SPECIFICATION STANDARDS

TABLE of CONTENTS

Article 01-001.1 Purpose

The following technical standards and requirements have been prepared and adopted by the City of Alamogordo, New Mexico, to guide and assist the subdividers and owners of subdivisions, their engineers and contractors, in the preparation of plans, specifications and for the construction of city utilities, streets and improvements inside the public right-of-way in accordance with the Alamogordo Municipal Code. These technical standards shall be the minimum requirements for the design and construction of these improvements.

All of the technical standards and requirements contained in the Subdivision Regulations of the Alamogordo Municipal Code are hereby made part of these requirements, even though they may not be specifically mentioned and described herein.

Article 01-002.1 General Requirements

1.0 DEFINITIONS AND TERMS

Abbreviations

AASHTO ..	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGC	Associated General Contractors of America, Inc.
ANSI	American National Standards Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BM	Bench Mark
FH	Fire Hydrant
G	Gas Line
ID	Inside Diameter
Inv.	Invert
MH	Manhole
mg/l	Milligrams per Liter
MUTCD	Manual on Uniform Traffic Control Devices
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NMSA	New Mexico Statutes Annotated--1978 Compilation as Amended
NMSHTD ..	New Mexico State Highway Department
OHP	Overhead Power
OHP&T ...	Overhead Power & Telephone
OHT	Overhead Telephone
OSHA.....	Occupational Safety and Health Association
PC	Point of Curvature
ppm	Parts per Million
PRC	Point of Reverse Curvature
psf	Pounds per Square Foot
psi	Pounds per Square Inch
PT	Point of Tangency
PVC	Polyvinyl chloride Pipe
Pvmt. ...	Pavement
Q	Rate of Flow

RCP ..... Reinforced Concrete Pipe

SCCP .... Steel Cylinder Concrete Pipe
Sec ..... Section
Sta. .... Station
Std. .... Standard

UGT ..... Underground Telephone
UL ..... Underwriters' Laboratories, Inc.

V ..... Velocity

Definitions

Alley – A minor public way intended for secondary service access to the rear side of a lot or piece of property. See section 3 of the Detail Drawings.

City - The City of Alamogordo.

Contractor - The person, firm, or corporation with whom an owner has executed the Agreement.

City Engineer – The City of Alamogordo's Chief Engineer and/or one of his/her representatives.

Cul-De-Sac – A local street with only one (1) outlet having an appropriate terminus for the safe and convenient reversal of traffic movement.

Drawings or Plans - The drawings which show the character and scope of the Work to be performed and which have been prepared or approved by an Engineer.

Driveway, Private – A vehicular way not serving more than one lot or parcel of land.

Driveway, Common – A vehicular way serving more than one lot or parcel of land.

Engineer - The person or firm designated by an owner, who is responsible for providing engineering services.

Easement, Private – A right-of-use granted for the limited use of private land owners and where general use and maintenance of such area is governed by and agreement which runs with the land. This easement is serviceable only by mutual consent of all of the parties that benefit from the easement.

Easement, Public – An easement dedicated for use by the public, which is included within the dimensions or areas of lots or parcels of land..

Field Order - A written order issued by an Engineer or Inspector which clarifies or interprets the plans and specifications.

Frontage Road – Used to relieve Major Arterial streets of side traffic.

Grade – The slope of any surface specified in percentage terms or in terms of elevation.

Grading – Any disturbance of the surface of the land with earth moving equipment.

Intersection – the location where two (2) or more streets cross at grade.

Median – A strip that separates the opposing flows of traffic on a street.

Owner – Legal deed holder(s) of the property being developed.

Pedestrian way – A specifically designated place, means, or way by which pedestrians shall be provided safe, adequate and usable circulation; normally provides access through the interior of a property or development. Does not include street or vehicular easement or right-of-way or required sidewalk along a street or vehicular way.

Property Line – The line(s) of record bounding a lot or other parcel of land.

Project - The entire construction to be performed as provided in the plans and specifications.

Public Works Inspector – Inspector representing the City of Alamogordo responsible for inspection of all work done and all materials furnished. He is authorized to call to the attention of the Contractor any failure of the work or materials to conform to the City's standards, plans and specifications. He shall have the authority to reject materials or suspend work until any questions at issue can be resolved.

Reference Specifications, Test Methods, and Applicable Codes - All standard specifications and test methods of any society, association, or organization referred to herein are hereby made a part of these Technical Standards the same as if written in full. (Any reference to a paragraph or subparagraph within an article shall include all general provisions of the article to which reference is made.) Reference to such standards refer to the latest published issues as of the date of the development or project is approved, unless otherwise specified. Reference to local or state codes and laws shall mean the latest adopted and published codes as of the date of the development or project is approved, unless otherwise specified.

Service Connections - Service Connections shall be construed to mean all or any portion of the pipe, conduit, cable, or duct which connects a utility main or distribution line to a building, home, residence, or property.

Shop Drawings - All drawings, diagrams, illustrations, brochures, schedules, and other data which are prepared by Contractor, a Sub-Contractor, manufacturer, supplier, or distributor which have been approved by Owner and/or the City Engineer and which illustrate the equipment, material, or some portion of the Work.

Special Conditions - Conditions which modify any article or paragraph of these Technical Standards.

Specifications (also Technical Specifications) - A written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work.

Street – a right-of-way dedicated to the use of the public by which vehicles and pedestrians shall have lawful and usable ingress and egress, which has been accepted for maintenance and control by the City, County or State. See Section 3 of the Detail Drawings for street classifications.

Street, Stub – A street that has been designed to allow for the future extension of the street through subsequent developments.

SubContractor - An individual, firm or corporation having a direct contract with Contractor or with any other SubContractor for the performance of a part of the Work at the site, and who has a current City of Alamogordo Business Registration.

Utility - Overhead or underground wires, pipes, conduits, ducts, or structures, operated and maintained in or across a public right-of-way or easement or private easement operated and maintained to supply such commodities as water, gas, power, telephone, cable television, or sewer.

A. Public Utility - Owned and operated by a municipality or another political subdivision of the State.

B. Private Utility - Owned and operated by a private company or corporation.

Work - Any and all obligations, duties, and responsibilities necessary to the successful completion of the Project assigned to or undertaken by Contractor, including all labor, materials, equipment, incidentals, and the furnishing and installation thereof.

1.1 GENERAL

The Contractor is required to locate all existing utilities prior to commencing work on the project. It shall be the Contractor's sole financial and legal responsibility to field verify locations and depths of all existing utilities and coordinate any relocation work required.

The Contractor shall be required to maintain adequate temporary access for the private residences and the businesses and facilities within the construction area, to the satisfaction of the City Engineer and/or Public Works Inspector.

At the end of each work day, or as required during each day, or as required due to weather conditions, the Contractor shall perform grading, shaping, and cleanup, to include sweeping the street surface, sidewalks and driveways, to maintain an acceptable site condition.

2.0 WORKMANSHIP AND MATERIALS

These standards are prepared with the intention that only first-class workmanship and materials of the best quality will be provided. Materials and workmanship of less than best quality will not be acceptable. In the event that these standards may not completely describe each and every part, item and detail, it will not relieve the Contractor of the full responsibility for providing the necessary part, item or work necessary to complete the project satisfactorily for proper operation, as intended.

The materials and equipment specified are considered the minimum standard of quality necessary to produce a satisfactory project. Substitutions for the materials and equipment that have been specified will not be permitted except on written approval of the City Engineer.

Any materials that are found to be damaged either before or after installation shall be removed promptly and replaced with new materials. The Public Works Inspector's inspection of the materials before they are installed shall not relieve the Contractor from any responsibility to furnish and install good quality materials, totally undamaged.

3.O WATER FOR CONSTRUCTION.

The Contractor will be responsible for purchasing all of the reclaimed water he needs for construction from the City of Alamogordo. The cost will be determined in accordance with the current reclaimed water rates. It shall be the Contractor's responsibility to transport and apply the reclaimed water as specified or as ordered by the Engineer.

Reclaimed Hydrant Locations
Purple Hydrants

1. Pivot Hydrant, Airport pivots
2. Lavelle Hydrant, East of Lavelle Pump Station on Bypass Hwy.
3. Sun City Hydrant, North of Sun City Furniture
4. McDonald Hydrant, Behind McDonalds west side of RR tracks
5. South Florida Hydrant, South Florida northwest corner of Bowling Alley
6. Canyon Rd Hydrant, Next to cemetery
7. City Yard Hydrant, in city yard compound

The Contractor shall meter the reclaimed water he uses at the fire hydrant from which the reclaimed water is taken. The Contractor shall furnish the meter or obtain a meter from the City for which he will have to pay a deposit, to be refunded when the meter is-returned in good working order.

The Contractor shall furnish and maintain the piping and/or equipment necessary to connect to the reclaimed water source and to convey the reclaimed water into the Contractor's reclaimed water tank. Contractor shall not allow reclaimed water to go to waste during the tank filling operations, and he shall not allow his piping and equipment to leak water.

The tank filling equipment shall be placed and maintained in such a way as to provide prevention against accidents of any nature to Contractor personnel or the public in general.

The Contractor is required to connect the fill stand or fill equipment to the fire hydrant, and leave the fire hydrant valve open. Contractor shall install a valve in the fill stand piping to control the water flow.

The hydrant valve shall not be closed except when water will not be needed over a weekend or a period of two or more days.

4.0 MATERIALS TESTING

A materials testing laboratory shall be retained. The frequency of the required testing shall be as specified in the following articles. The Contractor shall notify the testing laboratory and the Public Works Inspector when he is ready for each test that is required and cooperate fully in making way for the laboratory technician to make the tests that he is directed to make. If any of the work fails to meet the standards specified, the Contractor shall correct such failures in a manner acceptable to the Engineer and/or the Public Works Inspector. The Contractor shall pay for the cost of all re-testing necessary due to failure to meet specification requirements on initial testing. If the Contractor requests the testing laboratory to obtain density tests and the area to be tested is not ready when the technician arrives at the job site, the Contractor shall pay for all trip charges or stand by time assessed.

5.0 SANITARY FACILITIES

The Contractor shall provide the necessary number of sanitary toilet units for all of the workers on the work site. The chemical toilets shall be moved along the project routes so that they will be convenient for the workers.

Adequate potable drinking water shall be provided on the work site as well as drinking cups, for the benefit of all employees.

6.0 TRUCK BED COVERS

All trucks or other conveyances hauling any loose materials, including hot-mix bituminous materials, on public streets, highways and detours shall be of an approved type, and shall be covered in such a manner as to prevent such materials from dropping, sifting, leaking, or otherwise escaping therefrom. Coverings for trucks or other conveyances hauling loose materials as herein provided shall be securely fastened so as to prevent said covering or load from becoming loose, detached, or in any manner a hazard to public traffic. Any vehicles in violation of this provision will not be permitted to operate.

7.0 UNDERGROUND AND OVERHEAD UTILITIES

Any interference with, or damage to, either underground or overhead utilities of any nature shall be the Contractor's legal and financial responsibility, saving the OWNER harmless from any or all claims resulting from damage to these utilities by reasons of his operations.

The Contractor shall contact Blue Stake Utility Locate System (telephone no.437-7700) .They will receive requests for all field utility locations. They will deliver the location request to the proper utility company. A forty-eight (48) hour notice is required.

8.0 CONTRACTOR COMMUNICATIONS

The Contractor shall contact the City Engineer and the Department of Public Safety to inform them of any information or traffic condition that is encountered, as well as to obtain any new requirements or restrictions.

9.0 SEQUENCE OF WORK

The work shall be carried out with the intent of causing as little disruption as possible to the public. The Contractor shall perform clean up operations on a continual basis. Any area that the City Engineer and/or Public Works Inspector requests to be cleaned up shall be done so immediately.

Contractor shall be responsible for advising the businesses, residents and occupants along each street as to when work will be done in that particular area. He will notify the businesses, residents and occupants a few days in advance of doing the work. He will ask the businesses, residents and occupants to move their vehicles out of the way of construction if required. If a problem develops with any resident or occupant, the Contractor shall report it to the City Engineer, and the City Engineer will assist in solving the problem.

10.0 AUTHORITY AND DUTIES OF PUBLIC WORKS INSPECTORS

Certified Inspectors representing the City of Alamogordo shall be authorized to inspect all work done and all materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector is not authorized to revoke, alter, or waive any requirements of the specifications. He is authorized to call to the attention of the Contractor any failure of the work or materials to conform to the technical standards and/or the plans and specifications for a project, which ever is more strict. He shall have the authority to reject materials or suspend the work until proper materials are obtained, rejected materials are removed from the project site and/or improper work is corrected. Any questions at issue as to quality of materials and/or work installed may be referred to the City Engineer.

The Inspector shall in no case act as foreman or perform other duties for the Contractor, nor interfere with the management of the work by the Contractor. Any advice which the Inspector may give the Contractor shall not be construed as binding the City in any way or releasing the Contractor from fulfilling all of the terms required.

If the Contractor refuses to suspend operations on verbal order, the Inspector shall issue a written order giving the reason for shutting down the work. After placing the order in the hands of the man-in-charge, the Inspector shall immediately leave the job. Work done during the absence of the Inspector will not be acceptable.

11.0 SANITARY LANDFILL

All waste and recyclable materials shall be disposed of or stockpiled in approved locations per EPA regulations.

12.0 SIGN REMOVAL AND REPLACEMENT

The Contractor shall be responsible for removing and replacing all existing signs that are in the way of the project construction. The signs shall be indexed as to location and installation height before removing them. They shall be properly and adequately stored. When replaced, they shall be the installed to existing or better condition than before work began in all respects. The Contractor shall replace any signs that are damaged due to his negligence at his expense.

13.0 PROTECTING THE WORK

The Contractor shall be responsible for protecting all portions of the work until accepted against any and all damage, including but not limited to: vandalism, accidents and weather conditions.

14.0 EXISTING WATER VALVE BOXES

If there are existing water valve boxes within the construction areas. The Contractor shall reference their location. Any valve boxes that are damaged during construction shall be replaced. After the new PMPB has been installed and approved, the Contractor shall neatly saw-cut a 2ft. x 2ft. square opening in the new pavement centered on the valve and install a new reinforced concrete collar as shown in the Detail Drawings of this document.

15.0 EXISTING MANHOLES

If there are existing manholes within the construction areas. The Contractor shall reference their location, and carefully remove and store the manhole rings and lids. Any manhole rings and lids damaged shall be replaced. The top portion of the manhole shall be removed to a depth below the limits of work, and provide a steel plate covering over the manhole. After the new PMBP has been installed and approved, the Contractor shall neatly saw cut a 4 ft. x 4 ft. square opening in the new pavement, centered on the manhole.

The Contractor shall provide concrete adjustment rings as required to reconstruct the top of the manhole to the proper elevation so that the manhole frame and lid are flush with the new PMBP surface. Each manhole shall receive a new reinforced concrete collar, as shown in the detailed drawings of this document.

16.0 WATER SHUT-OFFS

All water shut-offs shall be done by the City. The Contractor shall notify the City Water Shop 48 hours prior to the date of the required shut-off. The Contractor shall also notify each household, office, business and/or other affected water user that a shut-off will be made atleast 24hours in advance of the shut-off.

17.0 SITE DRAINAGE

Any improvements to lots and/or parcels of land shall not substantially change the existing drainage conditions or the amount of water released onto adjacent properties.

On-lot ponding may be permitted provided that the lot is over ten thousand (10,000) square feet in size, vector control is provided and the drainage area for the pond is confined to the subject lot. If individual on-lot ponding is infeasible or if it is not permitted due to the lot size, common retention/detention ponds may be permitted. Common retention/detention ponds shall be located on parcels with an area greater than ten thousand (10,000) square feet. Provisions for the long-term maintenance, including vector control, of the common pond shall be provided. Ponds that will be maintained by the City shall serve not less than twenty (20) acres of developed area. Retention/detention ponds holding water for more than seventy-two (72) hours or having a ponding depth of greater than eighteen (18) inches for more than six (6) hours following a fifty (50) year storm event shall be fenced with a minimum six-foot high chainlink fence. A lockable gate, at least ten (10) foot wide, shall be

provided for maintenance purposes. On-lot ponding designs shall be submitted for review by the City Engineer prior to approval.

END OF ARTICLE 01-002.1

Article 01-002.2 TRAFFIC CONTROL MANAGEMENT

1.0 DESCRIPTION

This work shall consist of providing traffic control management in strict compliance with the Manual on Uniform Traffic Control Devices (MUTCD), including supervision of personnel and the installation, inspection, and maintenance of all traffic control devices.

2.0 REQUIREMENTS

2.1 Traffic control shall be required when construction interferes with thoroughfare traffic. It shall also be required to prevent through traffic where new development meets existing streets until all utilities, new streets and infrastructure have been completed.

2.2 All Traffic Control required to be in place for more than an eight (8) hour period, the contractor shall submit a traffic control plan to the City for approval. Traffic Control required to be in place less than eight (8) hours shall comply with the current MUTCD.

2.3 Where more than one Contractor is working in an area requiring traffic control, the Contractors shall coordinate all traffic control operations.

2.4 Traffic Control

A. Construction requiring traffic control for more than a 24hr period, the Contractor shall have a certified traffic control technician (TCT) on staff, or sub-contract traffic control management for the project.

B. The Contractor shall submit, to the City Engineer and Public Works Inspector, a schedule identifying who will be in charge of providing traffic control management.

2.5 Certification. Prior to commencing work requiring traffic control management, the Contractor shall submit to the City Engineer a copy of current certification from an agency approved by the City. Contractor's may submit current certification to the City on an annual basis. Contractors may submit a copy of current certification to remain on file for one calendar year.

2.6 Duties.

A. The TCT(s) shall provide management and supervision services at the project site.

B. The TCT(s) shall prepare any revisions to the traffic control plan and submit the new traffic control plan to the City Engineer for approval. All revised traffic control plans shall also be submitted to the Public Works Inspector.

C. The City recognizes that the Contractor does not have direct control over the traffic control operations of the utility companies. The coordination provided by the TCT when dealing with utility companies is for the purpose of coordinating concurrent utility traffic control with any other construction traffic control to avoid conflicts.

D. The TCT(s) shall coordinate all project activities with the appropriate individual traffic control law enforcement and fire control agencies.

E. The TCT(s) shall prepare and submit statements concerning road closures, delays, and other project activities to the news media as required. News releases shall be submitted to the City Engineer and/or Public Works Inspector for review and approval prior to the Contractor's submittal to the news media.

F. The TCT(s) shall be responsible for notifying the City Engineer of all accidents related to the project. The time and date shall be documented.

G. The TCT(s) shall be responsible for the maintenance, cleanliness, and replacement of traffic control devices of the traffic control plan during working and non-working hours.

2.6.1 Inspection of Traffic Control.

A. The TCT shall inspect traffic control devices every calendar day that traffic control devices are in use. The TCT shall provide for the immediate repair, cleaning, or replacement of traffic control devices not functioning as required to ensure the safety of the motorists and construction personnel.

B. Inspections of the traffic control devices shall be conducted at the beginning and end of each work day.

C. Traffic control devices in use longer than seven days shall be inspected at least once a week during nighttime periods.

2.7 Availability of TCT.

A. Traffic control management shall be provided under the supervision and direction of the TCT on a 24-hour-per-day basis throughout the duration of the project.

B. The TCT (or approved representative) shall be available on every working day – on call at all times – and available upon the City Engineer's request during normal working hours and during other-than-normal working hours.

C. The provisions for availability of the TCT shall also be met during times of partial or full project suspension.

3.0 COMPLIANCE.

3.1 Failure To Comply.

A. The City may suspend all or part of the Contractor's operation(s) for failure to comply with the approved "Traffic Control Plan" or failure to correct unsafe traffic conditions within a reasonable period of time after such notification is given to the Contractor in writing.

B. In the event that the Contractor does not take appropriate action to bring the deficient traffic control into compliance with the approved traffic control plan – or to correct the unsafe traffic conditions – the City may proceed with the corrective action using its own forces, and such shall be billed to the Contractor.

C. The Contractor shall not be relieved of the responsibility to provide traffic control safety to the traveling public when a project is under full or partial project suspension.

3.2 Engineer Modifications. The provisions included in the plans and specifications for handling and controlling traffic during construction may be changed by the City Engineer due to actual field conditions encountered. Such changes will be made by written instruction to the Contractor and shall be considered an amendment to the plans and specifications as of the date of change.

END OF ARTICLE 01-002.2

Article 01-022.1 Earthwork

1.0 SCOPE

This specification consists of equipment, materials, labor, and performing operations required for excavation, borrow, embankment, and backfill required to bring the existing ground to subgrade elevation.

2.0 TESTING FOR COMPACTION

A. Compaction testing requirements:

1) Determine the density of soil in place of the sand cone method, ASTM D 1556 or by nuclear methods, ASTM D 2922 and D 3017.

2) Determine the laboratory moisture-density relationship of soils by ASTM D698.

3) Determine the relative density of cohensionless soils by ASTM D4253 and D4254.

4) Sample backfill materials by ASTM D 75.

5) Compaction tests shall be preformed every 500 linear feet each lift or a minimum of 1 locations as designated by the Public Works Inspector.

3.0 GENERAL

A. Work shall consist of excavation providing borrow, constructing embankment, hauling, disposal, placement and compaction of all materials not covered under some other item which is encountered within the limits of the work necessary for the construction of the improvements in substantial compliance with the specifications and the lines, grades, thickness, and typical cross sections shown on the plans or established by the Engineer. All excavation will be classified as "unclassified excavation".

1) Unclassified Excavation. Unclassified excavation shall consist of the excavation and disposal of all materials of whatever character encountered in the work.

2) Borrow. Borrow shall consist of approved material required for the construction of embankments or for other portions of the work and shall be obtained from approved sources.

3) Embankment. Embankment shall consist of construction of embankments and miscellaneous fill with suitable materials, containing specified moisture, from unclassified excavation, structure excavation, and borrow, placed and compacted in place.

4) Backfill. Backfill shall consist of suitable materials from unclassified excavation and borrow, containing specified moisture and placed around or under pipes,

culverts, and minor concrete structures to the density specified in the Project Plans or as specified in these Technical Standards, whichever is more strict.

B. Existing utilities, services, facilities, and pipelines on, above, or under the surface of the area where earthwork operations are to be performed shall be carefully protected from damage.

4.0 CONSTRUCTION REQUIREMENTS

A. The excavation and embankments for the improvements shall be finished to reasonably smooth and uniform surfaces. Excavation operations shall be conducted so that materials outside of the limits of slopes will not be needlessly disturbed.

B. Prior to beginning excavation, grading, trenching, and embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed.

C. When the Contractor's excavating operations encounter remains of prehistoric people's dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The City Engineer will contact archeological authorities to determine the handling and disposition thereof. The Contractor shall cooperate with the archeological authorities in the preservation and removal of such artifacts.

5.0 EXCAVATION

A. General

1) Excavations shall be made to the lines and grades and at the locations shown on the plans, in accordance with these technical standards and all other applicable specification items. Cut sections resulting from excavation shall be finished to a reasonably smooth and uniform surface. The final surface of excavations which shall serve as subgrade for concrete work shall not vary more than 0.00 foot above or 0.05 foot below the established grade or elevation. Other areas shall be ±0.1 foot. The Contractor shall be required to remove unsuitable materials and refill the excavated area to the finished graded section with suitable material. Contractor shall conduct his operations for the removal of such unsuitable material in such a way that the Engineer and/or Public Works Inspector can make all necessary observations and measurements to determine the extent of such removal before any suitable material is placed. All unsuitable material shall be properly disposed of.

2) Excavations shall be performed insofar as practicable in the dry. Proper drainage for the excavated areas shall be maintained to prevent the ponding of water. Excavated areas shall be kept dry by pumping, dikes or other suitable means. Where excavated material which is to be incorporated into the permanent embankment, fill or backfill is found to have excessive moisture content, Contractor shall dry such excavation to achieve the proper moisture content before placement.

3) Sheeting and shoring shall be used when necessary for personnel safety and work protection. Sheeting and shoring shall conform to OSHA requirements.

B. Pipes and Concrete Structures

1) Excavation for pipes and concrete structures shall be made to the lines, grades, and cross sections shown in the Project Plans.

Contractor shall provide all trench wall sloping, shoring, sheeting and bracing, and incidentals required to provide safe working conditions, in compliance with OSHA requirements.

2) The width of excavations shall be sufficient to allow for proper jointing of pipes and for working with forming materials for concrete structures and to the dimensions indicated in the Project Plans and/or the Detail Drawings of this document.

3) Unsuitable foundation material encountered at the bottom of the excavation shall be removed and backfilled with suitable material, compacted at optimum moisture, to 95% density (ASTM D-1557).

4) The bottom of the completed excavation shall be firm and smooth for its entire width and length. Contractor shall notify the Engineer when the excavation, or section thereof, is completed and the Engineer shall approve the excavation before any bedding material, refill or backfill material is placed.

6.0 BORROW

Borrow shall be obtained from the places indicated in the Project Plans or as approved by the Engineer.

Borrow shall consist of approved gravelly material excavated for the purpose of blending and mixing with finer excavated materials to provide suitable material for fill, backfill, and embankment.

7.0 EMBANKMENT AND FILL AREAS

A. General

1) Prior to the placement of suitable material for embankment or fill areas, all necessary clearing and grubbing, excavation, and installation of pipes and appurtenances shall have been performed, all in accordance with the project plans and/or these technical standards.

B. Material Classifications

Embankment and fill materials shall conform to the following classifications:

The materials used in the embankment and fill shall not be uniformly fine grained materials. The fill materials shall be classified as SC, SM-SC, GC, GM, or GM-GC

according to the Unified Soil Classification System. No soils in the embankment material shall have granular material more than 50% passing the #200 USA Standard Sieve. Proper mixing and blending of materials will be required.

C. Placement of Embankment and Fill

1) Areas of natural ground to receive embankment or fill not already at optimum moisture shall be scarified to a depth of 8 inches, wetted or dried to bring the moisture content to within +2% to -1% of optimum and re-compacted to the specified percent of the maximum density, tested and approved before the first layer of suitable embankment material is placed.

2) Only suitable material for embankment and fill will be allowed in the permanent work at locations shown on the Project Plans.

3) After areas to receive embankment or fill have been properly prepared, suitable material shall be placed and spread in loose 8 inch lifts across the entire fill or backfill section. The City Engineer may authorize roadway fill materials to be placed in layers in excess of 8 inches thickness if the Contractor can demonstrate that the required compaction can be achieved for the full depth of the lift. Lesser thickness shall be used if necessary to achieve specified compacted density. Suitable material shall then be windrowed, disked, or manipulated by other suitable means to achieve a homogeneous mixture of proper moisture content, free of hard lumps of soil or frozen material, and compacted to the required density.

4) Rocks larger than 2-1/2 inches shall not be placed within 12 inches of the subgrade for paving.

5) Compacting shall begin only after the suitable material has been properly placed and the material to be compacted is at optimum moisture, not to exceed +2% or -1% of optimum. All materials used for embankments shall be compacted to a minimum of 90% of maximum dry density, modified proctor, (ASTM D-1557). Embankment within 8 inches from subgrade shall be compacted to a minimum of 95% of maximum dry density (ASTM D-1557).

6) If the suitable material to be compacted contains excessive moisture, such material shall be processed to reduce the moisture to the specified content. If the suitable material has less than the specified moisture content, or is likely to lose enough moisture to bring the moisture content below requirements before completion of compaction, water shall be added and the lift thoroughly mixed before compacting.

7) Subsequent layers of suitable material for embankment shall be placed as described above in generally horizontal layers of loose thickness not to exceed 8 inches, unless otherwise approved, and shall extend across the full width of the embankment area.

8) After compacting of the material, in place density tests shall be made. If the compacted material fails to meet the density specified, the course shall be

reworked as necessary to obtain the specified density.

9) Embankment, of fill, adjacent to structures such as concrete walls, culverts, boxes or similar structures shall not be compacted with heavy equipment but shall be compacted with hand operated equipment to a distance of 4 feet or greater, beyond the sides of the structure.

D. Finishing

1) The final surface of compacted embankments, berms, or fills shall be carefully trimmed to the cross sections, lines, grades, and elevations indicated on the plans.

2) Embankment or fill shall not vary more than 0.05 foot below or 0.00 foot above the established plan grades and cross sections where it is to serve as subgrade for concrete work. Other areas shall be ±0.1 foot.

END OF ARTICLE 01-022.1

Article 02-022.2 Trenching and Backfilling

1.0 SCOPE

This section includes materials, testing, and installation for trench excavation, backfilling, and compacting.

2.0 GENERAL

2.1 TESTING FOR COMPACTION

A. Compaction testing requirements:

1) Determine the density of soil in place of the sand cone method, ASTM D 1556 or by nuclear methods, ASTM D 2922 and D 3017.

2) Determine the laboratory moisture-density relationship of soils by ASTM D698.

3) Determine the relative density of cohensionless soils by ASTM D4253 and D4254.

4) Sample backfill materials by ASTM D 75.

5) Compaction tests shall be preformed every 500 linear feet each lift or a minimum of 1 locations as designated by the Public Works Inspector.

B. Where compaction tests indicate a failure to meet the specified compaction and the contractor does not want to rework the entire area, the Contractor will take additional tests every 100 feet in each direction until the extent of the failing area is identified. Rework the entire area between locations that have passed the tests until the specified compaction has been achieved.

2.2 PIPE ZONE

A. The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, see Section 7. Thickness of pipe zone above the highest top of pipe shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed: 6 inches or smaller pipe = 6 inches; 8 inches or larger pipe = 12 inches.

2.3 PIPE BASE OR BEDDING

A. The pipe base or bedding shall be defined as a layer of material immediately below the bottom of the pipe and extending over the full trench width in which the pipe is bedded, see Section 7. Thickness of pipe base shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed: 16 inches and smaller pipe = 4 inches; 18 inches and larger = 6 inches.

3.0 MATERIALS

3.1 FLOWABLE FILL - TRENCH ZONE @ EXISITNG STREET CROSSINGS

A. A flowable or lean backfill used above the pipe zone shall be used in each crossing above Engineered fill pipe zone materials a minimum of 12 inches below the base coarse grade at locations where trench crosses a street. Lean fill is defined as flowable concrete using only a sand or pea gravel aggregate and minimal cement content that can be re-excavated with standard earthwork equipment. Submit flowable or lean fill mix design to the City Engineer for approval.

3.2 ENGINEERED FILL – TRENCH ZONE, BEDDING, AND PIPE ZONE

A. Engineered fill may be used under paved areas in the final backfill zone when trenching in existing streets. When native fill material is not suitable Engineered fill or suitable fill material from another location shall be used. See typical Trench Details in Section 7 of the Detail Drawings.

4.0 EXECUTION

4.1 COMPACTION REQUIREMENTS

A. Unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed, see Section 7 for relative compaction.

4.2 MATERIAL REPLACEMENT

A. Remove and replace any trenching and backfilling material which does not meet the specifications.

4.3 SHEETING, SHORING, AND BRACING OF TRENCHES

A. Trenches shall have sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P - Excavations, OSHA requirements.

4.4 TRENCH WIDTHS

A. Trench widths in the pipe zone shall be 24 inches greater than the pipe outside diameter. Comply with 29CFR Part 1926 Subpart P – Excavations, and provide adequate room for compaction equipment access.

4.5 TRENCH EXCAVATION

A. Excavate the trench to the lines and grades shown in the drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base encasement or special bedding. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade with pipe base material. Place the refilling material over the

full width of trench in compacted layers not exceeding 8 inches deep to the established grade with allowance for the pipe base or special bedding.

4.6 LOCATION OF EXCAVATED MATERIAL

A. During trench excavation, place the excavated material only within the working area. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

4.7 INSTALLING BURIED PIPING

A. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

B. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.

C. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipe laying to provide firm, continuous, uniform support along the full length of pipe, and compact to the relative compaction specified herein. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities.

D. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill the area excavated for the joints with the bedding material specified for use in the pipe zone.

E. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts compacted, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

F. Carefully place pipe zone material so as not to damage pipe.

G. Compact each lift to the relative compaction specified herein.

H. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.

I. When the pipe laying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals, or foreign material to enter the pipe.

J. Remove and dispose of all water entering the trench during the process of pipe laying. Keep the trench dry until the pipe laying and jointing are completed.

4.8 BACKFILL COMPACTION

A. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping in confined or pipe zones. Do not use high impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

B. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping.

C. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, or other structures.

D. Jetting or flooding will not be allowed.

E. Flowable or lean fill is acceptable in confined backfill zones.

END OF ARTICLE 01-022.2

Article 02-025.1 Base Course

1.0 SCOPE

This work consists of furnishing and placing base course aggregate in compliance with the specifications and the lines, grades, dimensions and typical sections.

2.0 MATERIALS

A. Base course aggregate shall be composed of materials consisting of crushed stone, crushed or screened gravel, caliche, sand or a combination of such materials. Base course shall be free from vegetable matter and all other deleterious materials.

B. Base course aggregate materials shall be combined in such proportions that the resulting composite blend meets the requirements of the following table:

BASE COURSE CLASSIFICATION
CLASS II-B

Sieve Size	Percent Passing
1"	100
3/4"	85-100
No. 4	40-70
No. 10	30-55
No. 200	4-12
Soundness	18 or less
L.A. Abrasion	50 or less
L.L.	25 or less

When base course material is produced from pits or quarries, all oversize material up to and including rocks and boulders 10 inches in greatest dimension shall be crushed and mixed with other material.

Fifty percent by weight of all plus No. 4 materials shall have a minimum of two mechanically fractured faces. When base course is to be treated with cement or asphalt, the requirement for mechanically fractured faces shall not apply unless otherwise indicated on the plans.

3.0 CONSTRUCTION

A. General - The subgrade, subbase, or base course upon which base course is to be placed shall be cleaned of all loose and deleterious materials, shall be free from frozen material, and the top 6 inches shall have a moisture content not exceeding optimum plus or minus 2 percent as determined by AASHTO T 99 for subgrade and AASHTO T 180 for subbase or base course, Method C or D.

B. Mixing and Placing - Mixing shall provide a homogenous mixture of unsegregated and uniformly dispersed materials as placed in position for compacting. Plant and equipment shall be adequate in all respects.

C. Testing - The Contractor shall spread and compact base course in layers which will permit the required density to be obtained. Density requirements will be determined by ASTM D-1557. Unless otherwise provided, base course shall be compacted to not less than 95 percent of the laboratory established density. Field density tests will be preformed every 500 linear feet. each lift or a minimum of 2 locations as designated by the Public Works Inspector. Densities will be determined in accordance with AASHTO T 205, or through nuclear methods in accordance with AASHTO T 238 and T 239, or other approved methods. Where compaction tests indicate a failure to meet the specified compaction and the Contractor chooses not to rework the entire area, the Contractor will take additional tests every 100 feet in each direction until the extent of the failing area is identified and rework the entire area between locations that have passed the tests until the specified compaction has been achieved.

D. Surface Tolerance - The top surface of base course shall not deviate in excess of 3/8 inch when tested with a 10-foot straightedge in any direction. All deviations from this tolerance shall be corrected.

END OF ARTICLE 02-025.1

Article 02-025.2 Prime Coat

1.0 SCOPE

This work shall consist of providing and applying bituminous material, or other prime material and blotter material, when required by the type of PMBP to be placed.

2.0 MATERIALS

A. Bituminous material for prime coat shall be of an approved type.

1. Certification: The Contractor shall provide a manufacturer's written certification that the prime materials to be used are chemically the same materials as those on the NMSHTD's "Approved Products Listing," and have not been changed or altered in any way.

B. Blotter Material: The blotter material shall be a fine aggregate (sand) conforming to the gradation requirements of Table 116 unless otherwise approved by the City Engineer.

TABLE 116
BLOTTER MATERIAL

Sieve Size	Percent Passing
3/4 inch	100
No. 4	80-100
No. 16	45-80
No. 50	10-30
No. 100	2-10

3.0 CONSTRUCTION REQUIREMENTS

A. Weather and Temperature Limitations: Prime material shall not be applied on a wet surface, or when the atmospheric temperature is below 50°F, or when weather conditions prevent the proper placement of the prime coat. In order to protect the work in progress, these weather and temperature limitations may be waived by the City Engineer.

B. Equipment: The equipment shall include at least one pneumatic tired roller, a distributor, and equipment for heating bituminous material.

The distributor shall be capable of maintaining prime material at an even temperature, distributing the material uniformly on variable widths with uniform pressure, and at readily determined, controlled rates ranging from 0.05 to 1.0 gallon per square yard.

The distributor shall circulate the prime material within the tank, the spray bar and all other accessories used therewith, when spraying is not being performed.

The distributor shall be equipped with a hand spray gun having a means for precise control with single or double nozzle and a positive shut-off valve.

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

C. Preparation of Surface: The surface to be primed shall be shaped to the specified grade and section, and shall be free from all ruts, corrugations, segregated materials, or other irregularities, and shall be uniformly compacted. Prime coat shall only be placed when the moisture content of the top 3 inches of the surface to be primed is 2% below optimum or less.

D. Prime material shall be applied to a width of the section to be primed by means of a pressure distributor, in a uniform and continuous spread.

Should clogging, skipping, streaking or other irregularities in distribution occur, operations shall cease until corrective action is taken.

The total amount of prime material applied in overlapped areas shall not exceed the application rate specified.

When traffic is permitted on the surface, one-way traffic shall be maintained on the untreated portion of the roadbed until the prime material has been absorbed by the surface and will not pick up. Traffic shall then be transferred to the treated portion and the remaining width of the section can then be primed.

When required by the Engineer, the prime coat shall be rolled with a self-propelled pneumatic tired roller until uniform distribution is obtained and the surface is smooth and consolidated. The Engineer will determine when the surface has been adequately rolled. Each tire shall have a contact pressure of at least 90 pounds per square inch.

Application of prime material, loading and cleaning of distributor, dilution rates of prime material concentrate where applicable, curing of material and storage shall be accomplished in accordance with the manufacturer’s recommendations.

E. Application Of Blotter Material: If the prime material fails to penetrate the surface before the roadbed is to be used by traffic, blotter material shall be spread in the amounts necessary to absorb excess material.

END OF ARTICLE 02-025.2

Article 02-025.3 Plant Mix Bituminous Pavement

1.0 SCOPE

A. This work consists of constructing one or more courses of plant-mix bituminous pavement (PMBP) mixed in a central mixing plant and shall be composed of a mixture as specified in the job mix formulas approved by the City. The PMBP shall be placed on a prepared base in accordance with the project plans and these Technical Standards.

B. Each course shall be constructed to the depth, typical section, or elevation required by the detail drawings of this document and/or approved plans and shall be rolled, finished, and approved before the placement of the next course.

2.0 MATERIALS

2.1 Laboratory Mix Design. A laboratory mix design developed by an approved testing laboratory shall be submitted to the City for approval. A mix design may stay on file with the City as approved for one (1) calendar year. All costs associated with the development of the mix design by an approved laboratory shall be borne by the Supplier. The mix design shall be summarized in a format approved by the City Engineer and submitted by the Supplier for review and acceptance. The submittal shall include the results of all testing determinations for the individual mix components as well as for the mixture itself. The City Engineer may take ten (10) business days to review the mix design submittal. The approval of a mix design by the City Engineer shall not relieve the Supplier of full responsibility for producing an acceptable mixture through the plant. The laboratory mix design shall be considered as a starting point and may be adjusted as described in subsection 2.4.3. The resultant job mix formula gradation shall be within the master range for the specified type of PMBP. When hydrated lime is to be added, it is included in the gradation for establishing the laboratory mix design. The laboratory mix design for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single percentage of bituminous material to be added to the aggregate. The Supplier shall provide a mixture that meets all applicable criteria. Factors such as durability, water resistance, and asphalt film thickness will be considered during the development or review of all mix designs. The judgment as to the significance of these factors with regard to issuing or accepting the mix design will rest with the City Engineer. All mix designs must be submitted for review and approval on an annual basis. An extension for up to three (3) years may be granted, provided acceptable evidence is submitted verifying that the component materials have not changed significantly. If a change in sources of materials or crushing operations is made, the City Engineer may require a new laboratory mix design before the new materials may be used. When unsatisfactory results or other conditions make it necessary, the City Engineer may require that a new mix design be developed.

2.2 All materials shall be tested in accordance with applicable AASHTO methods, as modified when applicable, or other test procedures designated by the City. Material that is improperly graded or segregated, or fails to meet requirements, shall be corrected or removed and disposed of immediately as directed by the Engineer or Public Works Inspector.

2.3 Aggregates. The combining of materials from two or more sources to produce aggregate will be permitted only when each source meets all applicable quality

requirements.

2.3.1 Acceptance of Aggregate. The plasticity index, sand equivalent, fine aggregate angularity, flat and elongated particles count, and fractured face count of PMBP aggregate will be determined from representative samples taken after the aggregate materials have been blended and prior to the addition of hydrated lime and mixing with bituminous material. The test results from these samples will be the basis for acceptance of such aggregate. Samples of aggregates shall be furnished at the start of production and at intervals during production or at every 500 tons with a minimum of one per project. The sampling points will be designated by the Public Works Inspector. The samples will be the basis of approval of specific lots of aggregates.

2.4 Bituminous Materials: Bituminous materials employed shall be of the type, grade, and amount shown on the job mix formula. The Contractor shall furnish the vendor's certified test reports for each tank load of bituminous materials delivered to the project. The asphalt source to be used will not be changed without written approval.

2.4.1 Blending Sand. Blending sand shall consist of the natural fines from the scalping process, concrete sand, sandy material or a combination of any or all of these that is graded in such a manner that it satisfies the mix design requirements. The need for and actual percentage of blending sand will be determined based on design mix criteria tests developed from samples taken from the Supplier's stockpiles and submitted to the mix designer.

2.4.2 Mineral Filler. Mineral filler shall conform to the requirements of AASHTO M 17, and shall be approved by the City Engineer. Fly ash will not be acceptable as a mineral filler for PMBP.

2.4.3 Mix Design Adjustment. Material shall be evaluated for acceptance using the mix design in effect at the time the material was produced. The laboratory mix design and/or subsequent field designs may be adjusted as described herein.

A. Job Mix Formula. The job mix formula (JMF) is defined as the combined aggregate gradation and the percentage of each material component to be used in the mix. The JMF shall comply with all aggregate gradation requirements and shall result in a mix that meets all specified mix design requirements.

B. Job Mix Formula Adjustment. The Contractor may propose adjustments to the job mix formula for approval by the City Engineer when required by site conditions.

3.0 PRODUCTION REQUIREMENTS

3.1 General. Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the cold feed system feeding the drier. The storage yard shall be maintained neat and orderly and the separate stockpiles shall be readily accessible for sampling. In placing the coarse aggregate and fine aggregate in storage or moving it from storage to the cold feed bins, methods that cause segregation, degradation or the combining

of materials of different gradings will not be permitted. Segregated or degraded material shall be re-screened or wasted. Should mineral filler material be required, a separate storage and bin feeder shall be provided for the filler material. Aggregates shall not require prior preparation other than gradation control, except that those containing gravitational water shall be stockpiled and allowed to drain prior to mixing. After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until all aggregate particles are completely and uniformly coated with the bituminous material. If it is determined by the Public Works Inspector that excessive uncoated aggregate exists, the Supplier shall take corrective action to remedy the problem. The moisture content of the bituminous mixture at discharge from the mixer shall not exceed 0.5%.

3.2 Mix Temperature Requirements. The target temperature of the bituminous mixture at discharge from the mixer shall be as specified on the mix design. The temperature shall not exceed the target temperature by more than 20º F.

3.3 Mixing Plants

3.3.1 Plant Scales. Scales shall be accurate to 0.5% of the maximum load that may be required. Scales must be certified by a licensed scale serviceman.

3.3.2 Equipment for Preparation of Bituminous Materials. Tanks for storage of bituminous material shall be equipped to heat and hold the material at the required temperatures. The tank shall be provided with a capability to measure the temperature of the asphalt in the tank. The heating shall be accomplished by approved means and such that no flame shall be in contact with the tank. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. A suitable outlet for sampling bituminous material shall be installed in the line leading from the storage tank to the plant, and provisions shall be made for measuring and sampling the storage tanks.

3.3.3 Feeder for Drier. The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and uniform temperature will be obtained.

3.3.4 Drier. The plant shall include a system to continuously agitate the aggregate during the heating and drying process. The drier shall be capable of drying and heating aggregate in such a manner as to preclude the mineral aggregate from becoming coated with fuel oil or carbon. If it is determined that the aggregate is coated, the Supplier shall take corrective action.

3.3.5 Bins. The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for hydrated lime. The gates on the bins shall not leak. Bins shall be equipped with low-bin warning devices that indicate at the control panel when the bins are low.

3.3.6 Bituminous Material Control Unit. The Supplier shall provide satisfactory means to obtain the proper amount of bituminous material in the mix within the tolerance specified, either by weighing or metering. The Supplier shall provide means for

checking the quantity or rate of flow of bituminous material into the mixer.

3.3.7 Thermometric Equipment. An approved thermometer shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit. The plant shall also be equipped with another approved thermometric instrument so placed at the discharge chute of the drier as to register automatically the temperature of the heated aggregates or mix as applicable. The record of discharge temperatures will be provided to the Public Works Inspector upon request.

3.3.8 Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the Supplier or on public scales.

3.4 Environmental Requirements.

3.4.1 Violation of Requirements. If there is a violation of Environmental requirements, the City shall cease all operations within city limits until such time as the Contractor / Supplier performs a complete cleanup of the waste and it is accepted by the NMED. The NMED's Environmental Section will determine the need for additional investigations and actions. All violations and fines from other state regulatory agencies shall also apply.

3.5 Requirements for Batching Plants

3.5.1 Weigh Box or Hopper. The equipment shall include a means of accurately weighing each size of aggregate. The gate shall close tightly so that no material is allowed to leak. The scales shall be regularly tested and inspected.

3.5.2 Bituminous Material Control. The equipment used to measure the bituminous material shall be accurate to plus or minus 0.3%.

3.5.3 Mixer. The batch mixer shall be capable of producing a uniform mixture within the specified tolerances.

3.5.4 Control of Mixing Time. The plant shall be capable of adequately controlling mixing time. The mixer shall be equipped with an accurate timing device that will signal the completion of mixing time.

3.6 Requirements for Drum Mix Plants. The drum mixer and necessary auxiliary equipment shall be specifically designed to provide a final product conforming to specifications. Auxiliary equipment to the drum mix plant at a minimum shall provide the following:

A. Means for determining moisture content of aggregate so the dry weight of cold feed can be determined for proper setting of asphalt and additive flow. The Supplier shall determine the moisture content of the aggregate at least twice daily and shall adjust the moisture correction equipment accordingly.

B. Equipment for temperature sensing of mix at discharge and automatic burner controls.

C. A minimum of one cold feed bin will be required for each aggregate fraction used in the mix.

D. The cold feed shall be equipped with adequate mechanical or electrical devices to indicate when the bins are empty or when the cold feed belt is not carrying the proper amount of material. The device shall automatically lock the cold feed belt and provide an audible or visual warning. The plant shall not be operated unless this automatic system is in good working order. The feeding mechanism shall include an individual belt feeder with a variable speed feeder drive controlled by electronically operated actuators. The bituminous feed control shall be coupled with the total aggregate weight measurement device in such manner as to automatically vary the bitumen feed rate as necessary to maintain the required proportion.

3.7 Addition of Hydrated Lime. The hydrated lime shall be added to the entire portion of aggregate in an enclosed pugmill immediately after leaving the cold feed and just prior to introduction into the dryer drum or aggregate dryer. The hydrated lime shall be added to the aggregate such that loss of hydrated lime is minimal or nonexistent. Placement of the lime on an open conveyer belt will not be permitted. Placement of the lime on an enclosed belt that does not permit blowing or loss of lime is acceptable. A vane feeder shall be located in the outfeed of the lime silo. A flow sensor shall be installed on the discharge from the vane feeder. The sensor shall activate an audible and visual signal at the control panel when lime flow is interrupted. The lime silo shall be provided with an approved means of metering the lime being added to the mix, at typical discharge rates, to an accuracy of 3.0% or better by weight of the hydrated lime.
Approved means for metering lime will include load cell weighing devices placed beneath each leg of the silo, or a weighbelt feeder between the silo discharge and the pugmill. Other means of metering the addition of lime must be approved by the Engineer and/or Public Works Inspector prior to use. External strain gauges affixed to the legs of the silo will not be permitted. The hydrated lime content shall be controlled within ± 0.2% of the mix design target value. If load cell weighing devices are used for lime metering, the silo shall be supported by a cast-in-place concrete foundation pad. Grout shall be placed between the foundation and the load cells to ensure intimate contact between the load cell and the foundation. Moisture content of the combined aggregates shall be 3.5% ± 0.5% by weight, at the time the aggregate and lime are mixed. The Engineer and/or Public Works Inspector may increase the moisture content of the coarse and fine aggregates to obtain proper coating of the aggregates with hydrated lime and to eliminate dust pollution. The Supplier will provide a method to positively determine the amount of moisture added to lime-aggregate mix.

4.0 Construction Requirements

4.1 Haul Equipment. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds which have been thinly coated with a minimum amount of approved release agent to prevent the mixture from adhering to the bed. Diesel fuel shall not be used.

4.2 Pavers. Pavers shall be self-contained, self-propelled units, provided with an activated screed or a strike-off assembly, heated if necessary, and capable of spreading and finishing courses of PMBP material to the widths and thickness as required. Materials introduced in front of the screed shall maintain a consistent depth to avoid variation in pressure on the screed. The auger box shall be maintained at 1/3 to 2/3 full. Pavers shall

be equipped with a receiving hopper having sufficient capacity to effect a uniform spreading operation. The hopper shall be equipped with a distribution system capable of maintaining a uniform amount of mixture in front of the screed. The paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture. The screed shall be adjustable for both height and crown, and shall be equipped with a controlled heating device. The screed or strike-off assembly shall produce a finished surface of an even and uniform texture for the full width being paved without tearing, shoving or gouging the mixture. A conventional bituminous paver or suitable equipment, approved by the Engineer and/or Public Works Inspector, may be used to place asphalt concrete material on shoulders depressed from the traveled lanes in order to establish a uniform typical section. Approval of the equipment used will be based upon the results obtained.

4.3 Placement Operations. The asphalt concrete mixture shall be placed on the approved surface, spread and struck off to the grade and elevation established. It shall be spread and compacted in layers as shown on the plans or as directed by the Engineer. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. The subgrade, base course or bituminous-treated base (BTB) upon which the PMBP is to be placed shall be cleaned of all loose material or other deleterious materials prior to placement of the PMBP. These surfaces shall be free of frozen material, and the moisture and density requirements of the applicable section shall be met prior to placement of the new PMBP. The PMBP may be dumped from the hauling vehicles directly into the paving machine or it may be dumped upon the surface being paved and subsequently loaded into the paving machine; however, no PMBP shall be dumped from the hauling vehicles at a distance greater than 250 ft in front of the paving machine. When PMBP is dumped upon the surface being paved, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the PMBP dumped shall be picked up and loaded into the paving machine. The speed of the paving machine shall be coordinated with the production of the plant to achieve a continuous operation. Sufficient hauling equipment shall be available to insure continuous operation. The control system on the paving machine shall control the elevation of the screed at each end. Failure of the control system to achieve the desired typical section shall be cause for the suspension of the paving operations. When dumping directly into the paving machine from trucks, care shall be taken to avoid jarring the machine or moving it out of alignment. All courses of PMBP shall be placed and finished by means of self-propelled paving machines except under certain conditions or at certain locations where the Public Works Inspector deems the use of self-propelled paving machines impracticable. Self-propelled paving machines shall spread the PMBP without segregation or tearing within the specified tolerances, true to the line, grade, and crown indicated on the plans. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be dumped, spread and leveled to give the required compacted thickness. Existing surfaces shall be cleaned and a tack coat shall be applied.

4.4 Temperature and Weather Limitations. PMBP shall not be placed on wet or frozen surfaces or when weather conditions otherwise prevent the proper handling, finishing, and compacting of the PMBP.

4.5 Compaction. Immediately after the bituminous mixture has been spread, struck-off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted. The

sequence of rolling operations shall provide the specified pavement density. Rolling operations shall not disturb the typical section placed by the paver. Rollers shall be operated slow enough to minimize displacement of the bituminous mixture. The use of equipment that results in excessive crushing of aggregates will not be permitted. Any roller marks resulting from use of a pneumatic roller shall be removed with additional passes using a static steel-wheel roller. Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected immediately by the use of rakes and addition of fresh bituminous mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted. Diesel fuel or other petroleum diluents are not acceptable. Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons or with mechanical tampers. On depressed areas, a trench roller or cleated compression strips under the roller may be used to transmit compression to the depressed area. Mixtures that become loose, broken, mixed with dirt, segregated, or are defective, shall be removed and replaced with fresh hot bituminous mixture, and compacted to conform with the surrounding area. Areas showing excess or deficiency of bituminous material shall be corrected immediately as directed by the Public Works Inspector.

4.6 Miscellaneous Paving. Construction of miscellaneous paving including guardrail pads, slope paving, ditch paving, minor turnouts, bituminous curb, and raised median paving shall be submitted to the City Engineer for approval.

4.7 Joints. Placing of the PMBP shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture. When PMBP is placed over bituminous-treated base or when open-graded friction course is placed over PMBP, longitudinal joints shall be staggered at least 6 in. relative to longitudinal joints of the underlying course. All transverse joints shall be cut and squared off prior to commencing new work. All joints shall be completely bonded. The surface of each course at all joints shall be smooth and shall not show deviations in excess of 3/16 in. when tested with a 10-ft straightedge. When paving under traffic, the Contractor shall plan the daily surfacing operations on a schedule so that the longitudinal joints are not left exposed longer than seven consecutive calendar days.

4.8 Surface Tolerances. The surface of each completed course shall be smooth and shall not show deviations in excess of 3/16 in. when tested with a 10- ft straightedge in any direction. All humps or depressions exceeding this tolerance shall be corrected immediately as directed by the Public Works Inspector.

4.9 Plan Surfacing Depths. Plan depths will be monitored and recorded throughout the surfacing operations with methods and at intervals designated by the Public Works Inspector. Should a deficient plan depth become evident and corrections no longer can be applied, the Engineer and/or Public Works Inspector will reject the in-place mixed material and require subsequent replacement with new material.

5.0 Quality Control Testing

5.1 Contractor Quality Control for Materials. The Contractor is responsible for the quality

of materials and construction. The City reserves the right to obtain samples of any portion of any material at any point of the operation. The Contractor shall implement a quality control and implementation plan that will effectively monitor the operations and provide the Engineer and/or Public Works Inspector with timely notice of conditions adverse to the continuous and uniform production of an acceptable product. The Contractor shall sample the stockpiled aggregate at a point agreed to by the Public Works Inspector and the mixed material behind the laydown machine and shall conduct testing on those samples in accordance with applicable test procedures. This sampling and testing shall be accomplished by qualified testing personnel. When applicable the Contractor shall submit verification that all of the Contractor's laboratory equipment meets the applicable standards. Results from Equipment that does not meet the applicable standards shall be rejected. Testing for quality control shall be performed under the direct supervision of a certified individual approved by the City. The applicable test procedures are as follows:
AASHTO T 2 Sampling Aggregates
AASHTO T 11 Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates
AASHTO T 30 Mechanical Analysis of Extracted Aggregate
AASHTO T 308 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 40 Sampling Bituminous Materials
AASHTO T 87 Dry Preparation of Disturbed Soil and Soil Aggregate
AASHTO T 89 Determining the Liquid Limit of Soils;
AASHTO T 90 Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 146 Wet Preparation of Disturbed Soil Samples for Test
AASHTO T 164 Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
AASHTO T 168 Sampling Bituminous Paving Mixtures
AASHTO T 176 Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
AASHTO T 248 Reducing Field Samples of Aggregate to Testing Size
AASHTO T 304 Uncompacted Void Content of Fine Aggregate
ASTM D4791 Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
Using these test procedures the Contractor's Quality Control Testing shall consist of the following as a minimum:

A. **Stockpile Testing.** The Supplier shall perform gradation tests, sand equivalent tests, fine aggregate angularity tests, liquid limit determinations, plastic limit determinations, flat-elongated particle determinations, and fractured faces determinations on each fraction of aggregate stockpiled at the hot mix plant. The location for the sampling of stockpiled aggregate shall be approved by the Public Works Inspector. Each fraction of material shall be sampled and tested at the rate of at least one test per 500 tons of material produced.

B. **Extracted Gradations.** The Contractor shall sample the bituminous mixture from behind the laydown machine and shall determine the asphalt content and the aggregate gradation of the sample. The material shall be sampled and tested at the rate of at least two tests per day's production when production exceeds 500 tons and a minimum of one test per day when production is under 500 tons.

C. Quality Control Test Submittals. The Contractor shall deliver to the Public Works Inspector a copy of all test results within 24 hours of receiving a day's production results. The Contractor's Quality Control Representative shall also certify that the test results obtained are a true and accurate representation of the material sampled. Aggregate gradations shall be controlled during production of PMBP by the Contractor on the project such that the maximum variation from the approved job mix formula is within the following tolerances:

Sieve Size	Percent Tolerance
No. 4 and Larger	± 5
No. 8, 16, 30, 50, and 100	± 4
No. 200	± 2

If the Contractor's production testing indicates that this requirement is not being met, the Contractor shall take corrective action to ensure that the requirement is complied with.

5.2 Contractor Quality Control for Compaction. The compaction process shall be monitored by determining the density of the PMBP with a portable nuclear density test device in conformity with ASTM D 2950. Calibration of the portable nuclear device shall be established from cut pavement samples. The density readings of the cut pavement samples shall be determined in accordance with AASHTO T 166 (weight, volume method) and the density readings of the pavement shall be determined by the portable nuclear density test device in conformity with ASTM D 2950 and shall be correlated by the Contractor. The Contractor shall conduct testing at the minimum rate of one per 500 tons and shall furnish all test results to the Public Works Inspector. It is intended that quality control density testing be done while the bituminous mixture is hot enough to permit further compaction if necessary. Rolling for any compactive effort will not be allowed beyond the point at which it becomes ineffective or damage begins to occur. Additionally, use of vibratory mode will not be permitted when the temperature of the mix is below 200ºF.

5.3 Suspension of Operations. If the test results for the properties listed in subsection 5.5, Quality Assurance Testing, indicate that the material fails to meet the specification requirements, the Contractor shall initiate corrective action. If the material continues to fail to meet the specifications for a total of two consecutive days the production of PMBP will be halted by the Public Works Inspector. The gradation information shall be used to determine the causes or factors that may be a contribution to the problem a solution to the problem determined. The Contractor shall propose a plan to solve the problem. Approval of the plan must be obtained from the Engineer and/or Public Works Inspector prior to resumption of paving operations. Upon approval of the proposed plan, the Contractor may resume operations to determine if the actions taken have corrected the problem. If testing indicates that the problem has been corrected, the Contractor may resume full operations. If the problem has not been corrected, further trial runs and testing will be required. The Contractor shall produce material in substantial compliance with all specification requirements. All material that is rejected shall be removed and replaced with specification material.

5.4 Project Assurance Testing. Project assurance sampling and testing may be performed by the City to assure that correct and accurate procedures, and proper equipment is being used. The project assurance testing will be done by the City's representatives.

5.5 Quality Assurance Testing:

A. PMBP Mix. Acceptance will be based on tests made from representative samples taken after the PMBP has been placed on the roadbed and prior to compacting. The Contractor shall control the mixture production on the project such that the tolerances of Table 5.0-D are met. The City may conduct quality assurance sampling, testing, and monitoring to insure that the Contractor provides a mix that meets the tolerances. This testing will be conducted by the City in accordance with the City's Minimum Acceptance Testing Requirements. Acceptance test results will be provided to the Contractor.

B. Compaction. The bituminous pavement structure course shall be divided into acceptance sections or lots of 500 tons or one day's production, whichever is less, for the purpose of defining areas represented by each series of acceptance tests. The City may use a stratified random sampling plan to enhance the quality of acceptance sampling and testing.

TABLE 5.0-D
ACCEPTANCE TESTING TOLERANCES

Characteristic	Lower Spec. Limit	Upper Spec. Limit
Air Voids	T.V. –1.3%	T.V. +1.3%
Asphalt Content (Binder ignition Oven)	T.V. –0.3%	T.V. +0.3%
Hydrated Lime Content	T.V. –0.2%	T.V. +0.4%
Gradation:		
Nominal Maxium Sieve	T.V. –5%	T.V. +5%
No. 8, 16, and 50	T.V. –4%	T.V. +4%
No.200	T.V. –2%	T.V. +2%

Target Value (T.V.) shall be obtained from the approved Job Mix Formula. The Nominal Maximum Sieve is one sieve size larger than the first sieve that retains 10% or more.

The density of each acceptance section or lot will be evaluated by a minimum of two cut pavement samples taken in conformity with AASHTO T 166 at randomly selected sites within the test section. The cut pavement samples shall be taken and prepared by the Contractor for testing. The testing will be done by City representatives. The Contractor shall core each lift of the PMBP full depth in accordance with applicable AASHTO and City procedures. All questions arising from the sampling operation, including diameter of core samples, will be decided by the Engineer and/or Public Works inspector. The Contractor shall identify each core sample with a location marking and deliver all core samples to the test site within the time specified by the Public Works Inspector. The mean density obtained for all tests in each acceptance section or lot shall be at least 93% of the theoretical maximum density as determined from AASHTO T 209. In addition, each individual test value obtained within an acceptance section or lot shall be at least 90% of the theoretical maximum density and shall not exceed 98% of the theoretical maximum density. In the event an individual test result falls below 90% or exceeds 98% of the theoretical maximum density, the Engineer shall determine

the disposition of the material represented by the test.

6.0 Method of Measurement

6.1 Plant mix bituminous pavement will be measured by the ton or yd^2.
Bituminous material will be measured by the ton. Hydrated lime will be measured by the ton. Liquid anti-stripping agent will be measured by the ton.

6.2 When plant mix bituminous pavement is to be measured by the square yard, the average width of the PMBP in place will be used in computing the quantities. The length used in computing the area shall be station to station along the centerline of roadway. All dimensions shall be as shown on the typical section of the plans.

END OF ARTICLE 02-025.3

Article 02-025.4 Pavement Patching

1.0 SCOPE

This work consists of cutting, removal and subsequent replacement of street base and surface for installation of underground utilities, repair of pavement failure, or transition of new pavement or pavement overlay to match existing pavement.

2.0 AGGREGATE BASE COURSE

A. Base course and subbase aggregate shall be composed of crushed stone, crushed or screened gravel or sand or a combination of such materials with selected fines to meet the required gradation.

B. Base course aggregate materials shall be combined in such proportions that the resulting composite blend meets the requirements of the following table.

Class II Gradation	
Sieve Size	% Passing
1"	100
3/4"	85-100
No. 4	40-70
No. 10	30-55
No. 200	4-12
2 Fractured Faces	50% or more

C. Aggregate shall be free from vegetable or organic or other deleterious materials, including silt or clay balls.

D. Aggregate shall have a percent wear of 50 or less and the course aggregate shall have a soundness loss of 18 or less in accordance with AASHTO T104 using magnesium sulfate solution and a test duration of 5 cycles. The liquid limit shall be 25 or less.

3.0 ASPHALTIC CONCRETE PAVING

A. Materials may be a B-Mix for streets constructed prior to the adoption of these Technical Standards. Materials shall be in accordance with Article 02-025.3 Plant Mix Bituminous Pavement for streets constructed after the adoption these Technical Standards.

B. Thickness shall vary as necessary to match existing pavement or minimum 2 inch thick.

C. Prime Coat – When required thoroughly clean surface of base of foreign materials before asphaltic surface is laid. Give base a prime coat application of Asphalt Emulsion applied with an approved sprayer at a minimum rate of 0.25 gallons per square yard or as indicated on the Plans.

D. Tack Coat - Thoroughly clean surface of existing pavement and/or concrete surfaces before the new overlay is laid. Give existing pavement and/or concrete surfaces a tack coat application of emulsified asphalt or Performance-Graded Asphalt Binder applied with an approved sprayer at rate of 0.10 to 0.15 gallons per square yard.

4.0 CONSTRUCTION

A. General - Where installation of pipe involves excavation of trench through any type of permanent surfacing, either asphalt or concrete or combination thereof, widen each side of trench 12 inches for depth shown. Where installation of pipe involves excavation through gravel, iron ore, or shell surfacing, widening of trench at top is prohibited. During time lapse between installation of pipe and replacement of surfacing, maintain all crossings, both public and private, by filling ruts, pot-holes, etc., with flexible base material.

Where pavement removal is for the purpose of preparing pavement transition section or repair of localized pavement failure, sawcut and remove section as shown on the plans or directed by City Engineer. During time lapse between pavement removal and replacement of surfacing maintain access to all driveways or adjacent pavement for crossing traffic by filling ruts, pot-holes and preparing ramps as necessary with flexible base material.

B. Utility Trenches Pavement Removal - Use power-driven tool to cut existing asphalt surfaces in a neat straight line on each side of widened section. Width of asphalt surface to be removed between neatly cut lines, equal to normal trench width plus 12 inches on each side of trench. Contractor to dispose of asphalt surfacing removed. No asphalt surfacing resulting from removal operation to be left on public rights-of-way or on private property.

C. Removal of Pavement for Transition or Repair - Asphalt Surfacing on Flexible Base - Use power driven tool to cut existing asphalt surfaces in a neat straight line as shown on the plans or directed by City Engineer. Contractor to dispose of asphalt surfacing removed. No asphalt surfacing resulting from removal operation to be left on public rights-of-way or on private property.

D. Removal of Flexible Base Surfaces - Flexible base may be removed ahead of trenching operation; stockpiled and subsequently reused. If Contractor elects to salvage existing flexible base for subsequent reuse, exercise care in removing flexible base so that subgrade soils are not removed with base material. When base materials are to be reused, handle, stockpile, and replace in such manner as to preclude intrusion of foreign materials (weeds, sticks, dirt, etc.). Flexible base material which becomes mixed with foreign materials will be prohibited from being reused.

E. Replacement of Base Material - Place base material, maximum of 4-inch lifts, to depth indicated. Thoroughly compact each layer at optimum moisture content to a density of 95 percent ASTM D1557, by rolling or mechanically tamping. Sprinkle and shape to conform to adjacent road section. If existing base material was salvaged and reused, provide such additional quantity of new base material, similar in quality to reused material, as needed to construct proper shaped section. If new flexible base is to be used, material to conform to applicable parts of this Article and be of type similar to existing adjacent base material.

F. Replacement of Pavement

1) General - After flexible base has been placed, compacted, and shaped, place asphalt surfacing. Material for asphalt surfacing to conform to applicable parts of this Article, be of similar quality or better as adjacent undisturbed surfacing, and placed in accordance with applicable provisions of Article 02-025.03 Plant Mix Bituminous Pavement.

2) Utility Trenches and Pavement Patching - Shape finished surface to conform to adjacent

surface.

3) Pavement Transition Sections - Where pavement transition section is preparatory to street overlay, prepare subgrade and base course as described in this Article and Article 02-025.1 Base Course. Place asphalt in inclined layer from existing pavement to be overlaid to existing pavement not to receive overlay so that after placement of overlay, seams are smooth and match existing pavement. For a street with existing 2" PMBP which will receive a 1" PMBP overlay, the transition section will vary from 2" thickness to 1" thickness.

END OF ARTICLE 02-025.4

Article 02-026.1 WATER SUPPLY SYSTEMS

1.0 SCOPE

This work consists of furnishing all plant, labor, equipment and materials and of performing all operations in connection with the installation of water lines and appurtenances. This section defines characteristics and properties of Poly Vinyl Chloride (PVC), and Ductile Iron Pipe (DIP), materials, fittings, and construction practices.

1.1 LOCATION

Waterline shall be located in the streets, and shall be approximately ten (10) feet north of the street centerline on East-West bound streets, and ten (10) feet west of the street centerline on the North-South streets. All water mains shall be laid with a minimum cover of three (3) feet.

Water meters shall be located in the sidewalk or in the landscape area between the sidewalk and curb. Water meters shall not be located in driveways.

1.2 SIZE

The minimum size of water mains shall be six(6) inches in diameter.

2.0 MATERIALS

2.1 GENERAL

Pipe and accessories shall be new and unused. Pipe shall be color-coded purple for Re-claimed water. Detectable Marking Tape shall be installed per the Detail Drawings, Section 7.

When PVC pipe is stored outside and exposed to prolonged periods of sunlight, an obvious discoloration of the pipe can occur. This is an indication of reduced pipe impact strength, and any particular length of pipe that is discolored will be rejected. All pipe rejected will be removed from the job site.

2.2 PVC PIPE

A. PVC pipe 4 inches through 12 inches shall be not less than DR18, Class 150 and in conformance with AWWA C-900, latest revision. Pressure class of PVC pipe shall be that required by Appendix A of AWWA C-900. PVC pipe over 12 inches shall be no less than DR25, Class 165 and in conformance with AWWA C-905, latest revision.

B. All PVC pipe shall be approved for use in potable water systems by an agency such as NSF Testing Laboratory.

C. Joints: Pipe 6 inches through 12 inches: Elastomeric gasket bell push-on type ends shall be used in accordance with ASTM F477.

D. Specials and Fittings: Pipe 6 inches through 12 inches: Specials and fittings for PVC pipe shall conform to the requirements of AWWA C-153 and shall be cement mortar lined in accordance with AWWA C-104. Fitting types shall include restrained mechanical joints where required. Restraining, standard mechanical joints, and fittings shall be submitted for Engineer approval.

2.3 MOLECULARLY ORIENTED POLYVINYL CHLORIDE (PVCO) PIPE

A. PVCO pipe 4 inches through 12 inches shall be in conformance with AWWA C-909. Pressure class of PVCO pipe shall be that required by Section 4 of AWWA C-909, but in no case shall it be less than Class 150**.**

B. All PVCO pipe shall be approved for use in potable water systems by an agency such as NSF Testing Laboratory.

C. Joints: Pipe 6 inches through 12 inches: Elastomeric gasket bell push-on type ends shall be used in accordance with ASTM F477, and meet requirements of ASTM D3139.

D. Specials and Fittings: Pipe 6 inches through 12 inches: Specials and fittings for PVCO pipe shall conform to the requirements of AWWA C-153 and shall be cement mortar lined in accordance with AWWA C-104. Fitting types shall include restrained mechanical joints where required. Restraining, standard mechanical joints, and fittings shall be submitted for Engineer approval.

E. Solvent cement shall not be permitted.

F. Tapping is allowed for service connections only as permitted with a pipe saddle per manufacturers recommendations.

2.4 DUCTILE IRON PIPE

A. Ductile iron pipe shall be in accordance with ANSI/AWWA C151/A21.51 and Federal Specification WW-P-421d, latest revision. All ductile iron pipe shall be minimum class 150, unless otherwise indicated in the plans. Ductile iron pipe fittings shall be pressure rated at 350 psi and be in accordance with ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.11.

B. All ductile iron pipe and fittings shall be internally mortar lined in accordance with ANSI A21.4, latest revision, and shall have an exterior coating in accordance with ANSI A21.6, A21.8, or A21.51.

C. All ductile iron pipe and ductile iron fittings shall have a polyethylene encasement in accordance with ANSI/AWWA C105/A21.5, latest revision.

D. The ductile iron pipe shall be push-on type joints, unless indicated otherwise on the plans, and the fittings shall conform to the requirements of AWWA C-153 and shall be cement mortar lined in accordance with AWWA C-104. Fitting types shall include standard flange fittings and mechanical joints.

2.5 Service Lines

Materials, valves, pipe and fittings for service connections 3/4-inch to 2-inch diameter shall conform to AWWA C 800 specifications. Pipe materials shall be schedule 40 PVC (ASTM D 1785), Poly SDR-9, or approved equal. Fittings shall be per maunfacturers recommendations.

2.6 ADAPTERS AND COUPLINGS

A. At all places where adapters, pipe couplings, or mechanical type couplings are required for any of the piping systems, they shall be of the type manufactured for the specific purpose of the use intended, and shall be installed in strict compliance with the manufacturer's specifications, and to the satisfaction of the Engineer and/or Public Works Inspector. Factory-made adapters shall be furnished for connecting transition material to the mechanical joint fittings and valves, where required, including plastic to steel and plastic to DIP.

B. Mechanical and/or flexible couplings shall be manufactured by Romac, or approved equal, and they shall be sized and styled in accordance with the requirement for the particular coupling, and used in accordance with the manufacturer's recommendations for the diameter, thickness and type of pipe to be connected. The mechanical and/or couplings shall be provided with an acceptable joint harness to prevent separation of the joint where required due to pressure, or change in direction of fittings. Couplings shall be polyethylene wrapped.

2.7 GATE VALVES: 4-INCH AND LARGER

All gate valves shall be resilient seated gate valves conforming to AWWA C-509 rated for 150 psi working pressure. Valves shall have a standard two (2) inch operating nut that opens counter clockwise. The wedge shall be constructed of ductile iron and fully encapsulated in synthetic rubber except for the guide and wedge nut areas. The wedge shall seat against seating surfaces that are inclined to the vertical at a minimum angle of thirty-two (32) degrees when stem is in vertical position to eliminate abrasive wear. The non-rising stem shall be sealed by at least two (2) o-rings. The waterway shall be smooth and shall have no depressions or cavities. The valve body and bonnet shall be epoxy coated, inside and out, and wrapped with polyethylene sheet encasement. Joints shall be restrained mechanical joint ends. Valve shall be as manufactured by Waterous Company, or approved equal.

2.8 VALVE BOXES

Valve boxes shall be deep skirted, adjustable cast iron two piece screw type, Series 6850 as manufactured by Tyler Pipe, Tyler Corporation, or approved equal. The valve boxes shall be five and one-quarter (5-1/4) inch diameter and the two pieces shall overlap at least six (6) inches. The drop lid shall have a depth of two (2) inches, shall weigh thirteen (13) pounds, and shall have the word "WATER" embossed on top.

2.9 FIRE HYDRANTS

A. Fire hydrants and their extensions shall be in accordance with AWWA C502, traffic type, Fire hydrants shall have two 2-1/2 inch hose nozzle connections, and one 4-1/2 inch steamer nozzle. All nozzle connections shall be National Standard Fire Hose Coupling screw threads. Fire hydrants shall have a bronze or cast iron pentagon operating nut. The main inlet shall be 6 inch restricted mechanical joint type. All fire hydrants shall be rated for 150 psi working pressure. Any marks or scratches on new fire hydrants, shall be corrected to the satisfaction of the City Engineer and/or Public Works Inspector. See section 7, Detail Drawings for installation. Extensions will be used, when required, to bring the bottom of the break-off flange 3 to 6 inches above the top of the surrounding finished grade. All fire hydrants shall be American Darling Model 62B or Mueller Centurion, Model A-423, or approved equal. All fire hydrants shall be fire engine red.

3.0 CONSTRUCTION REQUIREMENTS

3.1. TRENCH EXCAVATION

A. The pipe trenches shall be excavated along straight lines to the dimensions shown in the Project Plans.

B. All trenching work shall be done in a safe manner, and the trenches shall be rendered safe for the workmen by complying with the applicable safety standards, and by practicing safety measures consistent with good construction methods.

C. All excavations shall be adequately barricaded and secured in accordance with current New Mexico State Highway and Transportation Department Standards.

D. Unless trench banks are cut back on a stable slope, sheet and brace the trenches as necessary to prevent caving or sliding, to provide protection for the workmen and the pipe. All trenching work shall comply with OSHA safety requirements.

E. If overexcavation occurs the area shall be refilled with suitable material at optimum moisture and compacted to ninety (90) percent density per ASTM D 1557 in unpaved areas and (95) percent density in paved areas.

3.2. BEDDING

A. The trenches shall be excavated to the depth indicated in the Project Plans. The trench bottom shall be smooth and hand graded uniformly throughout. If rock or other unyielding material is encountered or if the trench is overexcavated, pipe bedding material consisting of screened select native material or engineered bedding material

shall be added, compacted, and graded to a smooth uniform surface. The compacted bedding shall support the pipe throughout its entire length, except at bells or couplings which shall not rest on the bedding. After the bell or coupling holes are excavated and after the pipe pieces are connected and properly aligned and graded, successive layers of select native material or engineered fill shall be placed and compacted, until the pipe is covered, as shown on the project plans or the Detail Drawings of this document. Contractor shall use due care to maintain proper alignment and grade during the bedding process. Any bent, cracked, chipped or damaged pieces of pipe shall be removed and replaced at Contractor's expense. Compaction tests on the pipe bedding will be required.

3.3 PIPE LAYING

A. The pipe shall be laid true to the line and grade indicated in the Project Plans or as established by the Engineer.

B. The pipe shall be protected during handling against impact shocks and free fall. Do not permit hooks, chains, cables, or handling equipment to come in contact with the pre-molded or pre-formed end surfaces.

C. Handle the pipe having pre-molded end surfaces or pre-formed end surfaces so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing material or surfaces. Do not drag the end of the pipe on the ground or allow them to be damaged by contact with gravel, crushed stone, or any other hard objects.

D. No damaged or deformed pipe will be incorporated in the work.

E. The interior of the pipelines shall be kept free from dirt and other foreign material as the work progresses and shall be clean upon its completion. Tight stoppers or bulkheads shall be securely placed in the ends of all pipelines when the work is stopped temporarily, or at the end of the day's work.

F. Immediately prior to jointing, both pipe ends shall be thoroughly cleaned and a lubricant shall be applied according to the manufacturer's recommendations. For push-on type joints, sufficient pressure shall be applied in making up joints to insure proper seating of the joints.

G. The full length of each section of pipe shall rest solidly upon the bed, with recesses excavated to accommodate bells and joints. Any pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water or when trench or weather conditions are unsuitable for the work except by permission of the Engineer. Minimum depth of cover over top of pipe shall be three feet, unless otherwise approved by the City Engineer.

H. All nuts and bolts utilized in underground pipe connections shall be stainless steel, high strength cast iron or high strength wrought iron. Carbon steel nuts and bolts may be

used except that they shall be protected by “cocoon” type protective coating of coal-tar and felt in accordance with AEES Standard C 203.

I. Where connections are made between new work and existing lines, the connections shall be made using specials and fittings as recommended by pipe manufacturer and approved by the Engineer. Couplings may be either cast iron or steel with bolts as stated above. If steel couplings are used, they will be cocoon wrapped as specified herein.

J. Water lines shall not be laid closer along horizontal dimensions than 10 feet from sewer lines, and with the water line at a higher elevation than the sewer. If this is not possible, and if concurrence from the Engineer is obtained by the Contractor, separate trenches will be required and the water line shall be at least 2 feet above the sewer or concrete encased. When water and sewer lines cross each other, the water line shall be at least 2 feet above the sewer or concrete encased, with no joint closer than 3 feet of the crossing.

K. Water lines shall not be constructed under walkways, sidewalks, curbs and gutters, drivepads, or similar concrete structures by tunneling underneath them. The Contractor will cut these concrete structures by using a concrete saw to the closest control joint or, at his option, he may remove the section of the concrete structure to the nearest full expansion joint or edge.

L. Encasement shall be performed as shown in the Detail Drawings, Section 7, at shallow crossings or other instances in which piping may be exposed or susceptible to excessive surface loading. DIP shall be used for these crossings with push-on or M.J. type connections, blocked with curved/conforming cinder blocks underneath, installed in prepared trench of adequate width to house pipe diameter and encasement. Trench excavation shall have 95% relative compaction or be in freshly excavated native material, and as approved by the Engineer may suffice with adequate dimensions to omit use of form work for encasement concrete placement. Encasement concrete shall be aggregate and Type II cement meeting or exceeding 3000 psi compressive strength. Rebar shall be placed as shown in the Detail Drawings, shall be new/unused, and tied with minimum 6-inch lap distances, with minimum 2-inch concrete cover on outside dimensions.

M. All valves shall be set true, level, vertical and plumb. All valves shall have and be supported by a concrete thrust block, have retainer rods, and shall comply with the details shown in the Project Plans. Backfill shall be compacted to 95% density under pavement, 90% in unpaved areas, ASTM D 1557.

The Contractor shall remove the valve box from all existing valves that are to be abandoned. The resulting excavation shall be backfilled and compacted to 95% density, ASTM D 1557. The top 6 inches of the excavation shall receive new base course placed to the above stated density. The pavement shall be sawcut to form a square opening. The cut faces of the existing asphalt shall be thoroughly coated with prime coat and new asphalt pavement shall be placed and densified to 95% density, ASTM D 1557.

N. Cast iron valve boxes shall be set vertical and plumb centered over the operating nut. All valve boxes shall be adjusted to proper elevation, providing the minimum overlap of six (6) inches of the two (2) pieces, and a concrete collar shall be built around the top of each valve box. The concrete collar shall be of the size, shape, and dimensions shown in the Detail Drawings. The concrete shall be 3000 psi at twenty-eight (28) days with one (1) inch aggregate and finished with a light broom finish. All concrete shall be removed from the top of the valve box and lid while it is still wet and they shall be left clean. Backfill shall be compacted to 95% density under pavement, 90% in unpaved areas, ASTM D 1557.

O. Adapters and couplings shall be installed in strict compliance with the manufacturer's recommendations. Contractor shall provide, in place, all additional straps, rods, and harness required to make a secure water-tight connection.

P. The Engineer and/or Public Works Inspector shall have the privilege of checking the pipe for line and grade by any method that he wants to use after the pipe is laid, and before backfilling begins. The Engineer and/or Public Works Inspector shall also have the privilege of checking each pipe joint with a gauge or by any means that he deems necessary in order to be assured that the gaskets are in place and properly seated. Any run of pipe that is found to be appreciably off of line or grade shall be removed from the trench, the trench bedding shall be re-graded and compacted, and the pipe shall then be laid accurately on line and grade. Any joint that is found to be improperly gasketed and/or seated shall be unjointed and correctly reassembled. If any gasket is found to be damaged, the entire pipe section containing the damaged gasket shall be replaced with a new one.

Q. Contractor shall furnish any tools, gauges, and all items required for the checking of the gaskets and joints, and he shall check every joint to be sure that the gaskets are seated and located in the correct place to avoid leakage at the joints.

3.4 THRUST BLOCKS

A. Thrust blocks shall be poured at all bends, valves, tees, reducers and fittings, where changes in pipe diameter, alignment or grade occur, and as indicated in the Detail Drawings or as required by Engineer. The minimum size of concrete thrust blocks shall be as shown on the Detail Drawings or as directed by the Engineer. The material of thrust blocks shall be concrete composed of concrete aggregates and shall have a compressive strength of no less than two thousand five hundred (2,500) psi in twenty eight (8) days for standard cement Type II and shall be placed between solid, undisturbed ground and the fitting to be anchored. The area of bearing on the fitting and on the ground shall in each instance be that required by the Engineer. Unless otherwise directed by the Engineer the thrust blocks shall be placed so that the pipe and fitting joints will be accessible for repair. Metal harness or tie rods, of the size and type shown in the Project Plans, shall be used.

3.5 BACKFILLING TRENCHES

A. After the pipe has been laid and bedded, it shall be inspected and approved by the Engineer and/or Public Works Inspector.

B. Backfill shall be constructed of suitable native material. Where native materials are not suitable engineered fill shall be used or suitable material from another location may be used.

3.0 FLUSHING AND DISINFECTION

A. DESCRIPTION

This section includes materials and procedures for flushing and disinfection of water mains by the continuous feed method and by the slug method. Do not use the tablet method to disinfect pipelines. Disinfect piping in accordance with AWWA C651 as modified below.

B. JOB CONDITIONS

1) Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility. The chlorinated disinfection water shall be properly disposed of by either pumping the water into a tank truck or directly into the sewer system. An air gap of 2 times the hose diameter must be provided to prevent cross contamination. The Contractor shall notify Public Works and the Waste Water Treatment Plant 24 hrs. prior to disposal into the sewer system.

2) Schedule the rate of flow and locations of discharges in advance to permit review and coordination with the City.

3) Use potable water for chlorination

4) Submit request for use of water from waterline of the City 48 hours in advance.

C. MATERIALS

1) LIQUID CHLORINE - Inject with a solution feed chlorinator and a water booster pump. Use an experienced operator and follow the instructions of the chlorinator manufacturer .

2) CALCIUM HYPOCHLORITE (DRY) - Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate.

3) SODIUM HYPOCHLORITE (SOLUTION) - Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

4) CHLORINE RESIDUAL TEST KIT - For measuring chlorine concentration, supply and use a medium range, drop count, titration kit or an orthotolidine indicator comparator with wide range color discs. Products: Hack Chemical or Helliege. Maintain kits in good working order available for immediate test of residuals at point of sampling.

D. EXECUTION

1) CONTINUOUS FEED METHOD FOR PIPELINES - Introduce potable water into the pipeline at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/1. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

2) SLUG METHOD FOR PIPELINES - Introduce the water in the pipeline at a constant measured rate. At the start of the test section, feed the chlorine solution into the pipeline at a measured rate so that the chlorine concentration created in the pipeline is 300 mg/l. Feed the chlorine for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/1 for at least three hours.

3) DISINFECTION OF VALVES AND APPURTENANCES - During the period that the chlorine solution or slug is in the section of pipeline, pen and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances.

4) DISINFECTION OF CONNECTIONS TO EXISTING PIPELINES - Disinfect per AWWA C651, Section 9. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1% sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor .

E. CONFIRMATION OF RESIDUAL

1) After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours. confirm that a chlorine residual of 50 mg/1 minimum exists along the pipeline by sampling at air valves and other points of access.

2) With the slug method, confirm by sampling as the slug passes each access point and as it leaves the pipeline. After confirming the chlorine residual, flush the excess chlorine solution from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/1 of the replacement water .

F. PIPELINE FLUSHING - After confirming the chlorine residual, flush the excess chlorine solution from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/l of the replacement water.

G. BACTERIOLOGIC TESTS - Collect two samples, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline after chlorination and refilling. The Public Works Inspector shall observe while samples are taken.

H. REPETITION OF PROCEDURE - If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.

I. TEST FACILITY REMOVAL - After satisfactory disinfection, replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.

5.0 HYDROSTATIC TESTS

A. The contractor shall be required to test all piping and other lines and appurtenances in the presence of the Public Works Inspector. Test reports shall be required for each test and submitted to the Public Works Inspector.Testing of lines shall be done without being connected to existing lines. If such connections are allowed it is with the understanding that the Contractor assumes any and all responsibility in case of damage, failure and/or contamination to the existing system. The new water pipe will be tested before the backfilling is done. After the pipe is laid, earth cover shall be placed over the middle of the pipe joints, leaving the corp stops, valves, service taps and laterals uncovered. The pipe will be filled with water, and the pressure in the pipeline shall be raised by means of a motor-driven water pump to a hydrostatic pressure of 150 psi at the lower end of the pipe section. This pressure shall be maintained for a period of at least two (2) hours for pipe sizes up to 8", four (4) hours for pipe sizes 10" to 20", pipe sizes above 20" shall be determined by the City Engineer. If any leaks appear in the pipe they shall be repaired to the satisfaction of the Public Works Inspector, and the test shall be performed until the pipe holds the prescribed pressure. As an alternative, the Contractor may opt to test the pipeline in sections between mainline valves.

B. All testing shall be conducted in accordance with AWWA Standard C-600 and those portions of the above standard related to hydrostatic tests shall apply to any type of water main construction. Test pressure shall be 150 psi.

C. All taps, gauges and necessary equipment shall be provided by the Contractor; however, the Public Works Inspector may utilize gauges provided by him if he so elects.

D. Leakage defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. If the pressure drops more than five (5) pounds in thirty (30) minutes, the pipe has failed to pass the test. If the pressure drop is less than five (5) pounds in thirty (30) minutes, water shall be added to the pipe section to maintain the one hundred fifty (150) psi test pressure and the volume of water added shall be duly recorded. This procedure shall be repeated at each thirty (30) minute interval for the test period. The total volume of water added to the pipe section to maintain the one hundred fifty (150) psi test pressure shall represent the total leakage during the test

E. Allowable leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

in which L is the allowable leakage, in gallons per hour, N is the number of rubber gasketed joints in the test section; D is the nominal diameter of the pipe, in inches, and P is the average test pressure during the leakage test, in pounds per square inch gauge.

F. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in. (0.0012 L/h/mm) of nominal valve size shall be allowed.

G. When hydrants are in the test section, the test shall be made against the closed hydrant.

H. Acceptance of installations: Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid disclosed leakage greater than that the contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance.

I. All visible leaks are to be repaired regardless of the amount of leakage.

J. The Contractor shall be notified of any leaks that may occur during the two-year warranty period, and shall make immediate arrangements after he is notified to return to the job site and repair any leaks that may develop in the pipeline.

END OF ARTICLE 02-026.1

Article 02-026.2 Air-Release and Vacuum-Relief Valves

1.0 SCOPE

This section includes materials and installation of combination air-release and vacuum valves.

2.0 MATERIALS

2.1 MATERIALS OF CONSTRUCTION

A. Materials of construction for air and vacuum valves for water service shall be as follows:

Item	Material	Specification
Body and cover	Cast iron or brass	ASTM A 48, Class 30; or ASTM A 126, Class B
Float, guide rod, guide bushings	Stainless steel	AISI Type 316, ASTM A 240 or A 276
Seat	Buna-N	--

2.2 SEATING

Valves shall seat driptight at a pressure of 1 psi.

2.3 VALVE END CONNECTIONS

Valves shall have threaded ends, and comply with ANSI B1.20.1.

2.4 COMBINATION AIR-RELEASE AND VACUUM VALVES

Valves shall have a float with lever arm to actuate a poppet valve. A needle shall be attached to the float arm. The poppet valve shall serve to admit large quantities of air when the pipeline drains. The needle shall serve to release small quantities of air as the pipeline fills or as air accumulates in the pipeline. Valves shall have an operating pressure of 300 psi. Body and cover shall be cast iron (ASTM A 48, Class 30). Float, lever, and poppet shall be Type 316 stainless steel (ASTM A 240 or A 276). Seat shall be Buna-N. Valves shall be Val-Matic Model 202C, as scheduled on plans or equal.

2.5 SERVICES SADDLES

2-inch size, double strap, style 202S by Romac Industries, Inc., or approved equal.

2.6 GATE VALVES

2-inch size, nonrising stem, solid wedge, threaded ends, model number 438 by Crane, or approved equal.

2.7 ENCLOSURES

A. Risers and adjustment rings shall be standard precast manhole sections of 4000 psi reinforced concrete.

B. Manhole frame and lid shall be ductile iron, H20 traffic rated, marked “Water” and have three ½-inch diameter vent holes.

2.8 PIPING

Brass, standard strength, highest quality, seamless, threaded, reamed and chamfered.

2.9 DRAINAGE MEDIA

Clean crushed rock, ¾-inch size.

2.10 REINFORCED CONCRETE TOP

Cast in place, 3000 psi concrete.

3.0 EXECUTION

3.1 INSTALLATION

A. Locate combination, air-release and vacuum-relief valves at high points (“peaks”) of the pipeline.

B. Holes in the pipe shall be the same size as the service saddle outlet.

C. Position enclosure and manhole frame and lid to allow personnel entry.

D. Valve and enclosure shall set vertical.

E. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads prior to installation of threaded valves. All joints shall be watertight.

3.2 VALVE PRESSURE TESTING

Test valves at the same time that the connecting pipelines are pressure tested. See Article 02-026.1 Water Supply System, for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

END OF ARTICLE 02-026.2

Article 02-027.1 Sanitary Sewer System

1.0 SCOPE

The work covered by this specification consists of furnishing and installing all of the pipe, fittings, and appurtenances required to tie into the existing sanitary sewer system.

The Contractor shall have the responsibility for furnishing the exact lengths of pipe, fittings, adapters and couplings for proper "make-up" and connections of the pipes.

1.1 LOCATION

Sewer lines may be placed either in the streets or alleys. In either case the sewer line shall be located on the south side of East-West streets or alleys, and on the East side of North-South streets or alleys at a distance of approximately five (5) feet from the centerline of the street or alley.

1.2 DEPTH OF SEWER LINE

Sewer lines shall be a minimum depth of three (3) feet below the finish surface of the street or alley. The depth shall be measured from the top of the pipe to the finish surface of the street or alley.

1.3 WATER AND SEWER

Lines shall be laid parallel to each other and parallel to the street centerline, when both are installed in the same street. Sewerlines may be placed in alleys instead of streets. If both are laid in the street, a minimum distance between the lines shall be ten (10) feet horizontally, and the water line shall be atleast two (2) feet higher than the sewer line. Where the water and sewer lines cross each other, the waterline shall be a minimum of two (2) feet higher than the sewer line or the sewer line shall be concrete encased a minimum of ten (10) feet on each side of the water line, per the detail drawings of this document.

2.0 SANITARY SEWER PIPE

A. PVC sewer pipe and fittings shall be gravity sewer pipe, ASTM D-3034, SDR 35.

B. All elastomeric gaskets for PVC pipe shall comply with ASTM F 477.

C. PVC sewer pipe and fittings shall meet the requirements of ASTM 3034, ASTM D-3212, and Uni-Bell UNI-B-4.

D. A certification from the manufacturer shall be furnished attesting compliance with appropriate ASTMs. Only pipe manufactured in the United States of America is acceptable.

E. All PVC pipe shall be coded to eliminate future confusion and prevent accidental damage to or interruption of the water and sanitary sewer facilities. Detectable marking tape shall be installed per the Detail Drawings of this document.

F. All pipe shall have a home mark on the spigot end to indicate proper penetration when joint is completed. The sockets and/or spigot configurations for the fittings and couplings shall

be compatible to the pipe.

G. Pipe with gasketed joints shall be manufactured with a socket configuration that will prevent improper installation of the gasket and will ensure that the gasket remains in place during joining operations. The gasket shall be manufactured from a synthetic elastomer material and shall conform with the requirements of ASTM F 477.

H. Solvent cement joints shall only be limited to 4 or 6 inch diameter plastic pipe, which will be used exclusively for sanitary sewer service lines. The solvent cement shall be compatible to the pipe manufacturer's product and shall conform to the requirements as specified in ASTM D 2564 for PVC pipe and ASTM D 2235 for ABS pipe.

I. When PVC pipe is stored outside and exposed to prolonged periods of sunlight, an obvious discoloration of the pipe can occur. This is an indication of reduced pipe impact strength, and any particular length of pipe that is discolored will be rejected. All pipe rejected will be removed from the job site.

J. The materials in plastic pipe shall comply with ASTM D 1784.

K. All plastic pipe shall be push-on, flexible elastomeric gasketed. Exception will be the plastic pipe used for sanitary sewer service lines, which will be joined per manufacturer's recommendations.

L. Polyvinyl chloride (PVC) pipe shall meet the requirements of ASTM D 3034 for pipe sizes 8 inches through 15 inches diameter. Minimum wall classification shall be SDR 35 or SDR 26, as required. Only solid wall pipe will be acceptable.

M. PVC pipe which will be used for sanitary sewer service lines shall conform to ASTM D 2665 for Schedule 40 pipe, or ASTM 3034 for SDR 35 or SDR 26.

N. Pipe for this purpose shall be solvent-welded joined, per manufacturer's recommendations, or gasketed joints conforming to ASTM F 477.

3.0 SANITARY SEWER MANHOLES

A. Manhole bases: Manhole bases poured-in-place shall be Class A concrete, 3000 psi, and reinforced as indicated in Section 7 of the Detail Drawings of this document.

B. Manhole Sections: Manhole riser sections shall be precast concrete sections, precast concentric cone sections and precast concrete grade rings, in conformance with ASTM Designation C-478, latest revision. All joints of the manhole sections shall be sealed with Ram-Nek, or approved equal.

C. Manhole Covers: Manhole covers shall be cast iron frame and solid lid, ASTM Designation A-48, Class 30 or stronger. The frames and lids shall be machined to provide a non-rocking bearing surface and uniform clearance around the edge of the lid. The lids shall have the word "SEWER" embossed on them, and each lid shall have two lifting lugs or pick holes.

D. Manhole Collars: Manhole collars shall be poured-in-place with Class A concrete, 3000 psi, and reinforced as indicated in Section 7 of the Detail Drawings of this document.

4.0 CONSTRUCTION REQUIREMENTS

A. Trench Excavation

1) The pipe trenches shall be excavated along straight lines to the dimensions shown in the Project Plans.

2) All trenching work shall be done in a safe manner, and the trenches shall be rendered safe for the workmen by complying with the applicable safety standards, and by practicing safety measures consistent with OSHA and good construction methods.

3) All excavations shall be adequately barricaded and secured in accordance with current New Mexico State Highway and Transportation Department Standards.

4) Unless trench banks are cut back on a stable slope, sheet and brace the trenches as necessary to prevent caving or sliding, to provide protection for the workmen and the pipe. All trenching work shall comply with OSHA safety requirements.

5) If overexcavation occurs beyond the limits indicated by the trench details the overexcavated area shall be refilled with suitable material at optimum moisture and compacted to 95% density.

B. Bedding

The trenches shall be excavated to the depth indicated in the Project Plans. The trench bottom shall be smooth and hand graded uniformly throughout. If rock or other unyielding material is encountered or if the trench is overexcavated, pipe bedding material consisting of select native material or engineered bedding material when required shall be added, compacted, and graded to a smooth uniform surface. The compacted bedding shall support the pipe throughout its entire length, except at bells or couplings which shall not rest on the bedding. After the bell or coupling holes are excavated and after the pipe pieces are connected and properly aligned and graded, successive layers of select native material or engineered fill material when required shall be placed and compacted, until the pipe is covered, see typical trench details in this document. Contractor shall use due care to maintain proper alignment and grade during the bedding process. Any bent, cracked, chipped or damaged pieces of pipe shall be removed and replaced.

C. Pipe Laying

1) The pipe shall be laid true to the line and grade indicated in the Project Plans or as established by the Engineer.

2) The pipe shall be protected during handling against impact shocks and free fall. Do not permit hooks, chains, cables, or handling equipment to come in contact with the pre-molded or pre-formed end surfaces.

3) Handle the pipe having pre-molded end surfaces or pre-formed end surfaces so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing material or surfaces. Do not drag the end of the pipe on the ground or allow them to be

damaged by contact with gravel, crushed stone, or any other hard objects.

4) No damaged or deformed pipe will be incorporated in the work.

5) The interior of the pipelines shall be kept free from dirt and other foreign material as the work progresses and shall be clean upon its completion. Tight stoppers or bulkheads shall be securely placed in the ends of all pipelines when the work is stopped temporarily, or at the end of the day's work.

6) Immediately prior to jointing, both pipe ends shall be thoroughly cleaned and a lubricant shall be applied according to the manufacturer's recommendations. For push-on type joints, sufficient pressure shall be applied in making up joints to insure proper seating of the joints.

7) Lay all pipe straight between ends, fittings or bends and on uniform grade. Excavate bell holes for each pipe joint. After the pipe is jointed in the trench, the pipeline shall form a true line and consistent grade.

8) The Public Works Inspector shall have the privilege of checking the pipe for line and grade by any method that he wants to use after the pipe is laid, and before backfilling begins. The Public Works Inspector shall also have the privilege of checking each pipe joint with a gauge or by any means that he deems necessary in order to be assured that the gaskets are in place and properly seated. Any run of pipe that is found to be appreciably off line or grade shall be removed from the trench, the trench bedding shall be re-graded and compacted, and the pipe shall then be laid accurately on line and grade. Any joint that is found to be improperly gasketed and/or seated shall be unjointed and correctly reassembled. If any gasket is found to be damaged, the entire pipe section containing the damaged gasket shall be replaced with a new one.

9) Contractor shall furnish any tools, gauges, and all items required for the checking of the gaskets and joints, and he shall check every joint to be sure that the gaskets are seated and located in the correct place to avoid leakage at the joints.

10) Pipe and appurtenances shall be new and unused. The type of pipe to be installed shall be as approved by these technical standards. Pipe and appurtenances shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken to prevent damage to any pipe coating.

11) The interior of the pipe shall be thoroughly cleaned of foreign material before being lowered into the trench and shall be kept clean during construction operations. When work is not in progress, the open ends of pipe shall be securely closed so that no foreign materials will enter the pipe. Any section of pipe found to be defective before or after laying shall be replaced with sound pipe, or repaired in a manner satisfactory to the Public Works Inspector and Engineer.

12) The Contractor shall install a plug in the new sewer at any point of connection to an existing system. The plug shall remain in place until the project has been completed and all work approved. The Contractor shall not flush or otherwise discharge any flow into an existing system unless approved in writing by the City.

13) Pipe shall be laid to line and grade as shown on the plans and as staked in the field. The bedding of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe barrel. Suitable excavation shall be made to receive the bell of the pipe and the joint shall not bear upon the bottom of the trench. All adjustments to the line and grade shall be made by scraping away or filling in with pipe zone material under the body of the pipe, and not by wedging or blocking. When connections are to be made to any existing manhole, pipe, or other improvement, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for and expose the existing improvement before laying the connecting pipe or conduit. When existing underground improvements may reasonably be expected to conflict with the line or grade established for the new sewer line, the Contractor shall excavate as necessary to expose and locate such potentially conflicting underground improvements prior to laying the new pipe. Any adjustment in line or grade which may be necessary to accomplish the intent of the plans will be made.

14) Connections to existing manholes shall be made by core drilling through the manhole wall, concrete saw or other cutting device approved by the City Engineer. Sledgehammers are not acceptable. The Contractor shall take care to avoid unnecessary damage to the existing manhole. Manholes broken by the Contractor shall be replaced.

15) Pipe shall be laid upgrade in a continuous operation from structure to structure, with the socket or collar ends of the pipe upgrade unless otherwise permitted by the City Engineer.

16) Sanitary sewer mains shall not be constructed under walkways, sidewalks, curbs and gutters, drivepads, or similar concrete structures by tunneling underneath them. The Contractor will cut these concrete structures by using a concrete saw to the nearest control joint. the Contractor may remove the section of the concrete structure to the nearest full expansion joint or edge.

17) Plastic sewer pipe shall be connected and placed in the trench in accordance with the manufacturer's recommendations.

18) The reference mark (a distinct circumferential line) is placed on the pipes spigot end by the manufacturer to indicate the correct depth of spigot penetration into the pipe gasket joint. If the pipe is seated too deep or too shallow the pipe may buckle or separate due to thermal expansion/contraction. Spigot penetration shall be within 1/4 inch of the manufacturer's recommended mark.

19) For plastic pipe connection to manholes, the Contractor shall install an appropriately sized press seal gasket, such as PS-10 by Press Seal Gasket Corporation, Large Diameter Waterstops for Concrete Manhole Adapters by Fernco, or approved equal. The gasket shall be installed per manufacturer's directions.

D. Existing Manholes

1) Where the Contractor is required to connect to the existing manholes, he shall exercise all due care required to support and protect the manholes from damage. Any damage to the existing manholes resulting from the Contractor's activities shall be corrected to the satisfaction of the City Engineer and/or Public Works Inspector.

2) Each manhole penetration shall be sawcut along premarked lines to form a uniform

opening. The existing manhole invert shall be removed as required to build the new sewer line through the manhole at the alignment and grade called for in the Project Plans.

3) Prior to grouting the openings and manhole invert, the walls and floor of the manhole shall be clean and free of all foreign matter or other condition that would affect the bonding of the new grout. Additionally, a rubber manhole gasket shall be installed around the new sewer line where it will be in contact with the new grout. All voids shall be filled, and the invert shall be grouted to form a smooth sloping surface toward the opening in the new pipe.

4) Existing sanitary sewer manholes designated for removal shall be demolished and disposed of at an appropriate site. The resulting excavation shall be properly refilled with compacted backfill.

E. Temporary By-Passes

1) Where required, the Contractor will be required to control the sewage in the existing sewer lines and service lines.

2) The sewage shall be pumped, diverted or otherwise accommodated to facilitate construction of the new sewer line.

3) The Contractor shall conduct his sewer line construction so that fittings, couplings and all required materials are on hand to quickly complete each section of sewer line, there by minimizing the time frame that the bypass is in place. The Contractor shall present to the City Engineer a bypass proposal that accurately details his operations, for approval by the City Engineer prior to beginning work on the sewer line.

F. Backfilling Trenches

1) The trenches shall be excavated to the depth of 4-inches for pipe size 16-inches and smaller below the bottom of the pipe, 6-inches for pipe size 18-inches and larger below the bottom of the pipe. The trench bottom shall be smooth and hand graded uniformly throughout. The compacted bedding shall support the pipe throughout its entire length, except at bells or couplings which shall not rest on the bedding. After the bell or coupling holes have been excavated and after the pipe pieces are connected and properly aligned and graded, successive layers of backfill material shall be placed and compacted, until the pipe is covered. Contractor shall use due care to maintain proper alignment and positive grade during the bedding process. Any bent, cracked, chipped or damaged pieces of pipe shall be removed and replaced. Compaction tests on the pipe bedding will be required. After the pipe has been laid and bedded, it shall be inspected and approved by the Engineer and/or Public Works Inspector.

2) Backfill shall be constructed of suitable native material. Where native materials are not suitable engineered fill shall be used or suitable material from another location may be used.

G. Manhole Construction

1) Soil foundations for manhole base shall be compacted to a density of 95% of the maximum density per ASTM D 1557.

2) Manholes shall be pre-cast reinforced concrete units in accordance with the Detail Drawings of this document and as shown on the plans.

3) Invert elevation of the pipes entering or exiting the manhole and interior inverts shall not vary more than 0.05 foot from the elevations indicated on the construction plans.

4) All cement used for poured foundations, mortar, fillets, grout, and concrete shelf construction shall be Type II or approved equal.

5) All concrete for formed in place foundations or bases shall be 3000 psi compressive strength concrete.

6) Manhole risers should be constructed using the tallest barrels possible from the pre-cast manufacturer. The base barrel shall be a minimum of four (4) feet, but not less than 2 times the size of the sewer pipe penetrating the manhole.

7) Concrete, used for precast bases, vertical sections, and eccentric cones, shall be 4000 psi compressive strength concrete.

8) All precast sections of the manholes shall conform to the requirements of ASTM C 478, latest revision.

9) Circular pre-cast manhole sections shall be provided with mastic gasket to seal joints between sections, such as Ram-Nek, Kent Seal, or approved equal.

10) All lifting holes and gaps at joints shall be filled with a nonshrink grout.

11) Precast concrete manhole bases may be used. It shall be with the understanding that the Contractor shall be responsible for placing the bases at the specified elevation, location, and alignment.

H. Pavement Patching

After all trenching and backfilling is complete, the pavement shall be marked and sawcut to form a smooth, uniform edge. The resulting cut face shall be coated with tack coat and new plant mix bituminous pavement shall be placed and densified as specified. The resulting pavement patch shall have a smooth riding surface in any direction.

I. Testing

1) Testing for tightness – After the pipe has been laid and backfilled, the line shall be tested between manholes by a low pressure air or water test at 5psi for 2 hours, unless specified otherwise by the Project Engineer and approved by the City Engineer.

2) Exfiltration test – The maximum water exfiltration for a given pipe shall be at a rate of fifty (50) gallons per inch of internal pipe diameter per mile per day. During the exfiltration testing, the maximum internal pressure at the lowest end may not exceed twenty-five (25) feet or 10.8 psi. The internal water head must be a minimum of two (2) feet higher than the top of the pipe.

3) Deflection testing – Long term pipe deflection shall not exceed 7 ½%. When required the contractor shall perform deflection test between successive manholes using appropriate instrument. The specifying Engineer will designate when the test is to be preformed. If it is determined that the pipe has exceeded deflection requirements, the pipe shall be removed and replaced.

4) Manholes shall be tested as follows: Manhole shall be filled with water to a minimum of one section above the highest pipe penetration. Water level shall remain for a minimum of 6 hours.

J. Flushing Sewer lines

All completed sewer lines shall be flushed with water to remove any dirt or formatter from the line. The flushing shall be done in the presence of the Public Works Inspector.

END OF ARTICLE 02-027.1

Article 03-032.1 Steel Reinforcement

1.0 SCOPE

This work consists of furnishing all equipment, materials and labor and performing all operations required for the providing and placing all steel reinforcement in substantial compliance with these specifications and all other applicable specification items.

2.0 MATERIALS

A. General

All steel reinforcement shall conform with the requirements herein provided.

B. Bar Reinforcement

1) Shop Bending

Bent bar reinforcement shall be cold shop bent around a pin to the shapes shown on the Project Plans. Unless otherwise provided, bends shall have a radius measured on the inside of the bar of not less than 2-1/2 bar diameters.

2) Bundling and Tagging

Bar reinforcement shall be shipped in standard bundles, tagged, and marked in accordance with the Code of Standard Practice of the Concrete Reinforcement Steel Institute. The Contractor shall furnish, from the fabricator, a certificate of compliance. Two (2) copies shall accompany all shipments of reinforcing steel to the project. The certificates of compliance shall show the name of the manufacturer, pounds shipped, heat numbers, laboratory test report numbers, and grade of steel.

3) Bar reinforcement shall be deformed bars of Grade 60 and shall conform with the requirements of ASTM A 615. Field bending of Grade 60 bars will not be permitted.

4) Bar mat reinforcement shall conform with the requirements of ASTM A 184, billet steel, Grade 60.

C. Welded wire fabric shall conform with the requirements of AASHTO M 55.

D. Metal chairs or other metal supports for reinforcement which contact the exposed surfaces of the concrete shall be galvanized and bond breaker provided between metal chairs and reinforcement.

E. Wire for reinforcement shall conform with the requirements of AASHTO M 32.

F. Dowel bars for load transfer in concrete shall be plain, straight, with ends square, and free from burrs and shall conform with the requirements of ASTM A 306, Grade 80. Expansion caps for one end of the dowel bars shall be close fitting and shall be a minimum length of three (3) inches. The enclosed end of the expansion cap shall contain a suitable stop to hold the end of the dowel bar one (1) inch from the end of the cap.

3.0 CONSTRUCTION REQUIREMENTS

A. Before concrete is placed, the reinforcement shall be cleaned of dirt, mortar, oil, loose rust, loose mill scale and any other analogous material that would reduce or destroy the bond.

B. Reinforcing bars shall be placed as shown on the Project Plans and shall be securely tied in position with 0.080-inch diameter or 0.0624-inch diameter wire at all intersections, except where the spacing is less than one (1) foot in either direction. Where the spacing is less than one (1) foot in either direction, alternate intersections shall be tied. Metal spacers, chairs, hangers, and other approved devices of adequate strength to prevent crushing under full load shall be used to hold the reinforcing in position. The use of concrete blocks to support reinforcement will not be permitted, except that dense, rectangular concrete blocks may be used to support the bottom mat of reinforcement in slabs which are cast on earth. Such concrete blocks shall meet the following requirements:

1) Have compressive strength and density equal to, or greater than, the concrete to be placed.

2) Occupy a small area.

3) Be not subject to deterioration.

4) Contain embedded tie wires to provide for the attachment of reinforcement to the block.

Reinforcement other than lower mats in slabs cast on earth shall be supported with metal spacers, chairs, or hangers.

Wooden spacers or supports shall not be used to hold reinforcing in position.

Bars shall be placed with a variation in spacing between adjacent bars of not to exceed 1/2 inch or one-twenty-fourth of the spacing dimension shown on the Project Plans, whichever is the greater. With the exception of slabs cast on earth, the clear coverage of the reinforcement shall not vary more than 1/4 inch or one-eighth of the dimension shown on the Project Plans, whichever is the greater. The clear coverage of reinforcing cast on earth shall not vary more than minus 1/4 inch to plus 1/2 inch from the position shown on the Project Plans.

C. Reinforcement shall be furnished in the full length indicated on the Project Plans, unless otherwise approved by the Engineer. Splicing of bars, except where shown on the Project Plans, will not be permitted. Bars in lapped splices shall be placed and securely tied in a manner to maintain not less than the minimum distance to the surface of the concrete shown on the Project Plans.

D. Welded wire fabric and bar mat reinforcement shall be lapped as shown on the Project Plans, but not less than two (2) mesh in width, and securely tied at the ends and edges.

E. Reinforcing steel shall be welded only when shown on the Project Plans or authorized in writing by the Engineer. Welding shall conform with the requirements of AWS Specification D12.1-Reinforcing Steel Welding Code.

F. The minimum cover from the surface of the concrete to the face of any reinforcement bar shall be not less than shown below, unless otherwise shown on the Project Plans.

1) Minimum cover shall be as follows:

a) Concrete cast against and permanently exposed to earth-two (2) inches.

b) Concrete exposed to earth or weather:

Principal reinforcement - 2 inches.
Stirrups, ties, and spirals - 1-1/2 inches.

c) Concrete not exposed to weather or in contact with the ground:

Principal reinforcement - 1-1/2 inches.
Stirrups, ties, and spirals - 1 inch.

2) For bar bundles, minimum concrete cover shall be equal to the lesser of the diameter of a single bar of equivalent area or two (2) inches, but not less than the minimum cover given in 1) above.

3) Exposed reinforcing bars, inserts, and plates intended for bonding with future extensions shall be protected from corrosion.

G. Inspection-No concrete shall be placed until the Engineer has inspected the reinforcing steel in place and has authorized the Contractor to place the concrete. Acceptance of the reinforcing steel will not relieve the Contractor of responsibility for coverage and position control of the steel.

END OF ARTICLE 03-032.1

Article 03-033.1 Portland Cement Concrete

1.0 SCOPE

This work consists of furnishing and placing portland cement concrete in substantial compliance with the specifications and the lines, grades, and dimensions in accordance with the plans, these technical standards, and all other applicable specification items.

1.1 CLASSIFICATION

The following classes of concrete are included in these specifications and shall be used where required by the Project Plans:

Table 03-033-A
Concrete Classes for Design of Concrete Mixtures

Class	Use	** Compressive Strength at 28 Days (Production)	Maximum Allowable Design Slump	Percent Air Content
A	Cast-in-Place Structural	3000 psi	4.5 in	6% ±2
AA		4000 psi	4.5 in	
D	Non-Structural	2500 psi	4.5 in	---
E	Slip Form Structural	2500 psi	2.5 in	6% ±2
F		3000 psi	2.5 in	
HPD	Bridge Decks	Submit per Project	-	-

** Maximum over design strength is 50%, maximum under design strength is 5%.

1.2 CLASS SUBSTITUTION

Any structural class of concrete approved for a specified compressive strength requirement in excess of that called for in the project plans and specifications may be substituted for a lower strength mixture, as long as the design slump characteristics remain the same (i.e. Class AA for Class A, Class F for Class E). Class A or Class AA shall not be substituted for a Class E or Class F concrete mix.

2.0 Concrete Mix Design

2.2 Mix Design Submittal

A. A request for concrete mixture design(s) approval shall be submitted to the City Engineer. Each request shall have the Stamp of the Professional Engineer, who is currently registered by the State of New Mexico, who is principally responsible for the concrete mixture design work. All concrete mix designs must be submitted for review and re-approval on an annual basis, unless an extension is granted in accordance with the provisions contained herein. The mix design submittal shall accompany the requester's written request for review and approval, and shall include, at a minimum, the following:

1) Comprehensive list of all materials used in the mixtures, and the properties of each of the components, including:

a. Aggregates

1. Coarse and fine aggregate source name(s).

2. Specific location of coarse and fine aggregate source(s).

3. For new sources a complete ASTM C295 “Petrographic Examination of Aggregates for Concrete” and an ASTM C294 “Constituents of Natural Mineral Aggregates” for both the coarse and fine aggregate material must be submitted after all processing and manufacturing procedures have been completed and the aggregate is ready for use in a concrete mixture design. The report must include the geologic origin of the material. The analysis is to be performed and certified by a an approved petrographer.

4. Soundness loss (coarse and fine aggregates) with calculations.

5. Percent of fractured faces for the coarse aggregate.

6. Gradations for the coarse and fine aggregate, including AASHTO T11.

7. Bulk saturated surface dry (SSD) specific gravities (coarse and fine aggregates).

8. Los Angeles wear abrasion.

9. Fineness modulus (fine aggregate).

10. Aggregate absorption (coarse and fine aggregate).

11. Aggregate correction factor.

12. Sand equivalent of fine aggregate.

13. Dry-rodded unit weight of the coarse aggregate.

14. Clay lumps content of the fine aggregate.

15. Organic impurities content, including soft fragments, coal and lignite, flat or elongated pieces and other deleterious substances.

b. Cement

1. ASTM C150 Analysis.

2. Chemistry and physical properties of the cement, including the amount of C3S, C2S, C3A, the amount finer than No. 325 sieve and the Blaine Fineness.

3. Cube strengths.

c. Fly Ash

1. ASTM C618 Analysis.

2. Specific gravity.

3. Material retained on the No. 325 sieve.

4. Moisture content.

5. Loss on ignition.

6. Magnesium oxide content.

7. Calcium oxide content.

d. Blended Cement

1. ASTM C595/C1157 Analysis.

2. Chemistry and physical properties of the cement, including the percentage of C3S, C2S, C3A, the amount finer than No. 325 Sieve and the Blaine Fineness.

3. Total alkalis.

4. ASTM C618 Analysis.

5. Documentation of percent of fly ash added to cement.

e. Admixtures

1. Documentation of compliance with appropriate ASTM requirements.

2. Verification of supply availability.

f. Water

1) Concrete mixture proportions for each class of concrete for which approval is being requested. If the supplier is submitting under the combined gradation provisions, this must be clearly stated on the submittal.

2) Water/cementitious ratio for each concrete mixture design.

3) Type and amount of admixtures used in each mixture design (admixtures must be on the approved materials list).

4) Water source and location (including pH, available akalies, and a full chemical analysis, if the water source is not a certified NMED public potable water supply).

5) Material test results documenting the required properties of the fresh and hardened concrete, including:

a. Plastic concrete.

1. Ambient air temperature.

2. Concrete temperature.

3. Slump (in the case where super-plasticizer is used, the slump before and after addition of the super-plasticizer).

4. Unit weight.

5. Air content measured in accordance with AASHTO T-152 “Air Content of Freshly Mixed Concrete by the Pressure Method” or AASHTO T-196 “Air Content of Freshly Mixed Concrete by the Volumetric Method” (if super-plasticizer is used, show the measured air content before and after the super-plasticizer has been added).

b. Hardened Concrete (**for new mixes**)

1. Compressive strength tests (the average of three cylinders tested at the ages of 7, 28 and 56 days, except for Class E and Class F which will have two cylinders tested at 7, 14, 28 and 56 days).

2. Type of fracture of each cylinder.

3. Durability factor (for structural mixes only).

4. Hardened air void analysis (for structural mixes only).

5. Rapid chloride penetrability (for structural mixes only).

6. Expansion data from AASHTO T 303.

c. Hardened concrete (**for existing mixes**)

1. Consecutive compressive strength data with individual specimen test results from 7, 28 and 56 days (at least 15 tests required). This data will be presented in chronological order.

2. Durability factor (for structural mixes only).

3. Hardened air void analysis (for structural mixes only).

4. Rapid chloride penetrability (for structural mixes only).

5. Expansion data from AASHTO T 303.

6) Incidental concrete mixes defined as concrete mixes intended for projects for which less than 300 yd^3 of each class of concrete is anticipated, but not more than 750 yd^3 for all concrete used on the project:

a. Compressive strength data (field performance data if the mix has been used within the previous 12 months, or laboratory mix performance data if it has not been used in the field).

b. Air content, as measured by the pressure method or the volumetric method. If superplasticizer is used, show the air before and after the superplasticizer has been added.

B. After all of the documentation has been received by the City Engineer, a minimum of ten (10) working days shall be allowed for the review of the mixture design submittal packages. If the documentation verifies compliance with the City's requirements, the designs will be approved for a period of one (1) year from the date of issuance. A minimum of thirty (30) days before the anniversary of an approved mixture design issuance, the supplier may request that the mixture design(s) be reissued. The supplier must provide test reports showing that the mixture design(s) met all specification requirements during the issue period. The ready-mix concrete supplier may request that existing mixture designs be re-issued for an additional two years, so that the total approval period for any individual mix design does not exceed three (3) years. This approval period will be granted if documentation is provided to prove that:

1) All constituent materials and the material's properties remain the same.

2) The compressive strength performance criteria described in Paragraph 1.1, Classifications, are satisfied.

3) All other fresh and hardened properties are complied with on all projects that the mixture has previously been used on.

4) The coefficient of variation (CV), determined in accordance with ACI 214, for all concrete produced from any production facility used to supply concrete is less than 12%; If field performance data shows that the Coefficient of Variation exceeds 12%, the supplier must submit a Comprehensive Operations QC/QA Manual in writing that will reduce the variability of his production process, and improve the dependability.

C. If the constituent materials change, it will be the supplier's responsibility to provide the necessary documentation to the City Engineer describing their resolution to the problem. Either the supplier will return the affected material to the approved condition, or a new concrete mixture design package must be submitted for approval. If the compressive strengths do not comply with City requirements, the supplier will adjust the quality control system, the concrete mixture proportions, the mixture ingredients, or a combination of the above. A written summary of the supplier's resolution will be submitted for approval. The subject concrete mixture may not be used until written approval from the City Engineer is received by the supplier. Simply adding additional cement will not be considered a sufficient explanation or resolution without additional documentation explaining why other measures are not required.

3.0 MATERIALS

A. All materials shall be tested in accordance with applicable AASHTO and ASTM methods or other test procedures designated by the City Engineer. All questions arising as to the interpretation of test procedures shall be decided by the City Engineer. Material that is improperly graded or segregated, or fails to meet the requirements herein provided, shall be corrected or removed and disposed of immediately as directed by the Engineer and/or Public Works Inspector.

B. The contractor shall use pre-approved materials. No change in the source or character of the materials shall be made without due notice and written approval from the City Engineer.

3.1 Portland Cement

A. Portland cement shall be "low-alkali" and shall meet the requirements of ASTM C 150 for the type required. Unless otherwise approved Type II, Low-Alkali cement shall be furnished.

B. Acceptance of Portland cement will be based on certification of approved sources and satisfactory test results on project verification samples. Cement from a particular source or supplier must be pre-approved by the City Engineer before being used in Portland cement concrete. The request for source approval shall include the following information:

1) The name of the supplier or company.
2) Location of the cement plant.
3) Type and capacity of storage facilities.
4) Average and maximum production capabilities.
5) Production procedures.
6) Details regarding the in-house quality control program, including the following:
  a. Routine sampling and testing frequency.
  b. Documentation that the laboratory responsible for the certified ASTM C 150, ASTM C 595, and ASTM C 1157 test results is currently participating in the Cement & Concrete Reference Laboratory (CCRL) proficiency sample and the pozzolanic inspection programs. Additionally, the laboratory shall submit a copy of their letter authorizing CCRL to send a copy of their inspection programs and proficiency result reports directly to the City.
  c. Measures taken to ensure that cement not meeting specification requirements is kept separated from other cement meeting these specifications.
7) Copies of test reports showing results obtained in the quality control program for the previous six months, including at least one (1) comprehensive ASTM C 150 analysis for each month.

Sources approved by the New Mexico State Materials Bureau will be accepted as approved materials.

C. Withdrawal of Source Approval - Source approval may be revoked for any of the following reasons:
1) If there is a change in equipment or production procedures from those shown in the original request for approval.
2) If a project sample fails to comply with specification requirements.
3) If the chemistry and or physical properties vary more than allowed above.
4) If a source becomes inactive for a period of three (3) months or more, all cement for any given structure shall be manufactured at the same production facility unless

otherwise approved by the City Engineer. Source changes in cement will only be allowed upon written request by the Supplier to the City Engineer for written approval.

Compliance with ASTM C 150 is not sufficient documentation to verify equivalence of the proposed cement. Proof that the proposed cement produces concrete in which all of the hardened properties are equal to or better than the original cement must be provided before approval can be issued.

3.2 Blended Portland-Fly Ash Cement

A. Blended Portland-fly ash cement shall meet the requirements of ASTM C 595 and ASTM C 1157 and shall consist of Portland cement uniformly blended with fly ash, either by intergrinding the Portland cement and fly ash or by blending the Portland cement and the fly ash. The Portland cement and the fly ash shall meet the requirements of their individual respective specifications. The cement producer shall provide proof that the blended Portland-fly ash cement contains a minimum 20% maximum 25% of fly ash (by weight of the cement only).

B. Approval of Blended Portland-Fly Ash Cement Source. The prospective blended Portland-fly ash cement supplier shall furnish acceptable test data showing that the blended Portland fly ash cement does impart satisfactory strength and durability to the concrete per the requirements of Table 03-033-A and Paragraph 2.0, “Mix Design”.

3.3 Packaging

When Portland cement and blended Portland-fly ash cement are delivered in packages, the packages shall plainly state the name brand, the source manufacturing facility, and the cement type. When cement is delivered in bulk, the same information shall be contained in the shipping documents accompanying the shipment.

3.4 Storage

All cement shall be well protected from rain, condensation and all other sources of moisture. Cement of different brands or types, or which comes from different production facilities shall be stored separately. Separate, readily identifiable storage shall be furnished for blended Portland-fly ash cement. Portland cement and Portland-fly ash cement shall not be mixed or intermingled.

3.5 Rejection

All cement which has come in contact with moisture, fly ash or other cements or which has partially set, contains lumps, or fails to meet the specified requirements shall be rejected by the Engineer and/or Public Works Inspector.

3.6 Admixtures

A. The total chloride content (both soluble and insoluble) of any admixture or combinations of admixtures shall not exceed 1000 ppm. All admixtures used must be submitted for approval.

B. Air entraining Admixtures - Air-entraining admixtures for concrete shall conform to the requirements of AASHTO M 154.

C. Chemical Admixtures - Water-reducing and set-controlling admixtures (including all normal, middle, and high-range water reducers), set-retarding admixtures, and non-chloride set-accelerating admixtures, or combinations thereof shall conform to the requirements of Paragraph 3.6, "Admixtures" and AASHTO M 194.

3.7 Curing Materials

A. Liquid Membrane Forming Compounds - Unless otherwise specified, liquid membrane-forming compounds for curing concrete shall conform to the requirements of Type 1-D or Type 2 when tested in accordance with AASHTO M 148.

B. Linseed Oil Emulsion - Linseed oil emulsion-curing agent shall not be used on any projects.

C. Sheet Materials for Curing Concrete - Sheet materials for curing concrete shall meet the requirements of AASHTO M 171 except that only white reflective type shall be permitted.

D. Water - Testing of potable water from municipal or other sources approved by the New Mexico Environmental Department (NMED) shall not be required. Water from other sources must have prior approval from the City Engineer before incorporating into any work. Water shall be sampled and tested in accordance with AASHTO T 26. Water used in mixing and curing concrete or for washing concrete aggregates shall be clear and free from injurious amounts of acid, oil, alkali, organic matter, or other deleterious material. Water shall have a pH value of not less than 6.0 or more than 8.5, as determined by AASHTO T 26, prior to its use. The sulfate content and the chloride content each shall not exceed 1000 ppm. Where a source of water is relatively shallow, the intake shall be enclosed and the level of water shall be maintained at such a depth to exclude silt, clay, vegetable matter and other foreign material. Residual water, wash water, or recycled water generated from any equipment, mixer trucks or central mixers shall not be used as all or any part of the water added to any concrete mixture used.

3.8 Aggregate

A. The combining of materials from two (2) or more approved material sources to produce aggregate will be permitted as follows:

2) The blended material meets all requirements, including the gradation requirements.

B. All aggregates shall be evaluated for reactivity by AASHTO T 303 or by ASTM C 1293. The initial "Proof-of-Reactivity-Potential" test will be performed utilizing a standard Rio Grande Type I-II low alkali cement from the Rio Grande Cement plant located at Tijeras, New Mexico. This cement shall have an alkali content between 0.5% to 0.6%. Aggregates that exhibit mean mortar bar expansions at 14 days greater than 0.10% shall be considered potentially reactive. Aggregates will be considered innocuous if their maximum expansion is less than 0.10% at 14 days unless ASTM C 1293 is used, then the aggregate shall be considered to be innocuous if the average expansion measured at the end of one (1) year is less than 0.04%. A current list of reactive, potentially reactive and non-reactive (innocuous) aggregate sources tested to date may be obtained from the NMSHTD's State Materials Bureau.

C. Combined Gradation - At the option of the supplier, the aggregates used in any concrete mixture may be evaluated in accordance with the combined gradation resulting from the addition of specified weights of individual coarse and fine aggregates. The gradation of the combination of all the proposed aggregates shall be evaluated in accordance with the following parameters:

1) Each individual source complies with all material requirements except the gradation;

1) Coarseness Factor (CF) = Q / (Q + I) Equation (3)

Where:

Q = the percentage of the combined gradation, by weight of total aggregate retained on or above the 3/8 in. sieve; and

I = the percentage of the combined gradation, by weight of total aggregate, passing the 3/8 in. sieve, but retained on the No. 8 sieve.

2) Workability Factor (W) that is defined as the percentage of the combined gradation, by weight of the total aggregate, passing the No. 8 sieve

3) **Mortar Factor** that is defined as the percentage of the total volume of the entire concrete mixture occupied by cement, fly ash, water, air, all other pozzolans and W; and

4) **Paste Factor** that is defined as the percentage of the total volume of the entire concrete mixture occupied by cement, fly ash, water, air and all other pozzolans (W is not included in this factor).

All aggregates shall be graded and/or combined to produce a uniform gradation, from the coarsest to the finest particle sizes. If the combined gradation protocol is chosen, all aggregates used shall be in compliance with the individual physical and chemical properties required below. Only the individual gradation requirements will not apply. Concrete mixtures designed on the combined gradation basis should use a target for the coarseness factor of between 55 to 65 with a workability factor between 33 to 35. The gradations for the individual aggregate stockpiles used to achieve these factors should be realistically maintainable in the field so that the supplier can maintain these designated factors during production.

D. Coarse Aggregate - Coarse aggregate shall be crushed stone, crushed gravel, or natural washed gravel, conforming to the requirements herein provided. Unless otherwise specified below, or by other special provisions, at least 50% by weight of the plus 3/8 in sieve size particles shall have a minimum of one (1) fractured face. A face will be considered fractured when at least one-half of the projected particle area exhibits a rough, angular, or broken texture with well defined edges.

E. Deleterious Substances The amount of deleterious substances shall not exceed the limits shown in Table 03-033-B when tested in accordance with the procedures shown in Table 03-033-F.

Table 03-033-B
Coarse Aggregate Deleterious

Substance TolerancesSubstance	Percent by Weight (Maximum)
Soft Fragments	2.0%
Coal and Lignite	0.25%
Clay Lumps	2.5%
Materials Passing No. 200 Sieve	1.0%
Flat and Elongated Pieces	* see note

***** The plus 3/8in. material shall contain a maximum of 15.0% flat, elongated particles with a dimensional ratio of 3:1 or greater as determined by ASTM D 4791.

Concrete aggregate shall be free from all sticks, roots and other organic matter. Aggregate contaminated with sticks, roots, and other organic matter shall be rejected.

H. Fine Aggregate - Fine aggregate shall consist of natural sand or manufactured sand conforming to the requirements herein.

I. Deleterious Substances - The amount of deleterious substances shall not exceed the limits shown in Table 03-033-C:

Table 03-033-C
Fine Aggregate Deleterious Substance Tolerances

Substance	Percent by Weight (Maximum)
Soft Fragments	2.0%
Coal and Lignite	1.0%
Clay Lumps	3.0%
Materials Passing 75µm (No. 200) Sieve	1.0%

3.9 Fly Ash

A. Fly ash shall conform to the physical and chemical requirements of ASTM C 618, including the optional requirements for available alkalis and reactivity with cement alkalis, as modified with the exceptions shown in Table 03-033-D. The Supplier shall use Class F Fly Ash if either the coarse or the fine aggregate is reactive. If both the coarse and the fine aggregate are non-reactive, then the Supplier may choose to use a C/F blend Fly Ash or a Class C Fly Ash, maximum 25% by weight of the cement.

Table 03-033-D

Fly Ash Requirements

Characteristic	Class C	Class F
Sum of Al_2O_3, SiO_2, and Fe_2O_3	---	> 85%
Moisture Content, Maximum %	1.0	1.0
Loss on Ignition, Maximum %	3.0	3.0
Magnesium Oxide (MgO), Maximum %	5.0	5.0
Available Alkalis, Maximum % *	1.5	1.5
Calcium Oxide (CaO), Maximum % **	50.0	8.0

***** When the autoclave expansion or contraction limit is not exceeded when combined with the cement, a MgO content above 5.0% will be acceptable.

****** Fly ash meeting the requirements of ASTM C618 and containing more than 10% by weight of bulk CaO may not be used in concrete exposed to sulfate environments or with potentially reactive or known reactive aggregate.

B. If fly ash is supplied in bags, the bags must be waterproof and the name brand, the manufacturer, type, and source shall be clearly identified thereon. Each fly ash shipment shall be accompanied by a copy of a properly executed certificate of compliance. Source changes in fly ash may be allowed only after a written request by the Supplier is made to the City Engineer for review and written approval once the equivalency of the proposed material has been verified. Compliance with ASTM C 618 is not sufficient documentation to permit a change of sources. Information must be provided verifying the equivalence in performance of the proposed source to the original source. Blending of Class C and Class F fly ash is permitted. However, the blended fly ash must be approved before its actual use by the City Engineer. Blended fly ash shall meet all requirements of ASTM C 618, and may only be used in concrete mixes in which both the coarse and the fine aggregate is non-reactive (innocuous).

C. Source Approval and Acceptance - Acceptance of fly ash will be based on certification of approved sources and satisfactory test results on verification samples. Fly ash from a particular source or supplier must be approved before being used in Portland cement concrete. The request for source approval shall include the following information:

1) The name of supplier or company
2) Location of the source power plant
3) Coal type and origin
4) Combustion process
5) Storage facilities and capacity
6) Production procedures
7) Details regarding the supplier's quality control program including the following:

- **a.** Routine sampling and testing frequency;
- **b.** Evidence that the Laboratory responsible for the certified ASTM C618 test results is currently participating in the Cement & Concrete Reference Laboratory (CCRL) proficiency sample and pozzolanic inspection programs. Additionally, the laboratory shall submit a copy of their letter authorizing CCRL to send a copy of their inspection and proficiency reports directly to the City.
- **c.** Measures taken to ensure that fly ash not meeting specification requirements is kept separated from material meeting the requirements.

8) Copies of test reports showing results obtained in the quality control program for the previous six months including at least one complete ASTM C618 analysis for each month.

Sources approved by the NMSHTD's State Materials Bureau does not mean that this material can be automatically substituted for a different source.

3.10 Fibrous Concrete Reinforcement

Fibers used in the concrete mix shall be used at a minimum dosage rate of 1.5 lb/yd^3 of concrete. All fibers shall be 100% virgin polypropylene fibrillated fibers, containing no reprocessed olefin materials, and specifically manufactured for use in Portland cement concrete. Fibers shall be added to all concrete used in driveways and alley aprons.

3.11 Lithium

A. The Contractor may use lithium nitrate ($LiNO_3$) as an admixture to control expansions caused by reactive aggregate. Lithium shall be used in the form of a solution consisting of 30%, by weight, lithium nitrate ($LiNO_3$). If used, it shall be used at a dosage rate of 0.55 gal of solution for each lb of sodium equivalent, as determined from the cement mill certificate. For each liter (gallon) of lithium nitrate solution used, 0.2 gal. of water shall be subtracted from the total design water in the concrete mixture design. The lithium solution used shall be certified to comply with the following characteristics as shown in Table 03-033-E:

Table 03-033-E
Lithium Solution Requirements

Characteristics	Requirement
Lithium Nitrate, Weight %	29.5 minimum
NaOH, Weight %	0.1 maximum
CI, Weight %	0.2 maximum
SO_4, Weight %	0.1 maximum
Heavy Metals, ppm	250 maximum
Elemental Mercury, ppm	0.8 maximum

3.12 Aggregate Testing

Coarse and fine aggregate will be tested in accordance with AASHTO methods as shown in Table below and such other methods as may be required by the City Engineer. Approval of a concrete mixture design using the designated aggregate source will remain in effect for the duration of the designated approval period as long as the results of tests for specific gravity, absorption, gradation and sand equivalent (for fine aggregate only) performed on representative samples on a semi-annual basis comply with all requirements contained herein.

Table 03-033-F
Aggregate Test Methods

Aggregate Test	Method
Sampling	AASHTO T-2
Clay Lumps	AASHTO T-112
Amount of Material Passing No. 200 Sieve	AASHTO T-11
Sieve Analysis	AASHTO T-27
Soundness with Magnesium Sulfate	AASHTO T-104
Sand Equivalent	AASHTO T-176
Soft Fragments	AASHTO T-112
Flat and Elongated Pieces	ASTM D-4791

3.13 Control of Alkali-Silica Reactivity (ASR)

A. If the Supplier elects to use an aggregate source which has been designated as potentially reactive or known reactive, a combination of one or more of the following ASR inhibiting admixtures, per Table below, shall be used to provide a concrete mixture that meets the maximum expansion requirements below:

Table 03-033-G
ASR Inhibiting Admixtures

Fly Ash (Class F)	Paragraph 3.9
Blended Cement	Paragraph 3.2
Ground Granulated Blast Furnace Slag (GGBFS), Grade 100 and 200	AASHTO M-302
Silica Fume	AASHTO M-307
Lithium Nitrate ($LiNO_3$)	Paragraph 3.11
Heavy Metals, ppm	250 maximum
Elemental Mercury, ppm	0.8 maximum

B. Unless it is determined in Paragraphs 3.13, C, “ASR Mitigation” and 3.13, D, “ASR Mitigation Evaluation Criteria” that a larger dosage is required to properly mitigate ASR, the admixture(s) shall be incorporated into the concrete per Table below :

Table 03-033-H
ARS Mitigation Dosage Rate Requirements

Fly Ash (Class F)	20 % minimum 25% maximum by weight of cement only for binary blends; 12% minimum by weight for ternary blends as long as the total pozzolan dosage is at least 20%
Blended Cement	20% minimum by weight of cement only
GGBFS	25% to 30% by weight of cement only
Silica Fume	5% to 12% by weight of cement only
Lithium Nitrate	4.6 Liter?meter^3 (0.55 gallons/yard^3) of solution for each kg (pound) of cement sodium equivalent

C. ASR Mitigation Requirements - The effectiveness of the admixture(s) in controlling deleterious expansion shall be determined by mortar bars made and tested in accordance with AASHTO T 303-96 using the cement, fly ash, other mitigating

admixtures and the proposed aggregate intended for use in the proposed concrete mixture.

D. ASR Mitigation Evaluation Criteria - An admixture shall be considered effective in controlling deleterious expansion due to ASR when the mean mortar bar expansion at 14 days is less than or equal to 0.10%, when tested in accordance with Paragraph 2.0, "Concrete Mix Design". Aggregates that are classified as reactive shall be retested each time the comprehensive mix evaluation is performed to verify the effectiveness of the mitigation measures being exercised. If the supplier feels that the coarse and the fine aggregates are innocuous although the test results generated from AASHTO T 303 or ASTM C 1293 indicate either potentially reactive or reactive material, the following documentation can be submitted for proof that the coarse and the fine aggregates are innocuous:

1) A letter prepared and signed by a registered Professional Engineer in New Mexico who is familiar with ASR stating that he/she has direct knowledge of ASR and its manifestations in concrete and that the subject aggregates have never been observed to be associated with any ASR deterioration of concrete.

2) At least two core samples shall be obtained from completely different structures, each of which are at least 15 years old, and which used the subject aggregates in a cement-only mixture (no fly ash). These cores will be submitted to a petrographer for evaluation of the presence of ASR gel.

3) Upon receipt of the stamped letter from the Registered Professional Engineer, if there is no evidence of ASR gel found in either of the cores, then the aggregate sources will be considered as innocuous.

4.0 Construction Requirements

4.1 City Engineering Representatives and Contractor personnel performing field testing of concrete shall be certified by ACI or TTCP as a Concrete Field Testing Technician.

A. The contractor shall be responsible for providing a concrete mixture that has been reviewed and approved by the City Engineer.

B. If it is found that the approved mixture design will not work, the Testing Laboratory who designed the mixture and the City Engineer will be contacted immediately. The Testing Laboratory will work directly with the City Engineer to determine why the approved mixture design will not work, and will make the necessary changes to resolve any problems found.

4.2 Batching

A. Measuring and batching of material shall be done at a batching facility or by continuous volumetric batching in a continuous mixer. Any facilities or equipment used to batch concrete shall comply with the requirements in Chapters 9-11 of AASHTO M 157. If the Coefficient of Variation for the batch facility shown on the mix design submittal exceeds 12%, then a comprehensive Plant Operations and Quality Control Manual shall be submitted and approved by the City Engineer before any facilities and/or equipment can be approved. Methods and equipment for adding air-entraining agent or other admixtures to the batch must be included in the Plant Operations and Quality Control Manual.

B. Batching plants shall include clearly separated aggregate bins or clearly separated stockpiles, silos for cement and fly ash, weighing hoppers, and scales. They shall also be equipped to proportion aggregates, bulk cement and fly ash by means of properly calibrated weighing devices. Aggregate scales and hoppers may provide for weighing each aggregate on a separate scale or for accumulative weighing on a single scale for all aggregates. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. Fly ash may be weighed in the same hopper with the Portland cement, however, the cement shall be weighed first, with the fly ash weighed only after all the cement has been placed onto the scale. The weighing hoppers shall be properly sealed and vented to preclude dusting during operations. The Batch plant operator shall have a direct view of each of the individual scales and admixture sight tubes from the normal operating position while preparing each individual batch of concrete. The batch plant shall:

1) Accurately weigh and batch materials for Portland cement or Portland cement/fly ash concrete within the tolerances specified.

2) Provide a means of removing an overload of any one material prior to contamination by any other material when more than one material is weighed in one hopper.

3) Provide scale dials or instrumentation devices for admixture bottles, beam scales and load cells, which are readily visible to both the operator and the inspector, regardless of whether a computer is utilized to prepare the batch.

4) Incorporate weighing hopper or hoppers of sufficient size to contain the material without loss or spillage.

5) Properly combine and re-combine the various mixture components to obtain the required uniformity and consistency.

The weighing hopper or hoppers shall be so designed to efficiently discharge all weighed materials for each batch. The material charging equipment shall deliver the batch to the mixer without loss or spillage of any of the components. Scales for weighing aggregates, cement, water and fly ash shall be inspected and certified annually or each time the scales are relocated. Scales shall be accurate within tolerances prescribed by state law.

4.3 Portland Cement and Fly Ash

A. Either sacked or bulk cement and fly ash may be used. No fraction of a sack shall be used in a batch of concrete unless the cement or fly ash is weighed. Cement and fly ash shall be measured by weight. Fly ash may be weighed cumulatively with the Portland cement. However, the cement shall be weighed before the fly ash. All bulk cement and fly ash shall be weighed on an approved weighing device, except when continuous proportioning and mixing equipment is used. The accuracy of batching shall be such that the weight of cement, and the combined weight of cement plus fly ash is within $\pm$ 1% of the required weights. All other cementitious materials, such as silica fume, GGBFS, metakaolinite, etc., shall also be weighed within $\pm$ 1% of the required weight. If a load of concrete arrives on the project with a cement or total cementitious weight which exceeds the target weight by more than $\pm$ 1.0%, the supplier will be notified immediately of the discrepancy by the Public Works Inspector so that corrective actions can be taken by the Supplier. However, at the discretion of the Public Works Inspector, if this target weight is not exceeded by no more than +2.0% or not less than –1.5%, no more than five (5) individual loads of such out of specification concrete may be accepted, regardless of whether the excesses are for the same material or for other target batch weights. Any subsequent loads, past the five (5) individual loads if they were allowed by the Public

Works Inspector, of concrete that exceed the specified target weights for any of the batch constituents shall not be used, and shall be immediately rejected by the Public Works Inspector. If silica fume is used in a slurry form, it shall be properly agitated to insure the mixture has not settled. The dosage of silica fume shall be based on the weight of solids only. The water in the slurry shall be included in the total water amount used to determine water/cementitious ratio. The water in the slurry shall be subtracted from the total water content shown on the approved mix design (along with the water contained in the aggregates) to determine the total amount of free water to be added to the mix. Scales and hoppers shall be used for weighing the cement and fly ash with a device to indicate complete discharge of the batch of cement and fly ash into the mixer. Cement and fly ash supplied in bulk shall be contained in weather tight bins and weighing hoppers. Discharge chutes shall not be suspended from the weighing hoppers and shall be arranged so that cement and fly ash will not lodge in, or leak from them.

4.4 Water

A. Mixing water shall consist of water added to the batch, ice added to the batch, and water occurring as surface moisture on the aggregates. The added water shall be measured by weight or volume such that the maximum amount of total water shown on the approved mix design is not exceeded. Added ice shall be measured by weight. In the case of truck mixers, the wash water shall be completely discharged before loading the next batch of concrete.

4.5 Aggregates

A. Aggregates for all concrete shall be handled from stockpiles, or other sources, to the batching plant in such a manner as to secure a uniform grading of the material. Aggregates that have become segregated or mixed with earth or other foreign materials shall not be used. Methods of handling aggregates that result in segregation, degradation, contamination or excessive breakage of particles will not be permitted. No aggregate in the form of frozen lumps shall be used in the manufacture of concrete. The gradation of the stockpiles shall be maintained unless the mixes have been approved under the combined gradation protocol. If the mix is approved under the combined gradation protocol, then the on-site gradation of the stockpiles shall be arithmetically combined in the proportions shown on the approved mix design. The coarseness factor must be within $\pm$ 4% of the approved coarseness factor shown on the approved mix design, and the workability factor must be within $\pm$ 3% of the value shown on the approved mix design. If the concrete mixture being used has been approved under the combined gradation protocols, then at the discretion of the concrete supplier, the actual gradation of the aggregate stockpiles can be determined immediately before the concrete placement. If the existing gradations cannot be adjusted to re-create the original gradation, those stockpiles shall not be used until the gradations have been corrected sufficiently to provide a combined gradation within the designated tolerances. Fine aggregate and individual sizes of coarse aggregate shall be separately stored and accurately weighed in an adequate hopper or hoppers in the respective amounts required by the approved mixture design. Batching shall be so conducted as to provide the weights of material required, within a tolerance of $\pm$ 2%. If a load of concrete arrives on the project with a fine aggregate or coarse aggregate weight which exceeds the target weight by more than $\pm$ 2%, but not more than $\pm$ 3%, the supplier will be notified of the discrepancy, but the subject load of concrete may be used, at the Public Works Inspector's discretion. However, no more than five (5) individual loads which exceed the maximum allowable batch tolerances for any of the batch constituents, as described herein will be permitted, regardless of whether the excess are for the same material or for other target batch weights. Any subsequent loads of concrete that exceed the

specified target weights for any of the batch constituents shall not be used and shall be immediately rejected by the Public Works Inspector. Any loads that exceed the target aggregate weights by more than ± 3% shall be immediately rejected by the Public Works Inspector. Aggregates that do not comply with the specified gradations shall be recombined to bring them within the specified limits or they shall be rejected.

4.6 Stockpiles

A. Fine and coarse aggregates from different sources of supply shall not be mixed or stored in the same stockpile or used alternately in the same work without prior approval. All aggregates shall be stockpiled in such a manner that segregation of coarse and fine particles of each size is avoided. Aggregates from different sources and of different gradings shall not be stockpiled together. The quantity of material in the stockpile shall be adequate to provide all of the concrete required for the section or sections to be constructed during a scheduled operation. The Supplier shall take necessary measures to prevent intermingling of the different sizes of stockpiled aggregates. The Supplier shall take necessary measures to prevent contamination of aggregates by contact with the ground and stockpiled aggregates shall be protected from dust and other foreign matter.

4.7 Moisture Control

A. The moisture content of the fine aggregate shall be continuously monitored by the supplier, in the case of an operation which uses moisture sensing equipment, or it shall be checked at least once daily by the supplier, in the case of a manually operated facility. The moisture content of the coarse aggregate shall be checked by the supplier at least once per day. Operations which utilize moisture sensing equipment will also have the moisture content of the aggregates measured manually by the supplier at least once per day. This moisture determination shall be performed immediately preceding the preparation of the first load of concrete and compared to the moisture determination made by the moisture sensing equipment. If the moisture content determined by the moisture sensing equipment differs from the manually determined moisture content by more than 0.5%, the computer will be adjusted immediately, and rechecked. A certificate will be prepared by the Batch Operator and submitted to the project with the first load of concrete showing the following:

1) Pan weight (it is not acceptable to tare out the pan weight on scales equipped to do so)
2) Wet weight of the pan and the sample
3) First dry weight of the pan and the sample
4) Second dry weight of the pan and the sample
5) Third dry weight of the pan and the sample (if necessary)
6) The absolute moisture content of the sample
7) The actual reading of the moisture probe from the same sample as that which was actually tested
8) The calculated difference between the actual moisture content test and the moisture content shown by the moisture sensing equipment.

B. Moisture content determinations for the purposes of calibrating and/or checking the moisture content of aggregates used in the batching operation shall be performed in accordance with one of the following procedures and shown to the nearest 0.5%:

1) AASHTO T 217 “Determination of Moisture in Soils by means of a Calcium Carbide Gas Pressure moisture Tester;”. The shelf life of the calcium carbide is relatively

short. The age of the calcium carbide shall be closely monitored, and replaced in strict accordance with the manufacturer's recommendations.

2) AASHTO T 255 "Total Moisture Content of Aggregate by Drying". The hot-plate method may be used for this purpose, as long as no material is lost and the pan is continuously agitated during the drying process.

C. All aggregates produced or handled by hydraulic methods and washed aggregates shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. If the aggregates contain high or non-uniform moisture contents, storage or stockpile periods in excess of 12 hours may be required.

4.8 Air-Entraining and Chemical Admixtures

A. Admixtures shall be stored in separate containers and in a manner that will avoid contamination, evaporation, and damage. Liquid admixtures shall be protected from freezing and from temperature changes that adversely affects their characteristics. Methods and equipment for adding air-entraining agent or other admixtures to the batch shall be approved by the City Engineer prior their actual use. For admixtures used in the form of suspensions of non-stable solutions, agitating equipment shall be provided to ensure thorough distribution of the ingredients. Volumetric measures for each batch shall be marked in ounces, and shall be constructed so that the quantity of admixture required can be readily determined before being injected into the batch. All liquid admixtures shall be measured into the mixer within $\pm$ 3% of the required amount.

4.9 Mixing

A. Concrete may be mixed at the site of the work, in a central mix plant, or in agitating truck mixers. The uniformity of the concrete mixture shall be in accordance with the criteria presented in AASHTO M 157 Section 10.2. The mixer shall be of a type and capacity approved by the Public Works Inspector except that the central plant mixer shall have a rated capacity of at least 3 cubic yards. Continuous mixed concrete shall be mixed at the placement site. Mixers shall be completely cleaned before the start of the project and at suitable intervals thereafter. The pick up and throw-over blades in the mixing drum shall be repaired or replaced when they are worn down 0.75 in. or more. The Contractor shall Provide permanent marks on blades to show points of 0.75 in. wear from the original new conditions. Drilled holes of 0.25 in. diameter near the end and at the midpoint of each blade are recommended.

4.10 Production Requirements

The production of ready-mixed concrete and the production of site-mixed concrete shall meet the applicable requirements of AASHTO M 157, as well as the following requirements:

A. All production facilities shall be certified to comply with National Ready Mix Concrete Association (NRMCA) criteria for concrete production facilities.

B. Addition of Materials. There shall be no water in the drum before initiating batching of concrete. When initiating batching operations, the batch shall be charged into the drum so that a portion of the mixing water shall enter in advance of the cement and aggregates. Introduction of the unmixed materials (cement, coarse aggregate, fine aggregate, admixtures, and the remainder of the water) shall then be performed by a

uniform and simultaneous flow into the mixer, with all water introduced into the drum by the first fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum. When the concrete is delivered in transit mixers or agitators, additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements. Any water added to the concrete in the field shall be noted by the field inspector. The maximum amount of water shown on the approved mix design sheet shall not be exceeded under any circumstances.

C. Slump Requirements. Concrete that is not within the specified slump limits at the time of placement shall not be used.

D. Mixing Speed. The mixer shall be operated at a drum speed not to exceed the maximum speed shown on the manufacturer's nameplate.

E. Mixer Capacity. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic ft, as shown on the manufacturer's standard rating plate on the mixer. An overload of up to 10% above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place. The volume of concrete mixed or transported shall not be less than 1.0 cubic yard.

F. Mixing Time. For purposes of these specifications, the term "mixing time" shall be defined as the time elapsed from the time the cement comes in contact with the aggregates until the concrete is deposited in place at the site of the work. Concrete mixed less than the minimum specified time shall not be used. When the concrete is hauled in truck mixers or truck agitators, the mixing time shall not exceed 1.5 hours. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 80^{o} F or above for all superstructure concrete, or 85 °F for all other concrete, the mixing time shall not exceed 60 minutes. When the concrete is hauled in non-agitating trucks, the time elapsed from initial mixing to completion of the final finish of the concrete at the project shall not exceed 45 minutes. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 80 ^{o}F or above, the allowable placement time shall not exceed 30 minutes.

4.11 Transporting

A. Mixed concrete from a central mix plant may be transported in non-agitating trucks only when the slump is less than 2 in. Concrete with a slump in excess of 2 in. shall only be transported in properly certified revolving-drum mixer trucks. Concrete produced in a dry-batched concrete plant shall only be transported in revolving-drum mixer trucks.

B. Non-Agitator Trucks - Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection.

C. Truck Mixers and Agitators - All agitator trucks shall be equipped with a plate directly attached to the truck in a readily visible location, designating specific properties regarding that truck, including, but not limited to the designated mixing speed of the drum. The truck mixers or agitators shall have been inspected and found to comply with the National Ready Mix Concrete Association Guidelines within the last 12 months. A copy of the inspection for each unit shall be on file and available for review upon request. When the truck arrives at the project site, the site tube on the water tank will be

immediately checked. If there is any water missing from the tank, the truck will be immediately rejected unless the missing water can be properly accounted for.

D. On-Site Mixing - Upon arrival at the project site, Agitator Trucks shall re-mix the concrete in accordance with the following criteria:

1) If the concrete was mixed in a central mix plant, the concrete shall be mixed at the designated mixing speed for a minimum of two minutes, before discharging any concrete;
2) If the concrete was mixed inside the Agitator Truck, then the concrete shall be mixed at the designated mixing speed for a minimum of five minutes, before discharging any concrete;
3) If any water, water reducing admixtures, entrained air or other ingredient is added to the concrete, the additional material shall be mixed at the designated mixing speed for at least five minutes before discharging any concrete.

E. Weather and Temperature Limitations: Concrete shall have a temperature of at least 50°F and not more than 90°F at time of placement.

1) Hot Weather Concrete: When concrete is placed during high ambient temperatures, low humidity, and/or windy conditions precautions shall be taken to reduce the rate of evaporation and control the temperature of the concrete per ACI 305, latest revision.

2) Cold Weather Concrete: When concrete is placed at or below an atmospheric temperature of 35º F., the water or aggregates, or both, shall be heated, and suitable enclosures and heating devices shall be provided. The mixed concrete shall have a temperature of at least 50º F. and not more than 90º F. at the time of placing. The heating equipment or methods shall be capable of heating the water and aggregates uniformly, and these materials shall not be heated to a temperature exceeding 150º F. Concrete shall not be placed on frozen ground.

3) Protection of Concrete: After any concrete is placed, the CONTRACTOR shall provide suitable measures to maintain a concrete surface temperature of 40º F. or above for a period of not less than 24 hours.

4.12 Concrete Sampling and Testing

A. Slump, unit weight, air content tests and compressive strength test cylinders shall be prepared with concrete obtained from the point at which the concrete is placed by certified personnel. All results for the tests performed in accordance with this unit will be provided to the Contractor and the concrete supplier immediately upon completion of the final compressive strength test. If a super-plasticizer is used, the slump shall be measured before and immediately after the addition of the super-plasticizer. The slump specifications defined on the approved mix design shall not be exceeded before introduction of the super-plasticizer. The slump shall not exceed 8 in. after the super-plasticizer has been added. Super-plasticized concrete shall be checked for segregation before being placed and during the course of the placement. Segregated concrete shall not be placed. Concrete cylinders for compressive strength tests by the Contractor's certified personnel are to be molded and cured in accordance with AASHTO T23 "Making and Curing Concrete Test Specimens in the Field" using 4 in. by 8 in. single use plastic cylinder molds with plastic lids or 6 in. by 12 in. cylinder molds and air content tests cast from slip-form concrete shall be accomplished with a vibrator. The contractor is responsible for providing all vibratory equipment and all equipment required to operate the vibratory equipment. Rodding of slip-form concrete will not be permitted.

Responsibility for transporting the test specimens to a certified testing lab shall belong to the party who originally prepared the test specimens.

B. Concrete Testing - At least one (1) sample shall be taken from each of the first three (3) concrete loads delivered to the project site. Each of these loads shall be tested for slump, air content, and unit weight. Additionally, a set of compressive strength test cylinders will be cast from one of these three loads, determined on a random basis. Beginning with the 4^{th} load of concrete delivered to the project, one randomly selected load from each sub-lot of 6 trucks. All tests and cylinders shall be tested and handled in accordance with proper procedures.

C. Concrete Strength - Concrete compressive strength shall be determined from the average of two or more concrete cylinders made from the same sample of concrete and tested at the specified age. The cylinders will be made, handled, and stored in accordance with AASHTO T23 "Making and Curing Concrete Test Specimens in the Field" and tested in accordance with AASHTO T22 "Compressive Strength of Cylindrical Concrete Specimens".

D. Individual Strength Test. Unless otherwise specified, an "individual strength test" will be determined by testing two or more cylinders at 28 days (or at 14 days for slip-formed concrete). At least four (4) cylinders shall be made for each set. The first cylinder shall be tested at seven days for use as an indicator of the early concrete compressive strength. The second and third cylinders shall be tested to determine the "Individual Strength Test" result. The fourth cylinder shall remain available for testing if the Within-Test-Coefficient-of-Variation (WTCV) exceeds 5%, as determined by ACI 214.3.4.1. If the fourth cylinder is tested, the "Individual Strength Test" result will be the average of all of the cylinders tested at that age, unless one or more of the following conditions exist:

1) There is a visible defect in the cylinder or the capping, and/or orientation of the cylinder with respect to its perpendicularity or the parallelism of the ends.

2) A significant irregularity occurred while loading the test specimen to failure, such as a sudden load burst, cyclic or pulsating loads, or a loading rate not in accordance with AASHTO T22.

E. In-Place Concrete Strength Measurements - The Contractor may request to measure the in-place strength of the concrete for construction-related purposes. The equipment to perform the requested test shall be furnished by the Contractor. Field-cured cylinders will be tested by the City’s representative. The method of measuring the in-place strength of the concrete shall be one of the following procedures:

1) Core Testing. This method shall be performed in accordance with AASHTO T24, and as further defined in Subsection 510.514, Investigation of Low Strength Cylinder Test Results.

2) The Maturity Method. This method integrates the heat of hydration and the time since the concrete was batched. It shall be correlated for the specific concrete mix before being used in the field.

3) The Windsor Probe. This method measures the depth of penetration of a specially fabricated probe into the concrete. This method must be calibrated for the specific concrete mix before being used in the field.

4) The Pull-Out Test. This method measures the pull-out resistance of a specially fabricated plug cast into the concrete in question. This method must be calibrated to the specific concrete mix before being used in the field.

5) The Match-Cure Method. This method places additional cylinders into a specially controlled chamber which maintains the temperature to that of the concrete being represented.

6) The Cast-in-Place Cylinder Method. This method tests a cylinder, which is actually cast into the concrete being evaluated. The hole remaining after the cast-in-place-cylinder is removed must be filled with a non-shrink grout or a Type K cement.

7) Field Cured Cylinders. All field cured cylinders shall be cast in accordance with AASHTO T 23, and cured in strict accordance with AASHTO T 23, Section 9.4.1.

F. The method of measuring in-place strength chosen, with the exception of Method G (Field Cured Cylinders), must be submitted the City Engineer for approval, with complete supporting documentation before it can be used in the field.

G. Field cured cylinders will not be considered appropriate measurements of in-place strength for any superstructure considerations. In-place strength measurements for construction related purposes or for acceptance of concrete including, but not limited to removal of forms, post-tensioning, shoring, or vertical supports shall be performed by one of the methods outlined in A through F, above. Core testing, pull-out test or cast-in place cylinder methods will not be allowed on bridge decks.

H. Unless less stringent requirements are specified in the contract, forms may be stripped or traffic permitted on the structure or pavement when the correlated in-place compressive strength is at least equal to the strength required for the intended application.

I. Acceptance of Concrete Based on Cylinders - The concrete will be accepted with respect to compressive strength indicated by cylinder tests, when both of the following requirements are met:

1) The running average of three (3) consecutive individual strength tests meets or exceeds the specified strength.

2) No individual strength test falls below the specified strength by more than 500 psi; and,

When the cylinder based acceptance requirements are not met, the City Engineer will review the strength tests and notify the Contractor in writing whether the concrete will be accepted, or shall be removed and replaced by the Contractor. Only that area of concrete represented by the individual strength test failing to meet any one of the cylinder based acceptance requirements, shall be subject to investigation or removal. When the cylinder-based acceptance requirements are not met, steps shall be taken by the Contractor to resolve the problem. The proposed resolution will be submitted in writing to the City Engineer. The mere addition of extra cement will normally not be considered a sufficient resolution.

J. Investigation of Low Strength Cylinder Test Results - The Contractor may use one of the in-place strength test methods outlined in Paragraph 4.12, E, In-Place Concrete Strength Measurements if the normal acceptance tests do not comply with Paragraph 4.12, I, Acceptance of Concrete Based on Cylinders, above. Core tests may not be used for any investigation involving bridge decks.

1) If cores are used to determine the in-place compressive strength, all cores shall be obtained by the Contractor in accordance with AASHTO T24 "Obtaining and Testing

Drilled Cores and Sawed Beams of Concrete". The cores will be tested in accordance with AASHTO T22 "Compressive Strength of Cylindrical Concrete Specimens";

a. If the concrete in the structure will be dry under normal service conditions, the cores will be air dried at a temperature range of 60 to 80 °F, and at a relative humidity of less than 60% for seven days before testing. The cores will be tested dry.

b. If the concrete in the structure will be more than superficially wet under service conditions, the cores will be cured in lime-saturated water for at least 40 hours before testing. The cores will then be tested wet.

2) Procedure for Coring of Non-Bridge Structures. If the Contractor elects to core, the Contractor must core within 42 calendar days of the initial concrete placement. A core-set consisting of at least three cores shall be taken for each individual strength test falling below the specified strength, and a minimum of one core-set will be obtained for each lot of 2500 yd^2 for PCCP or for each lot of 500 yd^3 for any other structures. The Engineer will determine the locations to be cored.

3) As an alternative to Paragraphs 2 above, or to investigate any bridge decks, the Contractor may request in writing to the City Engineer that he be allowed to use one of the in-place strength test methods described in Paragraph 4.12, E, In-Place Concrete Strength Measurements, to determine the actual in-place strength of the concrete. Approval in writing from the City Engineer must be received before the requested test method can be used in the field.

4) Acceptance of Concrete Based on Measurement of In-Place Strength. The concrete will be accepted with respect to the compressive strength indicated by core tests, when the average of all core sets is at least 85% of the specified strength, and if the average of any core set is no less than 75% percent of the specified strength. If alternate in-place strength test methods are used, the concrete will be accepted with respect to the compressive strength determined when the average of all tests is equal to or greater than the specified strength, and no individual strength is less 500 psi less than the specified strength.

END OF ARTICLE 03-033.1

Article 03-033.2 Concrete Work

1.0 SCOPE

This work consists of new or replaced concrete curbs, gutters, walks, driveway aprons, curb returns, fillets, slope paving, and valley gutters placed on a prepared surface in accordance with these specifications and in conformance with the lines, grades, thickness and typical cross-sections shown in the detail drawings of this document and/or as shown on the plans.

2.0 GENERAL

A. Portland cement concrete curbs, walks, gutters, valley gutters, and driveway aprons constructed of concrete having a minimum 28 day compressive strength of 3000 psi, unless otherwise noted on the plans.

B. Subgrade preparation for concrete curbs, gutters, walks, driveways, alleys, intersections, and slope paving shall conform to the requirements of Article 02-022.1 Earthwork.

C. Unless otherwise specified or indicated on the plans, the minimum thickness of walks shall be 4 inches. The minimum thickness of gutters, driveway aprons, and alley intersections shall be 6 inches unless otherwise shown on the plans. The height and thickness of the curb section including other details of construction for items in this section will be shown on the project plans or the Detail Drawings of this document.

3.0 FORMS

A. 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. Timber forms may be used for forming curved section but shall not be used for straight work unless authorized in writing by the Engineer. Metal forms for such work being of a gauge that will provide proper rigidity and strength for the purpose for which they are intended. Wood forms used on curb returns shall be not less than 3/4 of an inch 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 forms shall be cut to conform exactly with the curb face batter, as well as being cut to the required length and radius. In every case, however, the forms shall be of sufficient rigidity and strength and shall be so supported as to adequately resist springing or deflection as a consequence of the placing and tamping of the concrete.

B. All curb and combined curb and gutter shall be divided into blocks or stones in lengths of 5 feet or 10 feet long using metal templates not less than 1/16 inch nor more than 1/4 inch thick cut to the same cross section as the curb or curb and gutter being constructed. Templates shall be securely attached to forms to prevent movement during concrete placement.

C. Form material shall be thoroughly clean at the time it is used and shall be given a coating of light oil or other suitable material immediately prior to the placing of the concrete.

D. Forms, except curb block planks, shall be set with the upper edges thereof flush with the specified grade of the finished surface of the adjacent portion of the work and shall be not less than a depth equivalent to the full specified depth of thickness of the concrete to be supported thereby.

E. Back forms shall be held securely in place by means of stakes driven in pairs, one at the front form and one at the back, at intervals not to exceed 4 feet; clamps, spreaders, and braces being used in connection therewith to such extent as may be necessary to insure proper rigidity of the forms. Forms for walks, gutters, and similar work shall be firmly secured by means of stakes driven flush with the upper edge of the forms at intervals not to exceed 5 feet. The stakes shall be of sufficient size and shall be so driven as to properly and adequately support the forms.

F. Form clamps, specifically designed and manufactured for the curb and gutter to be constructed, may be used if, in to opinion of the Engineer, they fulfill the requirement herein above specified for curb and gutter forms.

4.0 PLACING CONCRETE

A. The concrete shall be placed on a thoroughly dampened subgrade sufficiently moist to insure that no moisture will be absorbed from the fresh concrete.

B. Surfaces of structures in sidewalks, curbs, and gutters shall be adjusted as necessary prior to placing of concrete to meet the contiguous sidewalk surfaces.

C. Concrete shall be placed in horizontal layers not to exceed 6 inches each in thickness, each layer being spaded along the forms and thoroughly tamped. However, if the section is more than 6 inches in depth, the concrete may be placed to provide the thickness shown or specified, if mechanical internal vibrators are used.

D. After the concrete for walk has been placed between the side forms, a strike-off shall be used to bring the surface to the proper section to be compacted. It shall then be spaded along the form faces and tamped with appropriate tampers not less than 2 times, in order to assure a dense and compact mass, forcing the larger aggregate into the body thereof and bringing to the surface sufficient free mortar for finishing.

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

5.0 EXPANSION JOINTS

A. Expansion joints shall be constructed in curbs, walks, and gutters as hereinafter specified, being filled with premolded joint filler strips. No such joints shall, however, be constructed in cross gutters, alley intersection, or driveway aprons.

B. Unless otherwise shown on the plans, 1/2 inch joints shall be constructed in curbs and gutters at the end of all returns except where cross gutters are being constructed. They shall be at the ends of the cross gutter transitions and also along the line of the work at regular intervals not to exceed 50 feet, joints in gutter being continuous with those in adjacent curb. No joints shall be constructed in returns. Where continuous curb and gutter is constructed adjacent to cement concrete pavement, weakened plane joints shall be installed continuous with alternate joints installed in the adjacent pavement, in which case expansion joints for sidewalks shall be placed at intervals not to exceed 25 feet with joint filler strips.

C. Expansion joint filler strips shall be placed in walks at the PT and PC of all walk returns,

between walk and a building or structure, in walk returns between the walk and the back of the curb returns, and around all utility poles encountered along the line of the work. Joint filler strips shall extend the full depth of the concrete being placed. Joint filler strips between walk and curb shall be the full depth of the walk with the top of the filler strip set flush with the top of the concrete. Expansion joint filler strips including those around utility poles shall not be less than 1/2 inch in thickness.

D. Expansion joint filler strips shall be vertical and shall extend to the full depth and width of the work in which they are installed, being constructed at right angles or radially to the line of the curb or gutter as the case may be. The filler strips shall completely fill these joints at least to within 1/4 of an inch of any surface of the concrete that will be exposed upon completion of the work and must fully extend at least to those surfaces that will not be exposed. However, before the work will be accepted, any joint filler that protrudes beyond a surface that will not be exposed or beyond 1/4 of an inch below a surface that is exposed 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.

6.0 FINISHING

Surfaces of the various items of work shall be finished as specified. Edges of concrete at expansion joints shall be rounded to 1/4 inch radius. Upon completion, the finished surface shall be true to line and grade and free from irregularities.

A. Curb

1) The front forms may be stripped as soon as the concrete has set sufficiently but must be removed before the expiration of 6 hours after pouring. Immediately following the stripping of these forms, mortar, as thinned to the consistency of grout, shall be applied to the curb face. If monolithic curb and gutter is being constructed, this mortar shall be applied to the full-exposed face; otherwise, it shall extend for an additional 2 inches below the gutter.

2) The face and top of the curb shall then be carefully troweled to a smooth and even finish, the top being finished to a transverse slope of 1/4 of an inch toward the front, with both edges rounded to a radius of 3/4 of an inch. The troweled surface shall be finished with a fine hair broom parallel with the line of the work.

B. Walk

1) Following the placing of concrete, the surface shall be worked to a true and even grade, free from waves and irregularities. After the preliminary troweling, the initial scoring for the block marking shall be made to a depth of 1 inch in order to insure the scoring depth required. The work shall then be carefully troweled to a smooth and even finish, with the edges rounded to a radius of 1/2 inch, the scoring markings made to the required depth following which it shall be given a fine hair broom finish, applied transversely and remarked when required to insure a new uniform joint. Troweling may be done with a long handled trowel or "Fresno."

2) Contraction joints or block joints shall not exceed intervals of 5 feet. Joints shall be made at regular intervals along the line of the work. On straight work, the joints shall be parallel with and at right angles to the line of the work; at curves the joints shall, in general, be

long lines concentric with and radial to the proportion of the work in which they are placed. The markings shall be made with jointed tools that will round the edges of the scoring lines to a radius of 1/8 of an inch, with a depth of not less than 1 1/4 inch. The finished joint opening, excluding of radii, shall not be wider than 1/8 inch. The Contractor will be required to have a sufficient number of jointed tools on the job to accomplish the above specified requirements.

3) The side forms shall remain in place after completion of the walk until the concrete is sufficiently set but must be removed before the work will be accepted.

C. Gutter

1) After the concrete has been thoroughly tamped in such manner and to such extent as to force the larger aggregates into the body thereof and bringing to the top sufficient free mortar for finishing, the surface shall be worked to a true and even grade by means of a float, troweled with a long handled trowel or "Fresno" and then longitudinally broom finished, following which the flow line of the gutter shall be troweled smooth for a width of approximately 3 inches and the outer edge rounded to a radius of 1/2 inch.

2) Side forms shall remain in place until the concrete is sufficiently set, after completion of the gutter, but must be removed before the work will be accepted.

3) Valley gutter or cross gutter section shall have wire reinforcing mesh 6" x 6" No. 6 gauge and shall be used in both the slab of the gutter and in the slab of the fillets. Construction joints and 1/2 inch premolded expansion joints and other details of construction shall be as indicated on the plans and / or detail drawings of this document. The finished surface shall conform to the required roadway section as to both line and grade. The gutter sections will not be opened to traffic until specimen beams have attained a flexural strength of not less than 500 pounds per square inch (ASHTO T 97). When such tests are not conducted, the gutter shall not be opened to traffic until determined by the City Engineer.

D. Slope Paving

1) All subgrade preparation required for this item shall be done in accordance with applicable provisions of Article 02-022.1, Earthwork, with the exception that minimum density requirements will be 90% of maximum density as determined by ASTM D 1557 in all cases, instead of 95% of maximum in the top 6 inches or 12 inches of compacted fill.

2) Reinforcement shall be included as shown on the plans.

3) Thickness of concrete shall be as specified on the drawings. Concrete shall be screeded and finished with wood float or equivalent to a plane surface having no variation when measured with a 10 foot straightedge in excess of 1/4 inch, unless a curvilinear surface is designated for a particular job. All concrete shall be in accordance with Article 03-033.1 Portland Cement Concrete.

7.0 CURING

A. After the completion of the finishing operations, all curbing shall be sprayed with concrete curing compound. the surface of the concrete shall be kept thoroughly damp between the completion of the finishing operations and the application of the curing compound.

B. 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. The preparation so used shall be Type 2 as specified in ASTM C 309.

8.0 DRIVEWAY PAD AT ENTRANCES

A. Driveway entrances shall be provided in new curbs at all existing driveways along the line of the work and at locations shown on the plans or as directed by the Engineer.

B. The location and construction details for driveways shall conform the contract plans and specifications and the Detail Drawings of this document.

C. Where walk is to be constructed across driveway, the thickness of the walk shall be not less than 6 inches, unless otherwise specified or shown on the plans.

9.0 MISCELLANEOUS TYPES OF CURB, GUTTERS, SIDEWALKS

Extruded type concrete curb and gutter, precast curb and gutter sections, cut stone curbs, brick sidewalks, flagstone sidewalks, etc. will be permitted where approved by the City Engineer and in accordance with the plans and specifications.

10.0 REPAIRS AND REPLACEMENT

New work that is found to be defective or damaged prior to the acceptance or existing work damaged by the Contractor's operation shall be repaired or replaced by the Contractor. Sidewalk that is to be replaced shall be neatly saw-cut to the next control joint on either side of the defective or damaged portion. The minimum size slab that is removed and replaced shall be 5 feet long and for the full width of the walk. Curb and gutter shall be saw-cut on a neat line at right angles to the face of the curb to the next control joint of curb and/or gutter on either side of defective or damaged portion.

11.0 TESTS

The number of compression test cylinders to be taken shall be 3 cylinders for the first ten yards poured, and 3 cylinders for every 100 cubic yards poured thereafter.

12.0 BACKFILLING AND CLEANUP

A. Backfilling to the finished surface of the newly constructed improvement must be completed before acceptance of the work.

B. Upon completion of the work, all earth or burlap covering shall be removed, the surface of the concrete thoroughly cleaned, and the site left in a neat and orderly condition, including disposal of excess materials and earth.

END OF ARTICLE 03-033.2

DETAIL DRAWINGS

TABLE of CONTENTS