areas.
- C. Lightly rake surface to cover seed and to mix with fertilizer and then compact with a 200 lb. roller. Soil shall be irrigated immediately and kept moist but not saturated until the seed has germinated.
- D. Whenever the grass reaches a height of 3 inches, mow to 1-1/2 inches and remove all clippings. After second mowing of grass, apply second application of fertilizer. Apply fertilizer (16-6-8) at the rate of 6 lbs./1,000 sq. ft. uniformly over turf area. Apply again at the same rate 2 weeks prior to completion of maintenance.
- E. Protect grass areas with temporary fencing as necessary. Fencing shall not create a hazard for pedestrian or vehicular traffic. Contractor shall obtain approval of the City for fence type and locations prior to installation. Barriers shall be maintained by the Contractor and kept in orderly condition at all times until work has been accepted by the City. Any damage to turf shall be repaired by Contractor at no expense to the City.
- F. Until completion of the required maintenance period of the project, Contractor shall provide maintenance of grass area installed under this



contract by watering, weeding, seeding, mowing (includes trimming and edging), rolling and by performing any other necessary operations of maintenance including treatment for fungus diseases, insects, pests of rodents. Re-seed all bare spots at intervals of 10 days until a full stand of grass is established over the entire grass area in scope of work.

#### **20-3.4 Clean Up**

- A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his work. At the completion of the work he shall remove all rubbish, tools, scaffolding, and surplus materials from the site.
- B. Neatly dress and finish all planting areas.
- C. Pavement shall be broom clean.
- D. Rinse foliage of all plant materials within the construction area as often as necessary to keep the foliage free of dust.

#### **20-3.5 Preliminary Inspection**

At the completion of work, the Contractor shall request a preliminary inspection to determine the condition of planting and seeded lawn area.

- 1. Inspection shall be requested 48 hours in advance.
- 2. Present for the inspection will be: Contractor and City.
- B. Construction considered ready for inspection shall conform to the following:
  - 1. All planting shall be healthy and free of infestations.
  - 2. All planting areas shall be free of weeds.
  - 3. Grass areas shall show a uniform, smooth ground surface without eroded ruts or gullies, and evidence of uniform seed germination.
  - 4. Grass shall be mowed to 1-1/2" above finish grade.
  - 5. Stakes and ties shall be as specified in the contract documents.
  - 6. Mulch shall be raked to uniform surface. Areas not mulched shall be raked to uniform surface.

7. All debris shall be removed from site, all pavement shall be broom clean, and foliage shall be washed clean.

8. All plants shall be installed as per the Contract Documents.

C. Approval:

1. If the installation is found satisfactory, the work shall be approved by the City in writing.

2. If the installation is found unsatisfactory, the City will submit a punch list of conditions to correct to the Contractor. The Contractor is responsible for requesting additional inspections after the conditions of the punch list have been corrected.

3. No partial approvals will be given.

## **20-4 Maintenance**

### **20-4.1 Scope of Work**

A. The maintenance period following project installation is included in the contract and shall begin on the date the work is accepted by the Director of Public Works.

B. Maintenance period shall be for 1 year beginning the day of the acceptance of the construction by the City, or as specified in the Special Provisions if for a longer period of time.

C. Maintenance shall include, but is not limited to all watering, weeding, fertilizing, cultivation, spraying and pruning necessary to keep the plant material in a healthy growing condition and to keep the planted areas neat and attractive in appearance throughout the maintenance period. All plants shall be watered not less than twice a week. Each watering shall be of such quantity as to provide optimum growth conditions. The Contractor shall provide the equipment and means for its proper application. At the direction of the City, any plant exhibiting weakness and the probability of dying, shall be replaced immediately by the Contractor at his expense. Replacements of plants or grass shall be made in the same manner as specified for the original planting. At the end of the maintenance period, all plant material shall be in a healthy growing condition and free of physical injury of any kind.

D. Work under this Section shall include complete responsibility for maintaining adequate protection for all areas. Any damaged areas shall

be repaired at no additional expense to the City.

- E. Grass shall be mowed each time it reaches 3" in height and with blades set to 1-1/2" above grade. Grass shall be trimmed at the edges of curbs, paving, drains and headers. Grass areas which fail to germinate shall be reseeded at maximum 10-day intervals until a vigorous, even stand of grass is established. Seeding operation shall follow specifications for initial installation. Grass areas shall be kept free of weeds by hand pulling, or by spraying with the approved selective chemical herbicide before weeds exceed 2 inches in height. Clippings and debris shall be removed from the site.
- F. Plants installed under this contract shall be properly maintained by regular watering, cultivating, weeding, re-mulching, repair of stakes, pruning, and treatment of insects and pests. During the Maintenance Period, any plants which are vandalized, damaged by herbicide, diseased, dead, or in an unhealthy condition, shall be replaced by the Contractor at his expense within two weeks after notification from the City or his authorized representative. Maintenance shall also include treatment for fungus, diseases, rodents, and insects, the requirements for approval of treatment program shall be the same as for herbicide.
- G. Weed all areas at intervals of not more than (10) calendar days.
- H. Rocks, clods, and debris which appear on the surface shall be removed. Heaved, settled, or eroded areas shall be restored by excavating, filling, finish grading, and rolling as required.

#### **20-4.2 Final Inspection and Acceptance**

- A. Final inspection will be conducted at the end of the Maintenance Period. Notice requesting final inspection shall be submitted by the Contractor to the City at least 7 calendar days prior to the anticipated date.
- B. Acceptance of the project by the City will be contingent upon proper maintenance and the establishment of vigorous plant materials. Any portion thereof which does not show vigorous growth is subject to continued maintenance at the Contractor's expense.
- C. Prior to the final inspection, the Contractor shall also have performed weeding, repair or touch-up of paving, equipment, and structures, and the thorough cleaning of the site.
- D. Just prior to final inspection, 16-6-8 granular form commercial fertilizer shall be applied as follows:

Plant Size	Qty. Fertilizer
Specimen	1 pint
15 gal.	1 cup
5 gal.	1/2 cup
1 gal.	1/4 cup
ground cover	10 lbs./1,000 sq. ft.

- E. Mulch shall be raked away from around plant bases. Fertilizer shall be spread around plant base and worked into the top 2 inches of soil. Mulch shall then be replaced.
- F. At the final inspection, the City will determine the condition of improvements and planting. Plants which are missing, vandalized, dead, or unhealthy shall be replaced by the Contractor at his expense with the same species and sizes originally specified and following these same specifications for installation. The Contractor shall make replacements within two weeks after final inspection, and maintain plants for an additional 30 calendar days.
- G. The irrigation system shall also be tested at this time. See Irrigation Specifications for additional information.
- H. If project improvements, corrective work, and maintenance have not been performed as specified and to the satisfaction of the City, maintenance shall continue at the Contractor's expense until such time as work has been successfully completed and accepted by the City. Should work have been performed as specified and to the City's satisfaction, the City will assume maintenance responsibilities following the final inspection. The City will send written Notice of Acceptance of project to the Contractor.

## **20-5 Guaranty**

20-5.1 — All trees, and other plant materials shall be guaranteed to take root and grow, and thrive for a period of one year after final acceptance of work.

20-5.2 — Any trees or other plant materials that die back and lose the form and size originally specified shall be replaced, even though they have taken root and are growing after the die-back.

20-5.3 — Within 15 calendar days of written notification by the City, the Contractor shall, at his own expense remove and replace all guaranteed plant

materials which, for any reason, fail to meet requirements of guaranty. Replacements shall be made to same specifications as required for original materials and shall carry the same guaranty from the time they are replaced.

**20-6 Measurement and Payment** — The landscaping shall be measured and payment made at the contract lump sum or unit price and shall include full compensation for furnishing all labor, materials, tools, equipment, incidentals and for doing all work in landscaping and planting areas and tree areas including staking as shown on the plans and as specified in these specifications and as directed by the City.

The contract price for maintenance will be paid from the ten (10) percent retention on a pro-rata basis in twelve (12) equal monthly payments within 20 days after the successful completion of each monthly maintenance period.

The provisions of Section 9, "Payments" of the General Provisions, are hereby modified as necessary to comply with these provisions.

# CITY OF ALBANY

## Standard Specifications Technical Provisions

### Section 21

#### Tennis & Basketball Court Resurfacing

##### 21-1 General

The contractor shall:

- A. Submit the proposed construction schedule and recommendations regarding the extent of the refinement course needed (should it differ from the Engineer's Estimate) to the Engineer for review 7 days prior to commencing construction.
- B. Maintain adequate warning signs and barricades for the safety of the public and protection of the work acceptable to the City. Contractor shall maintain pedestrian access through work area.
- C. Bear all responsibility for all damages and costs of repair to existing utilities. Should any such utility be damaged during construction, all expenses of whatever nature arising from the restoration of the utility to its original service shall be borne by the contractor and no additional compensation will be allowed by the City.
- D. Remove all tennis nets prior to the commencement of work and reinstall nets following completion of work to the satisfaction of the inspector.
- E. Remove all fencing required to provide access for equipment, and/or adjustment for clearance as directed by the City. Any such fencing removed shall be re-erected in conformance to the standards of the trade and in a timely manner at no additional cost to the city.
- F. Clean all ground occupied by the work of all rubbish, excess material, and equipment prior to start of the job and prior to final inspection of the job.
- G. Exercise due care in the protection of all existing walks, fencing, landscaping and all adjacent improvements and shall repair all damages to

the satisfaction of the Engineer.

- H. Not perform any part of the resurfacing project during rainfall or when rainfall is imminent and/or unless the air temperature is at 50 degree F and rising.
- I. Understand and know job site relative to specifications herein specified.

## **21-2 Materials**

**21-2.1 Resurfacing System** — Plexipave System as manufactured by California Products Corporation. Decoralt Color System as manufactured by Koch Asphalt Company, or approved equal.

**21-2.2 Refinement Course** — A mixture of plaster sand, water, and either a acrylic resurface or asphalt refinement course material and asphalt emulsion. The mixture should conform to recommendations of the resurfacing system manufacturer and be subject to the approval of the Engineer. Suggested mixtures include either of the following:

### **Plexipave System**

Acrylic Resurface	55 gals.
Water	20-40 gals.
Sand (40-60 mesh)	600-900 lbs.

### **Decoralt System**

Plaster Sand	3 gals.
Surfix TT650 or Over Kote	2 gals.
Asphalt Emulsion	1/2 gal.

Asphalt Emulsion shall conform to Federal Specification SS-A-674c and/or ASTM D977.

Plaster Sand shall be clean, free from silt or clay, and graded as follows:

Sieve Size	% Passing
#4	100
8	95-100
16	70-100
30	40-75
50	10-35
100	2-15

#### 21-3.4 Texture Coat

Plexipave System: Plexipave filled with sand to produce a medium play surface.

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Decoralt System: Decoralt MP (920-27) filled with sand to produce a medium play surface.

#### 21-3.4 Finish Coat

Plexipave System: Plexichrome

Decoralt System: Decoralt MP (920-27)

21-3.5 Line Paint — Plexicolor Line Paint as manufactured by California Products Corporation or White Striping Paint manufactured by Koch Asphalt Company, or equal.

#### 21-3.6 Colors

Tennis Courts: All tennis courts shall have a dark green playing surface with red on the exterior. The resurfacing system shall be a full depth color system, i.e. the green playing surface shall receive all three color coats of green, the red surface shall receive all three color coats of red, etc. The Contractor shall submit color samples to the Engineer for approval prior to the beginning of work.

### 21-3 Application

21-3.1 Refinement Course — Prior to the application of any materials, the entire area shall be water flooded and all depressions holding over 1/8" depth of water shall be filled with refinement course mix and allowed to cure. All surface cracks and holes greater than 1/8" in depth shall be cleaned of any loose or foreign materials and filled with refinement course mix and allowed to cure. All ridges, loose or foreign particles shall be removed from the surface.

Apply two coats by pouring from a can or wheeled container to continuous parallel lines and spreading immediately with a rubber faced squeegee. The squeegee shall be pulled on an angle from the line and spread so as to continuously roll the material toward the operator and not overflow or "spill" on its forward edge away from the operator. After each coat has dried, any ridges shall be removed with scrapers and the surface rolled with a two to four (2-4) ton



roller.

The minimum applications shall be at the rate of not less than twenty five (25) gallons per coat of undiluted refinement course material per 1,000 square feet or as recommended by the manufacturer and shall cover the existing color coat.

Upon completion of rolling, the area shall be water flooded and rechecked for depressions holding over 1/8" depth of water. Should any depressions appear, these areas should be filled with refinement course material again as outlined above. The finished surface shall be smooth, free of ridges, valleys and too marks. Approval shall be made by the Engineer prior to proceeding to the color coatings.

### **21-3.2 Texture Coat**

**Plexipave System:** Over the completed refinement course or a thoroughly clean surface in areas not receiving a refinement course, apply two (2) coats of Plexipave mix in accordance with the manufacturer's direction at a rate of not less than 0.08-0.1 gallons per square yard total for the two coats. If the asphaltic surface course is not covered to a uniform, even texture, free of all porosity, a third texture coat shall be applied to attain uniformity. The first coat shall be applied lengthwise of the court and the second coat crosswise of the court. Care should be taken not to leave ridges of mix where adjoining applications overlap. Dilution rate shall not exceed 1 part water : 2 parts Plexipave.

**Decoralt System:** Over the completed refinement course or a thoroughly clean surface in areas not receiving a refinement course, apply two coats of DecoColor Multi-Purpose Coating 920-27 mix in accordance with the manufacturer's direction at a rate not less than 1 gallon per 100 square feet per application. If the asphaltic surface is not covered to a uniform, even texture, free of all porosity, a third coat shall be applied to attain uniformity. The first coat shall be applied to lengthwise of the court and the second coat crosswise of the court. Care should be taken not to leave ridges of mix where adjoining applications overlap.

### **21-3.3 Finish Coat**

**Plexipave System:** On a clean, dry underlying surface apply one application of Plexichrome in accordance to the manufacturer's recommendation at a rate not less than 0.04 gallons of material per square yard. The application shall be made cross-wise of the court and with a wide hair type pushbroom or a rubber bladed squeegee followed by a pushbroom and shall produce a uniform color throughout. Dilution rate shall not exceed 1 part water : 1 part Plexichrome.

**Decoralt System:** On a clean, dry underlying surface, apply one application of DecoColor Multi-Purpose Coating 920-27 in accordance with manufacturer's

recommendation at a rate not less than 0.5 gallons of material per 100 square feet. The application shall be made cross-wise of the court and with a wide hair type pushbroom or a rubber bladed squeegee followed by a pushbroom and shall produce a uniform color throughout. Dilution rate shall not exceed 1 part water:2 part Decoralt MP (920-27).

**21-3.4 Playing Lines** — Two inch wide playing lines shall be accurately located, applied by brush or spray, free from any fogging or overspray. Line paint shall be white. All measurements shall conform to the United States Tennis Association dimensions. All lines shall be straight and true with no irregular edges.

**21-4 Measurement** — The quantities of Tennis Court Resurfacing will be measured on a square foot basis of completed and acceptable resurfacing.

**21-5 Payment** — The contract unit prices for Tennis Court Resurfacing shall include full compensation for furnishing all labor, materials, tools, equipment, line painting, crack filling, coloring and incidentals for completing the resurfacing, as specified, and no additional payment shall be made therefor.

# CITY OF ALBANY

## Standard Specifications Technical Provisions

### Section 22

#### Tree Trimming & Stump Removal

**22-1 General** — As work under this contract shall be performed in accordance with these Provisions and the Standard Drawings.

- A) Contractor shall notify in writing residents adjacent to the work 48 hours prior to commencing work adjacent to their property.
- B) Unless arrangements are made otherwise with the property owner, access to driveways shall be maintained.
- C) Contractor shall furnish water as required for the job at no cost to the City, except as provided in the contract items of work. Use of homeowner's water shall be only upon written consent of the property owner.
- D) The Contractor shall have, at all times, a Certified Arborist on staff and supervising the work. The Contractor shall submit the Arborist's resume to the City with the Contract Bid Proposal.

Quantities of work are shown for estimating purposes only. The City reserves the right to increase or decrease any quantity or to eliminate any item of work. No adjustment will be made in unit prices for any such increase, decrease, or deletion regardless of the percentage of such adjustment. Final payment will be made on the basis of contract unit prices for work actually accomplished.

Trees shall be trimmed to accomplish the following: to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached, which have vertical spacing from 18 to 48 inches and radial orientation so as not to overlay one another; to eliminate marrow V shaped branch forks that lack strength; to reduce toppling and wind damage by thinning out crowns; to maintain growth within space limitation; to maintain a natural appearance; to balance crown with roots; all pruning cuts should be made to lateral branches or flush with the trunk. Under no circumstances should "stubbing" ever be performed.

**22-2 Tree Pruning** — The Contractor shall perform the following services in a professional workmanship like manner consistent with all appropriate rules of Safety.

- A) Follow the shape suggested by the natural growth habits of each tree species.
- B) Cut to laterals to preserve the natural form of the tree, leaving the head open enough for the branching system to show and permit dead material to be easily cleaned out and light to show through the head. Tree foliage shall not be reduced by more than 20% to 30%.
- C) All limbs one inch in diameter or over shall be undercut to avoid splitting. Where there is a chance of the bark tearing at the crotch, remove large limbs with the crotch.
- D) Trim to clear energized lines a minimum of two (2) feet, remove dead wood, hazardous branches, weak diseased, insect infested, broken, low or crossing limbs and all suckers, shoots and ivy. Branches with an extremely narrow angle of attachment shall be removed. Any structural weakness, decayed trunk, or branches shall be reported to the Superintendent.
- E) The Contractor shall provide for proper vehicle clearance at curb, both in height of lower branches and extension of branches into the street. Height clearance at the curb shall be fourteen (14) feet from street level.
- F) The Contractor shall allow adequate clearance for pedestrians to walk under the tree without concern for personal injury. Final head clearance shall be twelve (12) feet (minimum) as balance to curb pruning as possible.
- G) On trees known to be diseased, pruning tools as well as cut surfaces shall be disinfected with a ten percent (10%) chlorine bleach solution or sterilant after each cut and between trees where there is danger of transmitting the disease on tools.
- H) Pruning with hand pruners will be permitted. Small limbs, including suckers and water spouts, shall be cut close to the trunk or branch from which they arise.
- I) Trees with dense foliage surrounding street lights shall be opened to allow light to penetrate through the head.
- J) Pruning around high voltage transmission lines shall be done by a certified and qualified line clearance tree trimmer.

The Contractor should avoid any encroachment on adjacent properties and repair

and make good any damage caused to public or private property as a result of the work described in this contract. The Contractor will have an office or job site location where the person in charge of this project can be reached. The Supervisor for this project will be made known to a representative of the City of Albany so that he may be contacted immediately during working hours. In accordance with the project the Contractor will prepare a schedule for the entire project. This schedule shall be the basis for establishing the starting and completion dates of the work described in this project. It will be the responsibility of the Contractor to conform to the approved schedule and to arrange work in such a manner that it will be performed in accordance with the schedule. The Contractor will submit the final application for payment in accordance with procedures and requirements stated in the conditions of the Contract. The Contractor will take care not to damage existing surfaces and public and private property.

The Contractor will leave all portions of the work area in a safe, clean and sanitary condition satisfactory to the Director of Public Works.

**22-3 Tree Stump Removal** — Unless otherwise specified in the contract, special provisions or drawing, tree stump removal shall be as specified herein.

Stumps shall be removed by method approved by the City and in a manner as not to damage existing improvements.

The stump removal shall include the removal of the root ball to a depth of 24-inches below the existing curb grade or natural grade where no curbs exist, and to a minimum horizontal area of 18-inches each side of the center of the stump, or curb to sidewalk in the one direction when the planter strip is less than 36-inches wide.

After removal of the stump and root ball, the area shall be backfilled with topsoil to a minimum relative compaction of 85%.

Where existing improvements interfere with the stump and root ball removal, or when the Contractor desires to do so to facilitate his work, the improvements shall be removed and replaced in kind, at no additional expense to the City.

Removal and replacement of existing improvements by the Contractor shall be in accordance with the sections of these Standard Specifications, at no additional expense to the City.

The Contractor shall be responsible for notifying USA prior to work and the verification and protection of all existing subsurface improvements.

**22-4 Measurement** — Measurement shall be as indicated in the bid proposal. In general, trees shall be measured on a per each basis when listed by specific address. When tree trimming is listed in this bid proposal by “zone” or by entire “street,” the measurement shall be on a lump sum basis. Such lump sum shall include all City-owned

trees within the zone s indicated on the contract drawings and all trees on a designated street (both sides). When no limit is specified for the beginning and end of work on the street specified, it shall mean city limit to city limit as that designated street.

**22-5 Payment** – The Contract unit or lump sum prices shall be considered as including full compensation for furnishing all labor, materials, tools, equipment and incidentals required to complete the contract items of work, including but not limited to removals, hauling, disposal costs and clean up.

# **CITY OF ALBANY**

## **Standard Specifications Technical Provisions**

### **Section 23**

#### **Standard Specifications for Public Works Construction “Technical Provision”**

For construction materials and methods of work not covered by the City's Standard Specification, Technical Provisions, the latest edition, at the time of bid advertising, of the "Standard Specifications for Public Works Construction" shall apply.