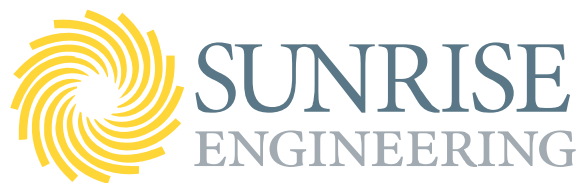


# Garden City

## PUBLIC WORKS STANDARD SPECIFICATIONS & DRAWINGS

2011



Prepared by Sunrise Engineering, Inc.

# Town of GARDEN CITY

## PUBLIC WORKS STANDARDS and TECHNICAL SPECIFICATIONS

MAYOR

*John Spuhler*

TOWN COUNCIL

*BRIAN HOUSE  
MIKE LEONHARDT*

*DAN KUREK  
BESS HUEFNER*

**PUBLIC WORKS**  
*TRAVIS HOBBS  
RILEY ARGYLE*

**TOWN CLERK**  
*KATHY HISLOP*

## **Important Information from Garden City's Public Works Department**

1. All new subdivision infrastructure must be built according to the standards outlined in this manual. Fines will be imposed on developers for any work done not in accordance with this manual.
2. All contractors and utility companies shall bore 4" and smaller lines under paved roads, sidewalks and bike paths. No exceptions unless authorized by the Public Works Director.
3. Digging up any pavement on roads, sidewalks or bike paths within the Town easements or right's-of-way must be approved by the public works director.
4. All water taps including mainline connections must be hot-tapped to avoid water service interruption.
5. All excavation construction within Town easements or right's-of-way shall be limited to the hours of 7:00 A.M to 5:00 P.M., Monday through Thursday, and Friday 7:00 A.M. to 12:00 P.M., April 15<sup>th</sup> through November 30<sup>th</sup>.
6. A type II slurry seal must be applied to all new subdivision roads, by the developer of the subdivision, 1 year after the roads are completed. Developer may choose to provide funds in the amount of 115% of current slurry seal prices, and the Town will contract to have the slurry seal applied to the roads.
7. All PUD/PRUD's must provide a bulk meter instead of individual meters. All waterlines within the PUD must meet Town standards and, at least, provide a curb valve on each water service.

# **PUBLIC WORKS STANDARDS and TECHNICAL SPECIFICATIONS**

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**PART 1**

**GENERAL  
REQUIREMENTS**

**100.1 DESCRIPTION**

This section defines the general requirements for improvements to be built by a subdivider, or contractor working within the public way.

**100.2 SCOPE**

The required improvements shall include all street improvements in front of all lots along all dedicated streets to a connection with existing improvements of the same kind or to the boundary or the subdivision nearest existing improvements. Design must provide for future extension to adjacent development and to be compatible with the contour of the ground for proper drainage. All water lines, sewer lines, and any other buried conduit shall be installed to the boundary lines of the subdivision.

**100.3 CONSTRUCTION DRAWINGS**

Complete and detailed construction plans and drawings of improvements shall be submitted to the City for the review by the City Engineer/City Representative prior to receiving final plat approval and prior to commencing construction. No construction shall be started until plans have been checked and approved by the City Engineer/City Representative. All costs associated with the plan review performed by the City Engineer/City Representative will be paid for by the developer.

**100.4 CONSTRUCTION & INSPECTION**

All construction work involving the installation of improvements in the subdivision or project shall be subject to inspection by the City. It shall be the responsibility of the person responsible for construction to ensure that inspections take place where and when required. Certain types of construction shall have continuous inspection, while others may have only periodic inspections. Inspectors provided by the City shall be paid for by the Developer.

A. Continuous inspection may be required on (but not limited to) the following types of work:

- (1) Laying of street surfacing.
- (2) Placing of concrete for curb and gutter, sidewalks, and other structures.
- (3) Laying of sewer pipe, irrigation pipe, drainage pipe, water mains, water service laterals and testing.

B. Periodic inspections shall be required on (but no limited to) the following types of work:

- (1) Street grading and gravel base.
  - (2) Excavations for curb and gutter and sidewalks.
  - (3) Excavations for structures.
  - (4) Trenches for laying pipe.
  - (5) Forms for curb and gutter, sidewalks and structures.
- C. The Developer's Engineer shall provide weekly written progress and inspection reports to the City's Public Works Department.
- D. All Excavation construction work within the City Limits/Rights of way/Utility Easements shall be limited to between the hours of 7:00 AM to 5:00 PM., Monday through Thursday, and Friday 7:00 A.M. to 12:00 P.M.
- E. All jobsites shall be kept clean including dumpsters and porta johns

#### **100.4.1 EXCAVATION CONSTRUCTION**

Excavation construction within City Limits/Rights of way/Utility Easements will not be allowed from November 1<sup>st</sup> to April 30th unless written permission is obtained from the Public Works Director.

#### **100.4.2 REQUESTS FOR INSPECTIONS**

Requests for inspections shall be made to the Public Works Department by the person responsible for the construction. Requests for inspection on work requiring continuous inspection shall be made three (3) working days prior to the commencing of the work. Notice shall also be given one (1) day in advance of the starting of work requiring periodic inspection, unless specific approval is given otherwise by the City Engineer/City Representative, or his duly authorized representatives.

On construction requiring continuous inspection, no work shall be done except in the presence or by permission of the City Engineer/City Representative.

#### **100.4.3 CONSTRUCTION COMPLETION INSPECTIONS**

An inspection shall be made by the City Engineer/City Representative or authorized representative after all construction work is completed. Any faulty or defective work shall be corrected by the persons responsible for the work within a period of thirty (30) days of the date of the City Engineer/City Representative's or authorized representative's Inspection Report defining the faulty or defective work.

#### **100.5 CONSTRUCTION TESTING**

All in-place density testing shall be performed by a materials testing laboratory that is certified by the State of Utah, and paid for by the Developer, Contractor or Project Manager. The cost of obtaining



necessary soil “proctors,” asphalt extractions, gradations, “Marshall” Asphalt densities, and concrete test cylinders shall be provided by and paid for directly by the Developer, Contractor or Project Manager.

#### **100.6 APPROVAL BY CITY ENGINEER/CITY REPRESENTATIVE**

All references within these specifications to the “Engineer/City Representative” shall be construed to refer to “The City Engineer/City Representative or his duly authorized representative.”

#### **100.7 DRAWINGS**

All references within these specifications to “Drawings” shall mean the City approved construction drawings or the Garden City Public Works Standards and Technical Specifications as is applicable.

#### **100.8 AMENDMENT PROCESS**

Whenever, in the opinion of the City Public Works Department, the City Engineer/City Representative, or the Superintendent having jurisdiction, a literal enforcement of these regulations may work an undue hardship or a literal enforcement of the provisions may be unnecessary to meet the goals and standards of the City, the City may modify those standards in the following manner:

Modifications may be granted when there are practical difficulties involving carrying out the provisions of the Public Works Standards and Technical Specifications and a panel consisting of the City Engineer/City Representative, and the Public Works Director or his Representative will meet to determine that granting of a modification for an individual case will meet the goals and requirements of the City without unduly jeopardizing the public and the individual’s interest. The City shall first receive a written request for a modification to the standards from any interested party. Upon receipt of the request the panel of three discussed above shall find that a special individual reason makes the strict letter of the standard impractical, and shall find the modification is in conformance with the intent and purpose of the standards and shall find that such modification does not in any way lessen the integrity of the standards. When such findings of fact are made, the panel may grant such modification as it deems appropriate. The details of any action granted as modification by this panel shall be recorded and entered in the files of the City, with the specific reason for the granting of said modification.

#### **100.9 CONTRACT RECORD DRAWING REQUIREMENTS**

Contract Record Drawings are required for formal and informal site plans and all systems that are dedicated to Garden City. Contract Record drawings shall be prepared by a surveyor or an engineer registered in the State of Utah and shall contain the following minimum information:

##### **100.9.1 MINIMUM REQUIRED DATA**

## A. WATER DISTRIBUTION SYSTEMS

1. At least two (2) ties to all valves, service lines, fittings, and fire hydrants from permanent points (manholes, property lines, property corners, curbs or pavement). An acceptable station and offset system may be used.
2. Location of mains from property or easement lines and alignment distance from centerline of road at 300+/-ft. intervals.
3. Separation distance between culinary water lines and waste/storm water lines if they exist within 10 feet of water mains.
4. Water main material, lengths, and distance of mains from building or structures within 10 feet of the water main.
5. Distance from hydrant to hydrant valve.
6. Pertinent easement information including width of easement, legal description, and distance from water main to sides of easement.

## B. STORM DRAINAGE SYSTEMS

1. Storm inlets are to be designated by stationing from a known, and easily located, starting point. Right and left offsets will be used.
2. Pertinent easement information including width of easement, legal description, and distance from storm drain pipe to side of easement.
3. Pipe size, length, and materials shall be shown.
4. Storm inlet tops and flow lines are to be designated to the nearest 0.01 feet and referenced to a known bench mark.

## C. ROADWAYS

1. Roadway centerline elevations shall be shown at intervals of 100 feet, except at high and low points which shall be designated whether at the designated interval or not.
2. Roadway elevations are to be designated to the nearest 0.01 feet and referenced to a known benchmark.
3. Street names should be shown on as-builts drawings.

## D. IRRIGATION SYSTEMS

## E. LIGHTS

1. Lighting Layout
2. Wiring Layout and Meter Location

## F. PARKS

1. Irrigation Layout which includes valve locations, blow-off locations, winterizing equipment and locations, and backflow prevention devices.

### 100.9.2 CONTROLS

#### A. MINIMUM HORIZONTAL CONTROLS

1. Within easements: Bearing and distance of utility as referenced to property corners. Bearing to be based on plat data when within a platted subdivision.
2. Within road right-of-way: Stationing with offsets right and offsets left. Stationing to begin at a prominent, easily described and easily identified point. Stationing to be based on plat data when within a platted subdivision.

B. VERTICAL CONTROL: A bench mark referenced to NAD datum of 1983.

### 100.9.3 CERTIFICATION

A. CERTIFICATION SHALL BE PLACED ON THE AS-BUILT DRAWING AND SHALL INCLUDE:

1. Basis of horizontal and vertical control.
2. Statement that drawings were checked in the field and are a true representation of improvements.

### 100.9.4 CONTRACT RECORD DRAWING FORMAT

A. Minimum Contract Record Drawing data letter height size shall not be less than 1/10-inch for 24" X 36" drawings and 1/20-inch for 11" X 17" drawings.

B. The statement "AS-BUILT DRAWING" shall be placed on the drawing.

C. As-Built drawings shall be drawn to scale on sheets not larger than 24" X 36", preferably on 11" X 17" sheets. Rights-of-way, easements, and lot lines shall be accurately shown. Lot and block numbers and street names shall be included.

D. One AutoCAD 2000 digital copy on CD/DVD and three (3) signed, dated, and sealed prints are required. The Engineer/Surveyor's name and registration number shall be either typed or printed, in legible form, below the seal. After the surveyor/engineer has certified the locations, the Engineer of Record shall certify that the system depicted on the As-Built plan was constructed in substantial conformance with approved plans and will function as intended.

E. All submitted Contract Record Drawings shall be inspected for compliance to the above-mentioned standards. Drawings found to be lacking in one or more items shall be returned to the owner with an

explanation of the reasons for rejection.

**100.10 POWER**

Any items that require power from the power company such as street lights, pump stations, etc. shall be transferred to the City's name after final acceptance of the improvements has been given.

**100.11 SNOW REMOVAL**

Snow removal responsibilities shall be provided by the developer until such a time that 25 percent build out has occurred.

**101.1 DESCRIPTION**

This section defines the general requirements for drainage, and grading plans including the Storm Water Pollution Prevention Plan (SWPPP).

**101.2 DRAINAGE AND GRADING PLAN**

- A. Plan drawn to scale not smaller than 100 feet to the inch, showing the road(s) and lot layout or site plan.
- B. Topography at 1 foot minimum contour intervals.
- C. Show any existing wetlands.
- D. Areas of grading and earth moving with erosion control plan.
- E. Location of existing watercourses, canals, ditches, springs and culverts.
- F. Location of any 100 year flood plain as designated by the Federal Emergency Management Agency (FEMA).
- G. The developer shall investigate the existing and proposed use of any irrigation ditch or canal within the project limits to determine if they are to be perpetuated. If the irrigation system is to be continued, the developer is responsible to contact the water right holders or canal company to obtain their requirements for protection of the irrigation system.
- H. The discharge of storm water into irrigation ditches shall not be allowed without special approval from the City. If an irrigation ditch is to be used as a storm water receptor, secure an agreement from the irrigation Ditch Company that the company will accept responsibility for receiving the water.
- I. A storm drainage plan showing water flow directions, inlets, outlets, catch basins, waterways, culverts, detention basins, orifice plates, outlets to off-site facilities and off-site drainage facilities planned to accommodate the project drainage. Drainage plans are to facilitate peak flow for the 25-year, 24-hour storm event. All detention and retention basins are to facilitate the 100-year, 24-hour storm event. Adequate spillway provisions must be provided to pass the storm water in excess of the 100-year, 24-hour storm event.
- J. Public water shall not be discharged onto or through private property without the appropriate easement. An easement with the right of access conveyed to the Garden City shall be provided whenever conveyance systems are constructed in lands of private ownership. A minimum easement width of twenty feet centered on the drain is required. The width may be in excess of the minimum when situations require.
- K. In the event that proposed construction shall direct surface or storm water runoff to properties or facilities owned and maintained by agents other than the Garden City, written proof of permission, or approval from these agents must be provided prior to acceptance of drainage concepts, and subsequent issuance of City drainage approval.
- L. It is City policy and the developer's responsibility wherever attainable to restore, protect and maintain the chemical, physical, and biological integrity of City and State waters and to restore their beneficial uses. To

do so, drainage design shall address the treatment of surface and storm water runoff, both wet-weather and dry-weather discharges.

- M. Prior to the beginning of construction on any development site larger than one acre, the developer or his representative must have a SWPPP in place and must file a Notice of Intent (NOI) with the EPA, in accordance with UPDES (Utah Pollutant Discharge Elimination System) requirements. The SWPPP will include provisions for reducing sediment discharges from the construction site and tracking of mud and dirt onto roadways. A copy of this plan and the NOI shall be provided to the City prior to any site grading or construction activities.

## **PRECONSTRUCTION MEETING**

Prior to commencement of construction activities a pre-construction meeting will be held at the City Office. Those in attendance shall be the Developer, Contractor, Developer's Engineer, Public Works and City Engineer.

The Developer shall provide four (4) copies of the approved plans which will be stamped approved and initialed by all parties, a copy of the Notice of Intent (NOI) from the Environmental Protection Agency, and a Storm Water Pollution Prevention Plan (SWPPP). A set will remain with the City, City's Engineer, Developer's Engineer and Contractor. The Contractor is required to keep this set of drawings, NOI, and SWPPP on-site at all times.

Items to be discussed at the preconstruction meeting are the following:

1. Construction Requirements and Procedures
2. Construction Approval Checklists
3. Testing
4. Warranty
5. "As-Built" Requirements

# PART 2

# TECHNICAL SPECIFICATIONS



**200.1 DESCRIPTION**

This section covers measures and instructions for prevention of damage to existing structures and utilities, whether above ground or underground.

**200.2 PROTECTION OF EXISTING UTILITIES**

**200.2.1 INTEGRITY OF UTILITIES**

The Contractor shall be responsible for safeguarding and maintaining the integrity of all conflicting utilities. This responsibility includes securing the assistance of available utility location services in the area in which the Work is being performed. The Engineer/City Representative has attempted to show the location of all utilities anticipated to conflict with the Work. However, when a conflicting utility line is discovered that was not shown on the plans, the Contractor shall contact the utility's owner and notify the Engineer/City Representative immediately for resolution of the conflict. When realignment or relocation of the Work, or relocation of the conflicting utility is deemed necessary, the Engineer/City Representative shall give direction in writing for the Contractor to proceed. Work resulting from such direction may be treated as a changed condition, and appropriate authorization and payment will be made in accordance with the General Conditions.

**200.2.2 LOCATING UTILITIES/BLUE STAKES**

It shall be the responsibility of the Contractor to locate and expose or identify all existing utilities, both underground and overhead, for the purpose of preventing damage to them. The Contractor shall notify all concerned utility offices at least 48 hours, Monday – Friday except Holidays, in advance of construction operations in which a utility agency's facilities may be involved. This shall include, but not be limited to, irrigation water, culinary water, telephone, gas, and electric.

**200.2.3 CHANGES TO UTILITIES**

The Contractor shall be responsible for any and all changes to, or re-connections to, public utility facilities encountered or interrupted during execution of the Work, and all costs related thereto shall be borne by the Contractor. The Contractor shall negotiate with, and pay, the respective utility agency for work it must do in connection with moving, repairing, or restoring its utility(s). The Contractor shall further make all necessary notifications, scheduling, coordination, and management of details related to any such interference. The potential or projected cost of any public utility interference shall be included in the Contractor's price covering the major Contract Item to which the interference or changes are attributable.

## 200.2.4 MAINTENANCE OF SERVICE

200.2.4.1 CONTINUOUS SERVICE - Unless otherwise required in the Contract Documents, all utilities, both underground and overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

200.2.4.2 ACCIDENTAL INTERRUPTION OF SERVICE - In the event of interruption of other utility services as a result of accidental breakage, the Contractor shall promptly notify the appropriate responsible authority. The Contractor shall then cooperate with that authority in restoration of service as soon as possible, and shall bear all cost of repair. In no case shall interruption of any water or other utility service be allowed outside working hours unless the Engineer/City Representative has issued prior authorization. When changeover of service connections to new utility lines becomes necessary, interruptions of individual services for periods of up to 8 hours will be allowed providing 24 hour advance notice has been given to affected users by contractors.

200.2.4.3 TEMPORARY INTERRUPTION AND RELOCATION - If the Contractor desires to temporarily or permanently relocate or shut down any utility or appurtenance, the Contractor shall make the necessary arrangements and agreements with the owner or operator of the respective utility and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. Shutdown and relocation and/or reconstruction shall be subject to inspection and approval by the Engineer/City Representative and the owner of the utility.

## 200.3 PROTECTION OF PROPERTY AND EXISTING STRUCTURES

200.3.1 REMOVAL OR RELOCATION OF PROPERTY - All property removed or relocated by the Work shall be reconstructed in its original or new location as soon as possible. Restoration of existing property or facilities shall be to a condition as good or better than its original condition.

200.3.2 DAMAGE TO PROPERTY - All property damaged by the Contractor, whether inside or outside the limits of easements provided by the Owner, shall be the responsibility of the Contractor. All such damages shall be repaired with like material and restored to its original condition, or better. Such repair or restoration shall be accomplished at the Contractor's expense without additional compensation from the Owner.

## 200.4 PROTECTION OF PAVED SURFACES

To avoid unnecessary damage to paved surfaces, tracked equipment shall use rubber cleats or paving pads when operating on or crossing all existing paved surfaces unless authorized otherwise in writing by the Engineer/City Representative.

2004.1            **BORING UNDER PAVED ROADS**  
Digging any paved roads, right-of-ways, sidewalks, or bike paths is prohibited. All work must be bored and with the approval and direction of the Public Works Director.

**200.5            RIGHTS-OF-WAY AND EASEMENTS**

200.5.1           **MINIMAL DISTURBANCE OF RIGHTS-OF-WAY** - When construction easements have been obtained by the Owner, the Contractor shall take appropriate measures to minimize disturbances to surface improvements within the easements. The Contractor shall obtain a signed release from each property owner, approving restoration work in the construction easements across its respective property/s.

200.5.2           **CONSTRUCTION AREAS** - The Contractor shall confine construction operations to the area within the dedicated rights-of-way for public thoroughfares, or within areas for which construction easements have been obtained, unless the Contractor has made separate special agreements with the affected property owners in advance.

200.5.3           **PROPERTY OWNER NOTIFICATION** - The Contractor shall give at least 48 hours advance notification of commencement of construction to property owners having land on which construction will take place. During all construction operations, the Contractor shall construct and maintain such facilities as may be required to provide access by all property owners to their property. No one shall be cut off from access to their property for a period exceeding eight (8) hours unless the Contractor has made special arrangements with the affected persons. The Contractor shall grade all disturbed surfaces required for motor vehicle traffic at least daily unless directed otherwise or in writing by the Engineer/City Representative.

**201.1 DESCRIPTION**

This Section includes requirements that shall be followed by the Contractor, to protect the environment. The Contractor shall also comply with any applicable additional requirements made by federal, state, or local government agencies.

**201.1.1 RELATED WORK AND REFERENCED SECTIONS**

Not used.

**201.1.2 SUBMITTALS**

Not used.

**201.1.3 DEFINITIONS**

Not used.

**201.2 MATERIALS**

Not used.

**201.3 CONSTRUCTION REQUIREMENTS****201.3.1 EXPLOSIVES AND BLASTING**

The use of explosives on the work will not be permitted unless approved Otherwise in the Contract Documents or in writing by the Engineer/City Representative.

**201.3.2 DUST ABATEMENT**

**201.3.2.1 CONTROL MEASURES** - The Contractor shall furnish all labor, equipment, water and means required to provide effective dust control and abatement measures. Control measures shall be applied as often as necessary and wherever directed in writing by the Engineer/City Representative, to prevent construction operations from producing dust in amounts that may be damaging to property, vegetation, or animals, or detrimental to persons within reasonable proximity of the work site.

**201.3.2.2 HAUL ROUTES AND WORK SITES** - The Contractor shall identify haul routes or material handling areas, outside of the Work site, whereon dust may be generated, and shall exercise appropriate measures to abate any dust problem caused by its operation. Such dust abatement measures

shall be taken immediately when observed or when required in writing by the Engineer/City Representative.

### 201.3.3 STORM AND GROUND WATER

201.3.3.1 CONTROL MEASURES - The Contractor shall provide and maintain, at all times during construction, ample means and devices to promptly remove all water entering the Work, whether the water is surface or ground water. Water removed by the Contractor shall be directed into ponds or areas separated from live streams or drainage ways, to keep sediment from entering live water.

201.3.3.2 DRAINAGE PATTERNS - In excavation, fill, and grading operations, the Contractor shall take care, to disturb the existing drainage pattern as little as possible. Particular care shall be taken not to direct drainage water onto private property or into streets or drainage ways inadequate for the increased flow.

201.3.3.3 FORDING OF WATERWAYS - Fording of live streams or any body of live water to accomplish the Work shall not be permitted. Mechanized equipment also shall not be operated in live water to accomplish the Work unless authorized in writing by the Engineer/City Representative, and appropriate state and/or federal agencies.

201.3.3.4 FILLING OF WATERWAYS - The Engineer/City Representative will not approve the filling of any ditches, washes, drainage ways, streams, wetlands, or other City surface waters by the Contractor to accomplish the Work unless specific instructions are included in the Contract Documents which will provide for how the affected drainages or surface waters are to be treated. Applicable state and federal laws and permitting processes shall be followed including contacting affected water rights holders and property owners.

### 201.3.4 NOISE ABATEMENT

In or near inhabited areas, particularly residential areas, the Contractor's operations shall be performed in a manner to prevent noise from becoming a nuisance or problem. Particular consideration shall be given to noise generated by repair and service activities during the night hours.

### 201.3.5 CHEMICALS

All chemicals and/or petroleum based products used during project construction or furnished for project shall be handled, applied and disposed of in strict accordance with the printed instructions of the manufacturer and regulations enforced by Federal, State and Local health authorities.

201.3.6 WASTE AND SURPLUS MATERIALS DISPOSAL

201.3.6.1 CLEAN WORK SITE - The Contractor shall keep the work site, haul roads and other areas of use in a neat, clean condition, free from any accumulation of surplus materials. It shall be the responsibility of the Contractor, at its own expense, to remove and legally dispose of all surplus materials resulting from all Work activities performed in accordance with the Contract Documents.

201.3.6.2 SURPLUS MATERIAL - Surplus material includes, but is not limited to, salvaged materials and equipment that otherwise would have been abandoned in place, rocks too large to be used as backfill, wood and other organic or unsuitable materials, trash, rubbish, and waste products of any nature, and any other debris generated by the Work.

201.3.6.3 REGULATORY COMPLIANCE - Disposal of surplus materials shall be accomplished in accordance with all local codes, laws, ordinances, and all applicable safety laws (particularly to the requirements of Part 1926 of the OSHA Safety and Health Standards for Construction) in effect at the approved disposal site. In no case shall it be acceptable for any surplus material to be disposed of in streams, marshes or wetlands.

201.3.6.4 APPROVAL OF DISPOSAL - The Engineer/City Representative will not approve any disposal operation, which creates an unsightly and/or unsanitary nuisance. The Contractor shall maintain disposal sites in a reasonable condition of appearance during construction. When designated and/or public disposal sites are unavailable, written approval must be obtained from the Engineer/City Representative to dispose of any surplus materials on any other site. All disposal sites are subject to approval by the Engineer/City Representative. The Contractor shall secure permission and all permits required for use of any dumpsite not previously arranged and designated by the Owner. The Contractor shall retain copies, and provide copies upon request, of all disposal permits and/or agreements obtained for the Contract Work.

201.3.6.5 SCHEDULED REMOVAL - The Contractor shall establish regular intervals of collection and disposal of surplus materials during construction. Stockpiling of surplus materials for later disposal will not be approved or allowed.

201.3.7 OPEN BURNING

Open burning of materials may be allowed only in strict accordance with all regulations in effect for the area at which the burning would be performed, and the Contractor shall obtain any necessary permits from the appropriate governing entity prior to the start of burning. The Contractor shall not allow fire to spread beyond the material intended for burning. No accumulation of residue from burning shall remain on or adjacent to

the construction site, without written approval of the Engineer/City Representative.

201.3.8 SANITATION

201.3.8.1 TOILETS - The Contractor shall provide fixed or portable chemical toilets for employee use in conformance with the requirements of Part 1926 of the OSHA Standards for Construction and when public toilets are not available or within fifteen (15) minutes walking distance of the Work site.

201.3.8.2 COLLECTION OF WASTES - The Contractor shall be responsible for daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor shall be disposed of away from the site in accordance with all laws and regulations pertaining thereto.

201.3.9 HAZARDOUS MATERIAL

201.3.9.1 REGULATORY COMPLIANCE - Disposition of any hazardous material or toxic or hazardous waste shall be made in accordance with the requirements and regulations administered by the State agency wherein the Work site is located.

201.3.9.2 ABNORMAL CONDITONS - Abnormal conditions include, but are not limited to, the following: buried barrels with liquid or solid contents; buried or above ground tanks with liquid contents; obnoxious odors; excessively hot earth; stained and discolored soils; smoke; unidentifiable powders, sludge, pellets; or any other similar condition.

201.3.9.3 DISCOVERY AND NOTIFICATION - If any abnormal conditions are encountered during construction, which indicate the presence of a hazardous material, toxic, or hazardous waste, the Contractor shall immediately suspend work in the area of the discovery and notify the Engineer/City Representative and treat the situation with extreme caution. The Contractor's operation in the area of discovery shall not resume until so directed by the Engineer/City Representative; however, the Contractor shall continue working in other areas of the project, unless otherwise directed by the Engineer/City Representative.

201.3.9.4 DISPOSAL - When it becomes necessary for the Contractor to dispose of discovered materials, the work may be considered a change and administered in accordance with the General Conditions. Should the disposition of discovered waste material require special procedures or handling by certified personnel, the Contractor will make all such arrangements. When it becomes necessary to obtain permits for transporting or handling discovered material, the Owner will obtain the permits.

201.3.9.5 SPILLS AND NOTIFICATION - In the event of spills of petroleum-based products or hazardous wastes by the Contractor, the Contractor shall immediately notify the Engineer/City Representative. The Contractor shall also notify the appropriate State environmental enforcement agency, unless the spill consists of less than one (1) gallon of petroleum based products. In no case will notification be made later than 24 hours after the discovery of the spill. In addition, written notification shall also be made within 5 calendar days of the discovery.

201.3.9.6 COST OF CLEANUP - All costs for cleanup and disposal of hazardous materials due to spills, inappropriate handling, or negligence of the Contractor shall be borne by the Contractor.

201.3.10 ENVIRONMENTAL COMPLIANCE

201.3.10.1 REGULATORY COMPLIANCE - The Contractor shall comply with the applicable requirements of the National Historic Preservation Act as it relates to the preservation of ALL environmental resources. Clearance for protection of environmental resources located within the designated Work site is the responsibility of the Owner and such clearance has been obtained for the Contract, unless provided for otherwise in the Contract Documents.

201.3.10.2 DISCOVERY OF HISTORIC/ARCHEOLOGICAL OBJECTS – The Contractor shall observe the following:

- DISCOVERY AND NOTIFICATION - If a suspected or unsuspected historic, archeological, or paleontological item, feature, or site is encountered, construction operations shall be immediately stopped in the vicinity of the discovery and the Engineer/City Representative shall be notified of the nature and exact location of the findings. The Contractor shall not damage the discovered objects and shall provide written confirmation of the discovery to the Engineer/City Representative within two (2) calendar days.
- RESTRICTION OF CONSTRUCTION - Should operations in the vicinity of a discovery be restricted, the Engineer/City Representative will keep the Contractor informed concerning the status of the restriction. The Contractor should be aware that the time necessary for the Owner to negotiate the handling of the discovered is variable and is dependent on the nature and condition of the circumstances. It is possible that a delay of as much as three weeks in the vicinity of the discovery can be expected. The Engineer/City Representative will inform the Contractor when the restriction is terminated. Changes required to accommodate delay or Work resulting from the discovery will be authorized in accordance with the General Conditions.

201.3.11 OPERATIONS OUTSIDE OF THE PROJECT SITE

In the event the Contractor chooses to use any site or means of obtaining



resources beyond those provided as part of the Contract, the Contractor shall retain the services of a qualified, certified environmental consultant to produce a research design or plan for obtaining any and all necessary environmental clearances for such use. The Contractor shall provide the plan to the Engineer/City Representative for review and approval, as required, following which the plan shall be implemented. The Contractor shall submit evidence of environmental clearances and compliance before commencing any activities within the extended use area. At a minimum, clearances will include those listed below. Additional clearances may be required as necessary.

- 201.3.11.2 CULTURAL RESOURCES (Archeological and Historic) - Clearance may require consultation with the State Historic Preservation Office.
- 201.3.11.3 THREATENED AND ENDANGERED SPECIES - Compliance may require written clearance from the U.S. Fish and Wildlife Service.
- 201.3.11.4 FLOOD PLAINS – May require consultation with the Federal Emergency Management Agency (FEMA) or corresponding state agency.
- 201.3.11.5 WETLANDS AND OTHER BODIES OF WATER – May require consultation with the Army Corps of Engineer/City Representatives and/or appropriate state agency.

The Contractor is cautioned that obtaining environmental clearances can be costly and time consuming.

**202.1 DESCRIPTION**

This section covers furnishing and maintaining all traffic control devices, flaggers and pilot vehicles necessary for protection of the Work, the workers and the traveling public. The requirements of this section are not intended to supersede, but shall supplement, the provisions contained in the "Manual of Uniform Traffic Control Devices" issued by the U.S. Department of Transportation, and any other applicable state or local traffic control regulations.

**202.1.1 RELATED WORK AND REFERENCED SECTIONS**

Not used.

**202.1.2 SUBMITTALS**

The Contractor, upon request of the Owner or Engineer/City Representative, shall submit detailed traffic control plans for specific areas of the Work.

**202.1.3 DEFINITIONS**

Traffic Control Devices - All temporary traffic control and warning devices required to warn traffic of, and to guide it through, construction areas as required under this Contract, including, but not limited to: portable cones and barricades, signs, channeling devices, paint striping, lighting devices, flags, etc. All traffic control devices must meet MUTCD regulations.

Flaggers - Qualified and alert persons equipped with safety warning devices who direct traffic through construction areas. UDOT certification may be required.

Traffic Lane - Ten (10) feet of clear street width with a safe motor vehicle speed of twenty-five (25) miles per hour.

Pilot Car - Any designated and properly marked vehicle used for leading groups of vehicular traffic through construction areas.

**202.2 MATERIALS**

Not Used.

## **202.3 CONSTRUCTION REQUIREMENTS**

### **202.3.1 COORDINATION OF WORK AND TRAFFIC CONTROL**

The Contractor shall endeavor to organize its work force in such a manner as to minimize the closure of public streets and roadways within the Work site. If conditions justify, the Engineer/City Representative may direct the Contractor to conduct Work in specific areas and/or to specific tasks to avoid closure or interference with traffic on public streets and roadways.

### **202.3.2 CLOSURE OF PUBLIC THOROUGHFARES**

The Contractor shall not close any public street or roadway without prior approval by the Engineer/City Representative and if necessary UDOT. When closure is necessary, and approved, the street or roadway shall only be closed to through traffic and not to local traffic. Closure may extend for one city block only, or 700 feet, whichever is less. Closure of streets and roadways shall be made with barricades meeting State MUTCO standards. Traffic shall be kept open on streets and roadways where no detour is possible.

### **202.3.3 MAINTENANCE OF EXISTING SIGNS**

Existing traffic signs other than stop, yield, and street name signs shall be maintained by the Contractor until such time as construction renders them obsolete. At that time the Contractor shall remove signs and posts without damage and deliver them as directed by the Engineer/City Representative.

### **202.3.4 PROTECTION OF WORK AND TRAFFIC**

All obstructions and excavations, within traveled streets and roadways, shall be protected with traffic control devices meeting State DOT and MUTCO standards. Traffic control devices, placed within streets and roadways, shall be illuminated at night, and such illumination shall function from sunset to sunrise. Local jurisdiction may require traffic control measures greater than those of State DOT and MUTCO standards, in which case the Contractor shall comply with such requirements.

Whenever the Engineer/City Representative finds traffic control conditions at the Work site to be inadequate to assure public safety, or the Contractor's protective facilities to be inadequate, the Engineer/City Representative may require the Contractor to provide the additional necessary facilities or services. The Contractor shall bear the cost of the additional protection.

**203.1 DESCRIPTION**

This section covers the investigation of existing miscellaneous pipelines, wires or cables, and other miscellaneous sub-surface features as required by the Engineer/City Representative.

**203.1.1 RELATED WORK**

Section 200 - Protection of Existing Improvements

**203.1.2 SUBMITTALS**

Not used.

**203.1.3 DEFINITIONS**

Not used.

**203.2 MATERIALS**

The Contractor shall provide a backhoe and qualified operator; laborer with hand shovel; appropriate fuel and lubricants, necessary equipment servicing materials; and appropriate equipment for transporting the backhoe to perform the investigation. The backhoe shall be a rubber tired CASE 580 backhoe, or an approved unit of equivalent or greater size and capacity, having accumulated not more than 5,000 hours operating time.

**203.3 CONSTRUCTION REQUIREMENTS****203.3.1 EXPOSURE BY EXCAVATION**

When directed by the Engineer/City Representative, the Contractor shall excavate and expose miscellaneous pipelines, structural features, soil materials and other underground features which may be present at the work site. The location and extent of exposure shall be determined on site by the Engineer/City Representative. Designation of such areas shall be made in writing, usually in the form of a Work Order, by the Engineer/City Representative.

**203.3.2 REPLACEMENT OF EXCAVATED MATERIALS**

Work required hereunder shall include replacement of excavated materials sufficiently to restore the site to a safe condition as determined by the Engineer/City Representative. Full restoration of materials such as pavement, concrete slabwork, sod, etc., in the investigated area will be accomplished in accordance with the Contract Documents and as directed by the Engineer/City Representative.

**204.1 DESCRIPTION**

This section covers obtaining permission, permits, clearances, etc.; as necessary to develop source(s), purchasing or manufacturing, loading, hauling, placing and compacting earthwork materials described herein or required by these Specifications.

**204.1.1 RELATED WORK**

Section 205 - Trench Excavation and Backfill

**204.1.2 SUBMITTALS**

When the Bid Schedule indicates quantities of materials described in this section in excess of 50 cubic yards or 50 tons, or when requested otherwise by the Engineer/City Representative, the Contractor shall provide test results from a certified independent laboratory which has sampled and performed the prescribed test(s) for those materials.

**204.1.3 DEFINITIONS**

Granular Material - Material for which the sum of plasticity index (AASHTO T-90) and the percent of material passing a No. 200 sieve (AASHTO T-27) shall not exceed 23.

Silt - Material which passes the No. 200 (AASHTO T-11) sieve and has a plasticity index not greater than 10.

Clay - Material which passes the No. 200 sieve and has a plasticity index greater than 10.

Bedding - Materials placed immediately around and adjacent to pipe installed in trenches.

Borrow - Material obtained from a source away from the site on which installed and/or excavated and used to supplement insufficient quantities of material required.

**204.2 MATERIALS****02105.2.1 ON-SITE TRENCH OR STRUCTURAL BACKFILL**

On-site trench or structural backfill consists of material excavated during trenching or foundation excavation which is free of cinders, ashes, wood, vegetation, frozen or other deleterious material or rocks with a maximum particle size not greater than 6-inches. Material may be required to be processed or transported along the excavation.

#### 204.2.2 IMPORTED TRENCH OR STRUCTURAL BACKFILL

Imported trench or structural backfill consists of granular material obtained from sources indicated on the Drawings, designated in the Special Provisions or approved by the Engineer/City Representative. Borrow materials shall be free of cinders, ashes, wood, vegetative matter, frozen or other deleterious matter with a maximum particle size not greater than 6-inches. Pit Run Borrow may be used as backfill in trenches, excavations for structures, in roadway subgrades, or as otherwise shown on the plans or called for by the Engineer/City Representative. Material may be processed or may be pit run.

#### 204.2.3 ON-SITE PIPE BEDDING

On-site pipe bedding consists of material excavated during the trenching operation which is free of cinders, ashes, wood, vegetation, frozen or other deleterious material or rocks with a maximum particle size not greater than that shown below in Table 1. Material may be required to be processed or transported along the trenching operation.

#### 204.2.4 IMPORTED PIPE BEDDING

Imported pipe bedding consists of granular material excavated from an approved borrow source which is free of cinders, ashes, wood, vegetation, frozen or other deleterious material or rocks with a maximum particle size not greater than that shown in Table 1 below. Material may be processed or may be pit run.

#### 204.2.5 SAND

Sand shall be graded granular material which passes a 3/8-inch sieve, with not more than 10 percent passing the No. 200 sieve (AASHTO T-27) and free from cinders, ashes, wood, vegetation, frozen or other deleterious material.

#### 204.2.6 GRAVEL PIPE BEDDING

Gravel pipe bedding shall be graded gravel which has been screened to meet the maximum particle size shown in Table 1 below for different pipeline materials and contains no more than 10 percent passing the No. 200 sieve (AASHTO T-11). Gravel pipe bedding material shall be free from cinders, ashes, wood, vegetative matter, frozen or other deleterious material.

**Table 1 - MAXIMUM PARTICLE SIZE FOR PIPE BEDDING**

| <b>Pipe</b>                            | <b>Size</b> |
|--|-------------|
| Corrugated Metal and Welded Steel      | 1"          |
| Galvanized Steel, PVC and Polyethylene | 1"          |
| Ductile Iron, Cast Iron and Concrete   | 2"          |

204.2.7 UNTREATED BASE COURSE

Untreated base course consists of processed natural gravel and crushed rock with an approved soil binder without any deleterious materials, tested in accordance with AASHTO T-27 and T-11 which meets the gradation requirements in Table 2 below.

**Table2 - MAXIMUM PARTICLE SIZE FOR UNTREATED BASE COURSE**

| <b>Sieve Size</b> | <b>Percent Passing</b> |
|-------------------|------------------------|
| 1-inch            | 100                    |
| ½-inch            | 70-90                  |
| #4                | 40-60                  |
| #16               | 20-40                  |
| #200              | 5-12                   |

204.2.8 BITUMINOUS SURFACING

Plant mix bituminous material, with maximum particle size not greater than 3/4-inch, meeting the requirements of Section 211 of these Specifications.

204.2.9 DRAIN GRAVEL

Drain gravel consists of washed natural gravel or crushed rock or slag, with a maximum particle size of 1-inch, with 100 percent being retained on the No. 10 sieve, and without any deleterious material.

204.2.10 RIPRAP

Riprap consists of durable, angular, sound and hard field or quarry stones free from cracks and structural defects. Source of supply shall be approved by the Engineer/City Representative. Fifty percent of the stones shall be of sizes between one-half and two-thirds of the riprap layer thickness shown on the Drawings. Not more than 10-percent of the stones by weight shall be of a size less than one-tenth of the riprap layer thickness shown on the Drawings and the specific gravity of the stones

must range between 2.5 and 2.82 (AASHTO T-85). Durability of the stones shall be in excess of 40 percent (AASHTO T-210).

204.2.11 SUBGRADE GRANULAR FILL

Subgrade granular fill consists of well graded granular soils with a maximum of 50 percent passing the No. 4 sieve and a maximum of 20 percent passing the No. 200 sieve and no materials greater than 4-inches in diameter.

**204.3 CONSTRUCTION REQUIREMENTS**

204.3.1 LOCAL GOVERNMENT SPECIFICATIONS

Not used.

204.3.2 BORROW AND DISPOSAL SITES

The Contractor shall, at its own expense, secure all necessary access and borrow sites for acquisition or removal and to dispose of excess backfill or waste materials.

204.3.3 ON-SITE MATERIALS

Unless otherwise directed by the Engineer/City Representative, on-site pipe bedding and trench backfill will be used for installation of all pipe. In areas where suitable on-site material is not available, other material, which meet these Specifications, will be used when approved by the Engineer/City Representative.

204.3.4 SCALES

Not used.



**205.1 DESCRIPTION**

This section covers excavation and backfill for piping appurtenances such as manholes, inlets, transition structures, junction structures, vaults, thrust blocks, valve boxes, catch basins, etc..

**205.1.1 RELATED WORK**

Section 202 - Traffic Control  
Section 200 - Protection of Existing Properties  
Section 204 - Earthwork Materials  
Section 208 - Water Pipe Installation  
Section 209 - Sewer Pipe and Manhole Installation  
Section 210 - Removal and Replacement of Surface Improvements  
Section 207 - Water for Construction

**205.1.2 SUBMITTALS****205.1.2.1 MOISTURE DENSITY TESTING AND GRADATION DETERMINATIONS** - A documentation system shall be maintained by the Contractor to record results from all moisture/density testing and gradation determinations. Records of these tests shall show the following information as a minimum:

- Date of test.
- Type of test.
- Name of person performing test.
- Location of sample taken.
- Results of test and comparison with specified value required for compliance.

Upon completion of each gradation test or moisture/density test, a copy of the record for the respective test shall be delivered to the Engineer/City Representative within one (1) working day following the completion.

**205.1.2.2 COMPLIANCE TESTING** - Documentation shall also be made, in field diaries, of all compliance tests performed by the Contractor. Documentation shall be made available to the Engineer/City Representative upon request.**205.1.3 DEFINITIONS**

Trench Width - Shall not be more than 18 inches greater than the outside diameter of the pipe being installed at a point 12 inches above the top of the pipe unless otherwise shown on the Drawings. The width of the trench above that level shall be the minimum width required for safe working conditions, sheeting, bracing and for proper installation of the

work.

Trench Grade - The vertical elevation of the flowline of the pipe being installed in the trench.

Open Trench - Shall include trench sections which have been excavated and are awaiting completion of pipe installation, backfill, compaction or installation of a temporary surface.

Surface Restoration - Shall include the Work required to restore the ground surface disturbed for trench excavation. Replacement of road surfacing, planting and landscaping removed for trench excavation, will not be considered as trench excavation and backfilling.

Consolidated Backfill - A condition of backfilling for which a specified compaction density is required. Maximum lift, prior to compaction, for consolidated backfill shall be 8 inches unless otherwise approved by the Engineer/City Representative.

Unconsolidated Backfill - A condition of backfilling for which no compaction density is specified and the required compaction effort is layer placing and then compacting by wheel rolling or use of compacting equipment. Lifts of up to 24 inches are allowed for unconsolidated backfill.

Unclassified Excavation - A determination for excavating whereby no consideration will be given to different kinds of materials that are encountered.

## **205.2 MATERIALS**

Not used.

## **205.3 CONSTRUCTION REQUIREMENTS**

### **205.3.1 PERMITS**

For work which is to take place within state and/or federal road and highway rights-of-way, the Contractor shall be responsible for obtaining all required encroachment and construction permits prior to beginning any work within the rights-of-way.

All work in any city, town or county public right-of-way will also require an approved excavation permit from that entity. The Contractor shall be responsible for obtaining all required encroachment and construction permits prior to beginning any work within the rights-of-way.

### **205.3.2 CLEARING AND GRUBBING**

On areas outside of established roadways, the area to be disturbed by the trenching operation shall be cleared and grubbed prior to beginning the

trenching operation.

205.3.3 EXCAVATION

205.3.3.1 Not used.

205.3.3.2 Not used.

205.3.3.3 EXPOSURE OF UNDERGROUND FEATURES - Before any trench excavation is started, the Contractor shall locate and expose all existing underground utilities, structures, etc., which may interfere with, or conflict with, the trench being excavated (Blue Stakes 800-662-4111) or 811. In case of conflicts, the Contractor shall make adjustments in the location of the excavation at the direction of the Engineer/City Representative.

205.3.3.4 The Contractor shall perform all excavation to the depth specified in the Drawings and/or as required to accomplish the Work. During the excavation operations, excavated materials which are suitable for use as backfill for trenches or around structures, shall be piled separately at sufficient distance from the edge of the excavation to be out of the way of equipment and to prevent slides and cave-ins from embankment overloading. All excavated materials not suitable for, or not required for, fill or backfill shall be separated and removed promptly from the site of the Work and disposed in an approved site in accordance with Section 201.

205.3.3.5 PUBLIC TRAVEL - Materials excavated within roadways, regardless of their disposition, shall be piled in such manner that will cause the minimum of inconvenience to public travel and always allow for emergency vehicle passage.

205.3.3.6 OPEN TRENCH - At no time shall the Contractor allow more than 150 cumulative feet of trench to be open for the overall project, unless otherwise approved by the Engineer/City Representative.

205.3.3.7 SHORING – All trench shoring shall meet Federal Requirements. Shoring and/or trench boxes shall be used wherever needed to protect workers and adjacent structures and property of the Work in accordance with OSHA requirements. The arrangement of bracing of shoring shall not be set so as to stress any portion of completed work.

205.3.3.8 BARRICADING OPEN WORK - Excavations left open at the end of the work day shall be surrounded by barricades, warning tape, and fencing.

205.3.4 EXCAVATION IN ROCK

205.3.4.1 SOLID ROCK EXCAVATION – If:

- The Contract Documents contain provisions for “Solid Rock Excavation”, and
- If rock has been encountered in the excavation, and
- If the Contractor has made three attempts to remove the rock using a "Kelly" or similar type ripper having not less than 235 fly wheel horsepower, then

the excavation of such material will be considered as "solid rock excavation".

205.3.4.2 **BLASTING** - When blasting is deemed necessary for rock removal, the Contractor shall comply with all applicable State and Local laws, ordinances, and provisions for blasting safety and obtain written approval from the Engineer/City Representative prior to starting of drilling and/or blasting operations.

In all cases, blasting shall be performed by experienced, qualified blasters. The Contractor is responsible for any and all damage caused by blasting, and blasting will not be allowed within 50 feet of any existing structures.

205.3.5 **OVER-EXCAVATION**

205.3.5.1 **UNAUTHORIZED OVER-EXCAVATION** - Care shall be taken to not excavate below the depth required by the Drawings. Any unauthorized over-excavation shall be refilled and compacted with material meeting the requirements of Section 204 and approved for use by the Engineer/City Representative at the expense of Contractor.

205.3.5.2 **ROCK** - Whenever rock is encountered in the trench bottom, the trench shall be over-excavated a minimum of 6 inches below the design elevation of the bottom of the pipe. The over-excavated portion of the trench shall be filled with approved bedding material and the bedding compacted.

205.3.5.3 **UNSTABLE NATIVE FORMATIONS** - The Contractor shall notify the Engineer/City Representative if soft, spongy, or otherwise unstable native formations, that are not suitable for structure or pipeline foundations, are encountered in excavations. In the event the Engineer/City Representative determines that the existing foundation materials are unacceptable, the Contractor will be directed to over-excavate, remove and replace the unsuitable soil materials. The over-excavation shall be backfilled with approved select materials and compacted in accordance with the requirements described herein.

205.3.6 **PIPELINE ACCESSORY INSTALLATION**

205.3.6.1 **EXCAVATION FOR ACCESSORIES** - The Contractor may excavate to place the sides of manholes, vaults, valve boxes, inlet structures, catch basins or other accessory structures directly against the excavated surface,

provided that the faces of the excavation are firm and unyielding and are at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing, the Contractor shall over-excavate to place the structure and this over-excavation shall be backfilled and compacted, using the same material required for the adjoining pipeline trench.

205.3.6.2 ACCESSORY SUPPORT - To prevent displacement of valve boxes and other accessory structures, trench backfill shall be compacted to at least 95% of maximum density as determined by AASHTO T-99 for 6 feet along the trench on each side of the box or structure.

#### 205.3.7 TRENCH BOTTOM PREPARATION

The bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of the pipe. Bell or coupling holes shall be made in accordance with the recommendations of the pipe manufacturer after the trench bottom has been graded. Such depressions shall be of sufficient width to provide clearance for connecting and/or bolting. Holes for depressions shall be excavated only as necessary to permit proper joining of pipe sections.

#### 205.3.8 SURFACE IMPROVEMENTS

When surface improvements must be removed, or are damaged or disturbed by the Work, their removal and restoration shall be accomplished by the Contractor in accordance with Sections 200 and 208 of these Specifications.

#### 205.3.9 PROTECTION OF EXISTING UTILITIES

The Contractor shall protect all existing utilities, either above or below ground, in accordance with the provisions of Section 200 of these Specifications.

#### 205.3.10 IRRIGATION DITCHES, PIPES AND STRUCTURES

The Contractor shall contact the owners of all irrigation facilities to be encountered by the work and make arrangements for construction clearances and/or facility shutdown schedules. All irrigation ditches, dikes, headgates, pipe, valves, culverts, etc., damaged or removed by the Contractor shall be restored by the Contractor to their original condition, or better, in accordance with Section 208 of these Specifications, at no additional cost to the Owner.

#### 205.3.11 BUILDING FOUNDATIONS AND STRUCTURES

Where trenches are located adjacent to building foundations and structures, the Contractor shall take all necessary precaution against damage to such facilities. Water settling of backfill material in trenches adjacent to structures will not be permitted unless authorized in writing

by the Engineer/City Representative. The Contractor shall be liable for any damage caused by the construction, and shall restore or replace damaged property in accordance with Section 208 of these Specifications.

- 205.3.11.1 SIDEWALK, CURB AND GUTTER - Where sidewalk, curb, and gutter exist, excavation may be made by tunneling provided the following requirements are met. Excavation shall be vertical and as near to the curb or sidewalk as possible. The length of the tunnel shall not exceed the width of the sidewalk, curb and gutter. Where a separate sidewalk and curb exist, an excavation shall be made between the sidewalk and the curb. At least three feet of undisturbed earth shall be left under the sidewalk. Where the excavation does not meet these requirements, a section of sidewalk from joint to joint shall be removed and replaced.

Gas Lines and Water Lines may be jacked, augured or jetted under sidewalk, curb and gutter provided the resulting hole diameter does not exceed one (1) inch plus the outside diameter of the pipe installed.

Backfill of Sidewalk Tunnels. Where the sidewalk has been tunneled, the hole shall be filled from each end with earth compacted with mechanical tampers to 90% of AASHTO T-180, Method C. A 3'-0" section of trench on each side of the tunnel and any space between the sidewalk and curb shall be backfilled with mechanically compacted earth as specified.

205.3.12 WATER

- 205.3.12.1 WATER FLOW - The Contractor's operation shall always ensure the free flow of water in gutters, culverts, and natural watercourses. In irrigated land areas, excavated materials shall be piled on the downhill sides of trenches.

- 205.3.12.2 GROUNDWATER - The Contractor shall have the responsibility of determining the presence and location of groundwater at the work site.

- 205.3.12.3 DEWATERING - Grading and other protective measures shall be performed as necessary to prevent surface or ground water from flowing into trenches or other excavations. Any water accumulated therein during construction, from surface or from underground sources, shall be promptly removed by pumping or by other approved methods at the Contractor's expense.

- 205.3.12.4 INSTALLATION IN WATER - No backfill, subgrade materials, concrete or masonry footings, foundations, floors, equipment, or pipe shall be placed or laid in water. Water shall not be allowed to rise over such work for at least 24 hours following the pour or placement of any concrete or mortar used in the work. Water shall not be allowed to rise unequally against structure walls for a period of 14 days following concrete placement or masonry erection.

Groundwater or surface water in piping trenches shall not be allowed to enter and flow through the piping while installation of pipe is in progress.

205.3.12.5 DISPOSAL - The Contractor shall dispose of all water from the work in a suitable manner without damage to adjacent properties.

205.3.13 BEDDING AND PIPELINES

205.3.13.1 Not used.

205.3.13.2 Not used.

205.3.13.3 BEDDING INSTALLATION - Pipe bedding shall be installed according to applicable sections of these Specifications for pipeline construction.

205.3.14 BACKFILL

205.3.14.1 BACKFILL MATERIALS AND PLACEMENT - Backfill shall be accomplished using acceptable materials as described in Section 02105 as follows:

- All backfill materials shall be at  $\pm 2\%$  of optimum moisture content when placed in the trench or other excavation.
- Consolidated trench backfill shall be placed in lifts not greater than 8 inches.
- Unsuitable excavated material, or material with incorrect moisture content shall be removed and replaced.
- Soft spongy material that causes areas which “pump” when heavy loads pass over them, shall be removed and replaced with suitable material.
- Dry material that will not “ball” shall be removed and replaced.

(The two foregoing conditions shall be considered sufficient evidence, without further testing, that the moisture content is incorrect and shall be grounds for removal and replacement of the material. Such replacement, if required, shall be at the sole expense of the Contractor.)

- Placement of backfill against cast-in-place concrete structures shall not be started until the concrete has been cured for the time required in these standard specifications or prescribed by the Engineer/City Representative.

205.3.14.2 COMPACTION – Compaction procedures shall be as follows:

- The Contractor shall be responsible for obtaining construction water needed for compaction in accordance with Section 207 of these Specifications.

- Bedding and consolidated backfill material shall be compacted with tamping, vibrating or conventional wheeled compaction equipment. Use care not to damage pipe while compacting bedding materials.
- The use of wheel rolling for compaction shall only be approved for compacting unconsolidated backfill materials.
- For work within state or federal highway rights-of-way, compaction shall meet the requirements of the respective applicable specifications.
- Backfill shall be thoroughly compacted to densities not less than those shown in the following table:

**TABLE OF MINIMUM DENSITY REQUIREMENTS**

**(based on AASHTO-99 and T-91 and on ASTM D-2922 and E-3017)**

| <b>Location</b>  | <b>From Surface to 2-Feet Below Surface</b>          | <b>From 2-Feet Below Surface to Top of Bedding</b> | <b>Bedding</b>       |
|--|--|--|----------------------|
| Within 6 feet of, and/or under, any existing or proposed structure, pavement, curb, sidewalk or similar construction included in the Contract: | 100% for granular and 95% for non-granular materials | 95% for all materials                              | 95% at all locations |
| Around any structure outside 6 feet:   | 90% for all materials                                | 90% for all materials                              | 90% at all locations |
| Cultivated and landscaped areas:   | 85% for all materials                                | 85% for all materials                              | 85% at all locations |
| Undeveloped Land:  | Unconsolidated – see definition                      | Unconsolidated - see definition                    | 85% at all locations |

205.3.15 **SETTLING AND SUBSIDENCE**

Dips or uneven surfaces caused by subsidence or post-construction settlement of fill or backfill in any trenches, excavations, fills, or embankments within the work, which become apparent within the warranty period, shall be repaired by the Contractor.

205.3.16 **SAMPLING AND TESTING**

205.3.16.1 **TESTING BY INDEPENDENT LABORATORY** - As directed by the Engineer/City Representative, the Contractor shall provide for all sampling and testing through a qualified, independent testing laboratory



at the Contractor's own expense.

205.3.16.2 SCHEDULE OF SAMPLING AND TESTING - The following schedule of sampling and testing provides minimum requirements, to assure compliance with all materials and compaction requirements described herein. The number of samples and tests shown shall be considered minimum, and field conditions may necessitate additional sampling and testing as required by the Engineer/City Representative.

**GRADATION DETERMINATION (AASHTO T-27 and T-11)**

| <b>Trench Location</b>   | <b>Testing Required</b>  |
|--|--|
| Materials imported or manufactured at a site determined by this contract | One test per site or source  |
| On-site excavated materials along trenches.                              | One test per geographical area where material composition and gradation visually appears consistent. |

**MOISTURE/DENSITY RELATIONSHIP (Proctor)  
(AASHTO T-99 or T-180 Method D)**

| <b><u>Trench Location</u></b>   | <b><u>Testing Required</u></b>   |
|---|--|
| Materials imported or manufactured at a site determined by this Contract. | One test per site unless the material visually appears to change.                      |
| On-site excavated materials along trenches.                               | One test per geographical area where material composition visually appears consistent. |

**COMPACTION COMPLIANCE TESTING REQUIREMENTS  
(AASHTO T-191 or Portable Nuclear Gauges)**

| <b><u>Trench Location</u></b>  | <b><u>Testing Required</u></b>   |
|--|--|
| Street crossing with gravel or bituminous surfacing.                         | One test per lift for each crossing.   |
| Parallel to centerline of bituminous or gravel surfaced streets or roadways. | One test per lift for each 500-feet of trench length.  |
| Along unsurfaced roads or in cultivated or landscaped areas.                 | One test per lift for each 1,000-feet of trench length with at least one test per area.                |
| Under or adjacent to manholes, wetwells, enclosures, boxes, etc.             | None, unless geological conditions are inconsistent and requested by the Engineer/City Representative. |

NOTE: The term "test" shall mean a single test with acceptable results, equal to or better than specified minimums. In the event

compaction test results fall below the required minimum density; the Contractor shall re-compact and test the material until a test with acceptable results is obtained. Any test failure shall result in additional tests as required by the Engineer/City Representative, at no cost to the City, to ensure that overall project quality objectives are met.

**206.1 DESCRIPTION**

This section covers construction of roadways and embankments, roadway ditches, channel changes, furrows, slope rounding, benches, berms, dips, approaches, and subsidiary work.

**206.1.1 RELATED WORK AND REFERENCED SECTIONS**

Not used.

**206.1.2 SUBMITTALS**

Not used.

**206.1.3 DEFINITIONS**

Roadway - The graded portion of a road within the top of cut slopes and the toe of embankment slopes, excavated and placed to form a surface for vehicular travel.

Excavation - That portion of the roadway which is removed from its original position and deposited within the roadway as embankment.

Embankment - Excavated earth materials moved from an original source and placed within the roadway.

Unsuitable Material - Excavated earth materials determined by the Engineer/City Representative to be unsuitable for placement in roadway embankment. Such materials may include rock too large for placement in embankment, topsoil containing excessive vegetative debris, unstable earth materials, etc.

Roadbed - That portion of the roadway graded to the surface upon which vehicles travel, including the shoulders.

Subgrade - The graded roadbed finished according to the details shown on the Drawings and prepared to receive surfacing when called for on the Drawings.

Borrow - Earth materials excavated from a designated source, outside the roadway, and placed in embankments within the roadway. Designated sources for borrow material shall be shown on the Drawings or elsewhere described in the Contract Documents, and shall be approved by the Engineer/City Representative prior to being placed in embankment.

Pioneering - The beginning or opening of a route on which a roadway is to be constructed prior to clearing or starting any earthwork excavation.

Structure Excavation - Excavation, backfill and/or disposal of material required in the roadway for construction of culverts, bridge foundations or other structures.

Cushion - Soil materials placed over rocks or solid rock portions of the roadway to provide a gradable surface. Cushion materials shall not contain rocks large than one-third of the minimum thickness of the cushion layer.

## **206.2 MATERIALS**

Not used.

## **206.3 CONSTRUCTION REQUIREMENTS**

### **206.3.1 CLEARING AND GRUBBING**

Not used.

### **206.3.2 PIONEERING**

Pioneering operations for the top of excavation slopes, toe of embankments, or pioneer road construction shall be accomplished to prevent undercutting of the final excavation slope, depositing of materials outside of the roadway limits and any restriction of drainage.

### **206.3.3 UTILIZATION OF EXCAVATED MATERIALS**

All suitable excavated material shall be used in the construction of embankments, subgrades, shoulders, slopes, bedding and backfill for structures and for other purposes as described below:

206.3.3.1 **EXCESS EXCAVATION** - Designed excess excavation shall be disposed of as indicated in these standard specifications.

206.3.3.2 **ROCK FOR SLOPE PROTECTION** - When approved by the Engineer/City Representative, excavated rock suitable for protection of embankments may be conserved and used in lieu of a designated materials source.

206.3.3.3 **CONSERVING MATERIAL** - Material encountered in the excavation, suitable for cushion, road finishing or other purposes, may be conserved and utilized instead of materials from designated sources.

206.3.3.4 **EXCAVATION OF UNSUITABLE MATERIAL** - Unsuitable material shall be excavated. Disposal will be as shown on the Drawings. Excavated areas shall be backfilled with suitable material when necessary

to complete the Work. Frozen material shall not be placed in embankments. Rocks that are too large to be incorporated into the embankment shall be broken for incorporation into the embankment or maneuvered to the face of the embankment and embedded so that they will not roll or obstruct the use and maintenance of the roadbed, or moved to locations approved by the Engineer/City Representative.

206.3.3.5 CONSERVATION OF TOPSOIL - Suitable topsoil shall be removed, transported, and deposited in designated stockpile areas.

206.3.3.6 ABANDONED STRUCTURES AND OBSTRUCTIONS - Abandoned structures and obstructions shall be treated in accordance with Section 208.

206.3.4 DRAINAGE EXCAVATION

Drainage excavation shall include construction of side ditches, minor channel changes, inlet and outlet ditches, furrow ditches, ditches constructed along the road but beyond the roadway limits and other minor earth drainage structures as shown on the Drawings. Excavated material shall be utilized in accordance with subsection 206.3.3 above.

206.3.5 FINISHING ROADBED

206.3.5.1 OVERSIZE MATERIALS - For roads receiving aggregate base or surface course, only rocks that do not protrude above the subgrade more than one-third of the depth of the base or surface course or 2-inches, whichever is less, may remain in place.

For unsurfaced roads, the top 4-inches below the finished road surface shall not contain rocks larger than 4-inches in greatest dimension. Oversize material shall be removed, reduced to acceptable size or covered by importing suitable material approved by the Engineer/City Representative.

206.3.5.2 SHAPING AND DRESSING - The subgrade shall be visibly moist during shaping and dressing. Low sections, holes, cracks or depressions shall be brought to grade with suitable material approved by the Engineer/City Representative. Final compaction of the subgrade shall meet the requirements of the embankment placing method specified.

206.3.6 SNOW REMOVAL

Snow and/or ice shall not be incorporated into the embankment. Snow shall be removed in advance of the work to be performed and shall be deposited beyond the roadway limits in a manner that will not result in erosion or waste material.

206.3.7 FINISHING SLOPES

- 206.3.7.1 SLOPE SURFACE - Slopes shall be finished as closely as is practicable to the lines staked on the ground or shown on the Drawings. The finished slope shall be left in a slightly roughened condition to facilitate the establishment of vegetative growth. The finish associated with template and stringline or hand-raking methods will not be allowed. Loose rock, loose debris and other loose material, each of which is large than 4-inches in diameter, shall be removed from the slope.
- 206.3.7.2 SLOPE TOP - The tops of excavations, excluding areas of solid rock, shall be blended with the adjacent terrain by rounding when shown on the Drawings. Decomposed rock that may be cut without blasting or ripping shall be rounded. Earth overlying rock shall be rounded above the rock.
- 206.3.8 BLASTING
- 206.3.8.1 CONTROLLED BLASTING - All rock excavations that require blasting shall be formed with controlled blasting techniques. Controlled blasting is defined as the controlled usage of explosives and blasting accessories in appropriately aligned and spaced drill holes for the purpose of producing a free surface or shear plane in the rock excavation slopes and of minimizing landscape damage, adjacent ground vibration and overbreak. Presplitting is not intended.
- 206.3.8.2 TEST SECTIONS - Unless directed otherwise by the Engineer/City Representative, the Contractor shall drill, blast and excavate short test sections (not to yield in excess of 1,000 cubic yards) to determine the controlled blasting method, hole spacing and charge best suited to the material encountered.
- 206.3.9 OVERBUILDING
- Unless otherwise agreed to in writing by the Engineer/City Representative, excavation or embankment material shall be confined within the roadway limits to avoid overbuilding and to protect the adjacent property.
- 206.3.10 SUBGRADE TREATMENT
- 206.3.10.1 TREATMENT MATERIALS - Subgrade treatment shall consist of soil modification by mixing aggregates, placing geotextiles, fiber mat, rock blanket or other similar materials over areas of unsuitable embankment foundation material.
- 206.3.10.2 SWAMPY GROUND - When an embankment is to be placed across swampy ground and removal of unsuitable material or subgrade treatment is not required, the lower part of the embankment may be constructed in a single layer to the minimum depth necessary to support construction equipment.

## 206.3.11 EMBANKMENT PLACEMENT

All embankments shall be placed by one or more of the following methods:

206.3.11.1 METHOD 1 - SIDE CASTING AND END DUMPING - Embankment may be placed by side casting and end dumping. Where material containing a large amount of rock is used to construct embankments, a solid embankment shall be provided by working smaller rocks and fines in with the large rocks and fines to fill the voids.

206.3.11.2 METHOD 2 - LAYER PLACEMENT - Surfaces steeper than a ratio of 3 horizontal to 1 vertical (3:1) upon which embankment is to be placed, shall be roughened or stepped when shown on the Drawings to provide permanent bonding of new and old materials.

- Embankment shall be layer placed, except over rock surfaces, in which case material may be placed by end-dumping to the minimum depth needed for operation of spreading equipment. Each embankment layer shall be leveled and smoothed before placement of subsequent layers. Hauling and spreading equipment shall be operated uniformly over the full width of each layer.
- Suitable material shall be placed in layers no more than 12-inches thick, except when the material contains rock more than 9-inches in diameter, in which case layers may be of sufficient thickness to accommodate the material involved. No layer shall exceed 24-inches before compaction.
- Placing individual rocks or boulders greater than 24-inches will be permitted provided the embankment will accommodate them. Such rocks and boulders shall be at least 6-inches below subgrade. They shall be carefully distributed and the voids filled with finer material to form a dense and compacted mass.
- Where material containing large amounts of rock is used to construct embankments, the layers may be of sufficient thickness to accommodate the material involved. A solid embankment with adequate compaction shall be constructed by working smaller rock and fines in with the larger rocks to fill the voids and by operating hauling and spreading equipment uniformly over the full width of each layer as the embankment is constructed.
- Material shall be at a moisture content suitable to obtain a mass that will not visibly deflect under the load of the hauling and spreading equipment. Excessively wet excavated material shall be handled in accordance with Subsection 206.3.3.1.

206.3.11.3 METHOD 3 - LAYER PLACEMENT (ROLLER COMPACTION) - Embankments shall be placed as specified in Method 2. Placement shall

be in horizontal layers not exceeding 12-inches prior to compaction, except when the material contains rock more than 9-inches in diameter, in which case layers may be of sufficient thickness to accommodate the material involved. Compaction shall be obtained with equipment in compliance with the requirements described in the Specifications. Compaction equipment shall be operated over the full width of each layer until visible deformation of the layer ceases or, in the case of the sheepsfoot roller, the roller "walks out" of the layer. At least three complete passes will be made.

206.3.11.4 METHOD 4 - CONTROLLED COMPACTION - Embankments shall be placed as specified in Method 2 except earth embankments shall be placed in horizontal layers not exceeding 12-inches (loose measure) and compacted. Material shall be at a moisture content suitable for attaining the required compaction. Embankments and the top 1-foot of excavation sections shall be compacted to at least 95 percent of the maximum density as determined by AASHTO T 180, Method C or D.

- The density of the embankment material shall be determined during the progress of the Work in accordance with AASHTO T 191, T 205 or T 238; T 217, T 239 or T 255; and T 224.
- Density requirements will not apply to portions of rock embankments that cannot be tested in accordance with approved methods. When this condition exists, compaction shall be provided by working smaller rocks and fines in with the larger rocks to fill the voids and by operating equipment over the embankment materials.

206.3.12 COMPACTION EQUIPMENT

206.3.12.1 EQUIPMENT - Compaction equipment shall be capable of obtaining compaction requirements without detrimentally affecting the compacted material. The compacting units may be any one of the types described herein, provided they are capable of compacting each lift of material as specified and meet the minimum requirements contained herein.

206.3.12.2 ROLLER REQUIREMENT - Minimum requirements for rollers are as follows:

- Stamping or grid rollers shall be capable of exerting a force of 250 pounds per inch of width of roller drum.
- Steel-wheel rollers, other than vibratory, shall be capable of exerting a force of not less than 250 pounds per inch of width of the compression roll or rolls.
- Vibratory steel-wheel rollers shall have a minimum weight of 6 tons. The compactor shall be equipped with amplitude and frequency controls and specifically designed to compact the material on which it is used.



- Pneumatic-tire rollers shall have smooth tread tires of equal size that will provide a uniform compacting pressure for the full width of the roller and capable of exerting a ground pressure of at least 80 psi.

206.3.13 CONSTRUCTION TOLERANCES

A Table of Tolerance is provided below:

**TABLE OF TOLERANCES**

| <u>MEASUREMENT</u>          | <u>TOLERANCE CLASS</u> |             |             |
|-----------------------------|------------------------|-------------|-------------|
|                             | A                      | B           | C           |
| Roadbed Width (feet)        | +0.5                   | +1.0        | +2.0        |
| Subgrade Elevation (feet)   | <u>+0.1</u>            | <u>+0.2</u> | <u>+0.5</u> |
| Centerline Alignment (feet) | <u>+0.2</u>            | <u>+0.5</u> | <u>1.0</u>  |

Deviations shall be uniformly graded in the direction of change for a distance of 200-feet or more along the roadway. Roadway ditches shall always be constructed to flow in the direction shown on the Drawings, regardless of allowable deviations. Roadbed width shall be no less than the dimension shown on the Drawings or staked in the field. When a tolerance class is not otherwise indicated on the Drawings, Class B tolerance deviations will be allowed for roadway construction.

206.3.14 WATER

Water provided for compaction, dust control, or planting and care of vegetation, shall be developed, hauled and applied in accordance with Section 207.

**207.1 DESCRIPTION**

This section covers the water for: dust control, pre-wetting, mixing or compacting earth materials for road, site, and/or trench construction, and for other needs associated with the Work.

**207.1.1 RELATED WORK**

Not used.

**207.1.2 SUBMITTALS**

Not used.

**207.1.3 DEFINITIONS**

Not used.

**207.2 MATERIALS**

Water shall be free of dirt and silt or any substances injurious to plant life. A separate supply of potable water shall be provided by the Contractor for drinking when it becomes necessary to provide water for workers.

**207.3 CONSTRUCTION REQUIREMENTS**

Water provided for construction shall be obtained from a source approved by the Engineer/City Representative and shall be sufficient to provide for the anticipated needs of the contract.

Water hauling equipment shall have watertight tanks of known capacity and shall be equipped with a pressure pump and spray system with the capability of applying the whole load uniformly. The spray system shall have a positive shut-off control. The water tank shall have a minimum capacity of 1,000 U.S. Gallons, and the capacity shall be clearly marked on the tank. The Contractor may be required to verify the tank capacity. All tanks shall have an air gap at the inlet.

A water meter with a backflow preventer will be used for water dispensing, providing its measurement can be verified. The contractor will pay for the water at a per gallon rate prior to filling the truck. Water payment and filling can be coordinated by contacting the city public works director.

**208.1 DESCRIPTION**

This section covers removal and restoration of existing features, public or private, including but not limited to asphalt or concrete pavement, concrete structures, curb and gutter, sidewalk, gravel surfacing, driveways, crosswalks, landscaping, field crops, irrigation ditches, fences, culverts, buried or exposed utilities, abandoned utilities, small utility buildings and the disposal of resulting waste materials and debris.

**208.1.1 RELATED WORK**

Section 200 - Protection of Existing Properties  
Section 205 - Trench Excavation and Backfill  
Section 209 - Hot Plant Mix Bituminous Surfacing  
Section 210 - Road Mix Bituminous Surfacing  
Section 213 - Pavement Cutting

**208.2 MATERIALS**

**208.2.1 GENERAL**

Restoration work shall be accomplished so as to restore the feature to its original, or better, condition and/or function as it existed prior to removal.

It is recognized that exact duplication of materials cannot always be achieved, but reasonable effort is expected from the Contractor to restore the feature with materials which will provide the same or better service and appearance as observed prior to removal.

All materials shall be new.

**208.2.2 BITUMINOUS SURFACE**

**208.2.2.1 PRIMER OR TACKER COAT** – Shall be an approved bituminous material such as type MC-70-250, SS1, or CS-1.

**208.2.2.2 PATCHING AND REPAIR** - Plant mix material that meets or exceeds the requirements of Section 209 herein, or of the local State Department of Transportation for asphalt surface road repair, shall be used for patching and repair.

**208.2.2.3 SURFACING** – Shall be hot or cold mix bituminous surfacing, meeting or exceeding the requirements of Sections 209 or 210 herein, or of the local State Department of Transportation for asphalt surface road repair.

## **208.3 CONSTRUCTION REQUIREMENTS**

### **208.3.1 UNCLASSIFIED REMOVAL AND RESTORATION**

**208.3.1.1 EXISTING IMPROVEMENTS** - All existing facilities disturbed by the Contractor in prosecution of the Work, including but not limited to asphalt or concrete pavement, concrete structures, curb and gutter, sidewalk, gravel surfacing, driveways, crosswalks, landscaping, field crops, irrigation ditches, fences, culverts, buried or exposed utilities, abandoned utilities, small utility buildings or any other structures or obstructions designated to be removed on the Drawings, by the Engineer/City Representative, or these Specifications, shall be removed, cleaned up, and then restored or replaced in kind by the Contractor in new condition.

**208.3.1.2 ADJACENT IMPROVEMENTS** - Care shall be exercised in such removal to assure that adjacent facilities or structures, which are to remain, are not disturbed. Any damage to such existing facilities or structures resulting from carelessness or negligence on the Contractor's part shall be satisfactorily restored to new condition at the Contractor's expense.

**208.3.1.3 VEGETATION** - Trees, shrubs, and other landscape plants designated to be saved for replanting shall be carefully removed, bundled, set aside and protected for replanting by the Contractor. Turf Sod to be saved for replanting shall be removed by machine cutting. In lieu of removal and replacement of turf sod or field crops, the Contractor may, upon approval of the property owner, remove and replant the same. Such agreements shall be documented on the final property release to be signed by the property owner.

### **208.3.2 TOPSOIL**

**208.3.2.1 REMOVAL AND PROTECTION** - In all construction areas where re-growth of vegetation is desired, and when called for by the Contract Documents, the Contractor shall remove, segregate, stockpile, store, and protect topsoil during excavation. Topsoil shall be kept free from contamination from foreign materials and other soils. The Contractor shall arrange construction activities to avoid damage or disturbance to the stockpiled soil.

**208.3.2.2 REPLACEMENT** - When backfill operations have been completed, the topsoil shall be replaced and restored to the original contours or as called for on the Drawings, in accordance with these Specifications.

### **208.3.3 GRAVEL SURFACE**

**208.3.3.1 REMOVAL** - When restoration of graveled driveways, roadways, or parking areas is required, the existing gravel surfacing shall be graded off and stockpiled safely away from ongoing work activities, to prevent contamination with subsurface materials. It may then be reapplied and compacted during restoration activities.

208.3.3.2 RESTORATION - Areas to be restored shall be backfilled and graded to uniform lines and compacted to the density prescribed for trenching in Section 205. Existing gravel surfacing materials shall then be replaced in uniform 3 inch layers compacted to 95% of maximum density. After compaction, the affected area shall be graded smooth. Sufficient new material of equal or better quality shall be applied and mixed in, to replace materials lost during prosecution of the Work, to ensure a 3-inch minimum gravel cover after compaction and grading.

#### 208.3.4 BITUMINOUS SURFACE

208.3.4.1 REMOVAL - Bituminous pavement surface shall be removed and restored in accordance with this paragraph unless provisions for restoration are made in other Sections of these Specifications. The pavement surface, public or private, designated for removal shall be removed to neat lines. No ripping or rooting will be permitted outside of the limits of the cut lines.

Existing driveways, sidewalks, etc., which do not match the new finish grade as shown on the Drawings, also shall be removed preparatory to restoration work.

208.3.4.2 DISPOSAL - Surfacing materials removed shall be disposed of in accordance with Section 201 of these Specifications, and will not be permitted in the backfill, except as specifically authorized by the Engineer/City Representative and in accordance with local requirements.

208.3.4.3 RESTORATION – Restoration of bituminous surface shall proceed according to the following steps:

- First, the sub-grade shall be graded to a uniform surface, and 6 inches of Untreated Base Coarse (UBC) gravel shall be placed over the area in lifts not thicker than 3 inches, compacted to 95% of its maximum density.
- Then, the exposed edges of existing pavement shall be primed with a material approved for this purpose.
- Unless shown otherwise on the drawings or required otherwise by the Engineer/City Representative, hot or cold mix bituminous surfacing shall be spread and compacted in individual, 3-inch maximum lifts over the base course. Minimum thickness of the new bituminous surfacing layer shall be equal to the adjacent surface thickness, but shall be not less than 3 inches thick when compacted to 95% of its maximum density.
- Rolling operations shall be conducted in such a manner that shoving or distortion will not develop beneath the roller. The surface shall be finished to a smooth, uniform line and grade with surface deviations

not exceeding plus or minus 1/4 inch in 10 feet, unless the surface is subject to more stringent State, County, or Municipal requirements. The determination of smoothness compliance may be made with a straight edge or string line at the option of the Engineer/City Representative. Any irregularities shall be satisfactorily corrected at the sole expense of the Contractor.

- Existing driveways, sidewalks, etc., which were removed because they did not match the new finish grade, shall be replaced and restored to their original or better condition to match the new finish grade shown on the Drawings, or as directed by the Engineer/City Representative.

### 208.3.5 REMOVAL AND RESTORATION OF CONCRETE IMPROVEMENTS.

208.3.5.1 REMOVAL - Existing concrete pavement in streets, alleys, driveways, sidewalks, etc., public or private, shall be cut in accordance with Section 213, and removed to the lines indicated on the Drawings, or as directed by the Engineer/City Representative. No ripping or rooting will be permitted outside of the limits of saw cut lines.

Existing driveways, sidewalks, etc., which do not match the new finish grade as shown on the Drawings, also shall be removed preparatory to restoration work.

208.3.5.3 DISPOSAL - All materials removed shall be disposed of in accordance with Section 201 of these Specifications, and will not be permitted in the backfill, except as specifically authorized by the Engineer/City Representative and in accordance with local codes.

208.3.5.4 RESTORATION - Sub surface preparations shall be the same as those in paragraph 208.3.4.3 above.

- Concrete pavement including sidewalks, driveways, roadways, and parking area surfacing shall be replaced by the Contractor in accordance with Division 3 of these Specifications, unless otherwise directed by the Engineer/City Representative
- Those existing driveways, sidewalks, etc., which were removed because they did not match the new finish grade, shall be replaced and restored to their original or better condition to match the new finish grade shown on the Drawings, or as directed by the Engineer/City Representative.
- Signs which were removed due to project must be replaced.
- All other concrete improvements shall be restored in accordance with details shown on the Drawings, or as directed by the Engineer/City Representative, and as required by the provisions of Division 3 of these Specifications.

#### 208.3.6 REMOVAL AND RESTORATION OF FENCES

When necessary to remove any fence to facilitate its operation, the Contractor shall obtain prior agreement with the owner of the fence for its removal. Temporary containment measures shall be provided, if needed, at no additional expense to the Owner. As soon as practical, the permanent fence shall be restored to its original condition or better.

#### 208.3.7 REMOVAL AND RESTORATION OF SIGNS

When necessary to remove any sign to facilitate its operation, the Contractor shall obtain prior agreement with the owner of the sign for its removal. As soon as practical, the sign shall be restored to its original condition or better.

#### 208.3.8 RESTORATION OF IRRIGATION DITCHES

Restoration of irrigation ditches shall be made in such a manner that the ditch configuration and size will be equivalent to its original condition and the ditch will be located on its original alignment. Any embankment required to restore the original slope of the ditch will be layer compacted with mechanical compaction equipment to 90% of maximum dry density determined by AASHTO T-99.

#### 208.3.9 CLEANUP

Areas of construction activity shall be left in a condition of uniform grade, blending into pre-existing contours and concealing, as much as possible, evidence of construction activity by back dragging or raking to conceal tire marks. Cleanup and disposal of surplus materials shall be performed in accordance with Section 201.

**209.1 DESCRIPTION**

This section covers manufacturing, transporting, laying and compacting hot mixtures of bituminous surfacing for roads, parking areas, sidewalks and other traffic surfaces.

**209.1.1 RELATED WORK**

Section 208 – Removal and Replacement of Surface Improvements  
Section 210 - Road Mix Bituminous Pavement  
Section 211 - Asphalt Tack Coat

**209.1.2 SUBMITTALS**

**209.1.2.1 MIX DESIGN** - The Contractor shall develop and submit proposed mix-designs based on the Marshall Method for Hot Asphalt Paving Mixtures as established in AASHTO T 245. The submittal shall include a laboratory report incorporating all of the information required by that specification, together with curves developed from the mix designs showing varying percentages of asphalt by dry weight of mix versus unit weight, percent air voids, stability, flow and percent voids in mineral aggregate.

**209.1.2.2 JOB MIX FORMULA** – At least 15 days prior to producing bituminous mixtures, the Contractor shall submit to the Engineer/City Representative, in writing, a proposed job-mix formula for each mixture for use in setting the job-mix formula to be used with the proposed materials. For bituminous mixtures, the proposed job-mix formula shall be based on a mix-design-run on aggregates, crushed or otherwise, produced for the project and using the bituminous material that will be furnished for the project.

Each job-mix formula shall propose definite single values (hereafter referred to as Target Values or TV) for:

- The percentage of aggregate passing each specified sieve based on the dry weight of aggregate. These percentages shall be within the range shown in Table 2-H.
- The percentage of bituminous material to be added based on the total weight of mixture.
- The temperature of the mixture as it leaves the mixer.
- The temperature of the mixture placed on the road immediately preceding initial compaction of the mixture.



- The kind and percentage of additives to be used (Hydrated lime may be added to prevent stripping).
- The kind and percentage of mineral filler to be used.
- The percentage of water, based on the total dry weight of mixture.
- The maximum specific gravity of dense graded hot mix bituminous paving mixtures as determined by AASHTO T 209 (For open graded hot mixes, the laboratory density developed during mix design shall be used as the TV. It shall be the maximum density for the TV bituminous content).
- The mixture shall have a minimum dry retained strength value of 200 psi.

After reviewing the Contractor's proposed job-mix formula, the Engineer/City Representative shall determine a job-mix formula with single values for the nine parameters listed above, and so notify the Contractor in writing.

Should a change in source of material be proposed, or should a job-mix formula prove unsatisfactory, the Contractor shall establish a new job-mix formula and shall submit same to the Engineer/City Representative.

209.1.2.3 PENETRATION/VISCOSITY/TEMPERATURE RELATIONSHIPS - The Contractor shall submit penetration/viscosity/temperature relationships for the bituminous material to be used in the Work along with a certification from the supplier attesting to their accuracy. If the supplier finds it desirable or necessary to change crudes or blends of crudes, new relationships must be supplied along with a sample to use in running a new mix-design. This submittal shall be made not less than 15 days prior to delivery of material from the changed source of materials. The penetration and viscosity values shall be determined at the temperatures and by the procedures specified in AASHTO M 226.

### 209.1.3 DEFINITIONS

Plant - Stationary machinery used for manufacturing mixtures of asphalt cement, liquid asphalt with aggregate to form a uniform mixture of bituminous surfacing. Sometimes referred to as "batch plant".

Aggregate - Crushed stone, gravel or slog with uniform particle sizes.

Gradation - A group of particle size limits that are prescribed for aggregate.

Job-Mix Gradation - A gradation of aggregate which has been developed by a contractor or material supplier which can consistently be produced from a given source.

Job-Mix Formula - A mixture of asphalt materials and aggregate which can be consistently produced from a given source with the available plant of a contractor or material supplier.

Course - A single layer of bituminous surfacing.

Mat - Single or multiple layers of bituminous surfacing which have been placed.

Lot - The amount of bituminous mixture placed during a production day.

## **209.2 MATERIALS**

### **209.2.1 ASPHALT CEMENT**

Shall meet the requirements of AASHTO M 20 for penetration-graded asphalt cement and AASHTO M 226 for viscosity-graded asphalt cement. When not shown otherwise, the Contractor shall use viscosity grade AC-20 asphalt cement for the bituminous mixture.

### **209.2.2 AGGREGATES**

Aggregates for hot bituminous mixtures shall be crushed stone, slag or gravel meeting the quality and gradation requirements shown below in Tables 1-H and 2-H.

When crushed gravel is used, at least 50 percent by weight of the particles retained on the Number 4 sieve shall have at least one mechanically fractured face.

**TABLE 1-H CRUSHED AGGREGATE QUALITY REQUIREMENTS FOR HOT BITUMINOUS PAVEMENT.**

| <b>Description</b>                            | <b>AASHTO Test Method</b> | <b>Requirements</b> |
|---|---------------------------|---------------------|
| Percent Wear                                  | T 96                      | 40 max.             |
| Durability Index, Coarse and Fine             | T 210                     | 35 min.             |
| Sand Equivalent (Alternative Method Number 2) | T176                      | 45 min              |
| Stripping Test                                | T 182                     | Min. 95% coated**   |

\*\* An approved chemical additive may be used to meet this requirement.

**TABLE 2-H GRADATION LIMITS FOR CRUSHED AGGREGATE USED IN HOT BITUMINOUS SURFACING.**

| Sieve Size                       | Percent of Total Aggregate (dry weight) |   |  |  |
|----------------------------------|---|---|--|--|
|                                  | 1-inch<br>(1)                           | <sup>3</sup> / <sub>4</sub> -inch<br>(2)<br>(Non-rutting) | <sup>3</sup> / <sub>4</sub> -inch<br>(3) | <sup>1</sup> / <sub>2</sub> -inch<br>(4) |
| 1 inch                           | 100                                     |   |  |  |
| <sup>3</sup> / <sub>4</sub> inch |   | 100   | 100                                      |  |
| <sup>1</sup> / <sub>2</sub> inch | 75-91                                   | 74-99   |  | 100                                      |
| <sup>3</sup> / <sub>8</sub> inch |   | 69-91   | 75-91                                    |  |
| No. 4                            | 47-61                                   | 49-65   | 46-62                                    | 60-80                                    |
| No. 8                            |   | 33-47   |  |  |
| No. 16                           | 23-33                                   | 21-35   | 22-34                                    | 28-42                                    |
| No. 50                           | 12-22                                   | 6-18  | 11-23                                    | 11-23                                    |
| No. 200                          | 5-9                                     | 2-6   | 5-9                                      | 5-9                                      |

When aggregate is produced and/or stockpiled in more than one size, the blend of sizes shall be based on results of mix design properties that yield the most ideal results. The blended gradations; however, must stay within the gradation limits given herein.

**209.3 CONSTRUCTION REQUIREMENTS**

209.3.1 BITUMINOUS SURFACE MIXING, PLACEMENT, AND FINISHING

209.3.1.1 PLANT DESIGN AND EQUIPMENT - Plants shall be specifically designed and manufactured to produce a uniform bituminous mixture. The plant shall be capable of controlling and accurately proportioning both aggregates and asphalt cement. Automatic controls shall be provided to shut down the plant when a supply of aggregate or bituminous material is not available.

The plant shall be equipped with appropriate dust collectors and/or control equipment, which enable operation of the plant to meet local and State environmental and health requirements. Liquids from a wet scrubber, when used, shall not be discharged into live streams, lakes or ponds. Effluent from such equipment shall be collected and deposited according to applicable State and local requirements.

Thermometers shall be installed in the plant to accurately indicate the temperature of the bitumen at the charging value in the mixer unit and at the discharge chute of the mixer unit.

Accurate weight measurement of ingredients is essential. Bituminous mix plants shall have associated weight measurement equipment (scales, etc.) with an incremental accuracy of not more than 10 pounds to weigh materials.

209.3.1.2 MIXING - The aggregates, bituminous material, additives, mineral filler and water shall be measured or gauged and introduced into the mixer in the amount specified by the job mix formula. The bituminous material shall be evenly heated to the specified temperature. A continuous supply of the bituminous material shall be fed to the mixer at a uniform temperature. The temperatures of asphalt cement delivered to the mixer shall be sufficient to achieve a kinematic viscosity of 150 to 300 centistokes.

Aggregate for pugmill mixing shall be heated, dried, and delivered to the mixing unit at a temperature within  $\pm 30^{\circ}\text{F}$  of the temperature of the bitumen, temperature not to exceed 325 degrees F. Moisture content of the aggregate shall not exceed 1 percent at the time it is introduced into the mixing unit. Flames used for drying and heating shall be properly adjusted to avoid damage to, and soot formation on, the aggregate.

After the required amounts of all materials have been introduced into the mixer, the ingredients shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate have been obtained.

209.3.1.3 HAULING - Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds that have been thinly coated with a material to prevent the mixture from adhering to the beds. Truck beds shall not contain any water or deleterious material prior to loading.

The Contractor, at no cost to the Owner, shall provide scales for weighing the vehicles used for hauling the bituminous mixture. If of the required accuracy, these scales may be the same as those used to weigh ingredients at the mix plant. The Contractor shall provide such scales at no additional cost to the Owner

209.3.1.4 PLACEMENT - Except for small areas inaccessible to such equipment, hot bituminous mixtures shall be placed with bituminous pavers. Pavers shall be self-contained, power-propelled units, provided with an adjustable activated-screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in lane widths and thickness' as shown on the Drawings. When shown on the Drawings, pavers shall be equipped with a control system capable of automatically maintaining the proper screed elevation.

Placement of the bituminous mixture shall be continuous. The mixture shall be spread and struck off to the grade and elevation established in the Contract Drawings. Unless otherwise shown on the Drawings, mix shall be placed in lifts which, when compacted, will not exceed 4-inches in thickness.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6-inches, making sure that the joint in the top layer shall be at the center or dividing line of every two-lanes of

traveled roadway. Transverse joints in succeeding layers and in adjacent lanes shall be offset at least 10-feet.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable (along forms, curbs, headers, walls and other places), the mixture shall be placed and finished using hand tools and then thoroughly compacted with hot hand tampers, smoothing irons or mechanical tampers.

Bituminous surface shall not be placed when: weather conditions prevent proper handling, hauling and placing of the mixture; when the base course is frozen; or when the average temperature of the underlying surface is below 35 degrees F. and air temperature is rising. Placement on water covered surfaces will not be permitted.

209.3.1.5      **COMPACTION** - Compaction shall be performed with vibratory or non-vibratory steel-wheel rollers and pneumatic-tire rollers. Initial breakdown rolling shall be accomplished while the mix temperature exceeds 250° F. Rolling shall be completed before the mix temperature drops to 175° F.

Rollers shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping 6-inches or two times the pavement depth, whichever is greater, gradually progressing to the center. When paving in echelons or abutting a previously placed lane, the longitudinal joint should be rolled first, then followed by the above rolling procedure. On super-elevated curves, the rolling shall begin at the low side and progress to the high side.

Rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back into the previous run to expose the full depth of the course. Heat shall be applied to contact surfaces of transverse joints just before additional mix is placed against them.

209.3.2      **EXCESS BITUMINOUS SURFACE MATERIAL.**

Material trimmed from the edges, together with any other discarded bituminous mixture, shall be removed from the roadway and disposed of by the Contractor in an approved area.

209.3.3      **TESTING**

209.3.3.1      **CONTRACTOR TESTING** - The Contractor shall be responsible for providing the necessary tests for controlling and maintaining the mixture within the limits indicated in the approved job-mix formula. Sampling and testing will be performed on each lot of material as it is placed. Gradation and asphalt content samples will be taken immediately behind the paver at the following rate:

## LOT TESTING

| <b>Lot Size –Sq.Yds.</b> | <b>Minimum Number of Samples</b> |
|--------------------------|----------------------------------|
| 1500 and greater         | 4                                |
| Less than 1500           | 3                                |

Density and thickness samples will be taken at a rate of one sample per each lot of up to 1500 square yards. When lot size exceeds 1500 square yards, two samples will be taken.

Checks for smoothness will be made at locations selected by the Engineer/City Representative for each lot. Smoothness checks will not be required where transitions or variations will not allow compliance with the criteria.

Acceptance of bituminous material placed shall be made by comparing test results with the job-mix formula and the dimensions provided in these Specifications. Acceptance of each lot will be given when test results are within the following tolerances:

### BITUMINOUS TEST

| <b>Test</b>     | <b>Maximum Deviation</b>                              |
|-----------------|---|
| Asphalt Content | Mean of tests on each lot is less than 1%             |
| Gradation       | Mean of tests for any sieve size is less than 10%     |
| Density         | Any test is 92% or greater                            |
| Thickness       | Any test is less than 0.5-inches                      |
| Smoothness      | 0.25-inches in 10-feet longitudinally or transversely |

Any corrective measures necessary to bring the bituminous surface into compliance must be made while the surface temperature is still greater than 175° F.

- 209.3.3.2 ENGINEER/CITY REPRESENTATIVE TESTING – At his own discretion, the Engineer/City Representative also may spot-check the bituminous mix for acceptability and for determination of compliance with installation requirements. These spot-checks will not be used for acceptance but for guidance. On request, the results will be made available to the Contractor by the Engineer/City Representative.

**210.1 DESCRIPTION**

This section covers the requirements for furnishing bituminous and aggregate materials, mixing those materials in place on graded surfaces and laying and compacting those mixtures for roads, parking areas, and other traffic surfaces.

**210.1.1 RELATED WORK**

Section 211 - Asphalt Tack Coat

**210.1.2 SUBMITTALS**

Not used.

**210.1.3 DEFINITIONS**

Blade - The grading or manipulation of road surfacing materials with a road grader blade.

Aggregate - Crushed stone, gravel or slag with uniform particle sizes.

Gradation - A group of particle size limits that are prescribed for aggregate.

Course - A single layer of bituminous surfacing.

Mat - A single or multiple layers of bituminous surfacing, which have been placed.

**210.2 MATERIALS****210.2.1 ASPHALT**

The asphalt shall be the type and grade of asphalt shown on the Drawings and shall meet the current requirements contained in the "Standard Specifications for Paving and Industrial Asphalts" issued by the Asphalt Institute. When the asphalt type and grade are not shown on the Drawings, or in these Specifications, MC-70 or MC-250 liquid asphalt will be acceptable.

**210.2.2 AGGREGATE**

Aggregate shall be crushed stone, slag or gravel meeting the quality and gradation requirements shown below in Tables 1-R and 2R, unless shown otherwise in the Special Provisions or elsewhere in the Contract Documents. At least 50 percent by weight of the particles retained on the

Number 4 sieve shall have at least one mechanically fractured face. Aggregates may be sampled and tested at random and must meet the requirements below. Failure of materials to meet the requirements of these standards may result in rejection of all materials placed prior to the tests.

**TABLE 1-R: CRUSHED AGGREGATE QUALITY REQUIREMENTS FOR ROAD-MIX BITUMINOUS PAVEMENT**

| Description                                   | AASHTO Test Method | Requirements             |
|---|--------------------|--------------------------|
| Percent Wear                                  | T 96               | 40 max.                  |
| Durability Index, Coarse and Fine             | T 210              | 35 min.                  |
| Sand Equivalent (Alternative Method Number 2) | T176               | 45 min.                  |
| Stripping Test                                | T 182              | Min. 95%                 |
|   |                    | co<br>at<br>ed<br>*<br>* |

\*\* An approved chemical additive may be used to meet this requirement.

**TABLE 2-R: GRADATION LIMITS FOR CRUSHED AGGREGATE USED IN ROAD-MIX BITUMINOUS SURFACING**

| Sieve Size                       | Percent of Total Aggregate (dry weight) |
|----------------------------------|---|
|                                  | <sup>3</sup> / <sub>4</sub> -inch       |
| <sup>3</sup> / <sub>4</sub> inch | 100                                     |
| <sup>1</sup> / <sub>2</sub> inch | ---                                     |
| <sup>3</sup> / <sub>8</sub> inch | 78-92                                   |
| No. 4                            | 55-67                                   |
| No. 8                            | ---                                     |
| No. 16                           | 28-38                                   |
| No. 50                           | ---                                     |
| No. 200                          | 7-11                                    |

### 210.3 CONSTRUCTION REQUIREMENTS

#### 210.3.1 BITUMINOUS MIXTURE

210.3.1.1 SCALES - If scales are not available for weighing vehicles used for hauling the aggregate and bituminous material, the Contractor shall provide such scales at no cost to the Owner.

210.3.1.2 AGGREGATE - When aggregate on the existing surface is to be used for the bituminous mixture, that aggregate shall be scarified to the depth indicated on the Drawings and bladed into a windrow away from the surface being constructed. The exposed surface shall then be uniformly bladed and rolled, or watered and rolled to form a tight, lightly moistened surface.



When new aggregate is to be used for the bituminous mixture, the existing base shall be lightly scarified and bladed to a uniform grade to the dimensions shown on the Drawings. This graded surface shall then be rolled, or watered and rolled, to form a tight lightly moistened surface. Aggregate then shall be placed on the prepared surface and bladed into a uniform section which can be easily measured to check its volume.

If the surface moisture of the aggregate is greater than 3 percent of the dry weight of the aggregate and emulsified asphalt is not being introduced, the aggregate shall be aerated by movement until its moisture content is reduced to 3 percent or less. When an acceptable moisture content is achieved, the aggregate shall be spread into a uniform layer of convenient width for introduction of the bituminous material.

#### 0210.3.1.3 MIXING – Mixing of materials shall be as follows:

- For blade grader mixing, application of bituminous material to the aggregate shall be accomplished with a distributor designed, equipped, maintained and operated so that bituminous material will be applied in successive applications at an even temperature and uniform rate on variable widths of surface up to 12-feet. The distributor must be capable of controlling rates of application from 0.05 to 2.0 gallons per square yard, with uniform pressure and with a variation from the rate set not to exceed 0.02 gallon per square yard. Operable measuring equipment shall be included on the distributor which includes a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring the temperature of the bituminous material in the tank. Asphalt viscosity shall range between 50 and 200 centistrokes at application. Distributors shall be equipped with (1) a power unit for the pump and (2) full circulation spray bars that adjust laterally and vertically.
- Traveling mixers shall not be used to introduce the bituminous material, unless specifically authorized in writing by the Owner. Approval also must be obtained in writing from the Owner before moving the unit to the work site.
- No more than 0.50 gallon of bituminous material shall be applied per square yard in any one application. Partially mix the asphalt material with the aggregate immediately after each application. Windrow and mix the entire surface course after the last application of asphalt by blading the mixture from side to side of the roadway. The mixture shall be blade mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is achieved, and no more than 50% of the original volatiles shall remain in the mix. The mixture shall be uniform in appearance, texture, asphalt content, and free from pockets of segregated aggregates. The Contractor shall not cut into the underlying base course or contaminate the mixture with earth or other foreign matter while mixing.

- Any excess or deficiency of material in the mix shall be corrected by the addition of aggregate or bituminous material as appropriate and the bituminous mixture re-mixed until it meets requirements. Should the mixture show an uneven distribution of materials, the materials shall be re-mixed until this condition is corrected.

## 210.3.2 PLACEMENT

210.3.2.1 SPREADING - The spreading of the mix shall not be started until the surface to be covered is approved by the Owner. Form the completed mixture in a windrow of approved cross section and spread in a single course to the plan elevations, grades, and cross sections.

210.3.2.2 WINDROWING MATERIAL AT DAY'S END - At the end of each day's work or if work is halted for other reasons, all loose material shall be bladed into a windrow, whether all mixing is complete or not, and retained in that windrow until operations are resumed. Do not leave non-compacted spread material on the roadbed overnight.

210.3.2.3 WEATHER CONDITIONS - The bituminous mixture shall not be placed when weather conditions prevent proper mixing and placing of the mixture; when the base course is frozen; or when the average temperature of the underlying surface is below 50° Fahrenheit and air temperature is rising. Placing on water covered surfaces will not be permitted.

## 210.3.3 COMPACTION

210.3.3.1 ROLLING - Steel-wheel rollers and pneumatic-tire rollers shall have a total compacting width of not less than 60-inches and a gross weight adjustable within the range of 200 to 350 pounds per inch of compaction width. All tires on the pneumatic roller shall be equally inflated and have a means of adjusting the contact pressure to suit project conditions. Roll without shoving or distorting the surface.

Initial rolling shall be with the pneumatic-tire roller and final rolling shall be completed with a steel-wheeled roller. Rollers shall begin at the sides and proceed longitudinally parallel to the center of the surface being placed, each trip overlapping 6-inches or two times the pavement depth, whichever is greater, gradually progressing to the center. When paving in echelons or abutting a previously placed lane, the longitudinal joint should be rolled first, then followed by the above rolling procedure. On super-elevated curves, the rolling shall begin at the low side and progress to the high side.

210.3.3.2 IRREGULAR AREAS - On areas where irregularities or unavoidable obstacles make the use of mechanical equipment impracticable, (along forms, curbs, headers, walls and other places) the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons or mechanical tampers.

210.3.3.3 TOLERANCES - Finish to a smooth, uniform line and grade with surface deviations not exceeding plus or minus 3/8-inch in 10 feet.

210.3.4 TESTING

210.3.4.1 CONTRACTOR TESTING - The Contractor shall be responsible for providing the necessary tests for controlling and maintaining the mixture within the limits indicated in these Specifications and the Drawings.

210.3.4.2 OWNER TESTING - The Owner may also make tests for spot-checking acceptability and determination of compliance with installation requirements.

210.3.4.3 SAMPLING - Sampling and testing will be performed on each lot of material placed. A lot equals the amount of material placed during a production day. When production is less than 500 square yards per day, the Owner may not require sampling and testing.

210.3.4.4 THICKNESS SAMPLES - Thickness samples will be taken at a rate of one sample per each lot of up to 1500 square yards. When lot size exceeds 1500 square yards, two samples will be taken. Specified thickness standards may be waived if additional thickness is required by the approved Contractor's drawings to level an existing surface.

210.3.4.5 SMOOTHNESS CHECKS - Checks for smoothness will be made at locations selected by the Owner for each lot. A straight edge or string line shall be used to determine smoothness compliance. Smoothness checks will not be made where transitions or variations will not allow compliance with the criteria.

210.3.5 EXCESS MATERIAL

Material trimmed from the edges and any other discarded bituminous mixture shall be removed from the roadway and disposed of by the Contractor in an approved manner conforming to State environmental codes and regulations.

**211.1 DESCRIPTION**

This section covers preparing an existing bituminous or concrete surface and then furnishing and applying an asphalt coating to it.

**211.1.1 RELATED WORK**

Section 209 - Hot Plant Mix Bituminous Pavement  
Section 210 - Road Mix Bituminous Pavement

**211.1.2 SUBMITTALS**

Not used.

**211.1.3 DEFINITIONS**

Not used.

**211.2 MATERIALS**

The asphalt coating shall meet the current requirements contained in the "Standard Specifications for Paving and Industrial Asphalts" issued by the Asphalt Institute, for the type and grade of asphalt shown on the Drawings or in these Specifications. When the asphalt type and grade are not shown on the Drawings or in these Specifications, SS-1 or SS-1h emulsified asphalt diluted with not more than one part water to one part emulsified asphalt will be acceptable.

**211.3 CONSTRUCTION****211.3.1 WEATHER LIMITATIONS**

Tack coats shall be applied only when air and roadbed temperatures in the shade are greater than 50° F. Application of tack coats shall not be made during rain, fog, dust, or other unsuitable weather.

**211.3.2 PREPARATION**

Prior to application of the tack coat, the receiving surface shall be broomed to remove dust and loose foreign materials. The Contractor shall provide notice of application to adjacent property owners 24 hours prior to applying the coating. Appropriate measures shall be taken to provide crossings for foot or vehicular traffic to minimize tracking of freshly applied tack coating.

If flushing of the surface with water is necessary for removal of dust and

foreign material, the Engineer/City Representative may require flushing. When flushing is ordered, the Contractor will be authorized compensation for flushing by issuance of a Change Order.

### 211.3.3 APPLICATION

Limit application of tack coats to areas which can be covered with an asphalt pavement layer that same day when possible.

Application of the coating shall be accomplished with a distributor designed, equipped, maintained and operated so that bituminous material will be applied at an even temperature and uniform rate on variable widths of surface up to 16-feet. The distributor must be capable of controlling rates of application from 0.05 to 2.0 gallons per square yard, with uniform pressure and with a variation from the rate set not to exceed 0.02 gallon per square yard. Operable measuring equipment shall be included on the distributor which includes a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperature of the bituminous in the tank. Distributors shall be equipped with (1) a power unit for the pump; (2) full circulation spray bars that adjust laterally and vertically; and (3) a hose and nozzle attachment for applying material to areas inaccessible to the distributor spray bar.

Spray rates for the coating shall be as required by these Specifications. When no rate is specified otherwise, the Engineer/City Representative may require an application rate for emulsions of 0.05 to 0.15 gallons per square yard.

### 211.3.4 PROTECTION

Protect adjacent structures,(curbing, sidewalks, guardrails, sign posts, etc.) from being spattered or marred by covering with suitable materials. The expense of removal of such spattering shall be born by the Contractor.

Traffic shall not be allowed to travel over the freshly applied coating until it has cured sufficiently to not be picked up by traffic.

**212.1 DESCRIPTION**

This section covers preparing an existing bituminous surface and then furnishing and applying an asphalt coating, followed with an application of cover aggregate when required.

## 212.1.1 RELATED WORK

Not used.

## 212.1.2 SUBMITTALS

Not used.

## 212.1.3 DEFINITIONS

Not used.

**212.2 MATERIALS**

## 212.2.1 ASPHALT COATING

The asphalt coating shall meet the current requirements contained in the “Standard Specifications for Paving and Industrial Asphalts” issued by the Asphalt Institute, for the type and grade of asphalt shown on the Drawings or in these Specifications. When the asphalt type and grade is not shown on the Drawings or in these Specifications, LM CRS-2A emulsified asphalt diluted with not more than one part water to one part emulsified asphalt will be acceptable.

## 212.2.2 COVER AGGREGATE

Cover aggregates shall be crushed slag or natural aggregates which meet requirements for quality and gradation shown below in Table S-1, unless shown otherwise in the Special Provisions.

**TABLE S-1 - COVER AGGREGATE QUALITY AND GRADATION REQUIREMENTS**

| Characteristic/Sieve Size  | AASHTO Method | Test Requirement       |
|--|---------------|------------------------|
| Quality  |               |                        |
| <i>Wear</i>  | T-96          | 40% maximum            |
| Stripping  | T-182         | 95% maximum (coated**) |
| Durability Index   | T-210         | 35% minimum            |
| One mechanically fractured face to material retained on No. 8 Sieve. |               | 50% minimum            |
| Gradation  |               |                        |
| 1/2-inch   | T-11          | 100% passing           |
| 3/8-inch   | T-11          | 70 100 % passing       |
| No. 4  | T-11          | 0-20% passing          |
| No. 8  | T-11          | 0-5% passing           |
| No. 200  | T-11          | 0-2% passing           |

\*\* An approved chemical additive may be used to meet this requirement.

The aggregate shall be clean and contain less than 2 percent moisture based on dry weight.

## 212.3 CONSTRUCTION

### 212.3.1 WEATHER LIMITATIONS

Seal coats shall be applied between May 15 and August 31 and only when air and roadbed temperatures in the shade are greater than 65 degrees F. Application of seal coats shall not be made during rain, fog, dust, or other unsuitable weather. Written approval must be obtained from the Engineer/City Representative to apply the seal coating at any other time or condition.

### 212.3.2 PREPARATION

212.3.2.1 CLEANING - Within four hours prior to application of the asphalt coat, the receiving surface shall be broomed to remove dust and loose foreign materials. The Contractor shall provide notice of application to adjacent property owners not less than 24 hours prior to applying the coating. Appropriate measures shall be taken to provide control of foot or

vehicular traffic to protect and minimize tracking of the freshly applied seal coating.

212.3.2.2 FLUSHING - If flushing of the surface with water is necessary for removal of dust and foreign material, the Engineer/City Representative may require flushing. When flushing is ordered, the Contractor will be authorized compensation for flushing by issuance of a Change Order if the reason for flushing is caused by something other than the contractor.

### 212.3.3 APPLICATION

212.3.3.1 ASHPALT DISTRIBUTOR - Application of the asphalt material shall be accomplished with a distributor designed, equipped, maintained and operated so that bituminous material will be applied at an even temperature and uniform rate on variable widths of surface up to 12-feet. The distributor must be capable of controlling rates of application from 0.05 to 2.0 gallons per square yard, with uniform pressure and with a variation from the rate set not to exceed 0.02 gallon per square yard. Operable measuring equipment shall be included on the distributor which includes a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperature of the bitumen in the tank. Distributors shall be equipped with (1) a power unit for the pump; (2) full circulation spray bars that adjust laterally and vertically; and (3) a hose and nozzle attachment for applying material to areas inaccessible to the distributor spray bar.

The distributor shall be moving forward at the proper application speed when the spray bar is actuated. Junctions of spreads shall be carefully joined, without overlap, to ensure a smooth surface results after the seal coating is applied. Transverse joints shall be made by using building paper to mask off previous adjoining seal coatings. Upon completion of a joint, the building paper and coating material shall be removed and disposed in a manner consistent with local waste disposal requirements.

Spray rates for the coating shall be as required by the Drawings or these Specifications. When no rate is specified otherwise, the Engineer/City Representative may require an application rate of 0.35 to 0.40 gallons per square yard.

212.3.3.2 AGGREGATE SPREADING - The aggregate spreader shall be specifically designed for uniformly depositing aggregate over a surface at variable controlled rates. Spreading of aggregate directly from a dump truck will not be approved. Spreading of aggregate on areas inaccessible to spreading equipment will be accomplished by hand spreading with shovels and rakes and then rolled with hand-operated rollers or compactors sufficiently to embed the aggregate. Spreading operations shall proceed in a manner that the aggregate contacts the bituminous material before it chills, sets up, dries, or other conditions occur that may impair adhesion of the aggregate to the asphalt. The aggregate spreader shall be operated so that it is not more than 100-



feet behind the asphalt distributor and so that the bituminous material will be covered with aggregate before any traffic passes over it.

Any piles or ridges of aggregate materials resulting from uneven distribution shall be removed before any rolling over the area. Initial rolling shall consist of one pass with a pneumatic-tire roller in a longitudinal direction. The amount of rolling shall be sufficient to uniformly bond the aggregate over the full width, and in no case shall be less than three complete coverages.

#### 212.3.4 PROTECTION

212.3.4.1 ADJACENT STRUCTURES - Adjacent structures, (curbing, sidewalks, guardrails, sign posts, etc.) shall be protected from being spattered or marred with sprayed asphalt by covering with suitable materials. The removal of resulting spattering shall be made at the expense of the Contractor.

212.3.4.2 TRAFFIC - Controlled traffic shall not be allowed to travel over the freshly applied coating for 4 hours after it has been rolled and cured sufficiently not to be picked up by traffic. The finished surface shall be swept to remove loose aggregate particles before allowing uncontrolled traffic on it.

**213.1 DESCRIPTION**

This section covers cutting through designated sections of bituminous and/or concrete pavement surface with approved equipment in preparation for pavement removal.

**213.1.1 RELATED WORK**

Section 208 - Removal and Replacement of Surface Improvements  
Section 205 - Trench Excavation and Backfill

**213.1.2 SUBMITTALS**

Not used.

**213.1.3 DEFINITIONS**

Not used.

**213.2 MATERIALS**

Not used

**213.3 CONSTRUCTION REQUIREMENTS****213.3.1 SAW CUTTING**

**213.3.1.1 NEATNESS IN CUTTING** - Pavement cuts shall be made with a saw to produce straight vertical cuts through the full depth of the surfacing layer. The Contractor is responsible to preserve and maintain a neat clean edge on the cut pavement to facilitate pavement repair or replacement under Section 208.

**213.3.1.2 CUT MATERIALS TO BE LEFT IN PLACE** - Cut pavement materials shall be left in place. Removal of cut pavement will be included as part of other work items in this Contract.

**2520.3.1.3 BROKEN PAVEMENT** - When pavement has deteriorated or is severely cracked and broken, the Contractor shall discontinue cutting operations and obtain direction from the Engineer/City Representative as to how cutting should proceed.

If pavement is broken after saw cutting and prior to replacement, the Contractor shall re-cut the pavement. Such re-cutting shall not be measured for payment.

**213.3.2 WHEEL CUTTING**

Wheel cutting is not permitted.

### 213.3.3 ROTOMILLING

Rotomilling of existing pavement is an acceptable alternative to saw cutting, providing that the resulting pavement edges are left clean and neat. Rotomilled material may be suitable for trench backfilling or as a substitute for road base. For such use, rotomilled material must meet the following conditions: that: no chunks or pieces larger than one inch in any dimension are used, that it is placed in separate lifts from untreated base course, that it is compacted to 95% of its maximum density, and that it is acceptable to the Engineer/City Representative and to the Owner.

**214.1 DESCRIPTION**

This section contains requirements for Portland cement concrete materials and concrete mix designs.

**214.1.1 RELATED MATERIALS AND WORK**

Section 215 - Concrete Forming, Finishing and Curing  
Section 216 - Concrete Reinforcement

**214.1.2 SUBMITTALS**

**214.1.2.1 PROPOSED MIX DESIGN** - Each proposed mix design shall be submitted 14 days prior to its use in the Work. Indicate whether mix has been designed for pumping. Mix design submittals shall include the following information:

- Water-cement ratio.
- Proportion of materials in the mix.
- Source and type of cement.
- Analysis of water to be used, unless potable.
- Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times.
- Slump, air content, and temperature of samples.
- Unit weights of fresh and dry light weight concrete.
- Any applicable and verifiable test documentation available if the submitted mix design has been used by the Contractor in prior projects.

**214.1.2.2 AGGREGATE TEST REPORT** - Aggregate Test Report (submit for each aggregate source):

- Data of test analysis.
- Sieve analysis.
- Organic impurities.
- Sodium sulfate soundness test.
- Reactivity of aggregate.
- Complete identification of source of aggregate.

**214.1.2.3 CHANGES IN MIX DESIGN** - After the design of the mix or mixes has been approved by the Engineer/City Representative, neither the source, character, or grading of the aggregate, nor the brand or type of cement shall be changed, without 48 hours written notice to the Engineer/City Representative. Should such changes become necessary, no concrete containing such new or altered materials shall be placed until the revised mix design has been submitted to the Engineer/City Representative for review and approval.

### 214.1.3 DEFINITIONS

Workability - The ease of placing, consolidating and finishing freshly mixed concrete.

Consolidation - Hand rodding or mechanically vibrating actions which give freshly mixed concrete the characteristics of a thick fluid so as to minimize voids when set.

Hydration - The chemical reaction between water and calcined limestone resulting in the excellent bonding properties of the cement particles with one another and with the aggregates in the mix.

Curing – Synonymous with the hydration reaction. May be enhanced by procedures which assure the retention of sufficient moisture to allow the reaction to go as far to completion as possible.

Strength - The maximum resistance of a mortar or concrete specimen to axial compressive loading expressed in psi.

Admixtures - Chemical additives to concrete mixes intended to adjust setting time, reduce water demands, increase workability and entrain air.

Air Entrainment - Introduction of chemicals to concrete mixtures which produce microscopic air bubbles which improve the workability and ability to resist deterioration due to freezing.

Reinforcement - Materials formed or mixed in concrete mixtures, to increase the ability of the concrete to withstand loading when set (hardened).

Water-Cement Ratio - The weight of the water divided by the weight of the cement in a concrete mixture.

Tempering - The addition of water to mixed concrete after arrival on site.

## 214.2 MATERIALS

### 214.2.1 CEMENT

214.2.1.1 **SITE-PLACED CONCRETE** - For site-placed concrete, cement shall be Type II (low alkali) cement, meeting requirements of ASTM C-150, unless otherwise directed by the Engineer/City Representative or these Specifications. Do not use cement containing lumps, or cement which has partially set. Do not mix cements originating from different sources or manufacturers.

214.2.1.2 **PRE-CAST CONCRETE** - For pre-cast concrete, cement shall be Class 5000 (minimum) in accordance with ACI 318 for units to be installed above ground. For units installed below ground, concrete shall be Class 4000 in accordance with ASTM C 478 and ASTM C 858.

## 214.2.2 WATER

Shall be potable or water which meets the requirements of AASHTO T-26.

## 214.2.3 REINFORCEMENT

Shall be in accordance with Section 216 of these Specifications.

## 214.2.4 ADMIXTURES

214.2.4.1 AIR ENTRAINMENT - Air entrainment of concrete shall meet the requirements of AASHTO M-154 (ASTM C-260).

214.2.4.2 PLASTICIZERS - Water reducing agents (plasticizers) and set retarding agents shall meet the requirements of AASHTO M-194 (ASTM C-494). Only types A or F will be approved as water reducing agents and only types D or G will be approved as set retarding agents. Water reducing agents and set retarding agents shall be pre-measured and added in strict accordance with manufacturer's instructions. Calcium chloride will not be approved.

214.2.4.3 FLY ASH - Pozzolan (fly ash) may be used to replace a percentage of cement in the mix design in accordance with ASTM C-618, under the following conditions:

- The minimum required cement content shall be expressed in the design formula before replacement calculations are made.
- The amount of Portland cement replaced by pozzolan shall be not exceed 15% for exterior concrete (concrete exposed to weather) and 20% for interior concrete.
- The ratio of replacement by weight of pozzolan to cement shall be 1.25 to 1.0.
- Loss of ignition of pozzolan shall be less than 3 percent, and the water requirement shall not exceed 100 percent.
- All other requirements of this Section still apply.
- Mix designs including trial batches are required for each aggregate source and for each concrete class.
- See also Subsection 216.2.7.4 below.

## 214.2.5 AGGREGATE

214.2.5.1 AGGREGATE RATIO - The combined weight of coarse and fine

aggregate material passing the No. 200 sieve shall not exceed 1.75 percent of the total weight of aggregate. The ratio of coarse to fine aggregate shall not be less than one (1) nor more than two (2), nor shall the amount of coarse aggregate be great enough to cause difficulty in concrete placement or honeycombing in the structure.

214.2.5.2 COARSE AGGREGATE - Coarse aggregate shall comply with AASHTO M-80, using gradations from the following table:

**COARSE AGGREGATE GRADATIONS**

| Aggregate Size | Percent Passing (by weight) |        |        |        |        |       |       |       |
|----------------|-----------------------------|--------|--------|--------|--------|-------|-------|-------|
|                | Sieve Size                  |        |        |        |        |       |       |       |
|                | 2½"                         | 2"     | 1½"    | 1"     | ¾"     | ½"    | ⅜"    | No. 4 |
| 2" to No. 4    | 100                         | 95-100 |        | 35-70  |        | 10-30 |       | 0-5   |
| 1½" to No. 4   |                             | 100    | 95-100 |        | 35-70  |       | 10-30 | 0-5   |
| 1" to No. 4    |                             |        | 100    | 95-100 |        | 25-60 |       | 0-10  |
| ¾" to No. 4    |                             |        |        | 100    | 90-100 |       | 20-55 | 0-10  |

Maximum coarse aggregate gradation shall not be larger than 1/5 of the narrowest dimension between sides of forms; shall not be larger than 1/3 the depth of slabs; shall not be larger than 3/4 of the minimum clear distance between reinforcing bars or between bars and forms, whichever is less; and shall not be larger than 2 inches.

The maximum percentage by weight of deleterious substances allowed in coarse aggregate materials shall be:

**DELETERIOUS SUBSTANCES ALLOWED IN COARSE AGGREGATE**

| Substance                    | Percent |
|------------------------------|---------|
| Soft fragments               | 2.0     |
| Coal and lignite             | 0.3     |
| Clay lumps                   | 0.3     |
| Other deleterious substances | 2.0     |

214.2.5.3 FINE AGGREGATE - Fine aggregate shall comply with AASHTO M-6 using gradations from the following table:

## FINE AGGREGATE GRADATIONS

| Sieve Size | Percent Passing (by weight) |
|------------|-----------------------------|
| 3/8-inch   | 100                         |
| No. 4      | 95 to 100                   |
| No. 16     | 45 to 80                    |
| No. 50     | 10 to 30                    |
| No. 100    | 2 to 10                     |

The maximum percentage by weight of deleterious substances allowed in fine aggregate shall be:

### DELETERIOUS SUBSTANCES ALLOWED IN FINE AGGREGATE

| Substance                    | Percent |
|------------------------------|---------|
| Coal and lignite             | 0.3     |
| Clay lumps                   | 0.5     |
| Other deleterious substances | 2.0     |

214.2.5.4 AGGREGATE SOUNDNESS AND REACTIVITY - As determined in accordance with ASTM C-88, potentially deleterious aggregates shall not be used unless service records have shown the aggregates to be innocuous, and the Engineer/City Representative subsequently approves them in writing.

214.2.6 MIXING REQUIREMENTS

214.2.6.1 CONCRETE CLASSIFICATIONS - Mixing requirements for the specific concrete classes indicated on the Drawings and/or within these Specifications shall be as follows:

## CONCRETE CLASSIFICATIONS

| <i>Concrete Properties</i>                                  | <i>Concrete Classifications</i> |            |            |
|---|---------------------------------|------------|------------|
|   | 5000                            | 3500       | 2000       |
| Coarse Aggregates (see requirements shown below)            |                                 |            |            |
| Maximum Water/Cement Ratio (gal/sack)                       | 5.0                             | 6.5        | 8.0        |
| Minimum Cement Content (sacks/CY)                           | ***                             | 6.0        | 4.5        |
| Slump (inches)**  | 2 to 4                          | 2 to 4     | 2 to 5     |
| Air Content (percent)                                       | 5.0 to 7.5                      | 5.0 to 7.0 | 3.0 to 5.0 |
| Required Average 28 Day Compression Strength Test (psi)**** | 5200                            | 3700       | 2200       |
| Required Minimum 28 Day Compression                         | 4800                            | 3300       | 1800       |



| <b>Concrete Properties</b> | <b>Concrete Classifications</b> |      |      |
|----------------------------|---------------------------------|------|------|
|                            | 5000                            | 3500 | 2000 |
| Strength Test (psi)****    |                                 |      |      |

Notes: \* All concrete installed shall be Class 3500 unless otherwise required in the Contract Documents.  
 \*\* When water reducing agents are not used.  
 \*\*\* Cement content shall be appropriate to produce a mixture meeting the requirements for water/cement ratio and workability for the specific job conditions.  
 \*\*\*\* One compressive strength test shall consist of the average strength of two cylinders in the test sample.

214.2.6.2 **REQUIRED AVERAGE DAY COMPRESSIVE STRENGTH** - The Contractor shall furnish and install concrete that will produce a Required Average (28) Day Compressive Strength as shown on the table above. The average of any three consecutive (28) day strength tests shall not fall below the required Minimum (28) Day Compressive Strength Test shown. If the average of any three consecutive tests falls below the Required Minimum, the average strength of the concrete shall be increased at the contractor's expense by increasing the cement content.

214.2.6.3 **WATER REDUCING AGENTS** - When water reducing agents (plasticizers) are used in the concrete mixtures shown above, maximum slump requirements may be increased to 5 inches with low range water reducers and to 8 inches with high-range water reducers.

214.2.6.4 **FLY ASH** - When fly ash is used in the mix, the cement in the water/cement ratio denotes the cement and fly ash combined. Cement shall be introduced into the batcher before the fly ash.

214.2.6.5 **CONCRETE PLACED IN WATER** - For concrete deposited in water, add one additional bag of cement per cubic yard more than the design requires for concrete placed above water.

**214.3 CONSTRUCTION REQUIREMENTS**

214.3.1 **STORING CEMENT**

Bagged and bulk cement shall be stored in weatherproof enclosures to exclude moisture and contaminants.

214.3.2 **STOCKPILING AND HANDLING AGGREGATE**

214.3.2.1 **CLEAN SITE** - The site provided for stockpiling aggregates shall be clean with adequate space to provide separate stockpiles for coarse and fine aggregates.

214.3.2.2 **WASHING AGGREGATE** - Washed aggregates shall be allowed to drain to a uniform moisture content, and stockpiles shall be built at least 48 hours before use.

214.3.2.3 **HEIGHT** - Aggregate shall not be dropped more than 10 feet from the conveyor, nor shall cone shaped piles more than 10 feet high be built.

- 214.3.2.4 STOCKPILE LAYERING - Stockpiles shall be built in thin layers (5 feet maximum) in such manner, to prevent spillage of aggregate over the sides of the stockpile.
- 214.3.2.5 FROZEN MATERIALS - Stockpiles containing snow, ice, or frozen materials shall not be used.
- 214.3.3 BATCHING MATERIALS
- 214.3.3.1 SCALES - The Contractor shall provide scales or arrange for usage of scales that have been certified by State agencies within the past 12 months.
- 214.3.3.2 BATCH MIXERS - Batch mixers shall be operated at the manufacturer's recommended drum speed. Drums and blades shall be kept free from excessive cement and mortar build up. Cement shall be introduced into the batcher before fly ash, and all admixtures shall be introduced to the mixer separately.
- 214.3.3.3 CENTRAL MIXING PLANT - At central mix plants, all materials shall be mixed for at least 80 seconds at recommended drum speed. When more water is added to the cement mixture, the materials shall be mixed for an additional 30 seconds.
- 214.3.3.4 MIXING PERIOD - The mixing period for truck mixers shall be maintained between 70 and 100 revolutions at mixing speed. Maintain a minimum of 90 revolutions for front end discharge trucks. Concrete mixing shall be completed before the truck leaves the batch plant yard.
- 214.3.3.5 WATER REDUCING AGENTS - If water reducing agents are added at the site, they shall be added using injection equipment capable of rapidly and uniformly distributing the admixture. Prior to discharge, the concrete shall be mixed for a minimum of 5 minutes at a drum rate not less than 12 rpm or more than 15 rpm discharge.
- 214.3.4 HEATING AGGREGATE AND WATER
- 214.3.4.1 HEATING EQUIPMENT - When approved by the Engineer/City Representative, the Contractor, at its own expense, may provide and operate heating equipment to heat aggregate and water because of cold weather conditions. All heating operations shall meet temperature limitations provided in these Specifications and shall conform to Standard ACI 306. The Contractor shall ensure that excessive heat does not cause "flash set" when the cement is added.
- 214.3.4.2 UNIFORM HEATING - Aggregates shall be heated uniformly with steam or dry heat. Water shall be heated to between 70°F and 150°F when introduced into the mixer. Measures shall be taken to prevent overheating and hot spot development. No combustion products (ash, smoke, gas and etc.) shall contact the aggregate.

### 214.3.5 COOLING CONCRETE MIXTURE

214.3.5.1 COOLING EQUIPMENT - When approved by the Engineer/City Representative, the Contractor, at its own expense, may provide and operate equipment to refrigerate water, provide ice or cool aggregate, to mix concrete due to hot weather conditions. All methods of cooling shall meet the requirements of ACI 305.

214.3.5.2 USE OF ICE - When ice is introduced into the mixer, it shall be in such form as to be completely melted and dispersed throughout the mix at the completion of the mixing time. The mixing time shall be held to the minimum practicable, consistent with producing concrete meeting the specified requirements.

### 214.3.6 CONCRETE TRANSPORT

214.3.6.1 TRUCKS - Concrete mixtures shall be transported only in conventional transit mixers or agitator trucks with rating plates that are readable. Trucks shall be equipped with visible water meters and revolution counters and shall be capable of measuring all water introduced into the mixing drum.

214.3.6.2 LOADING - Trucks shall not be loaded:

- In excess of their rated mixing capacity, or
- In excess of 63 percent of the drum gross volume, or
- In quantities less than 2 cubic yards

### 214.3.7 CONCRETE TEMPERING

214.3.7.1 ADDING WATER – Concrete may be tempered through the addition of water under the following conditions:

- Water shall be added within specified time limits.
- Wherever possible, water shall be added after the truck leaves the batch plant.
- Water shall not be added in excess of the water/cement ratio or in excess of that specified on the batch tickets.
- The mixing drum shall be rotated at least 30 revolutions at the manufacturer's recommended mixing speed when water is added, OR, addition of water for tempering shall be followed by 3 minutes of mixing at mixing speed prior to discharge.
- Water shall not be added after 1/2 cubic yard or more of concrete has been discharged from the drum.

214.3.7.2 LOW SLUMP - When concrete arrives at the site with a slump below specification, the Contractor may temper the mix up to the maximum approved water/cement ratio, provided:

- The mix design allows for on-site water addition;
- The amount of water added is accurately measured to the nearest gallon;
- The maximum slump is not exceeded; and
- The person adding water is approved to do so by the Engineer/City Representative and the concrete supplier.

214.3.7.3 TEMPERING WITH PLASTICIZER - Do not deliver concrete containing plasticizer to the site unless the batch delivery ticket displays water/cement ratio prior to plasticizer addition. Tempering with plasticizer after delivery time window expiration shall not be allowed.

214.3.8 CONCRETE PLACEMENT

Not used.

214.3.9 CONCRETE SAMPLING AND TESTING

214.3.9.1 PROCEDURE - Tests for slump, air entrainment, and temperature by an independent certified testing facility shall be provided by the Contractor. Independent test facility can be changed by Engineer/City Representative at any time. Sampling and testing will be performed at the expense of the Contractor and as directed by the Engineer/City Representative.

214.3.9.1 SAMPLING FREQUENCY - Concrete sampling frequency shall be as noted below:

- A minimum of one air test (ASTM C-231) and one slump test (ASTM C 143) shall be performed for each placement over 5 cubic yards. At least one air and one slump test shall be performed for each additional load of concrete placed.
- For each test, the concrete temperature and the time shall be verified and recorded. Air and slump test results shall be recorded on batch delivery tickets.
- If an air test fails, immediately retest the same load. The concrete shall be rejected if the second air test fails to meet specified requirements. If the second air test meets specified requirements, a third test will be performed to establish concrete acceptance or rejection.
- If the slump for an individual load cannot be corrected by tempering within the mix design requirements and within the requirements of these Specifications, the load shall be rejected.

- The testing facility shall prepare test cylinders for strength testing in accordance with ASTM C-31 & ASTM C-39.
- At least one strength test shall be performed for each placement over 5 cu. yd., and one additional test for every 50 cu. yards of concrete placed or more frequently at the Engineer/City Representative's discretion. Three cylinders shall be prepared for each test. One cylinder from each test may be set aside at the Contractor's request for strength verification prior to form removal. The average compressive strength of two cylinders constitutes one compressive strength test.
- The Contractor shall provide space in the work area and protect sample cylinders from disturbance for 24 hours after they are cast or until they are moved from the work area by testing laboratory personnel or under the direction of the Engineer/City Representative.
- The average compressive strength shall meet the requirements shown in the table in Section 214.3.1 for the class of concrete placed.

**215.1 DESCRIPTION**

This section covers materials, accessories and labor required to form, finish and cure interior and exterior cast-in-place concrete.

215.1.1 RELATED WORK

Section 214 - Portland Cement Concrete  
Section 216 - Concrete Reinforcement

215.1.2 SUBMITTALS

215.1.2.1 SHOP DRAWINGS - When called for in these Specifications, the Contractor shall furnish shop drawings of forms for specific concrete items. Such drawings shall show general construction of forms, jointing, location of ties and other items affecting visibility.

215.1.2.2 FORM RELEASE AGENT - Where concrete surfaces are scheduled to receive special finishes or applied coverings, which may be affected by the form release agent, submit manufacturer's instruction for use of agent.

215.1.2.3 CHEMICAL HARDENER - Submit name, type, chemical analysis and manufacturer's recommended rate of application for chemical hardener, when specified.

215.1.2.4 CURING COMPOUNDS - Submit manufacturer's specifications, test information, ingredients, certification, and installation recommendations for curing compounds. This information may become the basis of acceptance or rejection of the work cured by the material used. See also the submittal requirement under Membrane Curing Compounds in 215.3.6.2 herein

215.1.3 DEFINITIONS

Shoring - The framework installed to support formwork.

Re-Shoring - Framework installed or not removed which serves as support for form-work after concrete sets and there is less need for the support.

Form Coatings - Compound coated on forms, preventing concrete surface bonding to the forms.

Curing Compound - Liquid medium sprayed or coated on concrete to retain moisture.

## **215.2 MATERIALS**

### **215.2.1 FORM TIES AND SPREADERS**

Shall be removable or snap-off metal, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal. Form ties shall be factory fabricated. Field fabricated ties will not be acceptable. The portion of the tie remaining within concrete after removal of exterior parts should be 1 inch below the outer concrete surface, and the remaining hole in the concrete surface shall not be larger than 1 inch diameter, unless approved otherwise by the Engineer/City Representative.

### **215.2.2 JOINT FILLER**

Shall be furnished and installed.

### **215.2.3 FORM RELEASE AGENTS**

Commercial formulation form release agent compounds shall be used. Form release agents shall not bond with, stain or adversely affect concrete surfaces requiring later bond or adhesion. They shall not impede the wetting of surfaces to be cured with water or curing compounds. Surplus oil on forms and form oil on reinforcing steel and construction joints shall be removed before concrete is placed.

### **215.2.4 FILLETS FOR CHAMFERED CORNERS**

Shall be wood strips 3/4 inch by 3/4-inch size and of maximum possible length.

### **215.2.5 MORTAR AND GROUT**

Shall be furnished in accordance with.

### **215.2.6 LIQUID CHEMICAL HARDENER**

Shall be a colorless aqueous solution, containing a blend of magnesium fluosilicate, zinc fluosilicate and a wetting agent. The mixture shall contain not less than 2 pounds fluosilicate per gallon and shall not interfere with adhesives and the bonding of finishes where such is indicated.

### **215.2.7 WATER**

Water for curing shall meet the requirements of Section 214 herein.

### **215.2.8 MOISTURE RETAINING SHEETING**

Shall be white, waterproof paper, polyethylene film or burlap-polyethylene sheet which meets the requirements of ASTM C-171.

### **215.2.9 MOISTURE ABSORPTIVE COVER MAT**

Shall be clean cotton or burlap fabric roll goods.

### **215.2.10 CURING COMPOUND**

Shall be a clear type with fugitive dye conforming to ASTM C-309, Type 1, unless otherwise approved by the Engineer/City Representative.

**CAUTION!!** The method of application of curing compound specified herein requires more product than is normally suggested by the manufacturer. This is customary in the trade. The amounts specified herein shall be applied, regardless of manufacturer's recommendation or customary practice.

## **215.3 CONSTRUCTION REQUIREMENTS**

### **215.3.1 SITE CONDITIONS**

The Contractor shall examine the condition of the area on which forms are to be installed and conditions under which the work of this Section is to be performed, and shall correct unsatisfactory conditions which would prevent proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

### **215.3.2 DESIGN OF FORM-WORK**

**215.3.2.1 LOADING** - Form-work shall be designed to safely support all vertical and lateral loads that may be induced by wet concrete both during the placement and afterward, until such loads can be supported by the structure itself as the concrete sets and begins to cure. Forms and falsework shall be designed to include assumed values of live load, dead load, weight of moving equipment to be operated on form-work, concrete mix, height of concrete drop, vibrator frequency, ambient temperatures, foundation pressures, stresses, lateral stability and other factors pertinent to the safety of the structure during construction.

In form-work design, provide for all openings, offsets, keyways, recesses, moldings, reglets, chamfers, blocking, screed, bulkheads, anchorage, inserts and other features as required on the Drawings.

**215.3.2.2 TOLERANCES** – Form-work design shall call out material and components of sufficient strength, thickness, number of ties, amount of bracing, etc., to withstand the pressure of newly placed concrete without bow or deflection.

### **215.3.3 FORM-WORK CONSTRUCTION**

**215.3.3.1 COMPLIANCE** – Form-work shall be constructed in compliance with ACI 347, to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grade, and level and plumb work in finished structures.

**215.3.3.2 MATERIALS** – Form-work shall be constructed from steel, steel reinforced panels, smooth grade plywood, or other materials which may be approved by the Engineer/City Representative or shown on the Contract Documents for special purposes. Plywood material with raised grain, patches, or other defects that will mar the finished surface of the concrete surface shall not be used.



215.3.3.3 ERECTION - Form facing materials shall be erected, supported, braced and maintained by structural members spaced to prevent deflection. Form-work shall be tight, to prevent leakage of cement paste during concrete placement. Joints shall be solidly butted together and backed up as required to prevent leakage and fins. Forms placed in successive units for continuous surfaces shall be fitted to provide accurate alignment, free from irregularities, and within allowable tolerances. Use selected materials to obtain required finishes.

Provide for all openings, offsets, keyways, recesses, moldings, reglets, chamfers, blocking, screed, bulkheads, anchorage, inserts and other features required. Accurately place and securely support items to be built into forms. Provide formed openings for elements to be embedded in or pass through the concrete. Install accessories in accordance with manufacturer's instructions and ensure items are not disturbed during concrete placement. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Bevel wood inserts for forming keyways, reglets, recesses and the like, to prevent swelling and assure ease of removal

Form-work shall accommodate the work of all other trades where materials and products must be purchased and fabricated before the opportunity exists to verify the measurements of the adjacent construction affecting their installations. Verify size and location of all openings, recesses and chases with the trade requiring such items, and ensure that forms for openings and construction which accommodate installation by other trades, be accurately sized and located as dimensioned on the Drawings.

215.3.3.4 FORM RELEASE AGENT - Coat form/concrete contact surfaces with form coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.

215.3.3.5 CLEANING - Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt and other debris just before concrete is placed.

215.3.3.6 TOLERANCES – The Engineer/City Representative recognizes that, given the realities of the physical world, there are times when formwork for concrete cannot be constructed closely enough to yield zero tolerances in the finished work. Therefore, the following tolerances are allowed but shall not be exceeded:

- In general, deviation in alignment of slabs and walls shall not exceed ¼ inch in the horizontal or vertical dimensions of a pour. All slabs which are indicated to be level shall have a maximum deviation of 1/8 inch in 10 feet without any apparent change in grade.
- The maximum tolerance from true level and plumb throughout the entire length and/or height of a structure shall be +/- ¼ inch and without any abrupt changes from one part of the pour to another.
- Form-work construction for circular structures shall be allowed a maximum deviation in the arc of ¼ inch in each 10 feet of radius; therefor, as an example, a tank with a 50 foot radius shall be allowed a maximum deviation of 1-1/4 inch from the center of the tank to the arc of the wall. In circular construction, the Contractor also is allowed to deviate from the finish line shown on the Drawings through the use of form panels, which will give chord lengths not to exceed 2 feet.

In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions, as approved by the Engineer/City Representative, without additional expense to the Owner.

#### 215.3.4 REMOVAL OF FORMS

215.3.4.1 CONSIDERATIONS ASSOCIATED WITH FORM REMOVAL - Forms shall be removed in a manner to insure complete safety of the structure. Forms shall not be removed until concrete has sufficient strength to carry its own weight and the loads upon it with safety. Do not pry against face of concrete; use only wooden wedges.

215.3.4.2 MINIMUM ELAPSED TIME - Forms shall not be removed sooner than the minimum elapsed times given in the following schedule unless allowed otherwise in the Contract Documents or as directed by the Engineer/City Representative.

When directed by the Engineer/City Representative, because of weather conditions or for other reasons, the forms shall remain in place for longer periods than stated below. The periods of time for form removal set forth below are minimums with no allowances for external loading. The periods of time set forth below are permissive only and do not relieve the Contractor from responsibility for risks associated with form removal.

**MINIMUM ELAPSED TIME**

| <b>Structural Component</b>                       | <b>Over 50°F</b> | <b>Between 40° and 50°F</b> |
|---|------------------|-----------------------------|
| Walls and perimeter forms at slab on grade panels | 2 days           | 3 days                      |
| Underside of slabs                                | 10 days          | 14 days                     |
| Side forms of beams                               | 2 days           | 3 days                      |
| Underside of beams                                | 10 days          | 14 days                     |
| Stairways   | 10 days          | 14 days                     |

The time periods shown above are based on concrete materials being mixed and placed in accordance with these Specifications. When high early strength inducing admixtures are used in concrete, the Engineer/City Representative may permit form removal after shorter times than those shown in the table. Form removal time also may be reduced if test cylinders of concrete, field cured along with the concrete they represent, have reached the strength specified in Paragraph 214.3.1 of Section 214 – Portland Cement Concrete.

- 215.3.4.3 RE-SHORING - Where no re-shoring is planned, leave forms and shoring used to support weight of concrete in beams, slabs and other concrete members in place until concrete has attained its specified strength. Where re-shoring is planned, supporting form-work may be removed when concrete has reached 70 percent of specified strength, provided re-shoring is installed immediately.

Place re-shores as soon as practical after stripping operations are complete, but in no case later than the end of the working day on which stripping occurs. During re-shoring, do not subject concrete in beam, slab, column or any other structural member to combined dead, construction, and live loads in excess of loads permitted for developed concrete strength at time of re-shoring. Tighten re-shores to carry required loads without over stressing.

Re-shores shall remain in place until the supported concrete has reached its specified strength.

215.3.5 CONCRETE FINISHING

- 215.3.5.1 FINISHING FORMED SURFACES - Within 72 hours after forms are removed, the Contractor shall finish exposed surfaces in accordance with one of the procedures described below. Where no finish requirement is provided on the Drawings, formed concrete surfaces exposed to view and surfaces designated to receive paint shall be given a "Smooth" finish and slabs shall be given a "Trowel" finish. When workmanship is less than the acceptable standard, provide one of the rubbed finishes at no additional cost to Owner.

- F1 - As Cast Form Finish - No finish.

- F2 - Rough Finish - Patch defects and chip or rub off fins exceeding 0.33 inch height.
- F3 - Smooth Finish - In addition to the rough finish requirements, patch tie holes and defects and remove fins completely. When surface texture is impaired and form joints misaligned, grind, bush-hammer or correct such areas. Slurry grout areas evidencing minor mortar leakage to match adjacent concrete. Repair major mortar leakage as a defective area.
- F4 - Smooth Rubbed Finish - Remove forms and perform necessary patching as soon after placement as possible. Finish newly hardened concrete no later than 24 hours following form removal. Perform a smooth finish, then wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.
- F5 - Grout Cleaned Rubbed Finish - Undertake this operation after all contiguous surfaces are completed and accessible. Perform a smooth finish, then brush blast with abrasive basting to open surface pores. Wet surface of concrete sufficiently to prevent absorption of water from grout. Mix grout in accordance with the manufacturer's recommendations and rub a uniform coat over surface to be finished. Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids. While grout is still plastic, remove excess grout by working surface with rubber float or sack. After surface whitens from drying, rub vigorously with clean burlap. Keep damp for at least 36 hours after final rubbing.
- F6 - Cork Floated Rubbed Finish - Remove forms within 2 to 3 days of placement where possible. Perform a smooth finish and then dampen wall surface. Mix mortar in accordance with the manufacturer's recommendations, and apply with firm rubber float or with trowel, filling all surface voids and compress mortar into voids. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer. Produce a final texture with a cork float using a swirling motion.
- F7 - Unformed Finish - After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets and similar unformed surface occurring adjacent to formed surfaces. Float to texture which is reasonably consistent with formed surface. Continue final treatment on formed surfaces uniformly across unformed surfaces.
- F8 - Blasted Finish - Complete a smooth finish then perform abrasive blasting within 24 to 72 hours after casting. Coordinate with form-work construction, concrete placement schedule and form-work removal to ensure that surfaces are blasted at the same age for uniform results. Reapply curing protection after blast finishing.
- F9 - Architectural Finish - Finish in accordance with ACI 303.

- F10 - Tooled Finish - Dress thoroughly cured concrete surface with electric, air or hand tools to uniform texture, and give a bush hammered surface texture. Remove sufficient mortar to exposed coarse aggregate in relief and to fracture coarse aggregate for tooled finish.

215.3.5.2 REPAIRING FORMED CONCRETE SURFACES - When the Drawings indicate repairs are required or when the Engineer/City Representative determines areas are defective and require repair, the following procedure shall be taken to make repairs:

- Remove defective concrete to sound concrete and make edges perpendicular to surface or slightly undercut. Feathered edges are not permitted.
- Dampen area to be patched and at least 6 inches surrounding it.
- Prepare bonding grout by mixing to consistency of thick cream and brush into surface.
- Tie holes shall be cleaned, thoroughly dampened, and filled solid with patching mortar.
- Make any patches in concrete to closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial to obtain a good color match with concrete when both patch and concrete are cured and dry.
- Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint. Use a minimum amount of mixing water.
- Mix patching mortar in advance and allow to stand, without addition of water, and without frequent manipulation, until it has reached a stiff consistency. After surface water has evaporated from patch area, brush bond coat into surface. When bond coat begins to lose water sheen, apply patching mortar. Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface. Leave undisturbed for at least 1 hour before final finish. Keep patched area damp for 72 hours or apply curing compound.
- Do not use metal tools in finishing an exposed patch.
- Where as cast finishes are indicated, total patched area may not exceed 1 in 500 of as cast surface. This is in addition to form tie patches, if ties are permitted to fall within as cast areas.
- In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate. Outer 1-inch of patch shall contain same aggregates as surrounding concrete. After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

### 215.3.5.3

**FINISHING SLAB SURFACES** - In no case shall water be added to the surface (i.e., by sprinkling) to finish. Slab surfaces shall receive one of the following finish treatments as indicated on the Drawings:

- **S1 - Floated Finish** - After concrete has been placed, consolidated, struck-off and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and surface has stiffness sufficient to permit operation. During or after first floating, check plainness of entire surface with a 10 foot long straightedge applied at 2 or more different angles. Cut down high spots and fill low spots to the required tolerance. Re-float slab immediately to a uniform sandy texture.
- **S2 - Trowel Finish** - Float finish the surface. Power trowel or hand trowel as required to provide a uniform surface. Do not apply (i.e. sprinkle) water or dry cement to surface of concrete when finishing. First troweling after floating shall produce smooth surface relatively free of defects, but may still show some trowel marks. Second trowel by hand after surface has hardened. Leave finished surface essentially free of trowel marks, uniform in texture and appearance. On surfaces intended to support floor coverings, grind off defects which would show through floor coverings.
- **S3 - Broom Finish** – Trowel finish the surface. Power trowel or hand trowel as required to provide uniform surface. Lightly brush surface parallel to direction of drainage with a hair broom. Coarseness of broom bristle may be varied slightly, to achieve desired degree of surface roughness.
- **S4 - Exposed Aggregate Finish** - Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone. Embed aggregate into surface by light tamping. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgement. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush. Continue until aggregate is uniformly exposed. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.
- **S5 - Chemical Hardener Finish** - Apply liquid chemical hardener finish to interior concrete floors where indicated. Do not apply liquid chemical concrete hardener on floor areas scheduled to receive synthetic matrix terrazzo, setting beds for tile, terrazzo, vinyl flooring or like items. Apply hardener after complete curing and drying of concrete surface in accordance with manufacturer's recommendations. Evenly apply each coat and allow 24 hours for drying between coats. After final coat of chemical-hardener solution

is applied and dried, remove surplus hardener by scrubbing and mopping with water.

### 215.3.6 CONCRETE CURING

215.3.6.1 SURFACES WITH UNREMOVED FORMS - When forms are left in place (i.e., underside of beams, etc.) the Contractor shall proceed with curing adjacent surfaces without regard to the formed surfaces. When such forms are removed, curing shall then proceed over the entire surface.

215.3.6.2 CURING CONDITIONS - Immediately after finishing of concrete surfaces (formed or slab) the Contractor shall verify concrete surfaces are ready for curing. The Contractor shall correct any conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected. A minimum ambient temperature of not less than 40° shall be maintained for at least 7 days during concrete curing. Concrete shall then be cured by one of the following methods:

- Moisture Cover - Water or continuous water-fog spray shall be applied, or the concrete surface shall be covered with water saturated absorptive mat kept continuously soaked, for not less than 7 days and nights.
- Moisture Retaining Sheet - Place cover in widest practicable width with sides and ends lapped and sealed to prevent moisture loss for a period of not less than 7 days and nights. All holes or tears in the cover sheet shall be kept repaired during the curing period.
- Membrane Curing Compound – All required repairs, patching, and final finishing operations shall be completed prior to application. Curing compound shall be applied as soon as the concrete is firm enough to work on. Slab surfaces shall be coated with curing compound within one hour after form removal; if more than one hour has elapsed, the surface shall be water cured.

The compound shall be thoroughly mixed and a minimum of two coats shall be applied, with each coat applied in a direction different from that used for the preceding coat. The surface shall be coated and re-coated in a continuous operation until the surface has a uniform appearance; is effectively and completely sealed; and until a coating film remains on the surface of the concrete that can be scraped from the surface at any and all points after drying for at least 24 hours. Continuity of the coating shall be maintained, and all damage to the curing compound membrane shall be repaired, during the specified cure period.

Curing compound shall not be allowed within the silhouette of any construction joint. If any curing compound enters the construction joint, the joint shall be sandblasted prior to placing any new concrete.

Curing compound shall not be used on surfaces to be painted or coated.

Surfaces intended to contain potable water (tank interiors, etc.) shall not be cured with curing compounds.

Curing compound shall not be removed in less than 7 days from the time of application without written approval from the Engineer/City Representative. When approved and prior to such removal, the Contractor shall provide a detailed plan for adequately curing the concrete.



**216.1 DESCRIPTION**

This section covers the steel bars, wire fabric and rod mats required for cast-in-place concrete, with the necessary support chairs, bolsters, bar support and spacers required for supporting the reinforcement.

**216.1.1 RELATED WORK**

Section 214 - Portland Cement Concrete

**216.1.2 SUBMITTALS**

**216.1.2.1 MILL TEST CERTIFICATION** - Manufacturer's mill test certificates of supplied concrete reinforcement, indicating physical and chemical analysis shall be submitted.

**216.1.2.2 WELDER CERTIFICATION** - Each welder's certification data shall be submitted to and approved by the Engineer/City Representative prior to performance of welding on the project.

**216.1.2.3 SHOP DRAWINGS** - Shop Drawings shall be submitted and shall indicate the sizes, spacings, locations and quantities of reinforcing steel and wire fabric; bending and cutting schedules; any proposed splicing; and reinforcement support, spacing devices and stirrup spacing.

**216.1.2.4 BAR SUPPORT SAMPLES** - The Contractor shall submit for the Engineer/City Representative's approval, samples of all bar supports it proposes to use along with a written description of where each type of bar support would be used.

**216.1.3 DEFINITIONS**

Not used.

**216.2 MATERIALS****216.2.1 CONCRETE REINFORCEMENT MATERIALS**

**216.2.1.1 STEEL REINFORCEMENT** - Unless otherwise specified, reinforcing steel shall be grade 60 billet steel conforming with ASTM A-615, including supplementary requirements S1. All such reinforcing shall be deformed steel bars with deformations in accordance with ASTM A-615. Bars shall be either uncoated or coated as indicated. ASTM A-706 steel shall be used if welding is indicated or allowed. All reinforcement shall be supplied in the maximum lengths practical or as indicated, unless otherwise authorized by the Engineer/City Representative.

- 216.2.1.2 WIRE FABRIC - Welded steel wire fabric shall be in accordance with ASTM A-185 plain type. It shall be new stock and free of any rust when placed in the Work. Wire fabric may be supplied in flat sheets or coiled rolls, and may be either coated or uncoated as indicated.
- 216.2.1.3 STIRRUPS - Stirrup steel shall be in accordance with ASTM A-82.
- 216.2.1.4 SPIRAL REINFORCEMENT - Spiral reinforcement for columns or other components shall be cold drawn steel wire in accordance with ASTM A-82.
- 216.2.1.5 DOWEL BARS - Plain dowel bars for expansion joints shall be in accordance with ASTM A-615, 60-ksi-yield grade steel. Dowel bars shall be epoxy coated in roadway pavements. Metal dowel cans shall be provided at one end of dowel to permit longitudinal movement of the dowel within the concrete section. The Contractor shall provide for movement equal to the joint width plus 0.5-inch. Load transfer bars shall be painted with 1 coat of paint conforming to AASHTO M-254 and coated 1/2 with grease.
- 216.2.2 ACCESSORY MATERIALS
- 216.2.2.1 TIE WIRE - Tie wire shall be 16-gauge minimum cold drawn plain steel wire, and shall be in accordance with ASTM A-82.
- 216.2.2.2 REINFORCEMENT SUPPORTS - Unless otherwise required in the Drawings or these Specifications, reinforcement supports bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place shall be wire type bar supports complying with CRSI recommendations. Wood, brick, and other unacceptable materials will not be allowed.
- 216.2.2.3 SUPPORTS EXPOSED TO VIEW - Where support legs are in contact with forms on concrete surfaces exposed to view, supports shall be stainless steel or shall be provided with either hot-dip galvanized or plastic protected legs.
- 216.2.3 FABRICATION
- 216.2.3.1 STANDARDS - Steel reinforcement shall be cut, bent and fabricated in accordance with ACI 315 and with approved machine methods, in either the shop or the field.
- 216.2.3.2 BENDING - Bars shall be accurately formed to the dimensions shown on the Drawings or applicable bending schedule. Bending or straightening in the shop or the field shall be accomplished so that the steel is not damaged. All bars shall be cold bent. Bends for hooks on bars shall be made around a pin having a diameter not less than 6 times the minimum thickness of the bar. Kinked bars shall not be used. Bars with bends not indicated on Drawings or final Shop Drawings shall not be placed in the Work. Reinforcement bars shall not be bent after they are embedded in

concrete.

- 216.2.3.3 SPLICES - Reinforcing splices not indicated on the Drawings shall be approved by the Engineer/City Representative, and shall be located at points of minimum stress. The location of splices shall be indicated on Shop Drawings. Welding of reinforcing bars, when authorized by the Engineer/City Representative, shall be performed in accordance with AWS D1.4. All rebar which is welded shall be grade 60 ASTM A706 material.

## **216.3 CONSTRUCTION REQUIREMENTS**

### **216.3.1 DELIVERY AND STORAGE**

- 216.3.1.1 DELIVERY - Deliver reinforcement to the job site bundled, tagged and marked. Use metal tags indicating bar size, lengths and other information corresponding to markings shown on placement diagrams.

- 216.3.1.2 STORAGE - Take all means necessary to protect reinforcement materials before, during and after installation and to protect the installed work of other trades. Store all reinforcement materials in a manner to prevent excessive rusting and fouling with grease, dirt and other bond breaking coatings. Take all necessary precautions to maintain identification after bundles are broken. In the event of damage or errors, immediately make all repairs or replacements necessary and at no additional cost to the Owner.

### **216.3.2 REINFORCEMENT ERECTION**

- 216.3.2.1 CLEAN AND SOUND MATERIALS - At the time of placement in the Work, reinforcement shall be free of loose mill scale, loose or excessive rust, paint, oil or grease, or other coating which may destroy its bond with the concrete. Bars with reduced cross-section due to rusting or other cause, even if all rust has been removed, shall not be allowed in the Work.

- 216.3.2.2 CLEARANCE - Maintain the distance from vertical forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers or other approved devices in accordance with "reinforcement support" paragraphs below. Placement and fastening of reinforcement in each section of the Work must be approved before concrete is placed.

- 216.3.2.3 CLEAR DISTANCE - The clear distance between parallel bars shall not be less than one and one-half times the diameter of the bars, and shall in no case be less than 1 inch nor less than the maximum size of the coarse aggregate specified.

- 216.3.2.4 MINIMUM COVER - Unless otherwise shown on the Drawings or approved by the Engineer/City Representative, for all formed surfaces, the minimum concrete cover over the steel reinforcement shall be 1 1/2 inches for bars number 5 and smaller and 2 inches for bars number 6

through 18. The largest specified cover shall be used when different sized bars are encountered in the same face. No “bury” or “carrier” bars will be allowed unless specifically approved by the Engineer/City Representative.

216.3.2.5 CUTOUTS AND OPENINGS - Where reinforcing steel has to be cut to permit passage of pipe or to create openings with no detail available on the Drawings for extra reinforcement in such areas, the area of steel removed by the creation of the opening must be replaced by placement of at least double the area of the steel removed equally around the openings created. The steel shall be placed such that it extends 5 feet beyond the opening on each side, to provide for sufficient bond.

216.3.2.6 METAL MESH - Sheets of metal mesh shall be bent as shown or required on the Drawings to fit the work. It shall be rolled or otherwise straightened to make a perfectly flat sheet before placement in the Work. Supports for metal mesh shall meet requirements for reinforcing bar supports.

Sheets of metal mesh shall be spliced in accordance with ACI 318 and shall be overlapped no less than 12 inches or one square plus 6 inches, whichever is greater, to maintain a uniform strength. The mesh shall be securely fastened at the ends, edges and at all supports to maintain clearances and overlaps.

216.3.2.7 NOTICE TO OTHER TRADES - The Contractor shall ensure that all other crafts, sub-contractors, Engineer/City Representativeing support groups, and etc., whose work is related to concrete placement, are provided with ample notice and opportunity to introduce and finish required embedded items before concrete placement. All sleeves, inserts, anchors and any other embedded items shall be located and set in place prior to concrete placement. All voids in embedded items shall be temporarily filled to prevent entry of concrete.

216.3.3 SPLICING

216.3.3.1 ENGINEER/CITY REPRESENTATIVE APPROVAL - Except as shown on the Drawings, reinforcing steel shall not be spliced at any location without specific written approval of the Engineer/City Representative. Splices in adjacent bars shall be staggered as directed by the Engineer/City Representative.

216.3.3.2 LAP SPLICES - Unless shown otherwise on the Drawings, or approved by the Engineer/City Representative, bars up to and including number 11 shall be lap spliced in accordance with ACI 318 and shall be fastened together with steel wire.

Unless shown otherwise on the Drawings, or approved by the Engineer/City Representative, bars at a lap splice shall be in contact with each other, and in no case shall the lap be less than 40 diameters of the spliced bars.

Unless shown otherwise on the Drawings, or approved by the Engineer/City Representative, where bars are to be lap spliced at joints in the concrete, all bars shall project from the concrete first placed for a minimum length equal to the lap splice length as indicated on the Drawings. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sand blasting before the bars are embedded in a subsequent concrete placement.

216.3.3.3 WELDING - Reinforcing steel shall be welded only if shown on the Drawings, or approved in writing by the Engineer/City Representative. All welding of reinforcing steel shall comply with AWS D1.4.

216.3.3.4 EXPANSION JOINTS - Reinforcement, or other embedded metal items bonded to the concrete, shall not be permitted to extend continuously through any expansion joint, with the exception of dowels in floors bonded on only one side of joint.

#### 216.3.4 REINFORCEMENT SUPPORT

216.3.4.1 PLACEMENT - All reinforcement shall be supported and retained in place, true to indicated lines and grades, by the use of approved bar supports, sized to position the steel in the exact location required on the Drawings. Supports shall be spaced at intervals of not more than 5 feet on center in any direction, to prevent movement of the steel during concrete placement. Deck steel shall be tied down to beams or forms at regular intervals not exceeding 5 feet on center in any direction.

216.3.4.2 CONCEALMENT - Supports shall be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete.

216.3.4.3 SAND PLATES - Supports with sand plates or horizontal runners shall be used for slabs on grade where the base material will not support chair legs.

#### 216.3.5 QUALITY COMPLIANCE

Reinforcing materials found to be damaged or at variance with the requirements of the Drawings or these Specifications for size, quantity, strength, position, arrangement, or other attribute, shall result in rejection of the concrete Work if they are not brought into compliance.

**217.1 DESCRIPTION**

This section is a materials specification and is included for guidance in selecting materials for pipe and related fittings and appurtenances used in the construction of water and sewer systems.

**217.1.1 RELATED WORK**

Section 02222 - Waterline Pipe Installation  
Section 02224 - Sewer Line Pipe Installation  
Section 15230 - Waterline Valves and Hydrants  
Section 15232 - Water System Control Valves

**217.1.2 SUBMITTALS**

The Contractor shall submit for review complete information, showing all pipe, materials, fittings, gaskets, couplings, coatings, linings, supports, mechanical restraints, thrust blocks and configuration prior to the delivery of any components to the project. All information shall be provided in accordance with Section 01300 and written evidence of compliance from the manufacturer shall accompany each delivery of material.

**217.1.3 DEFINITIONS**

Not used.

**217.2 MATERIALS**

Mainline piping shall be PVC or ductile iron as described below.

**217.2.1 NSF COMPLIANCE**

All pipe and materials furnished and installed for culinary use shall comply with National Sanitary Foundation (NSF) Standard 61. Also, all plastic pipe must be approved by the NSF for potable water use and shall carry the factory "NSF " stamped label on the pipe indicating such approval.

**217.2.2 POLYVINYL CHLORIDE PIPE (PVC)****217.2.2.1 PIPE – Shall be as follows:**

- For sizes less than 4 inches OD, PVC pipe shall be Schedule Rated pressure pipe meeting the requirements of ASTM D1785 of the schedule and size shown on the Drawings.

- PVC pipe 4 inches and larger, shall be rigid, thermoplastic Class Rated pressure pipe meeting the requirements of ANSI/AWWA Standard C900 or C905 (latest revision). The pressure class or the dimensional ratio and the size shall be as shown on the Drawings.
- While Class Rated and Pressure Rated pipe materials are not interchangeable, when specifically allowed in the Contract Documents, for size 4" and larger, rigid thermoplastic Pressure Rated pressure pipe, meeting the requirements of ASTM D2241, may be furnished and installed. Operating pressure for this pipe shall be as shown on the Drawings.

217.2.2.2 FITTINGS FOR PVC PIPE – Unless specifically authorized otherwise, fittings for 4 inch and larger size PVC pipe in underground service shall be ductile iron (DI) and shall meet the requirements of NSF 61 and ANSI/AWWA C-153. They shall have a standard coating of cement mortar on the interior surfaces in complies with AWWA C-104. DI fittings meeting these requirements may be used with smaller PVC piping. PVC fittings meeting the requirements of ANSI/AWWA C-907 may be used with PVC pipe smaller than 4 inches, and, in some instances, where specifically authorized, with PVC pipe sizes 4 inches through 8-inches.

### 217.2.3 DUCTILE IRON PIPE

217.2.3.1 INTERIOR COATING - The interior surface of all DI pipe shall be coated with a standard coating of cement-mortar in accordance with ANSI/AWWA Standard C-104 unless required otherwise in the Contract Documents. Field coating of DI pipe will not be acceptable.

217.2.3.2 BURIED PIPE – Unless shown otherwise on the Drawings, shall be as follows:

- Buried ductile iron pipe shall be Thickness Class 51.
- Shall meet requirements of ANSI/AWWA C-151.
- Joints shall be bell and spigot or mechanical, which meet the requirements of ANSI/AWWA C-111.

217.2.3.3 EXPOSED PIPE – Shall meet these requirements, unless shown otherwise on the Drawings:

- Exposed ductile iron pipe shall be Thickness Class 53.
- Pipe shall comply with ANSI/AWWA Standard C-151.

- Pipe joints shall be flanged, meeting the requirements of ANSI/AWWA C-115, or mechanical type couplings (MTC), meeting the requirements of ANSI/AWWA C-606. MTC shall be Victaulic grooved couplings, as manufactured by Victaulic Company of America or approved equal), unless shown otherwise on the drawings.
- 3” to 12” compact flanged fittings shall be ductile iron and shall be produced in accordance with laying lengths specified in ANSI/AWWA C10/A21.10. Flange surface shall be faced and drilled in accordance with ANSI Class 125 B16.1. Nominal body thickness shall be Manufacturer’s Standard, but shall not be less than those specified in ANSI/AWWA C153/A21.53 “Standards for Ductile Iron Compact Fittings”. Flange thickness shall be in accordance with the Manufacturer’s Standards. Working pressure rating shall be 250 psi for water. Fittings shall be made in the United States of America and shall not have been refurbished or reworked by anyone other than the manufacturer. When greater than 250 psi is called for on the plans, then the Supplier shall furnish higher class rated flanges. Standard Class 125 template for drilling shall be used for all flanges. Drilling templates shall be in multiples of four, so that fittings may be made to face in any quarter. Boltholes shall straddle the centerline and shall be equally spaced. Misalignment of boltholes of two opposing flanges shall not exceed 0.12 inches. Blind flanges 12 inches and over shall be provided with lifting eyes. Insulated flanges shall be provided where required.
- Gaskets shall be full faced, 1/16-inch thick compressed sheets of Aramid fiber base, with nitrile binder and non stick coating, suitable for temperatures to 700°, pressures to 1000 psig and a pH range of 1 to 11. Blind flange gaskets shall cover the entire inside face of the flange and shall be cemented in place. Gaskets shall be as manufactured by John Crane, style 2160; Garlock, style 3000; or approved equal.

#### 217.2.4 PIPE AND FITTINGS FOR WATER SERVICE LINES

Shall meet the requirements provided in Section 15234 for water service connections.

#### 217.2.5 PIPE AND FITTINGS FOR IRRIGATION SYSTEMS

Shall be either DI or Pressure Rated PVC, of the type and class shown on the Drawings, for line diameters 4-inches and greater. Buried lines smaller than 4 inches in diameter shall be Schedule Rated PVC as shown on the Drawings.

#### 217.2.6 PIPE FOR DRAIN SYSTEMS

Piping for sub-drainage may be constructed with polyvinyl chloride (PVC) or polyethylene (PE) plastic non-pressure drainage or sewer pipe



and fittings. Such materials shall be of the type, configuration and size shown on the Drawings and/or on the Bid Schedule.

217.2.6.1 PVC PIPE - All PVC drainage pipe and fittings shall meet the standards of ASTM F794. Such pipe shall be manufactured with a rubber gasketed joining system which meets ASTM D3212 and may be furnished with ribbed, corrugated or smooth exterior walls with smooth interior wall surfaces, unless shown otherwise on the Drawings. Rubber gasketed joints will not be required for collection pipe applications with perforated or slotted pipe sections.

217.2.6.2 PE PIPE - All PE drainage pipe shall be solid, corrugated or ribbed wall high-density polyethylene pipe with smooth interior wall surfaces. Material shall conform to ASTM D1248, Type III, Class C, Category 5, Grade P34 with a P3408 rating from the Plastic Pipe Institute. Fittings for this pipe shall be molded from a polyethylene compound and with equivalent properties and configurations specifically designed to fit the pipe being supplied.

#### 217.2.7 MISCELLANEOUS FITTINGS AND MATERIALS

217.2.7.1 PIPE SUPPORTS - Floor mounted pipe supports for suspended, exposed piping systems shall be adjustable stanchion type supports designed to cradle the pipe diameter by 170 degrees. The support shall fit ductile iron or steel diameters snugly, without excessive gaps between the support and the pipe. Support saddle width shall be a minimum of 2 inches wide. The support must offer a minimum of 3 inches of final adjustment, after installation. Supports shall be supplied with independent base and adjustment collar designed to accept standard sized Schedule 40 galvanized steel pipe for coarse adjustment. Supports shall be fabricated from A36 mild steel, and shall have an electro-galvanized finish. Floor mounted pipe supports shall be the Standon Model S92 or C92 as manufactured by Material Resources, Inc., 22700 N. W. Quatama Street, Hillsboro Oregon 97124, or approved equal. The standard required model shall be the S92. Non standard materials or model numbers shall be as specified on the Drawings.

217.2.7.2 "Y" STRAINERS - shall be constructed of high-tensile ASTM A126 Class B Cast Iron with blow-off connections and self-aligning cylindrical screens and shall be equal to Watts Regulator Series 77F or better quality.

217.2.7.3 FASTENERS – Fastener requirements are as follows:

- Unless otherwise required in these Specifications or shown on the Drawings, all bolting hardware for buried pipe, fittings, valves, and components shall be of manufacturer's standard materials.
- Unless otherwise required in these Specifications or shown on the Drawings, all bolting materials for exposed pipe, fittings, valves, and

components shall be Type 316 stainless steel. Where space restrictions preclude the use of regular bolts, stainless steel threaded studs may be used on all valve flange connections.

- In all instances where stainless steel threaded fasteners are used, a coating of an approved, permanent anti-seize compound shall be applied to the fastener to prevent galling and to assist in disassembly.
- All bolts and/or studs shall extend through the nuts at least 1/4 inch.

217.2.7.4 COUPLINGS – Couplings shall meet the following requirements:

- Unless prescribed otherwise on the Drawings or in these Specifications, couplings shall meet the requirements of ANSI/AWWA C-219. All flexible couplings shall meet the minimum requirements of Smith Blair 400 series.
- Sleeves shall have a smooth inside taper and there shall be no surface irregularities on any sealing surface. Gaskets shall be suitable for the project application.
- Flexible couplings for buried DI and PVC pipe sizes 2 through 16 inches in diameter shall be fabricated of steel or ductile iron. For pipe sizes larger than 16 inches, flexible couplings shall be of steel. Coupling components for use in potable water systems shall be factory coated with an FDA approved, bonded epoxy coating, applied to an average 12 mil thickness.
- Flexible couplings for exposed pipe shall be manufactured of steel, unless shown otherwise on the Drawings, or approved by the Engineer. Coupling components for use in potable water systems shall be factory coated with an FDA approved, fusion-bonded epoxy coating, applied to an average 12 mil thickness.

217.2.7.5 RESTRAINT HARNESS – Where required, restraint harness for bell and spigot pipe joints shall be as manufactured by EBAA Iron Co. or an approved equal. The restraint shall consist of a split bell ring to go behind the bell and a split, serrated ring to grip the pipe on the other side of the joint. The harness shall be held together with clamping bolts and tie bolts. The rings shall be fabricated of 60-42-10 DI conforming to ASTM A-536. Clamping bolts shall be grade 5 galvanized machine bolts. Tie bolts are of low alloy steel. The harness shall have a minimum working pressure of 150 psi. Harness size shall be as shown in the schedule on the Drawings or as specified in the Special Provisions.

217.2.7.6 VALVES AND FITTINGS - Shall be as specified in their respective sections in these Specifications.

217.2.7.7 BOXES AND ENCLOSURES – Shall be of the size, type, and configuration indicated on the Drawings and Contract Documents.

**217.3 CONSTRUCTION REQUIREMENTS**

See Sections 02222 and 02224 for construction requirements for applicable piping systems.

**217.4 METHOD OF MEASUREMENT**

In general, fittings for pipe and piping systems are, and will be, considered appurtenant to the pipeline being installed unless specifically called out for separate payment on the Bid Schedule.

**217.5 BASIS OF PAYMENT**

Not used.

**218.1 DESCRIPTION**

This section covers pipe and fittings of the type, class and size designated for water systems defined, in this Specification.

**218.1.1 RELATED WORK**

Section 204 - Earthwork Materials  
Section 205 - Trench Excavation and Backfill  
Section 217 - Pipe and Piping Systems  
Section 219 - Waterline Valves and Hydrants  
Section 220 - Water System Control Valves  
Section 221 - Water Service Connections  
Section 222 - Water Main Flow Meters

**218.1.2 SUBMITTALS**

218.1.2.1 Not used.

218.1.2.2 **TESTING** - As construction proceeds, the Contractor shall submit test documentation in accordance with this section of these Specifications.

**218.1.3 DEFINITIONS**

**Fitting** - Any component of a pipeline, excluding the pipe itself and valves and meters, which is used for connecting pipe sections; changing line direction or size; connecting meters, valves, tanks, etc.; or starting or terminating pipelines.

**Mains** - Water distribution pipes, located in streets or rights-of-ways, to which water service connections are made for users of the system.

**Run** - Any identified section of a pipeline.

**Saddle** - A fitting placed on a pipe to reinforce the pipe wall, through which a tapping hole is drilled.

**Service Lateral** - The line which connects to the water meter or to the service stub at the property line extending from there, on private property, to the plumbing at the foundation of a house or business.

**Service Stub** - The line running from the tap on a main to the meter or to the property line as appropriate.

**Tap** - The actual connection made to water mains, which includes drilling an opening into the main, threading, installing a tapping saddle when appropriate, and installing a valve into the opening.

## **218.2 MATERIALS**

### **218.2.1 PIPE AND FITTINGS**

See Section 217

### **218.2.2 PIPELINE LOCATION IDENTIFIERS**

Pipeline location identifiers generally take the form of marker posts, warning tape, and tracer wire.

218.2.2.1 **TRACER WIRE** - Unless otherwise described on the plans or herein, the tracer wire shall be an insulated, #10, direct bury copper wire designed and manufactured for this purpose.

218.2.2.2 **WARNING TAPE** - The warning tape shall be an inert, plastic, direct bury type with a 2-inch minimum width, of the appropriate safety color, and specifically manufactured for underground utility identification. The tape shall have wording imprinted on it identifying the type of utility it is protecting.

218.2.2.3 **MARKING POSTS** - Shall be fiberglass compound, aluminum, or other corrosion resistant metal of 5 foot length and 4 inches wide, or otherwise as shown on the Drawings. They shall be fitted with a deterioration resistant warning notice or label appropriate to the application.

### **218.2.3 MISCELLANEOUS FITTINGS AND MATERIALS**

218.2.3.1 **POLYETHYLENE ENCASEMENT** - Where soil conditions are determined to be severely corrosive, tubular polyethylene encasement shall be installed around buried ductile iron piping and fittings in accordance with ANSI/AWWA C-105.

218.2.3.2 **CASING PIPE** - Where casing pipe is required by the Engineer/City Representative, the Contractor shall furnish and install the casing.

218.2.3.3 **PIPE PENETRATION OR CASING SEALS** - Where required on the Drawings or in these Specifications, the Contractor shall furnish and install pipe-to-wall linked rubber seals in core drilled structures, walls, pipe sleeves, or casings in accordance with the manufacturer's instructions. Seals shall be "Link Seals" by Thunderline Corporation, or an approved equal.

218.2.3.4 **PIPE RESTRAINTS** – Pipe restraints shall be as follows:

- Concrete thrust blocking shall be formed, sized, and placed as described herein and shown on the Drawings. Reinforcing bars used in thrust block construction shall be preformed and fusion bonded epoxy coated.

- Mechanical restraint of piping shall be accomplished with one of the following restraining systems or an approved equal:
  - ⇒ Grooved Ductile Iron AWWA Couplings by Victaulic Company of America (use only with exposed piping systems).
  - ⇒ MEGALUG thrust restraints by EBAA Iron Sales, Inc.

**No MJ fittings shall be allowed. All fittings shall be flanged, or restrained with the approved restraints shown above.**

All joints of pipe installed under streambeds or canal crossings, or installed in casing pipes, shall be protected with mechanical restraint.

Restraint protection of above ground or exposed piping in buildings or enclosures shall be accomplished only with mechanical restraints.

## **218.3 CONSTRUCTION REQUIREMENTS**

### **218.3.1 HANDLING AND APPROVAL OR REJECTION OF MATERIALS**

All materials delivered to and used at the job site are subject to approval of the Engineer/City Representative or the Owner. Care shall be taken during handling of pipe, to avoid any impact which might cause damage. Dropping pipe during unloading will not be permitted. Pipe will be carefully inspected in the field before and after laying. If any cause for rejection is discovered in a pipe before or after laying, it shall be removed and replaced by the Contractor at his own expenses. Any pipe found to be unfit or rejected due to cracks, broken bells or spigots, irreparable chipped lining, etc., shall be removed from the job site.

### **218.3.2 DIAGRAMMATIC LAYOUT**

Not used.

### **218.3.3 ALTERATION OF ALIGNMENT**

With written permission from the Engineer/City Representative, piping alignment may be varied from that shown on the Drawings, to avoid structural or mechanical difficulties, or to avoid the work of other trades. The Contractor still will be liable to provide all materials and labor required to complete all work in accordance with the best practice of the trade, and to the satisfaction of the Engineer/City Representative.

### **218.3.4 INSTALLATION**

#### **218.3.4.1 DEWATERING** - Prior to pipe laying and jointing, sufficient dewatering effort shall be provided to maintain the ground water level at or below the surface of the trench bottom or base of the bedding course. The

dewatering operation; however accomplished, shall be carried out in such a manner as to not permanently disturb natural underground water conditions.

218.3.4.2 CONNECTION TO EXISTING FACILITIES - When connections are to be made to any existing pipe or appurtenances, for which the actual elevation or position cannot be determined without excavation, the Contractor shall excavate for, and expose the existing pipe or appurtenances before laying any new pipe. The City or Engineer/City Representative shall be allowed to inspect the existing pipe or appurtenances before any connection is made. The Contractor shall make any adjustments in line or grade which may be necessary to accomplish the intent shown on the Drawings.

Where new fittings, valves, meters, restraints etc., are required to be installed in, or attached to, existing piping, or where connections are to be made to existing piping, the Contractor shall furnish and install the necessary components needed to accomplish the work, whether or not specifically indicated on the Drawings.

218.3.4.3 CAPPING PIPE END - At the close of each workday, or whenever the work ceases for any reason, the end of the pipe shall be securely closed.

218.3.4.4 JOINING – Joining of pipe shall be as follows:

- When making connections, pipe shall be cut and beveled in a neat and workmanlike manner, so as to provide a smooth, beveled end at right angles to the axis of the pipe. Pipe and fittings shall be assembled so there will be no distortion or springing of the pipelines. Flanges, unions, flexible couplings and other connections shall come together at the proper orientation. The fit shall not be made by springing any piping, nor shall orientation or alignment be corrected by taking up on any flange bolts. Flange bolts, union halves, flexible connectors, etc., shall slip freely into place. If the proper fit is not obtained, the piping shall be altered to fit.
- With bell and spigot joints, care should be taken to properly align the pipe before joints are forced home. Gaskets shall be lubricated in accordance with manufacturer's instructions. During insertion of the spigot end, the pipe shall be partially supported by hand, sling, or crane to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. Since the most flexible gasketed joints tend to creep apart when the end pipe is deflected and straightened, such movement shall be held to a minimum once the joint is home.
- Where fusion of polyethylene pipe joints is required, sections of pipe shall be joined in a continuous length on the job site above ground. Joining shall be by the butt fusion method and shall be performed in

strict accordance with the pipe manufacturer's recommendations. Equipment used for butt fusion joining shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and fusion pressures.

218.3.4.5 LAYING - All pipe laid shall be retained in position, using mechanical means if necessary, so as to maintain alignment and joint closure until sufficient pipe bedding and backfill have been completed to adequately hold the pipe in place. All pipe shall be laid to conform to the prescribed line and grade shown on the plans, within specified limits. No blocking of any kind shall be used to adjust the pipe to grade, except when used with concrete embedment. Bedding materials shall be placed so the bottom surface of the pipe will have full bearing for the entire barrel length. The pipe shall rest on not less than 1/4 of its outside perimeter. Bell holes shall be dug as required to assure uniform support along the barrel but shall be no larger than necessary.

Unless otherwise approved by the Engineer/City Representative, pipe shall be laid upgrade from the point of connection on the existing pipeline or from a designated starting point. Pipe shall be installed with the bell end forward or upgrade, unless approved otherwise. When pipe laying is not in progress, the forward end of the pipe shall be kept closed with an approved temporary plug.

218.3.4.6 PIPE RESTRAINT – Pipe restraint work shall be as follows:

- The Contractor shall provide and install either concrete thrust blocks or mechanical pipe restraints on all pressure piping not connected with bolted flanges or welded joints. Fire hydrants shall be restrained, on the 90° bend, with both a concrete thrust block and mechanical pipe restraints.
- For projects involving pipeline construction covered under this section of the Specifications, a pipe restraint schedule is included in the Drawings. Pipe restraints (thrust blocks and/or mechanical restraints) shall be furnished and/or constructed and installed as shown on the Drawings and described in the schedule.
- Pressure pipe shall be properly blocked or restrained at all fittings, wherever the pipeline makes a change in direction of 11.25 degrees or more, wherever it changes sizes, or wherever it ends.
- Placement of concrete thrust blocking shall provide bearing against undisturbed vertical earth banks or approved compacted backfill, sufficient to absorb thrust from line pressure, and in a configuration so that pipe joints and fittings will be accessible. All fittings restrained by concrete thrust blocks shall be wrapped in visquin prior to placement of concrete. Concrete shall not cover bolts, piping or weep holes.



- All restraints shall be in place before any hydrostatic testing and flushing are performed on the system.
- The Contractor shall allow visual inspection by city representative of every thrust block or mechanical restraint before it is buried.

218.3.4.7 FINISH BEDDING - After the pipe is laid, additional bedding material shall be placed in 6-inch lifts to a level even with the spring line of the pipe and compacted. The portion of the trench from the spring line to 12 inches above the top of the pipe shall then be filled and compacted in the same way.

218.3.4.8 REQUIREMENTS FOR INSTALLATION NEAR SEWER LINES - Locate potable water piping at least 10 feet horizontally (measured edge to edge) from any existing or proposed parallel sewer or wastewater leach line. Should conditions prevent the 10-foot separation, the water line may be laid closer than 10 feet to sewer lines (but not leach lines) provided:

- The water line is laid 18 inches above the top of the sewer line, but deep enough to prevent freezing, and
- The water line is laid in a separate trench, or
- The water line is laid on an undisturbed earth shelf on one side of the sewer line trench, or
- The water line is laid in a sewer or drain line trench, which has been backfilled and compacted to not less than 95% of maximum density, as determined by ASTM D-690.

Where potable water lines cross sewer lines, the bottom of the water line shall be at least 18 inches above the top of the sewer line for ten feet on each side of the sewer line, measuring perpendicularly from the water line to the sewer line. When such vertical separation is impossible to achieve, a vertical separation of less than 18 inches may be allowed provided:

- In new construction for both water line and sewer line they shall be constructed of ductile iron pipe or thermoplastic pipe joined by either mechanical or bolted flange joints. Thermoplastic pipe may also use solvent welded joints. In situations with an existing sewer line, the new water line shall be constructed as previously described.
- And, when making such crossing, install the water line in such manner that the center of a full length of pipe is on the centerline of the sewer line to isolate the water line joints as far as possible from the sewer line.

218.3.4.8.1 REQUIREMENTS FOR INSTALLATION UNDER WATER CROSSINGS – A minimum cover of two (2) feet shall be provided over the pipe and the following shall be provided:

- The pipe shall be special construction, having flexible, restrained, or welded water tight joints and encased in an approved pipe.
- Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and not subject to flooding.
- Permanent taps for other provisions to allow insertion of a small meter to determine leakage and obtain water samples shall be made on each side of the valve closest to the supply source.

218.3.4.9 EXPOSED PIPING - No exposed piping shall be installed until all equipment to which the pipe is to be attached has been installed and it can be determined where piping and fittings shall be located to make a neat, efficient arrangement. Piping shall be aligned with equipment connections such that no external load or stress will be transferred to any equipment from the piping. Piping shall be installed with a sufficient number of unions, flexible couplings, or flanged joints, to allow for convenient inspection and maintenance.

Exposed pipe work shall be suspended or supported, to prevent sagging or over-stressing of the pipe and connections. Assembly of pipe and fittings shall be accomplished so there will be no distortion or springing of the pipe. The fit shall not be made nor the alignment corrected by taking up on any flange bolts. Joints shall come together in proper orientation, and flange bolts, union halves, flexible couplings, and etc. shall slip freely into place. If the proper fit is not obtained, the piping shall be altered to make the fit meeting the above requirements.

Exposed pipe shall be installed in straight runs parallel to the axis of the structures. Pipe runs shall be horizontal and vertical; except that gravity drain lines shall be pitched down in the direction of flow at a slope not less than 1/8 inch per foot.

All exposed pipe shall be painted. Factory finished items are not required to be field painted except touch-up. The color and type of paint used shall be submitted to the City for their approval.

218.3.4.10 DRAINS AND OTHER SYSTEMS - In addition to other requirements in this Section, all irrigation and other lines fitted with drains shall be installed such that continuous slope is maintained to designated drain locations. In areas where there are both culinary water pipelines and irrigation pipelines, exposed portions of irrigation water piping shall be identified by distinctive coloring or other marking. Culinary and irrigation lines and extensions shall be completely separated, installed in separate trenches, and there shall be no cross-connection between the systems under any circumstances.

218.3.5 FLUSHING AND CLEANING

218.3.5.1 FLUSHING WITH WATER - Prior to proceeding with pressure testing (and/or disinfection if required) of completed lines, the Contractor shall fill the test section with clean, potable water and flush the lines. The Contractor shall furnish all equipment (including valves and blowoffs, etc.) and labor to complete the flushing as required by this section.

218.3.5.2 DIFFICULT CONTAMINANTS - Certain contaminants, especially in caked deposits, resist flushing at any velocity. If, in the opinion of the Engineer/City Representative, such contaminants have entered the line during construction, the interior of the pipe shall be swabbed, as necessary, to remove the debris prior to proceeding with flushing.

218.3.5.3 MINIMUM FLUSHING FLOW AND VELOCITY - The Contractor shall make all arrangements, to establish a minimum 2.5 feet per second (fps) flow velocity in the line during the flush. Flushing shall proceed until the installed pipe is free of debris. The flows needed to produce the required flushing velocity indicated above are provided in the table below.

**FLUSHING FLOW AND VELOCITY**

| <b>Pipe Diameter (inches)</b> |      |
|-------------------------------|------|
| 4                             | 100  |
| 6                             | 200  |
| 8                             | 400  |
| 10                            | 600  |
| 12                            | 900  |
| 16                            | 1600 |

NOTE: With 40 psi residual pressure, 2 1/2 inch and 4-1/2 inch hydrant outlet nozzles will have the ability to discharge approximately 1,000 GPM and 2,500 GPM respectively.

218.3.6 TESTING

The Developer's inspector and a City Representative shall be present during all testing procedures.

The Contractor shall perform all testing, and shall furnish all materials, equipment, and labor necessary to complete this work as required. Any work that fails to meet the acceptance criteria of prescribed testing shall be repaired and/or replaced at no additional cost to the City. All repaired work shall be re-tested. This sequence shall be repeated until the work meets the acceptance criteria. Samples shall be delivered to testing lab by City staff at developer's expense.

218.3.6.1 PRESSURE TESTING - All pipelines constructed for carrying potable, non-potable, and water-borne products shall be pressure tested for

leakage when they are completely assembled, unless directed otherwise in these Specifications or in writing by the Engineer/City Representative.

The City has portable recordable pressure testing equipment that may be used for the testing. The Contractor shall coordinate all tests with the Engineer/City Representative.

WARNING - The hydrostatic test procedures described herein are not applicable to air pressure testing.

Prior to pressurization all required flushing shall have been completed. Pipeline sections to be tested shall be isolated from any connecting lines. Air release taps shall be provided at points of highest elevation, the test section shall be filled with clean potable water, and all air shall be removed from the line. Pressure on the test section shall then be brought to test pressure of 200 psi for a duration of two hours. Permanent plugs shall be inserted into the air release tap holes after the test has been completed.

218.3.6.2 LEAKAGE TESTING - The leakage test shall be conducted concurrent with the pressure test. Amount of leakage, if any, will be determined by measuring the quantity of additional water required to maintain the prescribed hydrostatic pressure test during the test period. Accurate means shall be provided to measure the quantity of water required to maintain full pressure on the line for the 2 hour test period, the measured leak rate shall not exceed the rate "Q" computed as follows:

$$Q = LD(P^{0.5})/148,000$$

Where: Q= Leakage rate (gal/hour)  
L= Length of tested pipe (feet)  
D= Nominal diameter of pipe (inches)  
P= Average test pressure (psi)

When the allowed amount of leakage is exceeded, leaks shall be located and repaired and the system shall then be re-tested by the Contractor until compliance is achieved.

All visible leaks in exposed pipe shall be repaired.

218.3.6.3 OPERATIONAL TESTING (*pressurized irrigation only*) - Pressurized irrigation systems shall be tested for proper system operation after backfill is in place and sprinkler heads have been adjusted to final position. This test shall demonstrate that the system meets coverage requirements (based on operation of one circuit at a time) and that all automatic controls function properly.

218.3.6.4 NON-RIGID PIPE DEFLECTION TESTING - At the Engineer/City Representative's request, the Contractor shall test requested portions of all non-rigid pipe after being installed and backfilled to ensure that

circumferential deflection does not exceed 5% of the diameter. Such test will consist of passing a mandrel through an open section of pipe, sized appropriately to detect non-compliance. The mandrel shall be sized in accordance with the requirements provided in Section 219 for checking sewer pipe. In the event deflection non-compliance is found, the Contractor shall make repairs as outlined in Section 219 and additional testing of other sections of pipe will be requested.

218.3.6.5 TESTING DOCUMENTATION - The Contractor shall maintain a record of all testing performed, together with the test results obtained, for each line installed under this Contract. Minimum information to be included in these records shall be as follows:

- All Documents:
  - Date of issuance of the record
  - Name of Contract
  - Contractor's name and address
  
- Disinfection Report:
  - Name and address of treatment supervisor
  - Disinfection method used
  - Location and boundary description of section to be disinfected
  - Time and date of disinfectant introduction
  - Time and date of disinfectant release
  - Initial disinfectant residual (PPM) for each outlet tested
  - Time and date of flushing after disinfection
  - Signature of treatment supervisor (signifies completion of disinfection activities)
  
- Bacteriological Report:
  - Date issued
  - Project name and location
  - Laboratory's name, certification number, address and phone number
  - Test location
  - Time and date of sample collection
  - Name of person collecting sample
  - Time and date of laboratory test start
  - Coliform bacteria test results for each sample
  - Certification that water conforms (or fails to conform) to bacterial standards of the appropriate state public drinking water regulations
  - Bacteriologist's signature
  
- Test Report:
  - Type of test
  - Location of test
  - Sizes, types, and lengths of pipe in test section, and test boundary description

- Date and Time test started
- Date and Time test completed
- Test pressure (*Pressure Test only*)
- Amount of leakage/allowable leakage (*Pressure Test only*)
- Mandrel dimensions(*Obstruction and Non-Rigid Pipe Deflection Tests only*)
- Test result (*pass/fail*) (*All Tests*)
- Printed Name/Signature and Date of Test Supervisor (Contractor's representative) (*All Tests*)
- Printed Name/Signature of Inspector (Engineer/City Representative's representative) witnessing and approving the test (*All Tests*)

### 218.3.7 DISINFECTION

218.3.7.1 REGULATORY COMPLIANCE - All pipelines to be used for culinary water service shall be disinfected in accordance with the requirements of state and local public drinking water regulations.

### 218.3.7.2 REQUIREMENT OF CHLORINE

Before being placed into service, all new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than 25 ppm remains in the water after standing 24 hours in the pipe. The initial chlorine content of the water shall be not less than fifty (50) parts per million.

### 218.3.7.3 FORM OF APPLIED CHLORINE

Chlorine shall be applied by one of the methods which follow, to give a dosage of not less than 50 ppm of available chlorine. Calcium Hypochlorite granules must not be used on solvent welded plastic pipe or on threaded-joint steel pipe.

### 218.3.7.4 DRY CALCIUM HYPOCHLORITE

As each length of pipe is laid, sufficient high test calcium hypochlorite (65-70% chlorine) shall be placed in the pipe to yield a dosage of not less than 50 ppm available chlorine, calculated on the volume of the water which the pipe and appurtenances will contain.

The following table gives the amount of calcium hypochlorite (70% available chlorine) to be used for each 20 foot length of pipe to give a concentration of 50 ppm of available chlorine.

| AMOUNT OF CALCIUM HYPOCHLORITE FOR |   |                                |
|------------------------------------|---|--------------------------------|
| Diameter of Pipe                   | Each 20 ft. Length<br>In Tablespoonfuls | Pounds Per<br>1000 ft. of Pipe |
| 4-inch                             | 1/2                                     | 0.5                            |
| 6-inch                             | 1½                                      | 1.0                            |
| 8-inch                             | 2½                                      | 1.6                            |
| 10-inch                            | 4                                       | 2.5                            |
| 12-inch                            | 6                                       | 3.6                            |
| 14-inch                            | 8                                       | ---                            |

### 218.3.7.5 LIQUID CHLORINE

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device, or the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing the backflow of water into the chlorine

### 218.3.7.6 CHLORINE-BEARING COMPOUNDS IN WATER

A mixture of water and high-test calcium hypochlorite (65-70% CI) may be substituted for the chlorine gas-water mixture. The dry powder shall first be missed as a paste and then thinned to a 1% chlorine solution by adding water to give a total quantity of 7.5 gallons of water per pound of dry powder. This solution shall be injected in one end of the section of main to be disinfected while fitting the main with water in the amounts as shown in the table which follows.

| CHLORINE REQUIREMENTS FOR 100-FT. LENGTHS OF VARIOUS SIZES OF PIPE |                                     |   |  |
|--|-------------------------------------|---|--|
| Pipe Size Inches   | Volume of 100-ft.<br>Length Gallons | Amount Required<br>to<br>100% Chlorine<br>Lb. | Give 50 ppm Cl.<br>1%<br>Chlorine-Water<br>Solution in Gals. |
| 4  | 65.3                                | 0.027   | 1/3  |
| 6  | 146.5                               | 0.061   | 3/4  |
| 8  | 261.0                               | 0.108   | 1 1/3  |
| 10   | 408.0                               | 0.170   | 2  |
| 12   | 588.7                               | 0.240   | 3  |

### 218.3.7.7 SODIUM HYPOCHLORITE

Sodium Hypochlorite, commercial grade (15% CI) or in the form of liquid household bleach (5% CI) may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength if diluted with water and injected into the main in correct proportion to

the fill water so that dosage applied to the water will be at least 50 ppm.

#### 218.3.7.8 RETENTION PERIOD

Treated water shall be retained in the pipe at least twenty-four (24) hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least 25 parts per million

#### 218.3.7.9 CHLORINATING VALVES AND HYDRANTS

In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent and under normal operating pressure.

#### 218.3.7.10 FINAL FLUSHING AND TESTING

In the process, chlorine treated water shall be thoroughly flushed from the newly laid pipe until the replacement water throughout its length shows, upon test, the absence of chlorine. In the event chlorine is normally used in the source of supply, then the tests shall show a residual not in excess of that carried in the system.

#### 218.3.7.11 BACTERIOLOGICAL SAMPLES:

The Contractor shall take three bacteriological samples from the installed pipe line with the Engineer present. The locations of the samples shall be at intervals along the pipe line as directed by the Engineer. The sampling bottles and methods used shall be in accordance with the other similar applicable regulating agencies. Sample results shall be sent to the Public Works Director.

#### 218.3.7.12 REPETITION OF FLUSHING AND TESTING:

Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained. Failure to get a satisfactory test shall be considered as failure of the Contractor to keep the pipe clean during construction, or to properly chlorinate the main, and no additional payment will be made for reflushing and rechlorinating.

After disinfection, the lines shall be flushed until residual chlorine is reduced to the levels safe for consumption. Samples for bacteriological testing can then be taken. The Contractor shall safely and legally dispose of contaminated water used for disinfection after consultation with the local authorities. Under no circumstances shall heavily chlorinated water be allowed to mix with "live" waters, meaning waters in lakes, rivers, streams or wetlands.

#### 218.3.8 PIPELINE LOCATION IDENTIFIERS

The Contractor shall furnish and install such identifiers as prescribed in



these Specifications.

- 218.3.8.1 TRACER WIRE – Tracer wire shall always be installed in the trench with all pipelines, during their installation. Tracer wire placement shall be as shown on the Plans but shall generally be immediately beneath (preferred), to the side, or above the pipeline with approximately 4 inches of separation. Tracer wire shall be brought to the surface of the ground at all valves and risers and where otherwise shown on the plans.

Tracer wire shall be installed as shown in the Plan details. Where splices in the wire are required, the Contractor shall solder the wire connections. Tee splices shall be made with a minimum of 4 turns wrapped tightly around the bared portion of the main tracer. Do not cut main tracer wire. Line splices shall be made by crossing the two bare sections of wire with a minimum of 4 turns in opposite directions as shown in splice detail. Solder and finish connection using a No. 1 welding tip with a soft non-carbonizing flame or a propane torch, using rosin flux and 60/40 rosin core solder. Do not use acid core solder under any circumstances. Use only enough heat to insure a smooth solder joint. Heat should be applied to the wire, not to the solder. Heat the connection for a few seconds and touch the end of the solder to the joint; when the proper temperature is achieved, the solder will melt and flow freely around the connection. Allow the wire to cool and do not move while cooling. Insulate by applying several turns of 3 m 88 or approved equal electrical tape around the soldered joint. Extend the tape well over the wire insulation in all directions.

Some soil conditions and/or installation circumstances may require the additional installation of cathodic protection for the tracer wire. When this is the case, cathodic protection will appear as a separate bid item and details for its installation will appear on the Plans and elsewhere in these Specifications.

- 218.3.8.2 WARNING TAPE – A continuous ribbon of warning tape shall be installed during the backfill operation. Tape shall be placed 12-inches above the top of the pipeline or otherwise as shown on the drawings. At roll ends and at places where the tape has been broken, the loose ends shall be tied together to prevent separation during the rest of backfill.

- 218.3.8.3 MARKING POSTS – Marking posts shall be installed at the placement intervals shown on the Plans. Posts shall not be deformed or damaged during installation. The Contractor shall use a post hole digger to install markers when there is danger of damage to posts from pounding or hammering.

**219.1 DESCRIPTION**

This section covers the valves and fire hydrants in water transmission and distribution lines, together with fittings, thrust blocking, and boxes and enclosures related to the operating equipment.

**219.1.1 RELATED WORK**

Section 218 – Waterline Pipe Installation  
Section 217 – Pipe and Piping Systems  
Section 220 – Water System Control Valves

**219.1.2 SUBMITTALS**

Not used.

**219.2.1 VALVES 14 INCHES AND SMALLER, AND HYDRANTS** – For valve sizes 14-inches and smaller, and fire hydrants, the Contractor shall furnish the manufacturer's standard data and catalogues for review and approval.

**219.1.2.2 VALVES LARGER THAN 14 INCHES** – For all valves sized larger than 14-inches, the Contractor shall furnish shop drawings and technical data prepared by the manufacturer for review and approval.

**219.1.2.3 CONTENT** – Submittals shall include complete details, dimensions, weights, diameter of stems, alloy for all valve parts and any information that may be required to assemble, install, operate and maintain the valve.

**219.1.2.4 BUTTERFLY VALVES** – Certification of performance together with leakage and hydrostatic tests as described in Section 13 of ASTM/AWWA C-504 shall be furnished to the Engineer/City Representative upon the Engineer/City Representative's request.

**219.1.2.5 BALL VALVES** – Certification of performance together with leakage and hydrostatic tests as described in Section 5 of ASTM/AWWA C-504 shall be furnished to the Engineer/City Representative upon the Engineer/City Representative's request.

**219.1.3 DEFINITIONS**

Not used.

**219.1.4 DESIGN STANDARDS**

Water system gate or butterfly valves shall be installed at every change in direction. Tee intersections shall have valves installed on all legs.

## **219.2 MATERIALS**

### **219.2.1 GATE VALVES**

219.2.1.1 COMPLIANCE – All gate valves shall conform to AWWA C-515 with the following characteristics:

219.2.1.2 3-INCH AND SMALLER VALVES – Valves 3-inches and smaller shall be as follows:

- Valves shall be as manufactured by Ford, Hayes, Mueller, Red & White, or an approved equal.
- Valves shall be standard, double-disc, non-rising stem valves with wheel handles.
- Valve bodies shall be all bronze or brass.
- Valves shall be threaded, unless shown otherwise on the Drawings or required in these Specifications.

219.2.1.3 GATE VALVES 4-INCH THROUGH 14-INCH – Gate valves 4-inches through 14-inches in size shall be as follows:

- Valves shall be Mueller or Clow Brand.
- Valves shall have a ductile iron body.
- Valves shall have a solid cast iron, rubber coated, wedge gate and a resilient seat.
- Gate shall be designed to work equally well with pressure on either side of it.
- Valves shall be of the non-rising stem type and shall be left hand opening (counter-clockwise) with a 2-inch square operating nut.
- All interior ferrous surfaces exposed to fluid flow shall have an NSF approved, fusion bonded, epoxy coating. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process.

219.2.1.5 VALVES ON WATER MAINS – Valves on water mains shall have the following features:

- In-line valves shall be mechanical joints conforming to AWWA C-111.
- Valves attached to side outlets shall be flanged.
- By-pass valves shall be flanged.
- Valves in blow-off lines shall be flanged.
- Valves in air release and vacuum relief lines shall be flanged or threaded.
- Valves 14-inches and smaller shall be equipped with O-ring packing.

219.2.2 BUTTERFLY VALVES (valves larger than 14-inches shall be butterfly valves)

- 219.2.2.1 MANUFACTURER – Butterfly valves shall be Dresser Industries “450”, Allis-Chalmers “Streamseal”,-Henry Pratt “Groundhog”, Mueller Lineseal III, or an approved equal.
- 219.2.2.2 COMPLIANCE – Butterfly valves shall conform to AWWA C-504.
- 219.2.2.3 CLASS – Valves shall be Class 150 seated, tight closing valves, furnished with mechanical or flanged joints.
- 219.2.2.4 SEATS – Rubber valve seats shall be replaceable without disassembling the valve and shall not be interrupted by the shafting. Rubber seats may be retained on the disc edge by stainless steel clamping in lieu of bonding to the valve body.
- 219.2.2.5 SHAFT PACKING – Shaft packing shall be of the self-adjusting permanent type.
- 219.2.2.6 OPERATION – Underground opening and closing shall be accomplished with permanently lubricated screw-type operators, totally enclosed and of watertight construction. Overload protection shall be incorporated into the operator allowing the application of 450 foot-pounds input torque at full-open and full-closed positions without damage to the operator or valve. A 2-inch square wrench nut and valve box shall be provided for operating the valve. Valves shall open counter clockwise unless indicated otherwise in the Special Provisions.
- 219.2.3 BALL VALVES
  - 219.2.3.1 MANUFACTURER – Valves shall be produced by a manufacturer having at least 15 (fifteen) years experience in the manufacture of water works and valves.
  - 219.2.3.2 VALVES 4-INCHES AND LARGER – Ball valves, 4-inches and larger, shall be ductile iron or cast-steel body, double seated valves meeting the requirements of ANSI/AWWA C-507.
  - 219.2.3.3 SMALLER VALVES – Smaller valves shall be stainless steel, bronze, or iron bodied valves of the size, type and class shown on the Drawings.
- 219.2.4 CHECK VALVES
  - 219.2.4.1 COMPLIANCE – Check valves shall be manufactured in accordance with ANSI/AWWA C-508
  - 219.2.4.2 DESIGN – Check valves shall be of a clear waterway, swing-check type. They shall be designed to be mounted horizontally. They shall be fitted with flanged ends for easy servicing. They shall have an iron body and be bronze mounted.
  - 219.2.4.3 SEATING – Valves shall be provided with a metal to resilient material seating.

## 219.2.5 HOSE BIBS

Hose bibs shall be 3/4-inch bronze or brass body, Watts Model SC-1, Red & White Model RW 301 or approved equal. All hose bibs shall have a tee handle and hose bib vacuum breaker installed that are non-removable.

## 219.2.6 SAMPLE FAUCET

Sample faucet shall be a 1/2-inch chromed or brass body hose bib without hose connection threads.

## 219.2.7 FIRE HYDRANTS

### 219.2.7.1 Fire Hydrants shall be Mueller Centurion or Clow Medallion and shall be red in color.

Fire hydrants shall be of compression type. The name or mark of the manufacturer, size of the valve opening, and the year of manufacture shall be plainly cast in raised letters and so placed on hydrant barrel as to be visible after the hydrant has been installed. As a minimum requirement, hydrants shall be of a dry barrel type and shall be designed for working pressures of two hundred fifty (250) pounds per square inch and shall conform to AWWA C502. All hydrants shall breakaway at ground level on impact and shall be designed to prevent water leakage when damaged.

The hydrant body shall be ductile iron, fully mounted with approved non-corrodible metals. All wearable surfaces shall be either bronze or some other non-corrodible material and there shall be no moving bearing or contact surfaces of iron in contact with iron or steel. All contact surfaces shall be finished in the workman-like manner and all wearing surfaces shall be easily renewable.

Fire Hydrants shall have a minimum of (5) five inch main valve opening with mechanical or flanged ends. Hydrants shall have a (4 1/2") four and one half inch steamer nozzle national standard hose coupling threads and (2 1/2") two and one half inch hose nozzles all conforming to ASA specifications B-26.

All hydrants shall withstand hydrostatic tests of twice the design working pressures. Hydrants shall open by turning to the left (counter clockwise); operating nut shall be national standard one and one half (1 1/2") pentagon measured from point to opposite flat. Hydrants shall have an all bronze drain valve, which shall provide for rapid drainage of the hydrant after use and shall close securely when the hydrant is open.

All nozzles shall be fitted with cast iron threaded caps with operating nut of same design and proportions as the hydrant's operating nut. The cap shall be threaded to fit the corresponding nozzle and shall be fitted with

suitable neoprene gaskets for positive water tightness under test pressures.

All iron parts of the hydrant, both inside and outside, shall be thoroughly cleaned and painted. All inside surfaces below the sidewalk ring shall be coated with asphalt varnish, Federal Specifications TT-P\_51A or JANP-450. They shall be covered with two (2) coats, the first having dried thoroughly before the second is applied.

The outside of the hydrant above the sidewalk ring shall be thoroughly cleaned and thereafter painted with one (1) coat of paint of durable composition conforming to Federal Specification TT-P-86a, type live and two additional coats of red or approved equal on the body and cap.

The traffic section shall be a minimum of thirty-four (34") inches between ground level and the hose nozzles. The entire nozzle section shall be able to rotate 360 degrees by loosening four bolts.

Fire hydrants must be installed level/square and flush with final grade, no exceptions, steamer must face roadway.

219.2.7.2 DESIGN – Hydrants shall be designed as follows:

- Hydrants shall be of the “compression” with safety flange and safety stem coupling above the ground line so that they can be repaired without shutting of the water.
- Hydrants shall be of the dry top design with two or more “O” rings sealing the water from the operating mechanism.
- Hydrants shall be furnished with 5-inch minimum valve openings, one 4 1/2-inch NST pumper connection and two 2 1/2-inch hose connections.
- Hose nozzle threads, pump nozzle threads, operating nut and opening direction shall match existing hydrants in the system.
- Hydrants shall be designed for 5-feet of cover, unless shown otherwise on the Drawings.
- Hydrants shall be submitted to the City for approval.

219.2.7.3 PAINTING – The portion of the hydrant above the ground line shall be painted red in accordance with the City’s standards.

219.2.7.4 SNOW FLAGS – Snow flags shall be the RoDon Hydra-Finder standard 5’ length. The “flat” mounting brackets shall be used for installation.

219.2.8 VALVE BOXES

Valve boxes shall be cast iron, two piece, and adjustable valve boxes. Valve boxes shall be of the slip joint screw type and be of sufficient length for the pipe burial depth required. The cast iron cover of the valve box shall have the word “water” stamped thereon.

## 219.2.9 CONCRETE ENCLOSURES

Concrete enclosures for valves shall be precast and of the type, size and configuration shown on the Drawings and shall be fabricated in accordance with the requirements for precast concrete construction.

## 219.3 CONSTRUCTION REQUIREMENTS

### 219.3.1 SETTING VALVES AND VALVE BOXES

All valves shall be set and jointed to the pipe in the manner described for pipe laying and jointing in Section 218 of these Specifications. Valves shall be oriented with the operating nut vertical. Valve boxes shall be centered and plumb over the operating nut and shall be set so that no shock or stress will be transmitted to the valve. Tops of the valve boxes shall be set flush with the ground surface, concrete collars, or street surfacing, unless otherwise shown on the Drawings.

### 219.3.2 VALVE RESTRAINT

Restraint shall be installed on all valves connected with slip-on, gasketed, or O-ring joints (i.e., bell & spigot, mechanical, etc.) in accordance with these Specifications and as shown on the Drawings.

### 219.3.3 CONNECTING TO EXISTING MAINS

219.3.3.1 CONNECTION TO EXISTING WORK – All connections to existing water mains shall be made by the Contractor, unless otherwise provided in these Specifications. The Contractor shall provide labor and materials, including special fittings and restraint devices, required to make the required connections between existing lines and new lines.

219.3.3.2 HOT TAPPING – All connections to the city water system shall be hot tapped unless otherwise approved by the city.

219.3.3.3 INTERRUPTION OF SERVICES – Where the connection of new work to old requires interruption of service, the Owner, Engineer/City Representative and Contractor shall mutually agree upon a date for such connection which will allow ample time to assemble labor and materials and to notify all customers in accordance with Section 01510.

### 219.3.4 FIRE HYDRANT INSTALLATION

219.3.4.1 SETTING – All hydrants shall stand plumb use hand level with the pumper nozzle facing the street. The hydrant shall be set with the ground line at the location indicated by the hydrant manufacturer.

219.3.4.2 DRAINAGE – Drainage shall be provided at the base of the hydrant by placing clean gravel under and around the base of the hydrant as shown on the Drawings.

219.3.4.3 RESTRAINT – All hydrants shall be restrained by setting thrust blocks and mechanical restraint assemblies in accordance with the Drawings.

219.3.4.4 AUXILLARY GATE VALVES - All fire hydrants assemblies shall include auxiliary gate valves positioned as shown on the Drawings.

219.3.5 THRUST BLOCKS

Thrust blocks and joint restraints (Mega Lug) shall be formed to prevent coverage of the pipe joints in accordance with the details shown on the Drawings. All thrust blocks shall be set against undisturbed earth.



**220.1 DESCRIPTION**

This section covers the water system control valves, including: pressure release, pressure sustaining, pressure reducing, water level control, air relief, vacuum relief, deep well pump control, back flow prevention and surge control with their enclosures and miscellaneous support equipment.

**220.1.1 RELATED WORK**

Section 218 - Waterline Pipe Installation  
Section 214 - Portland Cement Concrete  
Section 215 - Concrete Forming, Finishing and Curing  
Section 216 - Concrete Reinforcement  
Section 217 - Pipe and Piping Systems  
Section 219 - Waterline Valves and Hydrants

**220.1.2 SUBMITTALS**

**220.1.2.1 CERTIFICATION OF COMPLIANCE** - Certification of compliance to the standards and Specifications contained herein shall be obtained from the manufacturer and provided by the Contractor at the time of delivery of these materials to the project site.

**220.1.2.2 DESCRIPTIVE LITERATURE** - Descriptive literature which identifies the manufacturer, model numbers, materials of which the control valves are fabricated, and their capacities shall be provided by the Contractor to the City.

**220.1.2.3 OPERATION AND MAINTENANCE INSTRUCTIONS** - Manufacturer's installation, operation and maintenance literature for each control valve shall be furnished to the City prior to the time of final acceptance for payment.

**220.1.3 DEFINITIONS**

Not used.

**220.2 MATERIALS**

All control valves shall be manufactured by CLA-VAL Company

**220.2.1 GENERAL**

All control valves furnished and installed under this contract shall be of the model, size, and type shown on the Drawings or required in these Specifications. They shall have been produced by the same manufacturer and shall be provided by a supplier located in the state in which the

installation is to be made. They shall be furnished with a manufacturer applied, NSF approved, fusion bonded, epoxy coating. Seats shall be designed so that they are easily maintained and without edges that induce cutting or wear at low flows. Unless otherwise required to meet specific service conditions, all cast iron or steel valves shall be 150 lb. Class.

#### 220.2.2 ALTITUDE CONTROL VALVES

Valves shall be of ductile iron flanged, spring loaded, 3-way, diaphragm actuated, globe pattern valves. Valve control shall be provided by a pressure difference sensor (and when called for on the Drawings or in these Specifications, fitted with a direct acting solenoid control) with appropriately sized piping and supports. Valves shall have a valve position indicator, cocks to isolate the pilot system and closing speed control. Four-inch and smaller valves shall be fitted with flow clean strainer while larger valves shall be provided with a "Y"-pattern strainer in the pilot control system.

#### 220.2.3 PRESSURE RELIEF/PRESSURE SUSTAINING VALVES

Shall be ductile iron, modulating, hydraulic operated, pilot controlled, flanged valves with globe pattern. All pressure sustaining valves shall be designed to maintain constant upstream pressure at the set point indicated on the Drawings or in the Special Provisions. Pressure sustaining valves shall be provided with a position indicator operated by a pressure difference sensor and shall have appropriately sized piping and supports. The pilot system shall be capable of being isolated with shut-off cocks, be fitted with a strainer, and shall be able to control closure to prevent surges.

#### 220.2.4 COMBINATION BACK PRESSURE/SOLENOID SHUTOFF VALVE

Shall be ductile iron, flanged, globe pattern, modulating hydraulic operated, pilot controlled, with solenoid activated shut-off. The valve shall open sufficiently to maintain a pre-set inlet (back) pressure. When the inlet pressure is less than the control setting, the pilot system shall close the valve tight. The pilot system shall be capable of being isolated with shut-off cocks, be fitted with a strainer and shall be able to control closure to prevent surges.

#### 220.2.5 PRESSURE REDUCING VALVES

Shall be modulating pressure reducing with globe pattern. Valves shall be provided with pilot control which operates such that positive and gradual closure can occur to prevent any surge or line shock. Pressure reducing valves shall be equipped with a valve position indicator, cocks to isolate the pilot system, speed for control of closure and a strainer on the pilot system inlet.

#### 220.2.6 BACK-FLOW PREVENTION VALVES

Shall meet standard C516512 AWWA and tested upon installation. All assemblies used shall be on the USC-FCCCR approved list and meet State and Local Requirements.

220.2.6.1 BACKFLOW PREVENTION ASSEMBLY – The nomenclature “assembly” refers to a backflow preventer which are designed to be in-line tested and repaired, and to meet the head loss and flow requirements of the recognized approval authority. The “assembly” consists of the backflow prevention unit, two resilient seated shutoff valves, and test cock(s).

220.2.6.2 BACKFLOW PREVENTION DEVICE – Backflow prevention devices shall be installed per Utah Division of Drinking Water regulations IDAPA:

- a. If double check valves and/or reduced pressure principle backflow prevention devices are used, they must pass a performance test conducted by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research or meet American Water Works Association C-510 or C-511 standard or another equal test approved by the Department. (7-1-97)
- b. If atmospheric vacuum breakers and pressure vacuum breakers are used, they shall be marked approved by the International association of Plumbing and Mechanical Officials (IAPMO) or by the American Society of Sanitary Engineer/City Representatives (ASSE). (10-1-93)
- c. Resilient seated shutoff valves shall be used after the effective date of these rules when double check valves, reduced pressure backflow prevention devices, and pressure vacuum breakers are installed. (12-10-92)

220.2.7 AIR/VACUUM RELIEF VALVES

Shall be simple lever type, kinetic combination air valves, with cast iron body and stainless steel floats. Vents for air/vacuum relief valves shall be threaded GI pipe and shall be protected with fittings covered with No. 24 stainless steel, bronze or aluminum screen.

220.2.8 DEEP WELL SOLENOID PUMP CONTROL VALVE

Shall be globe pattern, hydraulically operated diaphragm valve controlled by a solenoid pilot valve. The pilot system shall have separate adjustable flow control valves, a "Y" strainer, and shall be fitted with cocks to enable isolation during servicing. The valve stem shall have a limit switch to serve as an electrical interlock between the valve and pump motor.

220.2.9        **ENCLOSURES**

Enclosures for control valves shall be concrete, furnished and installed in accordance with these Specifications.

220.2.10       **MISCELLANEOUS PIPE, FITTINGS, VALVES AND EQUIPMENT**

Miscellaneous pipe, fittings, valves and equipment needed to assemble and support operation of the control valves shall be in conformance with Sections 217, 218, and 219 of these Specifications.

**220.3            CONSTRUCTION REQUIREMENTS**

Prior to installing control valves, the Contractor shall flush, blowout, or otherwise clean all dirt and debris from connecting lines. Control valves shall be installed with appropriate supporting piping and equipment in accordance with manufacturer's recommendations. Control valves shall be fitted with flanged connections or installed in a manner which will allow easy removal in the enclosure or area wherein the valves are installed. As soon as control valves are pressurized (placed in service), the Contractor shall check and adjust, if necessary, all valve assemblies to assure they are adjusted correctly and functioning as designed.

**221.1 DESCRIPTION**

This section covers the materials which include excavation, water main tapping, stops, valves, service lines, meters, settings, boxes and other accessories required for installing water services to system users.

**221.1.1 RELATED WORK**

Section 205 - Trench Excavation and Backfill  
Section 218 - Waterline Pipe Installation  
Section 217 - Pipe and Piping Systems

**221.1.2 SUBMITTALS**

**221.1.2.1 DESCRIPTIVE LITERATURE** - Descriptive literature which identifies the manufacturer, model, size, material and parts lists from which the piping, fittings, valves and meters are manufactured, including installation instructions, shall be provided to the City.

**221.1.2.2 CERTIFICATION OF COMPLIANCE** - Written certification of compliance from the respective manufacturer shall be provided with each delivery of metal fittings, valves and meters.

**221.1.3 DEFINITIONS**

Mains - Water distribution pipes, located in streets or rights-of-ways, to which water service connections are made for users of the system.

Tap - The actual connection made to water mains which includes drilling an opening into the main, threading, installing a tapping saddle when appropriate, and inserting (screwing) a valve into the opening.

Saddle - A fitting placed on a pipe to reinforce the pipe wall through which the tapping hole is drilled.

Key - Can mean either: the center piece of a corporation or curb valve which is turned to control flow through the valve; or, the "T-shaped" tool used by operators to reach and turn the key or closing piece of a valve.

Setter (also referred to as "yoke") - Is the prefabricated assembly of pipes and valves installed in a meter box and connected into the service line in which the water meter is mounted (or "set").

## **221.2 MATERIALS**

### **221.2.1 SADDLES**

Saddles shall be ductile iron with epoxy coating and stainless steel straps designed and sized specifically for tapping water mains. Threading shall be tapered and the saddle shall conform to ANSI/AWWA C-800. Straps shall provide full support around the circumference of the pipe and have a bearing area of sufficient width along the pipe axis so that the pipe will not be distorted when tightened.

### **221.2.2 CORPORATION STOPS**

Corporation stops shall be copper alloy body ball-type or balanced pressure, o-ring sealed plug type valves with tapered threads and in conformance with the requirements of ANSI/AWWA C-800.

### **221.2.3 CURB VALVES**

Curb valves shall be copper alloy body ball-type valves; or balanced pressure, o-ring sealed, plug type valves. Curb valves shall be furnished with McDougal 1" slide pipe box. The curb box shall be sized to properly fit the valve and adjust to the depth to which the valve is set.

### **221.2.4 SERVICE LATERAL PIPE**

Service lateral pipe shall be as called for on the Drawings and in accordance with the following:

**221.2.4.1 POLYETHYLENE PIPE** - Polyethylene service pipe shall conform to the requirements of AWWA C-901, "Polyethylene (PE) Pressure Pipe, Tubing and Fittings, 3/4-inch through 3-inch for water." PE Pipe shall be pressure tubing conforming to Table 6 of said specification. Tubing shall be Class 160 with a DR of 9.0 or Class 200 with a DR of 7.3. If not specified, DR 7.3 shall be used.

**221.2.4.2** Ends of polyethylene tubing inserted in compression connections should be fitted with insert reinforcement.

### **221.2.5 METER SETTER (YOKE)**

Meter setter shall be fit with copper tubing (when required) and copper alloy and copper alloy fittings. Setters shall be furnished with copper alloy body, angle or straight, ball-type inlet valves with fittings appropriately sized to fit the meter. When required, a cast iron yoke ban shall be furnished to provide the setting.

#### 221.2.6 DUAL CHECK VALVE

Unless indicated otherwise on the Drawings, a dual check valve shall be provided with each meter setting. Valves shall be copper alloy bodied, dual valves with independent/ internally loaded check valves which meet the requirements of the State and local health authorities and conform to ASTM/AWWA C-510.

#### 221.2.7 WATER METERS

Water meters shall be cold water displacement type meters which complies with ANSI/AWWA C-700. The main case and bottom plate shall be of bronze and the meter shall be sized and equipped as shown on the Drawings. All meters shall be Neptune E- Coder type.

#### 221.2.8 METER BOX

Meter boxes shall be as shown in the standard drawings and installed level and even with final grade with ring and cover.

#### 221.2.9 METER BOX RING AND COVER

The meter box ring and cover shall be cast iron with a minimum diameter of 18-inches but shall be appropriately sized to fit larger meter boxes where required. The words "WATER METER" shall be cast into the cover. The cover shall be a locking type with a pentagonal head, corrosion resistant, screw down, locking device. Lids shall be D&L Foundry brand recessed lid designed for Neptune Radio read meters.

#### 221.2.10 METER BOX DRAINAGE

Meter box drainage shall be provided by placing <sup>2</sup>-cubic yard of drain gravel at the base of new meter box drain.

### **221.3 CONSTRUCTION REQUIREMENTS**

#### 221.3.1 TRENCHING AND BACKFILL

Trenching and backfill for installation of service connections shall be completed in accordance with Section 205. Service lines shall have a minimum of 50-inches of cover.

#### 221.3.2 INSTALLATION OF CONNECTIONS

Installation of water service connection components shall be as shown on the Drawings. All connections to water main pipe shall be made by using a saddle rather than a direct tap. Service lines shall be slightly snaked in the trench near the connection to the water main to allow for some movement to avoid a rigid connection.

### 221.3.3

### REPLACEMENT OF EXISTING FACILITIES

When replacement of specified components of service connections is required, the Contractor shall: protect existing equipment, provide appropriate connecting fittings to accommodate the new component, use care in removal and salvaging of the existing component and deliver the existing components to the Owner's maintenance shop or headquarters.



**222.1 DESCRIPTION**

This section covers the materials which include excavation, water main tapping, stops, valves, service lines, meters, settings, boxes and other accessories required for installing 1.5" or larger water services to system users.

**222.1.1 RELATED WORK**

Section 205 - Trench Excavation and Backfill  
Section 218 - Waterline Pipe Installation  
Section 217 - Pipe and Piping Systems

**222.1.2 SUBMITTALS**

**222.1.2.1 DESCRIPTIVE LITERATURE** - Descriptive literature which identifies the manufacturer, model, size, material and parts lists from which the piping, fittings, valves and meters are manufactured, including installation instructions, shall be provided to the City.

**222.1.2.2 CERTIFICATION OF COMPLIANCE** - Written certification of compliance from the respective manufacturer shall be provided with each delivery of metal fittings, valves and meters.

**222.1.3 RESPONSIBILITY** – City responsibility for maintenance or repair will end at the meter. Developer or HOA will be responsible to maintain and repair the water system beyond the meter.

**222.1.4 CONSTRUCTION/INSTALLATION** - Compound/Bulk meter shall be constructed and installed as outlined in drawing number 5, 6, or 7, depending on size of meter to be installed. Installation will be in compliance and as outlined in these standards.

**222.1.5 SIZE OF METER** - Size of meter will be determined by the Town Public Works Director, the Town Engineer AND the Garden City Fire Chief. Determining factors in the size may include but is not limited to the size of the development, the number of units, structure spacing, distance to nearest fire hydrant, amount of grassy area, etc.

**222.1.6 PLACEMENT** – Meters shall be installed on the property line in a location that will be easily accessible for the purposes of reading and maintenance by the Garden City Public Works Department.

**223.1 DESCRIPTION**

Includes furnishing and installing tubular flanged water flow meter(s) of the size and type and location shown on the Drawings and as described in these Specifications.

**223.1.1 RELATED WORK**

Section 218 – Water Pipe Installation

**223.1.2 SUBMITTALS**

Not used.

**223.1.3 DEFINITIONS**

Not used.

**223.2 MATERIALS****223.2.1 TYPE**

Flow meters must be Neptune – E Coder Brand.

**223.3 CONSTRUCTION REQUIREMENTS**

Flow meters shall be installed in accordance with the manufacturer's recommendations and consistent with the Drawings. The Contractor shall provide all materials and installation labor to assure proper installation and calibration of the meter(s) required.

**224.1 DESCRIPTION**

This section covers pressure gauges and their support piping and fittings in buildings and other structures at locations shown on the Drawings.

**224.1.1 RELATED WORK**

Section 218 – Waterline Pipe Installation  
Section 217 – Pipe and Piping Systems

**224.1.2 SUBMITTALS**

Not used.

**224.1.3 DEFINITIONS**

Not used.

**224.2 MATERIALS****224.2.1 PRESSURE GAUGES**

Shall be US Gauge, Model 550L, stem mounted and oil filled, as manufactured by AMETEK or an approved equal. Gauges have a 2 1/2-inch (minimum) stainless steel case with a pressure relief plug. The window shall be polycarbonate plastic with neoprene sealing gasket. The pressure reading range shall be as required for the application.

**224.2.2 SUPPORTING PIPE AND FITTINGS**

Shall be 1/4-inch threaded Schedule 40 galvanized pipe.

**224.3 CONSTRUCTION REQUIREMENTS**

Pressure gauges shall be installed in accordance with the manufacturer's recommendations and at the locations shown on the Drawings. The Contractor shall provide sufficient supporting pipe to mount pressure gauges vertically and oriented to be read easily. When possible, pressure gauges should be installed at least three pipe diameters downstream from any valve in the pipeline.

**225.1 DESCRIPTION**

This section covers lighting requirements for Garden City.

**225.1.1 RELATED WORK**

Not used.

**225.1.2 SUBMITTALS**

Not used.

**225.1.3 DEFINITIONS**

Not used.

**225.2 MATERIALS**

Approved materials for the pole, lamp, and base are shown in the drawings contained in this section.

**225.3 CONSTRUCTION REQUIREMENTS**

Assembly and construction shall be done in accordance with the drawings provided in this section. All electrical work shall be performed by a licensed electrician.

**225.4 SPACING**

Light poles shall be installed at all intersections and spacing shall not be greater than 250 feet. Proposed lighting plans must be submitted to the City for approval.

**226.1 DESCRIPTION**

This section covers providing materials, equipment and labor necessary for installing topsoil, turf, mulch, and irrigation requirements for City Parks

**226.2 MATERIALS****226.2.1 TOPSOIL**

Topsoil shall be obtained from local sources, and shall have similar soil characteristics to those of the soil at the location where it is to be used. Topsoil shall be obtained from well-drained sites where it occurs to a depth of not less than 4 inches, and it shall not be obtained from bogs or marshes. Topsoil shall be fertile, friable, natural loam, reasonably free of subsoil, clay lumps, brush, weeds, litter, roots, stumps, stones larger than 2 inches in any dimension, or any other material which would inhibit the germination of seeds or the growth of the cover crop.

**226.2.2 TURF SOD**

Turf sod is required to be installed on all City Parks. Turf sod shall be vigorous, viable, strongly rooted sod, not dormant or less than 2 years old, free of weeds, undesirable native grasses, insect infestations, and fungus. It shall be machine cut to a pad thickness of 1 inch ( $\pm 0.33$  inch). Turf sod types and mixtures must be approved by the City.

**226.2.3 TREES AND SHRUBS**

**226.2.3.1 NURSERY GROWN** - Trees and shrubs shall be nursery-grown or donated, with botanical and common names of plants true to the approved names given in the latest edition of "Hortus", and shall meet the requirements of the American Standard for Nursery Stock adopted by the American Association of Nurserymen. Plants shall be sound, healthy, vigorous, symmetrically proportioned, well branched, densely foliated when in leaf, free of disease, insect pests, eggs, and larvae and shall have well developed root systems.

**226.2.3.2 ROOT BALLS AND PRUNING** - Root balls shall be protected at all times from sun, drying winds and frost. Plants shall not be pruned prior to delivery. If balled and burlapped plants are not installed immediately upon delivery, they shall be set on the ground and protected with moist soil or wet mulch.

**226.2.3.3 WARRANTY** - Trees and shrubs shall be warranted for a period of 2 years after Substantial Completion, against death and unsatisfactory growth, except in cases resulting from Owner's neglect, abuse by others or

natural phenomena. Unacceptable plant material shall be replaced at end of warranty period. Only one replacement is required.

#### 226.2.4 MULCH

226.2.4.1 TREE AND SHRUB MULCH - Tree and shrub mulch shall consist of well-aged fibrous or shredded bark.

#### 226.2.5 IRRIGATION SYSTEMS

226.2.5.1 All irrigation sprinkler heads shall be manufactured by Hunter.

226.2.5.2 All irrigation sprinkler system piping laterals shall be PE pipe with a 1 ¼ inch minimum diameter and 100 psi minimum pressure rating. Supply line PE pipe with a minimum size 2 inch diameter and 100 psi minimum pressure rating.

### **226.3 CONSTRUCTION REQUIREMENTS**

#### 226.3.3 TOPSOIL

226.3.3.1 REMOVAL OF TOPSOIL - Topsoil to be saved shall be carefully removed and set aside in a separate location. It shall not be mixed with the remainder of excavated material.

226.3.3.2 REPLACEMENT OF TOPSOIL - When site work conditions permit, topsoil shall be spread as shown on the Drawings. The minimum depth of topsoil shall be 4 inches over all designated areas. Topsoil shall be fine graded to a firm even surface, matching existing slopes, with no lumps or stones present. The topsoil shall be prepared to a good condition, not muddy or hard, and shall be scarified to a friable condition if it is hard before turf is placed.

226.3.3.3 PROTECTION AGAINST EROSION - Areas where topsoil has been spread shall be protected against erosion.

#### 226.3.4 TURF SOD

226.3.4.1 INSTALLATION - Turf sod shall be laid across slopes such that butt joints alternate. Sod pieces shall be fitted tightly together so no joint is visible and then firmly and evenly hand tamped. The sod shall then be rolled with a 150-pound roller to level and seal all seams.

226.3.4.2 WATERING - After rolling, sod shall be watered until water soaks into underlying topsoil to a depth of not more than 3 inches. For grades of 50% slope or steeper, the sod shall be secured with wooden pegs driven flush with the soil portion of the sod and 2 feet maximum on center.

## 226.3.5 TREES AND SHRUBS

226.3.5.1 LOCATION - Trees and shrubs shall be installed at locations designated on the approved Drawings. Tree and shrub types shall be approved by the City. Trees and shrubs to be saved and replanted shall be carefully removed, set aside, protected and preserved until they can be safely replanted.

226.3.5.2 PLANTING - The plant shall be set in the center of a hole of the proper size, plumb and straight. Burlap, ropes and all wire and other materials shall be removed, and then the excavated soil shall be returned to the hole and gently packed around the root ball. The planting shall be flooded with water to promote additional soil consolidation. The Contractor shall give care that, after settling, the top of the root collar shall be even with the adjacent finished grade. Planting shall include a 4-inch layer of mulch to be placed over a 6-ft. diameter weed control mat.

22.3.5.3 WATERING - Trees and shrubs shall be watered and maintained until Substantial Completion and defective work shall be corrected as soon as it becomes apparent and as weather and season permit.

## 226.3.6.5 IRRIGATION SPRINKLER SYSTEMS

226.3.6.5.1 The main line attached to the City Culinary Water System shall be sized (2-inch diameter minimum) to meet minimum demands of the sprinkler system. All sprinkler systems shall be installed to meet minimum backflow requirements as required by the City.

226.3.6.5.2 Maximum spacing for sprinkler system laterals shall be 30 ft.

226.3.6.5.3 Maximum spacing for sprinkler heads shall be 25 ft.

226.3.6.5.4 All sprinkler system solenoids shall be hard wired to one (1) timer for each park.