PARK CITY
DESIGN STANDARDS
CONSTRUCTION SPECIFICATIONS
AND
STANDARD DRAWINGS

Published: April, 2007

PREPARED BY:

THE OFFICE OF THE CITY ENGINEER
PARK CITY MUNICIPAL CORPORATION
PARK CITY, UTAH 84060

Edited by: Eric Anderson
Approved by: Eric W. DeHaan, M.S., P.E.

2007

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

(435) 615-5077

Notes:

PARK CITY MUNICIPAL CORPORATION
CONSTRUCTION SPECIFICATIONS

TABLE OF CONTENTS

SECTION 100 GENERAL REQUIREMENTS

Section	Title
100.1	Introduction
100.2	Definitions
100.3	Revisions of Standards and Specifications
100.4	Temporary Construction Drainage
100.5	Protection of Public and Private Utilities
100.6	Control of Material
100.6.01	Source of Supply and Quality Requirements
100.6.01A	Local Material Sources
100.6.01B	Contractor Furnished Sources
100.6.02	Samples, Test, Cited Specifications
100.6.02A	Untreated Aggregates
100.6.02B	Bituminous Mixtures
100.6.02C	Portland Cement Concrete
100.6.02D	Cement Treated and Lime Treated Materials
100.6.02E	Density Test
100.6.02F	Smoothness Determinations
100.6.02G	Thickness Determinations
100.6.02H	Manufactured Materials
100.6.03	Plant Inspection
100.6.03A	Contractor Cooperation
100.6.03B	Full Plant Entry
100.6.03C	Safety Measures
100.6.04	Storage of Materials
100.6.05	Handling Materials
100.6.06	Unacceptable Materials
100.6.07	City-Furnished Materials
100.7	Record Drawings and On-Site Contract Documents
100.8	Explanation of Measurement and Payment
100.9	Payment of Costs
100.10	Winter
100.11	Right-of-Way
100.12	Open Trenches
	GENERAL

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
	SECTION 200 GENERAL IMPROVEMENT REQUIREMENTS AND DESIGN GUIDELINES
200.1	Scope
200.2	Construction Drawings
200.3	Standards for Final Construction Drawings
200.3.01	Revisions
200.3.02	Required Information
200.3.03	Additional Information
200.4	Inspection
200.5	Construction Completion Inspection
200.6	Two-Year Correction Period
200.7	Required Improvements
	SECTION 500 STREET CONSTRUCTION AND RELATED WORK
500.1	General
500.2	Approved Plans
500.3	Licenses and Permits Required
500.4	Inspection
500.5	Contractor's Site Examination
500.6	Supervision by the Contractor
500.7	Traffic Control
500.8	Protection of Existing Improvements
500.8.01	Surface Improvements
500.8.02	Subsurface Improvements
500.8.02A	General
500.8.02B	Private Utilities
500.8.02C	Water Mains and Appurtenances
500.9	Use of Existing Streets
500.10	Use of Explosives
500.11	Prime and Tack Oil Application
500.13	Right-Of-Way Grades
501	**EARTHWORK**
501.1	General Description
501.2	Clearing and Grubbing
501.2.01	Description
501.3	Removal of Pavements, Sidewalks and Curb and Gutter
501.3.01	Edge Preparations
501.4	Excavation and Grading
501.4.01	Description

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS

TABLE OF CONTENTS

Section	Title
501.4.02	Classification
501.4.02A	Common Excavation
501.4.02B	Solid Rock Excavation
501.4.02C	Unclassified Excavation
501.4.03	Definitions
501.4.03A	Heavy Ripping Equipment
501.4.03B	Wheel Tractor-Scraper
501.4.03C	Pusher Tractor
501.4.04	Site Drainage and Ditches
501.4.05	Use and Disposal of Excavated Materials
501.4.06	Side Street, Alley and Driveway Approaches
501.4.07	Planting and Sidewalk Areas
501.4.08	Embankment Cut Slopes
501.4.09	Fill Slopes and Embankments
501.4.10	Slides
501.4.11	Overbreak
501.4.12	Subgrade
501.4.12A	Unsuitable Foundation Excavation
501.4.13	Subgrade Compaction
501.4.14	Subgrade Stabilization
501.4.14A	Clearing, Grubbing and Excavation
501.4.14B	Equipment
501.4.14C	Subgrade Preparation
501.4.14D	Subgrade Stabilization Fabrics
501.4.14E	Installation
501.4.14F	Compaction
501.4.15	Embankment Construction
501.4.15A	Rock Embankment Construction
501.4.15B	Earth Embankment Construction
501.4.15C	Embankment and Structures, Trestle and Bridge Ends
501.4.16	Compaction Control Testing
501.4.16A	Field Density Testing
501.4.17	Inadequate Compaction
501.4.18	Revegetation
501.4.19	Snow Removal
501.4.20	Measurement
501.4.21	Payment

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
503	**SUBGRADE, BORROW AND IMPORTED FILL MATERIALS**
503.1	General
503.2	Description
503.2.01	Subgrade
503.2.02	Common Fill (Borrow)
503.2.03	Select Fill (Granular Borrow and Backfill)
503.3	Construction Methods
503.4	Revegetation
503.5	Method of Measurement and Payment
505	**CONSTRUCTION WATER**
505.1	Description
505.1.01	Water for Streets
505.2	Source of Water and General Requirements
505.2.01	Water Supply
505.2.02	Requirements and Responsibility
505.3	Construction Details
505.3.01	General
505.4	Payment
506	**EXCAVATION FOR STRUCTURES**
506.1	Description
506.1.01	Classification
506.2	Construction Details
506.2.01	Preservation of Channel
506.2.02	Excavation in Open Pits
506.2.03	Depth of Footings
506.2.04	Preparation for Placing Foundations
506.2.05	Shoring, Cribs, and Cofferdams
506.2.06	Inspection
506.2.07	Disposal of Excavated Material
506.2.08	Backfilling
506.3	Measurement
506.4	Payment

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
510	**UNTREATED AGGREGATE BASE COURSE**
510.1	Description
510.2	Source
510.3	Mineral Aggregate Requirements
510.3.01	(Table) Aggregate Base Grading Requirement
510.3.01A	Acceptance of Material
510.4	Placement
510.5	Compaction and Shaping
510.6	Field Density Testing
510.6.01	Inadequate Compaction
510.7	Finishing
510.8	Method Measurement
510.9	Basis of Payment
520	**ASPHALT MATERIALS**
520.1	Description
520.1.01	Asphalt Material
520.1.02	Bill of Lading
520.1.03	Asphalt Cements
520.1.04	Catalytically-Blown Asphalt
520.1.05	Asphalt Emulsions
520.1.06	Slow Curing Cut Back Asphalt (SC)
520.1.07	Medium Curing Cut Back Asphalt (MC)
520.1.08	Rapid Curing Cut Back Asphalt (RC)
520.1.09	Deep Penetration Liquid Asphalt
520.1.10	Road Tars
520.1.11	Unauthorized Grades
521	**PLANT MIX BITUMINOUS PAVEMENT**
521.1	Description
521.2	Materials
521.2.01	Bituminous Asphalt Materials
521.2.02	Mineral Aggregates
521.2.02A	Coarse Aggregate
521.2.02B	Fine Aggregate
521.2.03	Mineral Filler

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
521.2.04	Paving Fabrics
521.2.04A	Fabric Type
521.2.04B	(Table) Minimum Physical Requirements
521.2.04C	Certificate of Compliance
521.3	Mix Designs and Submittals
521.4	Asphalt Mixture Composition
521.4.01	Combined Aggregate Gradings
521.4.01A	(Table) Master Gradation Limits
521.4.01B	(Table) Job Mix Gradation Tolerances
521.4.02	Asphalt Cement Content
521.4.03	Physical Test Properties
521.4.03A	(Table) Test Properties
521.4.03B	Index of Retained Strength
521.5	Acceptance of Delivered Material
521.6	Preparation of Roadway
521.6.01	Untreated Roadway Surfaces
521.6.01A	Prime Coat
521.6.02	Overlays
521.6.02A	Tack Coat
521.6.03	Paint Binder for Vertical Surfaces
521.6.04	Paving Fabrics
521.6.04A	Preparation
521.6.04B	Fabric Sealant
521.6.04C	Fabric Installation
521.7	Preparation of Asphalt Concrete Mixtures
521.7.01	Mixing
521.8	Mix Temperature Control
521.9	Hauling
521.10	Placement and Spreading
521.10.01	General
521.10.01A	Lift Thickness
521.10.02	Equipment
521.10.03	Joints
521.10.04	Weather Limitations
521.10.05	Miscellaneous Details
521.11	Compaction
521.11.01	Construction Details
521.11.02	Rollers

Section	Title
521.11.03	Field Density Testing
521.11.04	Inadequate Compaction
521.12	Finishing
521.12.01	Shoulders
521.13	Method of Measurement
521.13.01	Paving Fabric Measurements
521.14	Basis of Payment for Asphalt Concrete
522	**BITUMINOUS PRIME COAT**
522.1	General
522.2	Bituminous Material
522.3	Blotter Material
522.4	Surface Preparation
522.5	Application of Bituminous Material
522.6	Protection of Structures
522.7	Opening to Traffic and Maintenance
522.8	Weather and Limitations
522.9	Payment
523	**BITUMINOUS TACK COAT**
523.1	General
523.2	Materials
523.3	Application of Bituminous Material
523.4	Protection of Structures
523.5	Opening to Traffic
523.6	Weather Limitations
523.7	Payment
524	**BITUMINOUS SEAL COAT**
524.1	General
524.2	Bituminous Material
524.3	Cover Material
524.4	Construction Methods
524.4.01	Bituminous Additive
524.4.02	Surface Preparation
524.4.03	Application
524.4.04	Spreading and Compacting of Cover Material
524.4.05	Protection of Structures

Section	Title
524.4.06	Opening to Traffic
524.4.07	Weather Limitations
524.4.08	Supplemental Cover Material
524.5	Payment
525	**PLANT MIX BITUMINOUS SEAL COAT**
525.1	Description
525.2	Materials
525.2.01	Bituminous Material
525.2.02	Mineral Aggregate
525.2.03	Bituminous Additive
525.3	Construction Methods
525.3.01	Temperature Control
525.3.02	Mixing
525.3.03	Tack Coat
525.3.04	Spreading and Compacting
525.3.05	Weather and Seasonal Limitations
525.4	Method of Measurement
525.5	Basis of Payment
526	**EMULSION SLURRY SEAL**
526.1	Description
526.2	Materials
526.3	Equipment
526.4	Preparation of Surface
526.5	Composition and Rate of Application of the Slurry Mix
526.6	Weather Limitations
526.7	Application of the Slurry Surfaces
530	**PORTLAND CEMENT CONCRETE**
530.1	General
530.2	Materials
530.2.01	Cement
530.2.02	Aggregates
530.2.03	Water
530.2.04	Reinforcing Steel
530.2.05	Welded Wire Fabric
530.2.06	Tie Bars

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
530.2.07	Expansion (Through) Joints
530.2.08	Calcium Chloride
530.2.09	Water-Reducing and Set-Retarding Admixtures
530.2.10	Curing Compounds
530.2.11	Entraining Agent
530.2.12	Joint-Sealants
530.3	Classification
530.4	Air Content and Consistency
530.5	Design of the Concrete Mix
530.6	Inspecting and Testing
530.6.01	Concrete Testing
530.6.02	Acceptance of Concrete
530.7	Handling and Measurement of Materials
530.8	Mixer and Agitators
530.8.01	Stationary Mixers
530.8.02	Volumetric Batching and Continuous Mixing at the Site
530.8.03	Ready-Mixed Concrete
530.8.04	Truck-Mixed Concrete
530.8.05	Dry-Batched Concrete-Float Delivery
530.8.06	Shrink-Mixed Concrete
530.8.07	Central-Mixed Concrete
530.9	Forms
530.10	Preparation of Forms and Subgrade
530.11	Conveying
530.12	Placing
530.13	Consolidation
530.14	Construction Joints
530.15	Expansion and Contraction Joints
530.16	Waterstops
530.17	Removal of Forms
530.18	Finishing Formed Surfaces
530.19	Finishing Unformed Surfaces
530.20	Curing
530.21	Removal or Repair
530.22	Concreting in Cold Weather
530.23	Concreting in Hot Weather
530.24	Measurement and Payment

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
531	**CEMENT CONCRETE PAVEMENT**
531.1	Description
531.2	Materials
531.3	Construction
531.3.01	Subgrade
531.3.02	Forms
531.3.03	Compaction of Subgrade
531.3.04	Placing Concrete
531.3.04A	Placing Concrete at Expansion Joints
531.3.04B	Placing Concrete with Reinforcing Steel Bars or Wire Mesh
531.3.04C	Slip-Form Construction
531.3.05	Compacting Concrete
531.3.05A	Hand Compacting
531.3.05B	Machine Compacting
531.3.05C	Combined Vibration and Machine Compacting
531.3.05D	Vibrating Screed Concrete Pavement Construction
531.3.06	Water
531.3.07	Joints
531.3.07A	Formed Transverse Contraction Joints
531.3.07B	Construction of Formed Contraction Joints
531.3.07C	Sawed Contraction Joints
531.3.07D	Transverse Construction Joints
531.3.07E	Transverse Expansion Joints
531.3.07F	Sealing Expansion Joints
531.3.07G	Longitudinal Contraction Joints
531.3.07H	Standard Location for Longitudinal Joints
531.3.07I	Longitudinal Expansion Joints
531.3.07J	Longitudinal Construction Joints
531.3.08	Finishing Concrete
531.3.08A	Hand Finish
531.3.08B	Machine Finishing
531.3.08C	Edging
531.3.08D	Final Finish
531.3.08E	Surface Smoothness
531.3.09	Curing and Protection
531.3.09A	Moist Curing
531.3.09B	Waterproof Paper or White Polyethylene

Section	Title
531.3.09C	Membrane
531.3.09D	Cold-Weather Protection
531.3.09E	Curing in Hot Weather
531.3.10	Opening Pavements to Traffic
531.3.11	Cleanup
531.4	Measurement and Payment
532	**CONCRETE CURB AND GUTTER, CONCRETE GUTTER AND DRIVEWAYS**
532.1	Description
532.1.01	High-Back Curb and Gutter (Type A)
532.1.02	Outfall Curb and Gutter
532.1.03	Depressed Curb (Handicap Ramp)
532.1.04	Roll Gutter
532.1.05	Drain Gutter
532.1.06	Concrete Driveways
532.2	Material and Forms
532.2.01	Concrete
532.2.02	Preformed Expansion and Dummy Joint Filler
532.2.03	Curing Compounds
532.2.04	Forms
532.3	Construction Details
532.3.01	Excavation
532.3.02	Bedding
532.3.03	Entrances
532.3.04	Placing and Finishing
532.3.05	Contraction Joints
532.3.06	Expansion Joints
532.3.07	Backfilling
532.3.08	Monolithic Construction
532.3.09	Driveway Installations
532.3.10	Allowable Curb Cuts
532.4	Measurement and Payment
533	**CEMENT CONCRETE SIDEWALKS**
533.1	Description
533.2	Materials
533.3	Construction Details

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
533.3.01	Excavation and Subgrade
533.3.02	Bedding
533.3.03	Forms
533.3.04	Thickness
533.3.05	Placing and Finishing
533.4	Measurement
540	**STREET LIGHTING AND SIGNING**
540.1	Description
540.1.01	Regulations and Code
540.2	Materials
540.2.01	General
540.2.02	Inspection
540.2.03	Street Light Components
540.2.03A	Luminaire
540.2.03B	Pole
540.2.03C	Base
540.3	Construction Details
540.3.01	General
540.3.02	Placement
540.4	Measurement and Placement
541	**TOPSOIL**
541.1	Description
541.2	Materials
541.2.1	Topsoil
541.3	Construction Details
541.3.01	Placement of Topsoil
541.3.02	Removal and Replacement of Topsoil
541.4	Measurement
541.4.01	Topsoil
541.4.02	Removal and Replacement of Topsoil
541.5	Payment
542	**SEEDING, LAWN REMOVAL AND REPLACEMENT**
542.1	Description
542.1.01	Sod Removal and Replacement by Seeding
542.1.02	Sod Removal and Replacement by New Sod

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
542.1.03	Sod Removal and Replacement
542.2	Materials
542.2.01	Topsoil
542.2.02	Replacement by Seeding
542.2.02A	Seed
542.2.02B	Fertilizer
542.2.02C	Mulch
542.2.02Cl	Straw
542.2.02C2	Wood Cellulose Fiber
542.2.02D	Tackifier
542.2.03	New Sod
542.3	Construction Details
542.3.01	Seeding
542.3.01A	Preparation
542.3.01B	Placement of Topsoil
542.3.01C	Compaction
542.3.01D	Seeding
542.3.01E	Fertilizing
542.3.01F	Spreading Mulch
542.3.01G	Contractor's Responsibility for Work
542.3.01H	Final Inspection and Acceptance
542.3.02	Sod Removal and Replacement
542.3.03	New Sod
542.3.03A	Grading
542.3.03Al	Existing Subsoil Suitable for Sod Installation
542.3.03A2	Existing Subsoil is Poor
542.3.03B	Fertilizer
542.3.03C	Sod Placement
542.3.03D	Establishment
542.4	Measurement
542.4.01	Topsoil
542.4.02	Replacement by Seeding
542.4.03	Sod Removal and Replacement
542.4.04	Sod Removal and Replacement with New Sod
542.5	Payment

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
543	**RIP-RAP**
543.1	Description
543.2	Materials
543.2.01	Hand-Placed Rip-Rap
543.2.02	Loose Rip-Rap
543.3	Construction Details
543.3.01	Hand-Placed Rip-Rap
543.3.01A	Placing
543.3.01B	Finished Surface
543.3.02	Loose Rip-Rap
543.3.02A	Placing
543.4	Method of Measurement
543.5	Basis of Payment
550	**REMOVAL OF EXISTING STREET IMPROVEMENTS**
550.1	Description
550.2	Construction Details
550.2.01	General
550.2.02	Removal of Pavement
550.2.02A	Pavement Removal, Class A
550.2.02B	Pavement Removal, Class B
550.2.02C	Pavement Removal, Class C
550.2.03	Removal of Asphalt Concrete Pavement
550.2.04	Removal of Curbs
550.2.05	Removal of Curb and Gutter
550.2.06	Removal of Cement Concrete Sidewalks
550.2.07	Removal of Catch Basins, Manholes, Curb Inlets, Sumps, etc.
550.2.08	Salvage
550.2.09	Waste Disposal
550.3	Measurement and Payment
551	**PLACEMENT AND ADJUSTMENT OF NEW AND EXISTING UTILITY STRUCTURES TO FINISH GRADE**
551.1	Description
551.2	Contractor to Schedule Work
551.3	Construction Details
551.3.01	Adjusting to Manholes, Catch Basins, and Similar

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
	Structures
551.3.01A	General
551.3.01B	Cement Concrete Paving Projects
551.3.01C	Asphalt Concrete Paving Projects
551.3.01D	Asphalt Resurfacing Projects
551.3.01E	Storm and Sanitary Sewer or Water Projects
551.3.02	Adjustment of Inlets
551.3.03	Adjustment of Monuments and Cast Iron Frame and Cover
551.3.04	Adjustment of Valve Box Castings
551.3.05	Furnishing Castings
551.4	Measurement and Payment
552	**PAVEMENT PATCHING**
552.1	Description
552.2	Materials
552.3	Construction Details
552.3.01	General
552.3.02	Cement Concrete Pavements
552.3.03	Asphalt Concrete Streets on Granular Base
552.3.04	Oil Mat Streets
552.3.05	Responsibility for Pavement Patching
553	**FINISHING AND CLEANUP**
553.1	Description
553.2	Construction Details
553.3	Measurement and Payment

SECTION 600 SANITARY SEWERS AND STORM DRAINS

600.1	General
600.2	Approved Plans
600.3	Licenses and Permit Required
600.4	Inspection
601	**PIPE, MATERIALS, AND TESTING**
601.1	Description
601.2	General
601.3	Materials and Testing

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
601.3.01	Pipe and Joints
601.3.01A	Concrete Pipe, Non-reinforced
601.3.01B	Concrete Pipe, Reinforced
601.3.01C	Vitrified Clay Pipe
601.3.01D	PVC Pipe
601.3.01E	Galvanized Corrugated Steel Pipe
601.3.01E1	Protective Treatment
601.3.01E2	Asphalt Coatings and Paved Inlet
601.3.01E3	Spun Asphalt Lining
601.3.01E4	Galvanized Steel End Sections
601.3.01F	Corrugated Aluminum Culvert Pipe
601.3.01Fl	Coupling Bands for Corrugated Metal Pipe
601.4	Fittings
601.5	Material Certification
601.6	Measurement and Payment
602	**TRENCH EXCAVATION, BACKFILL, FOUNDATION AND BEDDING FOR SEWERS, DRAINS, AND CULVERTS**
602.1	Description
602.2	Construction Details
602.2.01	Excavation
602.2.02	Control of Water
602.2.03	Bedding and Initial Backfill for Sewer and Drains
602.2.03A	Bedding and Initial Backfill for Rigid Conduits
602.2.03Al	Suitable Subgrade
602.2.03A2	Unsuitable Subgrade
602.2.03A3	Solid Rock Excavation
602.2.03A4	Materials
602.2.03B	Bedding and Initial Backfill for Flexible Conduits
602.2.03B1	Bedding for PVC and ABS Composite Materials
602.2.03B2	Bedding and Initial Backfill for Corrugated Metal Pipe
602.2.04	Cribbing and Sheeting - Shoring
602.2.05	Backfilling for Sewers and Drains
602.2.06	Compaction of Trench Backfill
606.2.06A	Water Settling
602.2.06B	Mechanical Compaction
602.2.06C	Flowable Fill
602.2.07	Culvert Bedding and Backfill

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
602.2.08	Load Limits
602.2.09	Preservation of Existing Trees
602.2.10	Topsoil Removal and Replacement
602.2.11	Lawn Removal and Replacement
602.3	Measurement and Payment
602.3.01	Trench Excavation and Backfill
602.3.01A	Measurement by the Linear Foot
602.3.01B	Unexpected Objects
602.4	Payment
603	**PIPE LAYING AND JOINTING**
603.1	Description
603.2	Material
603.3	Construction Details
603.3.01	Survey Line and Grade
603.3.02	Storm Drain Pipe Laying
603.3.03	Culvert Pipe
603.3.04	Control of Water
603.3.05	Plugs and Connections
603.3.06	Pipe Jointing
603.3.06A	Gasket Type Joints
603.3.06B	Joints of Dissimilar Pipes
603.3.06C	Solvent Welded Joints
604	**MANHOLES**
604.1	Description
604.2	Materials
604.2.01	Precast Manhole Components
604.2.01A	Base Sections
604.2.01B	Precast Manhole Sections
604.2.01C	Precast Cones
604.2.01D	Flat Slab Lids
604.2.02	Cast-In-Place Concrete Bases
604.2.03	Cast Iron Frames and Covers
604.2.04	Grout
604.2.05	Steps
604.2.06	Other Material
604.3	Construction Materials

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
604.3.01	Foundation Preparation
604.3.01A	Dewatering
604.3.01B	Sub-base Preparation
604.3.02	Bedding
604.3.03	Precast Manholes
604.3.03A	General
604.3.03B	Precast Base
604.3.03C	Cast-in-Place Base
604.3.04	Channels
604.3.05	Streets at Grades
604.3.06	Streets with No Established Grade
604.3.07	Backfill
604.4	Measurement
604.5	Payment
605	**CATCH BASINS AND INLETS**
605.1	Description
605.2	Materials
605.2.01	Frame and Grate
605.2.02	Mortar
605.3	Construction Details
605.3.01	Grade Adjustment
605.3.02	Pipe Connections
605.3.03	Traps
605.3.04	Measurement and Payment
606	**SUBSURFACE UNDERDRAINS**
606.1	Description
606.2	Materials
606.2.01	Pipe
606.2.02	Filter Fabric Material
606.2.02A	Fabric Type
606.2.02B	Minimum Physical Requirements (Table)
606.2.03	Aggregates
606.2.03A	Grading Requirements for Permeable Materials Table
606.3	Construction Details
606.3.01	Trench Excavation
606.3.02	Fabric Installation

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
606.3.03	Pipe Installations
606.3.04	Pipe Jointing
606.3.04A	Corrugated Pipe
606.3.04B	Clay Pipe
606.3.04C	Concrete Pipe
606.3.05	Aggregate Installation
606.3.06	Drain Cover
606.3.06A	Drain Discharge Protection
606.4	Measurement and Payment
606.4.01	General
606.4.02	Pipe
606.4.03	Filter Material
606.4.04	Method of Measurement
607	**SEWER LATERALS AND CLEANOUT**
607.1	General
608	**FINISHING AND CLEANUP FOR UNDERGROUND CONDUITS**

SECTION 700 WATER MAIN AND SERVICE LINE CONSTRUCTION

700.1	General
700.2	Approved Plans
700.3	Licenses and Permit Required
700.4	Inspection
700.4.1	Construction Staking
700.5	Cold Weather Conditions
701	**PIPE FOR WATER MAINS**
701.1	General
701.2	Pipe
701.2.01	Cast Iron Pipe
701.2.02	Ductile Iron Pipe
701.2.02A	Fittings for Ductile Iron Pipe
701.2.02B	Fittings for Ductile Iron Pipe
701.2.03	Concrete Cylinder Pipe

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
701.2.04	Welded Steel Pipe
701.2.04A	Coatings for Steel Pipe
701.2.04B	Couplings for Steel Pipe
701.2.04C	Fittings
701.2.05	Polyvinyl Chloride Plastic Water Pipe
701.2.06	Glass-Fiber-Reinforced Thermosetting-Resin Pressure Pipe
702	**TRENCH EXCAVATION AND BACKFILL FOR WATER MAINS**
702.1	General
702.1.01	Ungraded Streets
702.1.02	Clearing and Grubbing in Ungraded Streets
702.1.03	Removal and Replacement of Pavement from Driveways and Sidewalks
702.1.04	Grade and Alignment
702.2	Trench Excavation
702.2.01	Protecting Existing Services
702.2.02	Solid Rock Excavation
702.2.03	Extra Excavation
702.2.04	Unforeseen Buried Objects Encountered in Trench
	Compaction on Graded Streets
702.2.05	Removal of Unsuitable Materials
702.2.06	Pipe Bedding
702.2.07	Backfilling Trenches
702.2.08	Compaction of Backfill
702.2.08A	Water Settling of Trenches
702.2.08B	Equipment for Water Settling Trenches
702.2.08C	Source of Water for Water Settling
702.2.08D	Compaction of Backfill under Special Conditions
702.2.09	Gravel Base Course for Trench Backfill
702.3	Measurement and Payment
702.3.01	Clearing and Grubbing
702.3.02	Trench Excavation and Backfill
702.3.03	Solid Rock Excavation
702.3.04	Removal and Replacement of Unsuitable Material
703	**PIPE INSTALLATION FOR WATER MAINS**
703.1	General
703.2	Construction

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
703.2.01	Dewatering of Trench
703.2.02	Handling of Pipe
703.2.03	Laying of Pipe on Curves
703.2.04	Laying Cast Iron Pipe
703.2.04A	Joints for Cast Iron Pipe
703.2.05	Jointing Mechanical Joint Pipe
703.2.05A	Cleaning and Assembling Joint
703.2.05B	Bolting of Joint
703.2.06	Jointing Rubber Gasket Joint Pipe
703.2.06A	Cleaning and Assembling Joint
703.2.07	Assembling Restrained Joint Pipe
703.2.08	Laying Steel Pipe
703.2.08A	Threaded Steel Pipe in Sizes Up To and Including 3-1/2 Inch
703.2.08B	Coupled Pipe 4-Inch and Larger
703.2.09	Laying Reinforced Concrete Pressure Pipe
703.2.09A	Cleaning and Assembling Joint
703.2.10	Laying PVC Pipe
703.2.11	Connections to Existing Mains
703.2.11A	Disruption of Services
703.2.11B	Wet Tap Connections
703.2.11C	Contracted Repair Work
703.2.11D	Accidental Repair Work
703.2.12	Field Tests
703.2.12A	Main Line Hydrostatic Tests
703.2.12A1	Test Restrictions
703.2.12A2	Pressurization
703.2.12A3	Air Removal
703.2.12A4	Examination
703.2.12A5	Testing Allowance Defined
703.2.12A6	Testing Allowance
703.2.12A7	Acceptance of Installation
703.2.12B	Water Service Line HydrostaticTesting
703.2.12C	Fire Line, Hydrants and Hydrant Service Line Hydrostatic Testing
703.2.12D	Testing Extensions from Existing Water Mains and Stubs
703.2.12E	Records and Documentation
703.2.13	Disinfection of Water Lines
703.2.13A	Flushing
703.2.13B	Chlorinating Valves and Hydrants

Section	Title
703.2.13C	Bacteriological Samples
703.2.13D	Records and Documentation
703.2.13E	Repetition of Flushing and Testing
703.2.14	Concrete Blocking
703.3	Measurement and Payment
703.3.01	Measurement of Water Mains
703.3.02	Payment for Water Mains and Water Service Connections
703.3.03	Partial Payment for Materials Delivered
703.3.04	Trench Excavation and Backfill for Water Service Connections
703A	Appendix A - Disinfecting Water Mains (from ANSI/AWWA C651)
703B	Appendix B - Chlorine Residual Testing
703C	Appendix C - Disposal of Heavily Chlorinated Water
703D	Appendix D - Notes on Procedures for Soil Survey Tests and Observations and Their Interpretation to Determine Whether Polyethylene Encasement Should Be Used
703E	Appendix E - American National Standard for Polyethylene Encasement of Ductile-iron Pipes for Water and Other Liquids
704	**VALVES FOR WATER MAINS**
704.1	Description
704.2	Materials
704.2.01	Manufacture and Marking
704.2.02	Type and Mounting
704.2.03	End Connections
704.2.04	Gate Valve Stem Seals
704.2.05	Tapping Valves
704.2.06	Hydrostatic Test Pressure at Factory for Class 150 Valves
704.2.07	Hydrostatic Test Pressure at Factory for Class 250 Valves
704.3	Installation of Gate Valves
704.4	Butterfly Valves
704.5	Globe Valves
704.6	Ball Valves
704.7	Check Valves
704.8	Air Relief/Vacuum Relief Valves
704.9	Miscellaneous Valves
704.10	Valve Boxes and Covers
704.11	Measurement and Payment

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
704.11.01	Payment for Valves
705	**WATER SERVICE CONNECTIONS AND FIRE LINES**
705.1	Description
705.2	Materials
705.3	Construction
706	**FIRE HYDRANTS**
706.1	Description
706.2	Materials
706.2.01	Material for Hydrants and Appurtenances
706.2.02	Hydrant Size and Type
706.2.03	Auxiliary Valve
706.2.04	End Connections
706.2.05	Sidewalk Flange Construction
706.2.06	Factory Hydrostatic Test
706.3	Construction Details
706.3.01	Setting Hydrants
706.3.02	Hydrant Connections
706.3.03	Relocating Existing Hydrants
706.3.04	Hydrant Extensions
706.4	Testing at Fire Hydrants
706.5	Measurement and Payment
706.5.01	Fire Hydrants
706.5.02	Relocating Existing Hydrants
706.5.03	Hydrant Extensions
707	**RESTORATION AND CLEANUP OF WATER MAIN CONSTRUCTION**
707.1	General
707.2	Construction Details
707.2.01	Removal of Existing Street Improvements
707.2.02	Restoration of Existing Street Improvements
707.2.02	Finishing and Cleanup
707.3	Measurement and Payment
707.3.01	Existing Street Improvements
707.3.02	Cement Concrete Curb, Curb and Gutter
707.3.03	Finishing and Cleanup
708	**DISINFECTING WATER STORAGE TANKS**
708.1	General
708.1.1	Record of Compliance

Section	Title
708.2	Cleaning
708.2.1	Other Materials
708.3	Forms of Chlorine for Disinfection
708.3.1	Liquid Chlorine
708.3.2	Sodium Hypochlorite
708.3.3	Calcium Hypochlorite
708.4	Alternative Methods of Chlorination
708.4.1	Chlorination Method 1
708.4.1.1	Liquid-chlorine Use
708.4.1.2	Sodium Hypochlorite Use
708.4.1.3	Calcium Hypochlorite Use
708.4.1.4	Retention Period
708.4.1.5	Handling of Disinfection water
708.4.2	Chlorination Method 2
708.4.2.1	Method of Application
708.4.2.2	Retention
708.4.3	Chlorination Method 3
708.4.3.1	Adding Chlorine
708.4.4	Bacteriological Sampling and Testing
708.4.4.1	Tests for Odor
708.4.4.2	Results of Testing
708.4.4.3	Care in Sampling
708.4.4.4	Recommended Additional Samples
708.4.5	Availability of Water
708.4.6	Safety
708A	Appendix A - Chlorine Dosages
708B	Appendix B - Disposal of Heavily Chlorinated Water
709	**BURIED CONCRETE WATER STORAGE TANKS**
709.1	General
709.2	Concrete
709.2.1	Concrete Mix Design
709.2.2	Mixing Concrete
709.3	Placement of Concrete
709.3.1	Buckets
709.3.2	Chutes
709.3.3	Drop Chutes, Elephant Trunks, and Tremies
709.3.4	Pumping
709.3.5	Conveying
709.3.6	Back-Up Placement Systems
709.3.7	Portholes in Wall and Column Forms - Limitations
709.3.8	Placing in Forms
709.3.9	Temperature Limitations
709.3.9.1	Cold Weather

PARK CITY MUNICIPAL CONSTRUCTION SPECIFICATIONS
TABLE OF CONTENTS

Section	Title
709.3.9.2	Hot Weather
709.3.9.3	Admixture Curing
709.4	Joints
709.4.1	Construction Joints
709.4.2	Movement Joints
709.4.3.1	Steel
709.4.3.2	Flexible Water-stops
709.5	Formwork
709.5.1	General
709.5.2	Form Design
709.5.3	Form Ties
709.5.4	Form Coating or Release Agents
709.5.5	Inspection Concreting
709.5.6	Removal of Forms
709.5.7	Re-shoring
709.6	Finishes for Exposed Surfaces
709.6.1	Finishing Unformed Surfaces
709.6.2	Non-Slip Finish
709.6.3	Finishing Formed Surfaces
709.6.4	Repair of Surface Defects
709.6.4.1	Tie Holes
709.6.4.2	Patching Minor Defects
709.6.4.3	Honeycombed Areas
709.7	Curing
709.8	Cleaning
709.9	Watertightness
709.9.1.1	Preparation
709.9.2.1	Measurement
709.10	Repairs
709.10.1	Concrete Repair
709.10.2	Epoxy Injection Grouting
709.10.2.1	Wall Repair
709.10.2.1.1	Epoxy Grouting
709.10.2.1.2.	Xypex Grouting
709.11	Tank Backfill

STANDARD DRAWINGS

SECTION 100

GENERAL REQUIREMENTS

April
2007
DeHaan/Anderson

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

(435) 615-5077

Notes:

SECTION 100

GENERAL REQUIREMENTS

100.1 Introduction: The following Park City Construction Specifications and Standard Drawings were developed to provide standards for the physical development of subdivisions of land, construction of public works improvements within Park City, including, but not limited to, the construction and installation of roads, streets, curbs, gutters, drainage systems, and water and sewer systems. These Specifications are not intended for extraordinary circumstances; in such instances alternatives may be allowed, where justified, upon approval of the Park City Engineer.

100.2 Definitions: In the interpretation and construction of these Specifications and the Contract, or in any documents or instruments dealing with the construction operations governed by these Specifications, the following words, terms and abbreviations, or pronouns in place of them shall each be construed as defined below:

Abbreviations: Wherever the following abbreviations are used in these Specifications and in the Contract Documents, they are to be construed the same as the respective expressions represented:

A.A.N.	American Association of Nurserymen
A.A.R	Association of American Railroads
A.A.S.H.T.O.	American Association of State Highway and Transportation Officials
A.C.I.	American Concrete Institute
A.G.A.	American Gas Association
A.G.C.	Associated General Contractors of America
A.I.A.	American Institute of Architects
A.I.S.C.	American Institute of Steel Construction
A.N.S.I.	American National Standards Institute
A.P.W.A.	American Public Works Association
A. R A.	American Railway Association
A.R.E.A.	American Railway Engineering Association
A.S.C.E.	American Society of Civil Engineers
A.S.L.A.	American Society of Landscape Architects
A.S.T.M.	American Society for Testing and Materials
A.W.P.A.	American Wood Preservers' Association
A.W.W.A.	American Water Works Association
A.W.S.	American Welding Society
F.H.W.A.	Federal Highway Administration
F.S.S.	Federal Specifications and Standards General Services Administration
I.E.E.E.	Institute of Electrical & Electronic Engineers
N.E.C.	National Electrical Code
N.E.M.A.	National Electrical Manufacturer's Association
S.B.W.R.D.	Snyderville Basin Water Reclamation District

U.D.O.T.	Utah Department of Transportation
U.O.S.H.D	Utah Occupational Safety and Health Division
U.S.A.S.I.	United States of America Standards Institute

"Acceptable Alternate": In order to establish a basis of quality for some things in the work, certain processes, types of machinery and equipment, or kind of material may be mentioned on the Approved Plans by designating a manufacturer by name and referring to his brand or model numbers. Such mention is not intended to exclude other processes, equipment or materials that will measure up to the designated standards of that mentioned. *If the Contractor desires to use other products as equal thereto, he shall secure acceptance by the City Engineer before entering an order for such products.* Wherever in the Specifications a manufacturer's name, brand or model is mentioned, it is to be understood that the phrase "or acceptable alternate" is assumed to follow thereafter whether or not it does in fact.

Amount of Contract: For the purpose of awarding the contract and determining the amount of the bond, the total amount of the bid and the full amount of the contract price will be the summation of the products of the quantities shown in the proposal by the unit bid prices, and state sales or use tax, whenever applicable.

Approved Plans: The final construction drawings, plans, profiles, typical cross-sections, specifications and materials, and supplemental drawings, or reproductions thereof, approved by the City Engineer or District Engineer, which show the location, character, dimensions and details of work to be performed. All such documents are to be considered as a part of the plans whether attached to the Specifications or separate therefrom.

As-Built Drawings: These drawings shall be reproducible mylar drawings made by the developers' Engineer. They shall include any and all changes made to the construction plans before and during construction.

Bridge: A structure, other than a culvert, which carries traffic over a water course, highway or railroad, or railroad traffic over a highway or street.

City Engineer: The person or Consulting Engineer, including his authorized Assistant(s), who represent the Park City Municipal Corporation.

City Inspector: The authorized representative of the City or City Engineer assigned to make all necessary inspections of the work performed or being performed, or of materials furnished or being furnished by the Contractor.

City or Owner: Park City Municipal Corporation, acting through its legally constituted officials, officers, or employees, or the Developer who sponsors construction.

City Manager or designee: The appointed Park City official responsible for issuing the "notice to proceed" to the Contractors on any project involving public improvements.

Contract Bond, Performance Bond: The approved form of security furnished by the Contractor and his surety, as required in the Contract Documents. It shall be conditioned that such person or persons who enter into contract with the City shall faithfully perform and fulfill all the provisions of the Contract documents and complete the work in strict accordance with the Approved Plans and Specifications including full payment for labor and materials used in the work.

Contract Documents: The written agreement between the city or Owner and the Contractor covering the performance of the work and furnishing of labor, materials, tools, and equipment in the construction of the work. The Contract Documents shall include the Park City Specifications, Notice to Contractors, Bid Proposal, Approved Plans and Specifications, Special Conditions and Contract Bonds; also any and all supplemental agreements amending or extending the work contemplated. Supplemental agreements are written agreements covering alterations, amendments or extensions to the contract and include contract change orders.

The Contract Documents are complementary and what is called for by one shall be as binding as if called for by all. *In case of discrepancies, Specifications shall govern over Approved Plans, Supplemental Specifications shall govern over Standard Specifications, and Special Conditions shall govern over Specifications and Approved Plans.* Where appearing on Approved Plans or Drawings, dimensions denoted by actual figures shall govern over scaled dimensions. In case of any ambiguity or dispute over interpretation of the provisions of the Contract, the decision of the City Engineer shall be final.

Contractor: The Contractor is the individual or organization responsible for doing the work. The Contractor is further defined as the individual, firm, co-partnership or corporation, and his, their, or its heirs, executors, administrators, successors and assigns, or the lawful agent of any such individual firm, partnership, covenantor or corporation, or his, their, or its surety under the contract bond, constituting one of the principals to the Contract and undertaking to perform the work herein specified. Were any pronoun is used as referring to the word "Contractor" it shall mean the Contractor as defined above.

Culvert: A drainage structure which may or may not directly support traffic, extending across and beneath a highway, street, driveway or alley.

Days: Unless otherwise designated, days as used in the Specifications will be understood to mean calendar days including weekends and holidays.

Developer: The person sponsoring construction.

Director of Public Works: The appointed Park City official in direct charge of public facilities in Park City.

District: Snyderville Basin Water Reclamation District.

District Engineer: The Consulting Engineer, including authorized assistants, who represent the Snyderville Basin Water Reclamation District.

District Engineer: The authorized agent of the District or District Engineer assigned to make detailed inspections of any or all portions of the sewer system construction.

Engineer: This term shall primarily mean a Licensed Engineer or an authorized member of a licensed consulting firm or organization retained by the developer for design and construction engineering of specific projects.

This term shall also apply to the City or District Engineer in cases where requirements need to be altered to serve the best interests of the City or District.

Liquidated Damages: the amount prescribed in the Specifications to be paid the Owner, or to be deducted from any payments due or to become due the Contractor, for each day's delay in completing the whole or any specified portion of the work beyond the time allowed in the Specifications.

Pavement: the uppermost layer of bituminous or Portland-cement concrete material placed on the traveled way or shoulders for a riding surface, whether rigid or flexible in composition. This term is used interchangeably with *surfacing*.

Roadway or Street (Right of Way): That portion of the highway included between curbs, gutters, or ditches, intended primarily for vehicular traffic, and including all appertaining structures and other features necessary to proper drainage and protection, together with a shoulder of from 5 feet to 10 feet outside of the paved area where vehicles may park and snow may be stored from time to time.

Special Conditions or Provisions: The contract requirements peculiar to the project which are not otherwise thoroughly or satisfactorily detailed and set forth in the Standard Specifications.

Specifications: The directions and requirements of the Standard Specifications contained herein, as supplemented by such Special Conditions as may be provided, pertaining to the manner of performing the work or the quantities and quality of materials to be furnished under the Contract Documents.

Standard Drawings or Plans: The standard illustrative details which accompany these Construction Specifications.

Subcontractor: The individual, firm, partnership or corporation to whom the Contractor sublets any part of the work covered by the Contract Documents.

Subgrade: That portion of the roadbed surface which has been prepared, as specified, and upon which a layer of specified roadbed material or base, or sub-surfacing, or pavement is to be placed.
Supplemental Specifications: Supplemental specifications are those adopted subsequent to the Standard Specifications and generally involve alterations and new construction items, or substantial changes in the Standard Specifications.

Surety: The surety responsible for the bidder's acts in the execution of the contract, or which is bound with and for the Contractor to insure performance of the Contract, the payment of all obligations pertaining to the work, and the fulfillment of such other conditions as may be specified or required by law.

Surfacing: The uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with *pavement*.

Traffic Control Devices: Fixed or portable signs, signals, street lights, barricades, guard rails, pavement markings, channelization and other equipment or materials used for the purpose of regulating, warning and guiding traffic.

Traveled Way: That portion of the roadway intended for movement of vehicles.

Work: All the work specified, indicated, shown or contemplated in the contract to construct the improvement, including all alterations, amendments or extensions thereto made by contract change order or other written orders of the City Engineer.

Working Drawings (Shop Drawings): Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or any other supplementary plans or similar data which the Contractor is required to submit to the Engineer for approval.

100.3 Revisions of Standards and Specifications: Technical Specifications produced by industrial or trade associations which are referred to in this document (ASTM, AASHT0, ANSI, etc.) are those Specifications as they appeared at the time this document is adopted. Subsequent revisions to those Specifications may be made from time to time, but shall not be construed as reducing the Construction Standards called for here. In the event a specific Technical Standard or Specification is revised or renumbered by the association preparing the standards, this document shall incorporate the successor provision to any of the Technical Specifications referred to herein. These Specifications may be modified or deleted by appropriate notes on Approved Drawings.

100.4 Temporary Construction Drainage: The Contractor shall be responsible for maintaining control of drainage and erosion during construction. Particular attention should be given to existing drainage patterns which run through cleared areas and over extreme slopes. These patterns should be identified to isolate problem areas where water will concentrate. Provisions shall be made to channel runoff away from new or existing improvements to prevent undermining and general site erosion. These provisions should be stabilized and should remain in place until the permanent storm drainage facilities are installed and functional.

100.5 Protection of Public and Private Utilities: The Contractor shall support and protect by timbers or otherwise, all pipes, conduits, poles, wires or other apparatus which my be in the way affected by the work, and do everything to support, sustain and protect the same, under, over, along or across said work. In case of any said pipes, conduits, poles, wires, or apparatus should be damaged they shall be repaired by the authorities having control of same, and the expense of such repairs shall be charged to the Contractor.

The Contractor shall protect all survey monuments located in the vicinity of the contract work. If the monuments are disturbed or destroyed, they will be reset by the proper authorities and the expense of such efforts shall be charged to the Contractor.

The Contractor shall further be responsible for any damage done to any street or other public property, or to any private property by reason of the breaking of any water pipes sewer or gas pipe, electric conduit, or

other utility by or through his negligence. The Contractor is responsible for locating all utilities and for notifying Blue Stakes at least 48 hours prior to commencement of construction.

Specific requirements in other sections of these Specifications or Special Provisions shall prevail over the foregoing requirements in case of conflict.

100.6 Control of Material:

100.6.01 Source of Supply and Quality Requirements: The materials used on the work shall meet all quality requirements of the Contract Documents. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of his proposed sources of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other approved sources.

100.6.01A Local Material Sources: Proposed Sources: Possible sources of local materials may be designated on the Approved Plans and described in the Special Provisions. The quality of materials in such deposits will be acceptable in general, but the Contractor shall determine for himself the amount of equipment and work required to produce a material meeting the Specifications. It shall be understood that It is not always feasible to ascertain from samples the limits for an entire deposit, and that variations shall be considered as usual and are to be expected. The Engineer may order procurement of material from any portion of a deposit and may reject portions of the deposit as unacceptable if the material fails to comply with the Specifications.

The City may acquire by option and make available to the Contractor the right to take materials from the sources designated on the Approved Plans and described under Special Conditions, together with the right to use such property as may be specified for plant site, stockpiles and hauling roads. Operations and use of property in connection with designated sources shall be subject to the detailed terms of the options granted by the City. The Contractor shall contact the property owner before entering on the property.

100.6.01B Contractor Furnished Sources: If the Contractor desires to use material from sources other than those designated or if no source is designated, he shall acquire the necessary rights to take materials from the sources and shall pay all costs related thereto, including any which may result from an increase in length of haul. All costs of exploring and developing such other sources shall be borne by the Contractor. The use of material from other than designated sources will not be permitted until representative samples taken by the Engineer have been approved and written authority is issued for the use thereof.

When material deposits are not designated in the Special Conditions, the Contractor shall provide sources of acceptable materials.

When sources of material or material deposits are not provided by the Contractor, the Contractor will assume the cost of processing samples to determine the suitability of the material. A period of 30 days shall be allowed for sampling and testing after the Engineer has been notified in writing of the location of the source or deposit.

Source of supply and control of pits shall comply with this section.

100.6.02 Samples, Tests, Cited Specifications: All materials must be inspected, tested and accepted by the Engineer before incorporation in the work. Any work in which untested and unaccepted materials are used will be performed at the Contractor's risk and may be considered as unacceptable and unauthorized work. Unless otherwise designated, tests shall be made in accordance with the most recent cited standard methods of AASHT0, ASTM, or those established by the City prior to the date of advertisement of bids. The tests will be made by and at the expense of the Contractor. *All materials are subject to inspection, test and/or rejection at any time prior to acceptance of the work.* Copies of test reports will be furnished to the City.

The Contractor shall furnish certificates of compliance for all manufactured materials obtained from vendors or producers, prior to their incorporation in the work. Such certification shall be subject to verification by field inspection or further testing by the Engineer.

References to AASHT0, ASTM, UL and other specifications shall be the most recent edition at the time of advertising the bids.

Samples shall be taken and compliance test made at the point of acceptance in accordance with the following:

100.6.02A Untreated aggregates: Samples of all untreated aggregates or soils taken from the road at the laydown machine prior to compaction, for the determination of gradation, plasticity and unit weight, if applicable.

100.6.02B Bituminous Mixtures: Samples of all bituminous mixtures shall be taken from the road at the laydown machine prior to compaction, for the determination of gradation and bituminous content. Cores may then be taken after compaction to assure pavement thickness.

100.6.02C Portland Cement Concrete: Samples of Portland Cement Concrete shall be taken from the structure immediately after discharge from the hauling unit, for the determination of slump and air content and for the fabrication of test beams and cylinders.

100.6.02D Cement Treated and Lime Treated Materials: Samples of cement treated and lime treated materials shall be taken from the road at the laydown machine prior to compaction, for the determination of gradation, moisture content, unit weight, and the fabrication of test cylinders.

100.6.02E Density Test: Test for density may be made on the road after the compaction process has been completed by one of the following methods:

1. AASHT0 Designation T191
2. The Utah Department of Highways Test Procedure 8-924
3. AASHTO Nuclear Device

100.6.02F Smoothness Determinations: Smoothness determinations may be made on the road, by straightedge, chalk line or profilographs, after all compacting and processing has been completed.

100.6.02G Thickness Determinations: Thickness determinations may be made on the road, by coring or test pitting, after all compacting and processing has been completed.

100.6.02H Manufactured Materials: Manufactured materials, such as Portland Cement, Hydrated Lime, Asphaltic Materials, paint, or any other material before being incorporated into the project may be sampled at the producer's plant whenever practical. Before final acceptance, such materials shall be subject to inspection and further testing after delivery to the project as determined by the Engineer. Project samples shall be taken before the material is incorporated into any other product.

100.6.03 Plant Inspection: The Engineer may undertake the inspection of materials at the source.

In the event plant inspection is undertaken, the following conditions shall be met:

100.6.03A Contractor Cooperation: The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.

100.6.03B Full Plant Entry: The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

100.6.03C Safety Measures: Adequate safety measures shall be provided and maintained.

100.6.03D Materials Retest: It is understood that the City may retest all materials prior to incorporation into the work which have been tested and accepted at the source of supply after the same have been delivered; and may reject all materials which, when retested, do not meet the requirements of the Specifications.

100.6.04 Storage of Materials: Materials shall be so stored as to insure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the right-of-way may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefore must be provided by the Contractor at his expense. *Private property shall not be used for storage purposes without written permission of the owner or lessee and, if requested by the Engineer, copies of such written permission shall be furnished by the Contractor at his expense. All storage sites shall be restored to their original condition by the Contractor at his expense, and inspected by the City.*

100.6.05 Handling Materials: All materials shall be handled in such manner as to preserve their quality and fitness for the work. Aggregates shall be transported from the storage site to the work in tight vehicles so constructed as to prevent loss or segregation of materials after loading and measuring in order that there may be no inconsistencies in the quantities of materials intended for incorporation into the work as loaded, and the quantities as actually received at the place of operations.

100.6.06 Unacceptable Materials: All materials not conforming to the requirements of the Specifications shall be considered as unacceptable and all such material will be rejected and shall be removed immediately from the site of the work unless otherwise instructed. No rejected material, the defects of which have been corrected, shall be used until approval has been given.
100.6.07 City-Furnished Materials: The Contractor shall furnish all materials required to complete the work, except those specified to be furnished by the City.

Material furnished by the City will be delivered or made available to the Contractor at the points specified in the Special Conditions.

100.7 Record Drawings and On-Site Contract Documents: Contractor shall maintain at the site for the Engineer one copy of all drawings, specifications, addenda, approved shop drawings, change orders and other modifications, in good condition and order, and marked to record all changes made during construction. These shall be available to the City Engineer and the Director of Public Works.

To facilitate the above, the Engineer will furnish the Contractor with one set of blue line prints of all drawings which are a part of this contract. Contractor shall maintain this set of prints in good condition in his field office. Installation of any work in locations or in a manner other than shown on the drawings shall be recorded daily by the Contractor on the drawings. The Contractor shall see that the mechanical and electrical subcontractors shall do likewise. Dimensions shall be given to permanent objects such as building columns, buildings, sidewalks, curbs and driveway and/or grids.

Whenever necessary to complete the record drawings in a neat, legible manner, the Contractor shall employ a competent draftsperson, satisfactory to Engineer, to make new drawings or to indicate changes on the prints.

On or before the date of final inspection, the Contractor shall deliver the corrected and completed prints to the Engineer as a record of construction. Delivery of the prints to Engineer will not relieve the Contractor of the responsibility of furnishing required information that may be omitted from the prints. Delivery of the prints must be made before payment of the final retained percentage.

100.8 Explanation of Measurement and Payment: The subsections regarding measurement and payment usually located toward the end of pertinent sections shall apply to projects bid for the Park City Municipal Corporation. Private developers have the option of adopting or amending these sections for use in their Contracts or Bidding Documents. It is understood that "Measurement and Payment" subsections therefore have no bearing on work by contractors for private developers.

100.9 Payment of Costs: Whenever work is required or performed under these specifications, and Park City incurs expense in the design, inspection, or review of private designs submitted for approval, the reasonable costs for that engineering work, whether performed by private consulting engineers or by members of the City staff, will be billed to the developer and must be paid in full before final certificates of occupancy or acceptance of the work will be granted.

100.10 Winter: Winter is after October 15 at 5:00 P.M. and before April 15.

Winter conditions may put additional responsibilities, limitations, and constraints on some construction activities:

Depositing mud on City roadways is not allowed: some preventive measures must be taken. Adherence to ACI cold weather concreting standards is required unless waived by the City Engineer.

Asphalt concrete may be placed after October 15 at 5:00 P.M. and before April 15 only with written permission by the City Engineer; and the asphalt concrete will be considered temporary, to be replaced after April 15 under suitable conditions, unless otherwise approved by the City Engineer.

See other sections for specific Winter requirements.

100.11 Right-of-Way: The City Right-of-Way is City property used for roads and utilities. Generally, Park City's Right-of-Way extends back about ten feet beyond the gutter or edge of asphalt on either side. Any backfill done in the City Right-of-Way shall be spread in uncompacted lifts not exceeding eight (8) inches, and then compacted by mechanical tampers to 96% as determined by ASTM Test method D-1557. The City Engineer may give a waiver requiring only 90% compaction within the most distant five (5) feet of the Right-of-Way.

100.12 Open Trenches: The length of trench excavated for pipe or other utility placement shall be kept to a minimum *and in no case shall any open trench exceed three hundred (300) feet* unless otherwise specifically authorized by the City Engineer. Trench widths, shoring, bracing, and trenching procedures shall conform to Utah Occupational Safety and Health Rules, Regulations and General Standards.

GENERAL:

Under no circumstances shall the presence, observations or testing by the City's authorized representative be construed as approval or acceptance of the Contractor's failure or refusal to fully comply with the requirements of the project plans and specifications.

SECTION 200

GENERAL IMPROVEMENT REQUIREMENTS AND DESIGN GUIDELINES

April
2007
DeHaan/Anderson

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

(435) 615-5077

Notes:

SECTION 200

GENERAL IMPROVEMENT REQUIREMENTS AND DESIGN GUIDELINES

200.1 Scope: This section defines the general requirements for all site Improvements to be built and installed within the City limits of Park City, Utah and/or improvements which may become the responsibility of Park City. In addition to these requirements, all other applicable codes and ordinances remain in effect. These requirements are intended to allow the public officials of Park City to protect the health, safety, and welfare of residents and visitors.

200.2 Construction Drawings: Complete and detailed construction plans and drawings of improvements shall be submitted to the City Engineer prior to commencing construction. This plan set may be required to contain a topographic site survey or orthotopographic mapping certified as to its level of precision by a registered Land Surveyor registered in Utah. No construction shall be started until plans have been approved by the City Engineer and, in the case of any improvements which may become the responsibility of Park City, a Notice to Proceed has been issued by the City Manager or designee.

200.3 Standards for Final Construction Drawings: The following instructions are for the purpose of standardizing the preparation of drawings to obtain uniformity in appearance, clarity, size and style. This level of detail is not necessary at any preliminary approval stage such as Planning Commission approval unless required by the City Engineer.

200.3.01 Revisions: All revision to plans shall be noted on the plans. All major revisions shall be corrected on the plans and submitted to the City Engineer for approval prior to construction.

200.3.02 Required Information: The plans and design shall meet the standards defined in the Park City Design Standards, Construction Specifications, and Standard Drawings, and other plans and ordinances of Park City. The minimum information required on drawings for improvements is as follows:

All drawings and/or prints shall be clear ant legible and conform to good engineering and drafting room practice. Size of drawings shall be no larger than 24" x 36" (trim line).
The following items are required on drawings:

A. North arrow (plan).
B. Vicinity map.
C. Scale and elevations referenced to Park City Engineer's Datum.
D. Stationing and elevations for profile.
E. Title block, located in lower right corner of sheet, to include:
    1. Name of City.
    2. Project title (subdivision, etc.).
    3. Specific type and location of work.

4. Space for approval signature of City Engineer with date.
5. Name of engineer or firm preparing drawings with license number.
6. Number all sheets.

F. Scale should generally by 1" = 50' horizontal; 1" = 5' or 10' vertical.

G. Both plan view and profiles must be shown for each side of the street and centerline. Profiles shall extend 300 feet beyond end of work. Maximum finished road slope shall be 10 percent. Minimum is 1.0 percent. Maximum cul-de-sac length is 650 feet. Minimum centerline radius of public streets shall be 80 feet.

H. Stationing and top of curb elevations with curve data must be shown for all curb returns.

I. Flow direction and type of cross drainage structures at intersections and adequate flow line elevations.

J. Benchmark location and elevation.

K. Type of curb and gutter and distance back of curb to back of curb.

L. Gradient of roadways. Cross-slope transitions must be shown in detail.

M. Storm drain pipe size, type, class and gradient.

N. Calculated amount of storm water flow at each drainage collection structure and in each curb at all intersections shall be shown on an included drainage plan for any project involving more than eight (8) residential units and for any commercial or industrial project.

O. Size and location of water mains, valves, meters and hydrants.

P. Type of water pipe. Water mains shall be metered unless they are in streets, roads, or road shoulders.

Q. Minimum cover five (5) feet over water lines; the minimum cover may be increased to seven (7) feet for dead-end lines or lines in areas to be snow-plowed. Minimum cover is 7 feet in all areas above 7,300 feet.

R. Each set of plans shall be accompanied by separate sheets of details for all pavement sections and structures which are to be constructed. A note disclosing the completion date of October 15 for all street patching and construction is desirable.

S. For subdivisions and private streets serving more than eight (8) residential units, both 400-scale and 1000-scale mapping shall be submitted to the City for the City's use in updating their master mapping corresponding to those scales.

200.3.03 Additional Information: The following is a list of information which may be required for Park City Fire District approval:

A. Legal description of property.

B. Location: Plot plan, existing adjacent structures.

C. Occupancy type/load.

D. Type of construction.

E. Access roads: grades, widths, parking, turn-arounds, cul-de-sac.

F. Height of building: from fire fighting grade.

G. Alarm systems: smoke, fire, sprinkler.

H. Water supply system: source, storage facilities, distribution system, hydrant locations on uphill side of street, if possible.

I. Fire sprinkler information.

J. Floor plan showing: exit signs, panic hardware, location of fire extinguishers, location of hose cabinet, any other protection devices.

K. Information may be required as determined by the Fire District/Marshal.

200.4 Inspection: All construction work involving the installation of improvements shall be subject to inspection by the City. Certain types of construction may require continuous inspection while others may have only periodic inspections. All inspection and testing costs are paid by developer or contractor unless Park City contractually assumes this financial burden. No inspections can be made on Sunday or federal holidays.

A. Continuous inspection is required on 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, drainage pipe, water pipe, valves, hydrants and testing.

B. Periodic inspection is required on the following:

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 gutters, sidewalks, and structures.
6. Staking of limits of disturbance.
7. Landscaping and landscape sprinkler information.
8. Water service connections.

C. Requests for Inspection: Requests for inspection of work requiring continuous inspection shall be made to the City three (3) working days prior to commencement of the work. Periodic inspection will require a two (2) full working day (Mon.-Fri.) notification prior to the requested inspection.

200.5 Construction-Completion Inspection: An inspection shall be made by the City Engineer or his authorized representatives upon notice by developer after all construction work is completed. Any faulty or defective work shall be corrected within a period of thirty (30) days of the date of the City Engineer's Inspection Report defining the faulty or defective work.

200.6 OneYear Correction Period: If within one year after completion any work is found to be defective, the contractor or developer shall promptly, without cost to the City, either correct such defective work or remove it from the site and replace it with non-defective work. If the contractor or developer do not promptly comply, or in an emergency where delay would cause serious risk of loss, injury or damage, the City may have the defective work corrected or the rejected work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be collected by the City in the manner most convenient to the City from the developer and contractor. Whatever sharing of cost may be agreed upon between the developer and contractor is strictly a private matter between the developer and the contractor.

200.7 Required Improvements: The following improvements are generally required unless waived by the City on the basis of site conditions which make these improvements unnecessary. The design of the improvements will vary depending on site conditions, and on the implementation of the Streets Master Plan, Parks and Trails Master Plan, and other similar planning documents adopted by the City that may cover the site or adjoining public properties. Unless otherwise stipulated all improvements shall be designed and built to generally-accepted engineering standards.

A. Curb and gutter, culverts, inlet boxes, and other drainage improvements reasonably necessary to provide proper drainage in accordance with good engineering practice and the Park City Master Storm Drainage Plan.

B. Detention of runoff to improve water quality and to delay and reduce peak runoff to a flow rate not exceeding the runoff rate which would have existed prior to any disturbance of the land surface.

C. Pavement designed on a site-specific basis by a registered professional civil engineer. Unless otherwise approved by the City Engineer, design traffic loading as an approximate equivalent to taking all design factors into consideration shall provide for 100 heavy trucks per day both ways (HTPDBW) for residential streets, 300 HTPDBW for collector roads, and 500 HTPDBW for arterial roads, as shown on the Park City Master Streets Plan.

D. Permanent survey control such as brass cap measurements.

E. Street lights, street signs, and traffic signs and markers. Operation and maintenance of street lights is a City responsibility only when the light is at the intersection of two City streets. Street name signs shall be in accordance with Standard Drawings 540-D and 540-E. Traffic signs and traffic markers (including but not limited to stop signs and pavement striping) shall be in accordance with the latest edition of the Manual on Uniform Traffic Control Devices. Street lights shall be in accordance with Standard Drawings 540-A, 540-B, and 540-C.

F. Fire hydrants are required at 150-foot intervals measured along public ways or walks or drives which are to be snow-plowed. All water mains serving a hydrant shall be a minimum of eight-inch diameter. Each hydrant shall have an auxiliary gate valve located flanged to the tee on the water main.

G. A metallic tracer wire and brightly-colored utility warning tape may be required to be placed over all underground utility lines.

H. Both public and private streets shall be built in accordance with cross-sections shown in the Park City Master Streets Plan, including pavement, gutter and sidewalks. Projects which would create an unreasonable traffic impact, either for construction or for permanent access, whether by vehicles, bicycles, or pedestrians on any City street shall be required to structurally improve those streets in a manner to be determined by the City Engineer such that the street is structurally capable of carrying both the temporary and permanent increases in traffic when analyzed by generally accepted engineering methods.

I. A study of geological hazards by a geologist or soils engineer may be required to be submitted for all sites unless City Staff specifically omits the requirement. Cuts and fills on each site shall be balanced to minimize hauling.

J. Right-of-way for public streets in accordance with the Master Streets Plan may be required to be dedicated to the City for sites adjacent to streets identified in the Master Streets Plan as being in need of additional right-of-way.

K. Regulatory traffic signage may be required if a project creates any traffic impact.

L. Sidewalks and/or pedestrian trails, with wheelchair ramps at curbs or other obstacles in accordance with Park City's Park and Trails Master Plan and as required to serve the proposed project.
M. All utilities and meter locations must be shown, including water and sewer laterals, power and phone cables, gas lines, and cable TV. Whenever a proposed project will alter, extend, or abandon sanitary sewer mains, all sewer construction shall be done according to standards established by S.B.S.I.D.

N. All connections to the City water system shall be inspected and metered unless otherwise approved by the City Engineer and Public Works Director. All connections 4 inches in diameter or larger shall also be provided with a valve at the tee or property line and in other locations subject to the approval of the City Engineer and Public Works Director. All connections, piping, and appurtenances on the consumer's side of the water meter or beyond a point 5 feet outside of the public roadway are to be maintained privately, not by Park City. Any large addition to the water system, such as a new condominium project or subdivision, may also be required to install a master zone meter in order to allow Park City to monitor line losses.

N1. The Water System Connection inspection is in three phases, each phase shall be inspected by the City Engineer or the City Public Improvements Inspector:

a. Excavation, Tapping, and Backfilling
b. Meter Set Request
c. Public Improvements (post-landscape)

O. Any staging area must be identified if requested by the City Engineer. Site survey information including detailed horizontal and vertical information relating to existing and future items may be required by the City Engineer.

P. A letter from each appropriate utility company approving all utilities, including but not limited to water and sewer laterals, power and phone cables, gas lines and cable TV can be required by the City Engineer prior to Park City approval. All utilities shall be placed underground unless otherwise approved by the City Engineer.

Q. Methods of temporary and permanent erosion control on construction sites and along all drainage channels, swales, or streams below construction sites. Methodology is subject to approval by an independent landscape architect and shall be in accordance with generally-accepted standards of landscape architecture. Limits of disturbance shall be shown on the plans. A landscaping and revegetation plan including irrigation sprinklers may be required.

R. Wherever possible open channels shall be preserved for all major drainages shown on the Master Storm Drainage Plan. Culverting of these channels is not allowed unless approved by the City Manager or designee. Landscaping and revegetation to stabilize soils may be required.

S. Water system improvements necessary to keep Park City's water storage and distribution system fully in accordance with recommendations from the Insurance Services Office and Utah State Board of Health regulations. Improvements required include but are not limited to: reservoirs and appurtenances, including excess capacity as need to provide efficient long-term system operation, pressure reducing stations, pump stations, valves, air release valve vaults, meter vaults, water distribution lines, telemetry, and computer modeling by Park City or the consulting engineer of the City's choice as necessary to determine the impacts of a proposed development on the City water system. The City Engineer may require manhole-size valve vaults as per Std. Dwg. 709 at any valve. A completely-detailed design of each pump house will be required; scope of review includes but is not limited to exterior design and safety issues such as kill switches, ground faulting, and panel locations (2 feet off floor minimum). Pumps and motors shall have a minimum of 75% wire-to-water efficiency unless otherwise approved by City Engineer and Public Works Director. To simplify parts inventories, water systems equipment manufacturers shall be as follows: pumps shall be manufactured by Aurora; motors by U.S. Electrical Motor; starters by Dayton; boxes and panels by Square D; chlorinators by Fischer and Porter; pump control valves by Cla-Val.

T. Bus shelters, with an estimated value of $6,000.00 each, are required for major developments along bus routes. If a bus shelter is provided, the developer's architect is required to use logos and signage in the design of the shelter but is encouraged to incorporate project design themes and features into the design of the shelter.

U. Snow storage sites and snow storage easements adequate to serve all plowed spaces within and adjacent to the developments. Snow which could be shed from roofs shall be

adequately accommodated to eliminate the possibility of snow and ice falling on access ways to buildings.

V. As-built drawings or record drawings showing the as-built location of all public improvements tied to as-built surface improvements.

W. Sewer improvements as required by the Snyderville Basin Water Reclaimation District (S.B.W.R.D.), including excess capacity as agreed upon between S.B.W.R.D. and the developer. Backfill over sewer lines in City streets or on City property shall be in accordance with these Specifications.

SECTION 500

STREET CONSTRUCTION AND RELATED WORK

April
2007
DeHaan/Anderson

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

(435) 615-5077

Notes:

SECTION 500

STREET CONSTRUCTION AND RELATED WORK

500.1 General: All pavement and street construction within Park City, including pavement patches, on City right-of-ways, or City owned property, and for private projects as determined by City ordinances, shall be constructed in accordance with the requirements of these Specifications. Because of the severity and sudden onset of winter in Park City, all asphalt placement and all street patching and construction shall be completed by 5:00 p.m. on October 15, unless approved otherwise by Public Works Director.

500.2 Approved Plans: Pavement and street construction shall be performed in accordance with the Contract Documents for the work, prepared under the direction of a Professional Engineer licensed in Utah and approved by the Park City Engineer. Construction shall conform to the Approved Plans, these Specifications, and the Standard Drawings included in these Specifications.

500.3 Licenses and Permits Required: All paving and street construction, including City right-of-ways shall be performed by a Contractor licensed and bonded in Utah. A permit shall be secured by the Contractor from the Building Department and approved by the City Engineer at least 48 hours before initiating construction. Park City's Inspector shall be notified by the Contractor at least 3 working days before the planned construction is to commence and also before starting whenever construction is delayed for any reason. The Chief of Police and the Park City Fire District must be notified 48 hours in advance of intended closure of any public way.

500.4 Inspection: All work shall be inspected by a City authorized Inspector who shall have the authority to halt construction. Whenever any portion of these Specifications and Contract Documents are violated, the City Manager or designee, by written notice, may order that portion of construction which is in violation of these Specifications and Contract Documents to cease until violation is corrected. A copy of the notice may be filed with the Contractor's license application for future review. If deficiencies are not corrected, performance shall be required of the Contractor's Surety.

500.5 Contractor's Site Examination: Prior to starting work, the Contractor shall visit the site to determine existing conditions, nature of materials to be encountered and all other pertinent factors concerning or affecting the work to be performed. The Contractor shall familiarize himself with utilities and other existing improvements which occur in or near the designated work areas. If the work requires the temporary removal or relocation of existing items such as street signs, fences, mail boxes, etc., the location of each item shall be accurately determined and recorded on the Contractor's field drawings. Following completion of work in the area the items shall be replaced to their original locations and condition. The Contractor shall assume full responsibility for the protection of such items during removal, replacement and/or storage.

500.6 Supervision by the Contractor: Before starting the work, the Contractor shall designate, in writing, a representative who shall have complete authority to act for him. An alternate representative may also be designated. The representative or alternate shall be present at the work site whenever work is in progress. Any order or communication given to this representative shall be deemed delivered to the Contractor. A joint venture shall designate only one representative and alternate. In the absence of the Contractor or his designated representative, necessary directions or communications relevant to the work may be given by the City's representative to the superintendent or foreman having charge of the specific work to which the order applies. Such order(s) shall be complied with promptly and referred to the Contractor or his designated representative.

500.7 Traffic Control: The Contractor shall direct all construction activities so as to minimize obstruction of vehicular or pedestrian traffic and to prevent damage to completed work. In this regard, the Contractor shall keep the proper City Authorities continuously informed as to the location(s) of this operations. *No City street or road shall be closed to vehicular traffic without the prior permission of the City and not until after the affected emergency response authorities have been notified.* Contact the City Engineer's office to apply for street closure authorization.

In order that the effect to both the flow of traffic and damage to the new work is minimized, the Contractor shall at all times provide approved barricades, lights, flag men and other traffic control devices approved by the City Engineer, specified on the drawings or specifications or as may be required by law. All barricades needed overnight shall have flashing amber lights.

The Contractor shall submit his traffic control plan to the City Engineer for approval, prior to the start of work. All necessary personnel and/or devices, including any additional as directed by the City Engineer, shall be provided solely at the expense of the Contractor.

500.8 Protection of Existing Improvements:

500.8.01 Surface Improvements: The Contractor shall be responsible for the protection of existing surface improvements as directed elsewhere in the various applicable sections of these Specifications and Contract Documents, and any damage resulting from his operations shall be his sole responsibility.

When required for construction approval, the limits of the disturbance area shall be fenced with a 6-foot chain link fence conforming to UDOT Specifications, or approved equal.

500.8.02 Subsurface Improvements:

500.8.02A General: Utilities of record will be shown on the Approved Plans insofar as it is possible to do so. Failure of the plans to show the existence of subsurface objects or installations shall not relieve the Contractor from his responsibility to make an independent field check nor relieve him from all liability for damages resulting from his operations unless otherwise provided in the Special Conditions or by exceptions hereinafter mentioned.

It shall be the responsibility of the Contractor to give proper written notification to the agencies that have utilities in place and to cooperate with these agencies in the protection and relocation of the various underground installations. These agencies will give assistance in the location of various utilities, but this shall not relieve the Contractor from responsibility for any damage incurred, except in cases where the installations are not located as closely as is normally possible with normal locator equipment. In such case, the Contractor will not be liable if he has proceeded with due caution.

Where sewer services are damaged through no fault of the Contractor, they shall be repaired and payment will be made therefore in accordance with the unit contract price, or by force account as the City Engineer may determine.

500.8.02B Private Utilities: Utilities other than those owned and operated by the City are in streets pursuant to franchises or to rights claimed under the laws of the U.S.A. or the State of Utah, and therefore, the respective utility agencies are responsible for all adjustments and relocations of their facilities. These agencies will locate their facilities for the Contractor and assist him in their protection. The Contractor shall coordinate his work with that of the affected agencies and shall protect their utilities from damage to the extent possible.

The Contractor shall be liable for all damage to private utilities resulting from his operations, and shall hold the City harmless.

500.8.02C Water Mains and Appurtenances: The Contractor shall be responsible for any damage to water mains and water facilities caused by his operations, for the cost of lost water, and also for the cost of City manpower, materials, and equipment costs as determined by the Public Works Director, except under the following conditions:

1. he has not excavated below or beyond the required excavation lines and,
2. he has given proper and timely notice of his work plans, and
3. he has used reasonable care and has cooperated in minimizing the damages.

Any damage to water gates, hydrants, valve chambers, and other surface appurtenances which results from the Contractor's operation shall be his sole responsibility.

500.9 Use of Existing Streets: Off-highway earthmoving equipment, tracked equipment and haul vehicles with loads in excess of legal limits will not be allowed to travel upon, haul on or across any existing streets not being improved under or otherwise included in the Contract.

500.10 Use of Explosives: Blasting will not be permitted in any case without specific authority of the City, and then only under such restrictions as may be required by the proper authorities. Explosives shall be handled and used in strict compliance with the "Utah Occupation Safety and Health; Rules and Regulations; General Standards" of the Utah State Industrial Commission.

When the use of explosives is necessary for the execution of the work, the Contractor shall be responsible for any and all damage or injury resulting from the use of explosives.

The Contractor shall notify the Park City Police Department, the Park City Fire District, and each public utility company having structures in proximity to the site of the work of his intention to use explosives and such notice shall be given sufficiently in advance to enable companies to take such steps as they may deem necessary to protect their property from injury.

Blasting shall be completed in the vicinity of new structures before construction on such structures is undertaken. All explosives shall be stored in a secure manner and placed in compliance with local laws and ordinances and all such storage places shall be clearly marked "Danger--Explosives". No explosive shall be left in an unprotected manner along or adjacent to any existing highway or public place.

500.11 Prime and Tack Oil Application: The prime and tack oil application rate will be allowed to vary depending on air temperature, soil moisture, and soil type from the rates specified herein down to 0.05 gallons per square yard. The determination will be made by the Park City Inspector as specific conditions are verified.

500.12 Import Fill Material: The Contractor shall obtain import fill material from one source only for each classification of fill material used on each project. The material from each source must meet the specifications for the classification and be approved by the City Engineer prior to delivery on site. Submittals to the City Engineer must be made a minimum of five (5) working days prior to the intended use of the material.

500.13 City Right-Of-Way Grades Behind Gutter/Edge of Asphalt : (REFER TO STD. DWG. 800-B) When Landscaping or excavating on City property or the City Right-Of-Way, the following conditions shall apply:
1. Within the outside ten (10) feet of the City Right-Of-Way, the final physical grade elevation shall be within the limits of the areas shown between the dashed lines in Standard Drawing 800-B, Right-Of-Way Grading Section. The change in grade within the first five (5) feet behind the back of curb (BOC), or edge of asphalt (if there is no curb or gutter), shall not exceed six (6) inches plus or minus from the BOC grade elevation. The change in grade between five (5) feet and ten (10) feet behind the BOC, or edge of asphalt (if there is no curb or gutter), shall not exceed three (3) feet plus or minus from the BOC grade elevation.

2. Any landscape materials used in the outside ten (10) feet of the City Right-Of-Way: rock, timber, etc. shall physically fit within the limits of the areas shown between the dashed lines in Standard Drawing 800-B, Right-Of-Way Grading Section.

3. Approval of the City Engineer or the Director of Public Works is required prior to doing work on City Property. A permit may be required. Contact the City Engineer's Office for Permit requirements and/or Approval.

SECTION 501

EARTHWORK

501.1 General Description: Earthwork shall consist of all work required to construct or shape the earthen foundation, embankment, subgrade, etc. of any street, alley, parking lot, or other such facility in accordance with the Specifications and in reasonably close conformity with the lines, grades, and typical cross-sections shown on the Plans or as established by the Engineer. Earthwork shall consist of, but not necessarily be limited to, any or all of the following items.

a. Clearing, Grubbing and the Removal of Obstructions.
b. Excavation; Embankment; Subgrade Preparation and Construction; and Compaction.
c. Materials Requirements.
d. Subsurface Drainage.

501.2 Clearing and Grubbing:

501.2.01 Description: This item shall consist of clearing and removing all materials and artificial objects, including trees, brush, logs, stumps, roots, grass, weeds, pavements, buildings, foundations and any other objectionable materials, which are encountered within the limits of the work; designated in the Project Specifications or indicated on the Plans.

501.2.01 Methods and Details: Clearing and grubbing operations shall be carried on well in advance of the construction operations so as to permit a well-planned schedule of work.

The natural ground surface shall be cleared of all vegetable growth such as trees, logs, upturned stumps, roots of downed trees, brush, weeds, and all other objectionable material within the limits of construction.

Clearing and grubbing shall cover all areas within the limits of the construction zone or as called for in the Plans or Special Provisions. The limits of clearing and grubbing operations on sewer and water main projects are dependent to a considerable degree upon the Contractor's operations and it shall be his responsibility to determine these limits, providing he does not go beyond right-of-way or easement lines. The clearing and grubbing shall be to such width as will provide for adequate area alongside the excavation for material such as trench excavation and backfill, and area for pipe and material storage, and for any haul roads which may be necessary. In areas where driveable streets exist and where the project calls for grading and/or paving, the limits of clearing will be outlined in the Approved Plans or in the Special Conditions. When an area is to be cleared prior to landscaping, the limits of the clearing will be outlined on the Approved Plans and will be staked by the Engineer.

No payment will be made to the Contractor for clearing and grubbing outside the stated limits unless such work is authorized by the Engineer.

Within the limits of the clearing and grubbing zone, all roots one-quarter (¼) inch in diameter *(the size of a standard pencil*) or larger, buried logs, and all other such objectionable material shall be removed down to a point three (3) feet below the existing, ground surface or final street subgrade, whichever is deeper. When

buried objects, such as boulders, foundations, underground tanks or any other natural or man-made items, are encountered, the objects shall be removed and the soil immediately underlying said items shall be over-excavated to firm ground or to a minimum of six (6) inches below the point of deepest embedment, whichever is deeper. When excessive excavation is required to facilitate removal, the excavation shall be backfilled with approved materials. The backfill shall be placed in layers not exceeding, eight (8) inches in loose depth and compacted to a minimum of ninety-six (96) percent of the laboratory maximum density as determined by ASTM Test Method D-1557 or to the minimum degree specified for subgrade preparation or any overlying, fill material, whichever is greater.

All trees to be felled shall be felled within the area to be cleared. All tree trimming directed by the Engineer or required to facilitate the Contractors operation shall be done by competent personnel and in accordance with good tree surgery practices. Trees, shrubbery, plants, and other landscaping items that are not to be removed shall be fully protected from injury by the Contractor at his expense. Where required, trees shall be removed in such a manner as not to injure adjacent standing trees, plants, or any other improvements which are to be preserved.

The Contractor shall be responsible for all damages to trees, shrubbery, plants, other landscaping and improvements when said damages are a result of his operations. In the case of damage, the Contractor shall replace the damaged item(s) in kind. Any item(s) requiring replacement or repair, including, trees and plants, shall be warranted by the Contractor for a period of one year.

No debris of any kind shall be deposited in any stream or body of water or in any street or alley or upon any private property except by written consent of the Owner. In the case that the Owner is other than the City, the City Engineer shall be provided with a copy of the written agreement.

The refuse resulting from the clearing and grubbing operations shall be hauled to a waste site provided by the Contractor and shall be disposed of in such a manner as to meet all requirements of State, County, and Municipal regulations regarding health, safety, and public welfare. When authorized by the proper authorities, the Contractor may dispose of such refuse by burning on the site of the project provided *all requirements set forth by said authorities are fully met and complied with*.

In all cases, the authority to burn shall not relieve the Contractor in any way from damages which may result from his operations. In no case shall any materials be left on the project or adjoining private properties, or be buried in embankments or trenches within the project area.

501.3 Removal of Pavements, Sidewalks and Curb and Gutter: Pavement removal shall be accomplished and compensation be made for as defined in Section 501.4 or as indicated in the Contract Documents. Where existing streets are to be excavated and are presently surfaced with asphaltic concrete, bituminous mats on earth or granular base, or Portland Cement Concrete, these surfaces shall be considered as part of the excavation unless otherwise specified in the Special Conditions. Where existing street pavement extends beyond the back of the new curb line, the Contractor will also be required to remove the pavement beyond the project limit as part of the excavation.

Asphalt pavements shall be removed to clean, straight lines with near vertical faces. Saw cutting of the edges to be joined is optional at the time of the excavation. (See SECTION 552 PAVEMENT PATCHING)

Existing Portland Cement Concrete pavements, sidewalks and curbs and gutter shall be removed to existing joints, whenever possible. If removal is terminated between existing joints, whether specified or by the Contractor's choice, an approved concrete saw shall be used to cut the concrete along the established lines. Sawing shall be done in neat, straight lines and shall be to a depth of at least one and one-half (1½) inches. The remaining thickness of the concrete member may be broken or chipped away, using particular care not to break the concrete on the back side of the sawed joint. Where the Contractor chips or breaks the concrete section behind either the newly sawed joint or an existing adjacent joint, he shall replace such damaged sections at his own expense.

501.3.01 Edge Preparations: Following the completion of any additional work, such as excavation, backfill, subgrade compaction, etc., and prior to the placement of new surfacing, including patching, the existing pavement edges shall be prepared in accordance with the details presented in Standard Drawings 552-A and 703-A, whichever is applicable. All edges shall be saw cut full depth and *the twelve (12) inches minimum distance set back from trench excavations or any other disturbed material shall be strictly adhered to.* Disturbed subgrade material or aggregate base resulting from removal of existing pavements for final edge preparation shall be recompacted to a minimum of ninety-six (96) percent of the laboratory maximum density as determined by ASTM Test Method D-1557.

501.4 Excavation and Grading: (also see Sec. 500.12)

501.4.01 Description: This work shall consist of excavating, grading and compacting the roadway; side streets, alleys and driveway approaches; sidewalk areas, parking lots, etc.; and other such work as may be necessary for the completion of the cuts, embankments, slopes, roadway ditches, side street approaches, sidewalk areas, planting areas, alleys, and subsidiary work including the disposal of all surplus or unsuitable material. All work shall be performed in accordance with the alignment, grades, cross-sections and lines shown on the Construction Plans or as established by the Engineer.

This work shall include the removal and disposal of structures or any miscellaneous obstructions which are visible or are indicated on the Plans which encroach upon or otherwise obstruct the work and for which a separate bid item is not provided.

501.4.02 Classification: Roadway excavation, comprising all materials within the roadway, planting, and sidewalk areas, but excluding trench excavation and borrow pits, will be classified under headings of "Common Excavation", "Solid Rock Excavation", or "Unclassified Excavation" in accordance with the Specifications herein. Any work involving mill tailings resulting from previous mineral processing may require special handling procedures to be defined by the City Engineer.

Excavation will be classified according to the following definitions and will be indicated on the plans, in the Special Provisions or in lieu thereof defined by the City Engineer, based on his judgement of the character of the materials and the site conditions.

501.4.02A Common Excavation: "Common Excavation" shall be defined as the excavation of all materials that can be excavated, transported, placed, or stockpiled by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded onto hauling equipment by means of excavators having a rated capacity of one cubic yard or more and equipped with

attachments (such as shovel, bucket, backhoe, dragline or clam shell) appropriate to the character of the materials and the site conditions.

501.4.02B Solid Rock Excavation: "Solid Rock Excavation" shall cover the removal and disposal of solid rock or concrete, i.e., ledge rock that requires drilling and blasting for its removal and boulders exceeding one cubic yard in a volume. Hard pan, hard clay, or glacial till will not be classified as solid rock excavation. Sandstone, siltstone, shale, or other sedimentary rocks that are soft, weathered or extensively fissured will not be classified as solid rock excavation.

501.4.02C Unclassified Excavation: "Unclassified Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed. When excavation is unclassified, none of the definitions or classifications stated in these Specifications shall apply.

The presence of isolated boulders or rock fragments smaller than one cubic yard in size will not in itself be sufficient cause to change the classification of the surrounding material.

501.4.03 Definitions: For the purpose of materials classification, the following definitions shall apply:

501.4.03A Heavy Ripping Equipment: Heavy ripping equipment shall he defined as a rear-mounted, heavy duty, single-tooth or multi-tooth ripping attachment mounted on a track type tractor having a power rating of 200 or more net horsepower (at the flywheel).

501.4.03B Wheel Tractor-Scraper: Wheel tractor-scraper shall be defined as a self-loading (not elevating) and unloading scraper having a struck bowl capacity of 12-20 yards.

501.4.03C Pusher Tractor: Pusher tractor shall be defined as a track type tractor having a power rating of 200 or more net horsepower (at the flywheel) equipped with appropriate attachments.

501.4.04 Site Drainage and Ditches: Where required, ditches shall be constructed as shown on the Approved Plans and shall be so graded as to conform to the natural flow of the water to inlets, catch basins, culverts, or channels. Ditches originating in cut(s) shall be located in such a manner as to bypass any part of the adjacent fill so that no damage will be caused thereto by running water. The roadbed and ditches shall be maintained in such condition that the work shall be well drained at all times, including periods of work suspension. Proper protection shall be provided to ensure that no erosion takes place.

If it is necessary in the prosecution of the work to interrupt the existing flow of irrigation water, existing surface drainage, sewers, or underdrainage, temporary facilities shall be provided until permanent drainage or irrigation work is completed. All areas where seepage or standing water exists, shall be thoroughly drained, if feasible and required, as directed by the Engineer. This work must be done in advance of any grading operations.

501.4.05 Use and Disposal of Excavated Materials: Suitable excavated material, conforming to these specifications, shall be used for construction of all required project embankments. The more suitable portions of the excavated material shall be stored on the project, as the Contractor elects, or off the project in areas approved by the City Engineer and used for backfilling of curbs and dressing up of planting areas. *The*

different materials shall not be mixed during storage or during backfilling unless specifically authorized by the City Engineer. The cost of this shall be considered as incidental to the excavation. Excavated material in excess of that needed to complete all embankments and for backfilling curbs and dressing planting areas shall be removed as directed by the Engineer. Any remaining excess or unsuitable materials shall be disposed of by the Contractor at his own expense.

The Contractor shall not waste any excavated material until he is certain there is sufficient material to complete all necessary project embankment and planting. If any undue amount is wasted, the Contractor shall secure and furnish approved borrow material at his own expense.

The Engineer may designate as unsuitable those materials that cannot be properly compacted in embankment. All such unsuitable material shall be disposed of as directed.

The street, alley, or other such project facility shall be maintained in such condition that it will be well-drained at all times. Where the Engineer deems any subgrade material to be unsatisfactory due to "soft spots" excavation below subgrade will be required to such depths as may be directed. If the excavated material is unsatisfactory for the specified use on the project solely because of high moisture content, the Contractor may be directed by the Engineer to either process the material to reduce the moisture content to an optimum condition, or to remove the material and replace it with suitable backfill material.

Where excavation to subgrade exposes an unsuitable subgrade material, the Engineer may require the Contractor to remove the unsuitable material to the extent necessary to provide a firm, stable foundation. If any excavated material is found to be unsatisfactory of the specified or intended use on the project solely because of high moisture content, the Contractor may be directed by the Engineer to process the material to reduce the moisture content so that the material can be utilized within the project in the intended manner.

501.4.06 Side Street, Alley and Driveway Approaches: Approaches to the project shall be excavated to the limits indicated on the Approved Plans or to such limits as the Engineer may direct. This excavation shall be made in conjunction with the street excavation and in such manner as to provide safe access for local and emergency traffic at all times.

Where the Engineer deems subgrade material to be unsatisfactory, excavation below grade will be required to such depths as he may direct. Excavation below grade shall be of the same classification as that above it, provided it is removed in the same operation as the normal excavation. Where the Contractor has completed the excavation and is required to move back to remove unsuitable material, or where the additional depth requires special equipment or procedures because of the presence of shallow utilities or other unforeseen conditions, the work shall be performed as directed and additional payment will be authorized with a "Change Order" at the bid contract unit price. No materials shall be wasted without permission of the Engineer. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed, unless otherwise directed.

If the excavation below grade is required because of negligence on the part of the Contractor, the necessary excavation below grade and the backfilling required to restore the surface satisfactorily shall be at the Contractor's expense.

501.4.07 Planting and Sidewalk Areas: The class of excavation as specified shall include all excavations of planting and sidewalk areas and shall extend to the lateral and terminal limits shown on the construction plans. Planting areas shall be defined as those areas existing between the roadway surface and property line, exclusive of the areas occupied by other improvements such as sidewalks. Excavation on planting strips in developed areas, shall be made and be terminated to blend neatly with the existing contours. Planting strips shall be filled with topsoil comparable to existing topsoil and shall conform to the plan grade.

501.4.08 Embankment Cut Slopes: Following the clearing and grubbing operation, the construction of cut slopes will be performed to neat and clean lines in accordance with the cut stakes, showing depth of cut and slope planes as staked. Shoulders of slopes shall be cleared and formed at the highest point and the slopes brought down to the finished subgrade elevations as staked. Loose soil and rocks will be removed from cut slopes during this excavation. Over-excavation of cut slopes shall be replace with suitable mechanically compacted materials in accordance with requirements of the City Engineer.

The maximum allowable slope on cuts or fill embankments shall be 2:1 unless justified by specific site tests conducted by a Soils Engineer and approved by the City Engineer. Any changes in the sideslope shall be smoothly graded to avoid abrupt transitions. UBC Chapter 70 and Park City Erosion Control Guidelines shall be strictly adhered to.

Rock excavations will follow uniform slopes and planes as close as reasonably possible.

501.4.09 Fill Slopes and Embankments: All fill being placed on fill embankments will be placed in level, horizontal, uniform layers of sufficient width to allow thru-passage for working construction equipment. All fill slopes or embankments being constructed on hillside slopes shall be horizontally benched into hillside natural ground prior to initial placement of material.

Unless otherwise shown on the approved plans, the width of each bench cut or terrace shall be the width of the machine being used to bench. Each bench shall be cut to a minimum of two (2) feet and a maximum of four (4) feet vertically, and the excavated material shall be mixed and compacted with the fill material being placed on the embankment. ***Unless otherwise shown on the Approved Plans, the fill slopes resulting from the roadway or drainage channel construction shall be graded no steeper than two (2) horizontal to one (1) vertical, or (2:1).***

501.4.10 Slides: Side slopes in cuts and on embankments shall be constructed as staked or established by the Engineer. In the case that a slope finished to the lines as staked or established by the Engineer shall slide back of the established slope onto the roadway prism, or out of an embankment before final acceptance of the work, such slide material shall be removed by the Contractor from the roadway, or be replaced in the embankment by him, at the unit contract price for the class of excavation involved, and the slopes shall be refinished as directed by the Engineer.

Rock cut slopes shall be scaled of all loose rocks and fragments, and left in a neat, safe and workmanlike condition.

In the event the slide material cannot be measured accurately, or if the slide material will require a different type of equipment than that available on the project, payment may be made on a force account basis when so authorized by the Engineer.

Materials to replace embankment slides shall be obtained from sources approved by the Engineer. Slope undercut at the base or destroyed in a manner by an act of the Contractor shall be re-sloped by him parallel to the damaged slope, or as established by the Engineer.

501.4.11 Overbreak: In all materials encountered in the performance of the contract, overbreak is any portion of any such materials which is excavated, displaced or loosened outside and beyond the slope, lines, or grades as staked or established, with the exception of such material which occurs as slides as described hereinbefore, regardless of whether any such overbreak is due to blasting, to the inherent character of any formation encountered, or to any other cause. All overbreak as so defined shall be removed by the Contractor at his own expense and shall be disposed of by the Contractor in the same manner as provided for the surplus materials but at his own expense and without any allowance for haul.

Whenever it is agreed to in writing and in advance between the Contractor and the City Engineer, overbreak may be used in forming any embankment as planned to replace borrow, which otherwise would have to be provided for. In this event, payment will be made for the volume of common borrow or solid rock borrow, as the case may be, which the overbreak replaces at the respective contract price per cubic yard for such borrow with the additional allowance for haul, if any, of such available borrow; provided, however, that no allowance will be made for overbreak which is placed in the embankments as planned in lieu of available material coming from within the neat lines of the roadway prism.

501.4.12 Subgrade: The subgrade will be considered as the earthen surface or area of any new or existing street, alley, driveway, sidewalk, curb and gutter, parking lot, or other public facility upon which additional materials are to be placed, or which are to be constructed or prepared for future placement thereon of other materials in accordance with these Specifications, the Plans, or the Special Provisions, and which will be staked for lines and grades by the Engineer.

In advance of setting line and grade stakes, the subgrade area shall be cleared of brush, weeds, vegetation, grass, debris, etc., all of which shall be satisfactorily disposed of. All depressions or ruts which contain water shall be properly graded to drain. The subgrade shall be excavated and bladed to remove all uneven areas and to secure subgrade surface materials true to the required line and grade. The subgrade material shall then be scarified to a depth of twelve (12) inches, moisture conditioned to the optimum value and compacted by approved equipment to the specified density.

Grade and line throughout the various stages of constructing the subgrade, shall be secured from the reference stakes. The subgrade shall be maintained in the finished condition until the first course of surfacing is placed upon it.

All underground work contemplated in the area of the subgade shall be completed and properly backfilled before subgrade work is started. This is intended to include work under the Contract, work to be performed by the Owner or work to be performed by others.

All soft, pumping, or yielding spots shall be entirely removed and the so-excavated space refilled with suitable material and thoroughly compacted. If such areas are caused by negligence of the Contractor in his operations, the removal, replacement, and compaction shall be done by the Contractor at his own expense.

501.4.12A Unsuitable Foundation Excavation: When shown in the Contract Documents, unstable natural ground shall be excavated prior to preparation for placement of embankment over the area. The unstable material may consist of peat, muck, swampy or unsuitable materials, including buried roots and stumps. The material shall be excavated by the Contractor as directed by the Engineer to give the constructed embankment full bearing on firm ground. To obtain this result, the Contractor shall displace the overburden of unsuitable materials by such methods as the Engineer may approve. The overburden material outside of the new embankment shall be leveled off and blended in as directed by the City Engineer, and left in a neat condition.

When no unit contract price is provided in the Contract Documents for "Unsuitable Foundation Excavation", such work may be ordered by the Engineer, and shall be accomplished as extra work and payment will be negotiated.

When embankments are constructed across wet or swampy ground which will not support the weight of heavy hauling and spreading equipment, the Contractor will be required to choose such methods of embankment construction and to use such hauling and spreading equipment as will least disturb the soft formation. When soft foundations are encountered, the lower part of the fill may be constructed by dumping and spreading successive vehicle loads of approved materials in a uniformly distributed layer of thickness not greater than that necessary to support the vehicle while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified in the Contract Documents.

It is not the policy of the City to allow an increase in the planned depth of embankment material over soft, wet, or swampy ground for the sole purpose of providing support for heavy hauling and spreading equipment, unless the Contractor proves to the satisfaction of the Engineer that the planned depth is inadequate to support lighter vehicles. If it proves necessary for the Contractor to use smaller hauling vehicles or different methods of embankment construction than he had originally contemplated in order to comply with the foregoing, such shall not be the basis for a claim for extra compensation. The unit contract price for the various pay items involved shall be full compensation for all labor, materials and equipment necessary to perform the work as outlined herein.

501.4.13 Subgrade Compaction: After the required excavations have been completed and approved by the Engineer, the exposed surfaces shall be scarified to a depth of approximately eight (8) to twelve (12) inches. The materials shall be machine processed to provide a uniform, homogeneous mixture and moisture conditioned to within ± 2 percent of the materials optimum moisture as determined by ASTM Test Method D-1557. The upper eight (8) to twelve (12) inches of the subgrade shall then be graded, shaped to designated lines and compacted to a minimum of ninety-six (96) percent of the laboratory maximum dry density as determined by the test method specified above.

In the case, where the Approved Plans or Special Conditions specify that asphalt concrete surfacing, including Full-Depth Asphalt, or Portland Cement Concrete paving is to be placed directly on prepared subgrade without the use of an aggregate base course section, then the upper eight (8) inches of the subgrade shall be further

compacted to a minimum of one-hundred (100) percent of the laboratory maximum dry density as determined by ASTM Test Method D-1557.

Compaction of embankment material which contains excessive moisture shall not be started until the moisture content is reduced to the maximum amount specified heretofore. All costs and expenses involved in drying embankment materials shall be considered incidental to the various unit contract prices, unless a bid item or items for "Aeration Equipment" are included in the Contract.

501.4.14 Subgrade Stabilization: Where indicated on the Plans, in the Special Provisions or where directed by the Engineer the exposed subgrade to receive fill shall be stabilized, in lieu of compaction, by the following methods:

501.4.14A Clearing, Grubbing and Excavation: The subgrade areas shall be cleared, grubbed and excavate to the limits indicated on the drawings or as directed by the Engineer as specified in these specifications. Every effort shall be made by the Contractor to minimize over-excavations not required or directed and to minimize disturbance to the exposed subgrade.

501.4.14B Equipment: The Contractor shall select clearing and excavation equipment specifically chosen to minimize disturbance of the exposed subgrade including construction traffic. The Contractor's equipment shall be subject to the approval of the Engineer. Generally, the equipment shall be limited to track-mounted backhoe type excavators, equipped with tracks of sufficient area to support the machine on the material.

501.4.14C Subgrade Preparation: The Contractor shall take whatever steps necessary to control surface water run-off and groundwater at the site. Under no circumstances shall water from these sources be allowed to pond on or run across completed excavations. De-watering measures or run-off control facilities, if required, shall be fully completed and operational prior to the start of clearing and excavation.

501.4.14D Subgrade Stabilization Fabrics: Following the approved completion of excavations an approved geotextile fabric shall be properly installed over the exposed subgrade. The fabric shall meet the following minimum requirements:

Mullen Burst Strength	600 lb. min.
Puncture Strength	130 lb. min.
Equivalent Opening Size (EOS)	Max No. 20-U.S. Std.Sieve
Grab Strength	300 lb. min.
Modulus of Elongation at 10 percent	140 lb. min.

501.4.14E Installation: The fabric shall be installed in strict accordance with the manufacturer's recommendations and the following additional requirements:

1. The fabric shall be lapped along the sides a minimum of 30 inches; and a minimum of 36 inches at the ends of the rolls.

2. Only truck traffic to place cover or fill materials shall be allowed directly on the fabric. Dumping of aggregates shall be limited to end dumps and no turning of the trucks will be allowed on the fabric.

3. Dumping traffic shall be maintained at an absolute minimum and drivers shall be instructed to stagger their tire tracks to minimize subgrade and fabric disturbance. Minimum lap requirements shall be strictly maintained.

4. Aggregate base or select granular fill materials shall be placed full depth up to a maximum of sixteen (16) inches in uncompacted thickness. Following compaction, subsequent lifts shall be placed as required and shall not exceed twelve (12) inches in uncompacted thickness. Lifts near the maximum thickness shall be placed to minimize construction traffic.

501.4.14F Compaction: Each lift of fill overlying the fabric shall be compacted individually to a minimum of ninety-six (96) percent of the laboratory maximum as determined by ASTM Test Method D-1557.

If required to facilitate compaction, only the minimum amounts of water shall be added to the material to provide efficient compaction. In no case, shall the fill material be placed or compacted at a moisture content exceeding the optimum as determined by the test method specified above.

Compaction to the specified degree shall be accomplished utilizing steel drum rollers, preferably static. If the Contractor utilizes vibratory compaction methods, the procedure shall be closely monitored to assure that the procedure does not enhance moisture infiltration from the subgrade or further deteriorate the condition of the subgrade or fill materials, i.e., pumping etc. Should detrimental conditions begin to appear, the use of vibratory equipment shall be immediately discontinued.

All of the Contractor's fabric stabilization operations beginning with review of the cleared, grubbed and excavated subgrade and continuing through final placement, grading and compaction of any and all fill material shall be continuously observed and/or tested for compliance with these specifications as provided for in Section 500.4.

501.4.15 Embankment Construction: No embankment material shall be placed until the foundation has been approved by the Engineer.

Embankment construction shall be divided into two classes, rock embankments and earth embankments. Rock embankments shall be all, or any part, of an embankment in which the material contains 10 percent or more by volume of gravel or stone four (4) inches or greater in diameter. Embankments of all other material shall be considered as earth embankments.

501.4.15A Rock Embankment Construction: Rock embankments shall be constructed in layers not exceeding twelve (12) inches in depth, except in the case that the average size of the fragment exceeds twelve (12) inches, the layers may be as deep as required to allow their placement, subject to approval by the City Engineer. Occasional fragments exceeding the average size shall be disposed of instead of being incorporated in the embankment.

Each layer shall be consolidated by routing the loaded and unloaded hauling equipment or through the use of rollers. Where sufficient fines exist in the materials to facilitate efficient compaction the roadway shall be compacted to a minimum ninety-six (96) percent of the laboratory maximum density as determined by ASTM

Test Method D-1557 or other applicable test methods indicated on the Approved Plans, in the Special Provisions or as directed by the Engineer.

The material shall be placed carefully so that the larger pieces of rock or boulders are well distributed. The intervening spaces and interstices shall be filled with the smaller stone and earth as may be available so as to form a dense, well compacted embankment. Each layer shall be compacted as specified in the Contract Documents.

In making rock embankments, the Contractor will be required to bring the fills to within twelve (12) inches below grade, as designed by the Engineer, and to construct the remainder from suitable fine materials placed in layers, graded and compacted in accordance with the requirements specified for earth embankments. The finer materials from rock excavations shall be saved as far as is practical for use in topping out rock fill and backfilling over the subgrade excavation in rock cuts.

Across low swampy ground, the lower park of the embankment may be constructed by end-dumping granular material to form a uniform layer or thickness not greater than that necessary to support the hauling equipment. The remainder of the embankment shall be constructed in layers as specified.

501.4.15B Earth Embankment Construction: Earth embankment shall be constructed in compacted layers of uniform thickness and moisture. The layers shall be carried up full width from the bottom of the embankment to avoid widening the edges after the center has been brought to grade.

Earth embankment shall be compacted with modern, efficient, compacting units satisfactory to the Engineer. The compacting units may be of any type, provided they are capable of compacting each lift of the material to the specified density. The use of hauling equipment to obtain partial compaction will be allowed, but the Contractor will be required to compact the full width and depth of each layer of material to the required density. The right is reserved for the Engineer to direct the use of any particular compacting unit discontinued if it is not capable of compacting the material to the required density in a reasonable time.

Embankments normally shall be constructed in successive horizontal layers not exceeding eight (8) inches in loose thickness. If approved by the Engineer, successive horizontal layers up to a maximum depth of twelve (12) inches may be placed, provided the required density is obtainable throughout the full width and depth of each layer.

Each layer of the material shall be mechanically processed, moisture conditioned to within two (2) percent of optimum moisture and then be compacted to a minimum of ninety-six (96) percent of the laboratory maximum density as determined by ASTM Test Method D-1557.

At all locations that are inaccessible to a roller, the embankment shall be brought up in horizontal layers and compacted as specified above with mechanical tampers. The horizontal layers shall not exceed six (6) inches in loose thickness.

501.4.15C Embankment and Structures, Trestle and Bridge Ends: The work of filling around structures and the ends of trestles and bridges and the constructing of incidental embankments shall be undertaken and completed as soon as possible after each structure is completed, or when directed by the Engineer.

In filling around the structure, trestle or bridge ends, the Contractor shall bring the fill up equally on all sides of the bracing and the columns of the bridge to prevent distortion of the bents and columns. This method shall also be used in bringing up the fill on both sides of the bulkheads as shown on the Approved Plans, or as directed by the Engineer. The embankments shall be constructed under the bridge to the height and dimensions as shown on the Approved Plans, or directed by the Engineer. Fill shall not be placed against green concrete and wedging action against walls shall be prevented by stepping or serrating the sides of excavation. All drainage openings or seep holes in the masonry or concrete shall be backfilled one foot in each direction from the opening with coarse concrete aggregate. This concrete aggregate shall be furnished and placed without additional compensation to the Contractor.

The embankment and backfill at both ends of all rigid frame concrete structures which do not have provisions of expansion shall be brought up and compacted simultaneously to prevent lateral displacement of the structure due to unbalanced earth loading. The strength requirements for the closing placement of concrete for frame structures must be met and approved by the City Engineer or the placement shall have been completed at least seven days before backfilling.

The type of fill material to be used for backfill shall be specified on the drawings or in the Special Provisions. All backfill material shall be processed, moisture conditioned, placed and compacted in accordance with and to the degree specified for earth embankment construction in subsection 501.4.15B of these specifications.

All cost in connection with the above work shall be considered as incidental to the construction of the improvement and shall be included in the unit contract prices of the various pay item of work involved.

501.4.16 Compaction Control Testing: Optimum moisture content and maximum dry density shall be determined for each soil, aggregate or fill material type encountered and/or used. A minimum of one moisture-density relationship (Proctor) test shall be performed on a representative sample of each material type. The test shall be performed in accordance with ASTM Test Method D-1557 unless otherwise specified or directed by the City Engineer.

501.4.16A Field Density Testing: Field density testing to check the degree of compaction being attained shall be performed in accordance with AASHTO Test Methods T-238 and T-239 or ASTM D-1556. The frequency of density testing shall be sufficient to assure that all of the compacted subgrade or embankment fills have been compacted to the minimum degree specified. The City Engineer shall reserve the option of increasing or decreasing the frequency of field testing as conditions warrant.

501.4.17 Inadequate Compaction: When the results of field density tests indicate that less than the specified minimum degree of Compaction is being accomplished, the affected area(s) shall be subjected to additional compactive efforts.

If conditions warrant, or if directed by the Engineer, the affected areas shall be scarified, mechanically reprocessed and remixed, moisture conditioned and recompacted to the minimum degree specified.

The Contractor may, at his option or at the Engineer's direction, remove the material from the affected area(s) and replace the material with other acceptable materials, approved by the Engineer, and compacted to the degree specified .

In any case, the Contractor shall bear all costs associated with any additional work required to bring the material into minimum conformance with the specified degree of compaction and moisture conditioning.

501.4.18 Revegetation: All exposed cut and fill areas shall be revegetated in accordance with the requirements stipulated on the Approved Plan or specified in the Special Conditions.

501.4.19 Snow Removal: Whenever the surface of a cut or the site of an embankment is covered with snow sufficiently deep to impair the utility of the work, the snow must be removed and deposited beyond the slope stakes at the Contractor's own expense. Work of this nature shall be at least one hundred (100) feet in advance of the excavation or subgrade preparation operations.

501.4.20 Measurement: Excavation will be measured by the cubic yard in its original position by cross-sectioning by the Engineer. Pay quantities will be computed to the neat lines of the cross-sections as staked.

Stripping of quarries and pits will be measured by the cubic yard in its original position by cross-sectioning.

Unsuitable foundation excavation will be measured by the cubic yard in its original position by cross-sectioning.

501.4.21 Payment: Payment will be made for such of the following bid items as are included and shown in the Contract Documents:

1. "Common Excavation", per cubic yard
2. "Unsuitable Foundation Excavation", per cubic yard

The unit contract prices for such types and classes of excavation and borrow listed above shall be full compensation for excavating, loading, placing or otherwise disposing of the material as shown on the Approved Plans, as specified herein or as directed by the Engineer and shall include the removal and disposal, the wasting or stockpiling of forest debris or any top soil, organic matter, or other deleterious matter from the surface of a cut or fill, as specified or as may be directed by the Engineer.

SECTION 503

SUBGRADE, BORROW AND IMPORTED FILL MATERIALS

503.1 General: This section specifies minimum physical characteristics and guidelines for soil/rock combination materials to be used in the construction of prepared subgrade, embankments, roadway fills, backfill and for any other portions of the work previously specified in Section 501 - EARTHWORK.

503.2 Description: The work shall consist of providing materials as herein defined and specified, whether obtained from within or outside of the right-of-way, for use in the construction of prepared subgrade, embankments, roadway fills, backfill or for any applicable or specified portions of the work. Where a specified type of material is required the material type(s) and designated placement limits shall be indicated on the Approved Plans, in the Special Conditions as directed by the Engineer.

503.2.01 Subgrade: Subgrade as previously defined Section 501.4.12, shall consist of existing near surface or cut surface soil and/or soil rock combinations.

The materials to be prepared as compacted subgrade shall be free of vegetation, debris and other deleterious materials. During processing, moisture conditioning, compaction and overlying fill placement operations, the subgrade material shall be completely free of frozen particles and materials.
When the project grading requirements result in the upper twelve (12) inches of prepared roadbed, upon which aggregate base or other surfacing materials are to be placed, being comprised of subgrade material as described herein and in Section 503.3.12, then the subgrade material shall further conform to all of the minimum requirements specified in Section 503.2.02.

503.2.02 Common Fill (Borrow): Common Fill (borrow) shall consist of soils and/or soil-rock combinations completely free of vegetation, debris or other deleterious materials. During processing, moisture conditioning, placement and compaction, the materials shall be maintained completely free of frozen particles and materials.

Common Fill shall contain no rocks over six (6) inches in greatest dimension and not more than thirty (30) percent of the material shall be retained on the 3/4 inch sieve when tested in accordance with AASHTO Test Method T-27. In addition, when the project grading requirements result in the upper twenty-four (24) inches of prepared roadbed, upon which aggregate base or other surfacing materials are to be placed, being comprised of Common Fill (borrow) materials shall conform to the following minimum requirements.

1. That portion of the total material passing the number 200 sieve shall not exceed thirty-five (35) percent, when tested in accordance with AASHTO Test Method T-27.

2. The Plasticity Index (P.I.) of that portion of the total material passing the number 40 sieve shall not exceed (10), when tested in accordance with AASHTO Test Methods T-89 and T-90.

3. The California Bearing Ration Value (CBR) of the material shall be a minimum of twenty (20) when tested in accordance with ASTM Test method D-1883.

503.2.03 Select Fill (Granular Borrow and Backfill): Select Fill materials shall consist of soil and/or soil-aggregate mixtures completely free of vegetation, debris and other deleterious materials. During processing, moisture conditioning, placement and compaction, the materials shall be maintained free of frozen particles and materials. In addition, Select Fill materials shall further conform to the following minimum requirements.

1. The materials shall contain no rocks or particles over three (3) inches in greatest dimension, not more than thirty (30) percent of the materials shall be retained on the 3/4 inch sieve and that portion of the material passing the number 200 sieve shall not exceed twenty-five (25) percent, when tested in accordance with AASHTO Test Method T-27.

2. The Plasticity Index (P.I.) of that portion of the total material passing the number 40 sieve shall not exceed six (6), when tested in accordance with AASHTO Test Methods T-89 and T-90.

3. The California Bearing Ratio Value (CBR) of the material shall be a minimum of twenty (20) when tested in accordance with ASTM Test Method D-1883.

503.3 Construction Methods: The Contractor shall notify the Engineer sufficiently in advance of opening any borrow areas so that cross-section evaluations may be taken and the material tested, if necessary, before being used. Clearing of vegetation and stripping of unsatisfactory material from the pit or blending of materials when required, shall be performed by the Contractor at his expense. When there is a choice in quality of materials in the borrow source, the best material, when directed, shall be placed in the top portion of the embankment or fill.

Fill material shall not be placed until after the roadway excavation has been completed and approved by the Engineer. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the amount of such waste will be deducted from the borrow volume.

503.4 Revegetation: All borrow and stockpile areas shall be revegetated in accordance with the requirements stipulated on the Approved Plans or specified in the Special Conditions.

503.5 Method of Measurement and Payment:

Also see Sec. 500.12

SECTION 505

CONSTRUCTION WATER

505.1 Description:

505.1.01 Water for Streets: Water for compacting embankment, constructing subgrade, placement of screened gravel and crushing surfacing, and for laying dust caused from grading operations or public travel, if ordered by the Engineer, shall be applied in optimum amounts and placed as designated by the Engineer. Payment will be considered as incidental to the construction of the improvement and the costs thereof shall be included by the Contractor in the unit contract price of the pay items of the Contract.

505.2 Source of Water and General Requirements:

505.2.01 Water Supply: The Contractor shall make arrangements for and provide all necessary water at his own expense, unless otherwise provided in the Special Conditions.

If the Contractor purchases water from Park City at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment be made the utility on basis of the actual quantity of water metered. The Director of Public Works must authorize the opening of any City hydrants. All water usage will be metered. Application for service shall be made to the Finance office located in the City Offices.

505.2.02 Requirements and Responsibility: The Contractor shall use only those hydrants designated by the agency in charge of water distribution and in strict accordance with its requirements for hydrant use.

The Contractor shall secure permission from and comply with all requirements of the water utility before obtaining water from the fire hydrants. The Engineer or his authorized representative shall also be notified by the Contractor of such permission as soon as granted.

The Contractor shall use hydrant wrenches only to open hydrants. He shall also make certain that the hydrant valve is open "full," since "cracking" the valve causes damage to the valve. An approved auxiliary valve shall be provided on the outlet line for control purposes. Fire hydrant valves must be closed slowly and completely to avoid a surge on the system, which creates undue pressure on the water lines. The Contractor shall carefully note the importance of following these directions.

If one of the Contractor's employees shall knowingly or unknowingly damage any hydrant valve system, the Contractor will be responsible for all resulting costs and damages. He shall immediately notify the water utility so that the damage can be repaired as quickly as possible.

Upon completing the use of the hydrants, the Contractor shall notify the Department of Public Works, so that the hydrants may be then inspected for possible damage. Any damage resulting from the use

of the hydrants by the Contractor will be repaired by the water agency and the cost thereof shall, if necessary, be borne by the Contractor.

The Contractor shall furnish all connectors, wrenches, valves, and small tools that may be necessary to meet the requirements of the water distribution agency pertaining to hydrant use.

Violation of these requirements will result in fines and will lay the Contractor liable for damage suits because of malfunctioning of damaged fire hydrants, in the event of fire.

505.3 Construction Details:

505.3.01 General: Where hauled water is required, the tank truck and/or trailer shall meet all safety and licensing regulations and shall be provided with a pump of such size and capacity as to provide for a discharge equivalent to that required for hydrant settling water. Adjustable spray heads, front or rear, and spray bar shall provide uniform and controlled application of water without ponding or washing.

An approved pressure pipeline hose nozzle or sprinkling system may be used for applying water in embankment construction or to moisten material before excavation.

The Contractor shall provide sufficient equipment to apply water as directed. Insufficient or inadequate watering equipment shall be cause for closing down those operations affected by such until the Contractor makes proper remedy of the deficiency.

505.4 Payment: Water, which is required and used to secure adequate compaction of the subgrade and in sprinkling the subgrade for maintenance purposes shall not be a pay item, unless ordered by the Engineer.

SECTION 506

EXCAVATION FOR STRUCTURES

506.1 Description: The provisions of this section of the Specifications concern the removal or excavation of all materials of whatsoever nature that is necessary for the construction of footings, bases, or any other foundation work required to support pump stations, headwalls, water tanks, transmission towers, and similar structures.

This Section also includes the construction and subsequent removal of all shoring, cribs, cofferdams or caissons; the pumping which may be necessary for the execution of the work, and the placement and compaction of all necessary backfill.

It is not intended that excavation for culverts, sewers, and water mains and their appurtenances, manholes, inlets, and catch basins, conduits, and miscellaneous work covered elsewhere in these Specifications or in the Special Conditions shall be considered as structure excavation.

506.1.01 Classification: Structure excavation will not be further classified into solid rock excavation or common excavation, nor into wet or dry excavation. Structure excavation shall include the necessary grubbing of structure sites which otherwise would not be grubbed, the excavation of any and all formations encountered inside the limits which define structure excavation, and the removal and disposal of all debris, including submerged or buried timber, and all pumping that may be necessary for draining and dewatering the excavation. It shall also include the furnishing of all equipment necessary for the performance of this work, the placement of all necessary backfill inside the limits which define structure excavation, as hereinafter specified, and the disposal of excavated material that is not required for backfill.

506.2 Construction Details:

506.2.01 Preservation of Channel: When foundations or substructures are to be constructed in or adjacent to running streams, no excavation shall be done outside of cribs, cofferdams, caissons or sheet piling, nor shall the natural stream bed adjacent to the structure be disturbed without the written permission of the City Engineer. Care shall be taken to minimize damage to vegetation and to minimize siltation in the stream. Excavation work shall not be done during periods of high snowmelt. If any open pit excavation or dredging is permitted at the site of the structure before the placement of cribs or cofferdams, the Contractor shall, after the foundations are in place, backfill such excavations to the original surface of the stream bed with material satisfactory to the City Engineer. The backfilling material shall be of such quality and shall be placed in such a manner that it will offer the same resistance to scour as the material removed.

506.2.02 Excavation in Open Pits: When footings can be placed in the dry without the use of cofferdams and when cofferdams are not necessary for the preservation of conditions affecting the safety of the completed structure, the Engineer may permit the excavation of open pits without shoring, cofferdams or cribs. Such pits shall be constructed with side slopes sufficiently flat to prevent sliding or caving. The Contractor shall assume full responsibility for the prevention of any such slides adjacent to any such excavation, and in the event of any

such slide, the Contractor shall remove the additional material brought down by the slide at his own expense.

In case the material disturbed by a slide lies within an area upon which a portion of the structure is to be constructed, the Contractor shall excavate the disturbed material and backfill the excavated area to the original ground line with material satisfactory to the Engineer. This material shall be placed and compacted in the manner specified elsewhere herein. All costs in connection with excavating, backfilling, compacting, and restoring such a slide area to its original position and condition shall be borne by the Contractor.

When water is encountered, ample provision shall be made for draining or pumping, and the excavation shall be accomplished by such means as will prevent stirring up or softening the bottom. Foundation material unduly disturbed or softened by the use of equipment in the bottom of the pit or by inadequate handling of water shall be removed by the Contractor at his own expense. Such material removed shall be replaced, at the Contractor's own expense, with satisfactory material.

506.2.03 Depth of Footings: Foundation for all structures shall be excavated to the depth and lines indicated on the Approved Plans. The Engineer may require the Contractor to excavate below the elevations shown on the Approved Plans, or may order him to stop above the elevations shown, depending upon where suitable foundation material is encountered .

506.2.04 Preparation for Placing Foundations: In solid rock or other hard material, the excavation shall be carried at least 6" to 12" into the rock or hard material to form a key for the concrete footing, or to such additional depth as shown on the Approved Plans or directed by the Engineer. The bottom of the pit shall be cleaned of all loose material and cut to a firm surface, either level, stepped or serrated. When concrete is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of all loose or soft material shall be made just before the concrete is placed.

506.2.05 Shoring, Cribs, and Cofferdams: Except as provided in Section 506.2.02, all excavations shall be shored, braced, or protected by cofferdams in accordance with approved methods. No excavation or dredging shall be done before shoring, crib, or cofferdams are placed, except with the written permission of the City Engineer. If permission is given, it shall not relieve the Contractor of his obligation to anchor or otherwise hold the crib or cofferdam in place and secure it against tipping or displacement. Unless otherwise ordered, all cofferdams, sheeting and bracing shall be removed after serving their purpose.

506.2.06 Inspection: The Contractor shall notify the City Engineer before starting any excavation. From time to time during the progress of excavation, the City Engineer will examine at his discretion the character of material taken out.

506.2.07 Disposal of Excavated Material: The material obtained from structural excavation shall be used as the Engineer may require, either in construction embankments, or for backfilling over and around the structures after they are complete. When the material is unsuitable or not required for either of these purposes it shall be disposed of in a satisfactory manner.

506.2.08 Backfilling: All material used for backfill shall be of a quality acceptable to the Engineer and shall be free from large or frozen lumps, wood or other extraneous matter. The backfilling of openings made for structures shall be considered as a necessary part of the excavation, although the Engineer may require that the material for use in making a backfilling be obtained from a source entirely apart from the structure, in which case compensation will be on a force account or agreed price basis unless otherwise specified by the Contract Documents or the Engineer. Except as may be otherwise specified hereinafter, spaces excavated and not occupied by abutments, piers, or other permanent structures shall be backfilled up to the surface of the surrounding ground, with a sufficient allowance for settlement and, in general, the top surface of the backfill shall be neatly graded.

Backfill in existing street areas or in areas that must support roadway embankment or which is a part of any roadway embankment, shall be placed in horizontal layers not more than eight (8) inches thick, and each layer shall be tamped and compacted to 96% of the maximum density as measured by ASTM D-1557 Method of Compaction.

The use of mechanical tampers may be required for compacting backfill for certain items as shown in the individual specifications for such items, and as may be required in the Special Conditions or on the Approved Plans where greater density than that specified above is to be obtained.

Special precautions shall be taken to prevent any wedging action against abutments and wing walls. If the excavation has sloping sides, the slope shall be broken up by stepping or serrating to prevent wedge action before the backfill is placed. Fill placed around culverts, piers, and other underground utilities shall be deposited on both sides to approximately the same elevation at the same time.

The Engineer may order the backfill around piers and in front of abutments and wings to be of stone or lean concrete if the excavation has been in hard material exposed to erosion. Backfill of this nature will be paid for by force account unless otherwise provided for in the proposal. If the material used in making the backfill is too dry to permit proper compaction, the Engineer may require the addition of sufficient water to allow satisfactory compaction. Compensation for the use of water for this purpose shall be included in the contract prices for "Structure Excavation." If the material is too wet to permit proper compaction the Engineer may require a more suitable material to be substituted. Additional payment from such material will be made by change order or force account as authorized by the Engineer, prior to substitution.

506.3 Measurement: The materials excavated will be measured in their original position by volume in cubic yards. The quantity measured for payment will include only the material excavated from within the limits herein after defined, regardless of whether the excavation is made within a cofferdam enclosure or in an open pit. Any additional excavation outside of these limits shall be considered as having been made for the Contractor's benefit and all costs in connection with such excavation shall be at expense of the Contractor.

The horizontal limits for measuring the structure excavation for payment shall be for material removed up to but not beyond one foot outside the vertical planes of the footings, as shown on the Approved Plans.

The bottom limits for measuring the excavation for footings shall be the elevation of the bottom of the footing, as shown on the Approved Plans or as otherwise established by the Engineer. In pile foundations, the material resulting from the swell due to driving piles will not be included in the measured quantity.

The upper limit for measuring excavation shall be the top surface of the ground, or the bed of the stream as it exists at the time the excavation is started. When the contract designates the removal of certain materials in advance of excavation for structures and for which there is a designated pay item in the same contract, or in a separate contract, the upper limit shall be the completed subgrade of the designated grading section, as shown on the Approved Plans.

No measurement will be made of the materials involved in shoring, cribs, cofferdams and caissons.

Compaction costs shall be included by the Contractor in other pay items.

506.4 Payment: Excavation for structures will be paid for under such of the following bid items as are included and shown in any particular contract:

1. "Structure Excavation," per cubic yard.
2. "Shoring and Cribs or Extra Excavation," lump sum.

SECTION 510

UNTREATED AGGREGATE BASE COURSE

510.1 Description: This work shall consist of furnishing and placing one (1) or more courses of aggregate base material, as specified herein, on prepared surfaces in accordance with these specifications and in conformance with the line, grades, thickness and any other dimensions shown on the Approved Plans or as directed by the Engineer.

510.2 Source: It is anticipated that aggregate base materials will be obtained from existing commercial or Contractor owned pits. Should the Contractor choose or the project documents require the development of a new source, the Contractor shall be responsible for providing the source and for securing all the necessary zoning variances and permits which may be required, including those required for dust collection systems, wet-wash systems and truck traffic for haul access.

All work involved in clearing and stripping any aggregate source, including the handling of any unsuitable material encountered, shall be performed by the Contractor, and no additional compensation will be allowed for this work. In case the material deposit contains sand or other material, in excess of the specification gradation requirements or of an unacceptable quality, such excess or undesirable material shall be removed and disposed of prior to crushing.

In any case, each proposed aggregate source shall be tested in accordance with test method specified herein, and the results submitted to the City Engineer at least 48 hours prior to bringing any material on-site.

510.3 Mineral Aggregate Requirements: The mineral aggregate shall conform to the following requirements:

1. On that portion of the aggregate passing the No. 40 sieve, the liquid limit shall not exceed twenty-five (25), and the material shall be non-plastic, when tested in accordance with AASHTO Test Methods T-89 and T-90.

2. The aggregate shall have a percentage of wear not exceeding fifty (50), when tested in accordance with AASHTO Test Method T-96.

3. The aggregate shall be of uniform density and quality, and shall have a rodded weight of not less than 75 lbs. per cubic foot, when tested in accordance with AASHTO Test Method T-19. The material shall have a fracture face equal to 75%, on one or more sides.

4. The material shall have a California Bearing Ratio Value (CBR) of eighty (80) minimum when tested in accordance with ASTM Test method D-1883.

5. The dry material aggregate shall be uniformly graded within the following gradation limits, when tested in accordance with AASHTO Test Method T-27. The source of all materials must be approved in advance to importing by the City Engineer.

The total amount of material passing the No. 200 sieve shall be determined by washing in water in accordance with AASHTO Test Method T-11.

TABLE 510.3.01 AGGREGATE BASE GRADING REQUIREMENT:

Percent Passing by Dry Weight

SIEVE SIZE	1" MAX SIZE PERCENT PASSING	WIDE BAND PERCENT PASSING
1"	100	100
3/4"	95	90-100
1/2"	85	78-90
3/8"	74	67-81
No. 4	55	48-62
No. 16	30	24-36
No. 50	20	15-25
No. 200	8	5-11

510.3.01A Acceptance of Material: Acceptance of the on site delivered aggregate base material shall be based on periodic samples taken by the City Inspector by random selection.

If the result of any individual test indicates that the material does not comply with any of the requirements specified herein, then a second sample shall be obtained immediately from the same location to check the results obtained. In any case, the results of tests indicating nonconformance shall be immediately reported to the City Engineer, who shall solely have the option of accepting or rejecting the subject material. The City Engineer shall have the authority to direct the additional samples be obtained for testing at any time before, during or after placement. *Any rejected materials shall be removed from the site immediately.*

A minimum of two samples shall be obtained from the work area for each five (5) days of placement. The samples shall be tested for conformance of gradation and plasticity index. The City Engineer shall direct the frequency, if any, of testing to confirm CBR values of the material.

The City Engineer shall also have the authority to increase or decrease the frequency of sampling and testing, as conditions may warrant.

510.4 Placement: The foundation material, upon which aggregate base is to be placed, shall be cleaned of all loose and deleterious materials; shall be free of excess surface moisture and/or frozen materials; shall meet

the compaction, moisture and grading requirements outlined in Section 501 and shall have been approved by the City Engineer prior to the placement of aggregate base.

The Contractor shall provide a homogeneous mixture of unsegregated and uniformly dispersed aggregate base materials as placed in position for compacting. Unless otherwise specified, the material shall be mixed and spread by one (1) or a combination of the three (3) following methods:

1. Stationary Plant Method: The aggregate and water shall be mixed in an approved mixer. Water shall be added during the mixing operation in an amount necessary to facilitate compaction. After mixing, the base material shall be placed on the roadbed by means of an approved aggregate spreader.

2. Traveling Plant Method: After the material for each layer of base course has been placed through an aggregate spreader or windrow sizing device, the base shall be uniformly mixed by a traveling mixing plant. During the mixing, water shall be added in an amount necessary to facilitate compaction.

3. Road Mix Method: After material for each layer of base course has been placed, the materials shall be mixed by motor graders or other approved equipment until the mixture is uniform throughout. During the mixing, water shall be added in an amount necessary to facilitate compaction.

The aggregate base shall be deposited on the roadbed at a uniform quantity per linear foot which shall provide the required compacted thickness within the tolerances specified herein.

Where the required thickness is 0.50 feet or less, the base material may be spread and compacted in one (1) layer. Where the required thickness is more than 0.50 feet, the base material shall be spread and compacted in two (2) or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 0.50 feet. Each layer shall be spread and compacted in a similar manner. When vibrating or other approved types of special compacting equipment are used, the compaction depth of a single layer of the base course may be increased to 0.80 feet upon approval of the Engineer.

510.5 Compaction and Shaping : After each layer has been spread, as specified herein, it shall be compacted to the full width of placement. The number and type of compaction equipment shall be the Contractor's choice, as long as the selected equipment is adequate to produce the compacted and finished product as specified. Rolling shall commence along the edge of the area to be compacted and the rolling pattern shall gradually advance toward the center of the area. The rolling pattern shall be along lines parallel to the centerline of the roadbed or other areas being constructed.

Unless otherwise specified on the project drawing or in the Special Provisions, each individual layer of the aggregate base shall be compacted to a minimum of ninety-six (96) percent of the laboratory maximum dry density as determined in accordance with ASTM Test Method D-1557. During compaction the moisture content shall be maintained at such a degree as to provide efficient densification of the aggregate base, provided that in no case shall the moisture content exceed three (3) percent over optimum as determined by the test method specified above.

510.6 Field Density Testing: Field density testing to check the degree of compaction being attained shall be performed in accordance with AASHTO Test Methods T-238 and T-239 or ASTM D-1556. The frequency of density testing shall be sufficient to assure that all of the compacted aggregate base has been compacted to the minimum degree specified. The City Engineer shall reserve the option of increasing or decreasing the frequency of field testing, as conditions warrant.

510.6.01 Inadequate Compaction: When the results of field density tests indicate that less than the specified minimum degree of compaction is being accomplished, the affected area(s) shall be subjected to additional compactive efforts.

If conditions warrant, or if directed by the Engineer, the affected areas shall be scarified, mechanically reprocessed and remixed, moisture conditioned and recompacted to the minimum degree specified.

The Contractor shall bear all costs associated with any additional work required to bring the material into minimum conformance with the specified degree of compaction and moisture conditioning.

510.7 Finishing: The base shall be finished to a smooth uniform line and made with surface deviations not exceeding 0.5 inch, plus or minus in 10 feet. The determination of compliance with smoothness shall be made with a straight-edge, chalk-line, or profilograph.

The thickness of the base shall be reasonably close to that shown in the Contract Documents or as designated by the Engineer. Acceptance of the finished base with respect to thickness shall be on the basis of test areas selected by the City Engineer, not to exceed 50,000 square feet in size. Depth analyses shall be made by test holes located in a random pattern with not less than four (4) test holes in each test area. Test area shall be accepted when seventy-five (75) percent of the test holes are not deficient more than 0.5 inch of the designated thickness, and when no individual test hole shows a deficient thickness or more than 1.0 inch.

Test areas that are not acceptable shall be brought into compliance by the addition or removal of base material. Added material shall be blended with the in-place base and recompacted to the required density. Excess material shall be removed at the Contractor's expense, and shall be deducted from the pay quantities. If the City Engineer permits an excess thickness of base to remain in place, the amount of material in excess of the tolerances specified will not be included in the pay quantity.

The finished aggregate shall be maintained to line and grade, and at the specified density until covered by an additional course of base or surface course. Any base that becomes soft, washboarded or distorted under public or construction traffic shall be scarified, watered, remixed and recompacted to a firm, smooth surface at the Contractor's expense.

510.8 Method of Measurement: Untreated base course shall be measured by the cubic yards in place.

510.9 Basis of Payment: The accepted quantities of this item shall be paid for at the contract unit price. For "Untreated Base Course", the price shall include all work required to complete this item, including water added during mixing.

Any feature covered during the base course placement process that requires raising to a final grade must be raised to the proper grade within seven (7) days of being covered. These features include but are not limited to: manhole covers, valve box covers, and monument covers. Under no circumstances can the access to utilities be delayed more than seven (7) days unless otherwise approved by the City Engineer.

(Also refer to Sec. 500.12)

SECTION 520

ASPHALT MATERIALS

520.1 Description .

520.1.01 Asphalt Material: Asphalt of the grade specified shall fully comply with all of the requirements hereinafter set forth for each respective grade.

The particular grade or grades of asphalt to be used on any project will be those called for in the Contract Documents.

Each shipment of bituminous materials shall be uniform in appearance and consistency, and shall show no foaming when heated to the specified loading temperature. Shipments contaminated with other asphalt types or grades than specified shall be rejected.

520.1.02 Bill of Lading: The vendor of the bituminous material shall prepare a bill of lading for each shipment or material showing the following information:

1. Type and grade of material
2. Whether additives have been used and, if so, the type and amount
3. Destination
4. Consignee's name
5. Date of shipment
6. Railroad car or truck identification
7. Project number for which shipped
8. Loading temperature
9. Net weight (or net gallons corrected to 60°F., when requested)
10. Specific gravity
11. Bill of lading number
12. Source of bituminous material (manufacturer)

The vendor's bill of lading shall be prepared in triplicate, one copy to accompany the shipment to be delivered to the project, one copy to be mailed to the City Engineer, and one copy to be mailed to the designated testing laboratory.

520.1.03 Asphalt Cements: Penetration grades of asphalt cement prepared from petroleum shall conform to the requirements of Utah State Road Standard designation AC-10 or AC-20 when available, except that minimum flash point for all grades shall be 350°F.

520.1.04 Catalytically-Blown Asphalt: Shall be prepared only by the catalytic-blowing treatment of petroleum asphalt. The asphalt shall be homogeneous, free from water and shall not foam when heated to 347°F. Asphaltic materials for which ferric chloride or other compounds of iron have been used as catalysts in the blowing operation mill not be acceptable. Catalytically-blown asphalt shall meet the requirements of the State of Utah Standard Specifications for Road and Bridge Constriction.

520.1.05 Asphalt Emulsions: Emulsified asphalt shall conform to the requirements of ASTM of ISSA Specifications, for type SS1h, CSSlh or QUICK SETTING, MIXED GRADE EMULSION.

520.1.06 Slow Curing Cut Back Asphalt (SC): Shall conform to the requirements of AASHTO M-141.

520.1.07 Medium Curing Cut Back Asphalt (MC): Shall conform to the requirements of AASHTO M-82.

520.1.08 Rapid Curing Cut Back AsPhalt (RC): Shall conform to the requirements of AASHTO M-81, except that RC 4000 shall conform to the requirements shown in the State of Utah Standard Specifications for Road and Bridge Construction.

520.1.09 Deep Penetration Liquid Asphalt: The requirements of deep penetration liquid asphalt shall meet the State of Utah Standard Specifications for Road and Bridge Construction.

520.1.10 Road Tars: Shall be derived from gas-house, coke-oven, or water gas tars and shall conform to the requirements of AASHT0 M-52.

520.1.11 Unauthorized Grades: The use of grades of asphalt other than those called for on the Approved Plans or in the Special Conditions will not be allowed. Any work which proves to be defective because of the use of unauthorized grades of asphalt shall be repaired or removed at the expense of the Contractor, if ordered by the City Engineer.

SECTION 521

PLANT MIX BITUMINOUS PAVEMENT

521.1 Description: This work shall consist of providing and placing one (1) or more courses of Asphalt Concrete Paving on prepared subgrade, aggregate base or on existing asphalt surfacing as indicated on the Plans, in the Special Provisions or as directed by the Engineer.

Each course shall be constructed, as specified herein, to the depth, typical section(s) or elevation required on the Plans or otherwise directed by the Engineer. Each individual course shall be placed, compacted and otherwise finished as specified and shall be subject to the approval of the Engineer.

Any feature covered by asphalt during the asphalt paving process that requires adjusting to a final grade must be raised to the proper grade within seven (7) days of being covered with the asphalt. These features include but are not limited to: manhole covers, valve box covers, and monument covers. Under no circumstances can the access to the utilities be delayed more than seven (7) days after asphalting unless otherwise approved by the City Engineer.

521.2 Materials: Asphalt concrete mixes shall be composed of mineral aggregates and bituminous asphalt cement materials mixed in a central mixing plant.

521.2.01 Bituminous Asphalt Materials: Unless otherwise specified on the Plans or the Special Provisions, the asphalt cement shall be Viscosity Grade AC-10 meeting all requirements of AASHTO M-226 and Section 520 of these Standard Specifications.

The asphalt cement grade may be changed one step, up or down, by the Engineer at no change in the unit bid price.

521.2.02 Mineral Aggregates: It is anticipated that aggregate materials will be obtained from existing commercial or Contractor owned pits. Should the Contractor choose or the project documents require the development of a new source, then the Contractor shall be responsible for providing the source and for securing all the necessary zoning variances and permits which may be required, including those required for dust collection systems, wet-wash systems and truck traffic haul access.

All work involved in clearing and stripping any aggregate source, including the handling of any unsuitable material encountered, shall be performed by the Contractor, and no additional compensation will be allowed for this work. In case the material deposit contains sand or other material, in excess of the specification gradation requirements or of an unacceptable quality, such excess or undesirable material shall be removed and disposed of prior to crushing.

In any case, each proposed aggregate source shall be tested in accordance with test methods specified herein, and the results submitted to the City Engineer for approval.

Mineral aggregates shall consist of crushed stone, crushed gravel, or crushed slag. That portion of the materials retained on the No. 4 sieve shall constitute Coarse Aggregate and that portion of the materials passing No. 4 and retained on the No. 200 sieve shall constitute Fine Aggregates. Materials passing the No. 200 sieve are designated as Mineral Fillers.

When tested in accordance with AASHTO Test method T-104, the aggregates, both coarse and fine, shall have a weighted loss not exceeding twelve (12) percent, except that the maximum allowable percentage of loss shall be increased to sixteen (16) percent of asphalt treated base course materials when so identified on the plans.

The weight of minus 200 mesh material retained in the aggregate, as determined by the difference in percent passing a No. 200 sieve by washing and dry sieving without washing shall not exceed six (6) percent total sample weight.

521.2.02A Coarse Aggregate: Coarse aggregates, as defined above, shall consist of clean, hard, tough, durable and sound particles free from vegetable matter, deleterious substances or any adherent materials that would restrict thorough coating with asphalt cement. In addition, the coarse aggregate shall conform to the following minimum requirements:

1. The aggregate shall not contain more than five (5) percent by weight, of flat or elongated pieces. A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle as one having a ratio of length to width greater than five (5).

2. The aggregate shall contain at least fifty (50) percent by weight of crushed pieces having two or more fractured faces and sixty-five (65) percent having at least one (1) fractured face. The area of each face shall be equal to am least seventy-five (75) percent of the smallest midsectional area of the piece. When two (2) fractured faces are contiguous, the angle between the planes of fractures shall be at least thirty (30 degrees to count as two (2) fractured faces. Fractured faces shall be obtained by artificial crushing.

3. When tested in accordance with AASHTO Test Method T-96, the coarse aggregate shall have a percentage of wear not exceeding forty (40) percent, except that the maximum allowable percentage shall be increase to fifty (50) percent for asphalt treated base course materials.

4. The aggregate shall be of uniform density and quality and shall be a dry rodded weight of not less than seventy-five (75) lbs. per cubic foot when tested in accordance with AASHTO Test Method T-19.

521.2.02B Fine Aggregates: Fine aggregates, as defined herein, shall consist of clean, sound durable, angular particles, either manufactured by crushing or naturally existing. The aggregate particles shall be completely free from organic, clay balls or other deleterious matter. In addition the fine aggregates shall conform to the following minimum requirements:

1. When tested in accordance with AASHTO Test methods T-89 and T-90 that portion of the aggregates passing the No. 40 sieve shall have a liquid limit not exceeding twenty-five (25) and shall be non-plastic.

521.2.03 Mineral Filler: If mineral filler, in addition to that naturally present in the aggregates is required, the specified or designated material shall conform to the requirements contained in ASTM D-242. Mineral filler shall include Hydrated Lime or hydraulic cements required to increase the Index of Retained Strength characteristics of the asphalt concrete mixtures.

521.2.04 Paving Fabrics: When indicated on the Plans, in the Special Provisions or as directed by the Engineer, paving fabrics shall he furnished and placed to the lines or limits indicated. The fabric and placement shall conform to the minimum requirements specified herein or as otherwise indicated on the Plans or as directed by the Engineer.

521.2.04A Fabric Type: Paving fabrics shall consist of woven or non-woven polypropylene and/or polyester materials meeting the following minimum requirements:

TABLE 521.2.04B Minimum Physical Requirements

Property	Value
Weight, oz./s.y.	3.5-8.0
Grab Tensile Strength, lb.	90 lb. minimum
Grab Elongation at break, %	55% minimum
Asphalt Retention, gal/s.y.	0.20 minimum

521.2.04C Certificate of Compliance: Subsequent to the fabric material being delivered to the project site and prior to any placement, the Contractor shall submit to the Engineer, Manufacturer's Certificates of Compliance for each lot or partial lot representing material to be incorporated into the project.

In addition, each roll of fabric delivered to the project shall be clearly tagged indicating the lot or control number, date of manufacture, fabric type and identification, width and length of fabric rolls and sufficient information to determine the net weight of the fabric contained on each roll.

521.3 Mix Designs and Submittals: *At least ten (10) days prior to the start or asphalt concrete placement, the Contractor shall submit mix designs for each type of asphalt concrete mix to be used to the City Engineer for review and approval.* The design(s) shall be formulated by an independent testing laboratory, approved by the City Engineer, and shall have been completed prior to submittal, unless otherwise approved by the City Engineer. The costs of the mix design(s) shall be considered incidental to the work, and all costs of the mix design(s) shall be borne by the Contractor.

The mix designs shall be based on representative aggregate, mineral filler and asphalt cement samples from the source(s) to be used during production. The mix design(s) shall be performed in accordance with the applicable methods contained in the Asphalt Institute Manual MS-2. The design submittals shall include the following minimum information:

1. The results of laboratory quality tests performed on the proposed aggregates and mineral filler materials as indicated in Section 521.2.03.

2. The specific gravity and absorption of each aggregate fraction, as defined in Section 521.2, as determined by AASHTO Test Methods T-84 and T-85.

3. The gradation of each individual aggregate fraction, as defined in Section 521.2, as determined by AASHTO Test Methods T-27 and T-11.

4. The proposed combined aggregate grading, job mix grading tolerances and combined aggregate specific gravity used in the formulation of the design .

5. The specific gravity, grade and producer of the asphalt cement used in the formulation of the design.

6. The recommended asphalt cement content of the proposed mixture supported by the test properties for the recommended content. The submittal shall also include the test property curves indicated in Figure III-4 of the Asphalt Institute Manual MS-2.

7. The results of Index of Retained Strength Tests (Immersion-Compression) as determined in accordance with AASHTO Test Methods T-l65 and T-167.

8. The laboratory mixing temperatures and the recommended production mixing and lay-down temperatures for the mixture. Minimum lay-down temperature shall not be less than 250 degrees F.

521.4 Asphalt Mixture Composition: Unless otherwise approved by the City Engineer, all asphalt concrete and/or all asphalt concrete mix designs shall be formulated to conform to the minimum requirements specified herein.

521.4.01 Combined Aggregate Gradings: The combined job mix aggregate gradation shall establish a single, target percentage of aggregate passing each required sieve size. The gradation shall conform to the appropriate grading band, as specified, in Table 521.4.0LA. After the combined grading is established, asphalt mixtures for the project shall conform to the established gradation within the tolerances indicated in Table 521.4.01B.

continued . . .

TABLE 521.4.01A Master Gradation Limits

Percent Passing by Dry Weight of Aggregate

Sieve Size	1¼" Max.*	3/4" max.	½" max.
1¼"	100		
1"	86-98		
3/4"	68-93	100	
½"	57-81	79-99	100
¼"	49-69	68-88	79-99
No. 4	34-54	48-78	58-79
No. 8	22-42	33-53	39-59
No. 16	13-33	20-40	26-46
No. 30	8-24	14-30	19-35
No. 50	6-18	9-21	12-24
No. 100	4-12	6-16	7-17
No. 200	3-9	3-9	3-9

*ASPHALT TREATED BASE COURSE

TABLE 521.4.01B Job Mix Gradation Tolerances

Aggregates	Tolerances plus or minus
Retained on No. 4 and larger sieves	± 7 percent
Passing No. 4 and retained on No. 200	± 4 percent
Passing the No. 200 sieve	± 2 percent

521.4.02 Asphalt Cement Content: The asphalt cement content of the mixture shall be established by the approved mix design. During production and placement the asphalt cement content shall not vary by more than ± 0.30 percent without the approval of the City Engineer.

521. 4 . 03 Physical Test Properties: The mineral aggregates when combined with the determined percentage of asphalt cement shall conform to the following test properties:

continued . . .

TABLE 521.4.03 Test Properties

Property	Value
Number of blows/side:	50
Stability, pounds:	1750*
Flow, 0.01 inch:	10-18
Percent air voids:	2-5
Percent voids in mineral aggregate; VMA	
1¼" max. size aggregate:	13 minimum
3/4" max. size aggregate:	15 minimum
½" max. size aggregate:	16 minimum

*The stability of the design mix shall not exceed 3000 pounds unless approved by the City Engineer.

521.4.03B Index of Retained Strength: When tested in accordance with AASHTO Test Methods T-165 and T-167, the asphalt concrete mixture shall have an Index of Retained Strength value of not less than seventy (70). If the test value is less than seventy (70), the design mix shall be rejected or a minimum of one (1) percent hydrated lime shall be added to the mixture, as required, to produce an Index of Retained Strength of not less than seventy (70). In no case, shall the unconfined compressive strength of the Group 2 (wet compression) samples be less than 150 psi. Unless otherwise approved by the Engineer, anti-strip additives shall not be substituted for hydrated lime, and then only if laboratory test results indicate that the approved additive will result in a retained strength complying with the requirements specified herein.

The Index of Retained Strength value shall be used to evaluate the acceptability of the aggregates and proposed mix designs and shall not be used as a project control requirement, unless otherwise directed in the Special Provisions or by the City Engineer.

521.5 Acceptance of Delivered Material: Acceptance of the asphalt concrete material shall be based on periodic samples taken from the roadway by random selection.

If the result of any individual test indicates that the material does not comply with any of the requirements specified herein, then a second sample shall be obtained immediately from the same location to check the results obtained. *In any case, the results of tests indicating non-conformance shall be immediately reported to the City Engineer, who shall solely have the option of accepting or rejecting the subject material.*

A minimum of three (3) samples shall be obtained from the work area for each five (5) days of placement. The samples shall be tested for conformance with the requirements contained herein, and otherwise established

by the mix design. The City Engineer shall have the authority to increase or decrease the frequency of sampling and testing, as conditions may warrant.

521.6 Preparation of Roadway:

521.6.01 Untreated Roadway Surfaces: Where asphalt concrete, as described herein, is to be placed directly upon compacted subgrade or aggregate base, the subgrade or aggregate base shall be prepared in accordance with the requirements specified in Sections 501.4, 503 or 510, whichever is applicable.

The prepared surfaces shall be maintained in the same condition as prepared until the asphalt concrete is placed.

521.6.01A Prime Coat: Unless otherwise indicated on the Plans, in the Special Provisions or deleted by the City Engineer, all prepared subgrade or aggregate base upon which asphalt concrete is to be placed shall receive a prime coat. The prime coat shall conform to the material requirements and application procedures set forth in Section 522, except for the following modifications:

1. The prime coat shall be asphalt emulsion type CSS-1h unless otherwise specified in the Contract Documents or as directed by the City Engineer.

2. The prime coat shall be uniformly applied at a rate of 0.25 gal/sq. yd. unless otherwise specified in the Contract Documents or directed by the Engineer.

521.6.02 Overlays: Where asphalt concrete is to be placed as an overlap, the existing paved surfacing shall be thoroughly cleaned with power brooms, blowers, hand brooms or otherwise as directed by the Engineer.

All flushing or bleeding asphalt patches, accumulations of grease or oils and any other objectionable matter shall be entirely removed from the existing pavement. Excess asphalt and premolded joint filler material shall be removed to the satisfaction of the City Engineer.

Potholes, depressions, cracks as indicated, and other surface irregularities shall be patched by specified or otherwise approved methods satisfactory to the Engineer.

521.6.02A Tack Coat: Unless otherwise indicated in the Plans, in the Special Provisions or deleted by the City Engineer, all prepared existing paved surfaces upon which an asphalt concrete overlap is to be placed shall receive a tack coat. The tack coat shall conform to the material requirements and application procedures set forth in Section 523, except for the following modifications:

I. The tack coat shall be asphalt emulsion type CSS-1h unless otherwise specified in the Contract Documents or directed by the Engineer.

2. The tack coat shall be uniformly applied at a rate of 0.15 gal/sq. yd. unless otherwise specified in the Contract Documents or directed by the Engineer.

3. Where paving fabrics are specified for use, the prepared surface shall be tacked in accordance with Section 521.6.04B.

521.6.03 Paint Binder for Vertical Surfaces: Vertical faces of cut asphalt, cut concrete, manholes, etc. shall be sprayed, painted or otherwise coated with a uniform coating of emulsified asphalt binder type CRS-1 or CRS-2. The material shall be applied at the rate of 0.10 gal/sq.yd. of surface area covered or as otherwise directed by the Engineer.

521.6.04 Paving Fabrics: Where indicated on the Plans, in the Special Provisions or directed by the Engineer, paving fabrics conforming to the minimum requirements contained in Section 521.2.04 shall be placed in strict accordance with the Special Provisions, and manufacturer's recommendations except as modified below:

521.6.04A Preparation: Roadway preparation shall be completed in accordance with Section 521.6.02 or as otherwise specified.

521.6.04B Fabric Sealant: A fabric sealant coat shall be applied immediately prior to application of the fabric. The sealant coat shall be asphalt cement grade AC-10 applied at the rate of 0.25 gal/sq. yd. If for any reason the sealed fabric is not covered with the overlap in the same day as the fabric and sealant were placed, then the Engineer shall have the option of directing that an additional tack coat of AC-10 be applied, at an application rate to be determined by the Engineer.

521.6.04C Fabric Installation: The Contractor shall provide only qualified, experienced personnel, adequately equipped, to place the fabric materials. If, in the opinion of the Engineer, the assigned personnel are not adequately trained or experienced, then the Contractor shall provide manufacturer-trained representative to supervise or provide placement of the fabric.

The paving fabric shall be stretched, aligned and placed entirely on the tack coat with a minimum of wrinkles and folds. Hand and mechanical brooming shall be effected to maximize the fabric contact with the tacked roadway surface. If folds in excess of one-half (½) inch occur, the fabric shall be slit to remove the fold or wrinkle then overlapped in the direction of the paving.

All cutting or slitting of paving fabric shall be effected by a method approved by the Engineer. When cutting or slitting is employed, the Engineer will determine the additional amount of tack coat to be applied, to assure adhesion of the double fabric layer.

If manual placement methods are used, the fabric shall be unrolled, stretched, aligned and placed in increments not exceeding thirty (30) feet.

The fabric shall be rolled when required to seat the fabric to prevent movement and assure fabric saturation. Care shall be taken to avoid tracking plant mix bituminous pavement material onto fabric and to avoid distorting the fabric during rolling.

No vehicle shall be allowed on the fabric, except rolling equipment (if fabric seating is necessary), equipment needed to spread the of plant mix bituminous pavement material on top of the fabric, paving equipment and cross traffic. Prior approval by the Engineer shall be received before cross traffic is permitted.

Paving operations shall follow placement of the paving fabric within an hour or within ¼ mile whichever is less.

521.7 Preparation of Asphalt Concrete Mixtures: The mineral aggregate shall be dried prior to mixing. Drying shall be accomplished in a suitable dryer and shall continue until the average moisture content is not more than one (1) percent by weight. Moisture determinations shall be made on samples taken from the dryer discharge. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid contamination of the aggregate by soot or fuel oil.

521.7.01 Mixing: The mineral aggregate and bituminous binding shall be mixed at a central mixing plant. The shortest mixing time consistent with satisfactory coating of the aggregate shall be used as approved by the Engineer. The mineral aggregate shall be considered satisfactorily coated with bitumen when all of the particles passing on the No. 4 sieve are coated and ninety-six (96) percent of the particles retained on the No. 4 sieve are coated as determined visually by the Engineer. The required mixing time, as determined above, shall be used until change is approved by the Engineer.

If a dryer-drum mixing process is used, the dryer-drum mixing system shall be equipped to provide positive control of the cold aggregate feed and automatically regulate the feed gate and permit instant correction of variations in load. The cold feed shall be automatically coupled with the bitumen flow to maintain the required proportions. The system shall be equipped with automatic burner controls and shall provide for temperature sensing of the bituminous mixture at discharge. The mixing system shall be equipped with an adequate and approved surge bin capable of discharging in a manner as to prevent segregation of the mix. Dumping on the ground and reloading of the bituminous mix shall not be permitted. A mixing time consistent with satisfactory coating of the aggregate shall be used. The mineral aggregate shall be considered satisfactorily coated with bitumen when all of the particles passing the No. 4 sieve and ninety-eight (98) percent of the particles retained on the No. 4 sieve are coated as determined by the Engineer. The moisture content of the bituminous mixture shall not emceed one (1) percent by weight.

521.8 Mix Temperature Control: The viscosity of the asphalt as it is being used in the pug mill shall be between one hundred and fifty (150) and three hundred (300) centistoke, determined in accordance with ASTM Test Method D-2170. In no case shall the pug mill mixing temperature be less than two hundred and seventy-five (275) degrees F.

The Contractor shall advise the City Engineer in writing of the source of the asphalt to be used, who will then approve the mixing temperature limits for the asphalt, aggregate, mixing and lay down.

In the event a dryer-drum mixing process is used, the temperature of the bituminous mixture at discharge from the mixer shall not be less than two hundred and sixty (260) degrees F nor more than three hundred (300) degrees

The temperature of the asphalt concrete discharged from the mixing plant shall not vary more than twenty (20) degrees F for successive batches.

Minimum lay down temperatures of two hundred and fifty (250) degrees F shall be strictly adhered to. Any asphalt concrete delivered to the project at a lesser temperature shall be subject to rejection by the Engineer.

Final rolling and compaction to the minimum degree specified shall be completed before the mat temperature drops below one hundred and eighty (180) degrees F, when measured one-half (½) inch below the surface or mat.

If the source of asphalt cement is changed during the course of the work, notice shall be given in writing to the City Engineer. A new mix design shall be made, and new temperature limits will be specified before asphalt from the new source is used. In no case shall the asphalt from two different sources be intermixed.

521.9 Hauling: The beds of trucks used to haul asphalt concrete may be coated with a light film of distillate or light oil before loading. Amounts of oil that form visible pools in the truck bed shall be removed prior to loading. When the haul time from the mixing plant to the job site exceeds two (2) hours; when the atmospheric temperature is below fifty (50) degrees F, or when rain is falling along the haul route, asphalt concrete shall be covered with tarpaulins during transport. The tarpaulins shall completely cover the load and be firmly secured. Asphalt concrete shall be delivered to the site of the work without segregation of the ingredients and within the temperature range specified in Section 521.8.

521.10 Placement and Spreading:

521.10.01 General: Each individual course of asphalt concrete pavement shall be spread on the approved, prepared surface by means of mechanical, self-propelled bituminous paving machines. The paving machines shall be capable of placing a mat at least twelve (12) feet in width, without segregation or tearing of the mat.

521.10.0lA Lift Thickness: The asphalt concrete for each individual course shall be placed to the loose depths required to result in the compacted thickness specified on the Plans, or in the Special Provisions.

Where the specified total compacted thickness of the asphalt paving exceeds two and one-half (2½) inches, then the asphalt shall be placed in two (2) courses. In no case shall an individual course be placed in such a manner that will result in a compacted thickness exceeding two and one-half (2½) inches.

521.10.02 Equipment: Bituminous pavers shall be self-contained, power-propelled units with an activated screed or strike-off assembly, heated if necessary, and shall be capable of spreading and finishing courses of bituminous plant mix material which will meet the specified thickness, smoothness and grade. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant mix material in widths shown on the plans.

The paver shall be capable of operating at forward speeds consistent with satisfactory laying of the mixture.

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line or surface through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

The controls shall be capable of working in conjunction with any of the following attachments:

A. Ski-type device of not less than 30 feet (9.14 m) in length or as directed by the Engineer.

B. Taut stringline (wire) set to grade.

C. Short ski or shoe.

The asphalt concrete may be dumped from the hauling vehicles directly into the paving machine or it may be dumped upon the surface being paved and subsequently loaded by mechanical elevator, into the paving machine. No asphaltic concrete shall be dumped from the hauling vehicles at a distance greater then two hundred and fifty (250) feet in front of the paving machine. When asphaltic concrete is dumped first upon the surface being paved, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphaltic concrete dumped shall be picked up and loaded into the paving machine.

To achieve, as far as practicable, a continuous operation, the speed of the paving machine shall be coordinated with the production of the plant. Sufficient hauling equipment shall be available to ensure continuous operation. The Contractor shall provide and schedule enough smooth metal-bedded haul trucks, with covers as needed, to ensure orderly and continuous paving operations. When in the opinion of the City Engineer, excessive seams occur due to the stopping and starting of the paving equipment, the Contractor shall at his own expense correct the problems, by removal and replacement of the pavement to the satisfaction of the City Engineer. The corrective action is to occur within seven (7) days of the notification of the Contractor by the City Engineer.

The paver control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other indirectly either through controlling the transverse slope or alternately when directed, by controlling the elevation of each end independently, including any screed attachments used for widening, etc. Failure of the control system to function properly shall be cause for the suspension of the asphaltic concrete operations.

When dumping directly into the paving machine from trucks, care shall be taken to avoid jarring the machine or moving it out of the alignment.

Areas which are inaccessible to the spreading machine may be paved by other methods, as approved by the Engineer. When ordered by the Engineer, motor patrol graders or approved types of truck-attached spreaders shall be used to pave inaccessible or irregularly shaped areas. Hand raking shall be kept to a minimum.

521.10.03 Joints: The longitudinal joints in any upper course shall be offset from any longitudinal joint in the course immediately underlying by a minimum of twelve (12) inches.

Transverse joints in any upper course shall be offset from any transverse joint in the course immediately underlining by a minimum of two (2) feet. Transverse joints in adjacent lanes of the same course shall be offset by a minimum of ten (10) feet.

Where new paving joins or abuts with existing pavement surfaces, the edge of the existing surfaces shall be cut vertical and painted with tack coat as specified in Section 521.6.03.

Joints between successive days placements shall be made by placing a bulkhead of other approved material which when removed will provide a vertical faced joint. The joint shall be full width and depth. The joint surface from previously placed mix shall be painted with tack coat as specified in Section 521.6.03.

521.10.04 Weather and Seasonal Limitations: *Asphalt concrete paving shall be placed only between April 15, and October 15; when the surface temperature, upon which asphalt concrete is to be placed, is at least fifty (50) degrees F and/or when the wind chill factor has not fallen below thirty (30) degrees F, unless otherwise authorized by the City Engineer.*

In no case shall asphalt concrete be placed during rain or when the surface to be paved has free or standing moisture evident. Paving may be halted by the Engineer during any adverse weather condition which, in his opinion, may adversely affect the quality of paving.

Asphalt concrete placed after October 15, and before April 15, shall only be permitted by written authorization from the City Engineer and then only when conditions established by a proper review indicate that such placements are in the best interest of the City and the public. If the asphalt is placed it will be considered temporary, to be replaced under suitable conditions unless otherwise approved by the City Engineer.

521.10.05 Miscellaneous Details: The amount of asphalt concrete placed in one day shall not exceed that which can be compacted, in accordance with Section 521.11, in the day.

Construction of one course upon the previously placed course shall not be allowed until the underlying course has completely cooled. Tack coats between subsequent lifts shall be in accordance with Section 521.6.02A except that the application rate shall be 0.10 gal/sq. yd.

No traffic other than that necessary for construction purposes shall be allowed on any course of paving until the course has completely cooled. In no case shall traffic be used in an attempt to attain compaction.

521.11 Compaction: As each individual course is placed and spread, as specified in Section 521.10, it shall be thoroughly and uniformly compacted to a minimum of ninety-seven (97) percent of the laboratory maximum as determined in accordance with ASTM Test Method D-1559. Averaging is not allowed.

521.11.01 Construction Details: Compaction rolling shall start at the lower edge and progress longitudinally toward the centerline or higher point. Under no circumstances shall the center of the mat be rolled before the lower portions have been rolled. Each pass of the roller shall overlap the proceeding pass by at least one-half (½) the width of the roller.

Steel drum-rollers, either static or vibratory, shall be used to accomplish the initial break-down rolling. For subsequent intermediate and finish rolling, steel drum-rollers shall be supplemented with pneumatic-tired rollers. All rollers shall conform to the minimum requirements contained in Section 521.11.02.
During the first days placement, a specific rolling pattern for the specific rolling equipment being used shall be established by the Contractor and approved by the Engineer. The pattern shall not be modified without the approval of the Engineer. If the rolling pattern fails to achieve the specified degree of compaction and/or surface, it shall be modified to the satisfaction of the Engineer.

The number of rollers sufficient to attain the specified degree of compaction shall be furnished by the Contractor. *The Contractor's refusal, inability or failure to provide adequate rolling equipment, in the opinion of the Engineer, shall be sufficient cause for suspension of the work*. Should work be suspended for this reason, the Contractor shall take immediate action to provide the additional equipment required. All costs associated with or resulting from such suspensions, including wasted or rejected materials, damaged work and lost time shall be borne by the Contractor.

All asphalt concrete placed in a single day shall be compacted to the minimum degree specified in that same day. In no case shall the Contractor delay completing compaction for any reason within his control. Should compaction efforts be terminated by weather conditions, the City Engineer will review field density test results and other pertinent data in order to determine the suitability of the asphalt concrete. Should the review result in a determination that the material is inadequate or unsuitable and that the Contractor proceeded with placement without adequate consideration of impending weather conditions, then the City Engineer may order the subject asphalt concrete removed and replaced at the expense of the Contractor.

The surface of each course after compaction shall be smooth and true to established section and grade. Any mixture which shows an excess or deficiency of asphalt, or uneven distribution of asphalt due to insufficient mixing, or which becomes loose, broken, raveled, mixed with dirt, or is in any way defective, shall be removed and replaced with fresh hot mixture at the Contractor's expense, and be immediately compacted to conform with the surrounding area. *Areas of one square foot or more showing an excess or deficiency of asphalt shall be removed and replaced.*

At forms, curbs, headers, walls or other places not accessible to rollers, the asphalt concrete shall be thoroughly compacted to the degree specified with mechanical tampers, hot hand tampers, vibratory plates or other equipment approved by the Engineer.

521.11.02 Rollers: All rollers shall be in good condition, and the reversing mechanism so maintained that the roller is capable of changing directions smoothly. The roller shall be kept in continuous motion while on the hot mat in such a manner that all parts of the pavement receive equal compression. Reversing should not be done until the roller has completely stopped. Rollers shall be operated by competent and experienced personnel.

The number and weight of the rollers shall be sufficient to compact the asphalt concrete to the minimum degree specified while the mix is still in a workable condition and as otherwise specified herein.

Unless otherwise approved by the Engineer rollers shall not be operated at a speed exceeding three (3) m.p.h. during breakdown or intermediate rolling. Roller speeds during finish rolling shall be maintained at a safe level which provides the specified surface and compaction.

521.11.03 Field Density Testing: Field density testing to check the degree of compaction being attained shall be performed in accordance with ASTM Test Method D-2950 or by coring. The frequency of density testing shall be sufficient to assure that all of the asphalt concrete has been compacted to the minimum degree specified. The City Engineer shall reserve the option of increasing or decreasing the frequency of field testing, as conditions warrant.

521.11.04 Inadequate Compaction: When the results of field density tests indicate that less than the specified minimum degree of compaction is being accomplished, the affected area(s) shall be subjected to additional compactive efforts as long as such additional effort is completed within the temperature limits contained in Section 521.8 and within the time limits contained in Section 521.10.05.

In any case, the results of density tests indicating non-conformance shall be immediately reported to the City Engineer, who shall solely have the option of accepting or rejecting the subject material. Should the asphalt concrete be determined to be unsuitable, the Contractor shall bear all costs associated with removal, disposal and replacement. All remedial work required shall be performed in accordance with these Specifications.

The City Engineer shall have the authority to increase or decrease the frequency of sampling and/or testing, as conditions may warrant.

521.12 Finishing: The asphalt concrete shall be finished to a smooth uniform line and grade deviations not exceeding one-eight (1/8) inch, plus or minus, in ten (10) feet. The determination of compliance with smoothness may be made with a straight-edge, chalk line, high-low detector, or profilograph at the option of the Engineer. Surface ridges and irregularities shall be eliminated by rolling or other approved methods. The use of any equipment that leaves defects in the finished surface which cannot be eliminated, shall be discontinued.

When tested longitudinally, parallel to the surface, the surface shall not vary more than the following:

Length of Section	Leveling or First Course	Second or Surface Course
10 feet	1/4 inch	1/8 inch

25 feet	3/8 inch	1/4 inch
50 feet	1/2 inch	3/8 inch

Any variation from specified tolerance shall be corrected, at the expense of the Contractor, in a manner satisfactory to the Engineer.

The average thickness of the completed surface course shall be reasonably close to that shown on the typical sections. Acceptance of the completed surface course with respect to thickness shall be on the basis of test areas selected by the Engineer, not to exceed fifty thousand (50,000) square feet in size. Depth analyses may be made by cores located in a random pattern, with not less than four (4) cores in each test area. The test area shall be accepted when seventy-five (75) percent of the cores are not more than one-half (½) inch greater nor one-fourth (¼) inch less than the specified thickness and when no core shaw a deficient thickness of more than one-half (½) inch.

Test areas that are not acceptable because of deficient thickness shall be brought into compliance by removal and replacement or by placing additional surface course as directed by the Engineer.

Test areas that are not acceptable because of excess thickness shall be corrected as directed by the Engineer. Removal of portions of the surface course, if required, shall be at the Contractor's expense, and the amount of material removed shall be deducted from pay quantities. If the Engineer permits an excess thickness of surface course to remain in place, the amount of material in excess of the tolerances specified will not be included in the pay quantities.

The thickness tolerances established above shall not apply to those areas where additional thickness is required for leveling an existing surface.

521.12.01 Shoulders: Shoulders where indicated shall be finished to the lines, grades and cross-sections shown in the Approved Plans or Special Conditions and in conformance with these Specifications, unless otherwise directed by the Engineer.

521.13 Method of Measurement: Asphalt Concrete shall be measured by the specified thickness, per square yard in place, unless otherwise specified in the Special Conditions.

521.13.01 Paving Fabric Measurements: Paving fabrics shall be measured by and paid for at the contract unit bid price per square yard of material complete and in place. Fabric sealant tack coat shall be considered incidental.

521.14 Basis of Payment for Asphalt Concrete: The accepted quantities of this item shall be paid for at the contract unit price per square yard for "Asphalt Concrete" which price shall be full compensation for all work necessary to complete this item.

SECTION 522

BITUMINOUS PRIME COAT

522.1 General: This item shall consist of an application of liquid or emulsified asphalt to a prepared subgrade or untreated base course preparatory to placing a bituminous base or surface course. The prime coat shall be applied in conformity with the Approved Plans and these Specifications or as designated by the City Engineer.

522.2 Bituminous Material: Bituminous material shall be MC 70 and shall conform to the requirements of Section 520.

The grade may be changed one step by the City Engineer without a charge in the unit price.

522.3 Blotter Material: Blotter material, when required, shall consist of granular material that meets the following gradation requirements, then tested in accordance with AASHTO T-27.

Sieve Size	Percentage Passing Sieves
No. 4	90-100
No. 10	25-80
No. 200	0-15

522.4 Surface Preparation: If the surface to be primed contains an appreciable amount of loose material or is excessively dusty, it shall be wetted, bladed and rolled as approved by the Engineer, to make the surface satisfactorily tight. Priming shall not be started until all free surface moisture has disappeared.

522.5 Application of Bituminous Material: The bituminous material shall be sprayed over the prepared surface by means of a pressure distributor. The rate of application shall be approved by the Engineer.

The temperature range of the bituminous material at the time of application shall be such that the viscosity will be between 50 and 130 centistokes, as determined in accordance with ASTM D-2170. The exact temperature range shall be approved by the Engineer.

Where a surface is overprimed, resulting in a film of free liquid asphalt, it shall be blotted by spreading a light, uniform layer of blotter material applied at a rate approved by the Engineer.

Blotter material shall be applied by means of an approved mechanical spreader, capable of depositing a uniform layer of blotter material applied at a rate approved by the Engineer.

An underprimed surface shall immediately receive another application of bituminous material.

522.6 Protection of Structures: During the application of bituminous material, all structures shall be protected from being spattered or marred by covering with building paper or other suitable materials. If spattering or marring should occur, the condition shall be corrected at the expense of the Contractor.

Bituminous material shall not be discharged into borrow pits or gutters.

522.7 Opening to Traffic and Maintenance: *If a roadway has been open to traffic at any time, its closure for application of prime coat must be coordinated with the Public Improvements Inspector of the City Engineer's Office, 48 hours in advance.* After the prime coat has been applied, it shall be left undisturbed for at least 4 hours.

If after this time the surface is tacky or tends to pick up under traffic, the excess bituminous material shall be blotted with blotter material, before the surface is opened to any kind of traffic.

The Contractor shall maintain the primed surface until the next course is placed. Maintenance shall include spreading any necessary additional blotter material, replacing and restoring all portions of prime coat that have been destroyed, and patching any breaks in the primed surface. Any primed area that has became fouled by traffic, or otherwise, shall be cleaned before the next course is placed.

Under no circumstances should traffic be permitted to travel over freshly primed surface. If detours cannot be provided, the Contractor shall restrict his operation to a width that will permit it at least one-way traffic over the remaining portion of the roadbed. If one-way traffic is provided, the traffic shall be controlled by flagging or pilot car operation.

522.8 Weather and Limitations: Prime coat and tack coat shall be applied only when the air temperature in the shade is above 50°F and the roadbed temperature is above 50°F. Prime coat and tack coat shall not be applied during rain, fog, or other adverse weather conditions. See also Subsection 500.11.

The temperature restrictions may only be waived upon written authorization by the City Engineer.

522.9 Payment: There shall be no separate payment for bituminous prime coat. It shall be included in the costs of "Bituminous Surface Course," unless otherwise stated in the Bid Schedule.

SECTION 523

BITUMINOUS TACK COAT

523.1 General: This item shall consist of an application of liquid asphalt or emulsified asphalt to an existing surface applied in conformity with the Approved Plans and these Specifications or as directed by the City Engineer.

523.2 Materials: Bituminous material shall be SS1 or RC 70 and shall conform to the requirements of Section 520.

523.3 Application of Bituminous Material: Prior to applying the material, the surface to be treated shall be swept or flushed free of dust or other foreign material. The material shall then be sprayed over the prepared surface by means of a pressure distributor at the rate approved by the Engineer.

The temperature range of the bituminous material at the time of application shall be such that the viscosity will be between 50 and 100 centistokes, as determined in accordance with ASTM Designation D-2170. The exact temperature range shall be approved by the Engineer.

523.4 Protection of Structures: Structures shall be protected as provided in Subsection 522.6.

523.5 Opening to Traffic: Under no circumstances shall traffic be permitted to travel over the tacked surface until the bituminous material has cured so as to not be picked up by traffic. If detours cannot be provided, the Contractor shall restrict his operation to a width that will permit at least one-way traffic over the remaining portion of road. If one-way traffic is provided the traffic shall be controlled by flagging or pilot car operation.

523.6 Weather Limitations: The application of tack coat shall be subject to the conditions outlined in Subsections 522.8 and 500.11.

523.7 Payment: There shall be no separate payment for bituminous tack coat. It shall be included in the costs of bituminous surface course, unless otherwise stated in the Bid Schedule.

SECTION 524

BITUMINOUS SEAL COAT

524.1 General: This item shall consist of applying, a coat of liquid asphalt to an existing surface course. When required, an application of cover material shall follow the bituminous application. The seal coat shall be applied in conformity with the Approved Plans and these Specifications or as directed by the Engineer.

524.2 Bituminous Material: The bituminous material shall be RC 70, conforming to the requirements of Section 520.

524.3 Cover Material: Cover material shall consist of clean, hard, tough, durable, and sound fragments of broken stone, crushed gravel, or crushed slag conforming to the following requirements:

a. The dry mineral aggregate shall be uniformly graded with one of the gradation limits specified below, as is called for in the bid proposal, when tested in accordance with AASHTO T-27.

	Percentage Passing Sieves	
Sieve Size	Type A	Type B
1/2 inch	100	-
3/8 inch	90-100	-
No. 4	10-25	100
No. 8	0-10	85-100
No. 16	0-6	10-25
No. 50	0-4	0-5
No. 200	0-2	0-2

Acceptance of cover material with respect to gradation shall be based on the average gradation of 5 samples taken from a test lot of 500 tons. The samples shall be obtained from the stockpile prior to use. A test lot shall be accepted when the average gradation of the 5 samples is within the specified gradation band and when the number of individual samples in each test lot outside the gradation band does not exceed 2 and when they are not outside the band by more than 2 percentage points on any one sieve.

The total amount of material passing the No. 200 sieve shall be determined by washing with water in accordance with AASHT0 T-11.

b. That portion of the aggregate retained on the No. 4 sieve shall have not less than 90 percent, by weight, of particles with at least two mechanically fractured, or clean angular faces, when tested in accordance with the Utah State Department of Transportation Test Procedure 8-929.

c. The aggregate shall have a percentage of wear not exceeding 30, when tested in accordance with AASHT0 T-96.

d. The crushed mineral aggregate shall have a weighted percent of loss not exceeding 10 percent by weight, when subjected to five cycles of sodium sulfate and tested in accordance with AASHTO T-104.

e. The aggregate shall be of such nature that when the particles are thoroughly coated with the bituminous material specified for the project, not less than 90 percent of the coating shall be retained, when tested in accordance with Utah State Department of Transportation Test Procedure 8-945 .

524.4 Construction Methods:

524.4.01 Bituminous Additive: Bituminous additive may be used to improve the coatibility of the aggregate. The amount and type of additive to be used shall be approved by the Engineer.

524.4.02 Surface Preparation: Seal coat operations shall not be started until the surface to be sealed has been thoroughly compacted by traffic. In no event shall seal coat be placed on newly constructed bituminous surfaces within 7 days after such surfaces are laid.

Prior to placing the seal coat, the existing surface shall be cleaned of all dirt, sand, dust, or other objectionable material.

524.4.03 Application: The material shall be sprayed over the prepared surface by means of a pressure distributor. The material shall be applied in such a manner that an inspection of the spread can be made and any defects corrected before the cover material is applied. The rate of application shall be approved by the Engineer. Application of bituminous material shall not be more than 1000 feet in advance of the placing of cover material.

Joints between applications shall be made by starting and stopping the distributor on building paper. Valve action shall be instantaneous, both in starting and cut-off. The distributor shall attain the proper application speed at the time the spray bar is opened.

The temperature range of the bituminous material at the time of application shall be such that the viscosity will be between 50 and 100 centistokes, as deterrnined in accordance with ASTM D -2170. The exact temperature range shall be approved by the Engineer.

524.4.04 Spreading, and Compacting of Cover Material: The cover material shall be spread immediately after applying the bituminous material by means of an approved spreader, which can be adjusted to uniformly spread the required amount of aggregate. Provisions shall be made so that the larger particles will be deposited first. The rate of cover material application, in pounds per square yard, shall be approved by the Engineer. Immediately after spreading, the cover material shall be hand broomed, if necessary, to distribute the aggregate uniformly over the surface.

After the cover material has been satisfactorily spread, the surface shall be rolled in a longitudinal direction. Rolling, performed with pneumatic tire rollers, shall adequately seal the cover material and shall consist of at least two complete coverage. Rolling shall be completed the same day the bituminous material and cover material are applied .

After rolling, but not earlier than the next day, any loose material shall be redistributed over the surface. At the end of four days, any loose material shall be removed in such a manner that the material set in the bituminous binder will not be dislodged.

524.4.05 Protection of Structures: Structures shall be protected as provided in subsection 522.6.

524.4.06 Opening to Traffic: On completion of final rolling, traffic shall be permitted to travel over the seal coat. Traffic shall be controlled as directed by flagging and pilot car operation.

504.4.07 Weather Limitations: Seal coat shall be applied only when the air temperature in the shade and the roadbed temperatures are above 50°F. Seal coat shall not be applied during rain, fog, or other adverse weather conditions.

The temperature restrictions may only be waived upon written authorization from the Engineer.

524.4.08 Supplemental Cover Material: Cover material shall be stockpiled at the designated places in such quantities as contained in the bid proposal or as the Engineer may direct. Prior to stockpiling, the selected sites shall be cleared and leveled.

524.5 Payment: There shall be no separate payment for bituminous seal coat. It shall be included in the costs of "Bituminous Surface Course", unless otherwise stated in the Bid Schedule. Cover material shall be paid for by the unit price per square foot, when applicable.

SECTION 525

PLANT MIX BITUMINOUS SEAL COAT

525.1 Description: This item shall consist of a mixture of mineral aggregate and bituminous binder, mixed at a central mixing plant, spread and compacted on a prepared surface in reasonably close conformance with the lines, grades and dimensions shown on the Approved Plans and typical sections and in accordance with these Specifications.

525.2 Materials:

525.2.01 Bituminous Material: Bituminous material shall be of the type called for in the Bid Proposal and shall conform to the requirements of Section 520. The grade specified in the Proposal may be changed one step by the Engineer at no change in the unit bid price. The percentage of bituminous material used shall be approved by the Engineer.

525.2.02 Mineral Aggregate:

a. The dry mineral aggregate shall meet one of the gradations shown below when tested in accordance with AASHTO Designation T-30. The gradation to be used shall be designated in the Proposal.

At least ten working days prior to producing plant mix bituminous seal coat, the Contractor shall submit in writing a job-mix gradation to the Engineer for his approval. The job-mix gradation shall have definite single values for the percentage of aggregate passing each specified sieve based on the dry weight of the aggregate. The job-mix gradation shall meet the ideal gradation with the tolerances shown below:

Type A:

Sieve Size	Ideal Gradation (Percent Passing)	Ideal Gradation Tolerance
½ inch	100	0
3/8 inch	97	±2
No. 4	40	±4
No. 8	17	±3
No. 16	12	±2
No. 50	8	±2
No. 200	3	±1

continued . . .

Type B

Sieve Size	Ideal Gradation (Percent Passing)	Ideal Gradation Tolerance
½ inch	100	0
3/8 inch	97	±2
No. 4	40	±4
No. 8	17	±3
No. 16	21	±3
No. 50	13	±2
No. 200	4	±1

The total amount of material passing the No. 200 Sieve shall be determined by washing with water in accordance with AASHTO T-11.

Changes in the job-mix gradation may be made prior to a day's production, subject to approval by the Engineer who, before use, will make any necessary adjustments in the amount of bituminous material to be used. The request for changes shall be in writing and shall give the Engineer sufficient notice to review and approve this mix design. For major changes in the job-mix gradation, at least two working days notice shall be required.

Acceptance of the aggregate with respect to gradation shall be based on the average of the deviations from the job-mix gradation of the samples taken from a lot. A lot shall equal the number of tons of bituminous mix placed each production day. When the daily production exceeds 2,500 tons, a minimum of 5 samples shall be required. When it is between 1,500 and 2,500 tons, a Minim of 4 samples shall be required. When it is less than 1,500 tons, a minimum of 3 samples shall be required. In the event the minimum number of samples required can not be obtained, the test lot may be evaluated on the basis of fewer samples. The samples shall be taken on a random basis for the bituminous mix after it has been discharged into hauling units. In addition, the samples shall be distributed as uniformly as possible in time throughout the test lot so as to be representative of the Material being produced during the entire production day. A lot will be accepted when the average gradation of the 5 samples is within the specified gradation band and when the number of individual samples in each test lot outside the band does not exceed 2 and when they are not outside the gradation band by more than 2 percentage points on any one sieve.

The Contractor shall take steps to bring the plant mix bituminous seal coat into Specifications when the test results show a deviation from the job-mix formula that exceeds the Maximum deviation allowed.

b. That portion of the aggregate retained on the No. 4 sieve shall have not less than 90% of particles with at least one fractured face, or clear angular face, when tested in accordance with UDOT Test Procedure 8-929.

c. The aggregate shall have a percentage of wear not exceeding 30 when tested in accordance with AASHTO T-96.

d. The crushed mineral aggregate shall have a weighted percent of loss not exceeding 12% by weight when subjected to 5 cycles of sodium sulfate and tested in accordance with AASHTO T-104.

e. The aggregate shall be of such nature that when thoroughly coated with the bituminous material specified for the project not less than 90% of the coating shall be retained when tested in accordance with UDOT Test Procedure 8-945.

f. Before being fed to the drier the aggregate shall be separated into two or more sizes and stored separately. If two or three sizes are used the aggregate shall be separated on screens of such size that the quantity drawn from each storage is approximately equal.

The aggregate shall be fed to the drier at a uniform rate. The rate of feed shall be maintained within 10% of the amount set by the Contractor for his operation.

In placing the aggregate in storage or in moving from storage to the cold feed bins, any method which causes segregation, degradation, or the combining of materials of different gradings shall not be permitted. Any segregated or degraded material shall be re-screened or wasted.

Plant mix operations shall not commence until sufficient material for at least two days production has been separated and stockpiled.

g. The plant mix bituminous seal coat material shall have a co-efficient of thermal expansion of less than 1/2 inch per 100 feet when tested by the UDOT testing procedure. This requirement shall be used to determine the suitability of the aggregate source and shall not be used for routine project control. The Materials and Research Section of District Two Materials and Test Unit may be contacted for information regarding this test method and specification.

525.2.03 Bituminous Additive: Bituminous additive may be used to improve the coatability of the aggregate. The type and percent of super-concentrated additive to be used shall be approved by the Engineer. Bituminous additive shall conform to the requirements of Section 407 of the UDOT Standard Specifications for Road and Bridge Construction.

525.3 Construction Methods:

525.3.01 Temperature Control: The viscosity of the asphalt being used in the plant mix bituminous seal coat shall be between 400 and 900 centistokes at the time of mixing as determined in accordance with ASTM D-2170 of the UDOT Standard Specifications for Road and Bridge Construction. The exact temperature range shall be approved by the Engineer to be used for the asphalt, aggregate, mixing and laydown after notification as to asphalt source.

If a dryer-drum mixing process is used, the temperature of the bituminous mixture at discharge from the mixer shall be not less than 230°F. nor more than 260°F. Unless otherwise approved by City Engineer, the plant mix bituminous seal coat must be covered with a tarpaulin and delivered to the site before its temperature drops below 200°F. *It is necessary to complete compaction of the bituminous mixture before the temperature of the mixture drops below 180°F. unless otherwise approved by City Engineer. If the source of asphalt is changed during the course of work, a new mix design shall be made. In no case shall the asphalt from two different sources be intermixed.*

525.3.02 Mixing: Mixing shall be performed as specified in Subsection 402. 09 of the UDOT Standard Specifications for Road and Bridge Construction, except that the mineral aggregate shall be considered satisfactorily coated with bitumen when "all" particles are coated.

525.3.03 Tack Coat: The placing of the tack coat shall be in accordance with Section 404 of the UDOT Standard Specifications for Road and Bridge Construction.

525.3.04 Spreading and Compacting: The bituminous seal coat mixture shall be laid with self-propelled mechanical spreading and finishing equipment capable of laying at least a 12-foot width. The mixture shall be laid in one pass to the elevations, grades, and cross-sections shown on the Approved Plans.

Whenever asphalt slicks appear on the surface of the newly laid seal coat, they shall be raked immediately. Raking will usually cause the excessive asphalt to flow to the bottom of the mat. If a slick spot cannot be removed by raking, it shall be taken out and replaced by material which contains less asphalt. This replacement material shall be raked to conform to the contour of the seal coat. Asphalt slicks which appear after rolling has been completed shall be covered with a light course of fine sand. The slick spots shall then be rolled again.

The seal coat shall be rolled in a longitudinal direction, commencing at the outside edge or lower side and proceeding toward the higher side. Rolling shall be accomplished with a flat-wheel steel roller weighing not more than 10 tons. Each pass of the roller shall overlap the preceding pass by at least one-half the width of the roller. Rolling shall be confined to the amount necessary to consolidate the seal coat and bond it to the underlying surface course. Excessive rolling shall be avoided.

Longitudinal joints shall be located within 6 inches of what will be a traffic lane-line location.
The completed seal coat shall be protected from all traffic until it has hardened and set up sufficiently to resist abrasion as determined by the Engineer.

Acceptance of the completed plant mix seal coat with respect to thickness shall be based on the average thickness of the test lot. A test lot shall equal the number of tons of bituminous mix placed each production day. A lot shall be divided into sublots of approximately 3,200 square yards. A minimum of one thickness test, randomly selected by use of a random number table, shall be taken within each sublot. A lot shall be accepted when the average thickness of all sublots is not more than 1/4-inch greater nor 3/8-inch less than the total designated plant mix seal coat thickness.

Lots or sublots that are not acceptable because of deficient thickness shall be brought into compliance by placing a minimum of 3/4-inch additional plant mix seal coat to roadway or lane width at the Contractor's expense. Tapers shall be required on each end of the additional layer of plant mix seal coat. Tapers shall be constructed to the satisfaction of the Engineer.

In lots or sublots where the thickness exceeds the specified tolerance, 50% of the amount of material in excess of the specified tolerances shall be included in the pay quantities.

The Engineer will periodically check the depth of the plant mix bituminous seal coat with use of a depth probe. The Engineer, via his Inspector, will inform the Contractor or his laydown foreman/superintendent of any variance from the specified depth which exceeds 1/4-inch as soon as it is discovered. The Contractor will take immediate action to insure the plant mix bituminous seal coat thickness is adjusted to that specified on the Approved Plans.

Should the Engineer discover the depth of plant mix bituminous seal coat is less than 5/8-inch, he will direct the Contractor to take corrective action to add more material to the deficient area to produce the specified depth.

If the Contractor elects to overlay while the mat temperature is above 180°F. the total mat thickness must be at least that specified on the Approved Plans. *Corrections made after the mat has cooled to below 180°F. require an overlay of at least 3/4-inch*.

525.3.05 Weather and Seasonal Limitations: Weather and seasonal limitations shall conform to Sections 100.10 and 521.10.04.

525.4 Method of Measurement: Plant mix seal coat shall be measured by the specified thickness, per square yard in place, unless otherwise specified in the Special Conditions.

525.5 Basis of Payment:

a. The accepted quantities of this plant mix bituminous seal coat shall be paid for at the contract unit price per square yard for "Plant m Bituminous Seal Coat," which price shall be full compensation for all work necessary to complete this item.

b. Bituminous additive shall be measured and paid for as provided in Section 407 of the UDOT Standard Specifications for Road and Bridge Construction.

c. Rubber latex additive shall be paid for as specified in the Special Conditions of this item.

SECTION 526

EMULSION SLURRY SEAL

526.l Description: The slurry seal surface shall consist of a mixture of emulsified asphalt, mineral aggregate, and water; properly proportioned, mixed, and spread evenly on the surface as specified herein and as directed by the Engineer. The cured slurry shall have a homogenous appearance, fill all cracks, adhere firmly to the surface and have skid resistant texture.

526.2 Materials:

a. Asphalt Emulsion. The emulsified asphalt shall conform to the requirements of ASTM of ISSA Specification, for type SS1h, CSS1h or QUICK SETTING, MIXED GRADE EMULSION.

b. Aggregate. The mineral aggregate shall consist of natural or manufactured sand, slag, crusher fines, and others, or a combination thereof. Smooth-textured sand of less than 1.25 percent water absorption shall not exceed 50 percent of the total combined aggregate. The aggregate shall be clean and free from vegetable matter and other deleterious substances. When tested by AASHTO T176 of ASTM D2419, the aggregate blend shall have a sand equivalent of not less than 45. When tested according to AASHT0 T10-4 or ASTM C88 the aggregate shall show a loss of not more than 15%. when tested according to AASHTO T-96 or ASTM C131 the aggregate shall show a loss of not more than 35%.

Mineral fillers such as portland cement, limestone dust, fly ash, and other shall be considered as part of the blended aggregate and shall be used in minimum required amounts. They shall meet the gradation requirements of ASTM D242. Mineral fillers shall be used if needed to improve the workability of the mix or gradation of the aggregate.

The combined mineral aggregate shall conform to the following gradation when tested.

Sieve Size	Percent Passing
½"	-
3/8"	100
No. 4	70-90
No. 8	45-70
No. 16	28-50
No. 30	19-34
No. 50	12-25
No. 100	7-18
No. 200	5-15
Theoretical Asphalt Content % Dry Aggregate	17% 15%

Acceptable Variance	+ 2%	2%

c. Water. All water used with the slurry mixture shall be potable and free from harmful soluble salts.

526.3 Equipment: All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working order at all times. *Descriptive information on the slurry mixing and applying equipment to be used shall be submitted to the City Engineer for approval not less than five (5) days before the work starts*.

a. Slurry Mixing Equipment: The slurry mixing machine shall be a continuous flow mixing unit and be capable of delivering accurately a predetermined proportion of aggregate, water and asphalt emulsion to the mixing chamber and to discharge the thoroughly mixed product on a continuous basis. The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No violent mixing shall be permitted. The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined proportioned of mineral filler into the mixer at the same time and location that the aggregate is fed. The fines shall be used whenever added mineral filler is a part of the aggregate blend.

b. Slurry Spreading Equipment: Attached to the mixer machine shall be a mechanical type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained so as to prevent loss of slurry on curving grades and crown by adjustments to assure uniform spread. There shall be a steering device and a flexible strikeoff.

The spreader box shall have an adjustable width. The box shall be kept clean, and build-up of asphalt and aggregate on the box shall not be permitted. *The use of burlap drags or other drags shall have prior approval by the City Engineer*.

c. Cleaning Equipment: Power brooms, power blowers, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface.

526.4 Preparation of Surface: Immediately prior to applying the slurry, the surface shall be cleaned of all loose material, silt spots, vegetation, and other objectionable material. Any standard cleaning method used to clean pavements will be acceptable, except *water flushing will not be permitted in areas where considerable cracks are present in the pavement surface*. The City Engineer shall give final approval of the surface.

526.5 Composition and Rate of Application of the Slurry Mix: The amount of asphalt emulsion to be blended with the aggregate shall be that as determined by the laboratory report after final adjustment in the field. A minimum amount of water shall be added as necessary to obtain a fluid and homogeneous mixture. The rate of application shall be a minimum of 18 lbs. of dry aggregate per square yard.

526.6 Weather Limitations: The slurry seal surface shall not be applied if either the pavement or air temperature is 55 degrees F. or below and falling, but may be applied when the air and also the pavement temperature is 45 degrees F. or above and rising.

526.7 Application of the Slurry Surfaces:

a. General: The surface may be pre-wetted by fogging ahead of the slurry box. The slurry mixture shall be of the desired consistency when deposited on the surface and no additional elements shall be added. Total time of mixing shall not exceed four minutes. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that complete coverage is obtained. No lumping, balling or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry will be removed from the pavement. No excessive breaking of the emulsion will be allowed in the spreader box. No streaks such as caused by oversized aggregate will be left in the finished pavement.

b. Joints: No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints.

c. Hand Work: Approved squeegees shall be used to spread slurry in non-accessible areas to the slurry mixer. Care shall be exercised in leaving no unsightly appearance from hand work.

SECTION 530

PORTLAND CEMENT CONCRETE

530.1 General: This section of the Specifications defines materials to be used in all Portland cement concrete work and requirements for mixing, placing, finishing and curing. *All codified mixes or designed mixes must be defined and approved prior to delivery. Approval for the mix specifications will be by the City Engineer.*

530.2 Materials: Materials used in Portland cement concrete and reinforcing of Portland cement concrete shall meet the following requirements:

530.2.01 Cement: Portland cement shall be Type II and shall comply with the Standard Specification for Portland Cement, ASTM C-150. Cement shall be stored in such a manner as to be protected from weather, dampness or other destructive agencies. Cement that is partially hydrated, caked, or otherwise damaged will be rejected.

530.2.02 Aggregates: Concrete aggregates shall conform to Specifications or Concrete Aggregates, ASTM C-33.

The maximum size of the aggregate shall not be larger than:

1. 1/5 narrowest dimension between sides of forms, nor
2. 1/3 depth of slabs, nor
3. 3/4 minimum clear spacing between reinforcing bars, bundles of bars.
4. Cover on reinforcing bars for columns, beams, girders and walls.
5. One inch for slabs having No. 6 or smaller bars.

530.2.03 Water: Water used in mixing or curing concrete shall meet the requirements of AASHTO T-26 shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, or other deleterious substances.

530.2.04 Reinforcing Steel: All bar material used for reinforcement of concrete shall be intermediate grade steel conforming to the requirements of ASTM A615, Grade 40 or Grade 60.

Straight steel bars shall be deformed bars conforming to one of the following specifications:

Deformed Billet-Steel Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM A615.

Rail-Steel Deformed Bars for Concrete Reinforcement (Grade 50 or Grade 60) - ASTM A616.

Axle-Steel Deformed Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM A617.

Fabricated steel bar mats shall conform to the requirements of ASTM A184.

530.2.05 Welded Wire Fabric: Welded steel wire fabric reinforcement shall conform to the requirements of ASTM A185.

Welded deformed steel wire fabric for concrete reinforcement shall conform to the requirements of ASTM A497.

Cold-drawn steel wire for concrete reinforcement shall conform to the requirements of ASTM A82.

Deformed steel wire for concrete reinforcement shall conform to the requirements of ASTM A496.

530.2.06 Tie Bars: Tie bars shall be deformed steel bars meeting the requirements in ASTM A615. The bars shall be free from rust, loose mill scale, dirt, soil, grease or other defects affecting the strength or bond with the concrete.

530.2.07 Expansion (Through) Joints: Preformed joint filler for use in expansion (through) joints shall conform to the Standard Specifications for Preformed Expansion Joint Filler for Concrete, ASTM D1751. **Homex 300® is acceptable if used in accordance with manufacturer's recommendations.**

530.2.08 Calcium Chloride: The use of calcium chloride will be allowed only in accordance with the following:

A. Calcium chloride shall not be used in concrete in which aluminum or galvanized metal work is to be embedded or in concrete where it may come in contact with prestressed steel.

B. The Contractor may use a maximum of 1½ percent of calcium chloride by weight, or the cement in all other concrete placed when the mean daily temperature in the vicinity of the worksite is lower than 40°F.

C. Calcium chloride shall conform to ASTM D98 (AASHTO M-144).

D. *Calcium chloride shall not be used until verbal approval has been obtained from the City Engineer*.

E. Calcium Chloride shall be measured accurately and shall be added to the batch in solution in a portion of the mixing water.

F. Use of calcium chloride in the concrete shall in no way relieve the Contractor of responsibility for compliance with the requirements of the Specifications governing protection and curing of the concrete.

530.2.09 Water-Reducing and Set-Retarding Admixtures: Water-reducing and set-retarding admixtures shall conform to the requirements of ASTM Specification C494 (AASHT0 194), except that resistance to freezing and thawing shall be determined in all cases, and the minimum relative durability factor shall be 95.

The admixtures used shall be in conformance to the requirements of ASTM Specification C494 (AASHTO 194). When added in the manner and amount recommended by the manufacturer to the concrete used on the job, with no change in the cement content or proportions of the aggregates, admixtures shall have the following effects:

Type A or Type D: The water content at the required slump shall be at least 5 percent less with the admixture than without. The air content shall remain within the range specified, but shall not exceed 8 percent in any case.

Type D: The time of initial setting, determined as prescribed in ASTM C494, shall be from 1 to 3 hours longer with the admixture than without.

No other admixture (except those specified above) will be permitted to be used in Portland cement concrete unless such use is specifically authorized by the City Engineer.

530.2.10 Curing Compounds: Transparent curing compounds shall meet the requirements of ASTM 309 (AASHTO M-148). The compounds shall be Type 1-D or 2 and Class B.

The compound shall be a liquid that, at the time of application, is free from suspended matter. It shall be sufficiently low in viscosity to result in an even, uniform coating when applied by spraying.

The compound shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from that of the natural concrete at the conclusion of the curing period. The compound shall, however, contain a dye of color strength sufficient to render the film distinctly visible on the concrete for a period of at least four (4) hours after application. Application rates shall comply with Section 530.20.

All curing compound shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner to prevent damage to the containers and to protect water-emulsion types from freezing.

530.2.11 Entraining Agent: *An air-entraining agent shall be used in all concrete exposed to the weather.* The agent shall conform to ASTM C260 (AASHT0 M-154), except the dilative durability factor in the freezing and thawing test shall not be less than 95.

530.2.12 Joint-Sealants: Joint sealants used in sealing pavement joints shall meet the requirements of one of the following: (1) AASHTO M-173, Concrete Joint Sealer, Hot Poured Elastic Type, (2) ASTM Designation D1850. Concrete Joint Sealed, Cold Application Type.

Upon request by the City Engineer, joint sealing materials shall be tested by an independent laboratory. In such case, a certificate shall be furnished by the laboratory stating that the materials have been tested and that they fully conform to the requirements of this section of these Specifications.

530.3 Classification: Concrete shall be classified according to the required compressive strength. The strength of the concrete at 28 days shall equal or exceed the *Minimum Compressive Strength* tabulated below for the class of concrete specified.

Cement Content Class of Concrete	Minimum Compressive Strength Bags/Cubic Yard	Minimum Compressive Strength at 28 days (psi)
5000	7	5000
4000	6½	4000
3500	6	3500
3000	5½	3000
2500	5	2500

530.4 Air Content and Consistency: Unless approved by the City Engineer, the air content (by volume) of the concrete at the time of placement shall be 6% ± 1%. *If the measured air content is found above or below this value, the contractor shall immediately make changes in mixing or materials as will be necessary to comply with the requirements for air content. If the air content of a load is found to be more than one (1%) percent above or below the required target, the load shall be rejected unless the air content can be brought into compliance through the addition of air-entrainment chemical or additional mixing. In no case shall be remedial actions result in a mix that violates any of the parameters of the approved mix design.*

Aggregates shall be adjusted to compensate for increased yield resulting from air-entrainment so that the specified amount of cement is contained in each cubic yard of concrete. Adjustment shall be made by decreasing the weight of fine aggregates only, unless otherwise directed by the Engineer.

The consistency of the concrete shall be such as to allow it to be worked into place without segregation or excessive laitance. Unless otherwise specified, the slump shall be:

Type of Structure	Required Slump (inches)
Massive sections, pavements, footings, curbs and gutters	3 ±1
Heavy beams, thick slabs, thick walls (over 12 in. thick)	4 ±1
Columns, light beams, thin slabs, thin walls (12 in. thick or less), wall	4 ±1
Walls with 3 curtains of steel	5

530.5 Design of the Concrete Mix: At least 35 days prior to any placement of concrete the contractor shall inform the City Engineer in writing of the source and grading of aggregates and the brand and type of cement and the brand and type of admixture, if any, he proposes to use for each class of concrete, and shall furnish certifications or other evidence satisfactory to the City Engineer that the proposed materials meet the requirements of these Specifications.

When acceptable sources, type and gradings of aggregates are designated in the Contract Documents, certifications for such aggregates will not be required.
After the job mix has been designated, neither the source, character or grading of the aggregates nor the type or brand of cement or admixture shall be changed without prior notice to the Engineer.

If such changes are necessary, no concrete containing such new or altered materials shall be placed until the Engineer has designated a revised job mix.

When specified, a water-reducing, set-retarding admixture shall be used. When conditions are such that the temperature of the concrete at the time of placement is consistently above 75°F, a water-reducing, set-retarding admixture may be used, at the option of the Contractor. The cement content shall be same as that required in the mix without the admixture.

The use of calcium chloride will be allowed only in accordance with Specification 530.2.08.

When it is anticipated that a water-reducing set-retarding admixture will be used, the Contractor shall furnish to the Engineer a sample of the admixture he proposes to use sufficient for the tests required by Specification 530.2.08. Concrete containing the admixture shall not be placed until test results have been obtained showing that its performance in the job mix meets the requirements of Specification 530.2.09.

530.6 Inspecting and Testing: The following tests will be performed by the methods indicated:

Test	Method (ASTM Designation)
Sampling	C 172*
Slump Test	C 143*
Air Content	C 231 * or C 173*
Compression Test Specimens	C 31* or C 42*
Compressive Strength	C 39 or C 42
Unit weight Yield	C 138

* TESTS OF A PORTION OF A BATCH MAY BE MADE ON SAMPLES REPRESENTATIVE OF THAT PORTION FOR ANY OF THE FOLLOWING PURPOSES:

(1) DETERMINING UNIFORMITY OF THE BATCH.

(2) CHECKING COMPLIANCE WITH REQUIREMENTS FOR SLUMP AND AIR CONTENT WHEN THE BATCH IS DISCHARGED OVER AN EXTENDED PERIOD OF TIME.

(3) CHECKING COMPLIANCE OF THE CONCRETE WITH THE SPECIFICATIONS WHEN THE WHOLE AMOUNT BEING PLACED IN A SMALL STRUCTURE, OR A DISTINCT PORTION OF A LARGER STRUCTURE, IS LESS THAN A FULL BATCH.

The Engineer shall have free entry to the plant and equipment furnishing concrete under the Contract. Proper facilities shall be provided for the Engineer to inspect materials, equipment and processes and to obtain samples of the concrete. All tests and inspections will be conducted so as not to interfere unnecessarily with the manufacture and delivery of the concrete.

530.6.01 Concrete Testing:

A. All concrete testing and inspection shall be accomplished by an approved independent testing laboratory approved by the Engineer, and at the expense of the Contractor.

B. At least one (1) strength test shall be made for each 40 cubic yards, or fraction thereof, placed in any one day for each class utilized. Not less than three specimens shall be made for each test.
Specimens shall be taken and cured in accordance with current ASTM Specifications C-31 and C-39. One (1) additional specimen will be taken during cold weather concreting, and cured on the job site under the same conditions as the concrete it represents.

C. One (1) slump test shall be made on each batch tested in accordance with current ASTM Specification C-143. The contractor shall make the necessary corrections to bring the concrete to specifications before placing.

D. One (1) or more air content test shall be made at the beginning of each day's concrete placement and as deemed necessary by the Engineer. The Contractor shall make the necessary corrections to bring concrete to specification requirements before placing.

E. The standard age of tests shall be 28 days, but 7 day tests may be used provided the relation between the 7 and 28 day strengths of the concrete is established by tests for the materials and proportions used.

530.6.02 Acceptance of Concrete:

A. The strength level of concrete will be considered satisfactory as long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

B. If strength is not satisfactory, the Contractor may be required to have the concrete tested in place at his own expense.

530.7 Handling and Measurement of Materials: Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size will be avoided and that various sizes will not become intermixed before proportioning. Methods of handling and transporting aggregates shall be such as to avoid contamination, excessive breakage, segregation or degradation, or intermingling of various sizes. Scales for weighing aggregates and cement shall be beam type or springless dial type. They shall be accurate within 1 percent under operating conditions. All exposed fulcrums, clevises and similar working parts of scales shall be kept clean.

The quantities of cement and aggregates in each batch of concrete, as indicated by the scales, shall be within the following percentages of the required batch weights:

Cement	± 1.0 percent
Aggregates	± 2.0 percent

Measuring tanks for mixing water shall be of adequate capacity to furnish the maximum amount of mixing water required per batch and shall be equipped with outside taps and valves to provide for checking their calibration unless other means are provided for readily and accurately determining the amount of water in the tank.

Except as otherwise provided in Section 530.8, cement and aggregates shall be measured as follows:

Cement shall be measured by weight or in bags of 94 lbs. each. When cement is measured by weight, it shall be weighed on a scale separate from that used for other materials, and in a hopper entirely free and independent of the hopper used for weighing the aggregates. When cement is measured in bags, no fraction of a bag shall be used unless weighed.

Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight plus the weight of surface moisture it contains.

Mixing water shall consist of water added to the batch, water occurring as surface moisture on the aggregates and water introduced in the form of admixtures. The added water shall be measured by weight or volume to an accuracy of 1 percent of the required total mixing water. Wash water shall not be used as a portion of the mixing water for succeeding batches.

Dry admixtures shall be measured by weight, and paste or liquid admixtures by weight or volume, within a limit of accuracy of 3 percent.

530.8 Mixers and Agitators: Concrete may be furnished by batch mixing at the site of the work or by ready-mix methods. Agitators may be truck mixers or track agitators.

Mixers shall be capable of thoroughly mixing the concrete ingredients into a uniform mass within the specified mixing time and of discharging the mix without segregation. Each mixer or agitator shall bear a manufacturer's

rating plate indicating the rated capacity and recommended speeds of rotation, and shall be operated in accordance with these recommendations.

Concrete shall be uniform and thoroughly mixed when delivered to the work. Variations in slump of more than I (one) inch within a batch will be considered evidence of inadequate mixing and shall be corrected by changing batching procedures; increasing mixing time, changing mixers or other means. Mixing time shall be within the limits specified below unless the Contractor demonstrates by mixer performance tests that adequate uniformity is obtained by different times of mixing. For this purpose the testing program and uniformity requirements shall be as set forth in ASTM C94, under supervision of the Engineer.

530.8.0l Stationary Mixers: For concrete mixed at the site of the work with paving mixers or stationary mixers, the time of mixing after all cement and aggregates are in the mixer drum shall be not less than 1 minute for mixer capacities of one cubic yard or less, plus l5 seconds for each cubic yard or fraction thereof of additional capacity.
The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates and all mixing water shall be introduced into the drum before one-fourth of the mixing time has elapsed.

When used for complete mixing of concrete, stationary mixers shall have controls provided to insure that the batch cannot be discharged until the required mixing time has elapsed.

If truck mixers are used, the requirements below for truck mixers and truck-mixed concrete shall apply.

530.8.02 Volumetric batching and continuous mixing at the site: Unless otherwise specified, volumetric batching and continuous mixing at the construction site will be permitted if approved by the Engineer. The batching and mixing equipment shall conform to the requirements of ASTM C685 (AASHTO 24l) and shall be demonstrated prior to placement of concrete, by tests with the job mix, as producing concrete meeting the specified proportioning and uniformity requirements.

530.8.03 Ready-mixed concrete: Ready-mixed concrete shall be mixed and delivered to the site of the work by one of the following methods (as per ACI 304 - Chapters 4 and 5):

A. Truck-mixed concrete: Mixed completely in a truck mixer.

B. Shrink-mixed concrete: Mixed completely in a stationary mixer, and the mixing completed in a truck mixer.

C. Central-mixed concrete: Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in a truck agitator or in a truck mixer operating at agitated speed or in non-agitating equipment.

Truck mixers and agitators shall be equipped with revolution counters by which the number of revolutions of the drum or blades may be readily verified.

When ready-mixed concrete is furnished, the supplier shall furnish the Engineer a statement-of-delivery ticket showing the time of loading, and the quantities of materials used for each load of concrete, amount and types of admixtures, bags of cement in lieu of batch weights, and all quantity of water added on site.

530.8.04 Truck-mixed concrete: Concrete that is completely mixed in a truck mixer shall be agitated at the mixing speed designed by the manufacturer *from 70 to 100 revolutions to produce a uniformity of concrete* as indicated in Appendix XI of ASTM C94. Mixing in excess of 100 revolutions shall be allowed only to reblend stagnant spots, 10 to 15 revolutions at mixing speed has shown to be adequate. Revolutions in excess of 115 must be at agitation speeds only.

The volume of mixed concrete shall not exceed 63% of the total volume of the drum or container. Exceeding this capacity is cause for rejection of the load unless performance tests for the mixer are provided.

A minimum of 30 revolutions shall be used at mixing speeds to blend the additional water added, at the job site, to bring the slump, of the concrete, to that specified. However, the water/cement ratio of the mix design should never be exceeded.

Mixing in excess of 100 revolutions shall be at the speed designated by the manufacturer of the equipment as agitating speed. The mixing operation shall begin within 30 minutes after the cement has been added to the aggregates and the water shall be added during mixing. When mixing is begun during or immediately after charging, a portion of the mixing water shall be added ahead of, or with, the other ingredients.

If trucks are found to be loaded beyond mixer capacity this shall be deemed as cause for rejection of the entire load.

530.8.05 Dry-Batched Concrete-Float Delivery: When the cement is batched as the last ingredient with the drum stopped and not rotated until mixing is performed at the job site, delays of three hours will be acceptable *if the mixed concrete shows no signs of hydration and the mix is uniform and consistent.*

Load size should be reduced by 10 to 20 percent to avoid spilling of the dry cement.

It should be noted that extreme care is required to load the cement for this type of an operation and this method is to be used only as a last resort. Mixing is in accordance with truck mixed concrete and all phases of this procedure are to follow ACI 304, 5.23; ACI 305, 3.3.1.1, 3.3.1.2, 3.3.2.

530.8.06 Shrink-mixed concrete: When concrete is partially mixed at a central plant and the mixing is completed in a truck mixer, the mixing time in the central plant mixer shall be the minimum required to inter-mingle the ingredients and shall be not less than 30 seconds.

The mixing shall be completed in a truck mixer and the number or revolutions of the drum or blades at mixing speed shall be not less than 70 nor more than l00. Mixing in excess of 100 revolutions shall be at the speed designated by the manufacturer of the equipment as agitating speed.

Absolute volume of all ingredients batched shall not exceed 63% of the drum volume.

530.8.07 Central-mixed concrete: For central-mixed concrete, mixing in the stationary mixer shall meet the same requirements as batch mixing at the site.

When an agitator, or truck mixer used as an agitator, transports concrete that has been completely mixed in a stationary mixer, mixing during transportation shall be at the speed designated by the manufacturer of the equipment as agitating speed.

The use of non-agitating equipment to transport concrete to the work site will be permitted only if the uniformity is consistency of the concrete is shown to be such as will maintain the integrity for which it was designed. Equipment should meet the requirements outlined in ACI 304,5.3.

530.9 Forms: Forms shall be of wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags or other irregularities. Forms shall be coated with a non-staining form oil before being set into place.

Metal ties or anchorages within the forms shall be equipped with cones, she-bolts or other devices that permit their removal to a depth of at least one inch without injury to the concrete. Ties designed to break off below the surface of the concrete shall not be used without cones.

All edges that will be exposed to view when the structure is completed shall be *chamfered*, unless finished with molding tools as specified in Section 530.19.

530.10 Preparation of Forms and Subgrade: Prior to placement of concrete the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar or other harmful substances or coating. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed. Rock surfaces shall be cleaned by air-water cutting, wet sandblasting or wire brush scrubbing, as necessary, and shall be wetted immediately prior to placement of concrete. Subgrade soils must be moist and uniformly compacted to the minimum required in the specifications. *Placement of concrete on mud, dried earth, uncompacted fill or frozen subgrade will not be permitted.*

Unless otherwise specified in the Contract Documents, when concrete is to be placed over drain fill, the contact surface of the drain fill shall be covered with a layer of asphalt-impregnated building paper or polyvinyl sheeting prior to placement of the concrete.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Weepholes in walls shall be formed with nonferrous materials.

530.11 Conveying: Conveying should be accomplished as rapidly as practicable without segregation or loss of material. Metal or metal lined chutes should be used with adequate baffling and hoppers.

Belt conveyors shall conform to ACI 304 Chapter 3 of Placing Concrete with Belt Conveyors.

Conveying by pumping methods shall conform to ACI 304 Chapter 3 of Placing Concrete by Pumping Methods.

530.12 Placing: All phases of placing concrete shall conform to the recommended practices as outlined in ACI 304 Chapter 6 of Measuring, Mixing, Transporting, and Placing.

No concrete shall be placed until forms, subgrade, reinforcing steel and all other preparations have been checked for compliance with the related specifications. All concrete is to be placed in the presence of the City Engineer or his duly authorized representative.

The concrete shall be deposited in such a manner as will prevent the segregation of aggregates and the rate regulated to maintain a plastic state of the mix.

Tremies or pumps shall be used as necessary to ensure that concrete does not free-fall more than 4 feet during placement.

For monolithic construction successive layers should be placed while the underlying layer is still responsive to vibration.

Internal stays and braces used for form alignment and shape retention shall be removed when the concrete has been placed.

If placement is interrupted causing the formation of "cold joints," the Contractor shall stop the placement of concrete and form a construction joint as per Section 530.15 or he may continue as specifically directed by the City Engineer.

The depth of the horizontal layer shall not exceed the form design limits or usually be limited to 4 feet in walls up to 12 inches thick.

If placing is discontinued prior to the completion of a layer, vertical bulkheads shall be formed as per the Engineer's direction.

530.13 Consolidation: Unless otherwise specified in the Contract Documents, concrete shall be consolidated with an approved type mechanical vibrator. Internal type, form and surface (screed) vibrators are all acceptable so long as the size and shape of the vibrator is matched to the mass and design of the concrete.

The location, manner, and duration of the vibratory device shall be such as to thoroughly consolidate the concrete without causing settlement of the coarse aggregate, sand streaking, less air entrainment and form deflection.

Vibrators should be inserted vertically at uniform spacing over the entire area of placement. Distance between insertions should generally be about 1½ times the radius of action or such that the area clearly overlays the adjacent just-vibrated area by a few inches.

Previous layers should be penetrated by a minimum of six inches and held *momentarily* to insure knitting.

Under no circumstances should the vibrator be used to transport concrete along the conveying system or the forms.

530.14 Construction Joints: Construction joints shall be made at the locations shown on the Approved Plans. If construction joints are needed which are not shown on the Approved Plans, they shall be placed in locations approved by the Engineer.

Where a feather edge would be produced at a construction joint, as in the top surface of a sloping wall, an insert form shall be used so that the resulting edge thickness on either side of the joint is not less than 6 inches.

In walls and columns as each lift is completed, the top surfaces shall be immediately and carefully protected from any condition that might adversely affect the hardening of the concrete.

Steel tying and form construction adjacent to concrete in place shall not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms shall be retightened. New concrete shall not be placed until the hardened concrete has cured at least 12 hours, or until the concrete is no longer plastic.

Surfaces of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, stains or debris by either wet sandblasting after the concrete has gained sufficient strength to resist excessive cutting, or air-water cutting as soon as the concrete has hardened sufficiently to prevent the jet from displacing the coarse aggregates, or both. The surface of the concrete in place shall be cut to expose clean, sound aggregate, but not so deep as to undercut the edges of larger particles of the aggregate. After cutting, the

surface shall be thoroughly washed to remove all loose material. ***If the surface is congested by reinforcing steel, is relatively inaccessible, or it is considered undesirable to disturb the concrete before it is hardened, cleaning of the joint by air-water jets will not be permitted and the wet sandblasting method will be required after the concrete has hardened.***

The surfaces shall be kept moist for at least one hour prior to the placement of new concrete. The new concrete shall be placed directly on the cleaned and washed surface.

530.15 Expansion and Contraction Joints: Expansion and contraction joints shall be made as shown on the Standard Drawings or Approved Plans. (see Standard Drawings for details)

Exposed concrete edges at expansion and contraction joints shall be carefully tooled or chamfered, and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

When open joints or weakened plane "*dummy*" joints are specified, the joints shall be constructed by the insertion and subsequent removal of a wood strip, metal plate or other suitable template in such a manner that the corners of the concrete will not be chipped or broken. The edges of the concrete at the joints shall be finished with an edging tool prior to removal of the joint strips.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

530.16 Waterstops: Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in metal waterstops shall be brazed or welded. Joints in rubber or plastic waterstops shall be cemented, welded or vulcanized as recommended by the manufacturer.

530.17 Removal of Forms: Forms shall be removed only when the Engineer is present and shall not be removed without his approval. Forms shall be removed in such a way as to prevent damage to the concrete. Supports shall be removed in a manner that will permit the concrete to take the stresses due to its own weight uniformly and gradually.

Forms, supports, and housings shall not be removed until the concrete has attained the strength specified for this purpose. The strength will be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM C31 for determining form removal time.

530.18 Finishing Formed Surfaces: All concrete surfaces shall be true and even, and shall be free from open or rough spaces, depressions or projections.

Immediately after the removal of forms:

All bulges, fins, form marks or other irregularities which in the judgment of the Engineer will adversely affect the appearance or function of the structure shall be removed. All form bolts and ties shall be removed to a depth of at least 1 inch below the surface of the concrete. The cavities produced by form ties and all other holes of similar size and depth shall be thoroughly cleaned. The interior surfaces of the cavities shall be coated with a bonding agent or kept continuously wet for at least 3 hours, then carefully packed with a non-shrink grout mixed not richer than 1 part cement to 3 parts sand.

Holes left by form bolts or straps which pass through the wall shall be filled solid with mortar.

Patching mortar shall be thoroughly compacted into place to form a dense, well-bonded unit, and the in-place mortar shall be sound and free from shrinkage cracks.

All patched areas shall be cured as specified in Section 530.20.

530.19 Finishing Unformed Surfaces: All exposed surfaces of the concrete shall be accurately screeded to grade and then float finished, unless specified otherwise by the Contract Documents or at the direction of the Engineer.

Excessive floating or troweling while the concrete is soft will not be permitted.

The addition of dry cement or water to the surface of the screeded concrete to expedite finishing will not be allowed.

Joints and edges on unformed surfaces that will be exposed to review shall be chamfered or finished with molding tools.

530.20 Curing:

A. Concrete shall be prevented from drying for a curing period of at least 7 days after it is placed.

B. Exposed surfaces shall be kept continuously moist for the entire period or until curing compound is applied as specified below.

C. Moisture shall be maintained by sprinkling, flooding or fog spraying, or by covering with continuously moistened canvas, cloth mats, straw, sand or other approved material.

D. Wood forms (except plywood) left in place during the curing period shall be kept wet.

E. Formed surfaces shall be thoroughly wetted immediately after forms are removed and shall be kept wet until patching and repairs are completed.

F. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

G. Water for curing shall be clean and free from any substances that will cause discoloration of the concrete.

H. Except as otherwise specified in the Contract Documents, and except for construction joint surfaces, concrete may be coated with curing compound in lieu of the continued application of moisture.

I. The curing compound shall be thoroughly mixed immediately before applying, and shall be applied at a uniform rate of l50 to 200 square feet per gallon. It shall form a uniform, continuous, adherent film that shall not check, crack or peel, and shall be free from pin holes or other imperfections.

J. *Curing compound shall not be applied to surfaces requiring bonding with subsequently placed concrete*, as at construction joints, shear plates, reinforcing steel, and other embedded items.

K. Surfaces subjected to heavy rainfall or running water within 3 hours after the compound has been applied, or surfaces damaged by subsequent construction operations during the curing period shall be resprayed in the same manner as for the original application.

530.21 Removal or Repair: When concrete is honeycombed, damaged or otherwise defective, the Contractor shall remove and replace the structure or structural member containing the defective concrete, or correct or repair the defective parts. The Engineer will determine the required extent of removal, replacement or repair.

Prior to starting repair work the Contractor shall obtain the Engineer's approval of his plan for making the repair. Such approval shall not be considered a waiver of the City's right to require a complete removal of defective work if the completed repair does not produce concrete of the required quality and appearance. Repair work shall be performed only when the Engineer is present.

Repair of formed surfaces shall be started within 24 hours after removal of the forms.

Except as otherwise approved by the City Engineer, the appropriate methods described in the ACI Manual of Concrete Practice shall be used. If approved in writing by the City, proprietary compounds for adhesion or as patching ingredients may be used. Such compounds shall be used in accordance with the manufacturer's recommendations.

Curing as specified in Section 530.20 shall be applied to repaired areas immediately after the repairs are completed.

530.22 Concreting in Cold Weather: When the atmospheric temperature may be expected to drop below 40 F at the time concrete is delivered to the work site, during placement, or at any time during the curing period, the following provisions also shall apply:

A. The temperature of the concrete at time of placing shall not be less than 50°F nor more than 70 F. The temperature of aggregates and mixing water prior to mixing with the cement shall be in accordance with "Recommended Practice for Cold Weather Concreting," ACI Standard 306.

B. When the daily minimum temperature is less than 40°F, concrete structures shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the concrete shall be maintained at not less than 50°F nor more than 90°F for the duration of the curing period.

C. Methods of insulating, housing and heating the structure shall conform to "Recommended Practice for Cold Weather Concreting," ACI Standard 306.

D. When dry heat is used to protect concrete, means of maintaining an ambient humidity of at least 40 percent shall be provided unless the concrete has been coated with curing compound as specified in Section 530.20 or is covered tightly with an approved impervious material.

530.23 Concreting in Hot Weather: When climactic or other conditions are such that the temperature of the concrete may reasonably be expected to exceed 90°F at the time of delivery at the work site, during placement, or during the first 24 hours after placement, the following provisions also shall apply:

A. The Contractor shall maintain the temperature of the concrete below 90°F during mixing, conveying, and placing. Methods used shall conform to "Recommended Practice for Hot Weather Concreting," ACI Standard 305.

B. The concrete shall be placed in the work immediately after mixing. Truck mixing shall be delayed until only time enough remains to accomplish it before the concrete is placed.

C. Exposed concrete surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or otherwise protected from drying during the time between placement and finishing, and after finishing.

D. Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay.

E. Concrete surfaces exposed to the air shall be covered as soon as the concrete has hardened sufficiently and shall be kept continuously wet for at least the first 24 hours of the curing period, and for the entire curing period unless curing compound is applied as specified in subsection G, below.

F. Formed surfaces shall be kept completely and continuously wet for the duration of curing period (prior to, during and after form removal) or until curing compound is applied as specified in subsection G, below.

G. If moist curing is discontinued before the end of the curing period, a curing compound shall be applied immediately, following the procedures specified in Section 530.20.

530.24 Measurement and Payment: For items of work for which specific unit prices are established in the Contract Documents, concrete will be measured to the neat lines or pay limits shown on the drawings, and the

volume of concrete will be computed to the nearest 0.1 cubic yard. No deduction in volume will be made for chamfers, rounded or beveled edges, or for any void or embedded item that is less than five cubic feet in volume. Where concrete is placed against the sides or bottom of an excavation without intervening forms, drain fill, or bedding, the volume of concrete required to fill voids resulting from over-excavation outside the neat lines or pay limits will be included in the measurement for payment where such over-excavation is directed by the Engineer to remove unsuitable foundation material; but only to the extent that the unsuitable condition is not a result of the Contractor's operations.

Payment for each item of concrete will be made at the contract unit price for that item. The payment for concrete will constitute full compensation for all labor, materials, equipment, transportation, tools, forms, falsework, cold and hot weather precautions, bracing and all other items necessary and incidental to completion of the concrete work, such as reinforcing steel, joint fillers, waterstops, dowels or dowel assemblies and shear plates.

Compensation for any item of work described in the Contract Documents but not listed in the Bid Schedule will be included in the payment for the item of work to which it is made subsidiary.

SECTION 531

CEMENT CONCRETE PAVEMENT

531.1 Description: The work covered in this section of Specifications pertains to the construction of Portland cement concrete pavements in streets, alleys and public rights-of-way.

531.2 Materials: Cement and other concrete materials, joint filler, curing materials and reinforcing steel, required by the Approved Plans and Specifications, shall conform to the requirements of Section 530. The job concrete mix shall be that shown in the Special Conditions. Ordinarily, the slump of the concrete then placed by machine methods shall be between one half (½) inch and three (3) inches.

531.3 Construction:

531.3.01 Subgrade: The preliminary subgrade before the setting of forms shall be graded and compacted as required under Section 503.

If subgrade paper or polyethylene sheeting is required it shall be placed in such a manner to protect it from tearing or puncturing. Minimum side lap is four (4) inches while minimum end lap is twelve (12) inches.

After the forms have been securely set to grade and alignment, the subgrade between the forms shall be brought to true cross-section. Where thickened edges for pavements are required, the subgrade shall be excavated and shaped to provide for the standard section.

Wherever possible, vehicles shall be kept off the finished subgrade. If vehicles must travel on the subgrade ahead of the paving, a power drag shall be carried immediately ahead of placing concrete. Irregularities in the subgrade caused by trucks during the placement of concrete shall be smoothed out and compacted immediately ahead of placing the concrete.

The subgrade as finally completed shall be maintained by the Contractor at required density and an optimum moisture content by wetting with water until the concrete is actually placed.

531.3.02 Forms: Forms may be of wood or metal or any other material at the option of the Contractor, provided the forms as constructed result in a pavement of specified thickness, cross-section, grade and alignment as shown on the Approved Plans. Slip form construction may be used subject to the approval of the City Engineer and the requirements of Section 531.3.04.

Forms shall be adequately supported to prevent deflection or movement. Forms shall be used which will result in concrete pavement conforming with the Approved Plans and Specifications. When checked for straightness, forms should not vary by more than 1/8 inch in 10 feet from the true plane surface on top and ¼ inch in 10 feet on the face of the form. Flexible or curved forms are highly recommended for use when the curve has a radius of 100 feet or less. The forms may be removed the day after placing if the concrete is sufficiently set to withstand removal without danger of chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth or sprayed with curing

compound immediately. All forms shall be cleaned, oiled, and examined for defects before they are used again.

531.3.03 Compaction of Subgrade: Covered in Section 503.2.

531.3.04 Placing Concrete: The concrete shall be placed upon the prepared subgrade between the forms to the required depth and cross-section in a continuous operation between construction or expansion joints.

The concrete shall be thoroughly consolidated against and along all forms or adjoining pavements by such means as will prevent gravel pockets along the edges of the finished pavement. Any gravel pockets found after removing the forms shall be repaired.

When integral curb is being constructed with the pavement, fresh concrete for the integral curb shall be placed at such time as will enable the top section of the curb to be consolidated, finished, and bonded to the pavement slab while the concrete is plastic.

Where curb is not being placed integral with the pavement slab, reinforcing steel dowels or keyways shall be placed in the base section for the curb.

Prior to placing concrete around manholes, catch basins, gate chambers, etc., a temporary cover fitting below the rim of the ring casting shall be provided to prevent the concrete from flowing into them.

531.3.04.A Placing Concrete at Expansion Joints: Concrete placement around expansion joints shall be such that the expansion joint assembly will not be disturbed and that it will remain in a straight line perpendicular to the subgrade, as shown on the Approved Plans. The concrete shall then be spaded thoroughly or vibrated along the entire length of the joint to consolidate the concrete and leave no rock pockets anywhere at the joint. If any rock pockets are exposed, they shall be repaired.

531.3.04.B Placing Concrete With Reinforcing Steel Bars or Wire Mesh: When reinforcing is to be used, concrete shall be placed in one lift with an adequate method used to position and secure the reinforcing bars or wire mesh at the designated locations in the slab.

Reinforcement shall be free of dirt, mill scale, oil, grease, or other foreign material that may impair bond. Steel, coated with some rust, may be used if the oxidations are not deep or loose coated in the opinion of the City Engineer.

Successive mats of steel or wire mesh shall be securely lapped together and tied. Longitudinal bars will lap a minimum of 30 bar diameters. Wire mesh will lap 6 to 12 inches, and provided one complete series of square mesh is incorporated in the overlap.

Reinforcing steel or wire mesh shall be laid as a continuous mat. Continuity shall be maintained between expansion joints. Steel shall terminate within two to six inches or the joint.

531.3.04.C Slip-Form Construction: At the option of the Contractor and with the approval of the City Engineer, concrete pavement may be constructed by the use of slip-form paving equipment.
Slip-form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape, and strength to support the concrete laterally for a sufficient period of time during placement to produce pavement of the required cross-section; the equipment shall spread, consolidate, screed, and float-finish the freshly placed concrete in such a manner as to provide a dense and homogenous pavement.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads to avoid breaking or cracking the pavement edge.

After the concrete has been given a preliminary finish by the finishing devices in the slip-form paving equipment, the surface of the fresh concrete shall be checked with a straight edge to comply with the tolerances and finished as specified in Section 531.3.08E.

Final finishing of slip-form pavement shall be as specified in Section 5312.3.08D.

531.3.05 Compacting Concrete: Concrete may be compacted by (1) hand methods, (2) machine methods and (3) combined machine and vibrators method at the option of the contractor. The hand method will be limited to irregular areas, irregular sections, alleys and pavements placed in confined work areas.

531.3.05.A Hand Compacting: Concrete shall be spread evenly with shovels and spaded along the forms with a perforated spade after which it shall be struck off with a rigid metal shod tamping rod. The strike-off rod shall be operated with a combined tamping, crosswise and sawing action to produce a smooth surface free from depressions or inequalities. A small amount of mortar must be kept ahead of and extending substantially along the entire length of the rod. Excessive stinging of the rod will not be permitted.

531.3.05.B Machine Compacting: The machine used for compacting shall be self-propelled and designed to run on the side forms. Movable parts shall be capable of adjustment and they shall be adjusted so as to produce accurately the roadway sections shown on the Approved Plans. The machine shall be equipped with two reciprocating screeds. The tops of the forms shall be kept clean with a suitable device attached to the machine.

The travel of the machine on the forms shall be maintained true without lift, wobble or other vibrations which might prevent a precise strike off.

The machine shall be put in forward motion as soon as concrete is deposited on the subgrade. On the first pass, a roll of concrete shall be carried ahead of the screed. Screeds and tampers shall be operated so as not to disturb expansion joints and caps.

Machines shall be operated prior to placing longitudinal and transverse dry joints.

Machines shall be operated as many times as may be necessary to compact concrete free from rock pockets and to a section that can be finished properly.

Care must be exercised not to overwork the concrete and bring an excess of mortar to the surface.

531.3.05.C Combined Vibration and Machine Compacting: The combined vibration and compaction equipment shall be demonstrated to the satisfaction of the Engineer as being capable of consolidating the concrete across the full width of the pavement into a homogeneous mass, free of rock pockets, and without separation of mortar and aggregates.

The equipment shall consist of the machine described in Section 531.3.05B, or an approved spreading machine to which is attached a vibrating unit composed of individual internal vibrators. The vibrators shall be spaced equidistantly, and the distance from the side forms to the nearest vibrator shall not exceed 14 inches.

The vibrating unit shall not rest upon the side forms nor impart vibration to the strike-off screeds. The individual vibrators shall be attached to a frame in a manner which will permit adjustment of both the depth of penetration into the concrete and the angle of the vibrator with the horizontal.

The vibrators shall be capable of vibrating at rates between 8,000 and 12,000 impulses per minute when inserted in the concrete.

On the first trip over the freshly placed concrete the vibration equipment shall be submerged in the concrete to ensure adequate consolidation. Unless otherwise directed by the Engineer, the vibration equipment shall be operated on the first pass only.

After the first pass with vibration, one or more trips without vibration shall be made as described in Section 531.3.05B.

As often as the Engineer may require, the Contractor shall make trial runs with concrete containing the full amount of cement as specified in Section 530.3, Concrete mixes, or as specified in the Special Conditions, compacting with and without vibration to determine the relative water contents required.

531.3.05.D Vibrating Screed Concrete Pavement Construction: The type of vibrating screed which the contractor proposes to use, whether roller or beam, shall be subject to approval by the Engineer. Upon request by the Engineer a test section of pavement shall be placed for the purpose of demonstrating the capabilities of the screed to satisfactorily compact and strike off the concrete to the established grade and section.

Concrete shall be uniformly distributed between the forms and it shall then be compacted and screeded to the level of the top of the forms by means of the vibrating screed. Supplemental
compaction by hand spading or mechanical vibration of the concrete adjacent to the forms will be required if the concrete cannot otherwise be adequately compacted.

The vibrating screed shall be operated over the freshly placed concrete in successive passes only a sufficient number of times to obtain maximum compaction. Over-vibration of the concrete, resulting in an excess of mortar at the surface of the pavement, will not be permitted.

After the final passage of the vibrating screed, the surface of the concrete shall be at the established pavement grade and cross-section and shall be sufficiently smooth as to require only a very moderate amount of hand finishing for smoothness to meet approval of the Engineer.
531.3.06 Water: Water for pavement construction will be furnished as provided in Section 505.

531.3.07 Joints: Transverse and longitudinal joints for street pavement may be contraction joints, construction or expansion joints as shown in the Standard Drawing numbers 531A and 531B and as called for in these Specifications. When the pavement abuts an existing pavement, the locations of the joints in the new pavement shall coincide with the joints in the existing pavement unless otherwise shown in the Contract Documents.

531.3.07.A Formed Transverse Contraction Joints: Standard spacing of transversely formed contraction joints shall be at intervals of fifteen (15) feet or less across the full width of the pavement and at right angles to the center line of the roadway. On horizontal curves the spacing of fifteen (15) feet shall be along the outer edge of the pavement .

For intersections and other irregular areas, the arrangement of contraction joints shall be placed in accordance with standard intersection patterns. The area of any one irregular pattern formed by contraction joints in intersections shall not exceed two hundred twenty-five (225) square feet and the greatest dimension thereof shall not exceed fifteen (15) ft.

When paving a second lane adjacent to the previously paved lane, the contraction joints shall be matched with the former; except on curves where resultant panel would be less than twelve and one-half (12½) feet, measured longitudinally.

Where uncontrolled cracks are existing in the first lane, they shall be matched as nearly as possible in the second lane. Should the uncontrolled cracks in the existing paved lane be too frequent or in random locations and impossible to match with a uniform spacing in the second lane, then in that event the two lanes shall be completely separated by 3/16-inch joint material extending from the surface to one (1) inch below the bottom of the concrete being placed.

Where integral curb or doweled curb is placed along with the concrete pavement, premolded joint filler material shall be placed in the full section of the curb in true alignment with the pavement joint and in perpendicular position.

531.3.07.B Construction of Formed Contraction Joints: Formed construction joints shall be constructed by embedding preformed joint material. The filler shall be cut to the exact sections of the joint.

Transverse contraction joints (*dummy joints*) shall be placed after compaction and finishing of concrete have been completed and before initial set. A groove shall be cut into the surface at the location of joint, using a tool provided with stops (*tee iron*) to prevent cutting the groove deeper than the planned depth of the joint filler. The joint filler shall then be forced into the groove until the top is flush with the pavement surface.

After the joint filler has been imbedded in the concrete, the surface of the pavement shall be finished against the filler strip with hand floats to restore the surface finish. While performing this operation, the filler strip must be maintained in a vertical or normal position, true to alignment. After finishing, the entire area of the joint shall be true to grade and smoothness without any irregularities.

No payment will be made for contraction joint material or its placement, and all costs thereof shall be included in the unit contract price per square yard for "Cement Concrete Pavement (class, inches)."

531.3.07.C Sawed Contraction Joints: Sawed contraction joints shall be constructed by sawing a vertical groove in the hardened concrete on an approved schedule after placing and before development of random cracks in the concrete slab. Transverse contraction joints shall be sawed before the longitudinal joints are sawed.

Sawed longitudinal joints in general are not critical as to a specific time schedule after hardening of the concrete and may be delayed under favorable conditions before an incidence of longitudinal random cracking begins. *Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling*, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking occurs. If necessary, the sawing operations shall be carried on both day and night until completed, regardless of weather conditions, as directed by the Engineer.

Two or more sawing units may be required to accomplish the sawing in order to minimize random cracking. Standby equipment shall be on the job to ensure continuous sawing as specified regardless of any breakdown of equipment.

Where curing membrane is used, the area disturbed by sawing of joints shall be resprayed immediately upon completion of the sawing and sealing operation and care shall be exercised to prevent the curing compound from getting into the groove. *Joint sealing compound will not adhere to concrete if curing compound is present*.

The depth of sawed transverse and longitudinal contraction joints shall be not less than one-fourth (¼) the depth of the slab.

After the curing period the joints shall be cleaned and sealed with joint sealants meeting requirements in Section 530.2.12. Excess scaling material shall be cleaned off the surface of the pavement before opening to traffic.

531.3.07.D Transverse Construction Joints: Transverse construction joints of the type shown in the Standard Drawings shall be placed whenever the placing of concrete is suspended for more than 30 minutes. A butt joint with dowels or a thickened-edge joint shall be used if the joint occurs at the location of a contraction joint. Keyed joints with tie bars shall be used if the joint occurs at any other location.

No separate payment shall be made for construction joints or for the premolded joint material, extra concrete, or sealing compounds required for the construction joints. All costs therefor shall be included in the unit contract price per square yard for "Cement Concrete Pavement".

531.3.07E Transverse Expansion Joints: Transverse expansion joints are placed only where shown on the Approved Plans or where directed by the Engineer .

Transverse expansion joints shall be constructed with pre-molded material, one-half (½) inch in thickness and conforming to Section 530.2.07B. They shall extend the full width of the pavement and from one (1) inch into the subgrade to the one (1) inch below the top of the pavement. The joint alignment must be at right angles to the pavement center line, unless otherwise specified .

The expansion joint filler shall be held in a vertical position. An approved installing bar or other device shall be used if necessary to ensure proper grade and alignment during placing and finishing of the concrete. The device must be in place long enough to prevent sagging of the material, especially on streets having steep grade.

Finished joints shall not deviate in horizontal alignment more than ¼ inch from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

In multiple lane construction, the joints shall be matched so as to form a continuous alignment over all lanes.

Expansion joints shall extend continuously through all curbs, where curbs are integral, special care being exercised to preserve alignment perpendicular to the pavement in the curb section.

No additional payment will be made for expansion joint material or its placement. All such costs shall be included in the unit contract price per square yard for "Portland Cement Concrete Pavement" of the required class and thickness.

531.3.07.F Sealing Expansion Joints: After the pavement is cured and before any traffic, the space above the top of expansion joint filler strip shall be thoroughly cleaned of all loose material. The one-half (½) inch wide groove shall be completely free of any projecting concrete from the sides and the groove shall be continuous across the slab to each edge. It shall then be filled level with the pavement surface with joint sealant meeting the requirements of Section 530.2.12.

The joint sealant material shall be heated and placed in complete accord with the manufacturer's instructions. Burned material will be rejected . The expansion joint groove shall be dry at the time of pouring the sealing compound. No additional payment will be made for the sealing filler or its application and the cost thereof shall be included in the unit contract price per square yard for "Portland Cement Concrete Pavement" of the required class and thickness.

531.3.07.G Longitudinal Contraction Joints: The joints shall be constructed in true alignment with respect to their proper location on center line or parallel thereto as is shown in a succeeding subsection. No payment will be made for contraction joint material and its placement except in case of alternate bids as described in Section 531.3.07B.

531.3.07.H Standard Location for Longitudinal Joints: Standard location for longitudinal joints, whether contraction or construction, shall conform to Portland Cement Association recommendations.

531.3.07.I Longitudinal Expansion Joints: Longitudinal expansion joints shall be placed where shown on the Approved Plans or where required for concrete pavement between or along retaining walls, curbs or other structures. They shall be placed to conform to Portland Cement Association recommendations.

531.3.07.J Longitudinal Construction Joints: Longitudinal construction joints shall be as shown on the Standard Drawings. The Contractor may use an approved keyed joint in lieu of thickened edge for longitudinal construction joint. The Contractor shall submit plans for the keyed joint for approval by the Engineer prior to construction.

Cost for the approved keyed joint used in lieu of the thickened edge will be included in the unit contract price per square yard for "Portland Cement Concrete Pavement" of the required class and thickness .

531.3.08 Finishing Concrete: Hand finishing or machine finishing of the entire pavement surface will be permitted unless otherwise provided in the Special Conditions.

On all vertical curves and at irregular intersections, modified tools shall be provided as necessary to secure a smooth, uniform contour and surface.

All tools shall be kept in first-class working order and shall be inspected daily. Worn or defective cools will not be permitted. A sufficient number of tools shall be provided for the work to proceed efficiently.

531.3.08.A Hand Finish: After the concrete has been struck off and consolidated, it shall be smoothed by longitudinal floating. Floating shall continue until all irregularities are removed.

After the final passage of the longitudinal float, transverse floating shall be continued with long handled floats operated from outside the pavement slab.

After floating, the surface shall be scraped with a grout rod at least ten (10) feet in length with a long handle for operating at the edge of the pavement. The grout rod shall be operated to correct irregularities in the pavement surface and remove water and laitance.

531.3.08.B Machine Finishing: The finishing machine shall be of a type approved by the Engineer. The machine shall be adjustable to both crown and plane of the finished pavement surface. The screed shall oscillate longitudinally during its travel transversely across the pavement.

The finishing machine shall be moved over the pavement as many times as is necessary to give the pavement a smooth even-textured surface, conforming to the exact crown and cross-section specified on the Approved Plans.

531.3.08.C Edging: Before final finishing is completed and before the concrete has taken the final set, the pavement shall be edged as indicated below:

Continued next page. . .

LOCATION	RADIUS
Edge of Pavement	One-Eighth (1/8) Inch
Formed Longitudinal Contraction Joints	One-Eighth (1/8) Inch
Longitudinal Construction Joints	One-Eighth (1/8) Inch
Transverse Construction Joints	One-Eighth (1/8) Inch
Formed Transverse Contraction Joints	One-Eighth (1/8) Inch
Expansion Joints - Type A	One-Eighth (1/8) Inch
Curbs--Back Edge	One-Half (1/2) Inch
Curbs--Front Edge	One (1) Inch

Particular attention shall be given to edge at the appropriate time. The concrete shall have attained a partial set and all free water shall have disappeared so that the edged joints will be clearly defined, which no tearing or slump of the edges.

531.3.08.D Final Finish: A burlap drag or broom shall be used for final finishing. The burlap drag shall be at least 3 feet wide and long enough to cover the entire pavement width. It shall be kept clean and saturated with water while in use. It shall be laid on the pavement surface and dragged in the direction in which the pavement is being placed. For a broom finish, a stiff bristled broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping to produce surface corrugations of uniform appearance and about 1/16 inch in depth.

Before using either the drag or the brush, the concrete shall have set sufficiently that the surface is not grooved or gouged in the finishing operation.

531.3.08.E Surface Smoothness: After all finishing is complete, the surface smoothness shall be checked with a straight-edge ten (10) feet long, mounted to a long handle to permit operation from outside the pavement. The straight-edge shall be placed on the surface of the pavement parallel to the center line and at intervals of no more than five (5) feet across the full width of the pavement. *At conclusion of the finishing operation the surface of the pavement shall not vary from a true surface, more than one-eighth (1/8) inch in 10 feet.*

In no case shall the grade in the gutter be such that it will allow pooling of water. If the surface smoothness of the pavement after curing is found to exceed the tolerance permitted, the high spots shall be ground until they meet the tolerance. If the surface tolerance cannot be met satisfactorily by grinding, then in that event the

pavement shall be removed and be replaced in conformance with the Specifications at the expense of the Contractor.

531.3.09 Curing and Protection: The concrete pavement shall be protected against excess loss of moisture, rapid temperature change, rain, water and mechanical injury during and immediately following the placing and finishing operations. Normally this will require the use of curing compound.

Concrete shall be cured by protecting it against loss of moisture, rapid temperature change, and mechanical injury for at least 7 days after placement. Moist curing, waterproof paper, white polyethylene sheeting, white liquid membrane compound, or a combination thereof may be used. After finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by a curing medium approved by the Engineer. The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these surfaces with continuous curing treatment equal to the method selected for curing the slab and curb surface.

The Contractor shall have at hand and ready to install before actual placement begins the equipment needed for adequate curing.

531.3.09.A Moist Curing: Moist curing shall be accomplished by a covering of burlap or other approved fabric mat used singly or in combination. Curing mats shall be thoroughly wet when applied and kept continuously wet and in intimate contact with the pavement surface for the duration of the moist curing period. Burlap or fabric mats shall be long enough to cover the entire width and edges of the pavement lane and lapped at joints to prevent drying between adjacent sheets.

531.3.09.B Waterproof Paper or White Polyethylene: Waterproof paper or white polyethylene sheets shall be in pieces large enough to cover the entire width and edges of the slab and shall be lapped not less than 18 inches. The paper or polyethylene shall be adequately weighted to prevent displacement or billowing due to wind, and material folded down over the side of the pavement edges shall be secured by a continuous bank of earth. Tears or holes appearing in the paper or polyethylene during the curing period shall be immediately repaired.

531.3.09.C Membrane: The membrane method of curing conforming to the requirements of Section 530.2.10 shall be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the minimum rate of 150 sq. ft. per gallon shall be required. The compound shall be kept agitated to prevent the pigment from settling, and it shall be applied to the pavement edges immediately after the forms have been removed. *Membrane curing will not be permitted in frost-affected areas on paving that will be exposed to de-icing chemicals within 30 days after completion of the curing period.*

531.3.09.D Cold-Weather Protection: Except by specific written authorization, by the City Engineer, concreting shall cease when the descending air temperature in the shade and away from the artificial heat falls below 40°F. It shall not be resumed until the ascending air temperature in the shade and away from artificial heat rises to 35°F.

When concrete has been placed in cold weather and the temperature may drop below 35°F., straw, hay, insulated curing blankets, or other suitable material shall be provided along the line of work. Whenever the air temperature may reach the freezing point during the day or night, the material shall be spread over the concrete deep enough to prevent freezing of the concrete. *Concrete shall be protected from freezing temperatures until it is at least 10 days old. Concrete injured by frost action shall be removed and replaced at the Contractor's expense.*

531.3.09.E. Curing in Hot Weather: In periods of low humidity, drying winds, or high temperatures, a fog spray shall be applied to concrete as soon after placement as conditions warrant in order to prevent the formation of shrinkage cracks. The spray shall be continued until conditions permit the application of a liquid curing membrane or other curing media. The Engineer shall make the decision when the use of a fog spray is necessary.

531.3.10 Opening Pavements to Traffic: The pavement shall not be opened to truck traffic until the field-cured concrete has attained a flexural strength of 550 psi, or a compressive strength of 3,500 psi. If such tests are not conducted, the pavement shall not be opened to automobile traffic until 3 days after the concrete was placed. Likewise, it shall not be open to truck traffic until 14 days after the concrete is placed. Before opening to traffic, the pavement shall be cleaned.

531.3.11 Cleanup: In addition to the cleanup specified in Section 553, the Contractor shall, before final acceptance of the work, flush the pavement clean and remove the debris. He shall also clean out all open culverts and drains, inlets, catch basins, manhole and water main valve chambers, within the limits of the project, of dirt and debris of any kind. The clearing and disposal of such waste material shall be considered as incidental to the construction and all costs thereof shall be included in the unit contract prices of various items of the work.

531.4 Measurement and Payment: Payment will be made for the items included in any particular contract as "Portland Cement Concrete Pavement (class, thickness)," per square yard. This item will include concrete for thickened edges, steel reinforcing bars, sawing contraction control joints, extra for furnishing high-early-strength cement, hot and cold weather precautions, and subgrade compaction.

Any feature covered by concrete during the concrete paving process that requires raising to a final grade must be raised to the proper grade within seven (7) days of being covered with the concrete. These features include but are not limited to: manhole covers, valve box covers, and monument covers. Under no circumstances can the access to utilities be delayed more than seven (7) days after paving unless otherwise approved by the City Engineer.

SECTION 532

CONCRETE CURB & GUTTER, CONCRETE CURB & DRIVEWAYS

532.1 Description: The construction of concrete curb and gutter and concrete gutter shall be in conformance with these Specifications and with the Standard Drawings.

532.1.01 High-Back Curb and Gutter (Type A): This type of gutter may only be used with written approval of the City Engineer. See Standard Drawing No. 532-A.

532.1.02 Outfall Curb and Gutter: This type of curb and gutter is limited to outfalling gutter conditions (i.e. medians parking lot islands). See Standard Drawing No. 532-A.

532.1.03 Depressed Curb (Handicap Ramp): At intersections where new cement concrete curbs are to be constructed, the contractor shall construct depressed curbs. The depressed curbs shall be constructed in accordance with Standard Drawing No. 533-A and as directed by the Engineer.

532.1.04 Roll Gutter: This type of curb and gutter is predominantly used on streets in Park City. Unless otherwise specified and approved, this type shall be installed along all City Streets. See Standard Drawing No. 532-A.

532.1.05 Drain Gutter: In intersections where water is to surface drain through the intersection drain gutters shall be used. See Standard Drawing No. 532-B.

532.1.06 Concrete Driveways: Concrete driveways shall conform to Standard Drawing No. 532-C.

532.2 Materials and Forms:

532.2.01 Concrete: The Portland cement concrete, joint filler, and curing materials shall conform to these Specifications - SECTION 530, PORTLAND CEMENT CONCRETE (Materials). Concrete mix for curbs shall conform to the requirements for Class 4000. Slump of the concrete mix shall not exceed three and one-half (3½) inches and the air content shall be 6% ± 1%. No reinforcing steel shall be used in City sidewalks, curb and gutter, concrete curb or driveways.

532.2.02 Preformed Expansion and Dummy Joint Filler: See Sections 530.2.07 and 530.15.

532.2.03 Curing Compounds: See Section 530.2.10.

532.2.04 Forms: See Section 531.3.02

532.3 Construction Details: Any deviation from the construction details shall be submitted to, reviewed and approved by the City Engineer before the start of any alternate procedures or use of alternate materials.

532.3.01 Excavation: All excavation for curb and gutter construction shall be the responsibility of the curb and gutter Contractor. *All excess excavated material shall be removed from the site within seven days after completion of the curb and gutter construction. After said time, the City may have such excess excavated material removed at the expense of the responsible Contractor.*

532.3.02 Bedding: All concrete curb and gutter, concrete drain gutter and concrete driveway shall be bedded with a minimum of five inches of untreated base course conforming to the requirements of Section 510, unless authorized in writing by the City Engineer.

532.3.03 Entrances: All driveways, alleys and other entrances disturbed by the curb and gutter construction shall be returned to a satisfactory usable condition with 96% (ASTM D-1557) relative subgrade compaction and surfacing equal to or better than the original. Such construction will not be measured for separate payment but will be considered incidental to the items to which they apply.

532.3.04 Placing and Finishing: While the concrete is being placed and consolidated, the face of the curb shall be formed with a fixed or moving form conforming to the dimensions shown on the Park City Standard Drawings. After placement, the concrete shall be consolidated by spading or vibration. The concrete shall be struck off and finished true to cross-section. As soon as the concrete has attained sufficient hardness, face forms, if used, shall be removed and the concrete finished with a wood float and trowel. Final finish shall be obtained with a brush. After final finishing, gutters and curb shall be tested with a ten-foot straight-edge to see that the finished gradient is uniform. ***Irregularities of more than one-quarter inch in ten feet shall be corrected at the expense of the Contractor.***

532.3.05 Contraction Joints:

A. Curb and gutter shall be divided into sections of length by contraction joints.

B. A contraction joint formed by division plates shall be used in such a manner so the curb and gutter shall be divided into uniform sections of ten feet except where shorter sections are necessary for closures, but no section shall be less than four feet in length.

C. The plates shall be one-eighth inch thick, fit neatly into the forms and be set perpendicular to the surface of the concrete and shall project through the curb head and no more than one-third of the depth of the gutter slab. The shape of the divider plate shall conform to the curb and gutter section with the exception that the lower two-thirds depth of the divider plate shall be removed.

D. This joint may be constructed by other methods that would obtain the same desired results if written authorization is first obtained from the City Engineer.

532.3.06 Expansion Joints: Non-extruding pre-molded expansion joint material of one-half inch thickness conforming to ASTM D1751 shall be placed at the junction of new concrete with existing concrete or existing structures at the tangent points of all alley and intersection returns as directed by the Engineer.

532. 3 .07 Backfilling: In fill sections a five-foot wide berm shall be constructed and compacted to 96% relative density, against the back of the curb and against the face of the gutter and sloped to the existing ground at a four to one slope. In cut sections the backfill shall be brought to the top of the curb and against the face of the gutter and compacted to 96% relative density (ASTM D-1557) so as to fill the area excavated during construction. *No areas within a street right-of-way may be sloped steeper than 2 to 1. No areas within 5 feet of the back of gutter may be sloped steeper than 10 to 1*. Cut and fill slopes shall be rounded into existing surfaces in accordance with the Approved Plans. The Contractor shall take precautions to prevent drainage water from draining or pooling behind or around the new curb and gutter. This work shall be the responsibility of the Contractor and payment for this work will not be a separate item but will be considered incidental to the items to which they apply.

532.3.08 Monolithic Construction: For all new construction the curb and gutter shall be constructed as one unit. For all areas where the curb heretofore has been constructed to the proper curb grades as established for such street, the gutter shall be constructed adjacent to such curb, but before placing such gutter the face of the curb shall be thoroughly scraped and brushed clear of all deleterious material. *If in the opinion of the City Engineer the existing curb is in need of repair, the City Engineer may order it removed and the combined curb and gutter installed*.

532.3.09 Driveway Installations:

A. All driveways constructed of concrete shall conform to the requirements of these Specifications and Standard Drawing 532-C.

B. When constructed of concrete the thickness shall not be less than seven inches in residential area and not less than eight inches in commercial areas and public alleys.

C. The subgrade shall be compacted to 96% of maximum relative density. (ASTM D-1557)

D. Driveways abutting a curb, gutter and sidewalk combination or drive-over curb and gutter or driveway gutter pan or any cross gutter shall have a strip of non-extruding expansion joint material one-half (½) inch thick, conforming to the cross-sections of the driveway, placed between the driveway and the sidewalk or curb or cross gutter so as to provide for the expansion of the sidewalk or curb or cross gutter and the concrete driveway.

E. All aforementioned expansion material shall conform to ASTM D1751.

532.3.10 Allowable Curb Cuts: Curb cuts will be allowed with authorization from the Engineer. The Engineer may permit valley gutter or any other types of curb cuts which, in his opinion best serve the property owner.

532.4 Measurement and Payment: Measurement and pavement will be made for the following bid items as they appear in the proposal:

1. "High-Back Curb and gutter" per linear foot.
2. "Outfall Curb and gutter" per linear foot.
3. "Roll Gutter" per linear foot.

Measurement for depressed curb (*handicap ramp*) will include that portion of the curb necessary to make the transition from the standard curb and gutter to the depressed curb and gutter.

SECTION 533

CEMENT CONCRETE SIDEWALKS

533.1 Description: Cement concrete sidewalks shall be constructed in compliance with these Specifications and the Standard Drawings. The particular type of sidewalk to be used will be that specified in the Contract Documents.

533.2 Materials: The Portland cement concrete, joint filler, reinforcing, steel and curing materials shall conform to the requirements specified in Section 530, Portland Cement Concrete. The concrete mix for sidewalk shall conform to the requirements for Class 4000. Slump of the concrete mix shall not exceed three and one-half (3-1/2) inches and the air content shall be 6% ± 1%.

533.3 Construction Details:

533.3.01 Excavation and Subgrade: All excavation and subgrade preparation or sidewalk construction shall be the responsibility of the Contractor. The subgrade shall be compacted to 96% of maximum density (ASTM D-1557). Payment for this work will not be a separate item but will be considered incidental to the items to which they apply.

533.3.02 Bedding: All sidewalks are to be bedded with a minimum of four (4) inches of untreated base course conforming to Section 510 unless otherwise authorized in writing by the City Engineer.

533.3.03 Forms: The forms shall be wood or metal and shall be free from warp. Straight wood forms shall have a thickness not less than one and five-eighths inches. The forms shall be set so that the walk shall have a slope toward the street of one-quarter inch for each foot of width.

533.3.04 Thickness:

A. All walks shall be constructed of concrete and shall have a minimum thickness of four inches.

B. All curbwalk shall be constructed of concrete and shall have a minimum thickness of six inches.

C. At residential driveways, the sidewalk thickness shall be seven inches. See Standard Drawing 532-C.

D. In commercial driveway areas and public alleys the sidewalk thickness shall be increased to eight (8) inches.

533.3.05 Placing and Finishing:

A. In all cases the walks shall be constructed in one course.

B. The surface shall be struck off to the established grade by means of a straightedge. The surface shall then be finished true to grade with a wooden float followed by a steel trowel, and afterwards roughened lightly with a broom or brush.

C. The walk shall be cut with a marking tool forming a groove at least one-half inch deep so that the walk is divided into sections, each section not longer than five feet.

D. *In no case shall a walk section exceed twenty-five square feet in area unless approved by the Engineer.*

E. Care should be exercised not to over work the concrete and bring an excess of mortar to the surface.

F. The slabs shall be rounded on all surface edges to a radius of one-quarter inch.

G. The surface shall be brushed with a fiber hair brush of an approved type in a transverse direction except that at driveway and alley crossings it shall be brushed longitudinally.

H. At intersections all sidewalks shall transition into handicap ramps as shown in Standard Drawing 533-A. Additional expenses incurred by this requirement shall be incorporated into the cost per linear foot of sidewalk.

533.3.06 Adjustments: Whenever any adjustments of the grade slope, or slab marking is necessary or advisable in order to have the walk conform to existing abutting walk or other abutting structures, the adjustment shall be made only with the permission of and under the direction of the City Engineer or his representative.

533.3.07 Expansion Joints: Strips of premolded non-extruding expansion joint material one-half inch thick conforming to ASTM D1751 shall be placed between the side forms and to the full depth of the walk at least once in every 100 feet of walk, or as directed by the City Engineer. Similar joints shall be provided when new walk abuts other concrete walk or structures.

533.3.08 Inscribing Contractor's Name: The Contractor, for the construction of any concrete sidewalk within the City limits, shall inscribe in the walk at each extremity thereof a seal designating the construction company name, and the month and year in which the walk is finished.

533.3.09 Protection from Traffic: When completed, the walk shall be protected from foot traffic and the elements for at least 72 hours, except alley and street crossings which shall be protected from light vehicular traffic for at least five (5) days and from trucks of more than one-ton gross weight for seven days.

533.3.10 Curing and Protection: The curing materials and procedures outlined in Section 531.2. shall prevail, except that white pigmented curing compound shall not be used on sidewalks. The curing agent shall be applied immediately after brushing and be maintained for a period of five (5) days.

The Contractor shall have readily available sufficient protective covering, such as waterproof paper or plastic membrane, to cover the your of an entire day in event of rain or other unsuitable weather.

The sidewalk shall be protected against damage or defacement of any kind until it has been accepted by the City. Sidewalk which is not acceptable to the City Engineer because of damage or defacement, shall be removed and replaced at the expense of the Contractor.

Additional requirements for curing in hot weather shall be as outlined in Section 531.3.09E. Additional requirements for curing in cold weather shall be as outlined in Section 531.3.09D.

533.4 Measurement: Measurement for cement concrete sidewalk will be by the square yard or by linear foot for a specified sidewalk width for all surface of concrete walk placed. Measurement for thickened edge of sidewalk will be by the linear foot for the distance thickened.

533.5 Payment: Payment will be made for each of the following bid items as are included in the Contract Documents:

1. "Concrete Sidewalk_____inches thick" per square yard.
2. " _____ foot wide Concrete Sidewalk_____inches thick" per linear foot.

The unit contract prices shall be full compensation for all labor, tools, equipment and materials required to perform the work as specified. Any work which is essential to the construction but for which no bid item is included in the Special Conditions shall be considered as incidental and the costs thereof shall be included in the pay items of the proposal.

Excavation, selected materials, water and compaction will be measured and paid for in accordance with applicable sections of these Specifications only if they are set up among the items in the Contract Documents; otherwise, the work and materials involved shall be considered as incidental to the sidewalk construction and the costs thereof shall be included in the bid items of the Contract Documents.

SECTION 540

STREET LIGHTING AND SIGNING

540.1 Description: The work to be performed consists of furnishing and installing all necessary materials to complete in place the street lights as shown on Standard Drawings 540A, B and C. In-place street signs shall conform to Standard Drawing 540D and E.

540.1.01 Regulations and Code: All electrical equipment shall conform to the standards of the National Electrical Manufacturer's Association (MEMA) or the Radio Manufacturer's Association, whichever is applicable. In addition to the requirements of these Specifications, the Approved Plans and the Special Conditions, all material and work shall conform to the requirements of the National Electrical Code, hereinafter referred to as the Code and the American Society for Testing Materials (ASTM).

540.2 Materials:

540.2.01 General: Unless otherwise indicated on the Approved Plans or specified in the Special Conditions, all materials shall be new. The major components of the street light shall consist of the products specified in Sections 540.2.03A through 540.2.03C of these Specifications or an equivalent product. The major components of the street sign shall comply with those specified on Standard Drawing 540D and E.

540.2.02 Inspection: All material shall be subject to inspection after delivery to the site and during installation in the work. Failure of the Engineer to note faulty material during construction shall not relieve the Contractor of the responsibility for removing or replacing any such material at his own expense.

Inspection or sampling of certain materials may be made at the factory or warehouse prior to delivery to the site, when required by the Engineer.

Material which has been rejected previous to delivery shall not be delivered to the work, and all material which has been rejected at the work shall be immediately removed from the site.

As-built drawings shall be kept by the Contractor showing exact locations of all underground conduit and connections, as well as all street lights and street signs. The as-built drawings shall be forwarded to the Engineer upon completion of work.

540.2.03 Street Light Components: (See Standard Drawing 540A for approved alternate materials)

540.2.03A Luminaire: The luminaire shall consist of a Kim EKG 401 fixture with a GE color corrected high pressure sodium lamp, the corresponding ballast, a dark bronze Duranodic 313 finish, a photocell receptacle, and photocell. The lamp shall be 150 watts for 12-foot and 16-foot poles and 250 watts for 20-foot poles.

540.2.03B Pole: The pole shall be a Valmont D6 220, square tapered, Cor-ten steel pole having a mounting height of 16 feet for residential streets and 20 feet for arterial streets.

The pole package shall include full base cover, handhole with cover, pole cap, four anchor bolts, and templet.

540.2.03C Base: The base shall consist of an Alcoa Breakaway Support 100-1 embedded in a finished concrete foundation with a minimum compressive strength of 4000 psi at 28 days. Foundation dimensions shall be 24 inches in diameter by 54 inches. If the base is to be placed in disturbed soil or a fill section the area should be compacted to 96% of maximum relative density (ASTM D-1557). A sauna tube form may be used with compaction completed after the concrete has cured.

540.3 Construction Details:

540.3.01 General: All electrical construction shall be carried out by competent crews under the direction of a licensed electrical contractor, or by the manufacturer's representatives where so required in the Special Conditions. All workmanship shall be complete and in accordance with the latest accepted standards of the industry, as determined by the Engineer.

Failure of the City Engineer or the City Public Improvements Inspector to note faulty workmanship during construction shall not relieve the Contractor of the responsibility for correcting the faults at his own expense.

540.3.02 Placement: Street lights and signs shall be placed in accordance with Standard Drawing 800A. Conduit and power cables shall be placed as necessary to serve the street lights. All underground conduit and cable shall have a brightly-colored warning tape buried twelve inches directly above the underground conduit or cable. The conduit shall be 1-1/2" PVC and the cable shall be 8 AWG stranded copper. The cable shall be connected to an approved power source.

540.4 Measurement and Payment: Measurement will be made by the number of street lights installed of the various mounting heights.

Payment will be made at the contract bid price per each for "Street Light" of the mounting height specified which shall include all materials and work required to install the street light, including the conduit, luminaire, pole, base and foundation.

SECTION 541

TOPSOIL

541.1 Description: These Specifications shall apply where the Approved Plans or Special Conditions require the procurement of top soil by the Contractor for the surface finishing of an area, or where the removal and replacement of existing top soil is required for the finishing of a specific construction area, generally in lawns or planting strips.

541.2 Materials:

541.2.01 Topsoil: The topsoil shall be friable surface soil typical of the topsoil common to the area, free from materials toxic to plant growth, noxious weed seeds, sage brush, rhizomes, roots, subsoil, stones, and other debris. It shall be capable of sustaining healthy plant life. One hundred percent of the topsoil shall pass through a one inch screen, unless otherwise stipulated on the Plans.

The maximum allowable percentage of gravel retained on a No. 4 screen shall not exceed 20 percent by volume. Of the material passing the No. 4 screen, the maximum allowable percentage of gravel retained on a Number 10 screen shall not exceed 10 percent by weight.

The topsoil shall be shown to be within allowable levels of toxic mineral contaminants, said levels to be set by the Engineer or by the Chief Building Official in cooperation with the Utah State Board of Health.

541.3 Construction Details:

541.3.01 Placement of Topsoil: Immediately prior to placing topsoil, the surface area upon which it is to be placed shall be cleaned of objectionable matter and the area smoothed and compacted to 85% of maximum relative density. After compaction and immediately prior to spreading topsoil, the subgrade surface shall be scarified by raking or harrowing.

Topsoil shall be placed where shown on the Approved Plans and to depths provided for in the Special Conditions, or at the direction of the Engineer. In level or slightly sloped areas the topsoil shall be leveled, raked, and compacted to 85% maximum relative density so as to provide a well shaped and uniform appearance. On steep slopes, the topsoil shall be left rough and uncompacted.

541.3.02 Removal and Replacement of Topsoil: Whenever it is necessary to remove topsoil with the purpose of later replacing it in the same area, the Engineer will direct the limits of the area and the depth of topsoil to be removed. The topsoil shall be removed in a uniform depth and be stored in such manner that it will not become mixed with unsatisfactory soils. The stored topsoil shall be replaced at a uniform depth in its original area. The topsoil shall then be shaped, leveled, and compacted to blend with the contour of adjacent ground.

In the event that additional topsoil is required and is procured from a source other than the construction area, the Contractor shall furnish and place it in compliance with Section 541.3.01 and the intent of this subsection. Additional topsoil shall be of similar texture as native soil .

541.4 Measurement:

541.4.01 Topsoil: Measurement of topsoil will be made by the cubic yard in net volume of truck loads at point of delivery.

541.4.02 Removal and Replacement of Topsoil: Topsoil removed and later replaced in original area will be measured by the cubic yard calculated upon the square footage of the area by the depth of soil removed.

541.5 Payment: Payment will be made for such of the following items as are included in the proposal of any particular Contract:

1. "Topsoil," per cubic yard.
2. "Remove and Replace Topsoil," per cubic yard.

The unit contract price per cubic yard for "Topsoil" shall be full compensation for the furnishing, hauling and placing of the soil in accordance with the Specifications, whether it be for the full depth upon any area or an additional quantity required where removal and replacement of topsoil resulted in a deficiency.

The unit contract price per cubic yard for "Remove and Replace Topsoil" shall be full compensation for all work and costs of scalping the original soil from an area, transporting it to storage, and then replacing it in the area in accordance with the Specifications.

SECTION 542

SEEDING, LAWN REMOVAL AND REPLACEMENT

542.1 Description:

542.1.01 Sod Removal and Replacement by Seeding: In many areas the existing lawn is such that the removal and replacement of existing sod is not feasible. In these areas, where seeding is a part of the project and is included in the bid proposal, the Contractor shall seed all lawn areas which are damaged during construction and plant lawn where shown on the Approved Plans and/or as directed by the Engineer.

542.1.02 Sod Removal and Replacement by New Sod: In many areas the existing lawn is such that the removal and replacement of existing sod is not feasible. In these areas, where lawn repair, using new sod, is part of the project and is included in the bid proposal, the Contractor shall replace all lawn areas which are damaged during construction with new sod where shown on the Approved Plans and/or as directed by the Engineer.

542.1.03 Sod Removal and Replacement: The work shall consist of the removal and replacement of existing lawn turf by cutting the sod to be removed into convenient sized squares or strips, cutting to uniform thickness, piling and storing in a dampened condition, and finally replacing the sod in its original position. Removal and replacement shall be completed within a 24-hour period. Removed sod shall be protected from direct sunlight and intensive heating conditions. This work will be performed wherever the Special Conditions provide for such work.

The Contractor may at his option use sod brought in from an outside source in lieu of replacing existing sod. If the Contractor so elects to use sod from an outside source, this source of supply must be approved by the Engineer.

542.2 Materials:

542.2.01 Topsoil: The soil material shall conform to the requirements of Section 541.2.01.

541.2.02 Replacement by Seeding:

541.2.02.A Seed: Grasses, legumes, or cover crop seed of the type hereinafter specified shall conform to the standards for "Certified" grade seed or better. Seed shall be furnished in standard containers on which shall be shown the following information:

1. Seed name
2. Lot number
3. Net weight
4. Percentage of purity
5. Percentage of germination

6. Percentage of weed seed content in inert material clearly marked for each kind of seed in accordance with the applicable State and Federal Laws.

Upon request, the Contractor shall furnish to the Engineer, duplicate copies of a statement signed by the vendor certifying that each lot of seed has been tested by a recognized seed testing laboratory within six (6) months before the date of delivery on the project. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

Seed mix and rate of application shall be as specified in the Special Conditions.

542.2.02.B Fertilizer: Fertilizer shall be a standard commercial grade of organic or inorganic fertilizer of the kind and quality specified herein. All fertilizers shall be furnished in standard unopened containers with weight, name of plant nutrients and manufacturer's guaranteed statement of analysis clearly marked, all in accordance with State and Federal laws. Fertilizer shall be stored in a dry and elevated location.

Acceptable commercial fertilizer may be supplied in one of the following forms:

1. A dry free-flowing granular fertilizer suitable for application by agricultural fertilizer spreader.

2. A soluble fertilizer ground to a fineness that will permit complete suspension of insoluble particles in water, suitable for application by power sprayer.

3. A granular or pelleted fertilizer, suitable for application by blower equipment.

4. A non-volatile liquid fertilizer.

Commercial fertilizer formulation and rate of application shall be as specified in the Special Conditions.

542.2.02.C Mulch: All mulch material shall contain a tackifier or it shall be crimped into the surface.

542.2.02.C.1 Straw: All straw mulch material shall be in an air dried condition free of noxious weeds, weed seeds, and other materials detrimental to plant life. Straw mulch so provided shall be suitable for spreading with mulch blower equipment.

542.2.02.C.2 Wood Cellulose Fiber: Wood cellulose fiber mulch shall be specially processed wood fiber containing no growth or germination inhibiting factors. When hydraulically sprayed on the ground, the material shall allow the absorption and percolation of moisture.

Each package of the cellulose fiber shall be packed by the manufacturer to show the air dry weight content. All fiber shall be kept dry before mixing. All mulch material must be acceptable to the Engineer.

542.2.02.D Tackifier: The proposed tackifier shall be of a readily available commercial type manufactured specifically for the purpose of tacking seed or mulch to soils. The type of tackifier, its manufacturer, and its supplier shall be submitted for approval by Engineer if requested by Engineer.

542.2.03 New Sod: All sod shall comply with the State and Federal laws, including quarantines, with respect to inspection, plant diseases and insect infestation. Sod shipments shall have a certificate of origination and/or certification of approved treatment when shipment originates in known infested areas.

All sod shall be guaranteed to survive in a healthy condition through an establishment period on ninety (90) days. The establishment period shall commence on the date of acceptance of placed sod by the Engineer. All sod which, in the opinion of the Engineer, is not in a healthy growing condition at the end of the establishment period, shall be removed and replaced by the Contractor at his own expense. Sod that is replaced shall be of the same mixture and grade as the surviving sod.

Sod shall be mature, densely-rooted grass and shall possess the following characteristics:

1. Uniformity.
2. Acceptable color.
3. Freedom from serious weeds and weed seeds.
4. Adequate sod strength for handling.
5. A minimum amount of thatch.

542.3 Construction Details:

542.3.01 Seeding:

542.3.01.A Preparation: All areas shall be scarified to a depth of two (2) inches unless otherwise specified immediately prior to topsoil distribution.

Cultivation of the soil shall be done at right angles to the natural flow of water on the slopes. All cost and expense incurred in performing the work herein specified shall be considered incidental to other bid items on the project and no additional compensation will be made.

Remove all visible rocks, clods and debris three (3) inches or larger in any dimension. Any exposed tree roots in cut slopes shall be neatly pruned at the finished grade of the slope and the cut treated with an approved sealer.

542.3.01.B Placement of Topsoil: Topsoil shall be evenly spread over the specified areas to a minimum depth of four inches unless shown otherwise on the Approved Plans. After the topsoil has been spread, all large clods, hard lumps, rocks and litter shall be raked up, removed and disposed of by the Contractor.

Topsoil shall not be placed when the ground or topsoil is frozen or excessively wet.

All damage occurring to existing roadbeds, shoulders, walks, curbs or other existing adjacent structures or areas due to the Contractor's operation in hauling and placing the topsoil shall be repaired by the Contractor at his own cost and expense.

542.3.01.C Compaction: All topsoil shall be compacted to 85% maximum relative density unless otherwise specified. Compaction shall be by sheepsfoot roller, cleated crawler tractor or similar equipment. Equipment shall be so designed and constructed to produce a uniform surface ready for sodding or seeding and mulching, and which will bond the topsoil to the underlying material. Compaction equipment shall be operated parallel to the natural flow of water on the slopes unless otherwise ordered by the Engineer .

542.3.01.D Seeding: Seeding shall not be done during windy weather or when the ground is frozen. Seed shall be placed at the rate and mix specified in the Special Conditions. A tackifier shall be used when seeding slopes steeper than 4 Horizontal to 1 Vertical. Seed may be sown by one of the following methods:

1. An approved type, hydro-seeder which utilizes water as the carrying agent, and maintains continuous agitation. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles which will provide a uniform distribution of the slurry. When only hydro-seeding is to be used the seed shall be raked into the surface. When hydro-mulching is used, a two step process of hydro-seeding followed by mulching shall be utilized.

2. Approved blower equipment with an adjustable disseminating device capable of maintaining a constant measured rate of material discharge that will insure an even distribution of seed at the rates specified. A tackifier shall be added to the seed mixture when blown on.

3. Approved power-drawn drills or seeders.

Areas inaccessible to above method of application shall be seeded and fertilized by approved hand methods. Distribution of the material shall be uniform and at the rates specified.

It shall be the Contractor' s responsibility to provide qualified personnel experienced in all phases of seeding and fertilizing operation, equipment and methods as herein specified.

542.3.01.E Fertilizing: Fertilizer shall be applied by mixing with the mulch at the rates and analysis specified. The fertilizing and mulching shall be done separately from seeding.

542.3.01.F Spreading Mulch: Tackifier and mulch material of the type herein specified shall be furnished, hauled, and evenly applied at the rates indicated, and shall be spread on seeded areas within forty-eight (48) hours after seeding unless otherwise spread.

542.3.01.G Contractor' s Responsibility for Work: The Contractor shall be responsible for all work herein described and the following requirements as directed by the Engineer.

1. Protect all areas involved against vehicles with barricades.

2. Reseed and fertilize areas failing to show a uniform stand of grass after germination of seed or damage through any cause before final inspection.

Maintenance and protection during a suspension of work shall be as herein described and as directed by the Engineer.

542.3.01.H Final Inspection and Acceptance: Acceptance of areas receiving seed, fertilizer and mulch as herein specified shall be based on a uniform stand of vegetation at the time of final inspection. Areas failing to show uniform stand of vegetation after germination, or damage through any cause prior to final inspection shall be reseeded as herein specified at the contractor's expense. Final inspection shall not be done before 90 days during which the temperature reaches or exceeds 40°F. on each of the 90 days.

542.3.02 Sod Removal and Replacement: The sod shall be removed to a uniform depth of approximately two (2) inches with an approved type of sod cutter. This operation shall be performed in such manner as to insure uniform thickness of sod throughout the operation.

As the sod scalping proceeds, the sod strips shall be placed in neat piles at convenient locations and from then on they shall be maintained in a damp condition continuously until the sod strips are replaced on the lawn. In no case shall the sod remain in piles longer than 24 hours before replacement on the lawn. Sod shall be kept shaded.

Prior to replacing the strips of sod, the scalped area shall be carefully shaped to proper grade, rototilled to a depth of six (6) inches, watered, raked smooth, and lightly compacted.

After rototilling, shaping and lightly compacting the finished grade, the topsoil shall be thoroughly dampened and fertilized prior to and immediately before replacing the sod. The sod shall be replaced to the required grade, taking care to butt each piece tightly against the adjacent one. Upon completion, the sod shall be dampened and rolled with a lawn roller.

All tools used shall be of a type specially designed for the work and be satisfactory to the Engineer. In no case shall sod be removed by the use of a mattock or other tool which will not meet requirements specified herein.

Wherever the construction operations have resulted in the placement or exposure of unsuitable or poorer soils in the area to be resodded, the surface shall be left low and covered with topsoil meeting all requirements of Section 541. 2. 01. Topsoil placement and replacement of the existing sod shall then be performed in the same manner as that set forth in Section 542.3.03.

542.3.03 New Sod:

542.3.03.A Grading:

542.3.03.A.1 Existing Subsoil Suitable for Sod Installation: Areas to receive sod shall be cleared, grubbed and leveled to a depth of four (4) inches below grade. Two (2) inches of topsoil shall be evenly spread over and cultivated into the top six (6) inches of existing subsoil and compacted so that the compacted surface is two (2) inches below finished grade. Topsoil shall be placed according to Section 542. 3.01A through 542.3.01C and Section 541.

5.2.3.03.A.2 Existing Subsoil is Poor: Areas to receive sod shall be cleared, grubbed and leveled to a depth of six (6) inches below grade. Four (4) inches of topsoil shall be evenly spread over the existing subsoil and compacted so that the compacted surface is two (2) inches below finished grade. Topsoil shall be placed according to Section 542.3.01A through 542.3.01C and Section 541.

542.3.03.B Fertilizer: A 16-16-8 fertilizer shall be rototilled into the top four (4) inches of the soil at a rate of three (3) pounds per 1000 square feet. Fertilizer shall be applied no less than two (2) days prior to sod placement.

542.3.03.C Sod Placement: Sod shall be placed in accordance with standard horticultural practices. Dry soil shall be moistened by sprinkling. All butt joints shall be staggered. On sloped areas the sod shall be laid with the long dimension parallel to the toe or top of slope. After placing, the sod shall be rolled and heavily watered by sprinkling.

542.3.03.D Establishment: The contractor shall be responsible for watering and fertilizing the sod during the establishment period of 90 days per Section 542.2.03. Watering shall be scheduled to prevent drying of joints between sod strips. 16-16-8 fertilizer shall be applied at three (3) week intervals at the rate of six (6) pounds per 1000 square feet per application.

542.4 Measurement:

542.4.01 Topsoil: Measurement for furnishing, hauling, placing and leveling will be made by the cubic yard.

542.4.02 Replacement by Seeding: Measurement for grade preparation, topsoil compaction, fertilizing, seeding, mulching, and water will be made by the square yard on the plane of surface planted.

542.4.03 Sod Removal and Replacement: Measurement for cutting, removing, storing, grade preparation, topsoil compaction, fertilizing, water and the placing of sod will be made by the square yard on the plane of surface scalped and resodded.

542.4.04 Sod Removal and Replacement With New Sod: Measurement for grade preparation, topsoil compaction, fertilizing, water and placing of new sod will be made by the square yard on the plane of surface scalped and resodded.

542.5 Payment: Payment will be made for such of the following items as are included in the proposal of any particular contract:

1. "Topsoil," per cubic yard.
2. "Seeding, " per square yard .
3. "Sod Removal and Replacement," per square yard.
4. "Sod Removal and Replacement With New Sod," per square yard.

The unit contract price per cubic yard for "Topsoil" shall be full compensation for furnishing, hauling, placing and leveling of the topsoil as required.

The unit contract price per square yard for "Seeding" shall be full compensation for the complete operation of grade preparation, topsoil compaction, fertilizing, seeding, mulching, and watering, as specified.

The unit contract price for square yard for "Sod Removal and Replacement" shall be full compensation for the complete operation of cutting, removing, storing, grade preparation, topsoil compaction, fertilizing, replacing of the sod, and watering, as specified.

The unit contract price per square yard for "Sod Removal and Replacement with new Sod" shall be full compensation for the complete operation of sod removal, made preparation, topsoil compaction, fertilizing, furnishing and placing of new sod, and watering, as specified.

SECTION 543

RIP-RAP

543.1 Description: This item shall consist of furnishing and hand placing or placing loose rip-rap in accordance with these specifications, at the locations indicated, and in conformity with the lines, grades, and dimensions shown on the Approved Plans or as directed by the Engineer.

5.3.2 Materials: Rip-rap shall consist of durable, angular field or quarry stone of approved quality, sound, hard, and free from seams, cracks, or other structural defects.

543.2.01 Hand-Placed Rip-Rap: When hand-placed methods are used, 75% of the rock shall not be less than one-third of a cubic foot in volume nor less than 3 inches in thickness. The stones shall be graded so that a reasonably dense mass is obtained.

543.2.02 Loose Rip-Rap: The greatest dimension of 50% of the loose rip-rap stone shall be at least two-thirds but not more than one and one-half times the thickness of rip-rap specified in the Contract Documents. The stones shall be graded in size so as to produce a reasonably dense mass. Not more than 10% of the rock shall have dimension less than 0.1 the thickness of rip-rap.

543.3 Construction Details:

543.3.01 Hand-Placed Rip-Rap:

543.3.01.A Placing: Slopes where rip-rap is used shall not be steeper than the angle of repose of the abutting material, unless otherwise indicated in the Contract Documents or as directed by the Engineer. The rocks shall be hand-placed and bedded, one against the other, and as far as practicable shall be keyed together. *Any large irregularities between the stones shall be filled with spalls of suitable size rammed tightly into place.*

543.3.01.B Finished Surface: The finished surface of the rip-rap shall present an even, tight surface, true to the lines, grades, and sections specified. *The rip-rap shall extend sufficiently below ground surface, as directed by the Engineer, to secure a firm foundation.*

543.3.02 Loose Rip-Rap:

543.3.02.A Placing: Slopes to be protected shall be free of brush, trees, stumps and other objectionable material and dressed to a reasonably smooth surface. The stone shall be dumped into place so as to secure a rock mass with the minimum thickness and height as specified. The rock shall be manipulated to secure a regular surface of graded sizes and mass stability. Excavation as shown in the Contract Documents or as directed by the Engineer, shall be made at the toe of the slope to provide a firm foundation and protection against undercutting.

543.4 Method of Measurement: Loose rip-rap shall be measured by the cubic yard computed from the specified thickness and the surface area.

543.5 Basis Of Payment: The accepted quantities of this item shall be paid for at the contract unit price per cubic yard for "Hand-Placed Rip-Rap" or "Loose Rip-Rap," which price shall be full compensation for all work necessary to complete the item.

SECTION 550

REMOVAL OF EXISTING STREET IMPROVEMENTS

550.1 Description: The work shall consist of the removal and disposal of various existing improvements, such as pavements, structures, pipe, curb, curb and gutter, gutter and other items necessary for the accomplishment of the improvement. Some of the items may be included in the Bid Proposal or covered in the Contract Documents.

Removal of items or things not contained in this section or in other sections of these Specifications shall be considered as incidental to the construction and the costs thereof shall be included in other items of the Contract by the Contractor, unless the Contract Documents specifically provide payment such work.

550.2 Construction Details:

550.2.01 General: ***The removal of street improvements shall be conducted in such a manner as not to injure utilities and any portion of the improvement that is to remain in place. Any deviation in this matter will obligate the Contractor at his own expense, to repair, replace or otherwise make proper restoration to the satisfaction of the City Engineer.***

When sawing of concrete or combinations of rigid materials is called for in the Approved Plans or in the Special Conditions, the Contractor will be paid the work at the unit contract price for the quantity involved.

550.2.02 Removal of Pavement: The pavement removal shall consist of those instances where portions or all of existing pavements are being removed in conjunction with street construction and for the placing of utilities such as sewers. Because of variable underground conditions, the limits of the pavement removal cannot be accurately determined prior to actual construction.

Pavement removal shall also consist of the removal required for narrow and shallow utility cuts in order to install light cables, conduits and similar shallow utilities.

The Contractor shall remove existing permanent type pavement and driveway pavement shown on the Approved Plans or as directed by the Engineer. Permanent type pavements will be classified according to their composition and thickness as defined below, unless the Contract Documents provide otherwise.
In the event a pavement, classified as described below, shall average more than the maximum thickness specified for its class, an additional payment will be made to cover the extra thickness removed at a mutually agreed to price or as stipulated in the Special Conditions. Where pavement removal is located in future planting areas, all pavement material and compacted base material shall be entirely removed to the native material. Prior to filling or topsoiling the subgrade shall be scarified to a minimum of 12 inches.

550.2.02.A Pavement Removal, Class A: Class A pavement removal shall apply to all cement concrete pavement having average thickness between four (4) inches and ten (10) inches.

550.2.02.B Pavement Removal, Class B: Class B pavement removal shall apply to all pavements which have a wearing surface of asphalt concrete upon a cement concrete pavement or cement concrete base, and for which the total combined thickness of the pavement will average between seven (7) inches and twelve (12) inches.

550.2.02.C Pavement Removal, Class C: Class C pavement removal shall apply to early type pavement o a cement concrete base upon which is a brick or cobblestone wearing surface (or perhaps an additional layer of asphalt concrete upon that), and for which the total combined thickness of pavement will average between ten (10) inches and twenty (20) inches.

550.2.03 Removal of Asphalt Concrete Pavement: Removal of existing pavements such as asphalt concrete, bituminous road mix, multiple lift bituminous surface treatments and any other combinations of above described components, placed upon an earth or granular subgrade located within the roadway excavation area shall be removed and paid for as "Common Excavation," per cubic yard. The roadway excavation area is defined as the area one (1) foot back of new curbs on either side and all areas in between.

Where asphalt concrete pavement exists in planting strips and is to be removed, it will be paid for as "Remove Existing Asphalt Concrete Pavement," per square yard.

Where "Remove Existing Asphalt Concrete Pavement," per square yard is being paid for and a vertical meet line must be trimmed, it shall be considered incidental to the removal.

Side street approaches to the project and street approaches at each end of the project paved with asphalt concrete having a depth of greater than two (2) inches, on an earth or granular base and which are to be removed, will be paid for per square yard as "Remove Existing Asphalt Concrete Pavement." (also see SECTION 552 PAVEMENT PATCHING)

550.2.04 Removal of Curbs: Existing curbs shall be removed where shown on the Approved Plans or where encountered in the work and designated by the Engineer. When pavement is being removed, the curb shall be considered as pavement removal and the measurement for payment thereof will be made to the back of the curb. Precast curbs and curbs of other materials which are to be removed will be further identified on the Approved Plans and in the proposal if payment is contemplated; otherwise, the second paragraph of Section 550.1 will apply.

550.2.05 Removal of Curb and Gutter: Curb and gutter to be removed may be of cement concrete, or may be a cement concrete curb with a brick gutter on a cement concrete base, or may be other combinations of rigid materials. In any event it is intended that the full section shall be removed.

When curb and gutter is removed, provisions shall be made by the Contractor to channel any runoff which would normally flow in the gutter into existing drainage structures to reduce undermining and erosion during construction.

Where cement concrete pavement is being removed, curb and gutter removal shall be considered as pavement removal and the measurement for payment thereof will be to the back of the curb.
550.2.06 Removal of Cement Concrete Sidewalks: All concrete slabs that average four (4) inches or less in thickness and which are to be removed, shall be considered as sidewalk removal. Pavement breakers used for this purpose shall meet the requirements outlined for pavement removal. Where concrete sawing is required, the provisions previously described shall apply. Sidewalk aprons and private walks on street grading and paving projects shall be removed to the extent necessary to provide for construction of pavements and curbs. After the curbs and pavement have been constructed, the Contractor will be required to provide proper connections and grades, as determined by the Engineer.

550.2.07 Removal of Catch Basins, Manholes, Curb Inlets, Sumps, Etc.: Where structures or installation of concrete, brick, blocks, etc., interfere with the construction, they shall be removed and all pipe openings shall be properly plugged watertight with Class 4000 psi (3/4), Type II concrete. Payment for such work will be made in accordance with bid items in the Contract Documents. If however, there is no bid item to cover any one or more of such removals, then in that event the removal shall be considered as incidental to the construction and costs thereof shall be included in other items of the work.

Where the structures are removed, the voids shall be backfilled with suitable job excavated material and compacted as the Engineer may direct, and such compaction work shall be considered as incidental to the removal work.

If the Engineer determines the job-excavated material to be unsuitable for backfill and he, therefore, specifies or directs that backfill from another source shall be used, the payment for such materials will be made at the unit contract price if same is carried in the proposal, or at a mutually agreed to price.

The removal and disposal of wooden structures shall be considered as incidental to the work, unless payment is otherwise provided in the Contract Documents.

550.2.08 Salvage: Unless otherwise indicated in the Approved Plans or in the Special Conditions, all castings, pipe and other material or recoverable value taken from the discarded facilities shall be carefully salvaged and delivered to the Owner in good condition and in such order of salvage as the Engineer may direct. Materials and items deemed of no value by the Engineer shall be removed by the Contractor and become his property to be disposed of as he wishes.

550.2.09 Waste Disposal: Unless otherwise provided in the Approved Plans, the Contractor shall provide the waste site for disposal of materials not required for the construction.

550.3 Measurement and Payment: Measurement and payment will be made for each of the following items as may be included in the proposal of any particular Contract Documents:

1. "Remove Existing Pavement, Type Class A," per square yard.
2. "Remove Existing Pavement, Type Class B," per square yard.
3. "Remove Existing Pavement, Type Class C," per square yard.

continued...

4. "Remove Existing Curb," per linear foot.
5. "Remove Existing Curb and Gutter," per linear foot.
6. "Remove Cement Concrete Sidewalk," per square yard.
7. "Remove Catch Basin," per each.
8. "Remove Manhole," per each.
9. "Remove Inlet," per each.
10. "Remove Curb Inlets," per each.
11. "Remove Sumps," per each.

SECTION 551

PLACEMENT AND ADJUSTMENT OF NEW AND EXISTING UTILITY STRUCTURES TO FINISH GRADE

551.1 Description: This work consists of constructing and/or adjusting all new and existing utility structures encountered on the project to finished grade.

551.1.A: Any structure or feature covered during the construction process that requires raising to a final grade must be raised to the proper grade within seven (7) days of being covered. These features include but are not limited to: manhole covers, valve box covers and monument covers. Under no circumstances can the access to utilities be delayed more than seven (7) days unless otherwise approved by the City Engineer.

551.2 Contractor to Schedule Work: The Contractor shall schedule his work and cooperate to the fullest extent so that structure adjustments by others can be satisfactorily accomplished. The Contractor shall do all pavement patching which may be necessary after adjustment of structures, and the cost thereof shall be considered as incidental to the adjustment of the various structures, except as modified hereinafter, and except that private utilities shall reimburse the Contractor for such patching.

551.3 Construction Details:

551.3.01 Adjusting of Manholes, Catch Basins, and Similar Structures:

551.3.01.A General: Manholes shall be brought to proper finished grade by utilizing the same methods of construction as required for manhole construction in Section 604.

551.3.01.B Cement Concrete Paving Projects: Manholes, catch basins and similar structures shall be constructed. The final adjustment shall be made and cast iron frame be set after forms have been placed and checked. In placing the concrete pavement, extreme care shall be taken not to alter the position of the casting in any way.

551.3.01.C Asphalt Concrete Paving Projects: On asphalt concrete paving projects, the manholes shall be adjusted prior to paving unless otherwise requested by S.B.W.R.D.'s director or engineer. See Section 551.3.01B for further discussion.

551.3.01.D Asphalt Resurfacing Projects: Adjustment of manholes on asphalt resurfacing projects shall meet the requirement of Section 551.3.01C. Existing pavement shall be removed to the extent necessary to remove the manhole casting. The cost of removing the pavement shall be considered as incidental to the work of adjusting the manhole.

551.3.01.E Storm and Sanitary Sewer or Water Projects: Manholes, catch basins, gate valve structures and other similar type structures being constructed in conjunction with sewer or water projects on graded or paved streets shall be brought to final grade as outlined previously in these Specifications.

551.3.02 Adjustment of Inlets: The final alignment and grade of cast iron frames for new and old inlets to be adjusted to grade will be established from the forms or adjacent pavement surfaces. The final adjustment of the top of the inlet will be performed in similar manner to that described for manholes.

551.3.03 Adjustment of Monuments and Cast Iron Frame and Cover: Monuments and monument castings shall be adjusted to grade in the same manner as for manholes.

551.3.04 Adjustment of Valve Box Castings: Adjustment of valve box castings shall be made in the same manner as for manholes.

551.3.05 Furnishing Castings: Where adjustment of existing manholes, catch basins, inlets, valve boxes, etc. are required and the existing castings are discarded or ordered to be salvaged by the City Engineer, the Contractor shall furnish new castings of the type specified and payment for such items will be made as specified in the Contract Documents and will be in addition to payment for making the adjustment. Ring extensions shall be in accordance with the Standard Drawings.

551.4 Measurement and Payment: Pavement will be made for each of the following applicable bid items as are included and show in any particular Contract, consistent with measurement and payment requirements contained in the Specifications for each particular item.

1. "Adjust Existing Manhole, Catch Basin or Valve Chamber to Grade," per each.

2. "Adjust Existing Inlet to Grade," per each.

3. "Adjust Existing Monument Frame and Cover to Grade," per each.

4 "Furnish Manhole Ring and Cover Casting Type ( )," per each.

5. "Furnish Inlet Frame and Cover Castings Type ( )," per each.

6. "Furnish Precast Concrete Manhole Reducing Slab (D to 'd')," per each.

SECTION 552

PAVEMENT PATCHING

552.1 Description: This work shall consist of the patching of various types of pavement cuts, the performance of which shall be in accordance with the requirements outlined hereinafter and as shown on Standard Drawing No. 552-A.

552.2 Materials: All materials shall conform to the requirements specified for material in other sections of these Standard Specifications.

552.3 Construction Details:

552.3.01 General: Pavement patching shall be scheduled to accommodate the demands of traffic and shall be performed as rapidly as possible to provide maximum safety and convenience to public travel.

The patching and compaction of the trench backfill, and the preparation and compaction of the subgrade shall be in accordance with the requirements of the various applicable Sections of these Specifications.

Before the patch is constructed all pavement cuts shall be trued so that the marginal lines of the patch will form a rectangular section with straight edges and faces. All edges shall be saw cut full depth and *the twelve (12) inches minimum distance set back from trench excavations or any other disturbed material shall be strictly adhered to.*

Proper signs, barricades, lights and other warning devices, as may be required by the City Engineer, shall be maintained all 24 hours of the day until the patch is completed and ready for traffic. The expense of these materials and effort shall be borne by the Contractor. Barricades in use during night-time hours shall have a working flashing amber light affixed. (Typical)

552.3.02 Cement Concrete Pavements: After the subgrade for the pavement has been compacted to 96% maximum relative density (ASTM D-1557) and constructed to line and grade, the cement concrete pavement patch shall be placed, compacted and struck off to the grade of the adjacent pavement in accordance with the pertinent provisions of Section 531. The Contractor shall submit for approval the type of curing compound to be used at the time of permit application. The approved curing compound shall be placed on the finished concrete immediately after finishing.

552.3.03 Asphalt Concrete Streets on Granular Base: After the subgrade has been prepared as shown on the Standard Drawings, or as directed by the Engineer, asphalt concrete pavement shall be placed to a minimum thickness of six (6) inches or to the thickness of the existing asphalt pavement depth plus 1 inch, whichever is greater. The edges of the existing asphalt pavements and castings shall be painted with CRS-2 asphalt emulsion immediately before placing the asphalt patching material. The asphalt concrete pavement shall then be placed, leveled, and compacted to a minimum of 97%, of maximum relative density, (averaging of density

tests is not allowed) to conform to the adjacent paved surface. ***Immediately thereafter, all joints between the new and original asphalt pavement shall be painted with hot asphalt or asphalt emulsion and be covered with dry paving sand before the asphalt solidifies. The material for tacking the bottom and sides of patches for asphaltic concrete shall be CRS-2 emulsion. For sealing the edges after placing the asphaltic concrete patch, RC70 cutback shall be used, the surface shall be sanded to prevent tracking.***

552.3.04 Oil Mat Streets: The existing oil mat shall be uniformly trimmed to a straight line. After the subgrade has been prepared as shown on the Standard Drawing, or as directed by the City Engineer, a minimum of two (2) inches of asphalt concrete pavement shall be placed and compacted to 97% of the laboratory maximum density.

552.3.05 Responsibility for Pavement Patching: The Contractor shall perform all work backfilling of excavations made under existing pavements, and the restoration of pavement cuts and patching, in accordance with these Specifications unless otherwise provided in the Contract Documents. ***Temporary or permanent asphalt patch maintenance shall be the responsibility of the Contractor until final acceptance by the City Engineer.***

Any structure or feature covered during the construction process that requires raising to a final grade must be raised to the proper grade within seven (7) days of being covered. These features include but are not limited to: manhole covers, valve box covers, and monument covers. Under no circumstances can the access to utilities be delayed more than seven (7) days unless otherwise approved by the City Engineer.

SECTION 553

FINISHING AND CLEANUP

553.1 Description: After all other work embraced in the Contract is completed and before final acceptance of the Contract, the entire roadway including the roadbed, planting, sidewalk areas, shoulders, driveways, alley and side street approaches, slopes, ditches, utility trenches, and construction areas shall be neatly finished to the lines, grades, and cross-sections shown on the Approved Plans and as hereinafter specified.

553.2 Construction Details: Slopes, sidewalk areas, planting areas, and roadway shall be smoothed and finished to the required cross-section and grade by means of a grading machine insofar as it is possible to do so without damaging existing improvements, trees, and shrubs. Machine dressing shall be supplemented by hand work to meet requirements outlined herein, to the satisfaction of the Engineer.

Upon completion of the cleaning and dressing the project shall appear uniform in all respects. All graded areas shall be true to line and grade as shown on the typical sections and as required by the Engineer. Where the existing planting is below sidewalk and curb, the areas shall be filled and dressed out to the walk regardless of limits shown on the Approved Plans. Wherever fill material is required in the planting area it shall be left higher to allow for final settlement but, nevertheless, the raised surface shall present a uniform appearance.

Trash of all kinds resulting from clearing and grubbing or grading operations shall be removed and legally disposed of and not placed in areas adjacent to the project. Where machine operations have broken down brush and trees beyond the lateral limits of the project, the Contractor shall remove and dispose of same at his own expense. Damage to existing vegetation shall be repaired by a qualified tree surgeon at the Contractor's expense. Pruning shall maintain the natural shape of the plant.

Drainage facilities such as inlets, catch basins, culverts, and open ditches shall be cleaned of all debris which is the result of the contractor's operations, unless the Specifications of any particular section or the Contract Documents provide otherwise.

Where, by permission, soil is dumped on private property, the Contractor will not be required to perform any work beyond that described in the Contract Documents.

All pavements and oil mat surfaces, whether new or old, shall be thoroughly cleaned. Existing improvements such as Portland cement concrete curbs, curb and gutters, walls, sidewalks, and other facilities which have been sprayed by the asphalt cement shall be cleaned to the satisfaction of the Engineer. Castings for manholes, monuments, water gates, lamp poles, vaults, and other similar installations which have been sprayed with the asphalt material shall be cleaned to the satisfaction of the Engineer .

The Contractor shall sweep the street at the conclusion of the work unless otherwise provided in the Contract Documents. Sidewalks shall be hand broomed.

On sewer and water distribution projects where all or portions of the construction is in undeveloped areas, *the entire area which has been disturbed by the construction shall be shaped so that upon completion the area will present a uniform appearance, blending into the contour of the adjacent properties.* All other requirements outlined previously shall be met, except that it will not be necessary to pick up more surficial rocks than is necessary to result in the appearance of adjacent undisturbed areas unless so provided in the Contract Documents.

553.3 Measurement and Payment: Measurement for "Finishing and Cleanup" will be based upon a lump sum contract price.

Payment shall include the finishing and cleaning of all side street approaches.

In event the proposal does not include a bid item for "Finishing and Cleanup," the work thereof shall be considered as incidental to the construction of the project and all costs thereof shall be included by the Contractor in other items of work.

SECTION 600

SANITARY SEWERS AND STORM DRAINS

April
2007
DeHaan/Anderson

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

(435) 615-5077

Notes:

SECTION 600

SANITARY SEWERS AND STORM DRAINS

600.l General: All sanitary sewer construction within Park City or for connection to the Snyderville Basin Water Reclamation District (S.B.W.R.D.) sewerage system shall conform to the S.B.W.R.D. Standards and Specifications.

All storm drain construction within Park City or intended for connection into the Park City Storm Drainage System shall conform to the requirements of these Specifications.

600.2 Approved Plans: Sanitary sewer and storm sewer main construction shall be done in accordance with the Contract Documents for the work prepared under the direction of a Professional Engineer licensed in Utah. Sanitary sewer construction plans shall be approved by the Snyderville Basin Water Reclamation District. Storm drainage construction plans shall be approved by the City Engineer.

600.3 Licenses and Permit Required:

A. All sanitary sewer and storm drain construction shall be done by a General Utility Contractor licensed and bonded in Utah.

B. When construction is required within the public right-of-way, a permit shall be secured by the Contractor from Park City Building Department and approved by the City Engineer at least 48 hours before initiating construction.

C. A street cut permit fee will be charged by the City Engineer.

D. A cash bond shall be posted to guarantee the work for a period of one year after completion and acceptance of all public portions of the work including necessary street repairs.

E. An indemnity bond may also be posted to guarantee that work will conform to Park City's Construction Standards and to guarantee that Park City will not be liable for any accidents, property damage or physical damage to any individual related to acts of the Contractor.

F. Current costs of permit fees and bonding amounts are available by calling the City Engineer's office.

G. The City Engineer and the Department of Public Works shall be notified 48 hours (two [2] full working days) before the planned construction is to commence.

600.4 Inspection: All work shall be inspected by a City authorized Inspector who shall have the authority to halt construction. Whenever any portion of these Specifications are violated, the City Manager or designee, by written notice, may order that portion of construction which is in violation of these Specifications and Contract

Documents to cease until such violation is corrected. A copy of the notice shall be filed with the Contractor's permit applications for future review. If deficiencies are not corrected, performance shall be required of the Contractor's Surety.

Inspections require a two (2) full working day (Mon.-Fri.) notification prior to the requested inspection.

SECTION 601

PIPE, MATERIALS, AND TESTING

601.1 Description: Pipe used in sanitary sewer construction shall conform to S.B.W.R.D. Standards and Specifications.

Pipe used in storm drains and culvert pipe shall be *reinforced concrete* unless otherwise approved by the City Engineer.

It is not intended that materials listed herein are to be necessarily considered equal or generally interchangeable for all applications. The Engineer shall determine from the materials list those suitable for the project and he shall so specify in the Specifications and/or the Approved Plans.

601.2 General: All pipe shall be clearly marked with type, class and/or thickness as applicable. lettering shall be legible and permanent under normal conditions of handling and storage.

601.3 Materials and Testing:

601.3.01 Pipe and Joints:

601.3.01.A. Concrete Pipe, Non-reinforced: Non-reinforced concrete pipe up to and including 27-inch size, shall conform to ASTM Designation C14, Class 3 except as otherwise provided. All pipe shall be made using Type V cement.

601.3.01.B. Concrete Pipe, Reinforced: Reinforced concrete pipe shall be used for all concrete storm drainage installations larger than 27 inches and for all installations which do not provide a cover of at least 3 feet over the top of the pipe. Reinforced concrete pipe shall comply with the requirements of ASTM C76 (Class III) unless otherwise noted in the Contract Documents.

Joints of reinforced concrete pipe shall be bell and spigot, with compression type rubber gasket design conforming to ASTM C443.

Both bells and spigots shall be reinforced in pipe thirty (30) inches or more in diameter.

601.3.01.C. Vitrified Clay Pipe: Vitrified clay pipe shall conform to ASTM Designation C700, Extra Strength, unless otherwise provided. All joints shall be of bell and spigot design. Flexible gasketed joints shall be polyurethane conforming to ASTM C425.

601.3.01.D. PVC Pipe: PVC sewer pipe will be permitted for storm drain installations up to 15-inch diameter. All PVC pipe and fittings shall conform with the provisions of ASTM D3034, with a minimum wall thickness of SDR-35.

All PVC pipe shall be made from clean, virgin Type 1, Grade 1, PVC conforming to ASTM D-1784. All pipe joints shall be bell and Spigot type with integral bell gaskets. Gaskets shall conform with ASTM D3212. Joints on pipe may be the solvent weld type.

601.3.01.E. Galvanized Corrugated Steel Pipe: Galvanized corrugated steel pipe used for storm drains an culverts shall conform to the material, fabrication and inspection requirements of AASHTO M36 as applicable. Pipe shall be 14 gauge (.079") for 12 and 15 inch pipe, 12 gauge (.109") for 18 through 33 inch pipe, and 10 gauge (.138") for 30 inch or larger pipe. Metal storm drain pipe shall not be used without specific approval from the City Engineer.

Pipe with helical corrugations shall have a continuous seam extending from end to end of each length of pipe section. Helical seams shall be fabricated in such a manner that they will develop the full strength of the pipe and not affect the shape or nominal diameter. Folded lock seams or ultra-high frequency resistance butt welded seams shall be used.

Folded lock seams shall be formed with sufficient pressure to prevent any seam slippage that would affect the load carrying capacity of the pipe but without creating a plane of weakness.

Welded seams shall be controlled to such an extent that the combined width of the weld and the adjacent spelter coating which has been burned shall not exceed three times the thickness of the metal. The weld and damaged spelter coating shall be cleaned and painted as specified in AASHTO M36, if the spelter coating is damaged beyond the width specified above.

The gauge or plat thickness shall conform to the requirements of Standard Drawings or as otherwise designated in the Contract Documents.

601.3.01.E.1. Protective Treatment: Steel pipe and pipe arch culverts and sewers shall be coated by one of the following protective treatments when such treatment is specified.

Treatment 1 - Coated uniformly inside and out with asphalt.

Treatment 2 - Coated uniformly inside and out with asphalt and with an asphalt paved invert.

Treatment 3 - Coated inside and out with asphalt and a 100% periphery inside spun asphalt lining (100% paved).

601.3.01.E.2 Asphalt Coatings and Paved Inverts: Asphalt for asphalt coatings and paved inverts shall meet the requirements of AASHT0 M190, Section 4. The coatings for aforementioned treatments shall be uniform, inside and out, and applied in accordance with the following requirements:

The metal shall be free from grease, dirt, dust, moisture or other deleterious contaminants.

The pavement shall have a minimum thickness of 1/8 inch above the crest of the corrugations except where the upper edges intercept the corrugation. The pavements shall be applied following the coating with asphalt or fiber bonding.

601.3.01.E.3 Spun Asphalt Lining: Asphalt for spun lining over 100% periphery shall conform to AASHTO M190, Section 4. Asphalt spun linings shall provide a smooth surface for the full interior of the pipe by completely filling the corrugations to a minimum thickness of 1/8 inch above the crests. The interior lining shall be applied by centrifugal or other approved methods.

The thickness of the lining over the crest of the corrugation shall not vary by an amount in excess of 1/2 inch over the entire area of the spun lining.

601.3.01.E.4 Galvanized Steel End Sections: Galvanized steel end sections shall be flared, beveled shop-assembled units to serve as structural, hydraulic and esthetic end treatment to corrugated steel culverts. They may be attached to corrugated steel culverts by threaded rods, by riveting or bolting per manufacturer's standard procedure.

The material for the end section shall be galvanized steel meeting the requirements of AASHTO M136.

If the end section is shop-attached to a stub of pipe (manufacturer's standard Type No. 3 connection), the pipe stub shall not be lighter in gage than the end section.

601.3.01.F Corrugated Aluminum Culvert Pipe: Corrugated aluminum alloy culvert pipe and coupling bands, as specified in the Contract Documents, shall conform to the material, fabrication and inspection requirements of AASHT0 M196. Pipe shall be 14 gauge for 12 and 15 inch pipe, 12 gauge for 18 through 33 inch pipe, and 10 gauge for 36 inch or large pipe.

601.3.01.F.1 Coupling Bands for Corrugated Metal Pipe: Coupling bands for corrugated metal pipe shall be watertight and shall be for corrugated steel pipe shall meet the requirements of AASHT0 M36, and for corrugated aluminum pipe shall meet the requirements of AASHTO MI96 and M197. Coupling bands for corrugated metal pipe shall be made by the same manufacturer as the pipe and shall be made of the same base material as the pipe which it connects. Asphalt coating on bands will only be required for asbestos impregnated galvanized corrugated steel bands. The coupling, bands shall also be so constructed as to lap on an equal portion of each end of the pipe sections to be connected.

601.4 Fittings: All fittings shall be of sufficient strength to withstand all handling and load stresses normally encountered. All fittings shall be of the same materials as the pipe. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

601.5 Material Certification: The intent of this requirement is that the pipe manufacturer or fabricator shall furnish appropriate certification, based on manufacturer's routine quality control tests, that the materials in the pipe meet the requirements of the pertinent ASTM or ANSI Specification. Such certification can be required by the Engineer once per construction season for each manufacturer.

601.6 Measurement and Payment: Measurement and payment for pipe and incidental accessories and for the testing as have been specified herein will be included in such other of the sewer and culvert sections to which their use is related. Accessories and testing shall be considered as incidental to the materials affected and the costs thereof shall be included in the unit contract prices of applicable bid items in the Bid Documents.

When corrugated pipe is used, the end section including the pipe stub, where applicable, will be paid for separate from the pipe.

SECTION 602

TRENCH EXCAVATION, BACKFILL, FOUNDATION AND BEDDING FOR SEWERS, DRAINS, AND CULVERTS

602.1 Description: Trench excavation and backfill shall include all excavation, backfilling, disposal or surplus and unsuitable material, and all other work incidental to the construction of trenches, including any additional excavation which may be required for manholes or other structures forming a part of the pipe line and not otherwise classified as "Structure Excavation."

Trench excavation, initial backfill, foundation and bedding for sanitary sewers shall conform to S.B.W.R.D. Standards and Specifications. Backfill above the initial backfill or pipe zone in sanitary sewer installations shall conform to these Specifications. All storm drain construction shall conform to these Specifications.

602.2 Construction Details:

602.2.01 Excavation: The Contractor shall notify S.B.W.R.D. and the City Engineer's Office 48 hours (two [2] full working days) prior to the start of sanitary sewer construction. The length of trench excavated in advance of the pipe laying shall be kept to a minimum and in no case shall it exceed three hundred (300) feet unless otherwise specifically authorized by the City Engineer. Trench widths, shoring, bracing, and trenching procedures shall conform to Utah Occupational Safety and Health Rules, Regulations and General Standards. The maximum permissible trench width from the bottom of the trench to the crown of the pipe, shall be as follows:

15-inch diameter and smaller	40 inches
18-inch diameter and larger	1½ x inside diameter + 18 inches

In all cases, trenches must be of sufficient width to permit proper jointing of the pipe and backfilling of material along the sides of the pipe. Trench width at the surface of the ground shall be kept to the minimum amount necessary to install the pipe in a safe manner. If the maximum trench width is exceeded by the Contractor without the written authorization of the City Engineer, the Contractor will be required at his own expense to provide a higher class of bedding, as may be deemed necessary by the City Engineer.

Removal of Pavement, Sidewalks, Curbs, etc., shall be in accordance with Section 550. The pavement, sidewalk, curb and gutter, driveway etc., shall be cut along the lines forming the trench, in such a manner as to not damage the adjoining pavement. An undercut level of one (1) inch per foot of thickness or an underlap joint shall be provided at the proposed junction between old and new surfaces. The portion to be removed shall be broken up in a manner that will not cause damage to the pavement outside the limits of the trench. Large broken paving materials resulting from the operations shall be removed immediately from the site of the work.

Tunneling or boring may be permitted as directed by the City Engineer for economy of construction or necessity of preserving existing improvements. Steel casings for bored or jacked construction shall be steel pipe conforming to ASTM A139.

Excavation for manholes and other structures shall be sufficient to provide a minimum of twelve (12) inches between their surfaces and the sides of the excavation.

All material excavated from the trenches and piled adjacent to the trench or in a roadway or public thoroughfare shall be piled and maintained so that the toe of the slope of the material is at least two (2) feet from the edge of the trench. It shall be piled in such manner as will cause a minimum of inconvenience to public travel, and provision shall be made for merging traffic where such is necessary. Free access shall be provided to all fire hydrants, water valves and meters, and clearance shall be left to enable free flow of storm water in all gutters, other conduits, and natural water courses.

602.2.02 Control of Water: All trenches shall be kept free from water during excavation, fine grading, pipe laying, jointing, and embedment operations. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water and in cases where the static ground water elevation is above the bottom of any trench or bell hole excavation, such ground water shall be lowered to the extent necessary to keep the trench free from water and the trench bottom stable when the work within the trench is in progress. Surface water shall be prevented from entering trenches.

602.2.03 Bedding and Initial Backfill for Sewer and Drains:

602.2.03.A Bedding and Initial Backfill for Rigid Conduits: Bedding and initial backfill procedures shall be categorized by various field conditions, *i.e. suitable subgrade, unsuitable subgrade, and solid rock*. The approximate limits for the various types of bedding will be indicated on the Approved Plans where it is feasible to do so.

The District or City Engineer shall have the authority to change the type of bedding and limits thereof as he may deem necessary during the progress of the construction, consistent with the requirements outlined under the definitions and requirements of the various types contained herein. Type of bedding will not constitute a pay item in itself.

Where unauthorized excavation has been made below the established grade the Contractor shall provide, place and compact suitable bedding material to the proper grade elevation at his own expense.

602.2.03.A.1 Suitable Subgrade: The trench bottom shall be constructed to provide a firm and stable support for the entire length of the pipe. The pipe subgrade shall be shaped to fit the bottom of the pipe for a width of ½ the diameter of the pipe. Each joint shall be properly bedded to insure uniform and continuous bearing along the pipe. Initial backfill shall be placed a minimum of 12 inches above the top of the pipe.

Selected backfill material consisting of earth, or sand, free of stones larger than 2 inches, hard clods, frozen material or other debris shall be placed in the trench simultaneously on each side of the pipe in 6-inch lifts and properly compacted for the full width of the trench in such a manner as not to damage or disturb the pipe. Compaction requirements will be as specification 602.2.06.

602.2.03.A.2 Unsuitable Subgrade: Whenever unsuitable subgrade material is encountered, 4 to 6 inches of foundation material will be required. This material shall be 1/4" to 3/4" clean, angular rock or clean sand. This same material shall be used for haunching. Haunching shall be placed to the springline of the pipe. Selected backfill material consisting of earth, or sand, free of stones larger than 2 inches, hard clods, frozen material, or other debris shall be placed in the trench simultaneously on each side of the pipe in 6 inch lifts and properly compacted for the full width of the trench in such a manner as not to damage or disturb the pipe. This selected backfill shall be placed a minimum of 12 inches above the top of pipe. Compaction requirements will be as specified in 602.2.06.

602.2.03.A.3 Solid Rock Excavation: In solid rock excavation, all ledge rock, boulders, or stones shall be removed to provide a minimum clearance of six (6) inches under the pipe. All materials thus removed shall be replaced with bedding sand.

A minimum thickness of 6 inches of foundation material will be required. The bedding sand shall be placed in the trench *simultaneously* on each side of the pipe in 6 inch lifts and properly compacted for the full width of the trench to an elevation 12 inches above the top of pipe. Compaction requirements will be as specified in 602.2.06.

602.2.03.A.4 Materials: Bedding material for suitable and unsuitable subgrade shall be one of the following, at the Contractor's option unless otherwise provided in the Special Conditions.

Sand: Sand bedding shall be a clean sand-gravel mixture free from organic matter and conforming to the following gradation when tested in accordance with ASTM D422.

U.S. Standard Sieve Size	Percent Passing, by Weight
3/4"	100
3/8"	75-100
#4	55-100
#10	35-95
#20	20-80
#40	10-55
#100	0-10
#200	0-3

continued . . .

Gravel: Gravel bedding shall be a clean mixture free from organic matter and conforming to the following gradation when tested in accordance with ASTM D422.

U.S. Standard Sieve Size	Percent Passing, by Weight
1½"	100
3/4"	95-100
#8	0-10
#200	0-3

Gravel Sand:

U..S. Standard Sieve Size	Percent Passing, by Weight
1½"	100
3/4"	30-75
½"	15-55
¼"	0-40
#200	0-3

Crushed Rock: Crushed rock bedding shall be a clean mixture free from organic material and conforming to the following gradation when tested in accordance with ASTM D422.

U.S. Standard Sieve Size	Percent Passing, by Weight
3/8"	100
¼"	50-65
#40	8-23
#200	0-10

Native Material: Native material will be acceptable for suitable or unsuitable subgrade bedding material provided it meets the requirements for any one of the above listed materials. The cost of bedding material, where required, shall be included in the unit Contract price for sanitary sewer or storm drain per lineal foot for each size of pipe. Payment will be made in accordance with applicable bid items in the Contract Documents.

602.2.03.B Bedding and Initial Backfill for Flexible Conduits:

602.2.03.B.1 Bedding for PVC and ABS Composite Materials: Material to be used for bedding of these Flexible Conduits shall conform to material listed under 602.2.03A4. Bedding and initial backfill shall be placed in the same manner as outlined under 602.2.03A2.

602.2.03.B.2 Bedding and Initial Backfill for Corrugated Metal Pipe: Material for sidefill around and to the crown elevation of corrugated metal pipe shall be selected and shall not contain stones larger than 3 inches in

greatest dimension, frozen lumps, roots, or moisture in excess of that permitting thorough compaction. Compaction zones shall be brought up simultaneously on each side of the pipe to 12 inches above the top of the pipe and compacted to 96% density as defined by ASTM D-1557 and verified by ASTM D2922 (AASHT0 T238) or ASTM D1556 (AASHTO T91).

602.2.04 Cribbing and Sheeting - Shoring: Unless otherwise provided in the Special Conditions the Contractor shall provide all materials, labor, and equipment necessary to adequately shore trenches to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench. The method of shoring shall be according to the Contractor's design. If the Contractor elects he may use a combination of shoring and overbreak, tunneling, boring, sliding trench shields or other methods of accomplishing the work provided the method meets with the Utah Occupational Safety and Health Rules and Regulations of the Utah State Industrial Commission.

Removal of any cribbing and sheeting, from the trench shall be accomplished in such a manner as to fulfill the above requirements.

Damages resulting from improper cribbing or from failure to crib shall be the sole responsibility of the Contractor. Cribbing will not be a pay item and the cost thereof shall be included in the unit contract price for "Trench Excavation" or the "Lineal Feet of Installed Pipe or Conduit. "

That portion of cribbing or sheeting extending below the springline of rigid pipe, or below the crown elevation of flexible pipe, shall be left in place unless satisfactory means of reconsolidating bedding or side support, disturbed by cribbing or sheeting removal, can be demonstrated.

The use or horizontal strutting below the barrel of pipe or the use of the pipe as support for trench bracing will not be permitted.

602.2.05 Backfilling for Sewers and Drains: In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting of the pipe. In general, backfilling shall be performed by pushing the material from the end of the trench into, along and directly over the pipe so that the material is applied in the form of a rolling slope rather than by side filling. Backfilling from the sides of the trench will be permitted after the initial backfill has been carefully placed over the pipe to the required depth.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the sewer installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and persons.

602.2.06 Compaction of Trench Backfill: Unless otherwise provided in the Special Conditions, compaction of trench backfill material is required. One of the following methods or combination thereof as set forth below shall be used. The Engineer shall retain the right to change methods and limits to better accommodate field conditions. The density of backfilled material shall be 96% of maximum relative density as determined by the Compaction Control Test specified in ASTM D-1557 and verified by ASTM D2922 (AASHTO T238) or ASTM

D1556 (AASHTO TI91), except that 90% relative compaction is allowable in areas where vehicle traffic will never occur, when approved by the City Engineer.

602.2.06.A Water Settling: Water settling, when permitted, shall be performed as specified in Sections 702.2.08A through C.

602.2.06.B Mechanical Compaction: When mechanical compaction is specified, backfill shall be placed in lifts and each lift shall be compacted to the density specified in 602.2.06.

602.2.06.C Flowable Fill (CLSM-CDF): When approved by or required by the City Engineer, flowable fill may be used. If such use is proposed by the Contrator, the Contractor shall submit a materials proposal, including manufacturer's specifications, to the City Engineer for review no less than five (5) days prior to the proposed use. Flowable fill shall not exceed 100 psi compressive strength at 28 days.

602.2.07 Culvert Bedding and Backfill: Placement of materials around and over culverts shall be performed in accordance with requirements specified herein within a defined pipe compaction zone as shown on Standard Drawing No. 602-A.

Material placed within the pipe compaction zone shall be selected and shall not contain stones larger than 2 inches in greatest dimension, frozen lumps, roots, or moisture in excess of that permitting thorough compaction. Material placed within the pipe compaction zone shall be brought up simultaneously on each side of the culvert to the top of the culvert.

In either trench or embankment installations the material within the pipe compaction zone shall be placed in layers of not more than 6 inches in loose thickness and compacted to 96% maximum relative density as defined in ASTM D-1557. Placement of materials within the pipe compaction zone shall be in accordance with Standard Drawing No. 602-A.

The contractor shall not operate tractors or other heavy equipment over the culvert until it has been backfilled as provided above, or until the embankment has reached a height of 2 feet above the top of the culvert, or as provided in Section 602.2.08 if the site of the culvert is at a location where legal highway load limitations are not in effect. Damage resulting from use of construction equipment over culvert shall be repaired by Contractor at his own expense.

602.2.08 Load Limits: After the culvert has been constructed and backfilled in accordance with the Specifications, and the embankment has reached a height of 2 feet above the top of the pipe. The Contractor may operate across those pipes with equipment having an axle weight on single axles of not more than 24,000 pounds or an axle weight of not more than 16,000 pounds each for tandem axles having an axle spacing of less than 10 feet in accordance with Standard Drawing No. 602-A.

After the embankment has reached a height of 5 feet above the top of the pipe, the Contractor may operate across those pipes with equipment having an axle weight on single axles of not more than 100,000 pounds if the outside wheel spacing is a minimum of 7 feet on centers on the axle.

602.2.09 Preservation of Existing Trees: Preservation of existing trees shall be performed in accordance with Subsection 501.2.

602.2.10 Topsoil Removal and Replacement: Removal of topsoil and replacement of it shall be performed in accordance with the provisions of Section 541 and payment will be made at the unit contract price per cubic yard as specified herein.

602.2.11 Lawn Removal and Replacement: Removal of lawn and the replacement of it shall be performed in accordance with the provisions of Section 542 and payment will be made at the unit contract price per square yard as specified herein.

602.3 Measurement and Payment:

602.3.01 Trench Excavation and Backfill: When the proposal contains a bid item of "Trench Excavation and Backfill," the measurement for payment such work will be made on the basis of section 602.3.01A as it applies to the Contract Documents.

When no bid item for "Trench Excavation and Backfill" is included in the Bid Proposal, all work and costs for excavating trenches to the grades shown on the Approved Plans and for backfilling with excavated materials shall be considered as incidental to the construction, and shall be included in the price per linear foot of sewer or storm drain.

602.3.01.A Measurement by the Linear Foot: When measurement and payment is called for by a unit contract price per linear foot, the trench shall be measured continuously along center line from the beginning point to the terminus and including the distances through structures is a bid item in connection with the structures, the allowable distance along center line through the structure excavation shall be deducted from the total length of trench.

The unit contract price per linear foot shall be full compensation for all labor, materials, tools and equipment required to excavate, backfill and compact the trench in accordance with the Approved Plans and Specifications .

602.3.01.B Unexpected Objects: Where unexpected objects, such as stumps, railroad ties, buried pavement, etc. are encountered in the trench excavation, they shall be removed and disposed of by the Contractor. In cases where they can be removed by the same equipment or method at hand for excavation, and where it is unnecessary to employ special equipment, install shoring or bracing, or to increase the trench width or depth more than two feet for any one object, then in that event the removal of such obstructions shall be considered as an incidental part of the Contractor's work and no additional payment will be made the work.

Where such unexpected objects require extra work beyond the scope of work outlined above, or extra equipment for their removal, the Contractor may submit to the Engineer a request for due compensation as "Extra Work."

602.4 Payment: This item of work shall be included in the unit bid price per linear foot for furnishing and the installation of pipe of the various sizes and types shown in the Contract Documents. This price shall be full compensation for all materials, labor and equipment necessary to complete this item of work.

The contractor shall obtain import fill material from one source only for each classification of fill material used on each project. The material from each source must meet the specifications for the classification and be approved by the City Engineer prior to delivery on site. Submittals to the City Engineer must be made a minimum of five (5) working days prior to the intended use of the material.

SECTION 603

PIPE LAYING AND JOINTING

603.1 Description: This section covers the pipe laying and jointing of storm drains and culverts. The construction of these lines shall meet the requirements stated herein and in the Standard Drawings. Pipe laying, jointing and testing of sanitary sewers shall conform to SBSID Standards and Specifications.

Before final acceptance of the Contract or before expiration of the guarantee period, any pipe or appurtenance which inadvertently or otherwise has been laid or jointed in non-conformance with these Specifications and Contract Documents shall, upon direction of the Engineer, be repaired, removed or replaced at the expense of the Contractor, and to the satisfaction of the City Engineer.

603.2 Material: The materials shall conform to requirements outlined in the various applicable sections of the Specifications.

603.3 Construction Details:

603.3.01 Survey Line and Grade: Survey line and grade control hubs will be provided by the Engineer in a manner consistent with accepted practices.

The Contractor shall constantly check line and grade and in the event they do not meet specified limits described hereinafter, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

603.3.02 Storm Drain Pipe Laying: Laying of storm drain pipe shall be accomplished to line and grade in the trench only after it has been dewatered and the foundation and/or bedding has been prepared in accordance with Section 602. Mud, silt, gravel and other foreign material shall be kept out of the pipe and off the jointing surfaces.

All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient backfill has 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 the limits that follow.

Unless authorized by the City Engineer all storm drain shall have a minimum cover of 18 inches. Variance from established line and grade shall not be greater than one thirty-second (1/32) of an inch per inch of pipe diameter and not to exceed one-half (½) inch, provided that such variation does not result in a level or reverse sloping invert.

The storm drain pipe, unless otherwise approved by the Engineer, shall be laid up grade from point of connection on the existing sewer or from a designated starting point. The storm drain 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 tightly closed with an approved temporary plug.

Where pipelines are to be laid on specified curves of sufficiently short radius to deflect the pipe joints in an amount greater than recommended by the manufacturer, the curves shall be achieved with a series of tangents and shop-fabricated bends, subject to the approval of the Engineer.

603.3.03 Culvert Pipe: Laying of culvert pipe shall conform to the requirements of Section 602.3.02.

603.3.04 Control of Water: See Section 602.2.02.

603.3.05 Plugs and Connections: Pipe branches, stubs or other open ends which are not to be immediately connected shall be capped, retained, or plugged and marked in a manner satisfactory to the Engineer. Under no circumstances shall such plugging, retaining or capping be done in such a manner as to allow soil to enter the pipe.

603.3.06 Pipe Jointing: All storm drain pipe shall have flexible gasketed joints unless otherwise specified.

603.3.06.A Gasket Type Joints: Flexible gasketed joints shall be assembled in strict accordance with the instructions furnished by the pipe manufacturer, and shall be in accordance with other provisions described below except in any case where they may be inconsistent with the manufacturer's instructions.

Pipe handling after the gasket has been affixed shall be carefully controlled to avoid disturbing the gasket and knocking it out of position, or loading it with dirt or other foreign material. Any gaskets so disturbed shall be removed and replaced, cleaned and re-lubricated if required, before the jointing is attempted.

Care shall be taken to properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe shall be partially supported to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned.

Sufficient restraint shall be applied to the line to assure that joints once home are held so, until fill material under and alongside the pipe has been sufficiently compacted. At the end of the work day, the last pipe laid shall be blocked in an effective way to prevent creep during "down time."

603.3.06.B Joints of Dissimilar Pipes: For dissimilar pipes where suitable adaptor couplings are not available, the jointing shall be accomplished with a special fabricated coupling or concrete encasement expansion block, as approved by the Engineer.

603.3.06.C Solvent Welded Joints: Solvent welded joints shall be made in accordance with manufacturers instructions.

SECTION 604

MANHOLES

604.1 Description: Sanitary sewer manholes shall conform to S.B.W.R.D. Standards and Specifications. Storm drain manholes shall conform to these Specifications.

604.2 Materials:

604.2.01 Precast Manhole Components: Precast manhole components shall conform to ASTM C478 except as modified herein.

604.2.01.A Base Sections: Base Sections shall conform to the requirements for precast manhole sections in Section 604.2.01B herein, except that the reinforced base slab shall be made an integral part of the unit, and openings for pipe shall be provided to meet job requirements as indicated on the Approved Plans. The base slab shall be not less than 6" in thickness and shall be cast monolithically with the wall section, or otherwise constructed in such a manner as to achieve a completely watertight structure.

The walls of the base section shall be reinforced in accordance with ASTM C478. Openings to receive pipe shall be circular, tapered in toward the inside of the section, and shall be held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joint. For storm drain installations, openings shall be equipped with flexible pipe connectors conforming to ASTM C923. Openings for pipe up to 21" diameter may be provided in 4 foot base sections. Openings for pipe up to 30" diameter may be provided in 5 foot base section.

604.2.01.B Precast Manhole Sections: Standard precast sections shall consist of circular sections in standard nominal inside diameters of, 48", 54", 72", and 96". Heights of 36" and 48" sections shall be multiples of 12" at the option of the manufacturer. Heights of 72" and 96" sections shall be as required to fit site conditions. Reinforcement for standard sections shall be as designed by the manufacturer. Joints shall be made with mortar, mastic, or flexible gaskets unless otherwise provided in the Special Conditions, and shall conform to ASTM C478.

604.2.01.C Precast Cones: Standard precast cones shall be eccentric type, except for manholes deeper than 6 feet, in which case eccentric cones with steps meeting latest O.S.H.I.A. Standards shall be supplied in the manhole.

604.2.01.D Flat Slab Lids: Standard flat slab lids shall be capable of carrying H_20 live loads and shall conform to ASTM C478. The 30" diameter opening shall be *eccentrically* located as specified in the Approved Plans.

604.2.02 Cast-In-Place Concrete Bases: All cast-in-place concrete placed under these Specifications shall have a minimum compressive strength of 4000 psi at 28 days.

Strength determination shall be in accordance with ASTM C39 (AASHTO T22), unless otherwise approved by the Engineer. Precast components shall conform to the strength requirements of ASTM C478.

604.2.03 Cast Iron Frames and Covers: All iron castings shall conform to the requirements of ASTM A48 (Class 30) for grey iron castings. Rings and covers shall have machined bearing surfaces. Castings shall be

cleaned and painted with a bituminous asphalt coating before delivery to the site. All castings shall have a combined minimum weight of 400 pounds with the cover approximately 150 pounds and the ring approximately 250 pounds. The cover shall be 24 inches in diameter. All covers shall be unvented with a pick-hole for opening, and marked "STORM DRAIN." The foundry name and casting number shall appear on the casting.

604.2.04 Grout: Grout for jointing precast manhole sections or masonry manhole units shall be pre-mixed non-shrink type (i.e. Master Builders "Embeco Mortar," Sohneborn "Ferrolith G- D.S. Redi-Mixed," or equal as approved by Engineer.

604.2.05 Steps: Steps shall be supplied in manholes deeper than four (4) feet at a maximum spacing of 12 inches O.C. and steps shall conform to ASTM C478. Steps shall be aluminum with a plastic coating to protect from corrosion with concrete. Steps shall be Comco 12653B or Neenah R-1982-W or M.A. Industries PS1-PF or equal as approved by Engineer.

604.2.06 Other Material: Manholes constructed from material other than concrete in the method as approved by these Specifications shall be allowed only on prior approval by the Engineer.

604.3 Construction Details:

604.3.01 Foundation Preparation:

604.3.01.A Dewatering: Dewatering of the site shall conform to the requirements for sewer trench dewatering in Section 602.2.02.

604.3.01.B Sub-base Preparation: Adequate foundation for all manhole structures shall be obtained by removal and replacement of unsuitable material with well graded granular material, or by such other means as provided for foundation preparation of the connected storm drains. Where water is encountered at the site, all cast-in-place bases shall be placed as to prevent any movement of water into the fresh concrete.

604.3.02 Bedding: Precast base sections shall be placed on suitable undisturbed soil or a well graded granular bedding course conforming to the requirements for sewer bedding in Section 602.2.03, extending either to the limits of the excavation or to a minimum of 12" outside the outside limits of the base section.

604.3.03 Precast Manholes:

604.3.03.A General: Precast manholes shall conform to the Standard Drawings in S.B.W.R.D. Specifications.

604.3.03.B Precast Base: The base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, and making sure that all entering pipes can be inserted on proper grade.

All lift holes and all joints between sections, grade rings and castings shall be sealed with a continuous bead of watertight bitumastic material or non-shrink grout. manholes in areas of high ground water shall have joints and lift holes grouted on the outside of the manhole in addition to standard sealing procedures.

Precast sections shall be placed and aligned to provide vertical sides and, when required, vertical alignment of the ladder runs. The completed manhole shall be rigid, true to dimensions, and watertight.

604.3.03.C Cast-In-Place Base: The base shall be poured monolithically. Cast-in-place bases shall be at least 6 inches in thickness below the invert and shall extend at least six inches radially outside of the outside dimensions of the precast manhole wall section. The base shall extend at least six inches above the bottom of the wall section on the outside of the wall section. The initial precast wall section shall be supported on concrete blocks and adjusted to proper alignment and grade prior to pouring of the base. *The precast wall section shall not bear directly on any of the pipes*. The joints and lift holes will be treated as specified in 604.3.03B.

604.3.04 Channels (Inverts): Channels shall be made to conform accurately to the pipe grade and shall be brought together smoothly with rounded junctions, satisfactory to the Engineer. Minimum drop through manholes shall be 0.2 feet. Channel sides shall be carried up vertically to between 2/3 and 3/4 of the height of the crown elevation of the largest pipe, and the concrete shelf between channels shall be smoothly finished and warped evenly with slopes to drain.

Where pipe lines pass through or enter manholes the invert channels shall be smooth and semi-circular in cross-section. The pipe shall protrude into the manhole *a maximum of three inches*. All openings around pipes shall be grouted to form a watertight seal. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible.

604.3.05 Streets at Grade: Where work is in paved streets or areas which have been brought to grade, the top of the cone or slab shall be constructed to provide a clearance not more than 24" and the underside of the manhole casting ring for adjustment of the casting ring to street grade.

Top of castings shall be set parallel and ½" to 1" below finished road surface. Castings shall be fully and uniformly supported. Wedges or shims used to elevate castings shall be brick or metal *with concrete placed for uniform support*. One full course of brick, with all joints sealed, may be used to elevate castings. Collars around manholes shall consist of hot-mix asphalt to match existing paving, except in areas where manholes are set in concrete pavement in which case a concrete collar of 9 inches minimum width will be required.

604.3.06 Streets With no Established Grade: Where work is in streets or other areas which have not been brought to grade, the top of cone or slab shall be constructed so as to provide clearance not less than 12" or more than 24" below the surface to be restored, unless otherwise directed by the Engineer. Castings shall be fully and uniformly supported, as specified in 604.3.05 .

604.3.07 Backfill: Backfill around the manhole and extending at least one pipe length into each trench shall be hand placed and tamped with selected native material up to an elevation of twelve (12) inches above the crown of all entering pipes. Work shall conform to the applicable provisions of sections 602.2.03 and 602.2.05.

604.4 Measurement: Each manhole will be measured to the nearest one tenth (0.10) of a foot, from invert of the outlet pipe vertically to the top of the casting.

604.5 Payment: Payment for each manhole shall consist of a basic price for each, plus a unit price per foot for all depth in excess of ten (10) feet, plus a unit price per linear foot for drop connections where they occur.

Where more than one type or size designation is shown on the Standard Drawings or called for in the Special Conditions, each shall be covered by a separate bid item of the following for.

I: "Manhole Type (No.___), Basic Price" per each.
2. "Extra Depth Manhole Type (No.___) ," per vertical foot.

Where an existing manhole is encountered in the work and it is required that it must be adjusted to new grade, the work and payment therefore shall be as extra work provided in Section 551.3.01, Adjust Existing Manhole or Catch Basin to Grade .

3. "Adjust Existing Manhole or Catch Basin to Grade," per each.

The unit contract prices shall be full compensation for furnishing and constructing manholes complete and connected to the storm drains, excepting however, that excavation, backfill, gravel bedding or foundation material or additional connection not shown on the Approved Plans will be paid for in accordance with the applicable bid items for other Sections.

Any structure or feature covered during the construction process that requires raising to a final grade must be raised to the proper grade within seven (7) days of being covered. These features include but are not limited to: manhole covers, valve box covers, and monument covers. Under no circumstances can the access to the utilities be delayed more than seven (7) days unless otherwise approved by the City Engineer.

SECTION 605

CATCH BASINS AND INLETS

605.1 Description: Standard catch basins and inlets may be constructed of precast units, or cast-in-place concrete, all in accordance with the Standard Drawings 605-A, 605-B, or 605-C and Construction Specifications.

605.2 Materials:

605.2.01 Frame and Grate: The frame and grate shall be bicycle-safe conforming to Standard Drawing 605-D.

605.2.02 Mortar: Mortar for jointing catch basins and inlets shall be one part non-shrinking Portland cement and not less than one part nor more than one and one-half parts plaster sand, mixed with the least amount of water necessary to provide a workable mortar.

605.3 Construction Details: Backfill around catch basins shall be adequate as a foundation to support shallow outlet connection pipe. The backfill material placed around the catch basins shall be compacted into place with mechanical tampers.

605.3.01 Grade Adjustment: The inlet frame shall not, in any case, be grouted to final grade until the final elevation of the pavement, gutter, ditch or sidewalk in which it is to be placed has been established and permission has been given by the Engineer to grout the casting in place. Location of elevation of catch basins will be staked by the Engineer.

605.3.02 Pipe Connections: All openings in the walls of catch basins constructed with precast sections for the insertion of pipe connections and outlet trap castings shall, after pipe or castings have been placed to their final position, be grouted tight in place using non-shrinking mortar in a workmanlike manner to present an inside and outside surface conforming to the Standard Drawings.

605.3.03 Traps: Traps shall be installed where shown on the Approved Plans.

605.4 Measurement and Payment: Payment will be made for such of the following bid items as are included in the Proposal:

1. "Catch Basin Type (___)," per each.
2. "Inlets Type (___)," per each.
3. "Catch Basin Trap (type size)," per each.
4. "Adjust existing catch basins (or inlet) to grade," per each.

The above unit bid contract prices shall be payment in full for all labor, materials, tools, and any other work necessary of whatsoever nature it may be to complete the work item as described in accordance with the Contract Documents.

SECTION 606

SUBSURFACE UNDER DRAINS

606.1 Description: This work shall consist of constructing UNDER DRAINS using filter fabric, pipe and granular filter materials, in compliance with the specifications and to lines and grades shown on the Approved Plan or as directed by the Engineer.

This section is intended to cover only the collection and control of subsurface water and does not apply beyond the point at which the water is discharged into the storm drain or other outlet.

606.2 Materials: All materials required to complete the work as described in this section shall conform to the minimum requirements specified on the Plans, in the Special Provisions or as indicated herein, whichever is applicable.

Prior to purchasing materials, the Contractor shall submit samples of the specified pipe and fabric material along with physical and chemical data sheets and Manufacturer's Certificates of Compliance to the Engineer, for his approval.

All material found to be defective at time of delivery or at any time during the progress of the work will be rejected by the Engineer. Rejected materials shall be promptly removed from the site of the work by the Contractor. The Contractor shall be responsible for all material(s) furnished by him and shall replace at his own expense any pipe, fabric or other materials which are found to be defective.

Materials shall meet the following minimum requirements, unless otherwise specified or directed by the City Engineer.

606.2.01 Pipe: Pipe for UNDER DRAINS shall be of the type and dimensions shown on the Plans, indicated in the Special Provisions and as herein specified:

1. Corrugated steel pipe shall conform with the requirement of AASHTO M-36.

2. Bituminous coated corrugated metal pipe shall conform with the requirements of AASHTO M-36 or M-197. Bituminous coating shall conform with the requirements of AASHTO M-190 and as further specified in the Special Provisions.

3. Corrugated aluminum alloy pipe shall conform with the requirements of AASHTO M-197.

4. Perforated clay pipe shall meet the requirements of ASTM Designation C-278 for extra strength pipe and shall be perforated in accordance with ASTM Designation C-211.

5. Perforated concrete pipe for UNDER DRAINS shall conform with the requirements of AASHTO M-175 or ASTM C-444.

6. Perforated bituminized-fiber pipe shall conform to the requirements of AASHTO M-177.

7. Polyvinyl Chloride (PVC) pipe shall conform to the applicable requirements of ASTM Test Methods D-1785, D-2464, D-2467 and D-2564 for the schedule shown on the plans. Unless shown otherwise on the plans, perforations shall conform to the requirements of AASHTO M-175.

606.2.02 Filter Fabric Material: Filter fabric shall be installed to the lines and limit specified on the Approved Plans or in the Special Provisions. If specific fabric criteria is not otherwise specified in the Special Provisions, then the fabric shall meet the following minimum requirements:

606.2.02.A Fabric Type: The fabric material shall be non-woven type.

Table 606.2.02.B Minimum Physical Requirements

Property	Value
Tensile strength, lbs.	115 lbs. min.
Puncture Strength, lbs.	50 lbs. min.
Mullen Burst strength, psi	200 psi min.
Equivalent Opening Size (EOS)	No. 60 max. size No. 140 min. size
Coefficient of Permeability, cm/sec	0.10 cm/sec. min.
Abrasion Resistance, lbs. (Bearded or soft side)	35 lbs. min.

606.2.03 Aggregates: As indicated on the Approved Plans or in the Special Provisions, the under drain trenches shall be filled with permeable aggregate material to the lines and grades indicated.

The aggregates shall consist of hard, durable, clean sand, gravel or crushed stone and shall be completely free from organic material, clay balls and/or other deleterious substances. The aggregates shall conform to one of the following grading requirements as specified or as directed by the Engineer:

continued . . .

Table 606.2.03.A Grading Requirements for Permeable Materials

	Percent Passing by Dry Weight		
SIEVE SIZE	TYPE 1	TYPE 2	TYPE 3
2"	100	-	-
1½"	95-100	-	-
3/4"	50-100	100	-
½"	-	95-100	-
3/8"	15-55	70-100	100
No. 4	0-25	0-55	95-100
No. 8	0-5	0-10	80-100
No. 16	-	-	50-85
No. 30	-	-	25-60
No. 50	-	-	10-30
No. 100	-	-	2-10
No. 200	0-3	0-3	0-2

606.3 Construction Details: Unless otherwise approved by the City Engineer, no under drain shall be installed without the use of an approved drainage fabric meeting the minimum requirements specified herein.

606.3.01 Trench Excavation: Drain trenches shall be excavated to the alignments, dimensions and grades indicated on the Approved Plans or as directed by the Engineer. The Contractor shall clean the trenches of all loose and protruding materials, including the removal of additional soil and/or rock, to provide unrestricted continuous flow throughout the entire length of the trench or trenches.

The trenches shall be excavated and graded to conform to the percent of slope specified on the Plans, in the Special Provisions or as directed by the Engineer. In lieu of a designated sloping requirement, the Contractor shall grade the trenches to provide a continuous, uniform flow throughout the length of the trench.

Extreme care shall be exercised by the Contractor at all times during the performance of the work to maintain the trench and excavated material with such condition that there will be no mixing of excavated material in the filter material to be used for backfilling. All excess excavated material not required for construction, shall be disposed of by the Contractor, unless otherwise provided in the Special Conditions.

Wherever necessary, sheeting, bracing, or cribbing shall be provided in accordance with the provisions of Section 602.2.04.

606.3.02 Fabric Installation: The Contractor shall install the specified or designated grade and type of fabric completely to the lines and grade indicated. Fabric installation shall be in strict accordance with the manufacturer's recommendation except as modified below:

1. Where lapping of the fabric is required the lap distance shall be a minimum of eighteen (18) inches. Laps placed longitudinally in the trench or along the blanket drain area shall be made such that the overlying fabric edge is down slope from the direction of flow

2. Trench closures of the fabric shall be made in such a manner as to provide a full width, double fabric, cover over the trench surface. Blanket drain closures shall be made in such a manner that the minimum fabric lap, previously specified herein, shall be strictly maintained.

606.3.03 Pipe Installations: Where required, subdrain pipe of the type and size specified shall be installed as indicated on the Plans or in the Special Provisions. Unless otherwise specified or directed by the Engineer, the pipe shall be installed directly on the fabric.

Unless otherwise shown on the plans, perforated pipe shall be placed with the perforations down. The pipe section shall be joined securely with the appropriate couplings, fittings, or bands.

Non-perforated pipe shall be laid with the bell end upgrade and with open joints. The pipes shall be wrapped with suitable material to permit entry of water, or unwrapped, as specified. Upgrade ends of all subdrainage pipe installations shall be closed with concrete plugs to prevent entry of soil materials.

If required by the Engineer or otherwise specified, prior to laying the pipe, a six (6) inch layer of filter material, meeting the requirements for permeable materials as specified herein, shall be placed uniformly in the bottom of the trench. This material shall be placed immediately prior to laying the pipe and shall be uniformly spread to true grade and be properly compacted. Should any of this filter material become contaminated by slough of the trench, by storm water or from other causes, it shall be immediately removed and be replaced with acceptable filter material at the expense of the Contractor.

606.3.04 Pipe Jointing: All pipe shall be inspected prior to lowering into the trench and, if necessary, cleaned of any material which might plug the perforations of the pipe.

The Contractor shall have available the proper tools, men and equipment for efficient execution of the work. All pipe and fittings shall be carefully lowered into the trench to avoid any contamination of the filter bedding material. Pipe shall be laid with perforations down, unless otherwise specified or directed by the Engineer.

606.3.04.A Corrugated Pipe: Corrugated metal pipe and fittings shall be connected with an approved band provided by the manufacturer.

606.3.04.B Clay Pipe: Clay pipe sections shall be butted up tight and centered so as to provide a continuous and uniform line of pipe with a smooth and regular interior surface. Pipe shall be laid without joint closure unless otherwise provided in the Special Provisions.

606.3.04.C Concrete Pipe: Concrete pipe sections shall be butted up tight an centered so as to provide a continuous and uniform line of pipe with a smooth and regular interior surface. Pipe shall be laid without joint

closure unless otherwise provided in the Special Provisions. Where joint closure is specified, jointing shall conform to the requirements indicated in the Plans or specified in the Special Provisions.
606.3.05 Aggregate Installation: The specified permeable aggregate materials shall be placed to the lines and grades indicated on the Plans or as directed by the Engineer. Care shall be taken not to displace the pipe or to alter open joints.

The permeable materials shall be compacted as directed by and subject to the approval of the Engineer. Where specified on the Plans or in the Special Provisions, the material shall be compacted to a minimum of ninety (90) percent of the laboratory maximum dry density as determined by ASTM Test Method D-1557 or other applicable test methods designated by the City Engineer.

606.3.06 Drain Cover: Following completion of the installation, as specified herein, the under drain shall be further backfilled, or covered with compacted soil or recompacted aggregate base as indicated on the Plans.

The cover material shall conform to the material and compaction requirements specified on the Plans, in the Special Provisions or as specified in Section 501 or 510, of this Standard Specifications, whichever may be appropriate.

606.3.06.A Drain Discharge Protection: Where UNDER DRAINS discharge onto fill or cut slope subgrade, the discharge area shall be protected against erosion by the placement of crushed gravel, cobbles or other approved materials. The extent of the cover shall be shown on the Plans or indicated by the Engineer.
The furnishing and placement of such protective materials shall be considered incidental to the construction and no direct payment will be made therefore.

606.4 Measurement and Pavement:

606.4.01 General: Except as otherwise specified herein, no direct payment will be made for the various miscellaneous and incidental items of work to be performed, nor for accessories to be furnished and installed. All cost in connection therewith shall be considered as incidental to the construction and shall be included in the unit contract price of the appropriate item(s) in the Bid proposal.

606.4.02 Pipe: Pipe of each kind and size, as required or specified, shall be measured by the linear foot for the pipe in place and accepted. The unit contract price per linear foot shall be full compensation for the kind and size specified in place, including connecting accessories, all fittings such as elbows, tee, wye, etc., and the price shall be full compensation for the furnishing of all material, labor and equipment necessary to complete the pipe laying and jointing as specified, and to the satisfaction of the Engineer.

606.4.03 Filter Material: Filter material both fabric and permeable aggregate, shall be paid for at the unit contract price per linear foot in place. Filter material will be placed in accordance with the limits shown on Standard Drawings, or as described in the Contract Documents.

606.4.04 Method of Measurement: Under drain and outlets will be measured by the linear foot for pipe of the type and size specified. Blind drains will be measured by the linear foot in place.

SECTION 607

SEWER LATERALS AND CLEANOUTS

607.1 General: Sewer lateral and cleanout installations shall conform to S.B.W.R.D. Standards and Specifications.

SECTION 608

FINISHING AND CLEANUP FOR UNDERGROUND CONDUITS

608.1 Cleanup: Before acceptance of sewer line construction, all pipes, manholes, catch basins, and other appurtenances shall be cleaned of all debris and foreign material.

After all backfill has been completed, the ground surface shall be shaped to conform to the contour of adjacent surfaces. General cleanup of the entire construction area shall otherwise conform to applicable requirements specified in Section 553.

SECTION 700

WATER MAIN AND SERVICE LINE CONSTRUCTION

April
2007
DeHaan/Anderson

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

(435) 615-5077

Notes:

Please visit our webpage for the updated specs:

http://www.parkcity.org/departments/community-development/engineering-division/water-guidelines-service-line-flow-chart

SECTION 700

WATER MAIN AND SERVICE LINE CONSTRUCTION

700.1 General: All water mains and service line construction within the Park City water system or intended to be connected to the Park City water system shall be accomplished in accordance with the requirements of these Specifications. In all cases, construction must conform to Section 12.2 of Utah's Drinking Water Regulations, which is included in the Appendix (703 App.). All water lines, connections, and appurtenances on the customer's side of the meter or beyond a point five feet beyond the edge of the nearest all-weather roadway, whichever creates the greater distance of private line, shall be privately maintained. No public water mains shall be accepted by the City until there is sufficient usage through the line to prevent winter-time freezing. No landscaping irrigation line shall be connected to the City system without a backflow preventer similar to Standard Drawing 710.

The maximum bury depth for water lines in Park City is ten (10) feet below finished grade, unless otherwise approved by the City Engineer.

700.2 Approved Plans: Water main construction shall be done in accordance with the Contract Documents for the work, prepared under the direction of a Professional Engineer licensed in Utah and approved by the City Engineer and the Director of Public Works.

700.3 Licenses and Permits Required:

A. All water mains and service line construction shall be done by a General Utility Contractor licensed and bonded in Utah.

B. When construction is required within the public right-of-way, a permit shall be secured by the Contractor from Park City Engineer's Office at least 48 hours (two full working days) before initiating construction. (Right-of-Way Permit applications can be obtained at the Park City Building Department window on the first floor of City Hall). When construction necessitates shutting down a segment of public water main for a connection, the connection shall be made between the hours of 2:00 a.m. and 7:00 a.m. local time unless otherwise approved by the Public Works Director and the City Engineer.

C. A street cut permit fee will be charged by the City.

D. A cash bond shall be posted to guarantee the work for a period of one year after final acceptance of the work by the City.

E. A certificate of insurance may also be required to be posted to guarantee that Park City will not be liable for any accidents, property damage or physical damage to any individual related to acts of the Contractor.

F. The Department of Public Works and the City Engineer's Office shall be notified 48 hours (two full working days) minimum before the planned construction is to commence and also before starting up whenever construction is interrupted for any reason.

G. A plumbing permit is required from the Building Department prior to connecting landscape irrigation lines to the City water system.

700.4 Inspection: All work shall be inspected by a City authorized Inspector who shall have the authority to halt construction when in the opinion of the inspector, construction is being performed contrary to the Contract Documents. Contractors are required to give notification two full working days, (Monday through Friday) prior to a requested inspection. Whenever any portion of these Specifications is violated, the City Engineer, the Community Development Director and/or the Director of Public Works, by written notice, may order that

portion of construction which is in violation of the Contract Documents to cease until violation is corrected. A copy of that order may be filed with the Contractor's license application for future review. If deficiencies are not corrected, performance shall be required of the Contractor's Surety.

700.4.01 Construction Staking: Whenever construction staking is inadequate to reflect a water line's location with respect to other utilities, structures, or curb and gutter, the City Engineer or City authorized Inspector may request additional staking be provided to enable verification of conformance with the approved construction drawings and the Specifications. Supplemental staking shall be provided prior to burial of the waterline and within 48 hours of the request. Supplemental staking not provided within the allotted period may be considered cause for Park City to halt waterline construction.

700.5. Cold-Weather Construction: During cold-weather conditions, special requirements must be followed to insure that proper construction methods are maintained. During the period from October 15th to May 15th, the following supplemental requirements apply. Inspection coordination is the responsibility of the Contractor. Failure to comply with these special requirements will be considered cause for Park City to halt construction.

1. Trench excavation is limited to the quantity of pipe laying that the Contractor can install in one day. Trenches shall be completely backfilled (including bends, valves and end of pipe) at the end of each day.

2. When frost is encountered, it must be moved away from the excavation area to avoid contaminating the backfill material.

3. Snow must be removed from the immediate construction area to avoid contaminating the backfill material.

4. Bedding material shall be protected from contamination by moisture, including ice and snow. Bedding material containing any quantity or ice, snow or frost shall not be placed in the trench.

5. Dewatering of the trench during cold-weather construction shall be conducted to discharge water away from the construction area and be prevented from entering pavement or gutters where freezing could present a hazard to the public.

6. When water has been introduced into pipelines prior to final acceptance of the water system (i.e., testing and disinfection purposes, interim fire protection, etc.), waterlines and appurtenances shall be protected from freezing. Backfilling shall be completed to the top of the casting around meter vaults, valve boxes, and reducing vaults.

7. Additional or supplemental testing of piping and backfill materials may be required by the City Engineer when warm-weather conditions return.

8. Concrete for structures and thrust blocking to be placed when the atmospheric temperature is below 40° F. shall comply with Section 530 of the Park City Design Standards, Construction Specifications and Standard Drawings.

SECTION 701

PIPE FOR WATER MAINS

701.1 General: These Specifications cover the pipe and fittings normally used for water distribution systems. Special conditions will be covered in the Approved Plans and Special Conditions.

701.2 Pipe:

701.2.01 Cast Iron Pipe: Cast iron pipe may only be used with special prior permission from the City Engineer and Public Works Director. It shall conform to AWWA Standard C106 Class 22, except that 21/45 iron shall be used. Cement lining shall be in accordance with AWWA C104. All polyethylene encasement used to coat any cast iron or ductile pipe and fittings shall conform to AWWA 105.

All fittings under this Specification shall be short body cast iron fittings confirming to ANSI/AWWA C110 or Ductile Iron Compact MJ fittings conforming to ANSI/AWWA C153/A21.53.

Joint sockets, socket flanges, packing glands, gaskets, and bolts shall conform to the requirements of ANSI/AWWA C111.

701.2.02 Ductile Iron Pipe: Ductile Iron Pipe shall be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50 for a minimum of 150 psi (or project requirements, whichever is greater) rated working pressure plus a 100 psi surge allowance (if anticipated surge pressures are other than 100 psi, the actual anticipated pressure should be used); a 2 to 1 factor of safety on the sum of working pressure plus surge pressure; type of laying conditions and a depth of cover of 5 feet below elevation of 7,300 feet and 7 feet depth of cover above elevation of 7,300 feet. Typically, Ductile Iron Pipe shall be of Pressure Class 350 for 3 through 12 inch diameter pipe.

Ductile Iron Pipe shall be manufactured in the U.S.A. in accordance with the latest revision of ANSI/AWWA for the appropriate class. Each pipe shall be subjected to a hydrostatic pressure test of at least 500 psi at the point of manufacture.

Pipe shall have standard asphaltic coating on the exterior. Pipe shall also have cement-mortar lining on the interior in accordance with ANSI/AWWA C104/A21.4, latest revision.

The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.

All pipe shall be furnished with Push-on Type Joints, such as Tyton® or Fastite®, or Restrained Type Joints, such as Thrust-Lock™ or TR Flex™. Push-on and mechanical type joints shall be in accordance with ANSI/AWWA C111/A21.11, of latest revision and be furnished complete with all necessary accessories. Restrained type joints shall be in accordance with ANSI/AWWA C111/A21.11, of latest revision, and the pipe manufacturer's requirements, and be furnished complete with all necessary accessories.

All ductile iron pipe will be encased in polyethylene during installation, in accordance with the procedures in Appendix 703E-2.

701.2.02.A Fittings for Ductile Iron Pipe: Restrained type joints shall be furnished on all water lines with the following uses or site conditions:

Aligned outside of paved surfaces;
Aligned at a slope in excess of 15% grade;
Adjacent to structures and retaining walls;
Where static water pressures exceeding 150 psi;
Within casings;
Where utility encroachment may interfere with proper thrust blocking;
All Water main stubs;
All fire lines and hydrant service lines.

Additionally, restrained joint pipe shall be furnished for water lines where the City Engineer and /or the Public Works Director determine that influencing factors warrant the supplemental method for providing longitudinal thrust restraint be used. The City Engineer and Public Works Director's basis for determination are the following general parameters:

Soil characteristics;
Future and potential site improvements;
Groundwater conditions;
Site earthwork cut/fill condition;
Soil bearing for thrust blocking.

The City Engineer's determination is not intended to limit the Design Engineer's use of restrained joint pipe.

To address limitations in the ability to identify actual site conditions which are required to determine the length of pipe that must be restrained on each side of a fitting, where restrained joint pipe is furnished, it shall be provided for the entire reach of water line (push-on and restrained joint pipe systems shall not be mixed).

Since restrained joint pipe may not be interchangeable between manufacturers, a single manufacturer's joint design shall be utilized throughout an entire project unless otherwise approved by the City Engineer.

701.2.02.B Fittings for Ductile Iron Pipe: Fittings shall be manufactured in the U.S.A. and be either Ductile Iron or Gray Iron. Ductile Iron fittings shall conform to the latest revisions of either ANSI/AWWA C110.A21.10 or ANSI/AWWA C153/A21.53. Gray Iron fittings shall be in accordance with ANSI/AWWA C110/A21.10 of the latest revision. Fittings shall have a standard asphaltic coating on the exterior. Fittings shall also have a cement-mortar lining on the interior in accordance with ANSI/AWWA C104/A21.4, of latest revision.

Fittings and accessories shall be furnished with either Push-on or Mechanical Type joints in accordance with ANSI/AWWA C111/A21.11, of latest revision, or Restrained Type Joints, such as Thrust-Lock™, TR Flex™, or Megalug™ retainer gland in accordance with ANSI/AWWA C111/A21.11, of latest revision and the pipe manufacturer's requirements. T-bolts for Megalug™ retainer gland fittings shall be standard mechanical joint t-bolts in accordance with ANSI/AWWA C111/A21.11, of latest revision and set screws shall be hardened ductile iron.

Ninety degree bends shall not be allowed unless otherwise approved by the City Engineer.

All pipe, fittings, and accessories shall be installed and tested in accordance with the latest revision of ANSI/AWWA C600, except as modified in these Specifications. Newly installed Ductile Iron water mains shall be disinfected in accordance with these Specifications prior to placing in service.

701.2.03 Concrete Cylinder Pipe: ***This type of pipe may be used only when special permission from the City Engineer and/or the Director of Public Works has been obtained***. Reinforced concrete water pipe, steel cylinder type, pre-tensioned shall conform to AWWA Standard C303. Size, class, marking, specials, lengths, etc., shall be specified in the Special Conditions.

701.2.04 Welded Steel Pipe: ***This type of pipe may be used only when special permission from the City Engineer and/or Director of Public Works has been obtained.*** The work of this section consists of furnishing and installing all steel pipe and fittings as described in the Approved Plans.

All steel pipe and materials shall be in accordance with AWWA Standard C200, for "Steel Water Pipe 6 Inches and Larger".

Fabrication Specifications shall comply with Section 3 of AWWA C200. Pipe fabricated from steel sheets shall conform to the requirements of ASTM A570, Grade 30 or plates conforming to ASTM A283, Grade C. The diameter of the pipe and steel wall thickness shall be shown on the Standard Drawings. The nominal diameter shall be O.D. for 28 inches and under and I.D. for 30 inches and over.

All pipe shall be shop tested to a hydrostatic pressure conforming to AWWA Specification C200. Pipe shall be designed and manufactured so as to conform, when laid, with the lines and grades as shown on the Approved Plans and profile with outlets, connections and appurtenances as shown on the Approved Plans.

701.2.04.A Coatings for Steel Pipe: Types of protective treatment shall be as follows:

1. Fusion Epoxy Lining and Coatings per AWWA 213.
2. Cement Mortar Lining and Coatings per AWWA 205.

701.2.04.B Couplings for Steel Pipe: All steel pipe 6 inches and larger shall be coupled by the following:

1. Dresser coupling Type 38, or equal.
2. Bell and spigot with O-ring gaskets which provide unrestricted flow in either direction.
3. Flanges shall conform to AWWA Standard C207.
4. Other types as approved by the City Engineer. Couplings shall be coated same as the pipe.

Steel Pipe used within the interior of a building shall be fabricated from steel sheets and plates. Approved Plans shall shown the sizes and general arrangements of all pipes and appurtenances. Responsibility for furnishing exact length of the various sizes of pipe for proper make-up rests with the Contractor. The pipe shall be shop fabricated. Field welding will be allowed only with the written permission of the City Engineer.

701.2.04.C Fittings: Steel fittings for pipe 4 inches and larger shall conform to AWWA C208. Pressure Class shall be at least the same as pipe. Fittings shall be coated the same as pipe. The Contractor shall supply certifications from supplier and/or manufacturer that the fittings meet all steel pipe fabrications.

701.2.05 Polyvinyl Chloride Plastic Water Pipe: ***This type of pipe may only be used with prior permission of the City Engineer and the Public Works Director.*** All PVC Pressure Pipe and Fittings shall conform to AWWA C900 Pressure Class 200 or better. PVC Pipe shall not be used on lines serving only a fire hydrant or on any other dead-end use because of difficulty in thawing frozen pipe.

The rigid PVC Pipe shall bear the seal of approval and "NSF Mark" of the National Sanitation Foundation Testing Laboratory, Inc., which has qualified the pipe for potable water service.

Pipe shall be produced in standard and random lengths. At least 85% of the total footage of any class and size shall be furnished in standard lengths. The remaining 15% may be in random lengths.

1. Standard laying lengths shall be 20 feet plus or minus one inch for all sizes.
2. Random length shall not be less than 10 feet long.

Each standard and random length of pipe shall be marked on the outside surface with the trade name with the appropriate designation code (e.g., PVC 1120) DR, nominal size, pressure classification and date of manufacture.

Samples of pipe, physical and chemical data sheets, may be required to be submitted to the Engineer for approval and approval may be required before the pipe is purchased. The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. The pipe shall be as uniform in color as commercially practical.

The rigid PVC Pipe used in the municipal water distribution system, when approved, shall be composed of PVC compounds meeting the requirements of ASTM D1784.

701.2.06 Glass-Fiber-Reinforced Thermosetting-Resin Pressure Pipe: ***This type of pipe specified in AWWA 950 shall not be used for water distribution systems in Park City. Tapping of existing lines made of this type material must have prior approval by the City Engineer. Special tapping materials will be required!***

SECTION 702

TRENCH EXCAVATION AND BACKFILL FOR WATER MAINS

702.1 General: The Specifications in this Section, and those of Sections 701 through 707, shall apply to the construction of water distribution mains and appurtenances in sizes up to and including twenty-four inches (24") in diameter for both temporary and permanent installation under ordinary conditions.

Water mains will be constructed on locations as shown on the Approved Plans.

Where grading is required, such grading or excavation and embankment shall conform to the requirements of Section 502, and rough grading shall be completed before excavation of the water main trench. (Also see Section 500.12 Import Fill Material).

Guarantee: Unless otherwise provided by the Special Conditions, the unit contract prices shall include a guarantee by the Contractor that the design, materials, workmanship and performance of the pipe, valves, hydrants, valve chambers, boxes, fittings and accessories furnished by him will be as specified, and that they and the installation of them will be satisfactory to the Owner for the purpose intended for a period of one year after final acceptance of the Contract.

702.1.01 Ungraded Streets: On streets, when grading is not provided in the contract schedule, the depth of trench excavation shall be as shown on the Approved Plan and Profile and as staked by the Engineer.

Where the Approved Plans show the pipe is to be laid above the existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the Approved Plans and the water main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Section 502.3.10B.

Where no bid items are provided in the contract schedule for earthwork, filling or embankment fill, such work shall be considered as incidental to the construction and all costs thereof shall be included in the unit contract price per linear foot for waterline installed.

Where, in the opinion of the Engineer, the extent of the work of earthwork, filling, or embankment fill justifies bid items, such items and payment will be as provided in Section 502, under these Specifications, unless otherwise provided in the Special Conditions.

702.1.02 Clearing and Grubbing in Ungraded Streets: Where not provided under schedules for "Grading" the area to be excavated or filled shall be cleared and grubbed by the Contractor. This work shall consist of the removal and disposal of all logs, stumps, roots, brush, organic soils, and other refuse. All such material shall be removed and disposed of as directed by the Engineer.

Payment for clearing and grubbing will be included in the unit contract price per linear foot for waterline installed unless otherwise provided.

702.1.03 Removal and Replacement of Pavement From Driveways and Sidewalks: Removal and replacement of existing street improvements shall be performed as specified in Section 550, except that payment therefor shall be considered as incidental to the construction and the costs thereof shall be included by the Contractor in the unit contract price per linear foot for installed waterline.

The removal of material from pavement, driveway and sidewalk and the disposal thereof shall be considered as incidental to the construction, and the costs thereof shall be included by the Contractor in the unit contract price per linear foot for installed waterline, unless otherwise provided.

702.1.04 Grade and Alignment: Grade and alignment on ungraded streets will be given from hubs set parallel to the line of the pipe, and on graded streets the grade and alignment shall be taken from established points on the existing curbs or sidewalks, when directed by the Engineer. Trenches for the pipe shall be opened in accordance with the lines and grades given or to the standard minimum cover of five (5) to seven (7) feet, depending on elevation and future surface treatment, whichever is greater. The Contractor shall transfer lines and grades to the pipe from hubs set by the Engineer or from existing concrete curbs or sidewalks as an incidental part of his work.

Sequence or operations, traffic requirements or restrictions on the amount of open trench, if any, will be provided in the Special Conditions.

702.2 Trench Excavation: The Contractor shall perform all excavation of every description and of whatsoever substances encountered to the depth indicated on the Standard Drawings or specified herein. All excavations shall be made by open cut unless otherwise provided in the Contract Documents. The banks of the trenches shall be kept in accordance with Utah Occupational Health and Safety Division (UOSHA) requirements. To protect adjacent structures the trench shall be properly sheeted and braced.

Work shall comply with the "Utah Occupational Safety and Health Rules and Regulations" for the Utah State Industrial Commission.

All grading and other excavations nearby shall be controlled to prevent surface water from flowing into the excavations. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance away from the edges of trenches to avoid overloading and to prevent slides or cave-ins. Unsuitable material, or that in excess to the needs for embankments or backfill, shall be removed and disposed of by the Contractor.

The Contractor shall exercise sound engineering and construction practices in excavating the trench and maintaining it so that no damage will occur to any foundation, structure, pole line, pipe line, or other facilities because of slough, slopes, or from any other cause. If, as a result of the excavation, there is disturbance of the ground such as to endanger other property, the Contractor shall immediately take remedial action at his own expense. No act, representation or instruction of the Engineer or his representatives shall in any way relieve the Contractor from liability for damages or costs that result from trench excavation.

Care shall be taken not to excavate below the depth indicated, and excavation below that depth shall be backfilled with selected backfill material and compacted to the satisfaction of the Engineer at the Contractor's expense.

The bottom of trenches shall be accurately graded to provide uniform bearing and support for each length of pipe or undisturbed or compacted soil at every point along its entire length, except at the joints. Bell holes shall be excavated to an extent sufficient to relieve bearing pressure at the bell joint.

702.2.01 Protecting Existing Services: The Contractor shall carefully do all necessary excavation to fully expose such services. If the Contractor elects to excavate the trench without first exposing the services, he shall be responsible for any and all damages incurred to the services by reason of his operations and shall immediately arrange for replacement of all damaged services. All additional costs incident to such work by the Contractor shall be considered as incidental to the construction and shall be included in the unit contract price

per linear foot for installed waterline.
702.2.02 Solid Rock Excavation: Solid rock, shall include solid rock formations requiring systematic drilling and blasting with explosives and any boulders or broken rock larger than one-half cubic yard in volume. Hardpan or cemented gravel, even though it may be advantageous to use explosives in its removal, shall not be classified as solid rock excavation. Solid rock shall be excavated to a width equal to the outside barrel diameter of the pipe plus 24 inches, and to a grade line not less than six inches below bottom of the pipe bell. Bottom of the trench shall be brought up to grade by backfilling with selected backfill material. The material shall be compacted to the satisfaction of the Engineer.

The Contractor shall notify the City Engineer, the Park City Police Department and the Park City Fire District at least 24 hours prior to any blasting. All blasting shall be done in accordance with local, county and state regulations governing this class of work. Any damage to persons or property resulting from blasting operations shall be the sole responsibility of the Contractor and his surety.

Payment for solid rock excavation will be made in accordance with Section 702.3.03.

702.2.03 Extra Excavation: Changes in grades of the water main from those shown in the Contract Documents may be necessary because of unplotted utilities, or for other reasons. If, in the opinion of the Engineer, it is necessary to adjust, correct, relocate or in any way change the line and grade, such changes shall be made by the Contractor under the terms of these Specifications.

When a change in horizontal alignment is ordered by the Engineer, payment will be made for any trench which has been excavated upon the original location at the unit price per linear foot acceptable to both parties.

Changes in grade which will involve additional depth of trench will be paid for either on a negotiated price basis or as force account work, as the Engineer may determine.

In cases where sheeting becomes necessary on account of the additional depth, payment therefore will be made the Contractor on a negotiated price basis or as force account work, as the Engineer may determine.

702.2.04 Unforeseen Buried Objects Encountered in Trench Excavation on Graded Streets: Where streets have been graded, it is presumed that stumps, railroad ties, buried pavements, etc., will have been removed in the original grading work. Where such unexpected objects are encountered in trench excavation for water mains, they shall be removed and disposed of by the Contractor. In cases where they can be removed by the same equipment or method at hand for excavating, and where it is unnecessary to employ special equipment or to install shoring and bracing, or to increase the trench width or depth more than two feet for any one object, then in that event the removal of such obstructions shall be considered as an incidental part of the Contractor's work and no additional payment will be made therefor.

Where objects, railroad ties, buried pavements, etc. are continuous and require extra work beyond the scope of the work outlined above, or extra equipment for their removal, additional payment will be made upon a negotiated price basis, or as force account work as the Engineer may determine.

702.2.05 Removal of Unsuitable Materials: Wherever in excavating the trench for water mains the bottom of the trench exposes peat, soft clay, quicksand, organic soils, or other material which is unsuitable in the opinion of the Engineer, such material shall be removed and disposed of by the Contractor. The material thus removed shall be replaced by suitable surplus materials obtained from trench excavation within the limits of the project which shall be deposited and compacted in eight-inch maximum depth layers by mechanical compaction. If surplus material is not available within the limits of the project, the Contractor shall furnish suitable material, as provided in Section 702.2.08, Gravel Base Course for Trench Backfill.

Measurement and payment for removal and replacement of unsuitable material will be made in accordance with Section 702.32.04.

702.2.06 Pipe Bedding: Pipe bedding material shall consist of road base of which 100% will pass the U.S.

Standard 3/4-inch opening and not more than 3% will pass the U.S. No. 200 (wet sieve) or graded granular sand. *Pea gravel or similar gravel products predominantly of one size shall not be used without prior approval of the City Engineer.* Bedding material will be placed in accordance with Standard Drawings 703-A and 703-B. *Under no circumstances shall mine excavated materials, processed materials, or tailings containing traces of arsenic, lead, strontium, rubidium, or radium be used as bedding material.* Cost for bedding material shall be incorporated into pipe costs.

702.2.07 Backfilling Trenches: Backfilling of trenches shall be made with the same materials excavated from the trenches unless these materials are found to be unsuitable by the City Engineer.

Prior to backfilling, all form lumber and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of the backfilling unless it is ordered by the Engineer to be left in place.

The initial backfill up to 12 inches over the top and both sides of the pipe shall be evenly and carefully placed, using bedding material conforming to 702.2.06, free of hard clods, frozen material or other debris capable of damaging the pipe and its coating. The balance of the backfill material may be placed in uniform layers to the compaction required in 702.2.08.

A minimum of a 3-inch sand cushion shall be placed between the water main and existing pipelines or other conduits when encountered during construction and as directed by the Engineer. No extra payment will be made for furnishing and placing sand as specified but the cost thereof shall be considered as being included in the unit prices bid for the various items comprising the improvement.

702.2.08 Compaction of Backfill: On graded streets without pavement or on roadway shoulders and unimproved areas, compaction of backfill may be by mechanical tamping or wheel rolling. Compaction by water settling may be done under the conditions stipulated in Section 702.2.08A.

For all graded streets, including the shoulders, asphalt and parkway strip located in the Right-of-Way, the backfill shall be compacted to 96% of the maximum modified proctor density as determined by the Compaction Control Tests specified in ASTM D-1557 and verified by the methods specified in ASTM D2911 (AASHTO T238) or ASTMD1556 (AASHTO T-191) The compaction may be reduced to 90% for areas where vehicle traffic will never occur, and/or the most distant five (5) feet of the Right-of-Way with written approval from the City Engineer.

702.2.08.A Water Settling of Trenches: Water settling is only allowed in sandy soil conditions where no clays are present and in other soils conditions, only with the approval of the City Engineer and under full-time inspection by an authorized City Inspector. Where water settling of trenches is used, the jetting method shall be utilized. Jets shall be inserted throughout the length of the backfilled area and shall be slowly forced down to the bottom of the trench and then slowly withdrawn until the trench backfill is saturated with water. The jetting operations shall be completed as close behind the pipe laying and backfilling as practicable.

After the water-settled trench has been set for several days, any depression in the trench shall be filled and mounded up over the trench, and then further compacted by the use of heavy rubber-wheeled equipment or equivalent as approved by the Engineer.

702.2.08.B Equipment for Water Settling Trenches: The Contractor shall furnish all hose and equipment necessary for jetting operations. The minimum size of hose and equipment shall be such as to provide not less than thirty-five (35) pounds per square inch pressure at the discharge. The jet shall be a rigid iron pipe with a minimum diameter of one (1) inch.

702.2.08.C Source of Water for Water Settling: Source of water will depend upon local conditions and shall be as provided in the Special Conditions. Where no provision for water is made in the Special Conditions, the Contractor shall make his own arrangements for it.

702.2.08.D Compaction of Backfill Under Special Conditions: At locations where paved streets, driveways or sidewalks will be constructed or reconstructed over the trench, or where provided for in the Special Conditions or directed by the Engineer, the backfill shall be spread in layers and be compacted by mechanical tampers. In such cases, the backfill material shall be placed in successive layers, not exceeding eight (8) inches in loose thickness and each layer shall be compacted with mechanical tempers to the density directed by the Engineer.

702.2.09 Gravel Base Course for Trench Backfill: Selected backfill material shall consist of gravel base course as specified in Section 510 excepting, however, that 100% of the material shall pass the 1-1/2" (one and one-half) inch square opening.

Payment for gravel base course will be made in accordance with Section 510.

702.3 Measurement and Payment:

702.3.01 Clearing and Grubbing: When an item for "Clearing and Grubbing" is provided in the Bid Proposal, payment will be made on basis of a *"Lump Sum"* contract price which shall be in full for the removal and disposal of all material as specified, or in accordance with provisions of Section 501.

When no item is provided in the Bid Proposal, all clearing and grubbing shall be considered as incidental to the work of constructing the water main.

702.3.02 Trench Excavation and Backfill: Payment for trench excavation and backfill will be made at the unit contract price per linear foot of water main, which price shall be full compensation for all costs of materials, labor and equipment required to excavate the trench to the depth and in the manner required by the Special Conditions including:

(a) excavation for bell holes, valves, fittings, and other appurtenances except vaults;

(b) the removal and disposal of pavements, sidewalks and driveways;

(c) the furnishing, placing and removal of sheeting;

(d) the clearing and grubbing if there is no separate item for such in the proposal; and

(e) the backfilling of the trench and compaction of backfill in accordance with these Specifications. Exception is made, however, that excavation of solid rock and of unforeseen buried objects will be paid for additionally in the manner hereinbefore described.

702.3.03 Solid Rock Excavation: Payment for "Solid Rock Excavation" will be made at the unit contract price per cubic yard, which price shall be in addition to the price per linear foot for installed waterline. The volume of solid rock excavation will be based upon a trench width equal to the outside barrel of the pipe plus 24 inches, and to a grade six inches below the bottom of the pipe and the profile of the top of the rock as established by field measurements. Payment for necessary pipe bedding material is included in the price for installed waterline.

702.3.04 Removal and Replacement of Unsuitable Material: Payment will be made at the unit contract price per cubic yard for "Removal and Replacement of Unsuitable material," which price shall be full compensation for hauling and placing of suitable excess material in the trench as specified.

If suitable excess material is not available the Contractor will be paid for furnishing suitable material from other approved source as provided in Section 702.2.08.

Compaction of suitable replacement material shall be as specified in Section 702.2.08.

SECTION 703

PIPE INSTALLATION FOR WATER MAINS

703.1 General: Pipe shall be installed in accordance with manufacturer's specifications and instructions for installing the type of pipe used unless modified or changed in the Special Conditions. The Contractor shall provide all tools and equipment including any special tools designed for installing each particular type of pipe used. All pipe shall be installed with the bell end positioned uphill.

All pipe shall be furnished with Restrained Type Joints, such as Thrust-Lock™ or TR-Flex™. With the prior written permission of the City Engineer, Push-on type Joints, such as Tyton® or Fastite® may be used. Push-on and mechanical type joints shall be in accordance with ANSI/AWWA C111/A21.11, of latest revision and be furnished complete with all necessary accessories. Restrained type joints shall be in accordance with ANSI/AWWA C111/A21.11, of latest revision, and the pipe manufacturer's requirements, and be furnished complete with all necessary accessories.

703.2 Construction:

703.2.01 Dewatering of Trench: Where water is encountered in the trench, it shall be removed during pipe-laying operations and the trench so maintained until the ends of the pipe are *sealed* and provisions are made to prevent floating of the pipe. Trench water shall not be allowed to enter the pipe at any time.

703.2.02 Handling of Pipe: All types of pipe shall be handled in such manner as will prevent damage to the pipe, pipe lining or coating. Damage to the pipe, pipe lining or coating shall be repaired to the satisfaction of the Engineer or the damaged pipe shall be removed from the job and methods of handling corrected to prevent further damage.

Threaded pipe ends shall be protected by couplings or other means until laid.

The pipe and fittings shall be inspected for defects and cast iron pipe, while suspended above grade, shall be rung with a light hammer to detect cracks.

Dirt of other foreign material shall be prevented from entering the pipe or pipe joints during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and re-layed. ***At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other effective seal approved by the Engineer to ensure absolute cleanliness inside the pipe.***

703.2.03 Laying of Pipe on Curves: Long radius curves less than eleven and one-quarter (11-1/4) degrees, either horizontal or vertical, may be laid with standard pipe by deflections at the joints. If the pipe is shown curved on the Approved Plans and no special fittings are shown, the Contractor cannot assume that the curves can be made by deflection of the joints with the standard lengths of pipe. The Contractor is responsible for verifying the maximum degree of curvature allowed according to AWWA for the type and size of pipe he is installing. If shorter lengths are required, Approved Plans will indicate maximum lengths that can be used.

Where field conditions require deflection for curves not anticipated by the Approved Plans, the Engineer will determine the methods to be used. No additional payment will be made for laying pipe on curves as shown on the Approved Plans, nor for field changes involving standard lengths of pipe deflected at the joints.

When special fittings not shown on the plans are required to meet field conditions, additional payment will be made for special fittings as provided in Section 703.3.02.

Maximum deflections at pipe joints and laying radius for various pipe lengths are as found in the following standards:

Ductile Iron Pipe Mechanical Joints	AWWA C600, Table 6
Ductile Iron Pipe Push-On Joints	AWWA C600, Table 5
Ductile Iron Pipe Restrained Joints	AWWA C600, Table 6 and Manufacturer's Specifications
Concrete Cylinder Pipe	AWWA C303, Section 4.3
Steel Pipe O-Ring Joints	See Manufacturer's Specifications
Steel Pipe Welded Joints	See latest AWWA Specifications
PVC	AWWA C900

When rubber-gasketed pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

The City Engineer may require the Contractor to run a *mandrel* through each section of curved water line to verify maximum deflection. Such verification shall be incorporated into the Contractor's bid price for water main.

703.2.04 Laying Ductile and Cast Iron Pipe:

703.2.04A Joints For Ductile and Cast Iron Pipe: Joints for cast iron pipe shall consist of one of the three following types unless otherwise provided in the Special Conditions:

1. Mechanical joints.
2. Rubber-gasket joints (push-on)
3. Restrained joints

703.2.05 Jointing Mechanical Joint Pipe: The outside diameter of the spigot end of bell-and-spigot pipe varies with the type, size and class of pipe. There is only one joint size for each diameter of mechanical joint pipe. Thus, difficulty may be met when attempts are made to connect existing bell-and-spigot pipe to mechanical joint pipe. When such a correction must be made, an adapter having a fitting bell and a mechanical joint socket is manufactured and shall be used.

703.2.05A Cleaning and Assembling Joint: The last 8 inches outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grit. Tar (other than standard coating), and other foreign matter from the joint, and then lubricated with an approved pipe lubricant meeting the requirements of ANSI/AWWA C111/A21.11. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket or bell end. The rubber gasket shall be lubricated and placed on the spigot end with the thick edge toward the gland.

703.2.05B Bolting of Joint: The entire section of the pipe shall be pushed forward to seat the spigot end of the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting, all

of the nuts inserted, and the nuts screwed up tightly with the fingers. *All nuts shall be tightened with a torque wrench.* The torque for various sizes of bolts shall be as follows:

Size (inches)	Range of Torque (ft.-lbs.)
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland. M.J. fittings shall use "Cor-ten" T-bolts made in the U.S.A. Flange fittings shall use stainless steel bolt packs made in the U.S.A. All fittings shall be protected from their environment with an application of FM-2 grade grease to the bolts and nuts and polyethylene wrap of a minimum thickness of eight millimeters unless otherwise approved by The City Engineer.

703.2.06 Jointing Rubber-Gasket Joint Pipe:

703.2.06A Cleaning and Assembling Joint: The inside of the bell shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other foreign matter from the joint. The circular rubber-gasket shall be flexed inward and inserted in the gasket seat provided in the socket and released with the gasket fitting over the bead in a gasket seat.

A thin film of gasket lubricant shall be applied to the inside surface of the gasket. Gasket lubricant shall be an approved pipe lubricant meeting the requirements of ANSI/AWWA C111/A21.11 provided by the pipe manufacturer and approved by the City Engineer.

The spigot end of the pipe shall be cleaned and entered into the rubber-gasket in the socket, using care to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket, using a forked tool or jack-type tool or other device approved by the Engineer. Pipe which is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.

Field cut pipe lengths shall be filed or ground to resemble the spigot end of manufactured pipe.

703.2.07 Assembling Restrained Joint Pipe: Install and assemble joint components in accordance with the manufacturer's recommendations. Restrained joint pipe of various manufacturer's differ in joint size and configuration. Thus, difficulty may be met when attempts are made to connect existing restrained joint pipe to restrained joint pipe. When such a correction must be made, an adapter shall be manufactured and used. Field cuts shall be restrained using a companion joint to the restrained joint system or an approved mechanical joint restraint system. Jointing to fittings and valves shall be restrained using an approved mechanical joint restraint system. *All nuts shall be tightened with a torque wrench to the manufacturer's recommended torque.* All Mega-lug™ restrained joint fittings shall be protected from their environment with an application of FM-2 grade grease to the bolts and nuts and polyethylene wrap of a minimum thickness of eight millimeters unless otherwise approved by The City Engineer.

703.2.08 Laying Steel Pipe:

703.2.08A Threaded Steel Pipe in Sizes up to and Including 3-1/2 Inch: All steel pipe in sizes up to and

including 3-1/2 inch shall be connected with malleable iron screwed couplings in accordance with USASI Specification B16.3. Couplings shall be galvanized. Unions or flanges shall be used on all equipment and valves. Steel pipe shall only be sued in vaults or other areas where it shall not be in contact with soil.

Exposed threads, after jointing, shall be brush-coated with an asphalt coating approved by the Engineer.

703.2.08B Coupled Pipe 4-Inch and Larger: All steel pipe 4-inch and larger for use in underground services shall be coupled by either one of the following methods:

Dresser Couplings, Style 38 or approved equal.

O-Ring rubber gasket joint of a design approved by the Engineer and having the following basic design.

One end expanded to form a bell.
The other, or spigot end, shall have a rolled groove to accommodate a round rubber gasket of proper diameter and cross-section.

All parts shall be thoroughly cleaned before assembly and a vegetable soap solution shall be brushed on the inside of the bell just prior to assembly.

All component parts of couplings, rings, bells, etc., shall receive a protective coating in the same manner as specified for steel pipe bolts and nuts, exposed edges, flanges, etc., shall, after installation, be covered with a heavy hot pour of asphalt if asphalt coated pipe is used, or with coal tar enamel if coal tar coated pipe is used.

All steel pipe 4-inch and larger for above-ground service shall be coupled with flanges, dresser type or victaulic type couplings. All flanges for steel pipe shall conform to AWWA Standard C207, Class B for working, pressures up to 86 psi, Class D for working, pressures up to 150 psi, and Class E for working pressure up to 275 psi.

Pipe for outdoor service above-ground shall be protected with one coat primer and one coat coal tar paint approved by the Engineer.

Pipe for indoor service shall be protected with one coat of red lead and two coats of approved enamel paint of a color specified or selected by the Engineer

703.2.09 Laying Reinforced Concrete Pressure Pipe: Reinforced concrete pressure pipe with steel joint rings, or concrete non-cylinder pipe when called for in the Contract Documents, shall be laid to conform with requirements that follow:

703.2.09A Cleaning and Assembling Joint:: All parts of the joint, both bell and spigot ends, shall be thoroughly brushed and cleaned to remove oil, grit and other foreign matter. The circular rubber-gasket provided with the pipe shall be stretched and snapped into the groove provided on the spigot end. It shall be lifted and released at several points on the circumference to equalize tension and remove twist in the gasket.

The bell end of the pipe shall be lubricated with a solution of vegetable soap and water or other prepared solution supplied by the pipe manufacturer and approved by the Engineer. The pipe shall then be jacked home until it stops.

The outside annular space at the joint shall be filled with cement mortar.

The grouting of the outside joints shall be made by wrapping the joint with two bands of strong, waterproof sisal kraft paper or visqueen. The bands of paper or visqueen shall then be tightly strapped to the pipe with 3/8-inch box strapping, using tools recommended by the manufacturer of the strapping. Hand-tamped backfill

shall be built up around the band to the horizontal diameter of the pipe. The joint shall then be filled with mortar from one side only until the mortar appears on the other side of the pipe. Mortar shall be mixed with the least amount of water that will permit placing by the method described. Flexible wires shall be worked around the joint to assist grouting and ensure proper filling on the joint. The top of the pipe shall then be grouted and the paper band laid over the entire joint to protect it while curing.

The inside annular space shall also be filled with cement mortar and troweled flush. Mortar shall consist of one part Portland cement and two parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for "dry packing".

No grouting of joints will be allowed within three joints of laying operations. A representative of the Engineer shall be present when outside joints are being poured.

703.2.10 Laying PVC Pipe: PVC pipe may be used only with the permission of the City Engineer and the Director of Public Works, and then only persons competent in the opinion of the City Engineer or Director of Public Works at laying plastic pipe shall be employed on this phase of the work, and complete suitable equipment necessary for the execution of same is required. Any incompetence observed by the Engineer must be rectified at his request, and where improper equipment or lack of same appears to be impairing the quality or speed of the work, such adjustments in same shall be made to the Engineer's satisfaction.

The pipe, fittings, and valves shall be placed in the trench with care. *Under no circumstances shall pipe or other materials be dropped or dumped into the trench.* The pipe shall not be dropped in a manner which would cause scratching of the pipe surface. An excessive amount of scratching of the surface of the pipe will be considered cause for rejection.

When requested by the Engineer, all PVC pipe will be tested after laying and backfilling by pulling a deflection detection device (mandrel). The device shall verify less than 5% deflection in all pipe sections.

703.2.11 Connections to Existing Mains:

A. All connections to water mains in use shall be made by the Contractor unless otherwise provided in the Special Conditions.

B. The Contractor shall notify the City Public Works Department at least 48 hours (two full working days) in advance of such connections.

C. ***Existing City water lines can only be shut down by crews authorized by the Public Works Director and the City Engineer***.

D. The Contractor shall also provide written notice giving the date of the notice, the date and time of the shut-down, and the duration of the shut-down. Major shut-downs shall only occur between 2:00 a.m. and 7:00 a.m.

E. ***The maximum time allowed for shut-down shall be four (4) hours***. If the Contractor should need more time than the above limit, it shall be necessary to turn on the water for at least 1 hour before the next period of shut-down begins.

All crosses or other specials required to be inserted in any main already in use shall be furnished and set by the Contractor. The Contractor shall furnish the special, as shown on the Approved Plans, and all other material required. He shall make all necessary excavations to assure gradual transition between the new and existing water main, and he shall perform all necessary backfilling to the requirements of Sections 702.2.06 and 702.2.07.

703.2.11A Disruption of Services: Where the connection of new work to old requires interruption of service and notification of customers affected, the Public Works Department, the City Engineer, and the Contractor

shall mutually agree upon a date for connections which will allow ample time to assemble labor and materials, and to notify all customers affected. The Contractor will be required to notify all affected customers, the Public Works Director and the City Engineer 24 hours in advance of service being interrupted.

703.2.11B Wet Tap Connections: ***Wet tap connections shall not be made on Friday, Saturday, Sunday, Holidays or after 12:00 Noon subject to approval by the City Engineer***. Where connections are made between new work and existing pipe lines, such connections shall be made in a thorough neat manner using suitable and proper fittings to suite the conditions encountered. ***Each connection with an existing water line shall be made at a time under conditions which will least interfere with normal user consumption and as authorized by the City.*** Suitable facilities shall be provided for proper dewatering, drainage and disposal of all water removed from the dewatered lines and excavations without damage to adjacent property. Air and/or water testing may be requested by the City Engineer. Where bottled flexible couplings or transitions are required, they shall be constructed of material corresponding to the pipe indicated in the following table:

TYPE OF PIPE	COUPLING MATERIAL
Steel Pipe	Cast Iron or Steel
Cast Iron Pipe (earth covered or inaccessible to periodic inspection)	Cast Iron
Cast Iron Pipe (accessible to periodic inspection and painted)	Cast Iron or Steel
Polyvinyl Chloride	Cast Iron

Coupling shall be equal to Smith-Blair, Dresser, Blair or Rockwell.

Great care shall be taken to prevent line contamination when dewatering, cutting, or making connection with existing pipes used for conveyance of distribution of potable water for domestic or public use. The Contractor shall conduct his operations in such a manner that no trench water, mud or other contaminating substances are permitted to get into the connected line or lines at any time during the progress of the work.

703.2.11C Contracted Repair Work: Certain repair work may be specified in the Contract Documents as part of a Contract. This work shall be done as specified/contracted and in accordance with this section.

703.2.11D Accidental Repair Work: If, for any reason, the Contractor accidentally cuts an existing waterline, replaces defective materials, or in any way disrupts water service, he shall notify the City Engineer and the Director of Public Works immediately. It shall be the Contractor's responsibility to immediately repair or replace the damaged pipe at no additional cost to the City. The Contractor shall notify the Public Works Department and/or the City Inspector of any repair work. Unless otherwise approved by the City Engineer, mechanical joint coupling sleeves, long body style, will be used for repairs. *Dresser* style couplings shall be used only with approval of the City Engineer. Only one repair is allowed for each section of pipe.

703.2.12 Field Tests: All exposed pipes, fittings, valves and joints shall be carefully examined during the tests. Any cracked or defective pipes, fittings, or valves discovered during the field tests shall be removed and replaced by the Contractor with sound material and the test repeated as required, at the expense of the Contractor. ***All testing shall be done in the presence of the City Inspector.*** The City Inspector shall be notified two full working days prior to any testing. The Contractor shall be responsible to provide testing equipment, with gauges and measuring devices accessible, and have all lines to be tested stabilized prior to the scheduled inspection time.

A visual inspection shall be made of each and every connection made to an existing main when, in the determination of the City Engineer, the field test procedure specified in this section cannot be accomplished.

703.2.12A Main Line Hydrostatic Tests: All pipe and appurtenances shall be subjected to a hydrostatic test for defects and leaks after installation. The Contractor shall be responsible to assure that each section of pipe between valves shall be tested as soon as possible after laying, or when directed by the City Engineer. *WARNING: The test methods described in this section are specific for water-pressure testing. These procedures should not be applied for air-pressure testing because of the serious safety hazards involved.*

The Contractor shall furnish all pumping apparatus, labor, tools, pressure gauges and other equipment for making the tests. Pressure gauges shall be properly calibrated for the test pressure range and tolerances.

Where the City has water available for testing, it may be furnished without charge upon arrangement with the Director of Public Works. All costs of tapping and piping shall be borne by the Contractor unless otherwise specified in the Special Conditions. Where water is not available from the City, the Contractor shall provide water from an approved source for testing and the cost thereof shall be included in other unit contract prices of the work.

Hydrostatic tests shall be performed on every complete section of water main between two gate valve or equivalent (in the determination of the City Engineer), and each valve shall withstand the same test pressure as the pipe, with no pressure active in the section of pipe beyond the closed gate valves. A test plan, indicating working and test pressures and test locations, shall be submitted to the City Engineer for approval prior to testing.

At points where pressure reaction and movement may occur, such as at bends, tees and plugs, the pipe shall be properly blocked or braced. Cast-in-place concrete blocking shall be have achieved adequate cure time to provide required compressive strength for support at test pressures. Where permanent blocking is not required, the Contractor shall furnish and install temporary blocking and remove it after testing. All costs to the Contractor for installing temporary blocking shall be included in the unit bid prices for the water mains.

703.2.12A.1 Test restrictions.

1. Test pressure shall not exceed pipe or thrust-restraint design pressures.
2. The hydrostatic test shall be of at least a two (2) hour duration.
3. Test pressure shall not vary by more than ±5 psi for the duration of the test.
4. Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure. A test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressure, the test setup should include a provision independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or the valve can be fully opened.
5. The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
6. When the elevation difference between highest and lowest points in the pipe section under test results in the test pressure at the lowest point exceeding pipe, thrust-restraint, and/or valve pressure ratings, the test pressure may be adjusted with the approval of the City Engineer with the following considerations:

    a. Test pressures shall not be less than 1.25 times the working pressure at the highest point along the test section or supplemental valving shall be installed.
    b. Tests at adjusted pressures may require the test setup to include a provision to test the piping independent of the valve (test through the valve), then upon completion of the pipe test reduce the line pressure and retest at the rated valve pressure.

703.2.12A.2 Pressurization. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the highest working pressure in the section under test, but not less than 225 psi. Each valved section of pipe shall be slowly filled with water, and the specified test pressure (based on the elevation at the highest point of the line or section under the test and

corrected to the elevation of the test gauge) shall be applied using a pump connected to the pipe in a manner satisfactory to the City Engineer. Valves shall not be operated in either the opened or closed direction at differential pressures above the rated test pressure. The system should be allowed to stabilize at the test pressure for a minimum of one (1) hour before conducting the hydrostatic test.

703.2.12A.3 Air Removal. Before applying the specified test pressure, air shall be expelled completely from the section of piping under test. If permanent air vents are not located at all high points, corporation stops shall be installed at these points to expel the air as the line is filled with water. After the air has been expelled, the corporation stops shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation stops shall be removed and the pipe plugged with brass plugs. The location of the brass plugs shall be indicated on the record drawings.

703.2.12A.4 Examination. Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, and joints that are discovered during following the pressure test shall be repaired or replaced with new reliable material, and the test repeated until satisfactory results are obtained.

703.2.12A.5 Testing allowance defined. Testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure to within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure in a test section over a period of time.

703.2.12A.6 Testing allowance. No pipe installation will be accepted if the amount of makeup water is greater than that determined by the following formula:

In inch-pound units,

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where,

L = testing allowance (makeup water), in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

This formula is based on a testing allowance of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

703.2.12A.6.1 Testing allowance at various pressures is shown in the Table 1 at the end of the section.

703.2.12A.6.2 When testing against closed metal seated valves an additional testing allowance per closed valve of 0.0078 gal/h/in. of nominal valve size shall be allowed.

703.2.12A.6.3 When hydrants are in the test section, the test shall be made against the main valve at the hydrant line.

703.2.12A.6.4 Makeup water shall be extracted from a container of sufficient size and shape to enable accurate measurement by the City Inspector. The container size shall not exceed 5 gallons without prior approval by the City Engineer.

703.2.12A.7 Acceptance of installation. Acceptance shall be determined on the basis of testing allowance. If any test of laid pipe discloses a testing allowance greater than that specified, the Contractor shall, at his own expense, locate and repair defective joints, make repairs or replacements to provide a water system capable of achieving the testing allowance.

703.2.12A.7.1 All visible leaks are to be repaired regardless of the allowance used for testing.

703.2.12B Water Service Line Hydrostatic Testing: The Contractor may select to perform hydrostatic testing of water service lines independently of the water main. The Contractor shall subject the pipe to a hydrostatic pressure of 50 percent higher than the highest working pressure, but not less than 150 psi for a period of not less than one (1) hour.

703.2.12C Fire Line, Hydrants and Hydrant Service Line Hydrostatic Testing: The Contractor shall perform hydrostatic testing of fire lines, hydrants and hydrant service lines independently of the water main. The Contractor shall comply with the requirements for testing water mains except the hydrant and hydrant service line hydrostatic test pressure shall be 200 psi for a duration of not less than one (1) hour.

703.2.12D Testing Extensions from Existing Water Mains and Stubs: Where an existing water main is extended, the connection of the new pipe to existing pipe shall not be made until after hydrostatic tests have been made to the required pressure on the new main (in both directions against new valves, where applicable). This shall be accomplished by a temporary cap or plug installed on the end of the new pipe as close as possible to the existing pipe for testing purposes.

A hydrostatic test shall be performed on the new extension at the required test pressure. The connection to the existing main shall be visually observed for leaks, at system pressure, by the City Inspector following connection to the existing system and prior to backfilling.

703.2.12E Records and Documentation: Hydrostatic tests shall be recorded by the Contractor with the City Inspector present. Records shall contain the length of pipe tested, size of pipe, type of pipe, rated working pressure of pipe, time and duration of test(s), pressure(s) used, makeup water volume used, complete list of test equipment used, list of personnel performing the test(s), and any comments about the test. Test records shall be submitted to the City before the water line will be accepted.

703.2.13 Disinfection of Water Lines: Before being placed in service, all new water lines and repaired portions or extensions of existing mains shall be chlorinated and flushed in accordance with these standards and AWWA C651, latest update, included as Appendices 703A, 703B, and 703C. The Contractor shall review the proposed method of chlorination with the City Engineer prior to water line construction and shall notify the City Inspector 48 hours (two full working days) prior to chlorination of the water line.

703.2.13A Flushing: The Contractor shall be responsible for maintaining the disinfected condition of existing water lines when connecting to, cutting into, repairing, or tapping existing water lines. Disinfection procedures for these operations shall be in accordance with the AWWA Standard C651, latest update, included as Appendix 703A, and Appendices 703B and 703C. Mains shall be flushed without using hydrants, unless approved by the City Engineer. Taps required by the Contractor for chlorination or flushing purposes shall be provided by the Contractor as part of the construction of water mains, unless otherwise provided in the Special Conditions.

The Contractor shall be responsible for disposal of heavily chlorinated treated water flushed from mains and shall neutralize the chlorinated water in accordance with Appendix 703C for protection of the environment before disposal into any natural drainage channel, sanitary sewer, storm drain, curb and gutter, or onto the ground, unless approved by the City Engineer. ***The Contractor shall be responsible to confirm the acceptable point of discharge with the City Engineer prior to chlorination of the water line.***

703.2.13B 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 pressures.

703.2.13C Bacteriological Samples: Twenty-four (24) hours after the line is flushed by the Contractor, the Contractor shall take three (3) 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 Utah State Board of Health, "Public Drinking Water Regulations", or other similar applicable regulating agencies. Sample results shall be sent to

the Public Works Director, P.O. Box 1480, Park City, Utah 84060, and the City Engineer (same address).

703.2.13D Records and Documentation: All disinfection operations shall be observed and recorded by the Inspector. Records shall contain the length of pipe disinfected, size of pipe, type of pipe, location of pipe, date, time, and duration of disinfecting operations, complete list of equipment used and personnel performing the disinfection, and any comments about the disinfection operations. Three sets of these records shall be submitted to the Engineer.

703.2.13E 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 re-flushing and re-chlorinating***.

703.2.14 Concrete Blocking: Concrete thrust blocking shall be placed at bends, tees, and crosses or as directed by the Engineer. Blocking shall be Class 4000 (1-1/2" minus aggregate) concrete mix placed in place, unless pre-cast blocks are authorized by the Engineer (*see Standard Drawings 703-C*).

Concrete blocking, when placed as indicated on the Standard Drawings, shall be bearing against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings. Payment for blocking will be included in the unit price for water line installed.

703.3 Measurement and Payment:

703.3.01 Measurement of Water Mains: Measurement shall be based on the slope distance from point to point. The point of beginning ro ending of measurement in any particular run of pipe shall be the vertical intersection of the center line of the pipe measured with the center line of the intersecting pipe, or with the beginning or ending of any new pipe laid. No deductions will be made for the linear length of fittings, valves, couplings, etc. contained within the measured length. At changes in pipe size connected by a reducer, the point of measurement shall be taken as the mid-point of the reducer.

703.3.02 Payment for Water Mains and Water Service Connections: The unit contract price per linear foot for each size and kind of pipe shall be full compensation for furnishing the pipe and all fittings required for complete installation along the run of each pipe size and kind. The unit contract price per linear foot shall also include all costs of every nature for laying and jointing of the pipe and fittings along each run, and also all costs for the testing, flushing and disinfecting of the pipe line.

In case any fittings are omitted in the construction by direction of the Engineer, or if any additional ones not shown on the Approved Plans are required, down or up, will be made to the Contractor upon basis of the unit contract price for "Extra Fittings". If there is no such item in the proposal, the adjustment will be made upon a negotiated basis.

Excavation and backfilling of trenches, pipe line, accessories such as hydrants, hydrant connections, gate valves, etc., will be paid for separately as provided in Sections 702, 706 and 704, respectively.

703.3.03 Partial Payment for Materials Delivered: Pipe and fittings delivered to the trench side but not installed will be included in the estimate of monthly payments to the Contractor.

703.3.04 Trench Excavation and Backfill for Water Service Connections: Trench excavation and backfill for water service connections shall be measured and paid for in accordance with Section 702.3.02.

TABLE 1 ALLOWABLE LEAKAGE PER 1000 FEET OF PIPELINE (gph)									
Avg. Test Pressure (psi)	**Nominal Pipe Diameter (inches)**								
	3	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
250	.36	.47	.71	.95	1.19	1.42	1.66	1.90	2.14
225	.34	.45	.68	.90	1.13	1.58	1.58	1.80	2.03
220	.32	.43	.64	.85	1.06	1.28	1.48	1.70	1.91
175	.30	.40	.59	.80	.99	1.19	1.39	1.59	1.79
150	.28	.37	.55	.74	.92	1.10	1.29	1.47	1.66
125	.25	.34	.50	.67	.84	1.01	1.18	1.34	1.51
100	.23	.30	.45	.60	.75	.90	1.05	1.20	1.35

*EXCERPTED FROM AWWA C600

APPENDIX 703A

DISINFECTING WATER MAINS

excerpted from ANSI/AWWA C651

703A.1 General:

703A.1.1 Scope: This standard presents essential procedures for disinfecting new and repaired water mains. All new water mains shall be disinfected before they are placed in service. All water mains taken out of service for inspecting, repairing, or other activity that might lead to contamination of water shall be disinfected before they are returned to service.

703A.1.2 References: This standard references the following documents. The latest current edition of each forms a part of this standard where and to the extent specified herein. In case of any conflict, the requirements of this standard shall prevail.

AWWA B300 - Standard for Hypochlorites.
AWWA B301 - Standard for Liquid Chlorine.
Simplified Procedures for Water Examination. AWWA Manual M12.AWWA, Denver, Colorado (1978).
Standard Methods for the Examination of Water and Wastewater. APHA, AWWA and WPCF Washington, D.C. (16th ed., 1984). Additional materials relating to activity under this standard include: Material Safety data Sheets for forms of chlorine used (provided by suppliers). Chlorine Institute, Inc. Chlorine Manual. AWWA - Water Quality and Treatment. AWWA - Introduction to Water Treatment.
Safety Practice for water Utilities. AWWA Manual M3. AWWA, Denver, Colorado (1983). Water Chlorination Principles and Practices. AWWA Manual M20. AWWA, Denver, Colorado (1973).

703A.1.3 Record of Compliance: The record of compliance shall be the bacteriological test results certifying the water sampled from the water main to be free of coliform bacteria contamination.

703A.2.0 Forms Of Chlorine For Disinfection: The forms of chlorine that may be used in the disinfection operations are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets.

703A.2.1 Liquid Chlorine: Liquid chlorine contains 100-percent available chlorine and is packaged in steel containers usually of 100-lb., 150-lb., or 1-ton net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water to be chlorinated; (2) under the direct supervision of a person who is familiar with the physiological, chemical, and physical properties of liquid chlorine, and who is trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices re observed to protect working personnel and the public.

703A.2.2 Sodium Hypochlorite: Sodium hypochlorite is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 qt. to 5 gal.; containers of 30 gal. or larger sizes may be available in some areas. Sodium hypochlorite contains approximately 5percent to 15 percent available chlorine, but care must be used in control of conditions and length of storage to minimize its deterioration. (Available chlorine is expressed as a percent of weight when the concentration is 5 percent or less, and usually as a percent of volume for higher concentrations. Percent X 10 = grams of available chlorine per liter of hypochlorite).

703A.2.3 Calcium Hypochlorite. Calcium hypochlorite is available in granular form or in approximately 5-g tablets, and contains approximately 65-percent available chlorine by weight. The material should be stored in a cool, dry and dark environment to minimize its deterioration.

703A.3.0 Basic Disinfection Procedure: The basic disinfection procedure consists of:

1. Preventing contaminating materials from entering the water main during storage, construction or repair.
2. Removing, by flushing or other means, those materials that may have entered the water main.
3. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
4. Determining the bacteriological quality by laboratory test after disinfection.

703A.4.0 preventive and Corrective Measures During Construction: Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is, therefore, essential that the procedures of this section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination.

703A.4.1 Keeping Pipe Clean And Dry: Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination/ Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. All openings in the pipe line shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used where it is determined that watertight plugs are not practicable and where thorough cleaning will be performed by flushing or other means.

Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the less likelihood of contamination.

703A.4.2 Joints: Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

703A.4.3 Packing Materials: Yarning or packing material shall consist of molded or tubular rubber rings, or rope of treated paper or other approved materials. Materials such as jute or help shall not be used. Packing material shall be handled in a manner that avoids contamination. If asbestos rope is used, it shall be handled in a manner that prevents asbestos from being introduced into the water-carrying portion of the pipe.

703A.4.4 Sealing Materials: No contaminated material or any material capable of supporting prolific growth of microorganisms shall be used for sealing joints. Sealing material or gaskets shall be handled in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in closed containers and shall be kept clean.

703A.4.5 Cleaning and Swabbing: If dirt enters the pipe, and in the opinion of the owner's engineer or job superintendent the dirt will not be removed by the flushing operation, the interior of the pipe shall be cleaned by mechanical means and then shall be swabbed with a 1-percent hypochlorite disinfecting solution. Cleaning with the use of a pig, swab, or "go-devil" should be undertaken only when the owner's engineer or job superintendent has determined that such operation will not force mud or debris into pipe-joint spaces.

703A.4.6 Wet-Trench Construction: If it is not possible to keep the pipe and fittings dry during installation, every effort shall be made to assure that any of the water that may enter the pipe-joint spaces contains an available-chlorine concentration of approximately 25 mg/L. This may be accomplished by adding calcium hypochlorite granules or tablets to each length of pipe before it is lowered into a wet trench, or by treating the trench water with hypochlorite tablets.

703A.4.7 Flooding By Storm Or Accident During Construction: If the main is flooded during construction, it shall be cleared of the flood water by draining and flushing with potable water until the main is clean. The section exposed to the flood water shall then be filled with a chlorinated potable water that, at the end of a 24-hour holding period, will have a free chlorine residual of not less than 25 mg/L. The chlorinated water may then be drained or flushed from the main. After construction is completed, the main shall be disinfected using the continuous-feed or slug method.

703A.5.0 Methods Of Chlorination: Three methods of chlorination are explained in this section: tablet, continuous feed, and slug. Information in the forward will be helpful in determining the method to be used. The tablet method gives an average chlorine dose of approximately 25 mg/L; and the continuous-feed method gives a 24-hour chlorine residual of not less than 10 mg/L and the slug method gives a 3-hour exposure of not less than 50 mg/L free chlorine.

703A.5.1 Tablet Method: The tablet method consists of placing calcium hypochlorite granules and tablets in the water main as it is being installed and filling the main with potable water when installation is completed.

This method may be used only if the pipes and appurtenances are kept clean and dry during construction.

703A.5.1.1 Placing of calcium hy7pochlorite granules. During construction, calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 foot intervals. The quantity of granules shall be as shown in Table 1.

WARNING: This procedure must not be used on solvent-welded plastic or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

TABLE 1 OUNCES OF CALCIUM HYPOCHLORITE GRANULES TO BE PLACED AT BEGINNING OF MAIN AND AT EACH 500 FOOT INTERVAL	
Pipe Diameter - Inch	**Calcium Hypochlorite Granules - Ounce**
4	0.5
6	1.0
8	2.0
12	4.0
16 and larger	8.0

703A.5.1.2 Placing of Calcium Hypochlorite Tablets: During construction, 5-g calcium hypochlorite tablets shall be placed in each section of pipe and also one such tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. The number of 5-g tablets required for each pipe section shall be $0.0112d^2L$ rounded to the next higher integer, where d is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet. TABLE 2 shows the number of tablets required for commonly used sizes of pipe. The tablets shall be attached by an adhesive such as Permatex No. 1 or equal. There shall be no adhesive on the tablet except on the broad side attached to the surface or the pipe. Attach all the tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section so it can be readily determined that the pipe is installed with the tablets at the top.

703A.5.1.3 Filling and Contact: When installation has been completed, the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than 1 ft/s. Precautions shall be taken to assure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. If the water temperature is less than 41 degrees F. (5 degrees C.), the water shall remain in the pipe for at least 48 hours. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service.

TABLE 2 NUMBER OF 5-G CALCIUM HYPOCHLORITE TABLETS REQUIRED FOR DOSE OF 25 mg/L*					
	Length of Pipe (Feet)				
Pipe Diameter inch	13 or less	18	20	30	40
	Number of 5-G Calcium Hypochlorite Tablets				
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

*Based on 3.25-g available chlorine per tablet rounded to next nigher number.

703A.5.2 Continuous-Feed Method: The continuous-feed method consists of placing calcium hypochlorite granules in the main during construction (optional), completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with potable water chlorinated so that after a 24-hour holding period in the main there will be a free chlorine residual of not less than 10 mg/L.

703A.5.2.1 Placing Calcium Hypochlorite Granules: At the option of the engineer, calcium hypochlorite granules shall be placed in pipe sections as specified in Section 5.1.1. The purpose of this procedure is to provide a strong chlorine concentration in the first flow of flushing water that flows down the main. This is recommended particularly where the type of pipe is such that this first flow of water will flow into annular spaces at pipe joints.

703A.5.2.2 Preliminary Flushing: Before being chlorinated, the main shall b filled to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 2.4 feet/second unless the owner's engineer or job super8intendent determines that conditions do not permit the required flow to be discharged to waste. TABLE 3 shows the rates of flow required to produce a velocity of 2.5 feet/second in pipes of various sizes. Note that flushing is no substitute for preventive measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity.

In mains of 24 inches or larger diameter, an acceptable alternative to flushing is to broom-sweep the main, carefully removing all sweepings prior to chlorinating the main.

703A.5.2.3 Chlorinating the Main: Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid water main. In the absence of a meter, the rate may be approximated by methods such as placing a Pitot gauge in the discharge, measuring the time to fill a container of known volume, or measuring the trajectory of the discharge and using the formula shown in FIGURE 1.

TABLE 3 REQUIRED FLOW AND OPENINGS TO FLUSH PIPELINES (40 psi RESIDUAL PRESSURE IN WATER MAIN)*

Pipe Diameter inches	Flow Required to produce 2.5 ft/s (approx) velocity in main gpm	Size of tap inches 1-1/2 Number of Taps on Pipe# 1	Size of tap inches 1-1/2 Number of Taps on Pipe# 2	Number of 2-1/2 in. Hydrant Outlets*
4	100	1	–	1
6	200	–	1	1
8	400	–	2	1
10	600	–	3	2
12	900	–	–	2
16	1600	–	–	4

*With a 40 psi pressure in the main with the hydrant flowing to atmosphere, a 2-1/2 inch hydrant outlet will discharge approximately 100-0 gpm and a 4-1/2 inch hydrant outlet will discharge approximately 2500 gpm.

#Number of taps on pipe based on discharge through 5 feet of galvanized iron (GI) pipe with one 90 degree elbow.

At a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals in accordance with the procedures described in the current edition of *Standard Methods for the Examination of Water or Wastewater* or AWWA Manual M12, or using appro8priate chlorine test kits. (See Appendix A).

TABLE 4 gives the amount of chlorine required for each 100 feet of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires 1 lb. Of calcium hypochlorite in 8 gallons of water.

During the application of chlorine, valves shall be positioned so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.

TABLE 4 CHLORINE REQUIRED TO PRODUCE 25 mg/L CONCENTRATION IN 100 FEET OF PIPE BY DIAMETER

Pipe Diameter *Inches*	**100 Percent Chlorine *Pound***	**1 Percent Chlorine Solution *Gallon***
4	.013	.16
6	.030	.36
8	.054	.65
10	.085	1.02
12	.120	1.44
16	.217	2.60

Direct-feed chlorinator, which operates solely from gas pressure in the chlorine cylinder, shall not be used for application of liquid chlorine. (The danger of using direct-feed chlorinators is that water pressure in the main can exceed gas pressure in the chlorine cylinder. This allows a backflow of water into the cylinder, resulting in severe cylinder corrosion and escape of chlorine gas). The preferred equipment for applying liquid chlorine is a solution-fed, vacuum-operated chlorinator and a booster pump. The vacuum-operated chlorinator mixes the chlorine gas in solution water; the booster pump injects the chlorine-gas solution into the main to be disinfected. Hypochlorite solutions may be applied to the water main with a gasoline or electrically powered chemical-fed pump designed for feeding chlorine solutions. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressure that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the main.

703A.5.3 Slug Method: The slug method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates, and slowly flowing through the mains a slug of water dosed with chlorine to a concentration of 100 mg/L. The slow flow ensures that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than 3 hours.

703A.5.3.1 Placing Calcium Hypochlorite Granules: Same as Section 5.2.1.

703A.5.3.2 Preliminary Flushing. Same as Section 5.2.2.

703A.5.3.3 Chlorinating the Main:

1. Same as Section 5.2.3(1)
2. At a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine. To ensure that this concentration is provided, the chlorine concentration should be measured at regular intervals. The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or "slug" of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least 3 hours.
3. The free chlorine residual shall be measured in the slug as it moves through the main. If a any time it drops below 50 mg/L, the flow shall be stopped, chlorination equipment shall be relocat4d at the head of the slug, and, as flow is resumed, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.
4. As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

703A.6.0 Final Flushing:

703A.6.1 Clearing the Main of Heavily Chlorinated Water: After the application retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.

703A.6.2 Disposing of Heavily Chlorinated Water: The environment to which the chlorinated water is to be discharged shall be inspected. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. (See Appendix B for neutralizing chemicals). Where necessary, federal, state and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

703A.7.0 Bacteriological Tests

703A.7.1 Standard Conditions: After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line, shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater*, and shall show the absence of coliform organisms. A standard plate count may be required at the option of the engineer. At least one sample shall be collected from the new main and one from each branch. In case of extremely long mains, it is desirable that samples be collected along the length of the line as well as its end.

703A.7.2 Special Conditions: If during construction, the trench water has entered the main, or if in the opinion of the owner's engineer or job superintendent, excessive quantities of dirt or debris have entered the main, bacteriological samples shall be taken at intervals of approximately 200 feet and shall be identified by location. Samples shall be taken of water that has stood in the main for at least 16 h9ours after final flushing has been completed.

703A.7.3 Sampling Procedure: Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by *Standard Methods for the Examination of Water and Wastewater*. No hose or fire hydrant shall be used in collection of samples. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

703A.8.0 Redisinfection: If the initial disinfection fails to produce satisfactory bacteriological samples, the main may be reflushed and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be rechlorinated by the continuous-feed or slug method of chlorination until satisfactory results are obtained.

NOTE: High velocities in the existing system, resulting from flushing the new main may disturb sediment that has accumulated in the existing mains. When check samples are taken, it si well to sample water entering the new main.

703A.9.0 Disinfection Procedures When Cutting Into or Repairing Existing Mains: The following procedures apply primarily when mains are wholly or partially dewatered. After the appropriate procedures have been completed, the main may be returned to service prior to completion of bacteriological testing in order to minimize the time customers are out of water. Leaks or breaks that are repaired with clamping devices while the mains remain full of pressurized water present little danger of contamination and require no disinfection.

703A.9.1 Trench Treatment: When an old main is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

703A.9.2 Swabbing with Hypochlorite Solution: The interiors of all pipe and fittings (particularly couplings and sleeves) used in making the repairs shall be swabbed or sprayed with a 1 percent hypochlorite solution before they are installed.

703A.9.3 Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.

703A.9.4 Slug Chlorination: Where practical, in addition to the procedures above, a section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in Section 5.3, except that the dose may be increased to as much as 300 mg/L and the contact time reduced to as little as 15 minutes. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the water is free of noticeable chlorine odor.

703A.9.5 Sampling: Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedure's effectiveness. If the direction of flow is unknown, samples shall be taken on each side of the main break. If positive bacteriological samples are recorded, the situation shall be evaluated by a qualified engineer who can determine corrective action, and daily sampling shall be continued until two consecutive samples are recorded.

703A.10.0 Special Procedure for Caulked Tapping Sleeves: Before a tapping sleeve is installed, the exterior of the main to be tapped shall be thoroughly cleaned, and the interior surface of the sleeve shall be lightly dusted with calcium hypochlorite powder.

Tapping sleeves are used to avoid shutting down the main to be tapped. After the tap is made, it is impossible to disinfect the annulus without shutting down the main and removing the sleeve. The space between the tapping sleeve and the tapped pipe is normally ½-inch, more or less, so that as little as 100 mg of calcium hypochlorite powder per square foot will provide a chlorine concentration of over 50 mg/L.

APPENDIX 703B

CHLORINE RESIDUAL TESTING

This appendix is for information only and is not a part of AWWA C651

SECTION A.1: DPD DROP DILUTION METHOD (FOR FIELD TEST)

The DPD drop dilution method of approximating total residual chlorine is suitable for concentrations above 10 mg/L, such as are applied in the disinfection of water mains or tanks.

Apparatus:

1. A graduated cylinder for measuring distilled water.
2. An automatic or safety pipette.
3. Two dropping pipettes that deliver a 1 MI sample in 20 drops. One pipette is for dispensing the water sample and the other is for dispensing the DPD and buffer solutions. The pipettees should not be interchanged.
4. A comparator kit containing a suitable range of standards.

Reagents:

1. DPD indicator solution. Prepare as prescribed in *Standard Methods for the Examination of Water and Wastewater*, (16th ed.), Section 408E, P. 309.
2. Phosphate buffer solution. Prepare as prescribed in *Standard Methods for the Examination of Water and Wastewater*, (16th ed.), Section 408E, P. 309.

Procedure:

1. Add 10 drops of DPD solution and 10 drops of buffer solution (or 20 drops of combined DPD-buffer solution) to a comparator cell.
2. Fill the comparator cell to the 10 MI mark with distilled water.
3. With a dropping pipette, add the water sample one drop at a time, allowing mixing, until a red color is formed that matches one of the color standards.
4. Record the total number of drops used and the final chlorine reading obtained (that is, the chlorine reading of the matched standard).
5. Calculate the milligrams per liter of free residual chlorine as follows:

$$mg/L\ Chlorine = \frac{reading \times 200}{Drops\ of\ sample}$$

SECTION A.2: HIGH-RANGE CHLORINE TEST KITS

Several manufacturers produce high-range chlorine test kits that are inexpensive, easy to use, and satisfactory for the precision required.

APPENDIX 703C

DISPOSAL OF HEAVILY CHLORINATED WATER

This appendix is for information only and is not a part of AWWA C651

1. Check with Snyderville Basin Water Reclamation District for conditions of disposal to sanitary sewer.

2. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in TABLE B.1.

TABLE B.1.
POUNDS OF CHEMICALS REQUIRED TO NEUTRALIZE VARIOUS RESIDUAL CHLORINE CONCENTRATIONS IN 100,000 GALLONS OF WATER*

Residual Chlorine Concentration mg/L	Sulfur Dioxide (SO_2)	Sodium Bisulfate ($NaHSO_3$)	Sodium Sulfite (Na_2SO_3)	Sodium Thiosulfate ($Na_2S_2O_3$-$5H_2O$)
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

*Except for residual chlorine concentration, all amounts are in pounds.

APPENDIX 703D

NOTES ON PROCEDURES FOR SOIL SURVEY TESTS AND OBSERVATIONS AND THEIR INTERPRETATION TO DETERMINE WHETHER POLYETHYLENE ENCASEMENT SHOULD BE USED

This appendix is for information only and is not part of ANSI/AWWA C105.A21.5

In the appraisal of soil and other conditions that affect the corrosion rate of ductile-iron pipe*, many factors must always be considered. They are outlined here. A method of evaluating and interpreting each factor and a method of weighting each factor to determine whether polyethylene encasement should be used are subsequently described.

These methods should be employed only by qualified personnel who are experienced in soil analysis and evaluation of conditions potentially corrosive to gray and ductile-iron pipe. Factors such as moisture content, soil temperature, location of soil sample with respect to pipe, time between removal of soil sample and testing, and other factors can significantly affect the soil-test evaluation. For example, certain soil environments are generally accepted to be potentially corrosive to ductile cast-iron pipe, and therefore, do not require evaluation to determine the need for corrosion protection. These environments include, but are not limited to, coal, cinders, muck, peat, mine wastes, and landfill areas high in foreign materials. Existing installations and the potential for stray direct-current corrosion should also be part of the evaluation.

Soil Survey Tests and Observations

Factors to consider when determining the need for polyethylene encasement of pipe are as follows:

1. Earth resistivity
   a. Four-pin
   b. Single-probe
   c, Saturated-Sample (soil-box)
2. PH
3. Oxidation-reduction (redox) potential
4. Sulfides
   a. Azide (qualitative)
5. Moisture content (relative)
   a. Prevalence
6. Soil description
   a. Particle size
   b. Uniformity
   c. Type
   d. Color
7. Potential stray direct current
   a. Nearby cathodic protection utilizing rectifiers
   b. Railroads (electric)
   c. Industrial equipment, including welding equipment
   d. Mine transportation equipment

*NOTE: The information contained in Appendix 703C is also applicable to gray-iron pipe. Although gray-iron pipe is no longer produced in the United States, many miles of this product remain in service.

8. Experience with existing installation in the area.

1. *Earth Resistivity*. There are three methods for determining earth resistivity: four-pin, single-probe and soil-box. In the field, a four-pin determination should be made with pins spaced at approximate pipe depth. This method yields an average of resistivity from the surface to a depth equal to pin spacing. However, results are sometimes difficult to interpret where dry topsoil is underlain with wetter soils and where soil types vary with depth. The Wenner configuration is used in connection with a soil-resistivity meter, which is available with varying ranges of resistance. For all-around use, a meter with a capacity of up to 10^4 ohms is suggested because it permits both field and laboratory testing of most soils.

   Because of this difficulty in the interpretation, the same meter may be used with a single probe that yields resistivity at the point of the probe. A boring is made into the subsoil so that the probe may be pushed into the soil at the desired depth.

   Because the soil may not be typically wet, a sample should be removed for saturated resistivity determination. This may be accomplished with a laboratory unit that permits the introduction of water to saturation, therefore simulating saturated field conditions. The unit is used in conjunction with a soil-resistivity meter.

   The interpretation of the results of resistivity measurements is extremely important. A determination on a four-pin reading with dry topsoil averaged with wetter subsoil would probably be inaccurate. Only by determining resistivity in soil at pipe depth can an accurate interpretation be made. Also, the local situation should be determined concerning groundwater table, the presence of shallow groundwater and approximate percentage of time the soil is likely to be water saturated.

   With ductile-iron pipe, corrosion protection provided by products of corrosion is enhanced if there are dry periods during each year. Dry periods seem to permit hardening or toughening of the corrosion scale or products, which then become impervious and serve as better insulators.

   In making field determinations of resistivity, temperature is important. The resistivity increases as temperature decreases. As the water in the soil approaches freezing, resistivity increases greatly, and therefore, is not reliable. Field determinations under frozen soil conditions should be avoided. Reliable results under these conditions can be obtained only by collection of suitable subsoil samples for analysis under laboratory conditions at a proper temperature.

   Interpretation of resistivity data. Because of the wide variance in results obtained using the methods described, it is difficult to interpret any single reading without knowing which method was used to obtain the reading. The interpretation should be based on the lowest reading obtained, with consideration to other conditions, such as typical moisture content of the soil. Because of the lack of exact correlation between experiences and resistivity, it is necessary to assign ranges of resistivity rather than specific numbers. Table A.1 shows the points assigned to various ranges of resistivity. These points, when considered along with points assigned to other soil characteristics (also shown in Table A.1), are significant.

2. PH. In the pH range of 0.0 to 4.0, soil serves well as an electrolyte. In the pH range of 6.5 to 7.5, soil conditions are optimum for sulfate reduction. In the pH range of 8.5 to 14.0, soils are generally high in dissolved salts, yielding a low soil resistivity.

   In testing pH, a combination pH electrode is pushed into the soil sample, and a direct

reading is made, following suitable temperature setting on the instrument. Normal procedures are followed for standardization.

TABLE A.1 SOIL TEST EVALUATION

Soil Characteristics Based on Samples Taken Down to Pipe Depth		*Points**
Resistivity - ohm-cm (based on water-saturated soil box)		
	<71,500	10
	≥1,500-1,800	8
	>1,800-2,100	5
	>2,100-2,500	2
	>2,500-3,000	1
	>3,000	0
pH:		
	0-2	5
	2-4	3
	4-6.5	0
	6.5-7.5	0†
	7.5-8.5	0
	>8.5	3
Redox Potential:		
	>+100mV	0
	+50 to +100mV	3.5
	0 to +50mV	4
	Negative	5
Sulfides:		
	Positive	3.5
	Trace	2
	Negative	
Moisture:		
	Poor drainage, continuously wet	2
	Fair drainage, generally moist	
	Good drainage, generally dry	0

*Ten points means that soil is corrosive to gray or ductile cast-iron pipe; protection is indicated,.
†If sulfides are presented and low or negative redox-potential results are obtained give three points for this range.

3. *Oxidation-Reduction (Redox) Potential.* The oxidation-reduction (redox) potential of a soil is significant because the most common sulfate-reducing bacteria can live only under anaerobic conditions. A redox potential greater than +100mV demonstrates that the soil is sufficiently aerated, preventing sulfate reducers from forming. Potentials of 0 to +1-mV may or may not indicate anaerobic conditions; however, a negative redox potential definitely indicates the anaerobic conditions under which sulfate reducers thrive. The redox test is

accomplished using a pH meter with a combination ORP electrode inserted into the soil sample. It should be noted that the soil samples removed from a boring or excavation can undergo a change in redox potential when exposed to air. These samples should be tested immediately after removal from the excavation. Heavy clays, muck, and organic soils are often anaerobic. For this reason, these soils should be regarded as potentially corrosive.

4. *Sulfides*. The sulfide determination is recommended because of its field expediency. A positive sulfide reaction reveals a potential problem due to sulfate-reducing bacteria. The sodium azide-iodine qualitative test is used. In this determination, a solution of 3 percent sodium azide in a 0.1*N* iodine solution is introduced into a test tube containing a sample of the soil in question. Sulfides catalyze the reaction between sodium azide and iodine, with the resulting in nitrogen. If strong bubbling or foaming results, sulfides are present, as are sulfate-reducing bacteria. If very slight bubbling is noted, sulfides are probably present in small concentration, and the result is noted as a trace.

5. *Moisture Content*. Since prevailing moisture content is extremely important to all soil corrosion, every effort must be made to determine this condition. It is not necessary that the specific moisture content of a sol sample be determined, because the content probably varies throughout the year. However, local authorities should observe the soil moisture conditions many times throughout the year. (Although mentioned under item 1, earth resistivity, this variability factor is reiterated to emphasize the importance of notation.)

6. *Soil Description*. In each investigation, soil types should be completely described. The description should include color and physical characteristics, such as particle size, plasticity, friability and uniformity. Observation and testing will reveal whether the soil is high in organic content; this should be noted. In a given area, corrosivity may often be reflected in certain types and colors of soil. This information is valuable for future investigations or for determining the most likely soil to suspect.

   Soil uniformity is important because of the possible development of local corrosion cells caused by the difference in potential, such as different soil types contacting the pipe. The same is true for uniformity of aeration. If one segment of soil contains more oxygen than a neighboring segment, a corrosion cell can develop from the difference in potential. This cell is known as a differential aeration cell.

7. *Potential stray direct current*. All soil surveys should consider the possibility of stray direct current which might interfere with the ductile-iron pipe installation. The widespread use of rectifiers and ground beds for cathodic protection of underground structures has increased the potential of stray direct current. The proximity of these cathodic protection systems should be noted. Among other potential sources of stray direct current are electric railways, industrial equipment (including welding equipment), and mine-transportation equipment.

   Normally, the amount of stray current influence from cathodic protection systems on an electrically discontinuous ductile-iron pipeline will be negligible. It is not detrimental to the expected life of the system, unless the pipeline comes close to an impressed-current, cathodic-protection anode bed where the current density is high. When ductile-iron pipeline are exposed to high-density stray current environments, the pipeline should be re-routed or the anode bed relocated. If neither of these options is feasible, the ductile-iron pipe in this area should be electrically bonded together, electrically isolated from adjacent pipe, polyethylene encased, and appropriate test leads and “current drain” installed.

8. *Experience With Existing Installations*. The best information on soil corrosivity with respect to ductile cast-iron pipe results from experience with these material in the area under investigation. Every effort should be made to acquire such data by questioning local officials and, if possible, by observing existing installations.

Soil-Test Evaluation

When the soil-test procedures described in this standard are employed, the following tests are considered in evaluating corrosivity of the soil: resistivity, pH, redox potential, sulfides, and moisture. For each of these tests, results are categorized according to the contribution to corrosivity. Point values are assigned, based on experience with ductile cast-iron pipe (see Table A,1). When results of these five test/observations are available, the assigned points are totaled.
If the sum is equal to 10 or more, the soil is corrosive to ductile-iron pipe, and protection against exterior corrosion should be provided. This system of evaluation is limited to soil corrosion and does not include consideration of stray direct current.

General. These notes address only with ductile-iron pipe, the soil environment in which the pipe will serve, and methods of determining a need for polyethylene encasement.

Uniquely Severe Environments

Research has shown that polyethylene encasement alone is a viable corrosion protection system for ductile- and gray-iron pipe in most environments. However, other options should be considered for environments where all the following characteristics co-exist: (1) soil resistivity $\leq$500 ohm-cm; (2) anaerobic conditions in which sulfate-reducing bacteria thrive [neutral pH (6.5 to 7.5), low or negative redox-potential (negative to +100 mV), and the presence of sulfides (positive or trace)]; and (3) water table intermittently or continually above the invert of the pipe.

APPENDIX 703E

AMERICAN NATIONAL STANDARD FOR POLYETHYLENE ENCASEMENT FOR DUCTILE-IRON PIPING FOR WATER AND OTHER LIQUIDS

Section 5.1 Scope: This standard covers materials and installation procedures for polyethylene encasement to be applied to underground installations of ductile-iron pipe. This standard also may be used for polyethylene encasement of fittings, valves, and other appurtenances to ductile-iron pipe systems.

Section 5.2 Definition: 5-2.1 *Polyethylene Encasement*: The encasement of piping with polyethylene film in tube or sheet form.

Section 5.3 Materials: 5.3.1 Polyethylene. Polyethylene film shall be manufactured of virgin polyethylene material conforming to the following requirements of ASTM D1248-84, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

5.3.1.1 Raw Material Used to Manufacture Polyethylene Film.
Type: I
Class: A (natural color) or C (black)
Grade: E-1
Flow rate: 0.4 maximum
Dielectric strength: Volume resistivity, min. ohm-cm = 10^{15}

TABLE 5.1 POLYETHYLENE TUBE AND SHEET SIZES

Nominal Pipe Diameter in.	Minimum Polyethylene Width in. (cm) Flat Tube	Sheet
3	14 (35)	28 (70)
4	16 (41)	32 (82)
6	20 (51)	40 (102)
8	24 (61)	48 (122)
10	27 (69)	54 (137)
12	30 (76)	60 (152)
14	34 (86)	68 (172)
16	37 (94)	74 (188)
18	41 (104)	82 (208)
20	45 (114)	90 (229)
24	54 (137)	108 (274)
30	67 (170)	134 (340)
36	81 (206)	162 (411)
42	95 (241)	190 (483)
48	108 (274)	216 (549)
54	121 (307)	242 (615)

5.3.1.2 *Polyethylene film*.
Tensile Strength: 1200 psi (8.3 MPa) minimum
Elongation: 300 percent minimum
Dielectric Strength: 800 V/mil (31.5V/µm) thickness minimum.

5.3.2 *Thickness*. Polyethylene film shall have a nominal thickness of 03008 in. (8 mil or 200 µm). The minus tolerance on thickness is 10 percent of the nominal thickness.

5.3.3 *Tube Size or Sheet Width*. Tube size or sheet width for each pipe diameter shall be as listed in Table 5.1.

Section 5.4 Installation:

5.4.1 *General*: The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material, but is not intended to be a completely airtight or watertight enclosure. All lumps of clay, mud, cinders, etc. on the pipe surface shall be removed prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil of embedment material from becoming trapped between the pipe and the polyethylene.

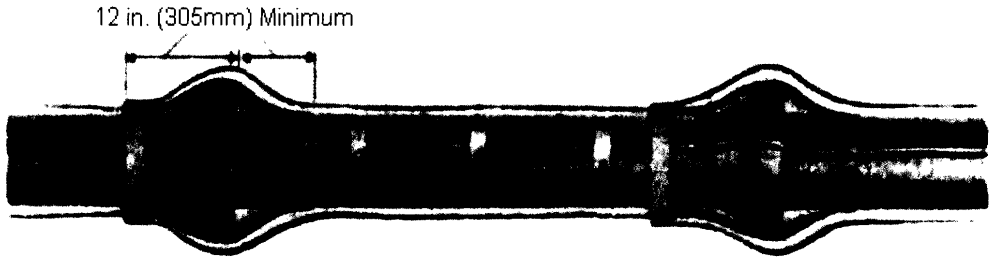
The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations. Overlaps and ends shall be secured with adhesive tape, string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are complete.

For installations below the water table and/or in areas subject to tidal actions, it is recommended that both ends of the polyethylene tube be sealed as thoroughly as possible with adhesive tape at the joint overlap.

5.4.2. *Pipe*. This standard includes three methods of installation of polyethylene encasement on pipe. Methods A and B are for use with polyethylene tubes and Method C is for use with polyethylene sheets.

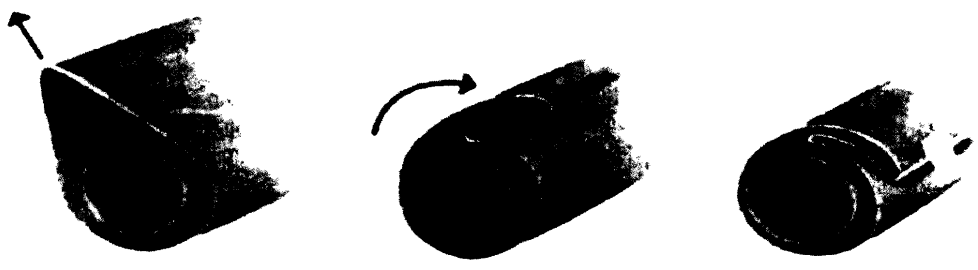
5.4.2.1 Method A. (Refer to Figure 5.1). Cut polyethylene tube to a length approximately 2 feet (0.6m) longer than the pipe section. Slip the tube around the pipe, centering it to provide a 1 foot (0.3m) overlap on each adjacent pipe section, and bunching it accordion-fashion length-wise until it clears the pipe ends. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the
polyethylene tube. After assembling the pipe joint, make the overlap of the polyethylene rube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure it in place. Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlap the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width at the top of the pipe as shown in Figure 5.2 to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points. Any cuts, tears, punctures, or other damage to the polyethylene shall be repaired as described in Section 5.4.5. Proceed with installation of the next section of pipe in the same manner.

Figure 1 Installation Method A



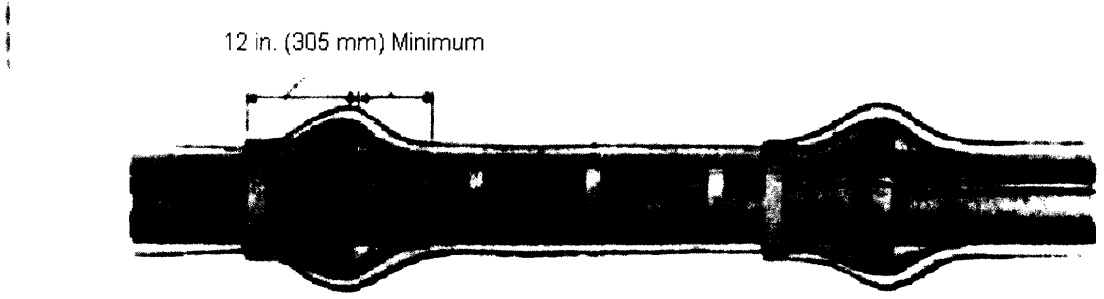
One length of polyethylene tube for each length of pipe, overlapped at joint.

Figure 2 Slack-reduction Procedure for Installation Methods A and B



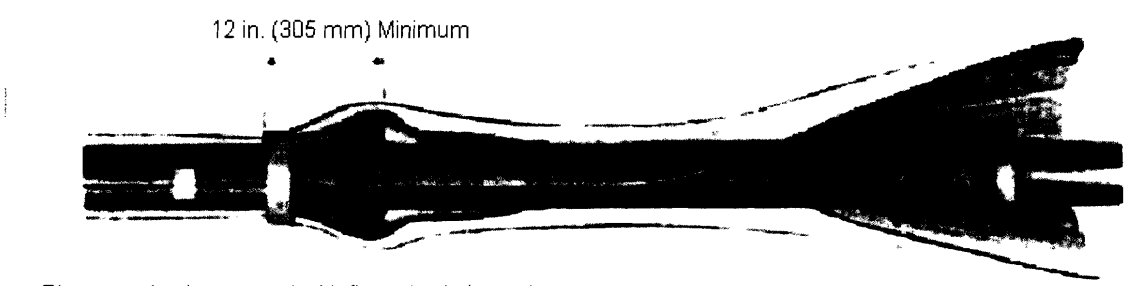
Take up the slack in the tube to make a snug fit. Fold the excess back over the top of the pipe, securing the fold at quarter points along the length of the pipe.

Figure 3 Installation Method B



Separate pieces of polyethylene tube for barrel of pipe and polyethylene tube or sheet for joints The polyethylene over joints overlaps tube encasing barrel. (Method B is not recommended for bolted-type joints unless an additional layer of polyethylene is provided over the joint as in methods A and C.)

Figure 4 Installation Method C



Pipe completely wrapped with flat polyethylene sheet.

5.4.2.2 Method B. (Refer to Figure 5.3). Cut the polyethylene tube to a length approximately 1 foot (0.3m) shorter than that of the pipe section. Slip the tube around the pipe, centering it to provide 6 inches (15 cm) of bare pipe at each end. Take up the slack width at the top of the pipe as shown in Figure 5.2 to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points; secure the ends as described in Section 5.4.1.

Before making up a joint, slip a 3 foot (0.9m) length of polyethylene tube over the end of the preceding pipe section, bunching it accordion fashion lengthwise. After completing the joint, pull the 3 foot (0.9m) length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least 1 foot (0.3m); make each end snug and
secure as described in Section 534.1.

Any cuts, tears, punctures, or other damage to the polyethylene shall be repaired as described in Section 5.4.5. Proceed with installation of the next section of pipe in the same manner.

5.4.2.3 Method C. (Refer to Figure 5.4). Cut polyethylene sheet to a length approximately 2 feet (0.6m) longer than that of the pipe section. Center the cut length to provide a 1 foot (0.3m) overlap

on each adjacent pipe section, bunching it until it clears the pipe ends. Wrap the polyethylene around the pipe so that it circumferentially overlaps the top quadrant of the pipe. Secure the cut edge of polyethylene sheet at intervals of approximately 3 feet (0.9m). Lower the wrapped pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene. After completing the joint, make the overlap and secure the ends as described in Section 5.4.1. Any cuts, tears, punctures or other damage to the polyethylene shall be repaired as described in Section 5.4.5. Proceed with installation of the net section of pipe in the same manner.

5.4.3 *Pipe-shaped Appurtenances*. Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in the same manner as the pipe.

5.4.4 *Odd-shaped Appurtenances*. When it is not practical to wrap valves, tees, crosses, and other odd-shaped pieces in a tube, wrap with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Make seams by bringing the edges together, folding over twice and taping down. Handle width and overlaps at joints as described in Section 5.4.2.1. Tape polyethylene securely in place at valve stem and other penetrations.

5.4.5 *Repairs*. Repair any cuts, tears, punctures, or damage to polyethylene with adhesive tape or with a short length of polyethylene sheet or a tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.

5.4.6 *Openings in Encasement*. Provide openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene, with tape. Service taps may also be made directly through the polyethylene, with any resulting damaged areas being repaired as described above.

5.4.7 *Junctions Between Wrapped and Unwrapped Pipe*. Where polyethylene wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least 3 feet (0.9m). Secure the end with circumferential turns of tape. Service lines of dissimilar metals shall be wrapped with polyethylene or a suitable dielectric tape for a minimum clear distance of 3 feet (0.9m) away from the ductile-iron pipe.

5.4.8 *Backfill For Polyethylene-Wrapped Pipe*. Use the same backfill material as that specified for pipe without polyethylene wrap, exercising care to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage polyethylene. In general, backfilling practice should be in accordance with the latest revision of AWWA C600, *Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances*.

SECTION 704

VALVES FOR WATER MAINS

704.1 Description: The valves shall be suitable for an ordinary waterworks service intended to be installed in a normal position on buried pipe lines for water distribution systems. All valves shall be Mueller non-rising stem valves. Valve vaults as per Standard Drawing 709 shall be installed at critical valve locations and in selected locations above 7,300 feet as determined by the City Engineer.

The minimum requirements for all gate valves shall, in design, material and workmanship, conform to the standards of AWWA C500. All materials used in the manufacture of waterworks gate valves shall conform to the AWWA Standards designed for each material listed. All gate valve operating stems shall be equipped with a two-inch (2) operating nut. All gate valves shall open counter-clockwise.

The minimum requirements for all butterfly valves shall, in design, material and workmanship conform to the standards of the AWWA C504. Any water valve 12 inches or large shall be butterfly-type. Also, any water line with working pressure greater than 150 psi shall have only butterfly-type valves installed.

Valves 12 inches or larger shall have approved concrete anchors, Submit detail for approval.

Where static line pressure exceeds 125 psi, only 250 psi working-pressure valves shall be used.

All valves shall be protected from their environment by an application of FM-2 grade grease to the bolts and nuts, including bonnet bolts, and a polyethylene wrap with a minimum thickness of eight (8) millimeters unless otherwise approved by The City Engineer.

704.2 Materials:

704.2.01 Manufacture and Marking: The valves shall have the name or mark of the manufacturer, year valve casting was made, size and working pressure plainly cast in raised letters on the valve body.

704.2.02 Type and Mounting: The valve bodies shall be cast iron, mounted with approved non-corrosive metals. All wearing surfaces shall be bronze or other approved non-corrosive material. Contact surfaces shall be machined and finished in the best workmanlike manner, and all wearing surfaces shall be easily renewable.

Valve bonnet bolts shall be stainless steel unless otherwise approved by the City Engineer.

All gate valves shall be two-faced, double disc, with parallel seats and bronze or other approved wedging devices placed between them. The stem shall be of high tensile strength bronze or other approved non-corrosive metal.

704.2.03 End Connections: The dimensions of hub or bell end connections shall conform to the dimensions of the AWWA Standard No. C100. The dimensions for the mechanical joint connections shall conform to the USASI Specifications No. A21.11.

The end flanges of flanged valves shall conform in dimensions and drilling to the standard USASI B16.1 for cast iron flanges and flanged fittings, Class 125, unless specifically provided otherwise. The bolt holes shall straddle the vertical center line.

704.2.04 Gate Valve Stem Seals: Unless otherwise designated in the Approved Plans, all gate valves up to and including 12-inch in size shall be furnished with O-Ring Stem Seals. Number, size and design shall conform to the AWWA Standards for gate valve O-Ring Stem Seals. For all valves over 12 inches, the stem

seals shall be conventional type stuffing-box with graphite packing per AWWA Standard No. C600-18.0.

704.2.05 Tapping Valves: Tapping valves shall be furnished with flanged inlet end connections having a machined projection of the flanges to mate with a machined recess on the outlet flanges of the tapping sleeves and crosses. The outlet ends shall conform in dimensions to the AWWA Standards for hub or mechanical joint connections, except that the outside of the hub shall have a large flange for attaching a drilling machine. The seat opening of the valves shall be larger than normal size to permit full diameter cuts.

704.2.06 Hydrostatic Test Pressure at Factory for Class 150 Valves: Each gate valve shall be tested at the factory for performance and operation prior to painting and shall be subjected to the following hydrostatic pressure tests; each 3-inch to 12-inch valve, inclusive, shall be subjected to hydrostatic test under pressures of both 300 psi and 175 psi, and each 16-inch to 48-inch valve, inclusive, shall be subjected to test pressures of 300 psi and 150 psi. These tests shall be conducted in a accordance with provisions of AWWA C500, Section 5. Tests for special valves shall be made as provided in the Special Conditions and shall be witnessed by a City Inspector.

704.2.07 Hydrostatic Test Pressure at Factory for Class 250 Valves: Each gate valve shall be tested at the factory for performance and operation prior to painting and shall be subjected to the following hydrostatic pressure tests; each 3-inch to 12-inch valves, inclusive, shall be subjected to hydrostatic test under pressures of both 400 psi and 275 psi, and each 16-inch to 48-inch valves, inclusive, shall be subjected to test pressures of 400 psi and 250 psi. These tests shall be conducted in accordance with provisions of AWWA C500, Section 5. Tests for special valves shall be made as provided in the Special Conditions and shall be witnessed by a City Inspector.

704.3 Installation of Gate Valves: All gate valves shall be inspected upon delivery in the field to insure proper working order before installation. They shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connection ends furnished. The valves shall also be carefully inspected for injury to the outer protective coatings.

Valves 12-inch and under shall be installed in a vertical position and be provided with a standard valve chamber or cast iron gate box so arranged that no shock will be transmitted to the valve. The box shall be centered over the operating nut, and the cast iron box cover shall be set one-half (½) inch below the roadbed or finished paved surface. All valve boxes must be brought to this elevation prior to the placement of asphalt, unless otherwise approved by the City Engineer.

After installation, all valves shall be subjected to the field test for piping as outlined in Section 703.2.13 of these Specifications. Should any defects in design, materials or workmanship appear during these tests, the Contractor shall correct such defects with the least possible delay and to the satisfaction of the Engineer. Should the Contractor fail to do this within a reasonable period of time in the judgment of the Engineer, he may cause such defects to be corrected and deduct the cost thereof from any moneys or payments due or to become due the Contractor.

704.4 Butterfly Valves: Butterfly valves shall be cast iron or ductile iron body, rubber seated, tight closing type butterfly valves conforming to AWWA Specification C504. Other types may be used if specified or approved by the Engineer.

Valves shall be fitted with Class 150 or Class 250 flanges conforming to ANSI B16-1.

The valve body shall be high strength cast iron ASTM A126 Class B with 18-8 Type 304 stainless steel body seat. Valve vane shall be high strength cast iron ASTM A48 Class 40, having rubber seat mechanically secure with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel nylon locked screws.

Rubber seat shall be a full circle 360° seat not penetrated by the valve shaft. Valve shaft shall be one piece, extending full size through the entire valve and operator with no neck-down, key-ways or holes to weaken it. Valve shaft shall have 304 stainless steel journals rotating in reinforced Teflon bearing. Packing shall be

"triple-seal" rubber designed for permanent duty in underground service.

Certification of performance, leakage and hydrostatic tests as described in Section 12 of AWWA SpecificationC504 shall be furnished. Valves shall be the product of a manufacturer having a minimum of five years experience in the manufacture of waterworks and distribution valves. Butterfly valves shall be as manufactured by Henry Pratt, Dresser or approved equal.

704.5 Globe Valves: As specified in the Contract Documents or as shown on the Approved Plans.

704.6 Ball Valves: As specified in the Contract Documents or as shown on the Approved Plans.

704.7 Check Valves: Check valves shall be of the weight and exterior lever spring check valve type, conventional flanged style, 150 lb. Class, as manufactured by Mueller Company, or approved equal.

Materials shall consist of a semi-steel body with Class 150 flanges, bronze plug and seat and guide bushing (ASTM C143) and stainless steel vertical spring (ASTM A176).

The plug, which shall be guided at both ends with a through integral shaft, will be opened by the flow velocity and closed by a lever and weight which can be adjusted to any position on the lever and which returns the plug to the seat before reversal of flow occurs.

All check valves shall have a maintenance pit size approved by the City Engineer to provide access.

704.8 Air Relief/Vacuum Relief Valves: Air Relief Valves shall be CLA-valves or equal of the type and model shown on the Approved Plans or as specified in the Contract Documents.

704.9 Miscellaneous Valves: All other valves on the main line shall be furnished according to the bid item description or Special Conditions and installed as shown on the Standard Drawings.

704.10 Valve Boxes and Covers: All valves not in a vault as per Standard Drawings 709 shall be provided with a cast iron valve box of the extension sleeve type, and the correct adjustable height to bring the top of the valve box flush with the finished surface. The valve box shall not be less than five (5) inches in diameter, and shall have a minimum thickness of 3/16-inch, and shall be provided with suitable base and cover. The word "Water" shall be cast on the cover. Valve boxes shall be e4qual to Mueller H-10357 with No. 6 or No. 8 round base as needed. *There shall also be furnished to the City Water Department, one (1) "T" handle operating wrench for each five (5) new valves installed on the project.*

704.11 Measurement and Payment:

704.11.01 Payment for Valves: Payment for valves will be made at the unit contract price pr each, which price shall be full compensation for all labor, material, equipment and tools necessary to furnish and install the valve and valve box complete in place in the water main, including trenching, jointing, painting, disinfecting and hydrostatic testing.

FOR PRESSURE RELIEF VALVE (PRV) SPECIFICATIONS: SEE STANDARD DRAWING 708-D AT THE BACK OF THIS DOCUMENT.

SECTION 705

WATER SERVICE CONNECTIONS AND FIRE LINES

705.1 Description: In all developments the service connections will be made by the Contractor, in accordance with these Specifications and Standard Drawings. This exclude setting the meter, which will be accomplished by City personnel, only after proper inspection of the service connection at the main, service line, yoke, and lid assembly (***furnished by the Contractor***). All connections to the Park City water system including fire lines shall be metered unless otherwise approved by the City Engineer and Public Works Director. In the case of metered connections serving only a fire system, the cost of the meter vault and appurtenances shall be borne by Park City=s Public Works Department. All service connections including fire lines shall be constructed in accordance with the provisions of this section up to the first shut-off valve within the building. Where the fire line doubles as a service connection, the cost of the meter vault and appurtenances otherwise necessary for the service connections shall be borne by the ***Developer or Owner.***

Service connections will be activated only after inspection, testing, chlorination and flushing of all new water line facilities, and also only after acceptance of the main line, unless otherwise approved by the Public Works Director and the City Engineer.

Each culinary service connection must be pressure tested in accordance with Section 703.2.11, except that the test pressure shall not be less than 150 pounds per square inch. Each fire line shall be pressure tested in accordance with Section 703.2.11 except that the test pressure shall not be less than 200 psi. At the discretion of the City Engineer, culinary-only water service lines of 2" diameter or less may be visually inspected for leaks under normal line pressure.

Water service connections shall be installed in accordance with the Standard Drawings 705-A, 705-V, 705-C.1, 705-C2, 705-D, 705-E1, 705-E2, 705-F1, 705-F2, 705-G1, 705-G2, 705-H1 and 705-H2, whichever is applicable. *No water service tap shall be made where the tap size exceeds one-third of the main diameter unless an approved tapping sleeve is used and prior approval is obtained from the City Engineer (see Section 705.3).*

705.2 Materials:

Corporation Stops: Corporation Stops will be of brass with the outlet being of copper flare in accordance with AWWA Standard C800. With prior approval, Ford or Mueller compression fittings may be used on lines larger than one (1) inch.

Service Clamps: All service taps made to PVC, Ductile Iron, Cast Iron, or Asbestos-Cement mains shall be equipped with bronze, double-strap service clamps.

Pipe Materials: All service lines up to 2" in diameter will be Type K, soft copper tubing, conforming to AWWA Standard C800 and ASTM B88, or 200 psi polyethylene tubing, copper tubing size, conforming to AWWA specification C901. Polyethylene tubing installations shall include a trace wire. Wire nuts will be installed on both ends of the trace wire, with no electrical continuity established between the water main and the building's plumbing. Service lines shall be installed without any connections or appurtenances between the Corporation Stop and the meter yoke. Commercial fire sprinkler lines shall typically be 4" or larger Ductile Iron Pipe connected by a tapping sleeve with valve to the main water line. Culinary lines shall be tapped at the main or fire line and installed according to the appropriate specifications.

Meter Yoke: Meter yokes for 1" and smaller will be a Ford ''copper setting'' of molded copper tubing with reinforcing bars and locking type angle valve; meter fittings will be standard thread. Copper tubing fittings to be copper flare in accordance with AWWA Standard C700. Meter yokes for 1-1/2-inch will be Ford VF-66 Series. Please refer to the appropriate Standard Drawing for specific part numbers.

Meter Box: Meter boxes will be 24 inch diameter for single 3/4-inch and single 1-inch meter installations; and

a 48-inch diameter vault for 1-1/2-inch meter installation *(refer to Standard Drawings 705-C.1)*. The meter box will be 14-gauge corrugated metal pipe, dual wall-smooth I.D. HDPE pipe meeting ASTM F 667 and AASHTO M-294 Type S, or approved equal. Meter boxes shall be located as per the Approved Drawings and is subject to approval by the City Engineer or Public Works Director. (See the applicable Standard Drawings for other size meter boxes and vaults).

Standard length of the corrugated metal and HDPE boxes will be 30 to 36 inches unless otherwise approved. Prior approval by the City Engineer is required to vary the length.

Meter Box Frost-Free Lid: Meter box lids will be dual frost-free type and of cast iron. The lid shall be secured with standard nut. All top meter lids shall have one (1) 1-5/8" tap and plug for each yoke to facilitate the remote read water meters used in Park City. All meter lids must have prior approval of the City Engineer or Public Works Director. Please refer to the appropriate Standard Drawings for part numbers.

Curb Stop and Curb Box: ***(Prior approval by the City Engineer required)*** Mueller Oriseal curb valve and cast iron extension-type curb box with arch pattern base with cast iron foot piece as manufactured by Mueller. Prior approval by City Engineer required for substitution.

Meters: As specified by the Public Works Director. Normally Park City provides meters. A fee may be charged. Acquisition, calibration, and distribution will be at the City's discretion.

705.3 Construction: Taps shall be made and pipe laid at a right angle to the water main. The tap shall be made on the middle of the main at an angle between 45° and 60° from the vertical plane, on the side of the main to which service is to be extended. For copper tubing larger than one (1) inch, it is allowable to increase the angle to approximately ninety degrees (90°) due to the difficulty of putting a goose-neck in the larger diameter copper. Taps of 3/4" or 1" shall be no closer than 24" to a pipe joint. Taps larger than 1" shall be no closer than 48" to a pipe joint. The minimum allowable distance between taps and any other fitting is twenty-four (24) inches. Hot taps are preferred to service lines and for fire lines. Tapping sleeves must be used for taps larger than two 2) inches. Mechanical joint Ductile Iron tapping sleeves may be used for PVC or other plastic mains. Permastran mains may NOT be hot tapped, but require a special tee to be installed.

Water line taps shall not be made on: Fridays, Saturdays, Sundays, Holidays, or after 12:00 Noon on any day unless otherwise authorized by the City Engineer and the Water Department.

The water main shall be tapped by machine drilling a hole in it the size to fit the corporation valve for the service line. The drilling machine and method of tapping shall be approved by the Public Works Department.

A representative of the City Engineer or the Department of Public Works shall inspect the main and tap prior to backfilling. *In the event the tap is covered before it is inspected, it shall be uncovered by the Contractor to allow for inspection. If the tap or water main is damaged during the process of locating, it shall be repaired immediately by the Contractor in a manner acceptable to the Public Works Department and the City Engineer.*

No service line may be constructed through, or in front of any adjoining property. When authorized by the City Engineer, a curb valve with curb box may be installed within four feet of the edge of road or back of gutter.

If the line is not connected initially to a meter yoke, the end of the service line shall then be sealed shut to keep rocks and dirt out of the line. Every precaution shall be taken to prevent foreign material, including trench water, from entering the pipe.

Where existing services are to be transferred from old to new mains, the Contractor shall plan and coordinate his work with that of the City Water Department so that service will be resumed with the least possible inconvenience to consumers.

Whenever the Contractor is required by the Approved Plans and Special Conditions to remove an existing water main, the Special Conditions will state whether or not the salvage of pipe, valves, hydrants and fittings will be required, and the method of payment thereof.

Unless otherwise approved by the City Engineer and the Director of Public Works, water meters, vaults/boxes, and the associated appurtenances shall be placed in the City Right-of-Way between five (5) and ten (10) feet behind the curb/gutter/edge of asphalt and in a landscaped area. Proposed interior placement of water meters must be submitted to the City Engineer at the time the building plans are submitted for initial review.

The City will maintain water service lines to the cold side of the water meter yoke or the edge of the City Right-of-Way, whichever is the shorter distance. If the water meter vault/box is on private property, the City will maintain the water meter, yoke, and vault/box only, not the line.

The frost-free meter lid shall have three (3) feet of soil placed and compacted radially from the edge of the lid at the approximate lid grade, while providing drainage away from the meter lid. All meter installations will be installed so that the frost-free meter box lid is at grade with a tolerance of +/-2".

Grade rings are acceptable only with prior approval of the City Engineer.

If the meter box is located on a slope, the following conditions must be met:

1. Satisfactory erosion control on the high and low side must be established.
2. A channel must be constructed in which the diverted water will flow around and away from the meter box.
3. The soil on the low side must be raised and compacted to the approximate elevation of the meter lid and radially out a minimum of three (3) feet from the edge of the lid, while providing drainage away from the meter lid.

The following are unacceptable conditions:

1. Silting in of the water meter lid and box.
2. Water pooling on the water meter lid.
3. The water meter lid being covered with soil and/or sod.
4. Trees being planted directly over the service line.

To avoid these and other potential problems, it is recommended to recognize them in advance and plan for the correct elevation and landscaping.

Erosion and drainage control must be totally established for a successful Public Improvements Inspection.

All irrigation sprinkling system will be connected on the customer side of the meter, but not within the meter box.

The Contractor shall not in any case remove old pipe until all service connections have been transferred to the new main. Adequate provisions shall be made by the Contractor during construction for the care and protection of mains or services in use.

Where salvage of pipe, valves, hydrants and fittings is required under the Contract, salvage methods shall be used which will save all materials intact and undamaged. Salvaged material shall be stored at the trench site for removal by the utility, unless otherwise provided.

If salvage is not specified, the materials therefrom shall become the property of the Contractor and shall be promptly removed from the site for disposal as he sees fit.

To supply customers with water during the construction of a water main project where any section of the pipe has passed a satisfactory hydrostatic and bacteriological test, the City reserves the right to tap corporation stops into the section of the new main and install service connections at such locations as the City may elect, at no expense to the Contractor. *The attaching of any such service connections by the City shall not be construed by the Contractor as an acceptance by the City or any*

part of the work required under the Contract. It is unacceptable to connect a service line to a fire line without specific prior approval by the City Engineer.

By-pass devices on 1-1/2" and 2" meter yokes are authorized for commercial buildings ONLY. The by-pass shall be lockable. By-pass devices on 1-1/2" and 2" meter yokes shall not be used for residential buildings.

Any request for a meter larger than 1-1/2" must be accompanied by a proposal submitted to the City Engineer prior to construction. The proposal needs to justify the larger meter.

SECTION 706

FIRE HYDRANTS

706.1 Description: These Specifications are to be used in conjunction with the AWWA Standard C502 or the latest revision thereof for fire hydrants for ordinary water works service. It is unacceptable to connect a service line to a fire line without specific approval by the City Engineer.

706.2 Materials:

706.2.01 Material for Hydrants and Appurtenances: All materials used in the production of fire hydrants for ordinary service shall conform to the specifications designated for each material listed in AWWA Standard C502.

706.2.02 Hydrant Size and Type: Hydrants shall be five (5)-inch minimum size with two (2) 2-1/2-inch hose nozzle and one (1) 4-1/2-inch pumper nozzle. Hydrants shall be supplied with O-Ring seals and a six (6)-inch ASA 125 pound flanged inlet. Each hydrant shall be supplied complete with a flanged mechanical joint auxiliary gate valve with box. They shall be Mueller Centurion, M&H Style 129, or Clow Model F-5110 Iowa. A hydrant key shall be provided to the Public Works Department for each five hydrants installed.

706.2.03 Auxiliary Valve: Per Section 704 of these Specifications.

706.2.04 End Connections: The dimensions of hub or bell end connections shall conform to the dimensions of the AWWA Standard N. 100. The dimensions of the mechanical joint connection shall conform to the USASI Specification No. A21.11.

The flanged lateral connection shall be faced and drilled to conform to the American Standard for 125-lb. W.P. flanged fittings when static pressures do not exceed 125 pounds and 250 pounds working pressure flanged fittings shall be used when working pressure is greater than 125 pounds. Flanges shall be machine finished to a true surface. Bolt holes shall straddle the vertical center line.

706.2.05 Sidewalk Flange Construction: Hydrants shall be provided with a sidewalk flange. Breaking devices, if required, shall be at the sidewalk flange which will allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. There shall also be provided at this point a safety stem coupling on the operating stem that will shear at the time of impact. Unless otherwise specified, all hydrants shall be equipped with O-Ring stem seals.

706.2.06 Factory Hydrostatic Test: All hydrants installed shall have certification of being subjected to an internal hydrostatic test of 300 pounds per square inch with the hydrant valve in a closed position and begin with the hydrant valve in an open position upon request by the City Engineer.

706.3 Construction Details:

706.3.01 Setting Hydrants: Hydrants shall be installed in accordance with the detail shown on Standard Drawing No. 706-A in the location specified in the Approved Plans or as designated by the Engineer. (REFER TO DRAWING 706-A).
All hydrants shall be inspected in the field upon arrival to ensure proper working order. After installation, they shall be subjected to a hydrostatic test not to exceed the factory test pressure. New hydrants are to be marked by a red-painted snow stake (2"X2"X8'). **Hydrants shall not be operated for the purpose of obtaining water for construction purposes. Any hydrant so operated shall be replaced by the Contractor.**

706.3.02 Hydrant Connections: Hydrant laterals shall consist of a section of mechanical joint ductile iron six (6)-inch pipe from the main to the hydrant and shall include an auxiliary gate valve set vertically and placed in

the line as indicated in the Standard Drawings for hydrant settings.

706.3.03 Relocating Existing Hydrants: When shown on the Approved Plans or when directed by the Engineer, existing hydrants shall be moved. When the existing tee is moved to a new hydrant location, a new tee shall be inserted and the open part of the abandoned tee shall be securely sealed and blocked. When the existing hydrants are blocked to the main line, the same method shall be used to anchor the hydrants at their new locations. The work shall conform in all respects to hydrant settings as described elsewhere in these Specifications. (See break-away flanges in Section 706.3.04).

706.3.04 Hydrant Extensions: The minimum requirements for all flanged hydrant barrel extensions, operating stems and flanged adapters for hydrant lateral connections shall, in design, material and workmanship, conform to the AWWA Standards for such castings. The drilling of the flanges on the extensions shall match the drilling of the flanges on the hydrant. The drilling of the adaptor flanges shall match those of the hydrant foot flange and the auxiliary gate valve flange. When a hydrant is installed, moved, or extended, the Contractor shall ensure that the break-away flange is at the final grade level, six inches above grade maximum, or manufacturer=s recommendation; and is positioned in the correct direction to facilitate proper break-away action upon vehicular or other object impact.

706.4 Testing of Fire Hydrants: Fire hydrants shall be subjected to a hydrostatic test at a hydraulic pressure of 200 psi for a period of one hour, after being connected to the main water line and after concrete anchor blocks at all thrust points are in place. Testing shall be made with the whole interior of the hydrant under pressure with the auxiliary valve closed and the foot valve open and the hose nozzles and pumper connections closed. Under the test procedure, there shall be no leakage through the main valve or stuffing box, nor through the castings or the joints of the assembled hydrant. Under the test conditions, the leakage through the drain valve shall not exceed four fluid ounces per minute. Other leakage or other imperfections found in either test shall be corrected before the hydrant is accepted. **The Contractor shall leave the foot valve open during all phases of water line construction and testing until the City Inspector has authorized closing the foot valve. Hydrants shall not be operated for obtaining water for construction purposes**.

706.5 Measurement and Payment:

706.5.01 Fire Hydrants: Payment will be made at the unit contract price per each for ''Fire Hydrant'' which shall be full compensation for the hydrant in place. As incidental thereto, the Contractor shall include in his unit contract prices of the hydrants all costs of auxiliary gate valves, tie rods, pier blocks, coarse gravel, painting, and other items that will be required for the complete installation of the hydrant as specified, excepting however, that the 6-inch ductile iron pipe connecting to the hydrant to the main will be paid for at the unit contract price per linear foot for ''Water Mains''.

706.5.02 Relocating Existing Hydrants: Payment will be made for ''Relocating Existing Hydrants'' at the unit contract price per each and shall include all costs for shackling, painting and all other labor, material and equipment necessary to move and reconnect the hydrant in its new position, excepting however, that the new pipe and fittings for hydrant connections will be paid for at the unit contract price per linear foot for ''Water Mains''.

706.5.03 Hydrant Extensions: Unless otherwise stipulated in the Contract Documents or Approved Plans, payment for vertical and horizontal hydrant extensions will be made at the unit contract price bid for ''Hydrant Extension Vertical'', per pound in place, and ''Hydrant Extension Horizontal'', per pound in place. The weight paid for shall include the weight of castings and the weight of additional length of hydrant rods, bolts, nuts, washers and gaskets.

The price paid per pound shall cover the cost of all machine work and all labor required to lengthen the rods and there will not be any additional compensation either per pound additional or otherwise for such work. Lengthening of hydrants to specified length with vertical hydrant extensions will not be allowed except by permission of the City Engineer, and in such cases no extra payment will be allowed for vertical extensions, and such cost shall be included in the unit price bid for ''Hydrants''.

In all cases, the Contractor shall follow the manufacturer's recommended procedures for changing the height of a fire hydrant.

In case of high groundwater, hydrant weep holes should be plugged with non-shrink concrete grout at the time of installation. The determination of plugging the weep holes will be made by the City Public Improvements Inspector or the City Engineer.

SECTION 707

RESTORATION AND CLEAN-UP OF WATER MAIN CONSTRUCTION

707.1 General: Surface improvements such as pavement curb, curb and gutter and other like surface facilities that have been removed or damaged during the construction of water mains, shall be restored by the Contractor.

707.2 Construction Details:

707.2.01 Removal of Existing Street Improvements: Restoring of existing street improvements shall be as specified in the applicable sections of these Specifications pertaining to their construction and the measurement and payment will be as described in Section 707.3.01 and 707.3.02.

At all pavement openings where backfill is to be compacted with mechanical tampers in accordance with Section 702.2.07D and where the pavement is not restored immediately, the Contractor shall place and maintain at his own expense an asphalt concrete surfacing to the elevation of the existing pavement until final restoration is made.

In the event backfill is placed at the direction of the Engineer without proper compaction to accommodate a critical traffic condition and the final settlement and compaction is made by traffic or otherwise, the cost of placing and maintaining the temporary asphalt concrete surfacing until final restoration is made will be paid for as extra work.

707.2.03 Finishing and Clean-Up: Finishing and clean-up shall be as specified in Section 553.

707.3 Measurement and Payment:

707.3.01 Existing Street Improvements: Cement concrete pavement, driveway, sidewalk, asphalt concrete pavement, or bituminous plant mix pavement will be measured and payment made therefor at the unit contract prices specified in the applicable sections pertaining to their construction, excepting however, that measurement and payment will be limited to a trench width equal to the outside diameter of the barrel of the pipe plus forty-eight (48) inches. **Any surfaces requiring restoration outside of this limit, which is removed or damaged by the Contractor, shall be restored by him at his own expense.** Payment will be made, however, for any additional area of cement concrete pavement necessitated by expansion joints or cracks that occur within three (3) feet of the recovery width above described.

707.3.02 Cement Concrete Curb, Curb and Gutter: Payment for cement curb or curb and gutter will be made at the unit contract prices set up for same in applicable sections pertaining to their construction. Measurement for payment will be restricted as follows:

1. Where the water main crosses the curb or curb and gutter at right angles, measurement for payment will be the length of the curb removed but not more than the outside diameter of the pipe plus forty-eight (48) inches. However, if at the request of the City Engineer a complete 10-foot section of curb or gutter is removed in order to provide for a continuous pattern of joints, the measurement for payment shall be ten (10) feet.

2. Where the water main crosses the curb or curb and gutter in a diagonal course, the measurement will be no more than the diagonal distance along the face of the curb between two lines, each projected parallel to the outside of the barrel of the pipe and each twenty-four (24) inches distant therefrom. However, is at the request of the City Engineer a complete 10-foot section of curb and gutter is removed to provide for a continuous pattern of joints, the measurement for payment shall be ten (10) feet.

3. Where it is necessary to remove curb or curb and gutter within the pay width of trench excavation (outside pipe diameter plus 24 inches each side), and where the curb r curb and gutter parallels the center line of the water main, or approximately so, measurement and payment will be at the unit contract price per linear foot for the actual length of curb, or curb and gutter, that is required to be constructed.

Existing Portland Cement Concrete pavements, sidewalks and curbs and gutter shall be removed to existing joints, whenever possible. If removal is terminated between existing joints, whether specified or by the Contractor=s choice, an approved concrete saw shall be used to cut the concrete along the established lines. Sawing shall be done in neat, straight lines and shall be to a depth of at least one and one-half (1-1/2) inches. The remaining thickness of the concrete member may be broken or chipped away, using particular care not to break the concrete on the back side of the sawed joint. Where the Contractor chips or breaks the concrete section behind either the newly sawed joint or an existing adjacent joint, he shall replace such damaged sections at his own expense.

707.3.03 Finishing and Clean-Up: Whenever the proposal includes an item per lump sum or per station for AFinishing and Clean-Up@, the measurement and payment will be made in accordance with Section 553, Finishing and Clean-Up.

If the Contract Documents do not include an item for AFinishing and Clean-Up@, the work required shall be performed as specified in Section 553, but shall be considered as incidental to the construction and the costs thereof shall be included by the Contractor in other bid items of the Contract.

SECTION 708

DISINFECTING WATER STORAGE TANKS

708.1 General. Disinfection of water storage tanks shall be in accordance with AWWA Standard C652, particularly Chapters 1 through 4, as specifically described in these Specifications. With large reservoirs where it is not economical to chlorinate the contents of the full storage facility (Chlorination Method 1), alternative Chlorination Methods may be used with the prior approval of the City Engineer and/or Public Works Director.

708.1.1 Record of Compliance. The record of compliance shall be the bacteriological test certifying that the water held in the storage facility is free of coliform bacteria contamination.

708.2 Cleaning. All scaffolding, planks, rags, and other materials not part of the structural or operating facilities of the storage tank shall be removed. Then the surface of the walls, floor, and operating facilities of the storage facility shall be cleaned thoroughly using a high-pressure water jet, sweeping, scrubbing, or equally effective means. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the storage facility or otherwise removed.

708.2.1 Other Materials. Following the cleaning operation, the vent screen, overflow screen, and any other screened openings shall be checked and put in satisfactory condition to prevent birds, insects, and other possible contaminants from entering the facility. Any material required to be in the storage facility after the cleaning procedure has been completed shall be clean and sanitary when placed in the facility. In such instances, care shall be taken to minimize the introduction of dirt or other foreign material. (For example, placing a layer of limestone granules on the unpainted bottom of the storage facility to prevent corrosion).

708.3 Forms of Chlorine for Disinfection. The forms of chlorine that may be used in the disinfecting operations are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets.

708.3.1 Liquid Chlorine. Liquid chlorine conforming to ANSI/AWWA B301 contains 100 percent available chlorine and is packaged in steel containers usually of 100-lb, 150-lb, or 1-ton (45.4-kg, 68.0-kg, or 907.2-kg) net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water to be chlorinated; (2) under the direct supervision of a person who is familiar with chlorine=s physiological, chemical, and physical properties, and who is trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices are observed to protect working personnel and the public.

708.3.2 Sodium Hypochlorite. Sodium hypochlorite conforming to ANSI/AWWA B300 is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 qt (0.95 L) to 5 gal (18.92 L). Containers of 30 gal (113.6 L) or larger may be available in some areas. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine by volume, and care must be take to control storage conditions and length of storage to minimize its deterioration.

708.3.3 Calcium Hypochlorite. Calcium hypochlorite conforming to ANSI/AWWA B300 is available in granular form in small tablets, and contains approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry, dark environment to minimize its deterioration.

708.4 Alternative Methods of Chlorination. Three methods of chlorination are explained in the standard. Typically, only one method will be used for a given storage- facility disinfection, but combination of the methods may be used with the prior approval of the City Engineer and/or Public Works Director. The three methods are (1) chlorination of the full storage facility such that, at the end of the appropriate retention period, the water will have a free chlorine residual of not less than 10 mg/L; (2) spraying or painting of all storage facility water-contact surfaces with a solution of 200-mg/L available chlorine; and (3) chlorination of full storage facility with water having a free chlorine residual of 2 mg/L after 24 h. For reference, amounts of chemicals needed for various chlorine concentrations are shown in Appendix 708A.

708.4.1 Chlorination Method 1. The water storage facility shall be filled to the overflow level with potable water to which enough chlorine is added to provide a free chlorine residual in the full facility of not less than 10 mg/L at the end of the appropriate 6-h or 24-h period, as described in Sec. 708.4.1.4. The chlorine, either as calcium hypochlorite, sodium hypochlorite, or liquid chlorine, shall be introduced into the water as described hereafter.

708.4.1.1 Liquid-chlorine use. Liquid chlorine shall be introduced into the water filling the storage facility in such a way as to give a uniform chlorine concentration during the entire filling operation. Portable chlorination equipment shall be carefully operated and shall include a liquid-chlorine cylinder, gas-flow chlorinator, chlorine ejector, safety equipment, and an appropriate solution tube to inject the high-concentration of chlorine solution into the filling water. The solution tube shall be inserted through an appropriate valve located on the inlet pipe and near the storage facility shun that the chlorine solution will mix readily with the inflowing water.

708.4.1.2 Sodium hypochlorite use. Sodium hypochlorite shall be added to the water entering the storage facility by means of a chemical-feed pump, or shall be applied by hand-pouring into the storage facility and allowing the inflowing water to provide the desired mixing.

708.4.1.2.1. When a chemical -feed pump is used, the concentrated chlorine solution shall be pumped through an appropriate solution tube so as to inject the high-concentration chlorine solution at a rate that will give a uniform chlorine concentration in the filling water. The solution tube shall be inserted through an appropriate valve located on the inlet pipe and near the storage facility, or through an appropriate valve located on the storage facility such that the chlorine solution will mix readily with the filling water.

708.4.1.2.2. When the sodium hypochlorite is poured into the storage facility, the filling of the storage facility shall begin immediately thereafter or as soon as any removed manhole covers can be closed. The sodium hypochlorite may be poured through the cleanout or inspection manhole in the lower course or level of the storage facility , in the riser pipe of an elevated tank, or through the roof manhole. The sodium hypochlorite shall be poured into water in the storage facility when such water is not more than 3 ft (0.9 m) in depth, nor less that 1 ft (0.3 m) in depth or as close thereto as manhole locations permit.

708.4.1.3 Calcium hypochlorite use. Calcium hypochlorite granules or tablets broken or crushed to sizes not larger than 1/4-in, (6.4-mm) maximum dimension may be poured or carried into the storage facility through the cleanout or inspection manhole in the lower course or level of the storage facility, into the riser pipe of an elevated tank, or through the roof manhole. The granules or tablet particles shall be placed in the storage facility before flowing water into it. The granules or tablets shall be located so that the inflowing water will ensure a current of water circulating through the calcium hypochlorite, dissolving it during the filling operation. The calcium hypochlorite shall be placed only on dry surfaces unless adequate precautions are taken to provide ventilation or protective breathing equipment.

708.4.1.4 Retention Period. After the storage facility has been filled with the disinfected water, it shall stand full as follows: (1) for a period of not less that 6 h when water entering the storage facility has been chlorinated uniformly by gas-feed equipment or chemical pump, or (2) for a period of 24 h when the storage facility has been filled with water that has been mixed with sodium hypochlorite or calcium hypochlorite within the storage facility as described in Sec. 708.4.1.2 and Sec. 708.4.1.3.

708.4.1.5 Handling of disinfection water. After the retention period stated in Sec. 708.4.1.4, the free chlorine residual in the storage facility shall be reduced to a concentration appropriate for distribution (not more than 2 mg/L) by completely draining the storage facility and refilling with potable water having a low chlorine concentration. When an appropriate chlorine concentration is reached and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system.

708.4.1.5.1. The environment into which the chlorinated water is to be discharged shall be inspected, and if there is any likelihood that the chlorinated water will cause damage, then a reducing agent shall be applied to the water to be wasted to thoroughly neutralize the chlorine residual in the water. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water. The proper authorities should be contacted prior to disposal of highly chlorinated water. ***The chlorinated water must be disposed of in an acceptable manner and in conformance with the Utah Wastewater Disposal Regulations***.

708.4.2 Chlorination Method 2. A solution of 200 mg/L available chlorine shall be applied to the surfaces of all parts of the storage tank that would come in contact with water when the storage facility is full to the overflow elevation.

708.4.2.1 Method of application. The chlorine solution may be applied with suitable brushes or spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it will have available chlorine of not less that 10 mg/L when filled with water. Overflow piping need not be disinfected.

708.4.2.2 Retention. The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 min., after which potable water shall be admitted, the drain piping purged of the 10 mg/L chlorinated water, and the storage facility then filled to its overflow level. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system.

708.4.3 Chlorination Method 3. Water and chlorine shall be added to the storage facility in amounts such that the solution will initially contain 50 mg/L available chlorine and will fill approximately 5 percent of the total storage volume. This solution shall be held in the storage facility for a period of not less that 6 h. The storage facility shall then be filled to the overflow level by flowing potable

water into the highly chlorinated water. It shall be held full for a period of not less than 24 h. All highly chlorinated water shall then be purged from the drain piping. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system.

708.4.3.1 Adding chlorine. Chlorine shall be added to the storage facility by the method described in Sec. 708.4.1.1, 708.4.1.2, or 708.4.1.3. The actual volume of the 50-mg/L chlorine solution shall be such that, after the solution is mixed with filling water and the storage facility is held full for 24 h, there will be a free-chlorine residual of not less than 2 mg/L.

708.4.4 Bacteriological Sampling and Testing. After the chlorination procedure is completed, and before the storage facility is placed in service, water from the full facility shall be sampled and tested for coliform organisms in accordance with the latest edition of *Standard Methods for the Examination of Water and Wastewater* by a State of Utah certified laboratory. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique.

708.4.4.1 Test for odor. The water in the full facility should also be tested to assure that no offensive odor exists due to chlorine reactions or excess chlorine residual.

708.4.4.2 Results of testing. If the test for coliform organisms is negative, then the storage facility may be placed in service with the approval of the City Engineer and/or the Public Works Director. If the test show the presence of coliform, then the situation shall be evaluated by the Engineer, City Engineer, and/or Public Works Director. In any event, repeat samples shall be taken until two consecutive samples are negative (*limited to 5 total samples)*, or the storage facility shall again be subjected to disinfection.

708.4.4.3 Care in sampling. The samples shall be taken from a sample tap on the outlet piping form the storage facility or from a sample tap connected directly to the storage facility. In either case, the operation shall be such as to ensure that the sample collected is actually water that has been in the storage facility.

708.4.4.4 Recommended additional samples. During disinfection operation and the required sampling of water from the storage facility, samples may be taken from the water inflowing to the storage facility to determine if coliforms are present in the typical potable water source.

708.4.5 Availability of Water. *The availability of water for filling, disinfecting and testing of the storage facility is subject to the approval of the Public Work Director and shall be coordinated by the Contractor a minimum of 30 days in advance of anticipated testing.*

708.4.6 Safety. The Contractor is responsible to comply with OSHA requirements related to disinfecting and testing operations.

APPENDIX 708A

CHLORINE DOSAGES

This appendix is for information only and is not a part of AWWA C652

Table A.1. Amounts of chemicals required to give various chlorine concentrations in 100,000 gal (378.5 m^3) of water*

TABLE A.1

Desired Chlorine Concentration in Water *mg/L*	Liquid Chlorine Required *lb*	Sodium Hypochlorite Required			Calcium Hypochlorite Required
		5 Percent Available Chlorine *gal*	10 Percent Available Chlorine *gal*	15 Percent Available Chlorine *gal*	65 Percent Available Chlorine *gal*
2	1.7	3.9	2.0	1.3	2.6
10	8.3	19.4	9.9	6.7	12.8
50	42.0	97.0	49.6	33.4	64.0

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may have caused a loss of available chlorine.

Table A.2. Amounts of chemicals required to give chlorine concentrations of 200 mg/L in various volumes of water*

TABLE A.2

Volume of Water *gal*	Liquid Chlorine Required *lb*	Sodium Hypochlorite Required			Calcium Hypochlorite Required
		5 Percent Available Chlorine *gal*	10 Percent Available Chlorine *gal*	15 Percent Available Chlorine *gal*	65 Percent Available Chlorine *gal*
10	0.02	0.04	0.02	0.02	0.03
50	0.1	0.2	0.1	0.07	0.15
100	0.2	0.4	0.2	0.15	0.3
200	0.4	0.8	0.4	0.3	0.6

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may have caused a loss of available chlorine.

APPENDIX 708B

DISPOSAL OF HEAVILY CHLORINATED WATER

This appendix is for information only and is not a part of AWWA C651

1. Check with Snyderville Basin Water Reclamation District for conditions of disposal to sanitary sewer.

2. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in TABLE B.1.

TABLE B.1.
POUNDS OF CHEMICALS REQUIRED TO NEUTRALIZE VARIOUS RESIDUAL CHLORINE CONCENTRATIONS IN 100,000 GALLONS OF WATER*

Residual Chlorine Concentration mg/L	**Sulfur Dioxide (SO_2)**	**Sodium Bisulfate ($NaHSO_3$)**	**Sodium Sulfite (Na_2SO_3)**	**Sodium Thiosulfate ($Na_2S_2O_3$-$5H_2O$)**
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

*Except for residual chlorine concentration, all amounts are in pounds.

SECTION 709

BURIED CONCRETE WATER STORAGE TANKS

709.1 General. Design and construction of buried concrete water storage structures generally should be in conformance with ACI 350R, particularly Chapters 4 through 13, except as specifically described in these Specifications.

709.2 Concrete.

709.2.1 Concrete mix design. In addition to the mixture design parameters established pursuant to structural characteristics, chemical resistance, and durability requirements, the concrete mixtures should be suitable for the placing systems to be employed.

Generally, a well-proportioned mix leaning toward the coarse range in coarse-to-fine proportioning with good cohesive qualities will be able to be placed well with all placing systems. Loose, sandy, or bleeding mixes should be avoided.

Mix proportions should be prepared in accordance with ACI 301 and ACI 211.1 and shall include a concrete waterproofing admixture of the cementitious crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete, Xypex Admix C-1000/C-2000, or approved equal.

709.2.2 Mixing concrete. Because uniformity is particularly important in obtaining water-tight concrete, the concrete materials should be mixed sufficiently to produce concrete uniform in color and consistency with the required slump and air content. Concrete may be either ready-mixed or mixed at the job site, as recommended in Chapter 7 of ACI 301. Concrete additive Xypex shall be added to the concrete at the time of batching in accordance with the manufacturer=s recommendations.

709.3 Placement of concrete. Detailed recommendations for acceptable placing practices to obtain durable and water-tight concrete, which is absolutely necessary in environmental engineering concrete structures, are given in ACI 304R. The contractor should provide for the continuation of concrete placements in the event of plant or equipment breakdowns. Back-up concrete placing equipment should be available for use within 30 minutes in the event the primary placing equipment breaks down. An alternate concrete source with acceptable materials and mixtures on hand will assure the continuation of concrete placements without unplanned and frequently unacceptable, irregular construction joints.

To prevent segregation, the concrete should be deposited in approximately 12 to 24 inches (305 to 610 mm) deep horizontal layers as near as possible to its final position (see ACI 309R). It should not be allowed to drop freely more than 4 ft. (1.2 m) or through a cage of reinforcing steel (see Section 709.3.3).

709.3.1 Buckets. Bottom-dump buckets may be used for transporting mixed concrete to the desired location. Particular care should be taken to avoid jarring or bumping that may cause segregation.

709.3.2 Chutes. Chutes used to transport concrete should be of metal, except aluminum, or wood with metal lining and should have a slope not exceeding one vertical to two horizontal so that the concrete will travel fast enough to keep the chute clean but slow enough to avoid segregation of materials. The end of each chute should be provided with a baffle to help prevent segregation, or the concrete should be discharged through a drop chute, tremie, or elephant trunk directly into the form.

709.3.3 Drop chutes, elephant trunks, and tremies. Drop chutes, elephant trunks, and/or tremies should be used in walls and columns to prevent free-fall of the concrete and to allow the concrete to be placed through the cage of reinforcing steel. They should be moved at short intervals to prevent stacking of concrete.

Vibrators should not be used to move the mass of concrete through the forms. Tremies should be used to place concrete under water and to avoid segregation.

709.3.4 Pumping. Pumping equipment should be a suitable type with adequate pumping capacity for the required slump and maximum size aggregate to be used. Pump lines should not contain aluminum. Loss of slump in pumping from pump hopper to point of placement should not exceed 1-1/2 in. (38.1 mm).

709.3.5 Conveying. Concrete conveying equipment should be designed specifically to place concrete without segregation. Conveyor systems should not impair the strength, slump, or air content of the concrete placed. The placement system should be capable of delivering concrete continuously over the entire placement area without delays for equipment relocations.

709.3.6 Back-Up Placement Systems. Alternate placing equipment should be immediately available for use in the event that the primary placing equipment or system breaks down during a placement. Such equipment should be able to commence placing operations with 30 minutes notice to avoid cold joints in the structural element being placed. Provisions should be made for the use of retarders.

709.3.7 Portholes in Wall and Column Forms - Limitations. Temporary openings or portholes in wall or column forms may be used to limit the free-fall of the concrete to less than 4 ft. (1.2 m) and should be so located to facilitate the placing and consolidation of the concrete. The ports should be spaced no more than 6 to 8 ft. (1.8 to 2.4 m) apart to limit the horizontal flow of concrete and to prevent segregation.

709.3.8 Placing in Forms. Sections of walls between joints should be placed continuously to produce a monolithic unit. At least 48 hours should elapse between casting of adjoining units.

Placing of concrete in beams or slabs should not begin until the concrete previously placed in walls or columns has attained initial set. As soon as possible after concrete has been deposited, it should be consolidated in an acceptable manner to work the concrete around the reinforcement and inserts and to prevent formation of voids. Each horizontal layer should be consolidated by the use of acceptable mechanical vibratory equipment. The vibrator should extend into the underlying layer to bond the two layers together. To avoid excessive pressure on the forms, the vibrator should penetrate no more than 2 ft. (610 mm) into the underlying layer. The use of vibrators to move concrete horizontally within the forms should not be allowed. Mechanical high frequency vibrators with a minimum frequency of 8000 revolutions per minute are preferred for consolidation of the concrete within the forms. The concrete should be vibrated in accordance with the recommendations contained in ACI 309R. Vibration should be continued until the escape or large bubbles at the surface stops and before the onset of any segregation.

Vibrators attached to the forms provide an excellent means of vibrating high walls and columns. The forms must be designed to allow for the full liquid head pressure produced by the use of form vibrators.

For more information on vibration and consolidation of concrete, refer to ACI 309R.

709.3.9 Temperature Limitations

709.3.9.1 Cold Weather. Unless the temperature is at least 40 degrees F. (4.4 degrees C.) and rising, water and/or aggregates should be heated so that the temperature of the concrete, when placed, is not less than 55 degrees F. (13 degrees C.) Provision should be made for maintaining the concrete moist and at a minimum temperature of not less than 50 degrees F. (10 degrees C.) For a period of at least 7 days.

Insulated tarpaulins and blankets may be used to cover concrete slabs or draped over and around walls, columns, and beams to retain the heat generated by hydration of the cement. Forms may be insulated or heated. Atmospheric steam curing may be utilized to accelerate curing and strength gain. Detailed recommendations are given in ACI 306R.

Because of potential dangers, form removal should be governed by attainment of adequate strength in the

field-placed concrete.

709.3.9.2 Hot Weather. When the ambient temperature is 90 degrees F. (32 degrees C.) or above, special precautions should be taken during batching, mixing, placing and curing. Aggregate and cement should be kept cool. The use of a set-retarding admixture may be beneficial, particularly with shrinkage-compensating concrete.

Sometimes it is desirable to cool the mixing water by the use of liquid nitrogen, refrigeration, or by replacing part of the water with shaved or crushed ice.

Wall forms should be removed as soon as the concrete has hardened sufficiently to prevent damage to the concrete. Curing should be commenced immediately with water and burlap covers or with the application of a non-staining, non-toxic white-pigmented curing compound acceptable to the engineer.

Curing of concrete slabs should be started as soon as possible, when finishing has been completed and/or the water sheen has disappeared. If liquid membrane-curing is used (see Section 709.6), the compound should be non-staining, non-toxic, and white-pigmented. Detailed recommendations are given in ACI 305R.

709.3.9.3 Admixture Curing. Concrete containing Xypex admixture shall be cured per ACI 308.

709.4 Joints.

709.4.1 Construction Joints. Vertical construction joints should be prepared and bonded as provided in Chapter 6 of ACI 301. This practice also may be used for horizontal joints. When the wall height exceeds 8 ft., new concrete should be placed on a layer of cement mortar evenly spread over the previously placed concrete. This mortar should be a mixture of cement, sand, and water in the same proportions used in the concrete but with all coarse aggregate omitted.

709.4.2 Movement Joints. Concrete surfaces must be clean and dry; free from grease, oil, bitumen, or curing compound; and should be primed according to the recommendation of the manufacturer of the sealant. When a joint sealant is used, it should be investigated for compatibility with the liquid being retained. For detailed recommendations on sealants, see ACI 504R.

709.4.3.1 Steel. Steel water-stops have been used successfully in construction joints. This type of water-stop is usually a 6 X 1/4 inch (152 X 6 mm) steel plate embedded 3 in. (76 mm) into the concrete on each side of the joint. To facilitate bonding to the concrete, the surfaces of steel water-stops should be free of all mud, oil, loose rust, or other material that would inhibit bond. Splices should be made by butt-welding the ends of the plates together.

709.4.3.2 Flexible Water-Stops. Water-stops fabricated of rubber, vinyl, metal, or other acceptable material should be of shapes and patterns to accomplish the required function. Where movement is anticipated as in expansion joints, a bulb or U-shaped center section with Atear-away@ closure should be provided of such size and pattern as required to accommodate anticipated movement.

When a flexible-type water-stop is used, all portions including ends and edges should be firmly tied and/or fixed in position to prevent movement during placement of the concrete. See Figure 12 and 16 of ACI 504R for installation recommendations.

709.5 Formwork.

709.5.1 General. Formwork should be designed, fabricated, erected, used and removed in accordance with the recommendations and guidelines of ACI 347 and SP-4.

709.5.2 Form Design. Formwork should be designed so that all components and members of the structure will be cast to the correct dimensions, shape, alignment, elevation, and position, without excessive deflection.

Formwork also should be designed to be erected, supported, braced, and maintained so that it will support safely all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure.

The form panels for liquid-containing structures and conduits should be constructed in the largest size consistent with the lifting equipment available to handle them. Form surfaces should be constructed of sheet steel, smooth-dressed wood or plastic-faced plywood, or fiberglass. Assemblies should provide for ease of stripping with minimum damage to the formed surfaces.

Vertical or lateral loads should be carried to the ground by the formwork and shoring system or by the in-place construction that has adequate capacity for that purpose.

Formwork and falsework vertical and lateral loads should also include live loads, wind loads and construction loads, together with appropriate safety factors and load multipliers as recommended by ACI 347.

All formwork should be mortar tight. Tie systems should provide for positive pressure at all joints to preclude grout leakage.

709.5.3 Form Ties. Form tie assemblies for environmental engineering concrete structures should permit tightening of the forms and should leave no metal or other material within 1-1/2 in. (38 mm) of the surface. The assembly should provide cone-shaped depressions at the surface of the formed concrete at least 1 in. In diameter and 1-1/2 inches deep to allow filling and patching.

Ties should be tight fitting, or tie holes in forms should be sealed to prevent leakage where ties penetrate the form.

When a portion of single rod ties are to remain in a liquid-retaining structure, the portion that is to remain should be provided with a tightly fitted washer at mid-point. Multi-rod ties do not require washers. Through ties that are to be entirely removed from the structure should be tapered over the portion that passes through the concrete. The large end of tapered ties should be on the liquid side of the wall. The contractor should be required to demonstrate the methods and materials to be used to fill the void thus formed.

709.5.4 Form Coating or Release Agents. Form surfaces that will be in contact with concrete should be coated with an effective bond-breaking form coating in accordance with Section 4.4 of ACI 347. For water storage tanks, the form coating should be non-toxic after a specified period, usually 30 days.

709.5.5 Inspection Before Concreting. Prior to placing concrete, forms should be inspected for cleanliness, accuracy of alignment, and reinforcing steel clearances. Inspection ports should be provided if, in the opinion of the Inspector, they are necessary to clean and inspect properly the interior of the formed element.

709.5.6 Removal of Forms. Removal of forms should be in accordance with ACI 347.

In hot, dry climates, wood forms remaining in place may not provide adequate curing and should be kept wet or removed or loosened so that the concrete surfaces can be kept moist or coated with a curing membrane. In cold weather, removal of formwork should be deferred and insulated until concrete has attained adequate strength, or formwork should be replaced with insulation blankets to avoid thermal shock and consequent crazing of the concrete surface.

709.5.7 Reshoring. Reshoring, if permitted, should be in accordance with ACI 347.

709.6 Finishes for Exposed Surfaces.

709.6.1 Finishing Unformed Surfaces. Detailed recommendations are given in Section 6.4.4 and Chapter 7 of ACI 302.1R. Concrete should be spread evenly ahead of the strike-off and worked as little as possible during early finishing operations. Any water brought to the surface by the strike-off or rough floating should be

allowed to evaporate. If the amount of water or laitance is excessive, it should be removed before the surface is floated or troweled again. If a smooth surface is required, final troweling should be delayed as long as possible. Generally, the proper time for final troweling is after the surface water has disappeared and when the surface cannot be dented easily with the finger. Final troweling should be only as required to produce the specified finish and close any surface cracks that may have developed.

709.6.2 Non-Slip Finish. All exposed floor areas, sidewalks, and steps subject to foot traffic and likely to be wet should have a non-slip finish, as described in Section 7.12 of ACI 302.1R.

709.6.3 Finishing Formed Surfaces. Requirements vary from merely removing fins and repairing obvious imperfections to finishing, which involves grinding, rubbing, floating, or brushing. Such work should be done as soon as forms can be removed. If surfaces are to be finished by grinding, chipping, bush-hammering, or sandblasting, the concrete must first be cured thoroughly. Chapter 5 of ACI 301 adequately covers these and other types of concrete finishes.

709.6.4 Repair of Surface Defects. Repair of surface defects should be in accordance with Chapter 9 of ACI 301 and with ACI 309.2R.

709.6.4.1 Tie Holes. After being thoroughly cleaned and dampened, the tie holes should be grouted solid with a non-metallic, non-shrinking grout. The tie hole should be filled from the large end of the cone-shaped hole and packed solid by rodding. The use of rubber or plastic plugs wedged deep in the wall prior to filling with grout is recommended. The grout material and the entire tie hole filling process should be acceptable to the engineer prior to the start of the work.

709.6.4.2 Patching Minor Defects. Surfaces to be patched or repaired after removal of forms should be corrected by acceptable methods and not by plastering over them. Patching of defective areas should be done as soon as the forms can be removed and before curing compound is applied.

A good patch well-bonded to adjacent concrete is essential. Non-shrink, non-staining grout should be used where appearance is important. Curing requirements for patches should be the same as for the mass of the concrete.

709.6.4.3 Honeycombed Areas. Honeycombed sections may result from improper placement and inadequate vibration. Whether patching of honeycombed areas is permissible depends on the extent and depth of the defective concrete and its location. If patching is allowed, all unsound material should be chipped out back to sound, solid concrete and inspected prior to the start of filling and patching operations.

709.7 Curing. Proper curing of fresh concrete requires that moisture be retained to promote additional hydration of cement during the curing period and to prevent formation of surface cracks due to rapid loss of water while the concrete is plastic. Detailed recommendations are given in
ACI 308.

When surfaces are cured with membrane curing compound, all finishing operations, except grinding, chipping, bush-hammering and sand-blasting, should be completed prior to application of the membrane.

Curing should commence as soon as possible following initial set or completion of surface finishing, and as soon as marring of the concrete surface will not occur. Various methods commonly used include sprinkling, ponding, using moisture retaining covers, or applying a liquid membrane-forming curing compound seal coat to form a thin water-impervious membrane.

Leaving wall forms in place provides an excellent means of retaining moisture. However, in hot, dry weather, the dry forms tend to absorb moisture from the concrete and inhibit dissipation of the heat of hydration. Therefore, in hot, dry weather, the forms should be kept moist or removed as soon as the concrete has hardened sufficiently to prevent damage to the concrete. Moist or membrane curing should be commenced immediately after removal of the forms.

The membrane curing compound should cover the entire surface to be cured with a uniform film that will remain in place without gaps or omissions for the full duration of the curing period. Exposed steel, keyways, or concrete to be surfaced should be protected from the curing compound unless tests show that satisfactory adherence of the surface is obtained.

Membrane curing compounds should conform to ASTM C 309 and should have a minimum of 18 percent solids, be non-yellowing, and have a unit moisture loss of less than 0.039 gm/cm^2 maximum at 72 hours. Rate of application of curing compounds should follow manufacturer=s recommendation or be in the range of 150 to 200 ft^2/gal. [See Section 2.3.3 of ACI 308-81 (Revised 1986)]. Polyethylene film for curing concrete should conform to ASTM C 171. Curing compounds used in water treatment plant construction must be non-toxic and free of taste and odor.

709.8 Cleaning. Remove all refuse and debris and surfaces washed with clean water prior to performing leakage testing and disinfection.

709.9 Watertightness: On completion of the tank, prior to any specified backfill placement at the footing or wall, and prior to placement of exterior wall treatments, the following test shall be applied to determine watertightness:

709.9.1.1 Preparation: Fill the tank with potable water to the maximum level and let it stand for at least 24 hours.

709.9.2.1 Measurement: Measure the drop in liquid level over the next 72 hours to determine the liquid volume loss for comparison with the allowable leakage. Evaporative losses shall be measured or calculated and deducted from the measured loss to determine the net liquid loss (leakage). The net liquid loss for a period of 24 hours shall not exceed 0.05 of 1 percent of the tank capacity.

709.9.2.2 If the leakage exceeds the maximum allowable, the leakage test shall be extended to a total of five days. If, at the end of the five days the average daily leakage does not exceed the maximum allowable, the test shall be considered satisfactory. If the net liquid loss exceeds the maximum allowable, leakage shall be considered excessive and the tank shall be repaired, re-disinfected, and retested until leakage falls within the appropriate limit.

709.9.2.3: Damp spots on the exterior wall surface or measurable leakage of water at the wall base shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. Leakage through the wall-base joint or footing shall likewise be corrected. Damp spots on the footing are generally to be expected, and are permissible.

709.10 Repairs: The Contractor shall make all necessary repairs if the tank fails the watertightness test or is otherwise defective. The method of repair shall be subject to acceptance by the City Engineer and/or Public Works Director, shall comply with NSF (National Sanitation Foundation Testing Laboratory, Inc.) requirements for materials and internal coatings for potable water contact, and the State of Utah, Division of Drinking Water, *Rules for Public Drinking Water Systems*.

709.10.1 Concrete Repair: The most common repair method for small areas of honeycombed concrete (rock pockets) and other defective concrete is removal and replacement with non-shrink aggregate grout (which may include a pea gravel aggregate) bonded to the concrete with an epoxy bonding agent. The minimum strength of material used in the repair shall equal or exceed that specified for the concrete.

Defective tie hole patches shall be removed and the holes re-packed or epoxy injected.

709.10.2 Epoxy injection grouting:

709.10.2.1 Wall Repair: Damp or wet spots resulting form leakage through the wall shall be repaired with a high-pressure epoxy injection grouting system, crystalline concrete waterproofing with XYPEX^{TM} admixture, or other method acceptable to the City Engineer and/or Public Works Director, and shall comply with NSF (National Sanitation Foundation Testing Laboratory, Inc.) requirements for materials and internal coatings for potable water contact, and the State of Utah, Division of Drinking Water, *Rules for Public Drinking Water Systems*.

709.10.2.1.1 Epoxy Grouting: When epoxy grouting is to be performed, a low-viscosity, two-component, water-insensitive, non-toxic epoxy-resin system with an in-line metering and mixing system shall be used. The pumps shall be capable of producing a minimum injection pressure of 100 psi (680 kPa). Injection pressure shall be limited to 300 psi (2.1 MPa) to ensure complete penetration of the defect without damaging the structure. Epoxy shall reach a minimum compressive strength of 6,000 psi (40 MPa) in 24 hours in accordance with the requirements of ASTM D695. An applicator with successful past experience in water-retaining structures shall be present on the job at all times while repairs are being made. Work shall be guaranteed against failure of the epoxy bond in the repair areas for a minimum period of one year.

Any exposed defect receiving epoxy repair shall first be cleaned of dirt, laitance, and other material that might prevent proper bonding. A suitable temporary seal shall then be applied to the surface of the defect to prevent the escape of the epoxy. Entry ports shall be spaced along the seal at intervals not greater than the thickness of the cracked element. The epoxy shall be injected into the crack at the lowest port first, with sufficient pressure to advance the epoxy to an adjacent port, using a small nozzle held tightly against the port. The operation shall continue until epoxy material begins to extrude from the adjacent port. The original port shall be sealed and the injection shall be repeated in one continuous operation until the crack has been injected with epoxy for its entire length. All ports, including adjacent locations where epoxy seepage occurs, shall be sealed as necessary to prevent drips and run-outs. On completion of the injection of the crack, the grout shall be allowed to cure for sufficient time to allow the removal of the temporary seal without any draining or running out of the adhesive epoxy material from the crack. The surface of the crack shall then be finished flush with the adjacent surfaces and shall show no indentations or evidence of port filling.

709.10.2.1.2 Xypex Grouting: Application shall be in accordance with the manufacturer=s recommendations. A factory certified technician shall supervise the repairs being made. Work shall be guaranteed against failure of the repair areas for a minimum period of one year.

709.5.10.2 Floor, Piping and Valves: Generally, the loss of water through the tank floor, piping and valves is difficult to determine separately. The total loss shall not exceed the criteria set forth in Section 709.9. If the loss of water exceeds the criteria, the tank floor shall be inspected for point sources or leakage with the tank full or empty.

Water loss through floor joints or shrinkage cracks shall be located and the defective sections removed and replaced, or repaired as specified earlier or by other means acceptable to the City Engineer and/or Public Works Director.

709.11 Tank Backfill: When wall backfill is required, it shall be initiated only after the tank has been satisfactorily tested and filled, unless another procedure is acceptable to the City Engineer and/or Public Works Director. Backfill material shall be placed in uniform layers and compacted to the satisfaction of the City Engineer and/or Public Works Director for the material and site conditions prevailing. No material greater than 6 inches in diameter shall be placed against the tank walls during backfill. Avoid unbalanced backfill placement variation in elevation around the tank except as may be fully provided for in the design.

STANDARD DRAWINGS

April
2007
DeHaan/Anderson

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

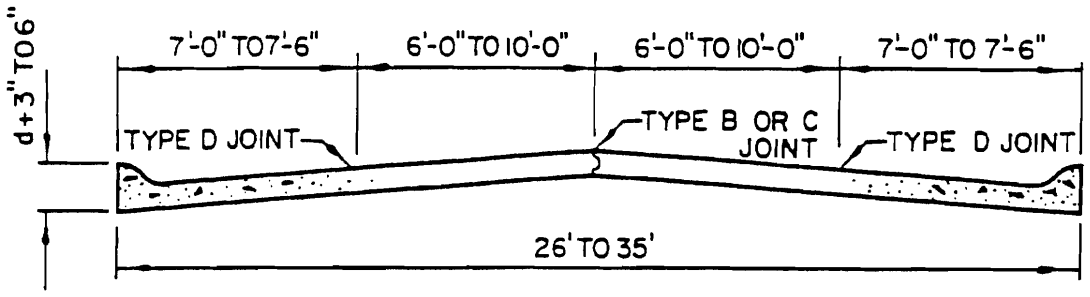
(435) 615-5077

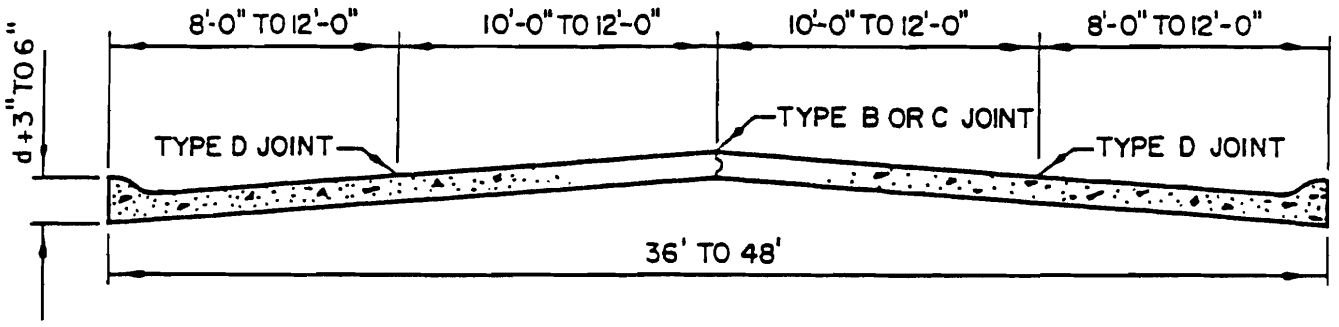
Notes:

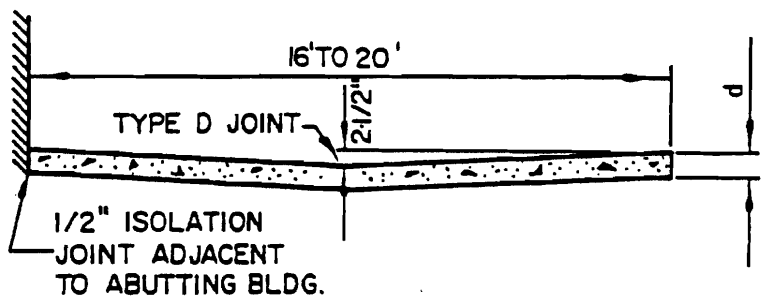
STANDARD DRAWINGS

TABLE OF CONTENTS

Drawing Number	Title
531-A	Pavement Cross-Sections
531-B	Concrete Pavement Joints
532-A	Curb and Gutter Details
532-B	Drain Gutter Details
532-C	Driveway Details
533-A	Handicap Ramp Details
540-A	Street Light
540-B	Street Light Foundation Detail
540-C	Street Light Support Detail
540-D	Street Sign Details
540-E	Street Sign Details
540-F	Mounting Detail for Sign on Light Pole
552-A	Pavement Patching Details
602-A	Culvert Compaction and Backfill
604-A [1-7]	Highback Curb Inlet Box
605-A	Single Gutter Inlet Box
605-B	Double Gutter Inlet Box "B"
605-C [1-2]	Storm Drain Cleanout Details
605-D	Bicycle-Safe Grating and Frame
702-A	Bedding and Backfill for Storm Drain or Sewer Pipe
703-A	Waterline Installation in Roadway
703-B	Waterline Trench Backfill
703-C	Thrust Blocking Detail
705-A	Water Service Connection
705-B	Meter Box Detail
705-C [1-2]	Meter Vault - Single 1½-inch Meter & Single 2-inch Meter
705-D	Meter Vault - 4-inch and 6-inch Meters
705-E [1-2]	Meter Vault - Multiple Meters
705-F [1-2]	Meter Vault - 1-inch Meters
705-G [1-2]	Meter Vault - 1½-inch Meters
705-H [1-2]	Meter Vault - 2-inch Meters
706-A	Fire Hydrant Details
707	Air Release Valve Manhole
708 [A-D]	Pressure Reducing Valve Vault
709	Valve in Manhole Vault
710	Typical Backflow Preventer Installation
800-A	Typical Intersection Location for Underground Utilities
800-B	Street Sections
800-C	Standard Street Monument
901	Excelsior Mat Installation
902	Jute Mesh Installation
903	Straw Bale Installation for Erosion Control

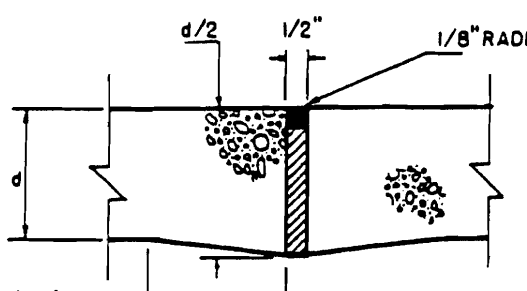




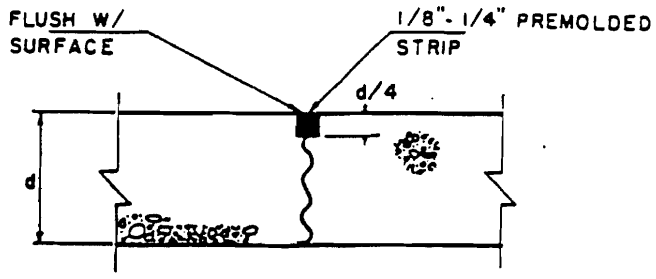


PAVEMENT CROSS SECTIONS INDICATING JOINT LOCATIONS

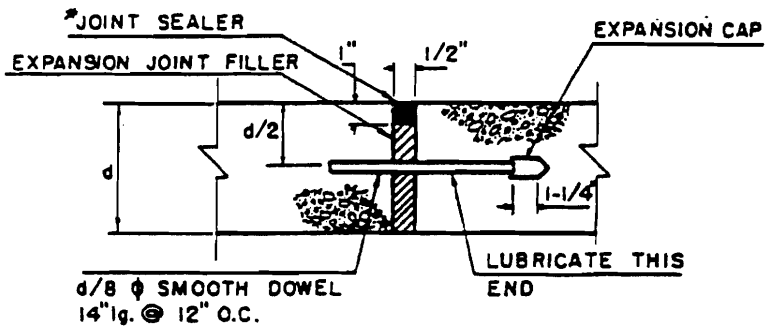
STANDARD DRAWING 531-A	**PAVEMENT CROSS SECTIONS** CONCRETE PAVEMENT WITH INTEGRAL CURB & GUTTER PARK CITY MUNICIPAL CORPORATION



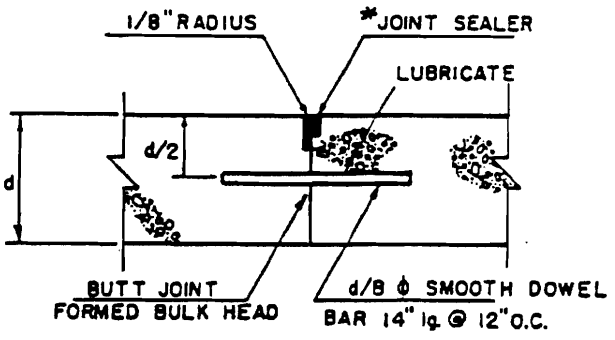
TYPE 'A' EXPANSION JOINT



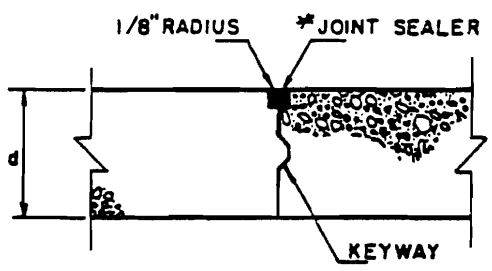
TYPE 'D' SAWED OR PREMOLDED STRIP LONGITUDINAL OR TRANSVERSE



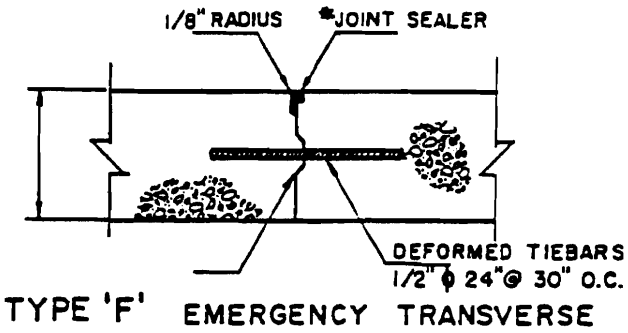
TYPE 'A' ALTERNATE EXPANSION JOINT



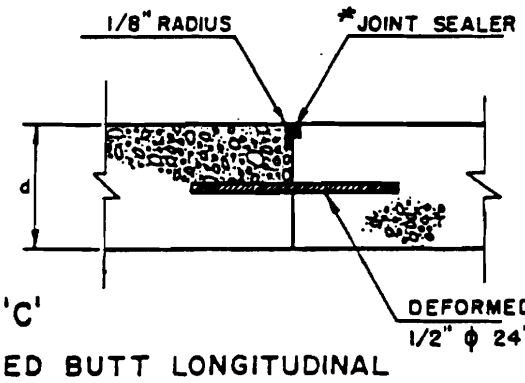
TYPE 'E' PLANNED TRANSVERSE CONSTRUCTION JOINT



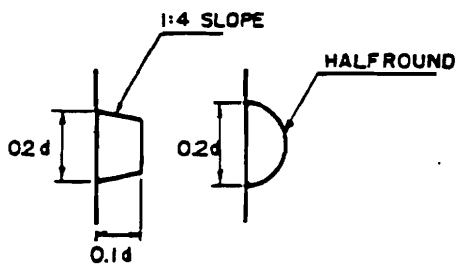
TYPE 'B' LONGITUDINAL CONSTRUCTION JOINT



TYPE 'F' EMERGENCY TRANSVERSE CONSTRUCTION JOINT



TYPE 'C' TIED BUTT LONGITUDINAL CONSTRUCTION JOINT

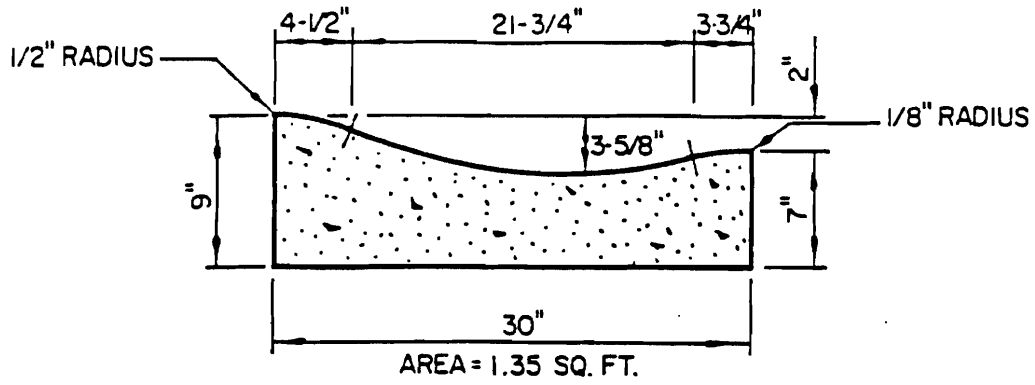


KEYWAYS FOR TYPE 'B' AND 'F'

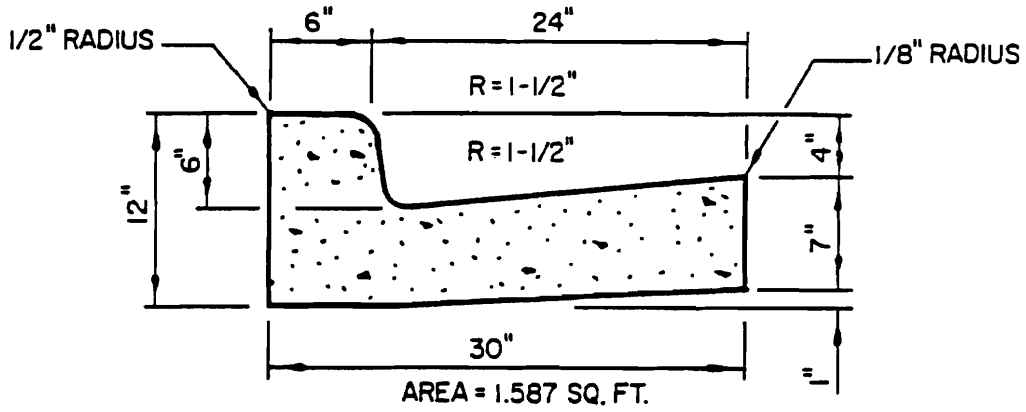
*JOINT SEALER IS SUBJECT TO APPROVAL BY CITY ENGINEER AND DIRECTOR OF PUBLIC WORKS.

STANDARD DRAWING 531-B	CONCRETE PAVEMENT JOINTS
	PARK CITY MUNICIPAL CORPORATION

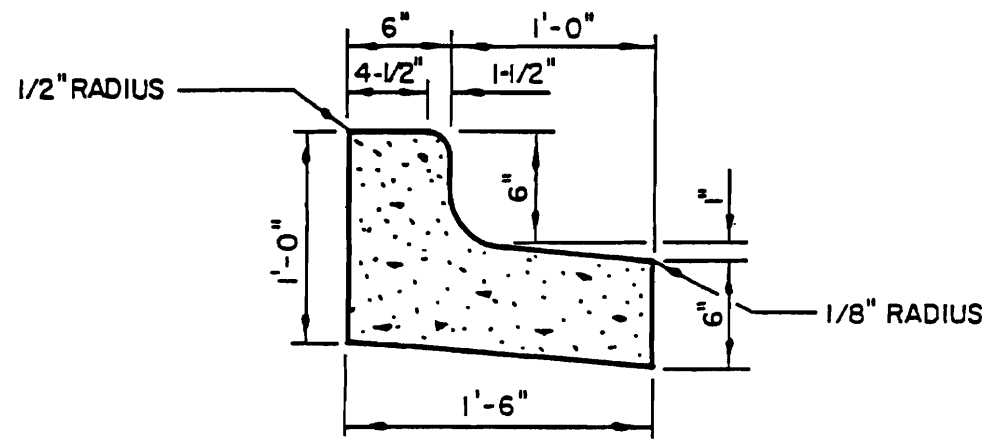
NOTE: The maximum distance between tooled control joints is ten (10) feet.
The maximum distance between expansion joints is fifty (50) feet.
The above conditions apply to all methods of placing concrete including paving machines unless otherwise approved by the City Engineer.



ROLL GUTTER



HIGH-BACK CURB AND GUTTER
(TYPE A)

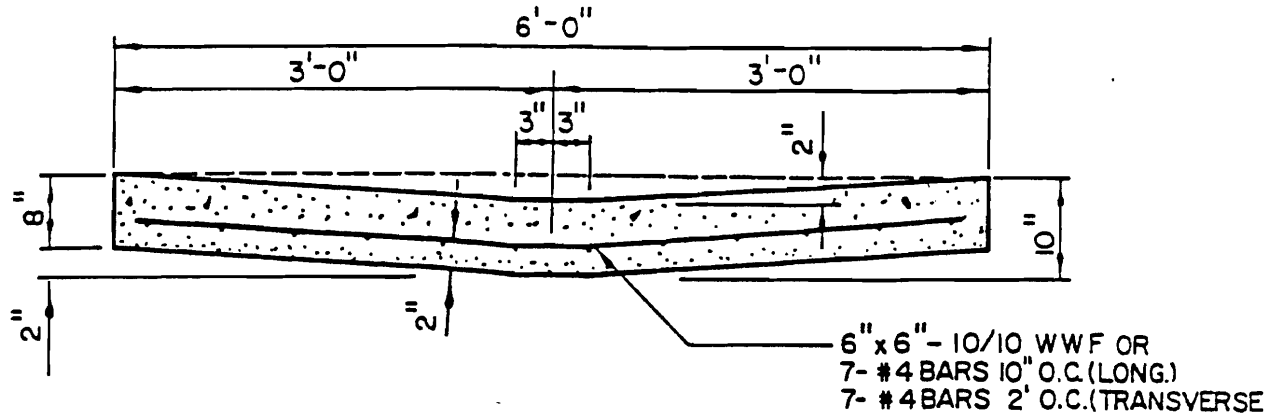


OUTFALL CURB AND GUTTER

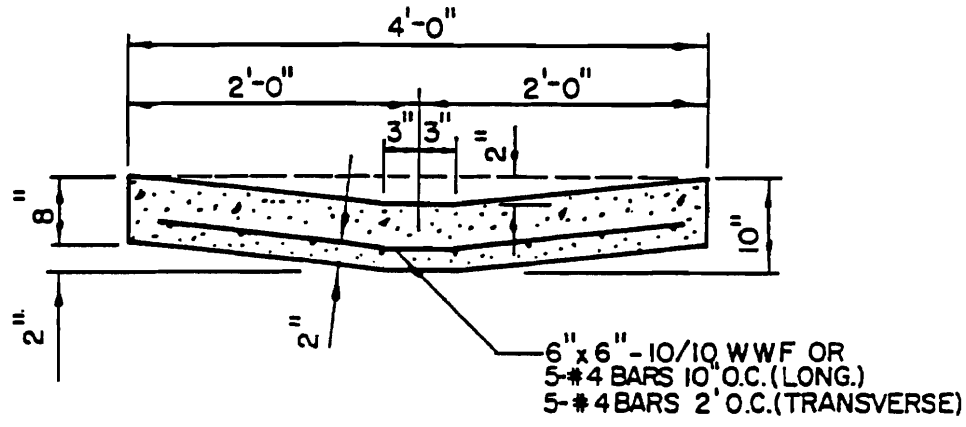
NOTE: ALL CURB & GUTTER IS TO BE BEDDED WITH A MIN. OF 5" OF UNTREATED BASE COURSE CONFORMING TO SECTION 510, UNLESS AUTHORIZED IN WRITING BY THE CITY ENGINEER

NO SCALE

STANDARD DRAWING 532-A	CURB AND GUTTER DETAILS
	PARK CITY MUNICIPAL CORPORATION



DRAIN GUTTER AT INTERSECTION

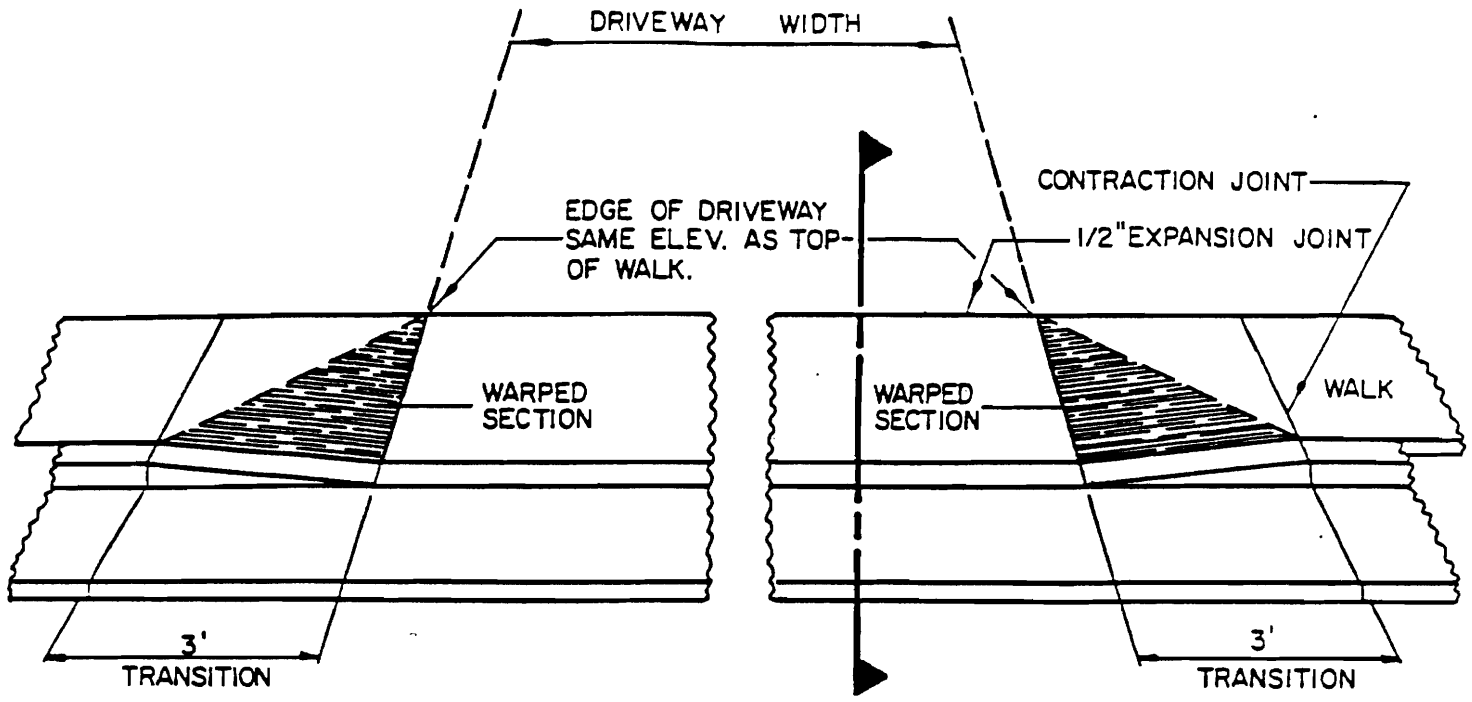


DRAIN GUTTER AT INTERSECTION

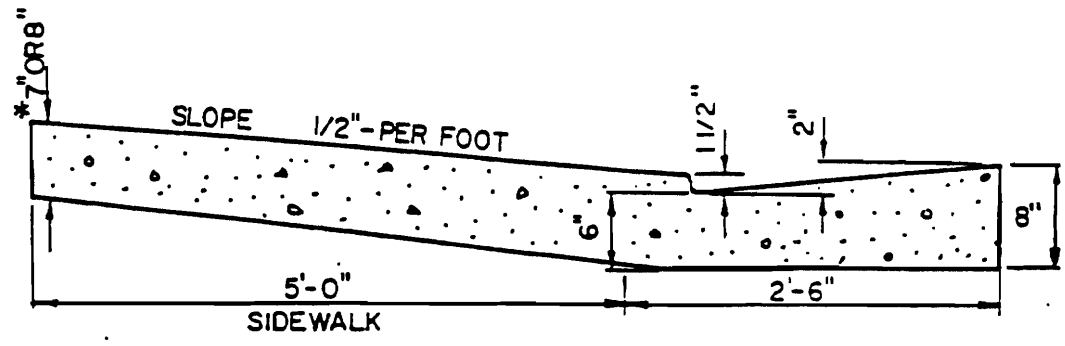
NOTE : ALL DRAIN GUTTER IS TO BE BEDDED WITH A MIN. OF 5" OF UNTREATED BASECOURSE CONFORMING TO SECTION 510, UNLESS AUTHORIZED IN WRITING BY THE CITY ENGINEER.

NO SCALE

STANDARD DRAWING 532-B	DRAIN GUTTER DETAILS
	PARK CITY MUNICIPAL CORPORATION



PERSPECTIVE VIEW

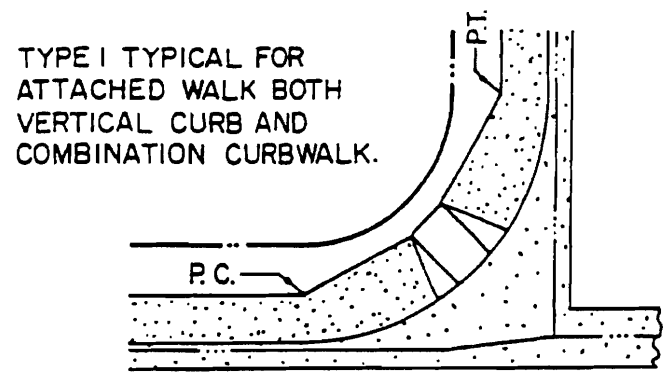


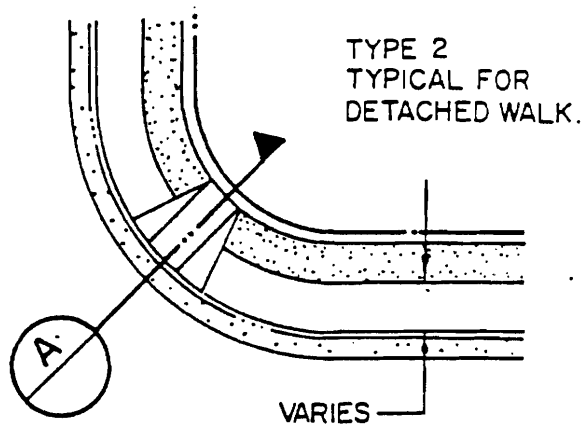
SECTION

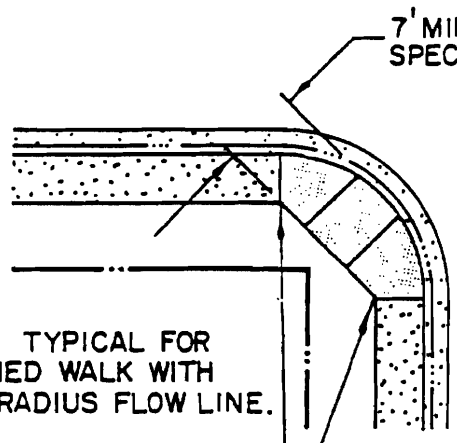
* DRIVEWAY THICKNESS : 7" FOR RESIDENTIAL AREAS
8" FOR COMMERCIAL AREAS AND PUBLIC ALLEYS

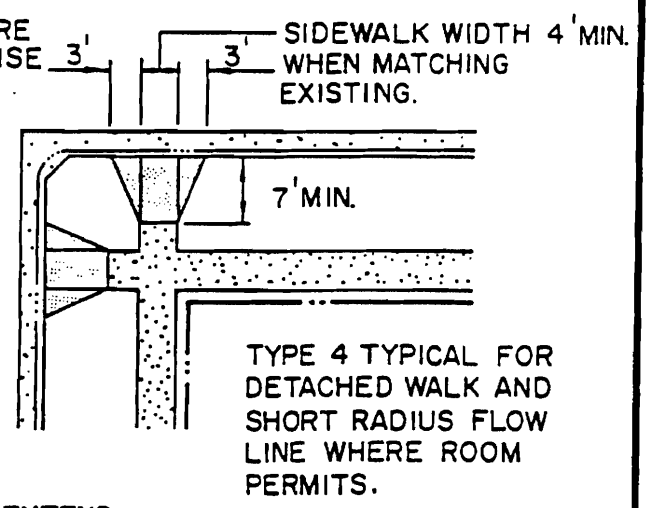
NOTE: ALL DRIVEWAYS ARE TO BE BEDDED WITH A MIN. OF 5" OF UNTREATED BASECOURSE CONFORMING TO SECTION 510, UNLESS AUTHORIZED IN WRITING BY THE CITY ENGINEER.

STANDARD DRAWING	DRIVE WAY DETAILS
532-C	HIGH BACK CURB & GUTTER
	PARK CITY MUNICIPAL CORPORATION

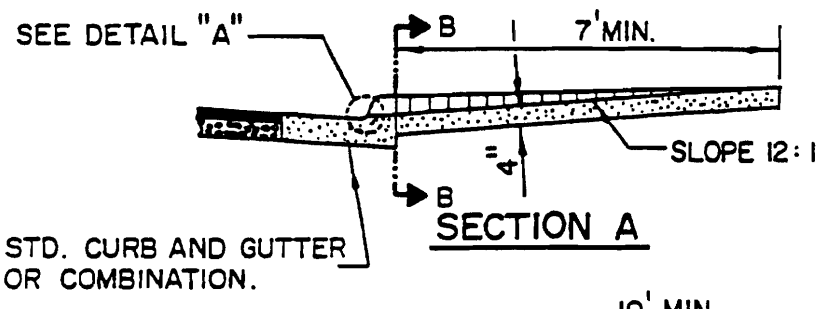




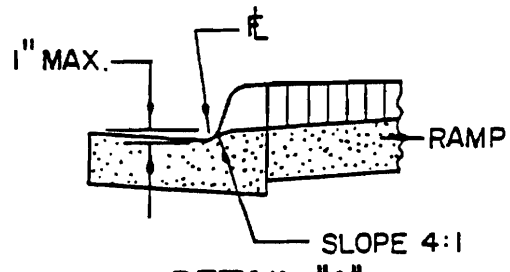




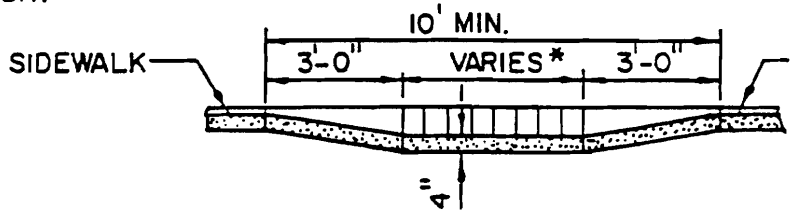
PLAN



SECTION A



DETAIL "A"

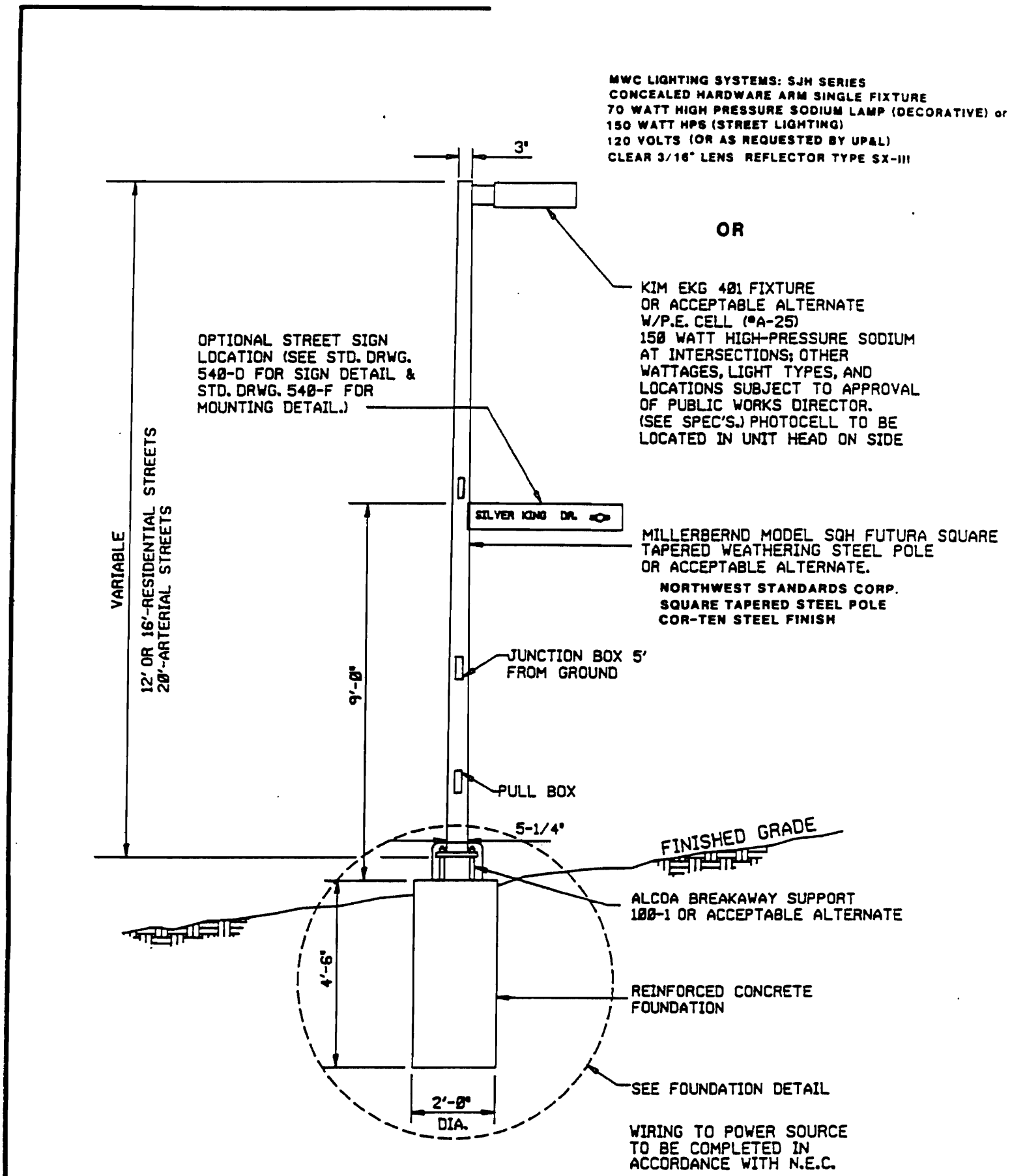


* TYPE 1, 2, & 3 RAMP
MIN. 6'-0"

SECTION B-B

NO SCALE

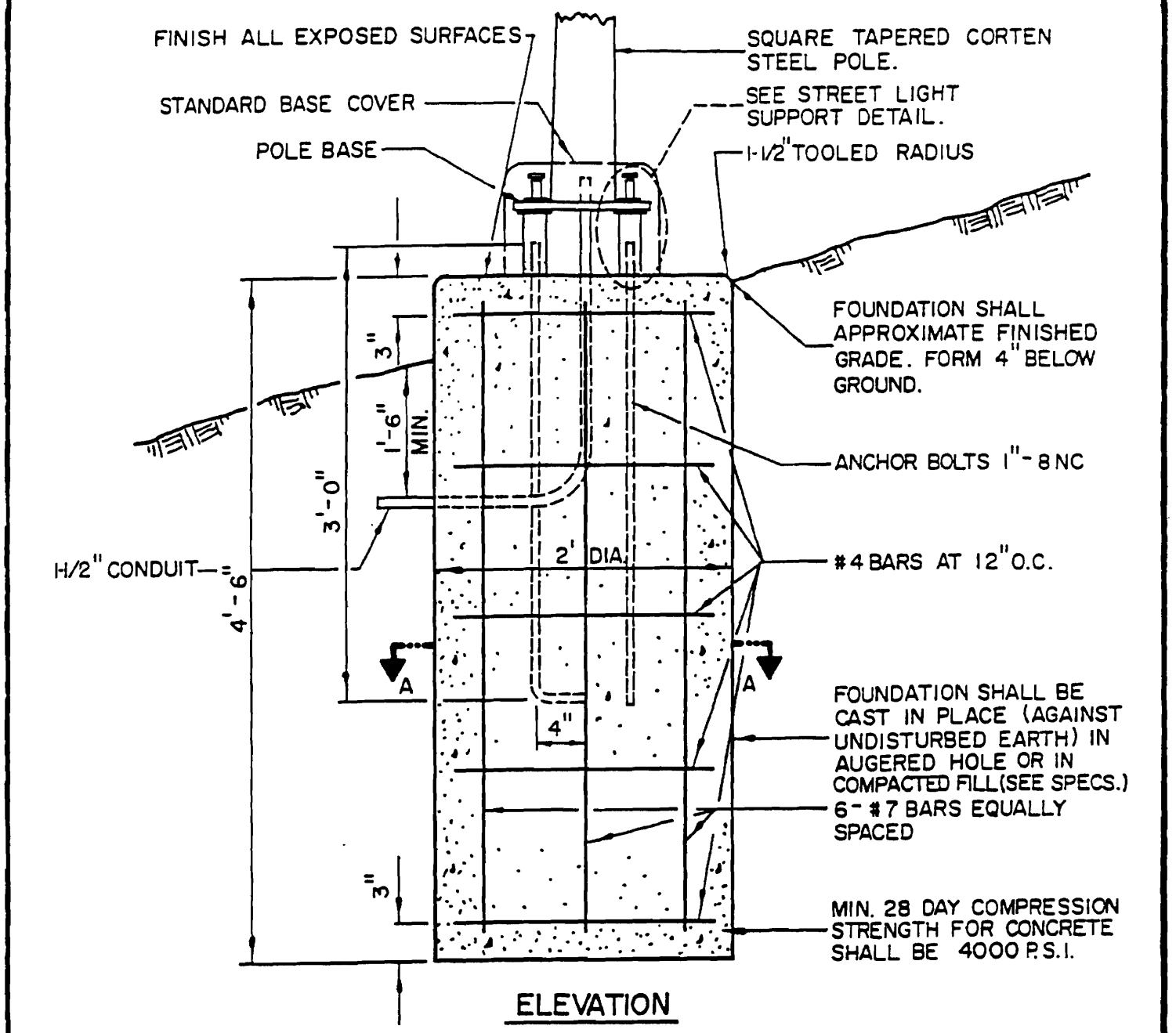
STANDARD DRAWING 533-A	HANDICAP RAMP DETAILS
	PARK CITY MUNICIPAL CORPORATION



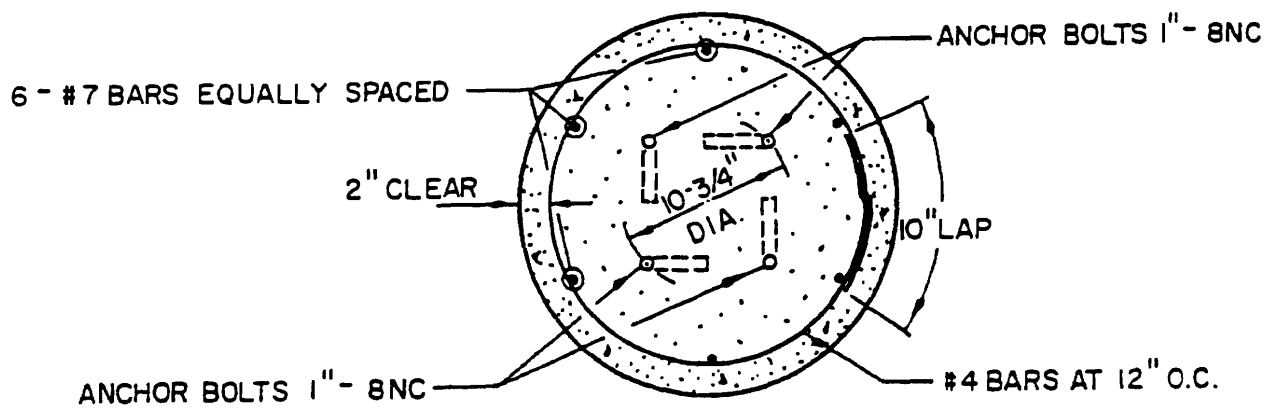
STANDARD DRAWING
540-A

STREET LIGHT

PARK CITY MUNICIPAL CORPORATION



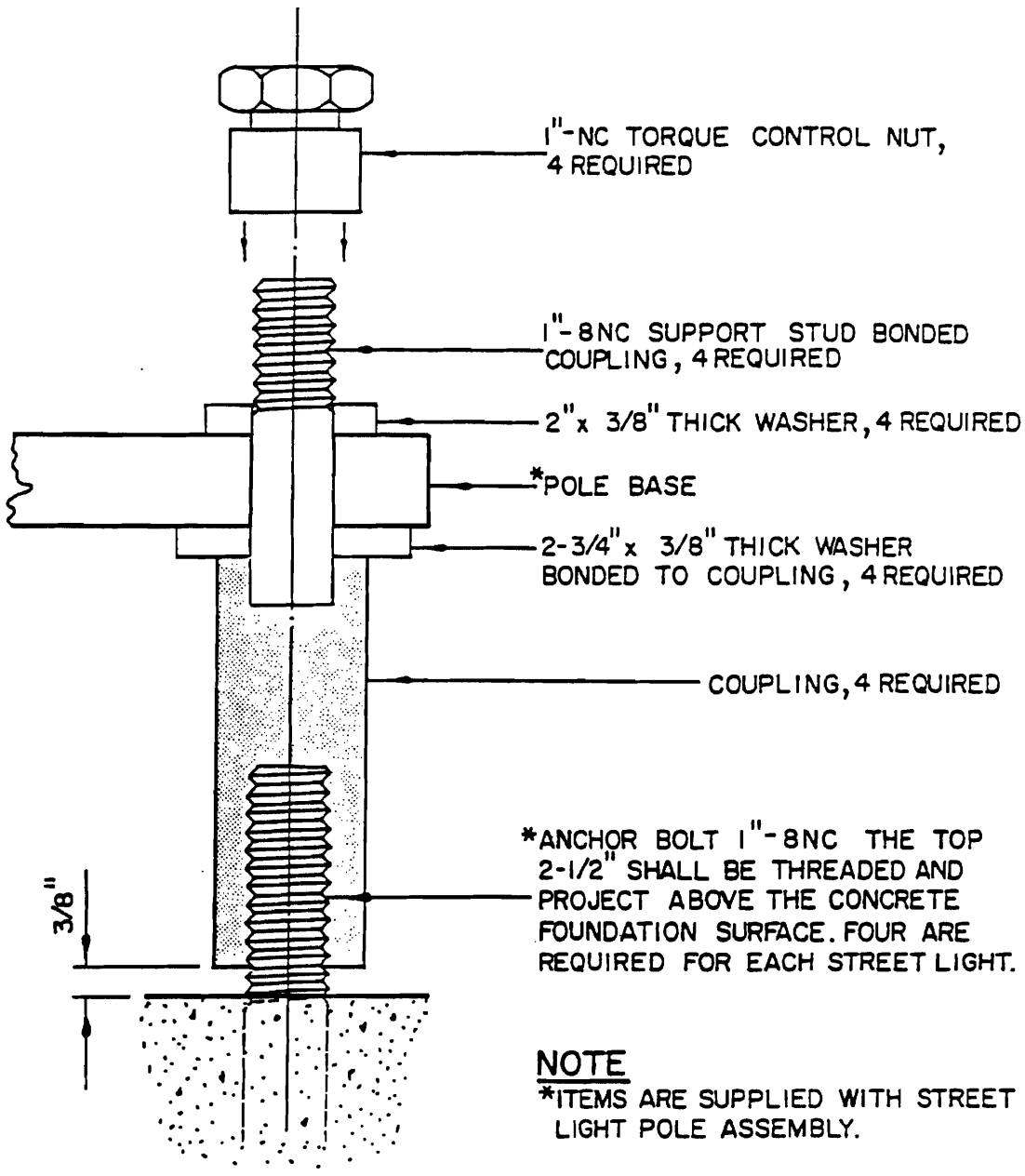
ELEVATION



SCALE 1" = 1'

SECTION A - A

STANDARD DRAWING 540-B	STREET LIGHT FOUNDATION DETAIL
	PARK CITY MUNICIPAL CORPORATION



NOTE

*ITEMS ARE SUPPLIED WITH STREET LIGHT POLE ASSEMBLY.

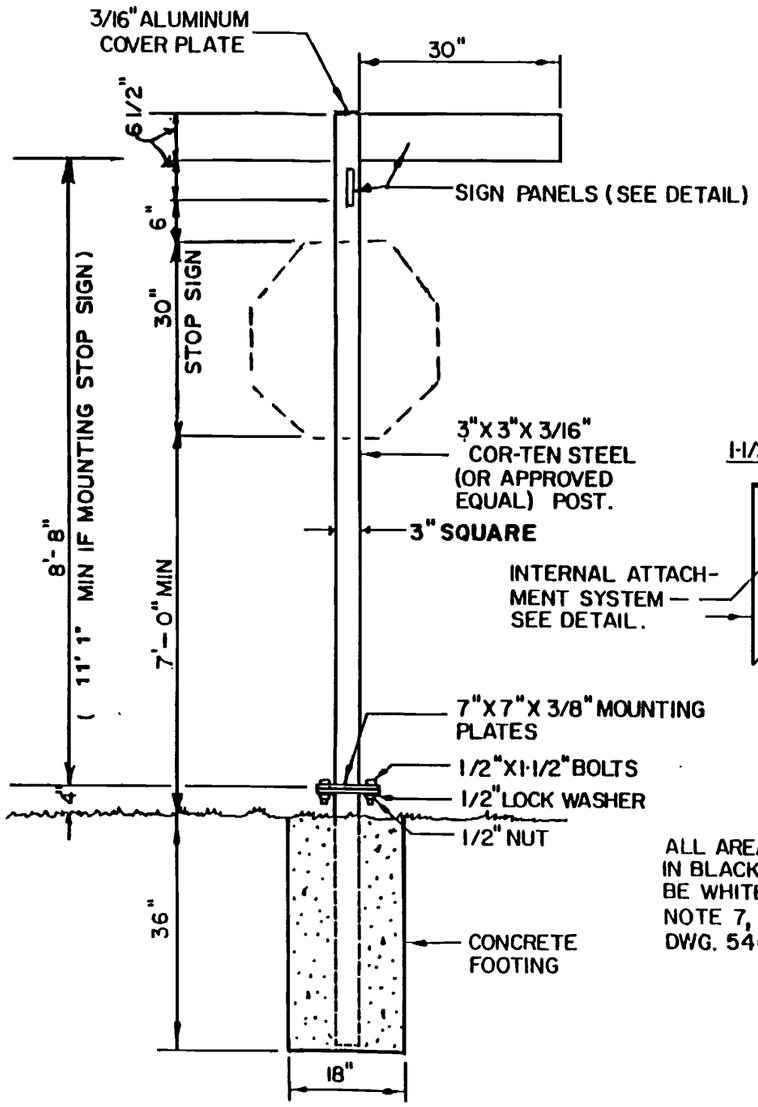
NO SCALE

STANDARD DRAWING 540-C	STREET LIGHT SUPPORT DETAIL
	PARK CITY MUNICIPAL CORPORATION

STANDARD DRAWING
540-D

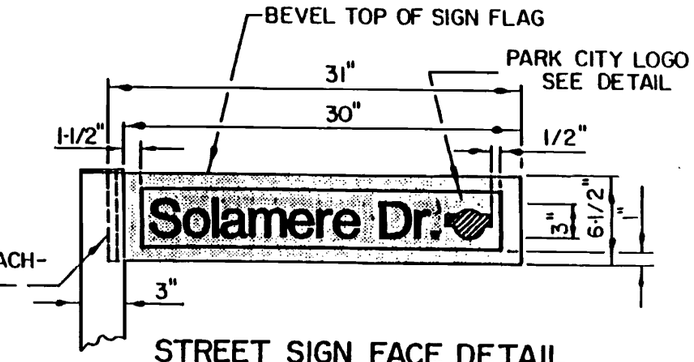
STREET SIGN DETAILS

PARK CITY MUNICIPAL CORPORATION

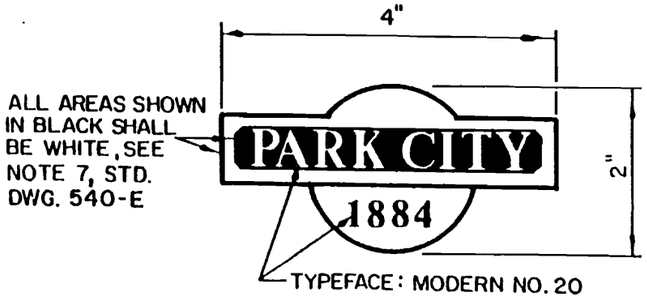


STREET SIGN ELEVATION
SCALE : 1/2"=1'-0"

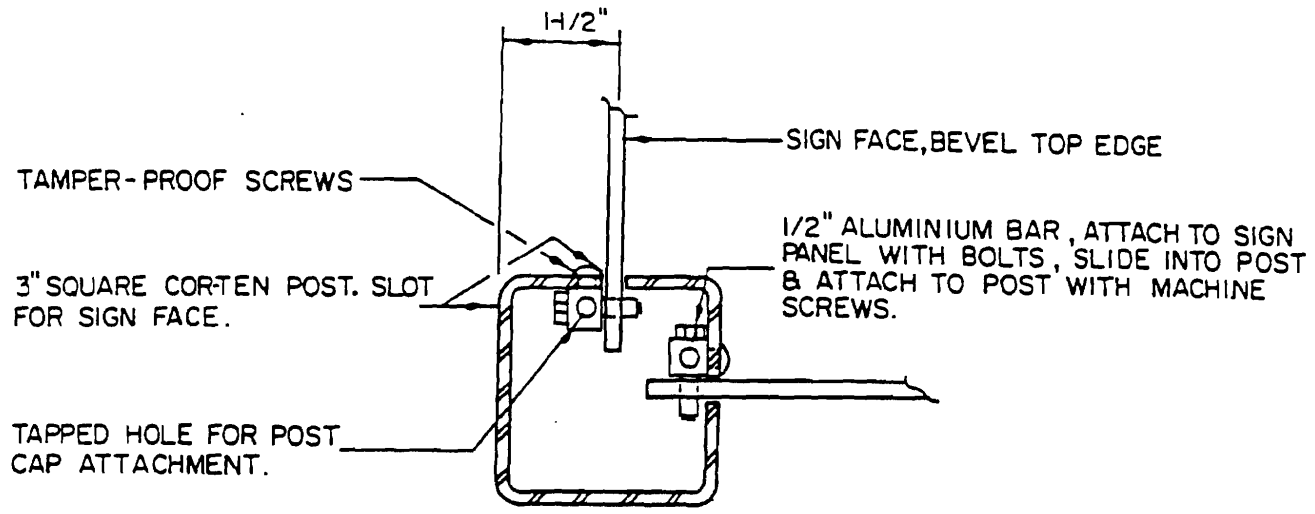
NOTE: SUBJECT TO APPROVAL OF PUBLIC WORKS DIRECTOR, STREET SIGNS AND TRAFFIC CONTROL SIGNS MAY BE MOUNTED ON STREET LIGHT POLE.



STREET SIGN FACE DETAIL
SCALE : 1"=1'-0"

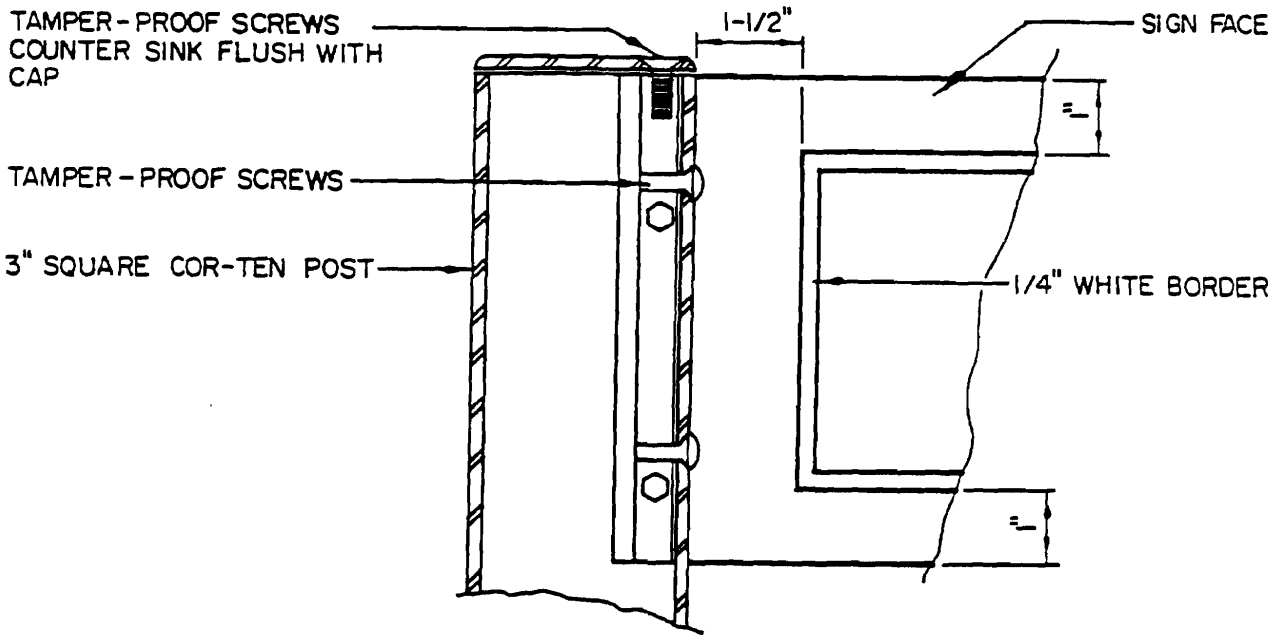


PARK CITY LOGO DETAIL
SCALE : 1/2"= 1"



SIGN ATTACHMENT SECTION

SCALE: 3/8" = 1"

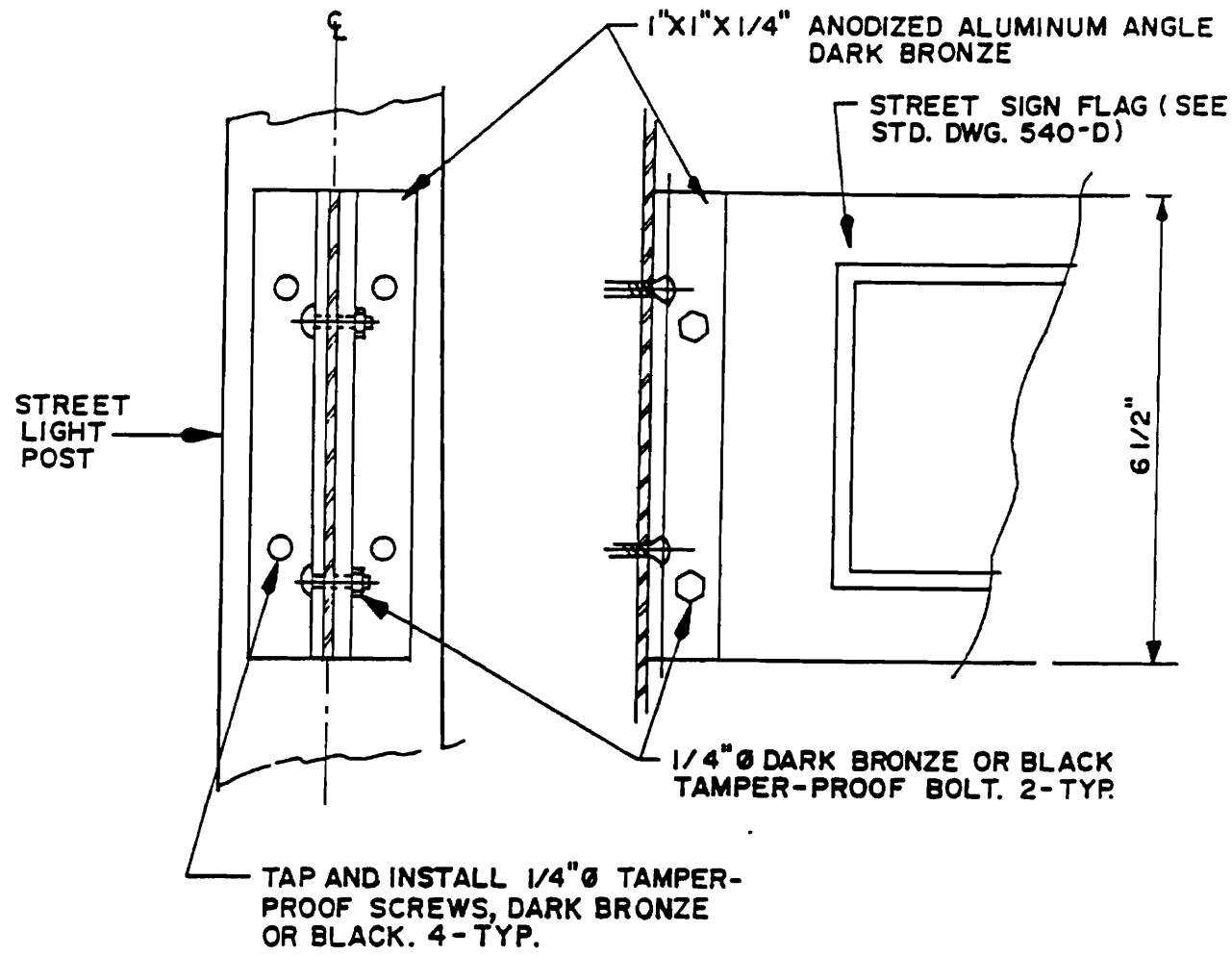


SIGN ATTACHMENT ELEVATION

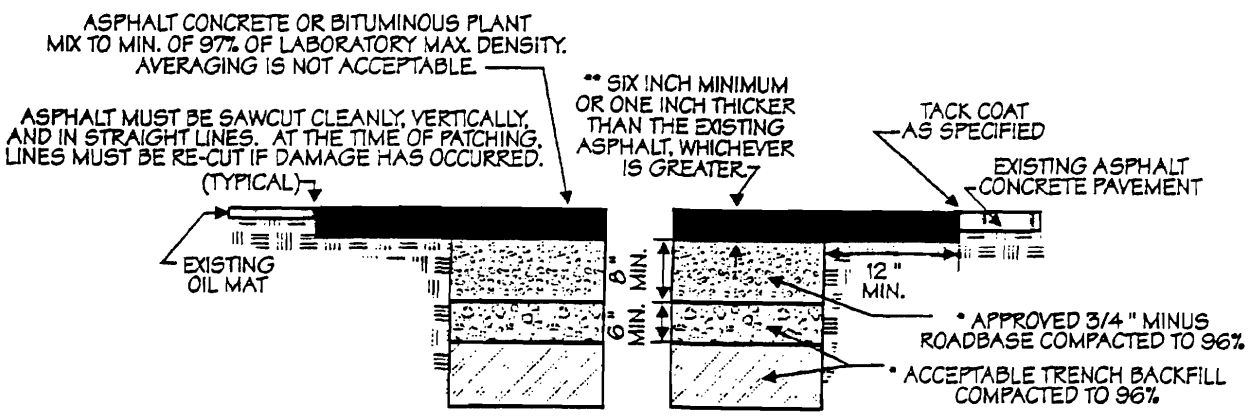
SCALE: 3/8" = 1"

1. 3"x3"x3/16" Cor-ten steel post.
2. 3"x3"x3/16" Cor-ten steel base embedded in concrete.
3. 1/4" thick sign plates electro-chemically plated to produce an anodized hard coat finish. Mount sign plates in the center and at right angles to the post.
4. The attachment of the sign panels to the post shall be vandal-proof.
5. All fasteners shall be dark bronze to match the sign face.
6. Lettering shall be 3" Helvetica Medium upper & lower case, reflective white scotch-lite applied to face & baked on.
7. The border & logo shall be applied by screen process and shall be white enamel.

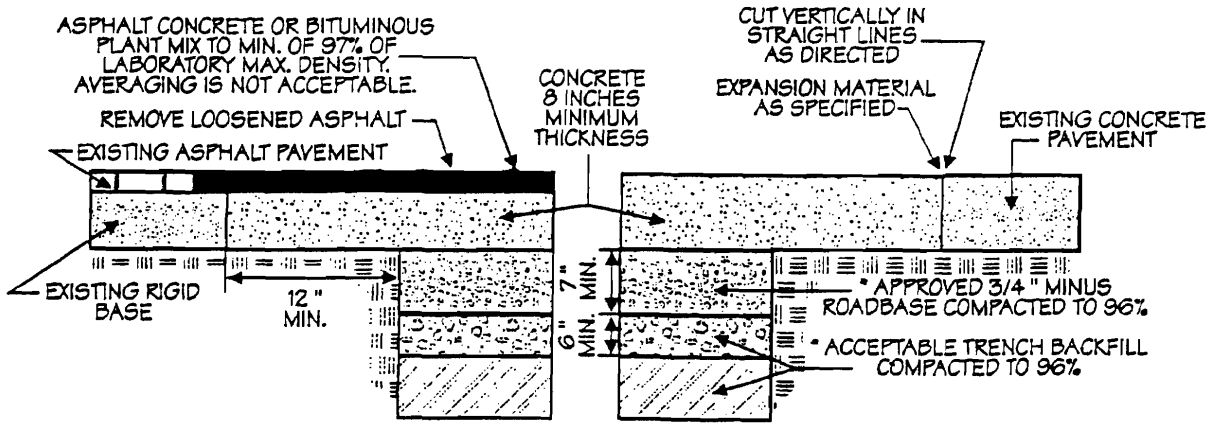
STANDARD DRAWING 540-E	STREET SIGN DETAILS
	PARK CITY MUNICIPAL CORPORATION



STANDARD DRAWING 540-F	MOUNTING DETAIL FOR SIGN ON LIGHT POLE
	PARK CITY MUNICIPAL CORPORATION



FLEXIBLE PAVEMENT PATCH



RIGID PAVEMENT PATCH (CONCRETE)

NOTES:

* ASTM D-1557 SHALL BE USED TO DETERMINE MAXIMUM SOIL DENSITY.

THIS TRENCH BACKFILL AND PAVEMENT PATCH SHALL BE USED IN ALL PAVED AREAS, FOR ALL UTILITY WORK AND IN ROADWAYS AND STREETS A DISTANCE OF UP TO TEN FEET FROM THE ASPHALT OR CONCRETE. (EXCEPT FOR ASPHALT & CONCRETE LAYER)

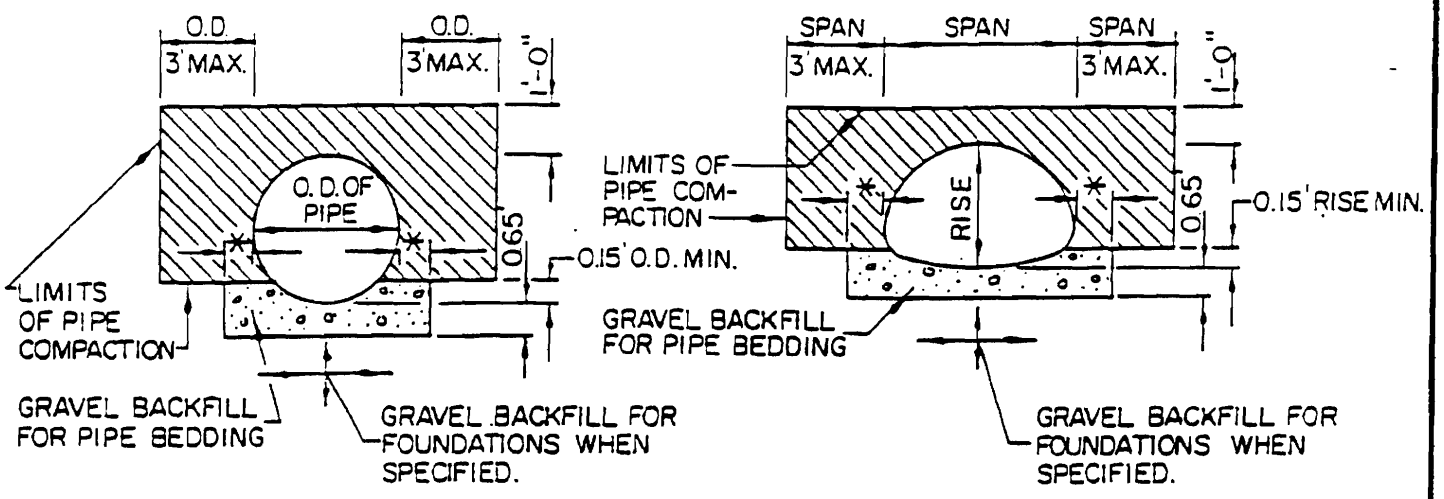
CONCRETE SHALL BE CLASS 4000 (PSI) HIGH EARLY STRENGTH CONCRETE MEETING THE REQUIREMENTS OF THESE SPECIFICATIONS.

ALL PATCHING SHALL BE DONE IN A MANNER TO FACILITATE THE SAFE AND EFFICIENT MOVEMENT OF TRAFFIC. SUFFICIENT FLAGPERSONS AND BARRICADES SHALL BE PROVIDED FOR THIS PURPOSE.

** ASPHALT PATCHES SHALL BE PLACED IN 2-1/2 INCH LOOSE LIFTS COMPACTED TO 2 INCHES UNTIL THE REQUIRED THICKNESS IS REACHED.

REV. 1/97 TFA

STANDARD DRAWING 552-A	PAVEMENT PATCHING DETAILS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER



INSTALLATION FOR METAL OR CONCRETE PIPE

PIPE	SIZE (INCHES)	MIN. DIST. BETWEEN BARRELS
CIRCULAR PIPE	12" to 24"	12"
CONCRETE & METAL	30" to 96"	DIAM. ÷ 2
(DIAMETER)	102" to 180"	48"
PIPE-ARCH	18" to 36"	12"
METAL ONLY	43" to 142"	SPAN ÷ 3
(SPAN)	148" to 199"	48"

TYPICAL PIPE-ARCH INSTALLATION

▨ BACKFILL MATERIAL PLACED IN 0.5' LOOSE LAYERS AND COMPACTED TO A MIN. OF 95% OF MAX. DENSITY.

NOTES:

Pipe compaction limits shown on this plan are for pipe construction in an embankment. For pipe construction in a trench, the horizontal limits of the pipe compaction zone shall be the walls of the trench.

O. D. is equal to the outside diameter of a pipe or the outside span of a pipe-arch. The dimensions shown as O.D. with 3' and 4' maximum shall be O.D. untill O.D. equals 3' and 4' at which point 3' and 4' shall be used.

✳ 1'-0" for diameters 12" through 42" and for spans through 50". 2'-0" for diameters greater than 42" and for spans greater than 50".

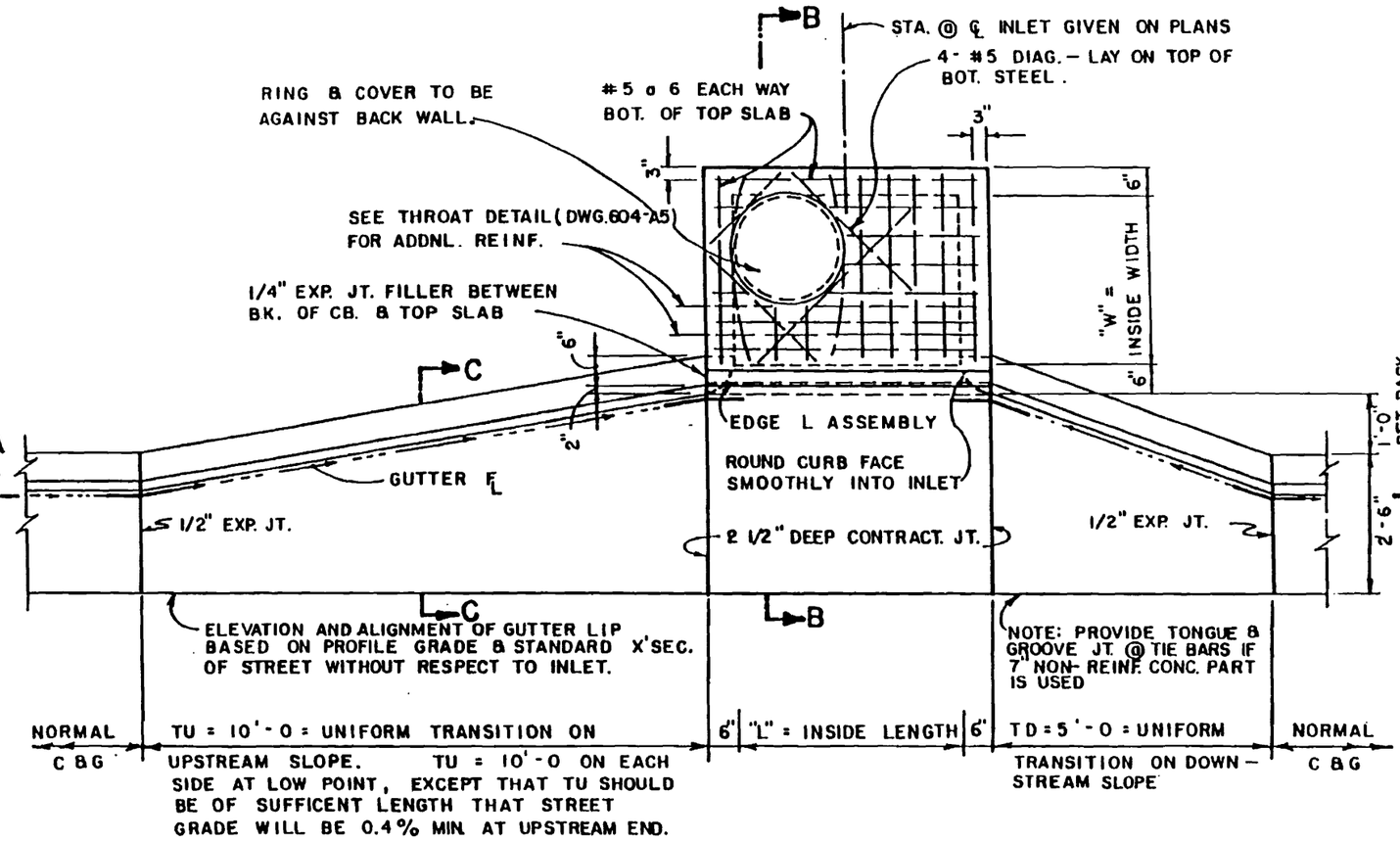
STANDARD DRAWING 602-A	CULVERT COMPACTION & BACKFILL
	PARK CITY MUNICIPAL CORPORATION

STANDARD DRAWING

604-A1

HIGHBACK CURB INLET BOX

PARK CITY MUNICIPAL CORPORATION



NOTES:
1. THIS DESIGN IS FOR L = 4'-0", 6'-0", 8'-0", OR 10'-0".
2. TU = 10'-0 AND TD = 5'-0 EXC. AS OTHERWISE SHOWN ON PLANS.
3. ON UNIT PRICE CONTRACTS, CURB INLETS WILL BE PAID FOR PER EACH, INC. ALL EXCAVATION, MATERIALS & LABOR. CURB & GUTTER WILL BE MEASURED FOR PAYMENT CONTINUOUS BY INLET
4. PRECAST CONCRETE INLET MAY BE USED WITH PRIOR APPROVAL OF CITY ENGINEER.
5. UNLESS OTHERWISE SPECIFIED ON PLANS, L = 60, W = 4
6. WHEN ROLL GUTTER IS USED, TRANSITION SMOOTHLY FROM ROLL TO HIGH-BACK GUTTER THROUGH TU & TD.

PLAN

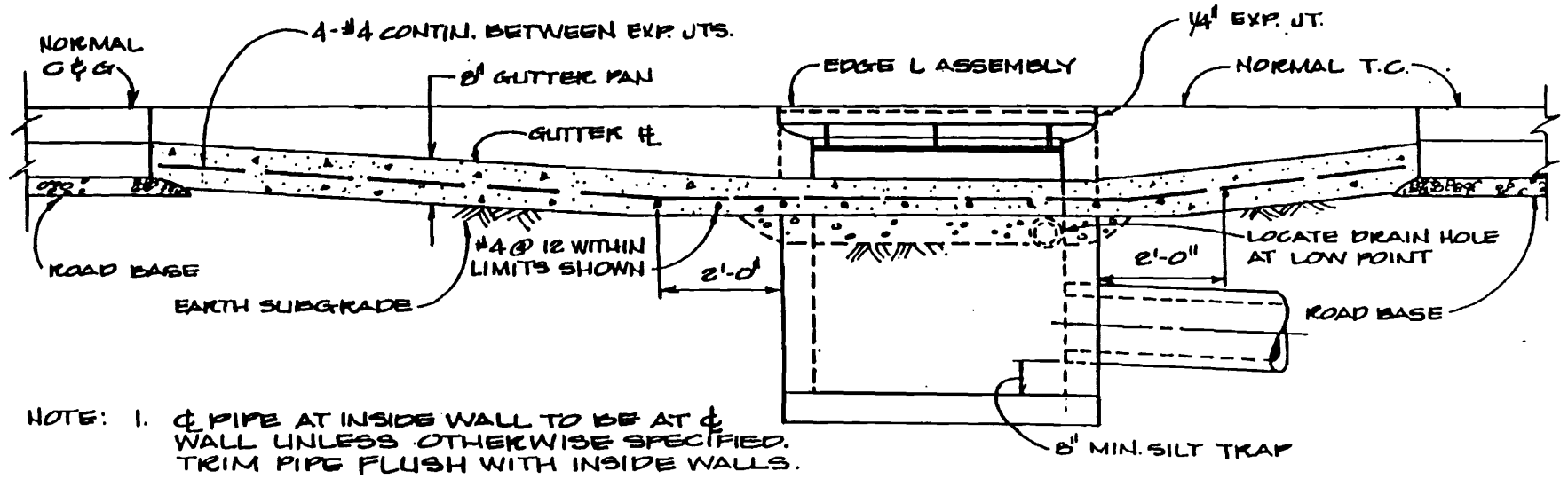
3/8" = 1'-0"

STANDARD DRAWING

604-A2

PARK CITY MUNICIPAL CORPORATION

HIGHBACK CURB INLET BOX



NOTE:
1. ℄ PIPE AT INSIDE WALL TO BE AT ℄ WALL UNLESS OTHERWISE SPECIFIED. TRIM PIPE FLUSH WITH INSIDE WALLS.
2. BROOM FINISH TOP SLAB.
3. MIN. COVER: 18" FOR CMP, 12" FOR RCP, 18" FOR HRCP OR CCP.

SECTION A-A

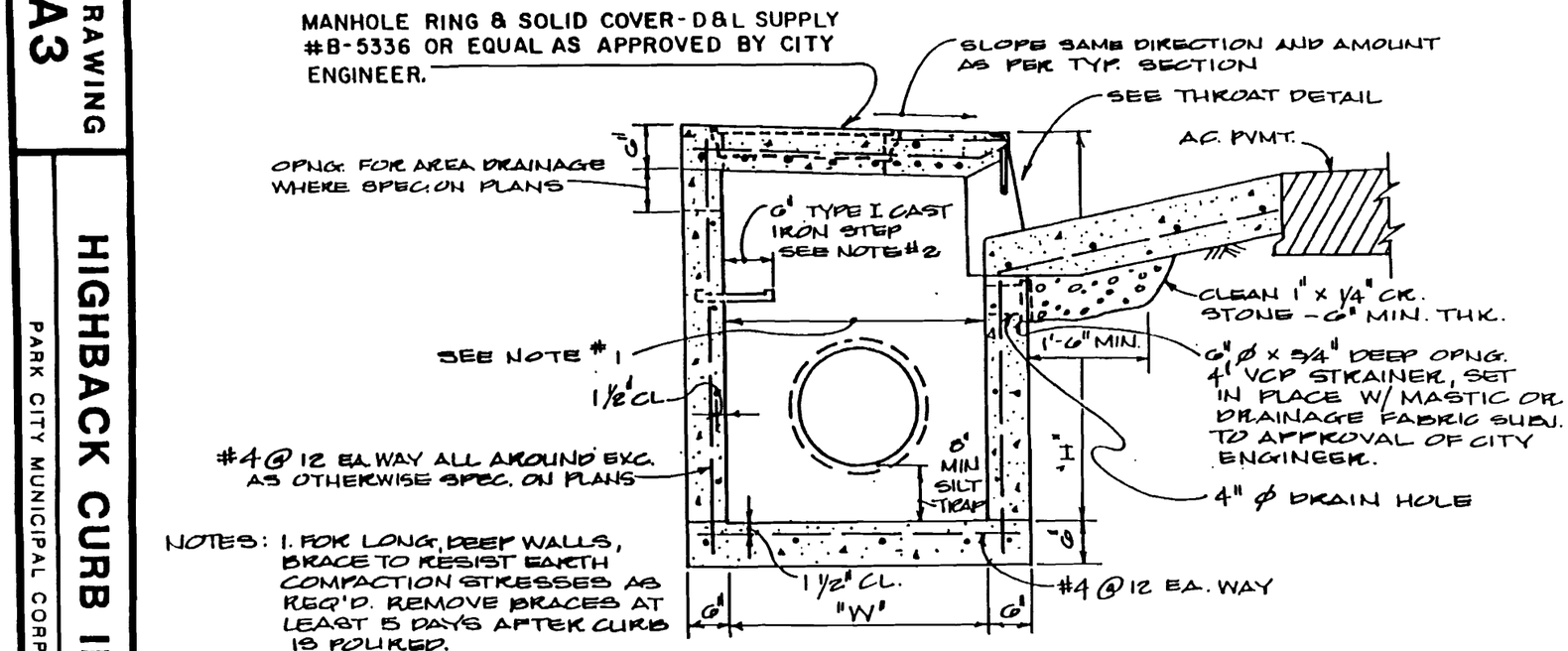
3/8" = 1' -0"

STANDARD DRAWING

604-A3

HIGHBACK CURB INLET BOX

PARK CITY MUNICIPAL CORPORATION



NOTES: 1. FOR LONG, DEEP WALLS, BRACE TO RESIST EARTH COMPACTION STRESSES AS REQ'D. REMOVE BRACES AT LEAST 5 DAYS AFTER CURB IS POURED.

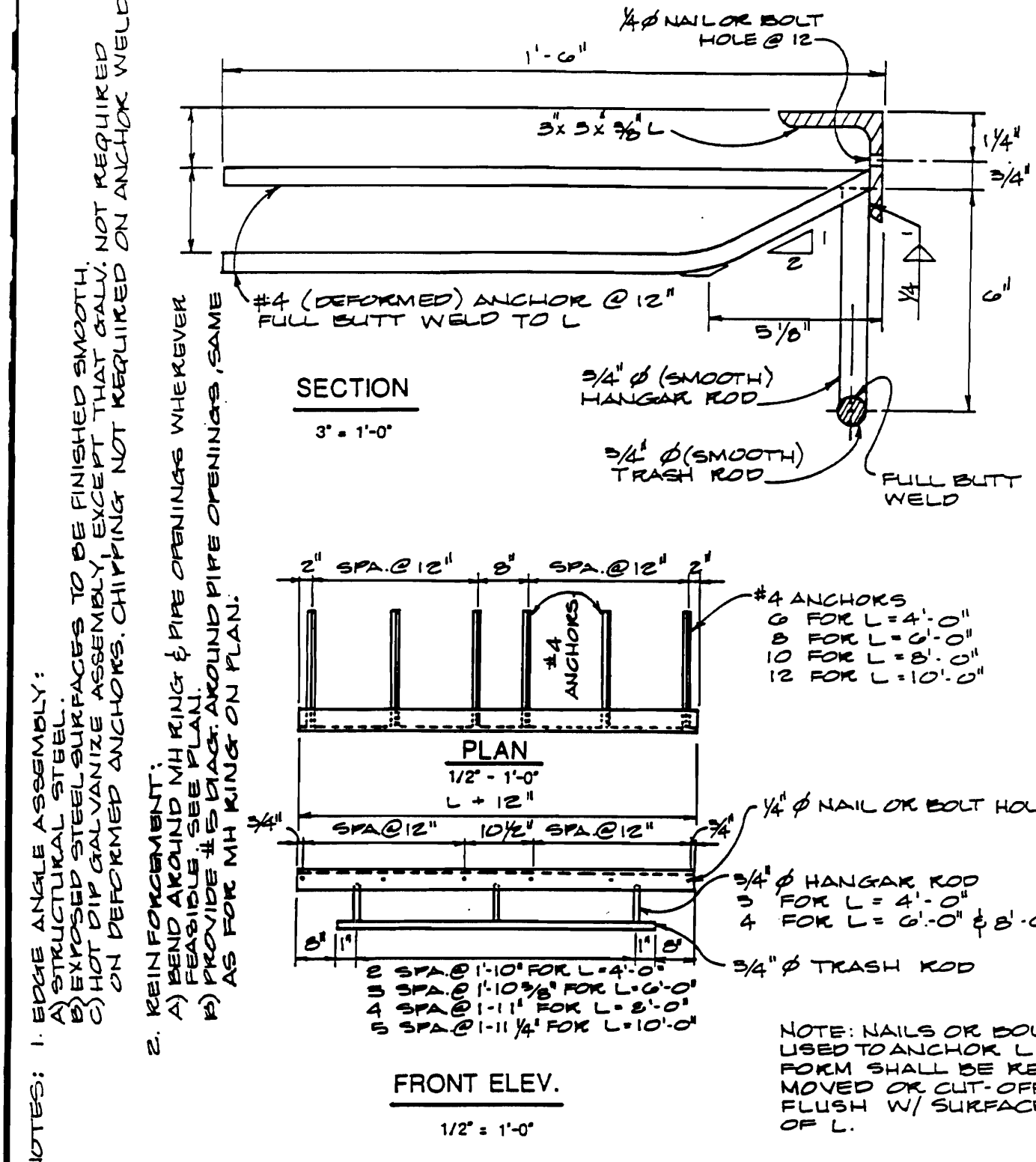
2. CAST IRON STEPS - TOP STEP 24" BELOW TOP OF TOP SLAB, THEN @ 16" SPA. BOTTOM STEP TO BE ABOVE CROWN OF DISCHARGE PIPE. STAGGER STEPS 2" EACH WAY FROM ℄ M.H. RING. STEPS NOT REQUIRED WHERE H IS LESS THAN 4'.

3. FORM ALL INVERTS FOR SMOOTH FLOW THROUGH STRUCTURE.

4. BROOM FINISH TOP SLAB.

SECTION B-B

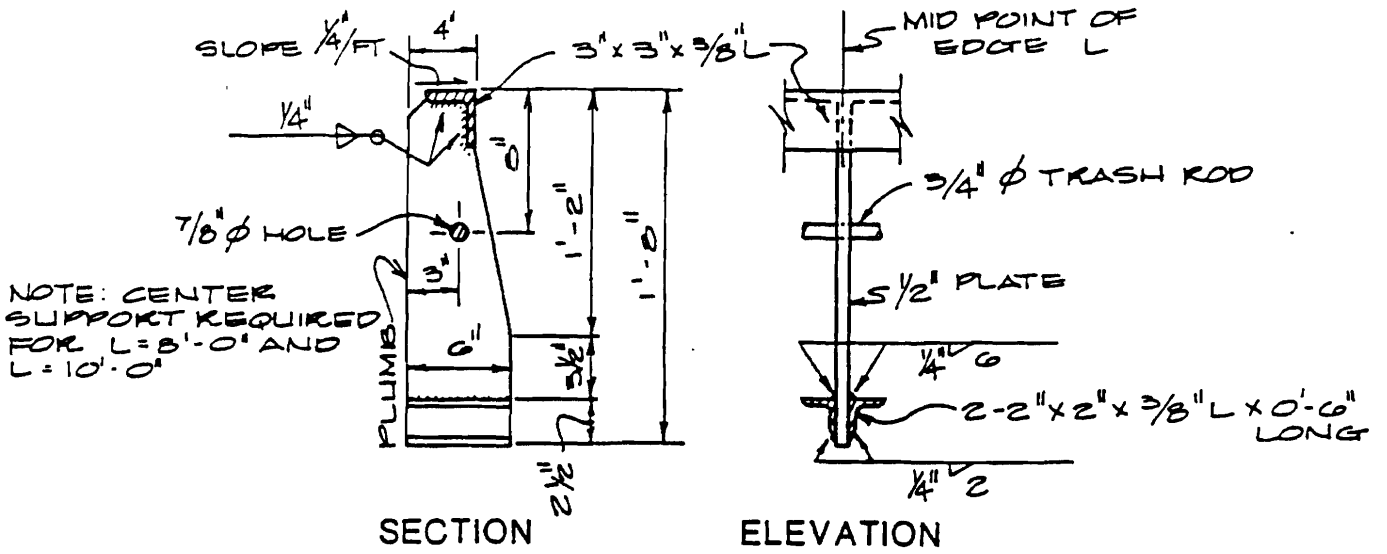
1/2" = 1' - 0"



NOTES:
1. EDGE ANGLE ASSEMBLY:
   A) STRUCTURAL STEEL.
   B) EXPOSED STEEL SURFACES TO BE FINISHED SMOOTH.
   C) HOT DIP GALVANIZE ASSEMBLY, EXCEPT THAT GALV. NOT REQUIRED ON DEFORMED ANCHORS. CHIPPING NOT REQUIRED ON ANCHOR WELDS.
2. REINFORCEMENT:
   A) BEND AROUND MH RING & PIPE OPENINGS WHEREVER FEASIBLE, SAME SIZE AS BARS SHOWN ON PLAN.
   B) PROVIDE #5 DIAG. AROUND PIPE OPENINGS, SAME AS FOR MH RING ON PLAN.

DETAIL OF EDGE ANGLE ASSEMBLY

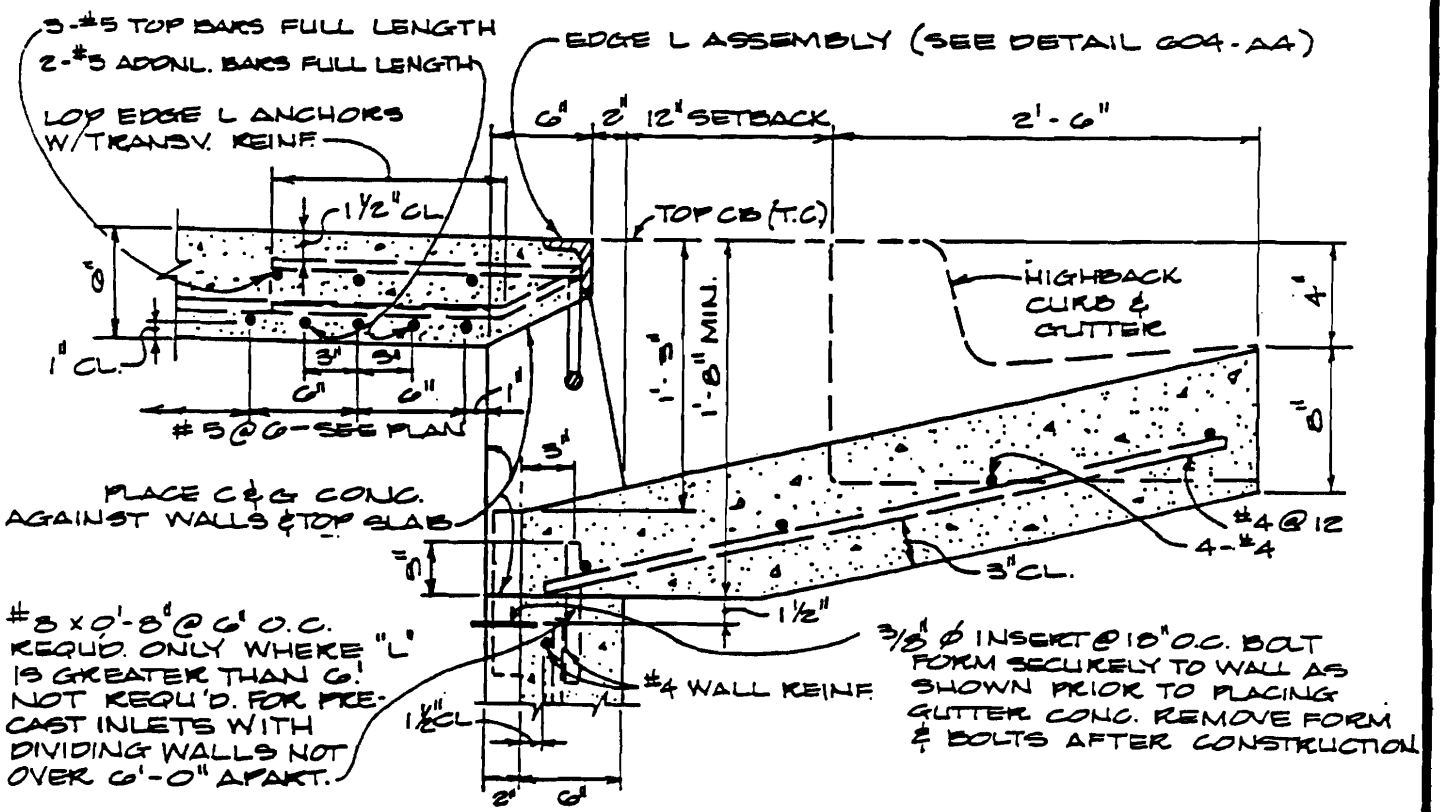
STANDARD DRAWING 604-A4	HIGHBACK CURB INLET BOX
	PARK CITY MUNICIPAL CORPORATION



SECTION ELEVATION

CENTER SUPPORT FOR EDGE ANGLE ASSEMBLY

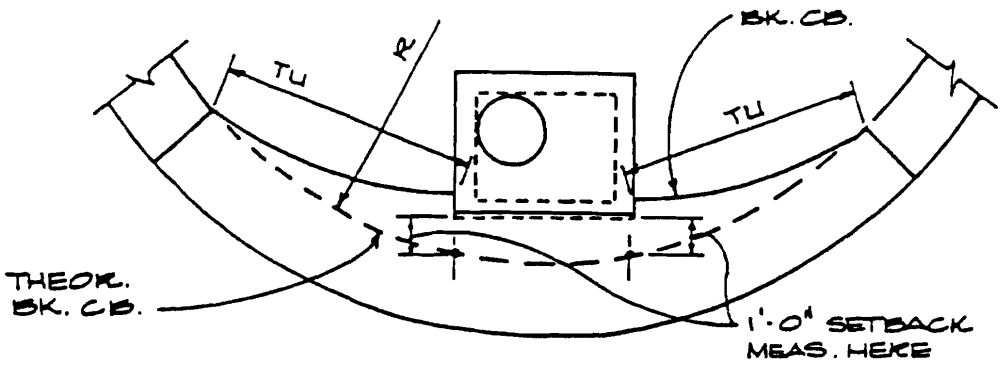
1" = 1'-0"



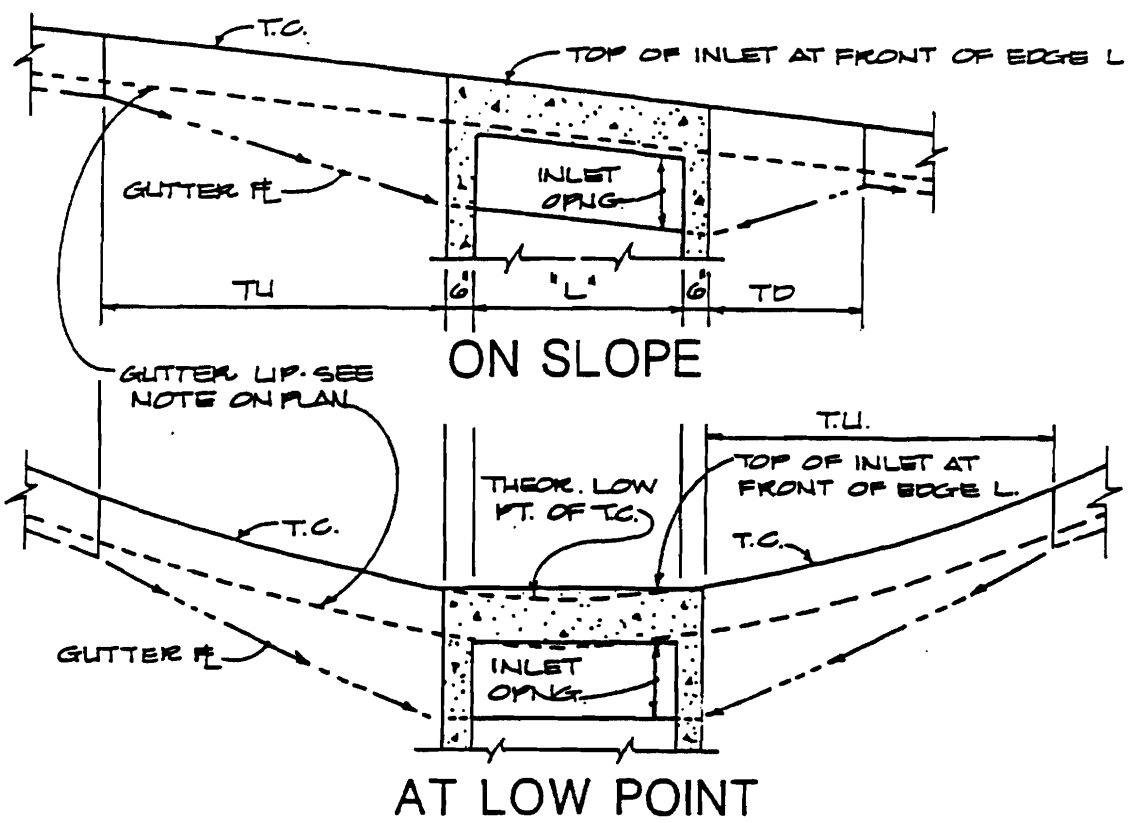
THROAT DETAIL

1" = 1'-0"

STANDARD DRAWING 604-A5	HIGHBACK CURB INLET BOX
	PARK CITY MUNICIPAL CORPORATION

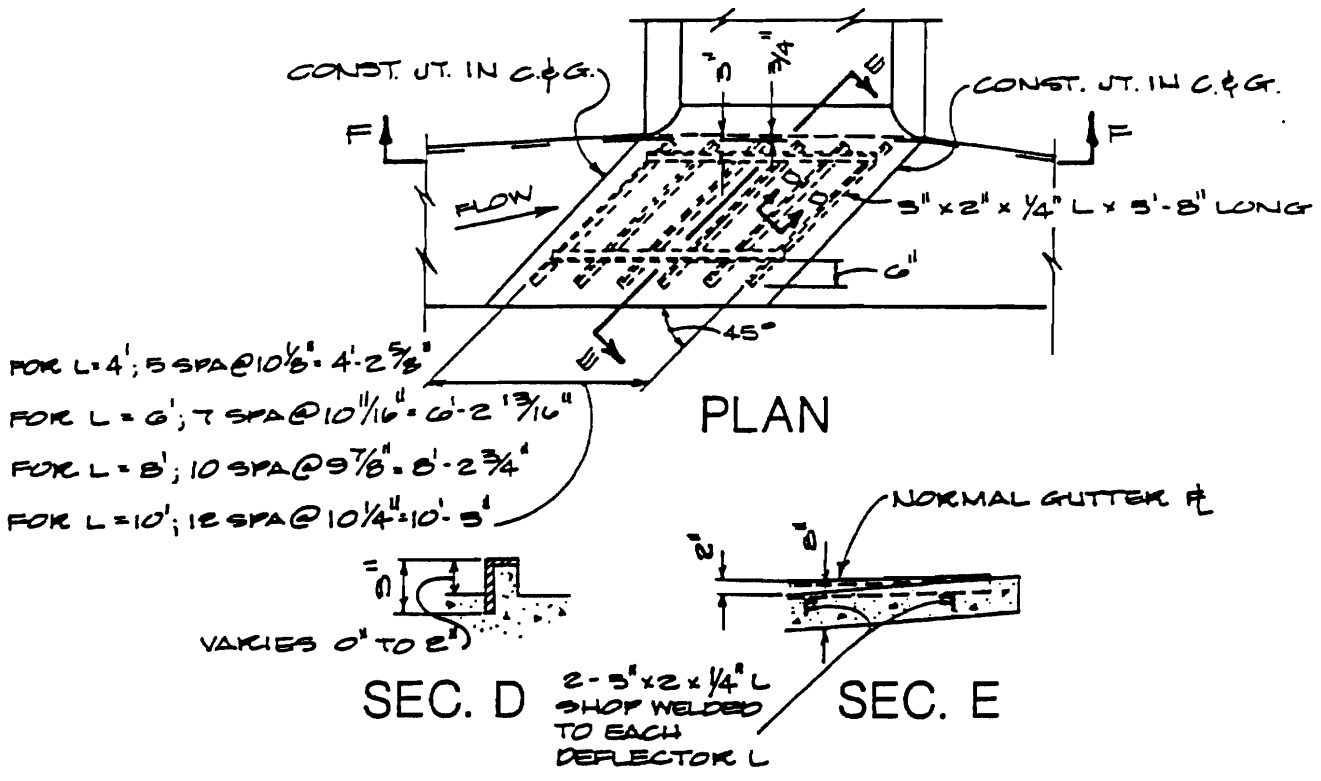


INLET SETTING ON CURB RETURN



INLET SETTING DIAGRAMS

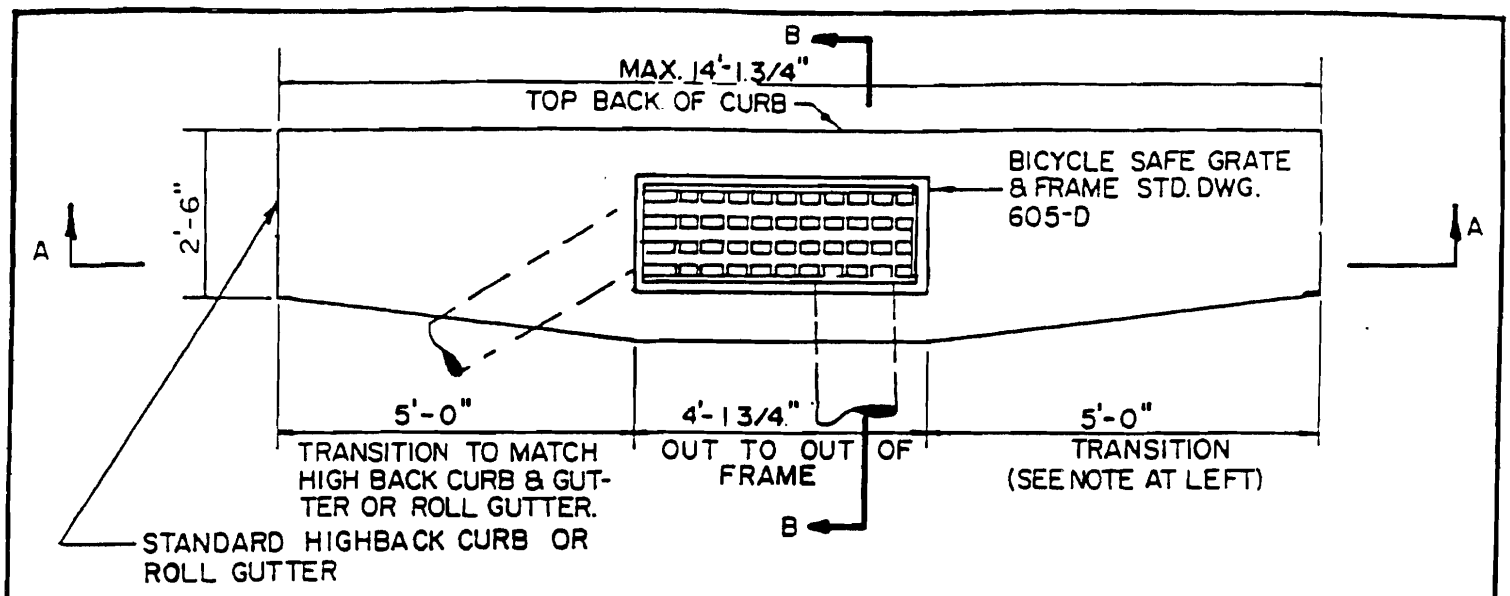
STANDARD DRAWING 604-A6	HIGHBACK CURB INLET BOX
	PARK CITY MUNICIPAL CORPORATION

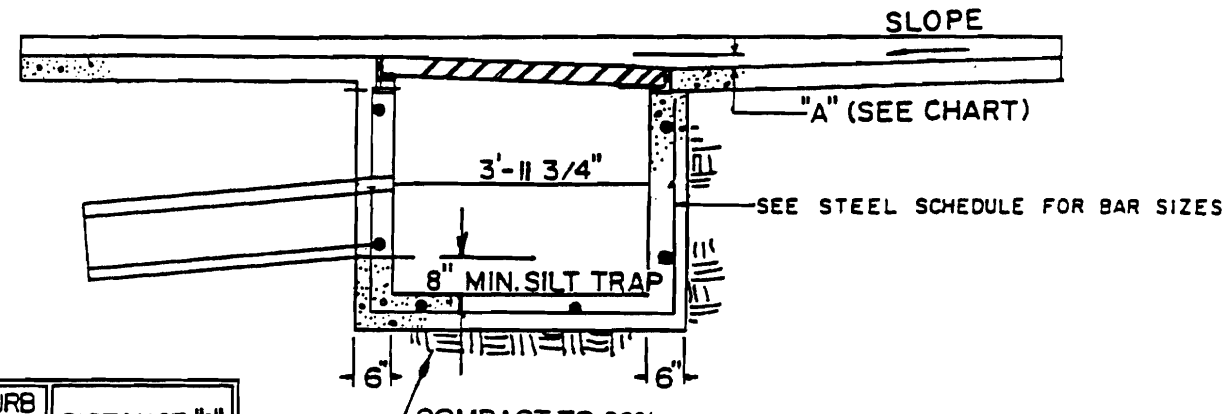


GUTTER DEFLECTORS DETAIL

NOTES: 1. BEFORE POURING CONCRETE, SUPPORT UNIT SECURELY IN FINAL POSITION BY ATTACHING TO METAL RODS DRIVEN INTO SUBGRADE OR BY OTHER SUITABLE MEANS.
2. ASSEMBLY TO BE HOT DIP GALVANIZED.
3. TO BE USED WHERE DEFLECTOR CURB INLET IS SPECIFIED.

STANDARD DRAWING 604-A7	HIGHBACK CURB INLET BOX
	PARK CITY MUNICIPAL CORPORATION





SECTION A-A

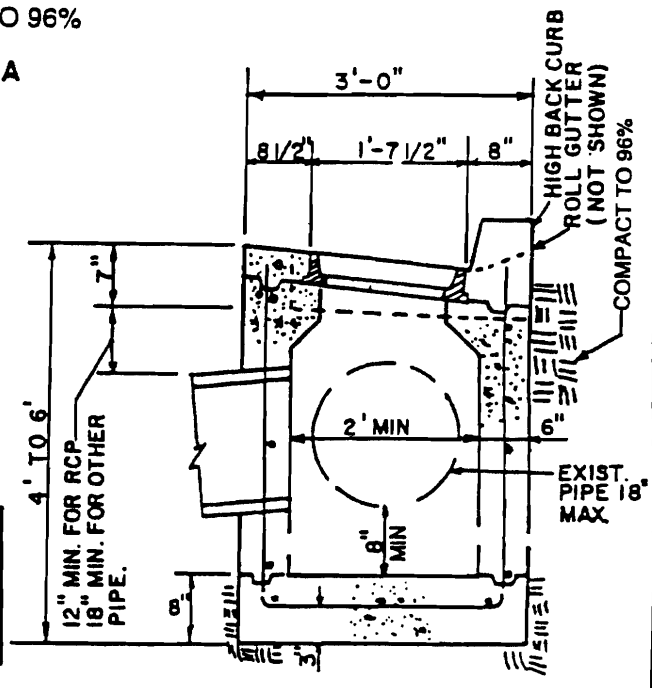
SLOPE OF CURB & GUTTER	DISTANCE "A"
10% to 8%	2"
8% to 6%	1-1/2"
6% to 4%	1"
4% to 2%	1/2"
2% to 0%	0

NOTE: THIS INLET BOX SHALL NOT BE USED WITHOUT EXPRESS APPROVAL OF PUBLIC WORKS DIRECTOR.

NOTE: TOP TO BE POURED SEPARATE FROM WALLS. FLOOR MAY BE POURED WITH WALLS. ALL CONCRETE TO BE CLASS 4,000 WITH AIR ENTRAINMENT.

STEEL SCHEDULE

	VERT. STEEL	HORIZ. STEEL	WALL THICKNESS
0' TO 6'	#4 AT 12" O.C.	#4 AT 12" O.C.	6" WALL
6'-0" OR DEEPER, CHECK W/ CITY ENGINEER			

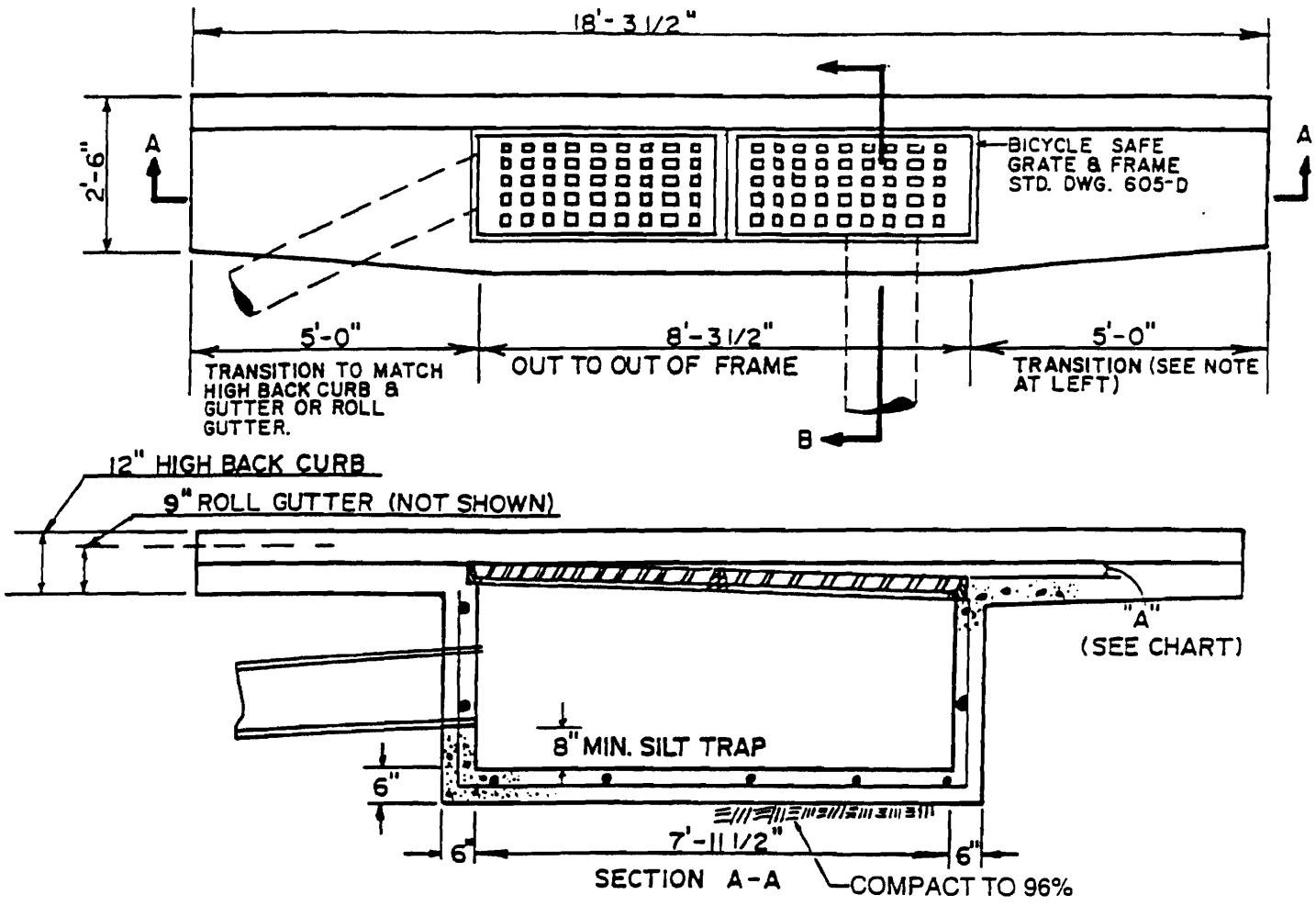


SECTION B-B

STANDARD DRAWING
605-A

SINGLE GUTTER-INLET BOX

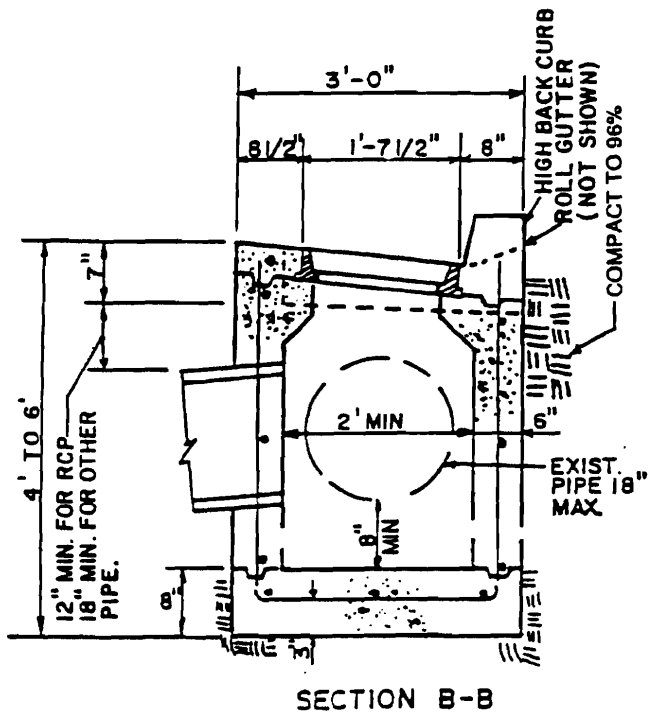
PARK CITY MUNICIPAL CORPORATION



SLOPE OF CURB & GUTTER	DISTANCE "A"
10% to 8%	2"
8% to 6%	1 1/2"
6% to 4%	1"
4% to 2 %	1/2"
2% to 0 %	0

	VERT. STEEL	HORIZ. STEEL	WALL THICKNESS
0' to 6'	#4 at 12"O.C.	#4 at 12"O.C.	6" WALL
6' or DEEPER, CHECK W/CITY ENGINEER			

NOTE: THIS INLET BOX SHALL NOT BE USED WITHOUT EXPRESS APPROVAL OF PUBLIC WORKS DIRECTOR.



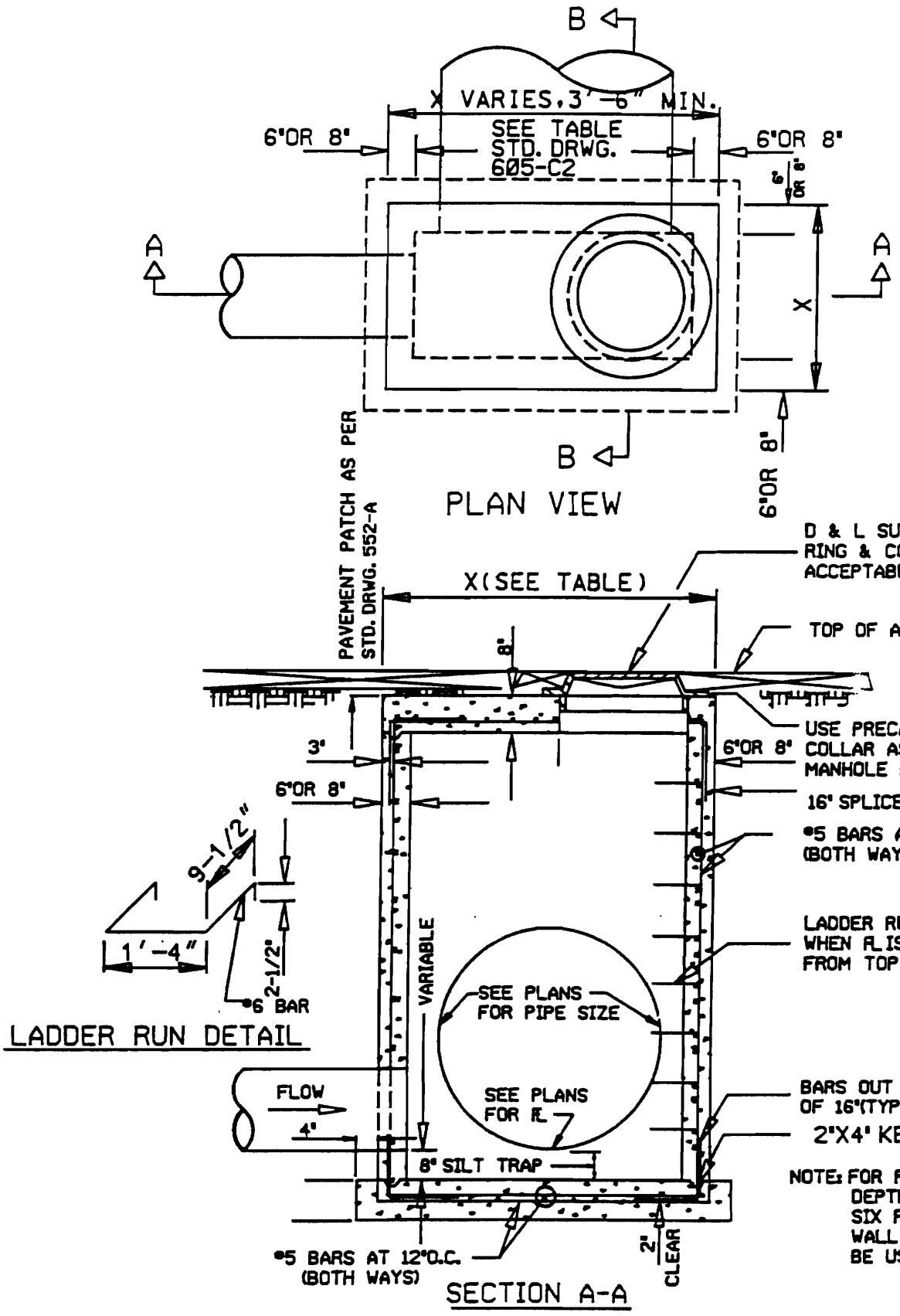
SECTION B-B

STANDARD DRAWING

605-B

DOUBLE GUTTER-INLET BOX"B"

PARK CITY MUNICIPAL CORPORATION

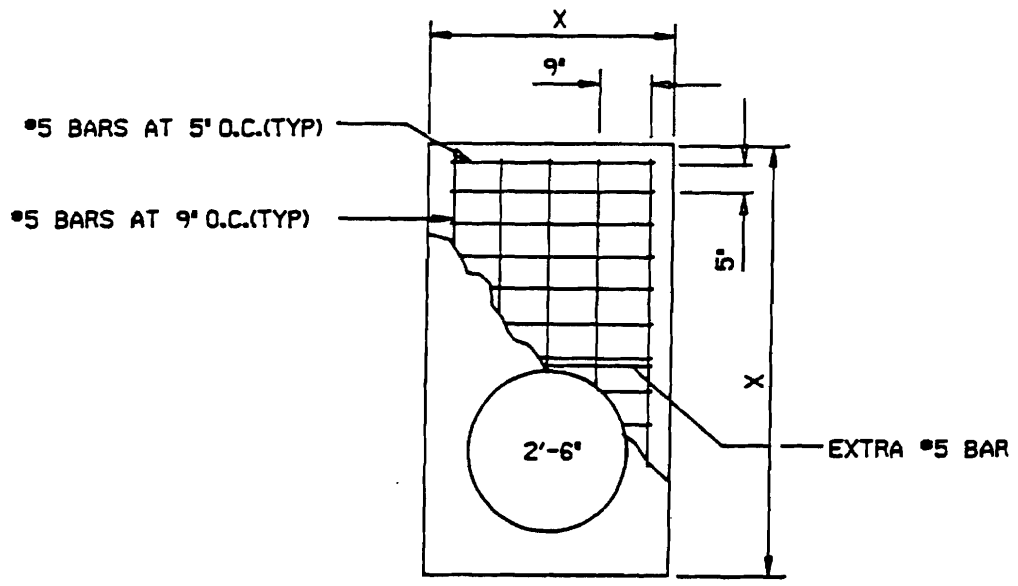


STANDARD DRAWING

605-C1

STORM DRAIN CLEAN-OUT DETAILS

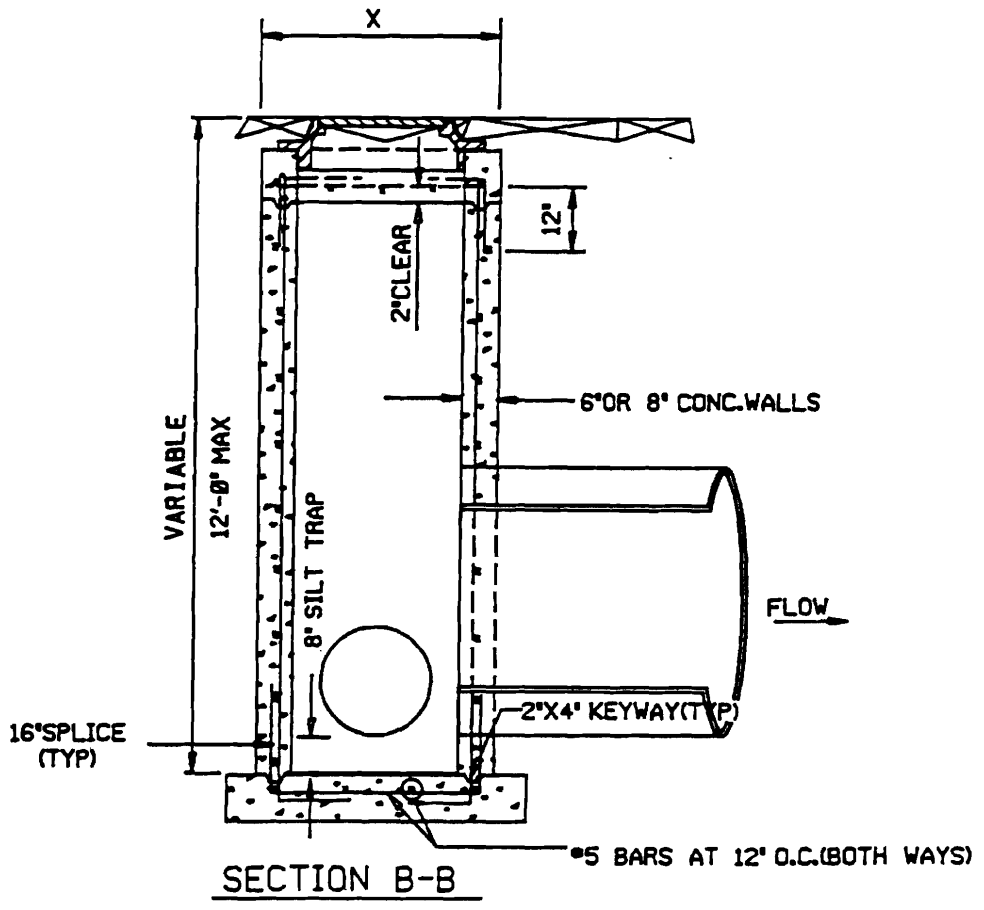
PARK CITY MUNICIPAL CORPORATION



STEEL PLACEMENT IN TOP SLAB

"X" TABLE

PIPE DIA.	X
NO PIPE	4'-6"
15"TO 24"	4'-6"
27"	4'-6"
30"	4'-6"
33"	4'-6"
36"	4'-8"
42"	5'-3"
48"	5'-11"
54"	6'-5"
60"	7'-1"
66"	7'-7"
72"	8'-2"

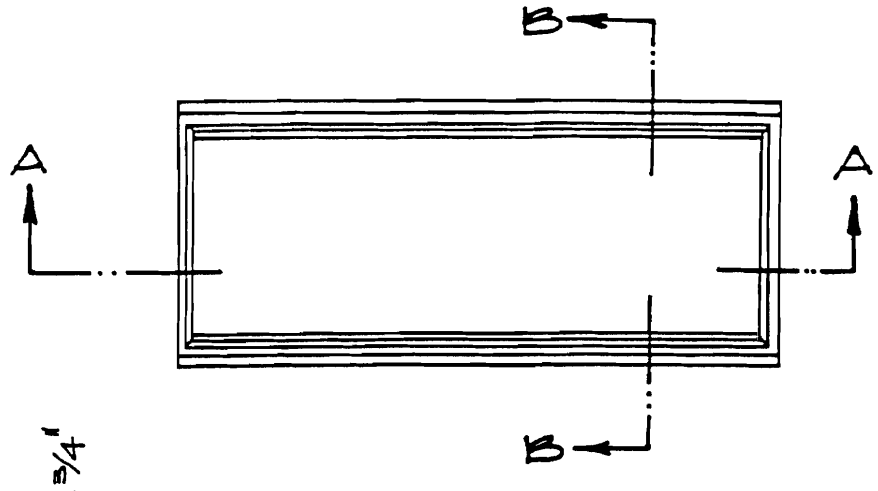


SECTION B-B

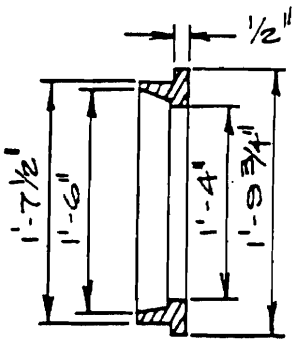
STANDARD DRAWING
605-C2

STORM DRAIN CLEAN-OUT DETAILS

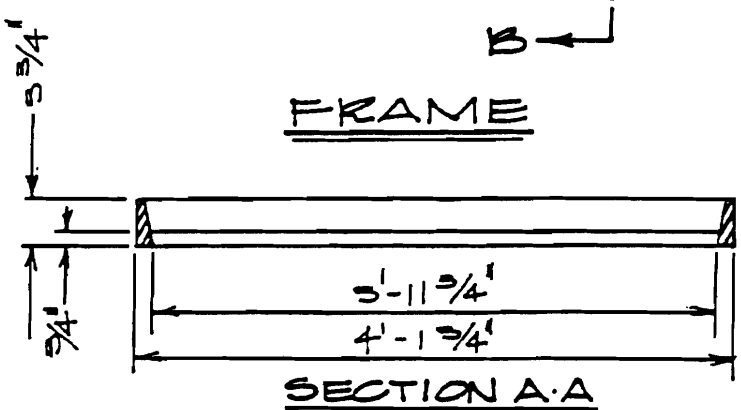
PARK CITY MUNICIPAL CORPORATION



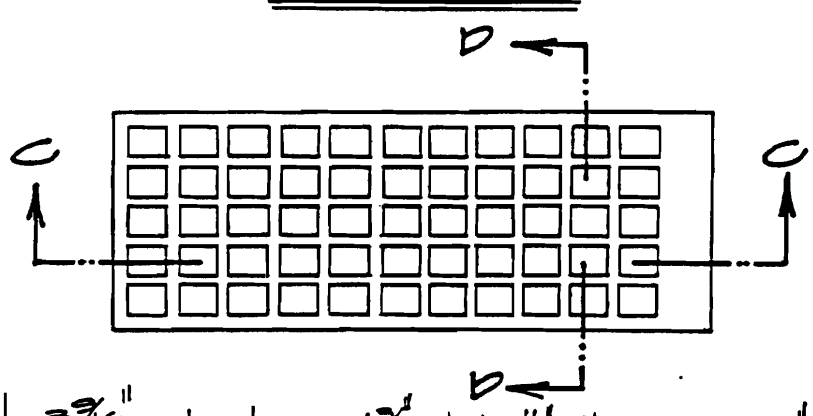
FRAME



SECTION B-B

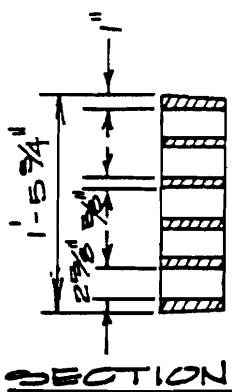


SECTION A-A

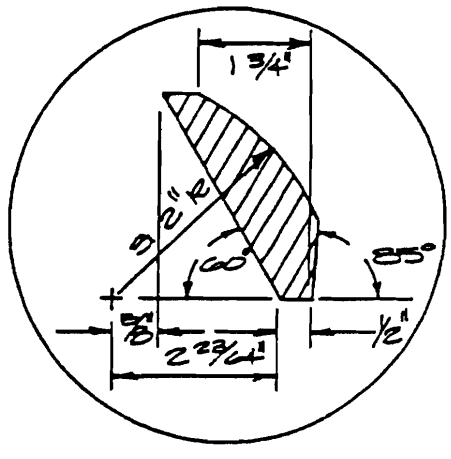


SECTION C-C

GRATE

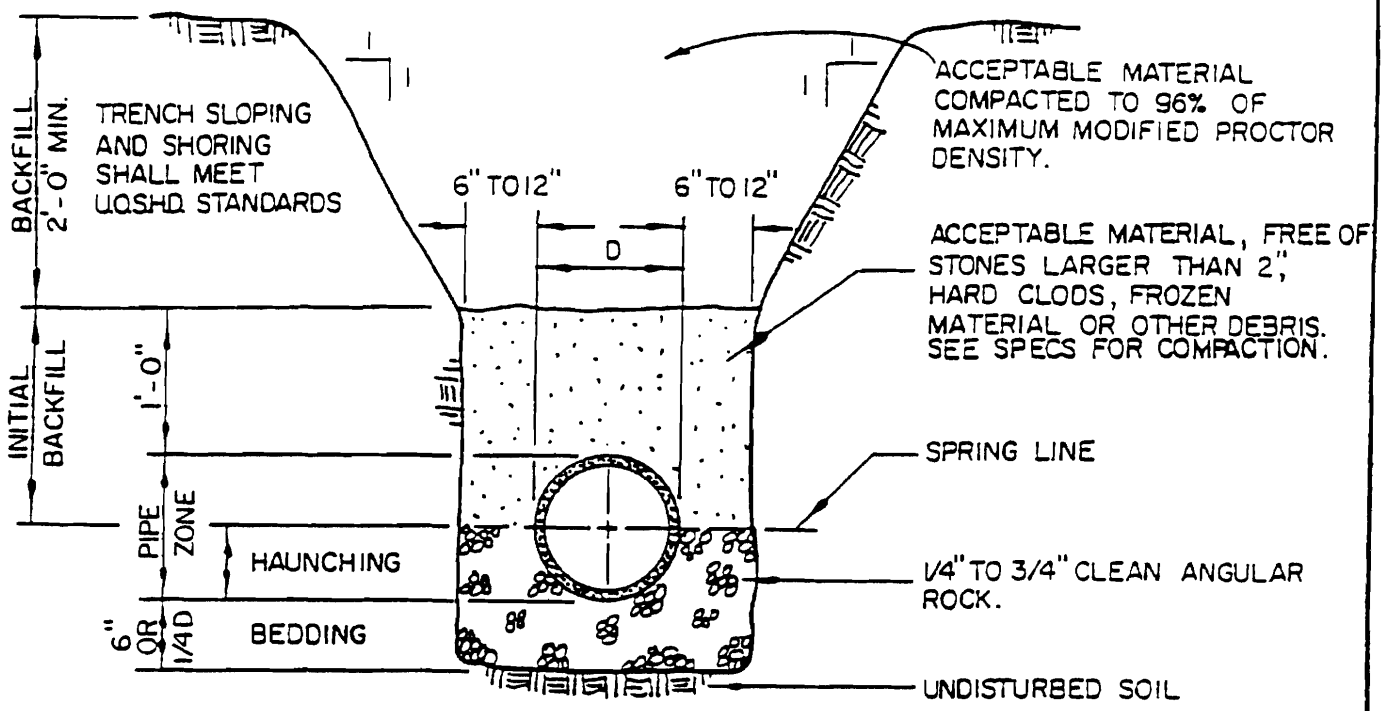


SECTION D-D



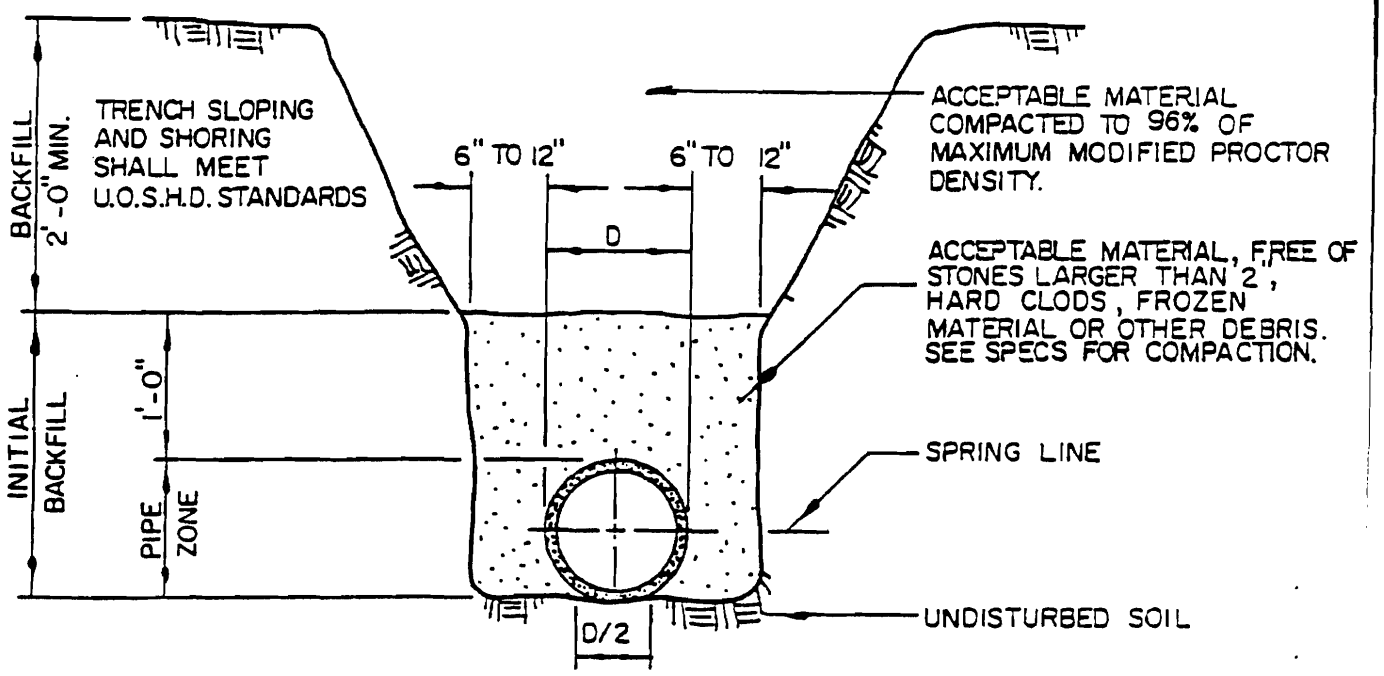
MANUFACTURER: D&L SUPPLY I 1803

STANDARD DRAWING 605-D	BICYCLE-SAFE GRATING & FRAME
	PARK CITY MUNICIPAL CORPORATION



CLASS 'A' BEDDING AND INITIAL BACKFILL

* FOR RIGID PIPE IN UNSUITABLE SUBGRADE
* FOR FLEXIBLE PIPE IN ANY SUBGRADE



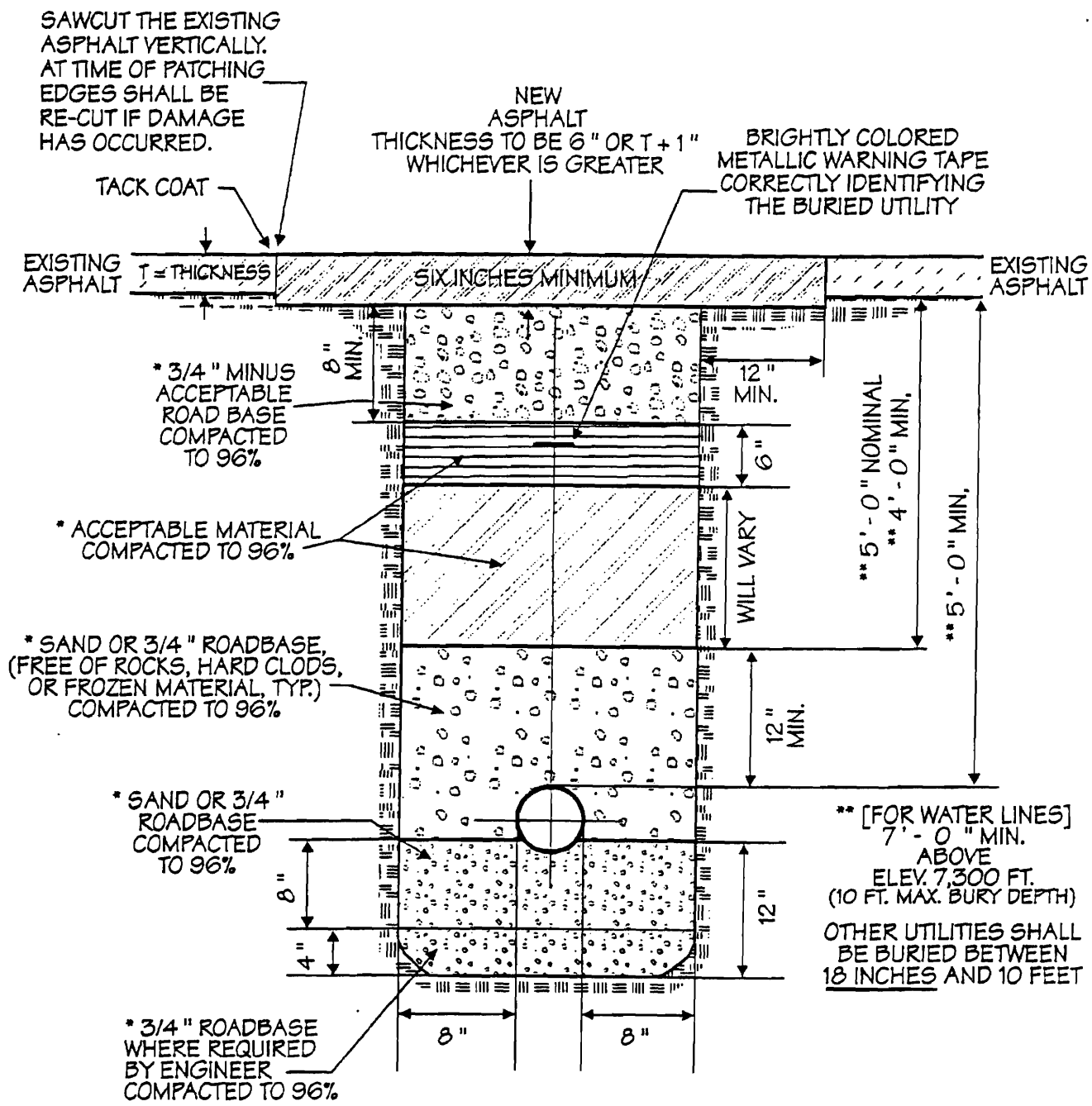
CLASS 'B' BEDDING AND INITIAL BACKFILL

* FOR RIGID PIPE IN SUITABLE SUBGRADE

FOR DETAILED INFORMATION SEE SPECIFICATIONS.

STANDARD DRAWING	BEDDING AND BACKFILL DETAIL
702-A	STORM DRAIN OR SEWER LINES
	PARK CITY MUNICIPAL CORPORATION

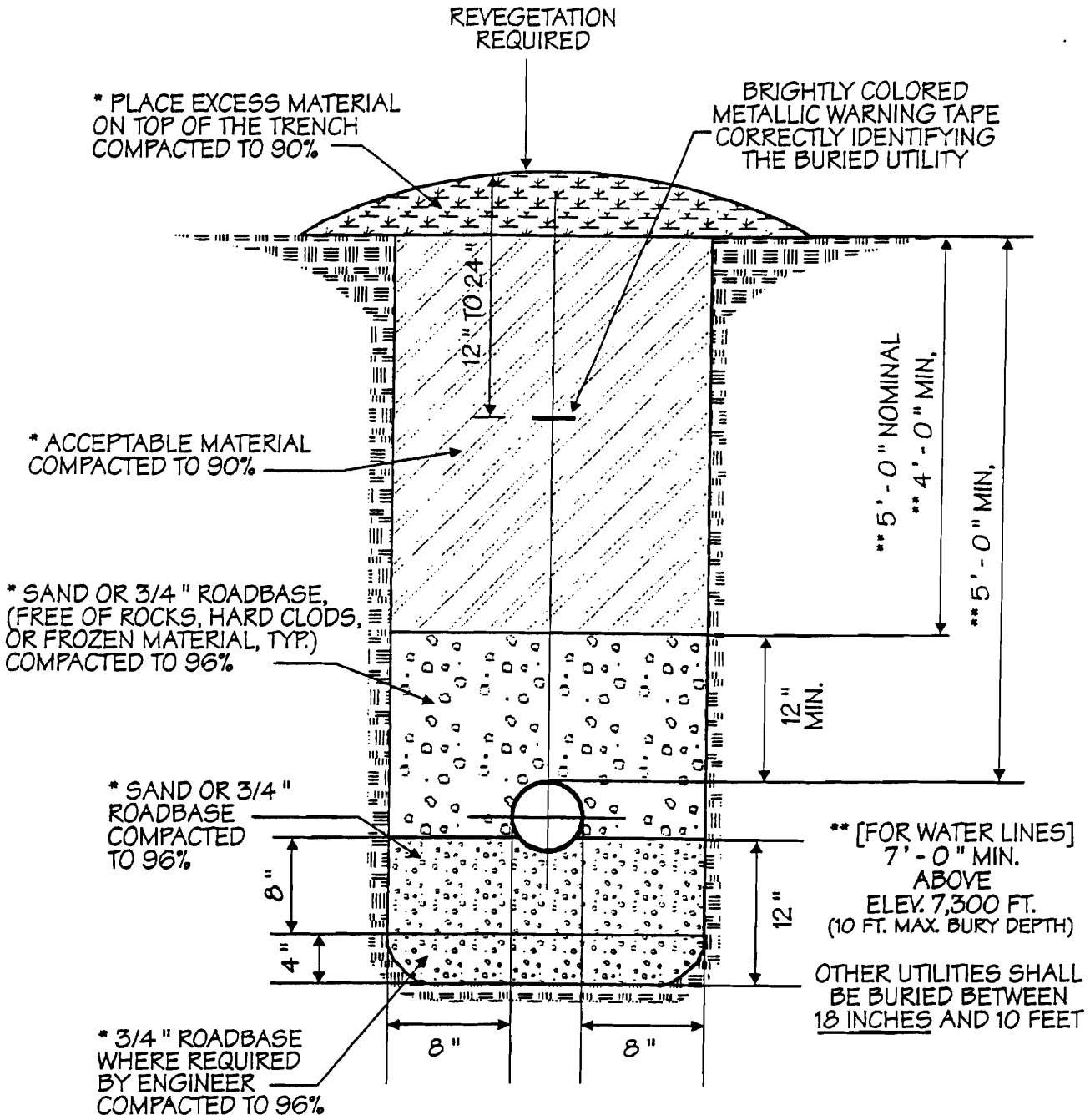
A RIGHT-OF-WAY PERMIT IS REQUIRED TO CUT CITY STREET ASPHALT
OR TO WORK IN THE CITY RIGHT-OF-WAY
ALL STATE HIGHWAY CROSSINGS TO BE APPROVED BY THE UTAH DEPT. OF TRANSPORTATION



* ASTM D-1557
SHALL BE USED IN
DETERMINING
MAXIMUM SOIL DENSITY

REV. 1/97 TFA

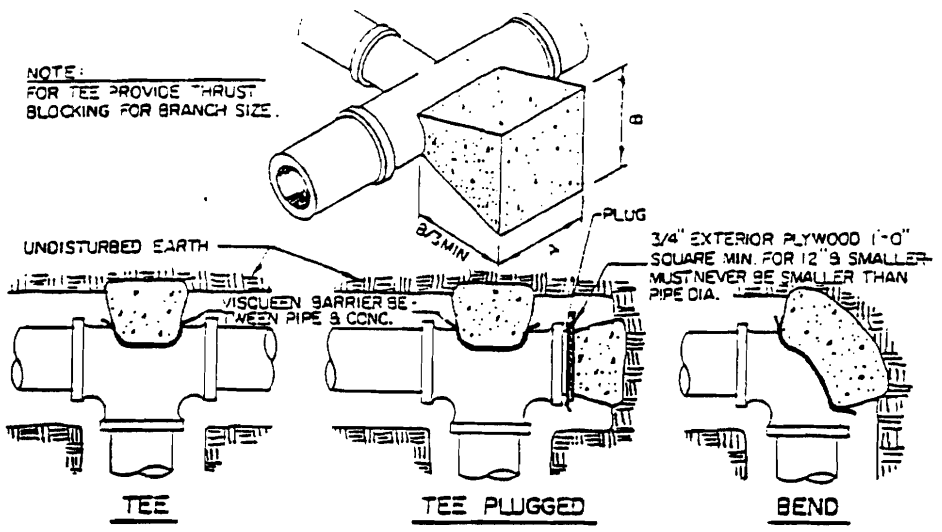
STANDARD DRAWING 703-A	TRENCH BACKFILL & WATERLINE IN ROADWAY
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER



* ASTM D-1557 SHALL BE USED IN DETERMINING MAXIMUM SOIL DENSITY

REV. 1/97 TFA

STANDARD DRAWING 703-B	TRENCH BACKFILL & WATERLINE NOT IN ROADWAY
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER



DIMENSIONS FOR THRUST BLOCKING								
FITTING	TEES & PLUGS		90 BENDS		45 BENDS & "Y"s		22 ½ BENDS	
SIZES	A	B	A	B	A	B	A	B
4"	1'-6"	1'-6"	1'- 6"	1'-9"	1'-3"	0'-6"	1'-0"	0'-6"
6"	2'-0"	1'-0"	2'-0"	2'-0"	1'-3"	1'-6"	1'-0"	1'-5"
8"	2'-0"	1'-6"	2'-3"	2'-3"	1'-8"	1'-8"	1'-0"	1'-3"
10"	2'-6"	2'-3"	2'-9"	2'-10"	2'-3"	1'-10"	1'-3"	2'-0"
12"	3'-0"	2'-9"	3'-6"	3'-3"	2'-6"	2'-4"	2'-0"	1'-6"
14"	3'-5"	3'-0"	4'-0"	3'-8"	3'-6"	2'-4"	2'-0"	2'-3"
16"	4'-0"	3'-6"	5'-0"	4'-0"	3'-6"	3'-0"	2'-6"	2'-3"
18"	4'-0"	4'-3"	6'-0"	4'-0"	4'-0"	3'-3"	2'-9"	2'-6"
20"	5'-0"	4'-3"	6'-0"	5'-0"	4'-3"	4'-0"	3'-0"	2'-9"
24"	6'-0"	5'-3"	8'-0"	5'-6"	6'-0"	4'-0"	4'-0"	3'-0"

THRUST BLOCKING DETAILS AND SCHEDULE

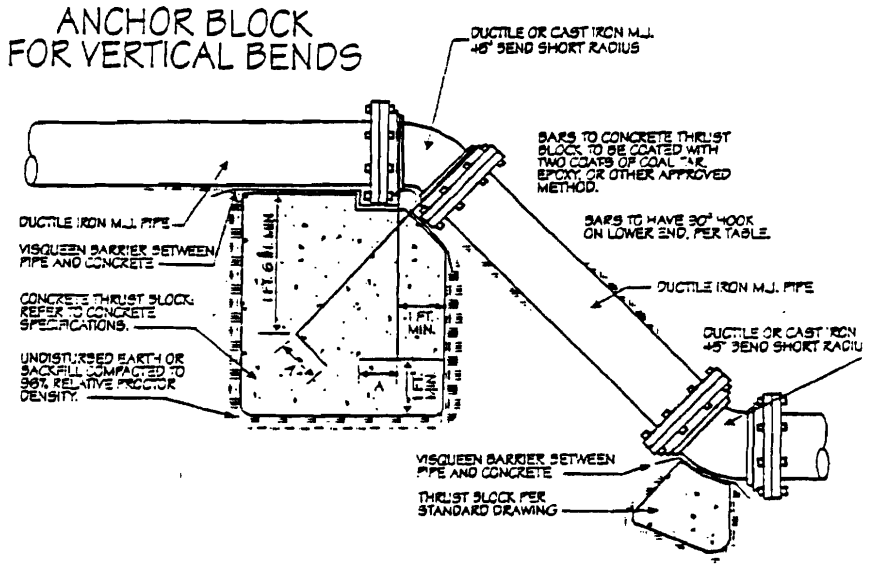
NOTES:

1. This table is based on 200 PSI main pressure and 2000 PSF soil bearing pressure. Adjust bearing areas in accordance with soil conditions and pressures encountred.
2. For asbestos cement pipe greater than six (6) inches in diameter, double the area required in the table above.
3. Use visqueen between concrete and pipe.
4. Refer to concrete sections in the standard specifications text.
5. The "Thrust Blocking Details" in no way limits the location or size of additional blocking when so warranted or required by the Engineer.

PIPE SIZE	MIN. BAR SIZE	"A" DIMENSION (HOOK)	MINIMUM * BLOCK SIZE
6 "	ONE # 4 (TWO BARS TOTAL)	6 "	3' X 3' X 3'
8 "	TWO # 4 (FOUR BARS TOTAL)	9 "	4' X 4' X 2.5'
12 "	THREE # 4 (SIX BARS TOTAL)	9 "	4' X 5' X 5'

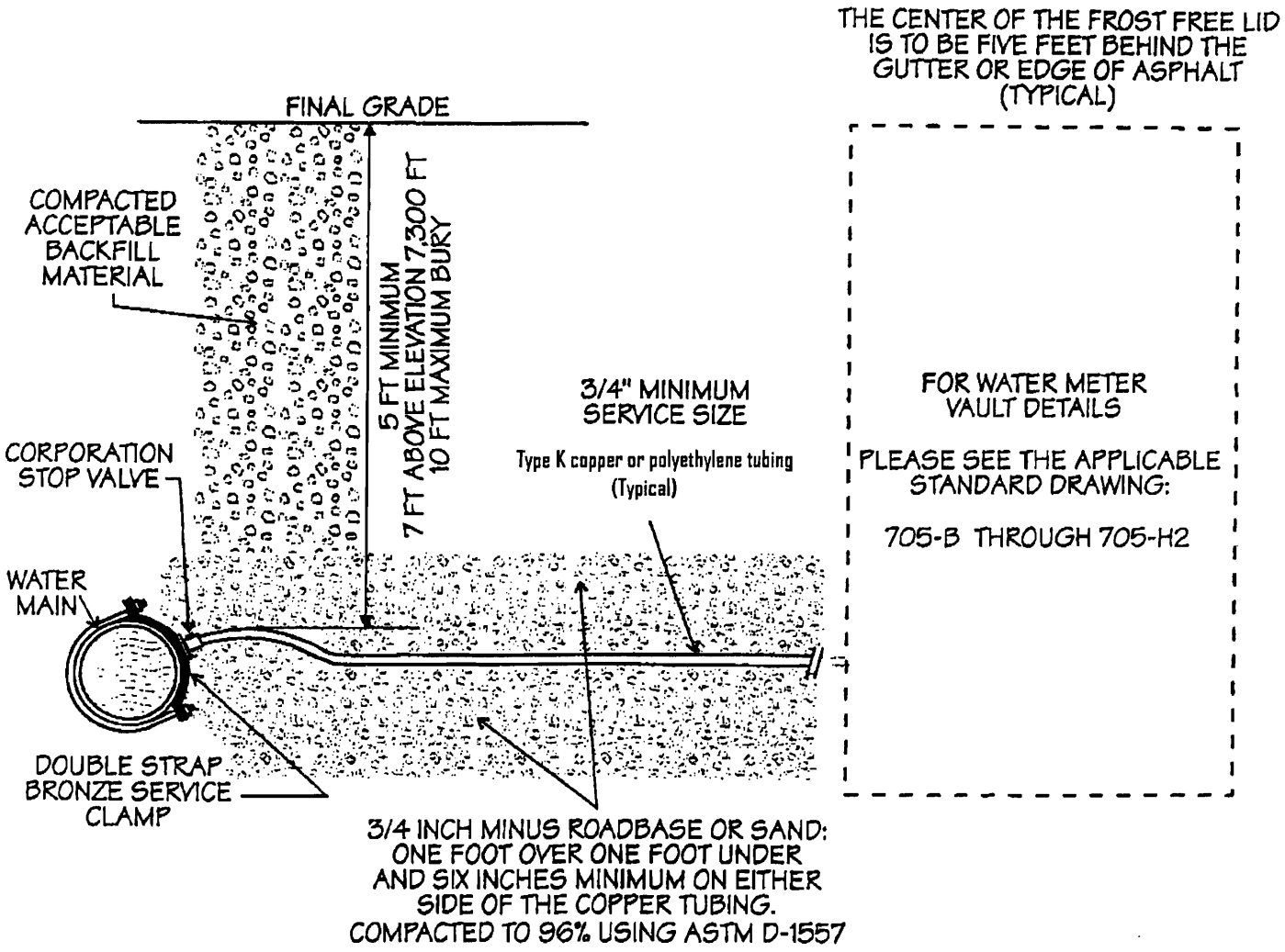
*FOR 125 PSI WORKING PRESSURE.
FOR OTHER PRESSURES CITY ENGINEER MAY REQUIRE OTHER DIMENSIONS.

ANCHOR BLOCK FOR VERTICAL BENDS



REV. 1/97 TFA

STANDARD DRAWING 703-C	THRUST BLOCKING DETAILS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION

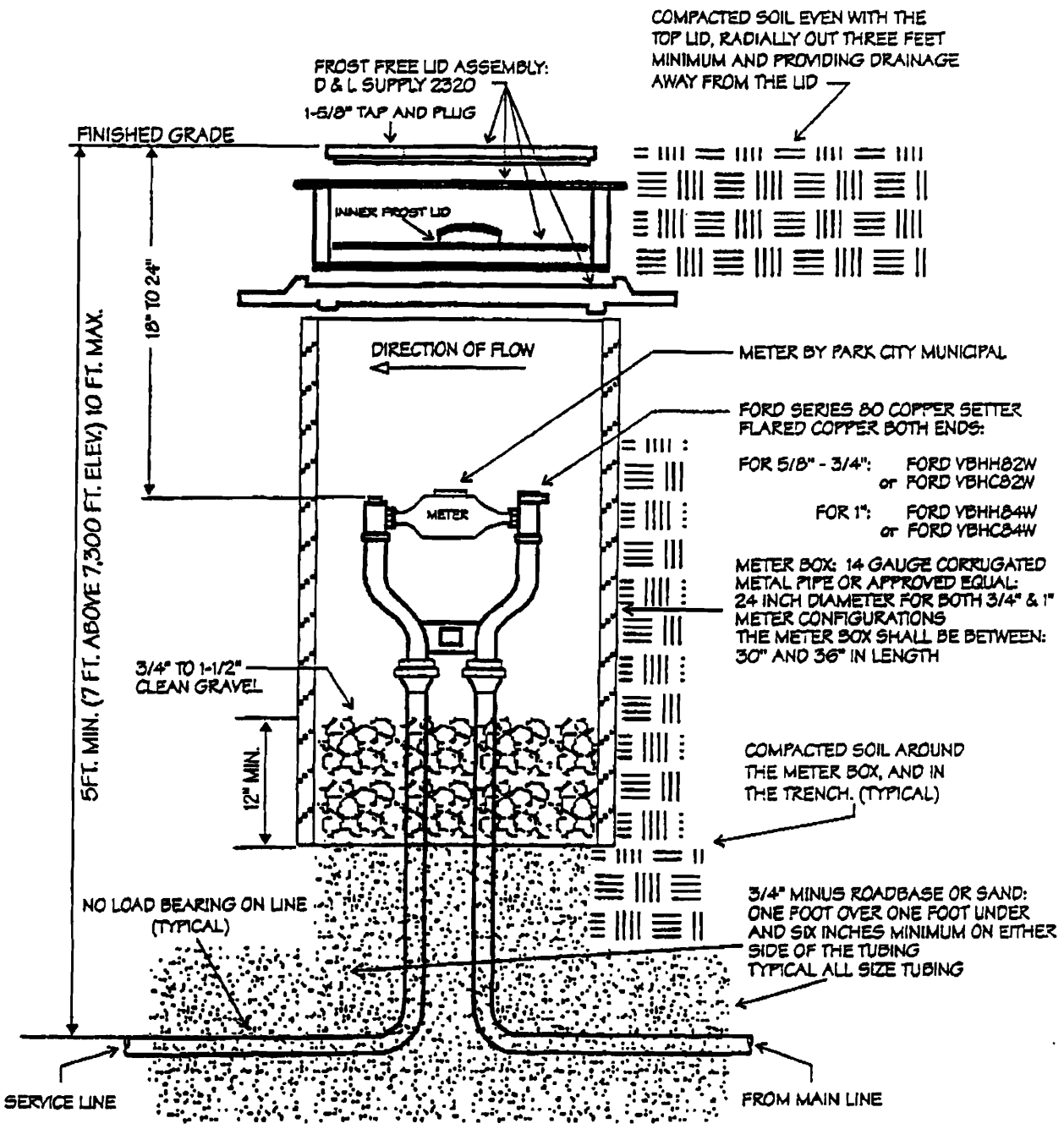


NOTES:

1. METER BOX SHALL BE SET PLUMB.
2. THREADS ON SERVICE CLAMP SHALL MATCH THREADS ON CORPORATION STOP.
3. REFER TO WRITTEN SPECIFICATIONS FOR ADDITIONAL DETAILS.
4. METERS ARE TO BE INSTALLED IN AN APPROVED LANDSCAPED AREA; NOT IN SIDEWALK, ASPHALT OR DRIVEWAY, UNLESS FIRST APPROVED BY THE CITY ENGINEER.
5. NO SWEAT FITTINGS ARE ALLOWED.
6. FLARE CONNECTIONS ARE TO BE USED ON 3/4" LINES, OTHER LINES SHALL BE APPROVED COMPRESSION TYPE CONNECTIONS.

REV. 1/99 TFA

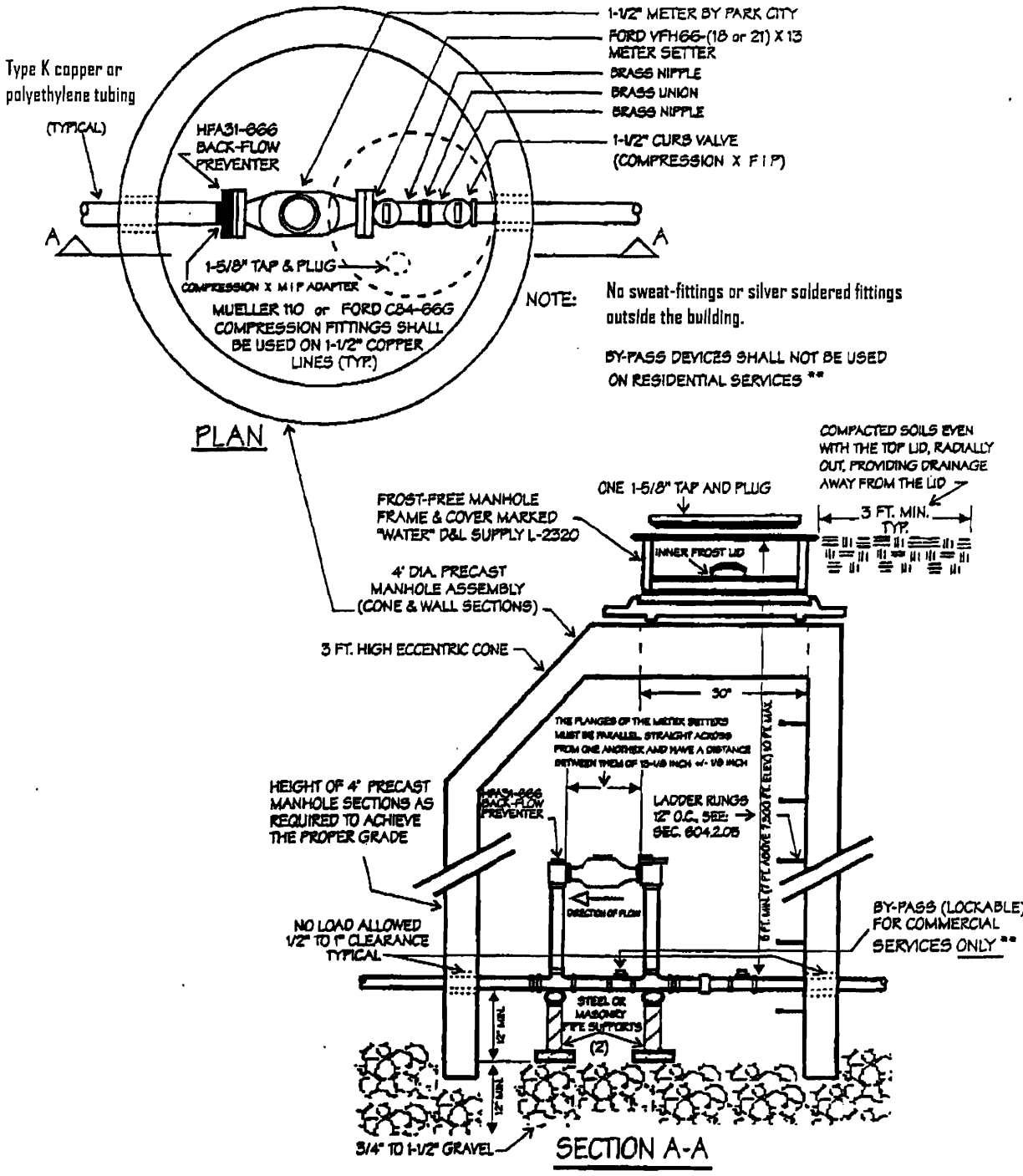
STANDARD DRAWING 705-A	WATER SERVICE CONNECTION (TYPICAL)
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER



NOTE: ALL COMPONENTS EXCEPT THE METER ARE PROVIDED BY THE CONTRACTOR. THE METER IS PROVIDED FOR A FEE BY THE PUBLIC WORKS DEPARTMENT. A SEPARATE SIGN-UP IS REQUIRED (TYPICAL ALL SIZE METERS)

REV 4/98 TFA

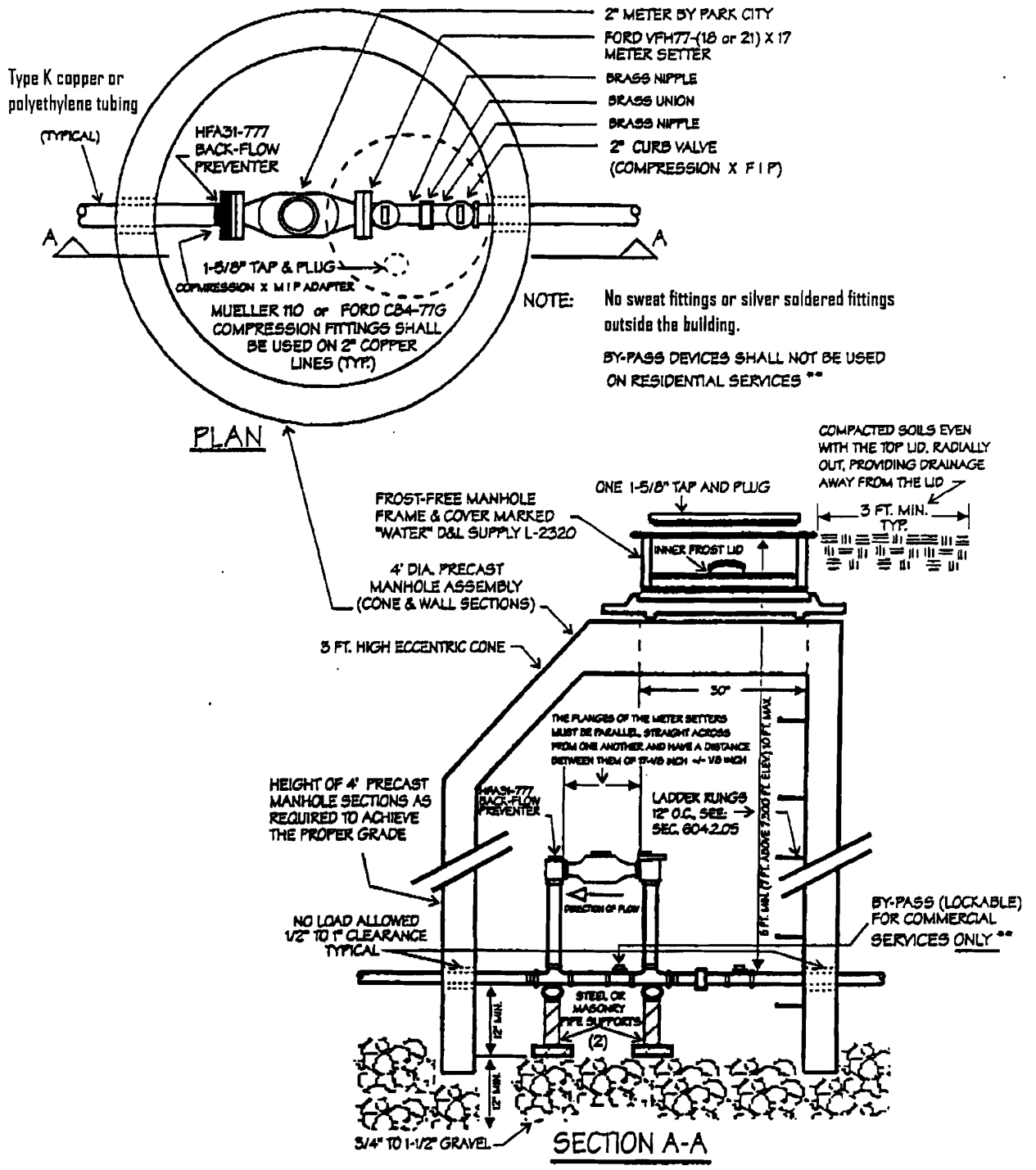
STANDARD DRAWING 705-B	METER VAULT / BOX DETAIL SINGLE 3/4" & 1" METER ONLY
DRAWN BY: T. FRED ABAY CHECKED BY: ERIC W. DuMAAN	PARK CITY MUNICIPAL CORPORATION



*ANY REQUEST FOR A METER LARGER THAN 1-1/2" MUST BE ACCOMPANIED BY A PROPOSAL SUBMITTED TO THE CITY ENGINEER

REV. 4/09 TPA

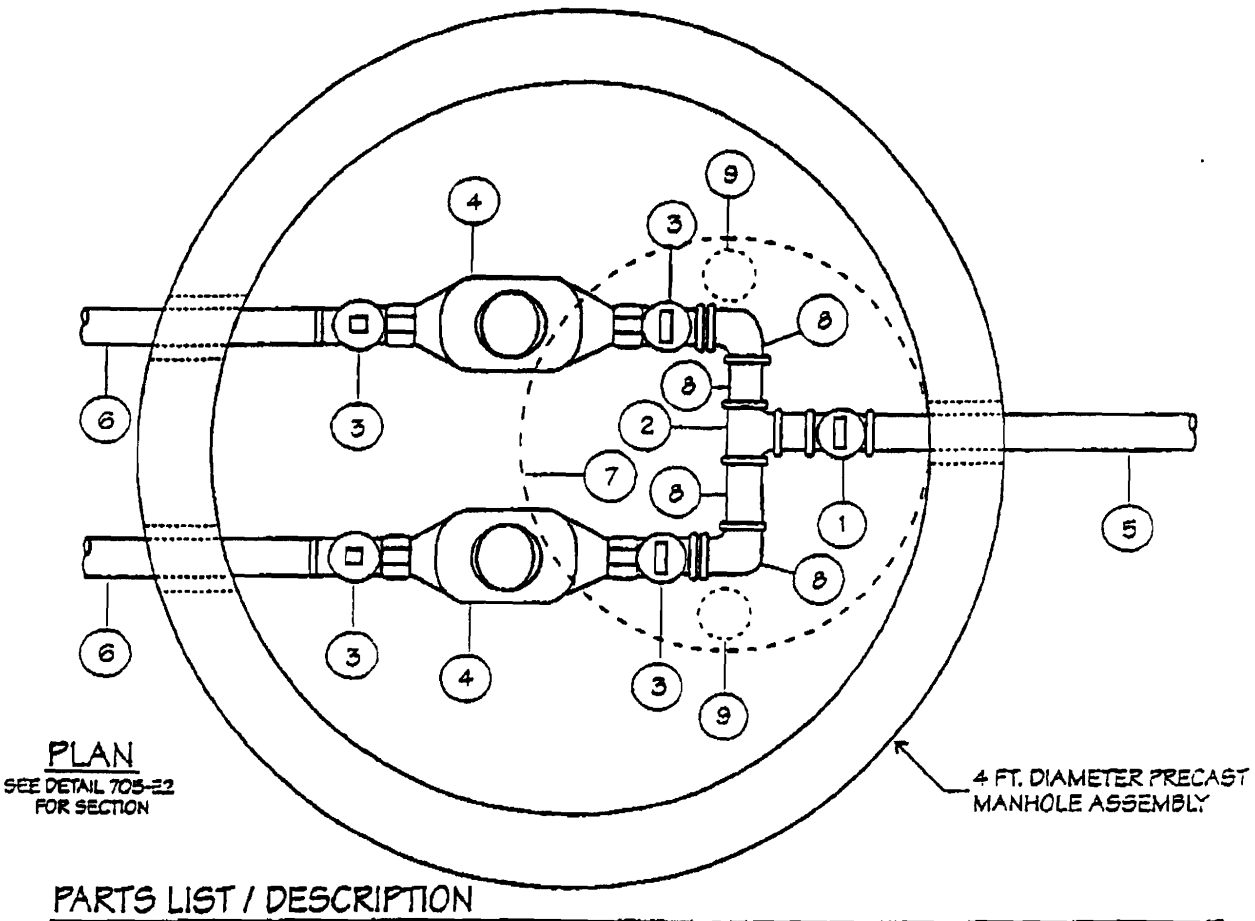
STANDARD DRAWING 705-C.1	METER VAULT FOR SINGLE METER 1-1/2" METER*
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DEMAAN	PARK CITY MUNICIPAL CORPORATION



*ANY REQUEST FOR A METER LARGER THAN 1-1/2" MUST BE ACCOMPANIED BY A PROPOSAL SUBMITTED TO THE CITY ENGINEER

REV. 4/08 TFA

STANDARD DRAWING 705-C.2	METER VAULT FOR SINGLE METER 2" METER*
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION



PLAN
SEE DETAIL 705-E2 FOR SECTION

4 FT. DIAMETER PRECAST MANHOLE ASSEMBLY

PARTS LIST / DESCRIPTION

1. MUELLER 1" MARK II ORASEAL VALVE # H-15209
2. BRONZE 1" X 3/4" X 3/4" TEE
3. FORD VBHH72W-18 OR VBHC72W-18 METER SETTER
4. 3/4" METER BY PARK CITY MUNICIPAL
5. 1" Type K copper or polyethylene from main line
6. 3/4" Type K copper or polyethylene service line
7. D&L SUPPLY L-2320 FROST FREE LID ASSEMBLY
8. 3/4" BRONZE NIPPLES AND 90° ELBOWS
9. 1-5/8" TAP AND PLUG
10. COMPACTED SOIL EVEN WITH THE TOP LID, RADIALLY OUT THREE FEET MINIMUM AND PROVIDING DRAINAGE AWAY FROM THE LID.

REV. 4/96 TPA

STANDARD DRAWING 705-E1	METER VAULT FOR MULTIPLE METERS DUAL 3/4" METERS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DEHAAN	PARK CITY MUNICIPAL CORPORATION

BEFORE ANY CONSTRUCTION ON A 4" or 6" WATER METER VAULT

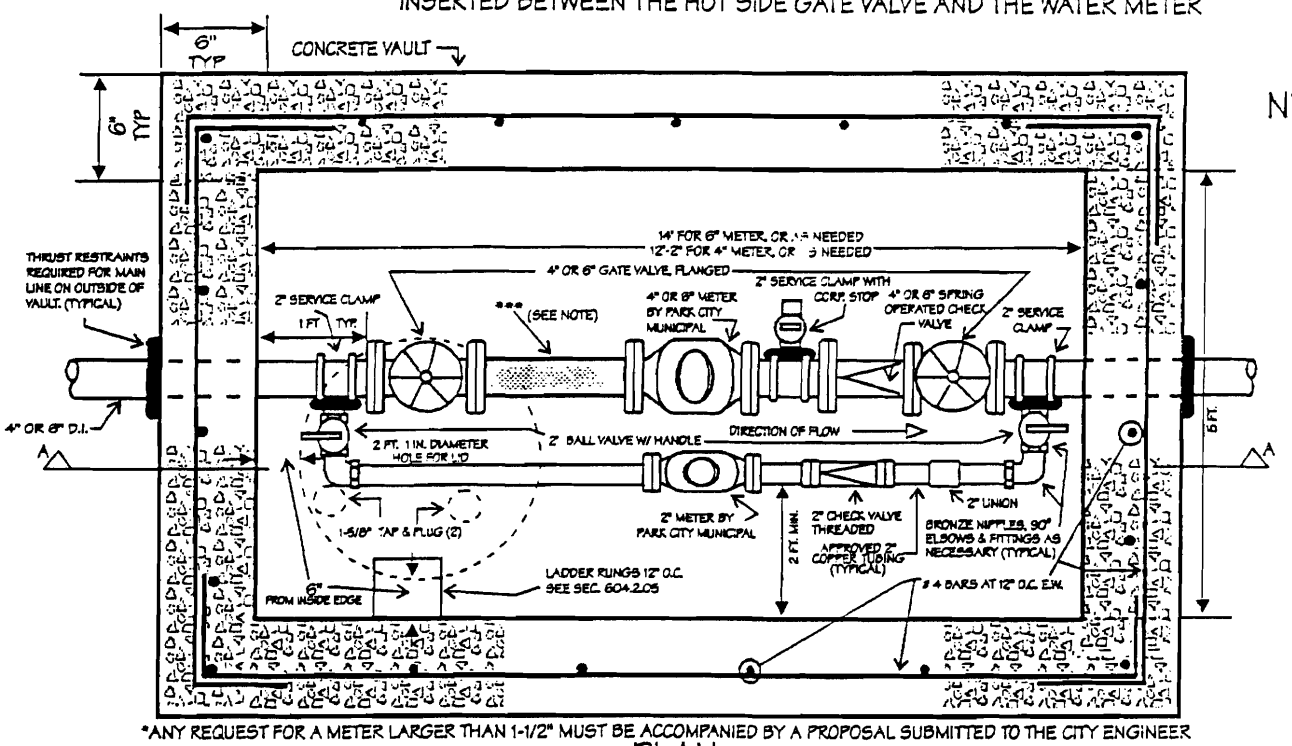
- FIRST THE SIZE OF THE METER NEEDS TO BE APPROVED BY PARK CITY ACCORDING TO HYDRAULIC AND FIRE PROTECTION NEEDS
- AFTER THE SIZE OF THE METER HAS BEEN DETERMINED THE PARK CITY WATER DEPARTMENT MUST BE CONTACTED SO THE TYPE OF WATER METER CAN BE DETERMINED. THE TYPE OF WATER METER WILL DETERMINE THE DIMENSIONS OF THE PIPING AND METER VAULT. THE TYPE IS DETERMINED BY CALCULATIONS OF AVAILABLE WATER AND DEMAND. THERE IS ALSO A REQUIREMENT FOR A TURBULENCE CALMING SPOOL, SEE BELOW.***
- IF THE PARK CITY WATER DEPARTMENT HAS THE CORRECT SIZE METER AVAILABLE THE METER CAN BE CHECKED OUT FROM THE WATER DEPARTMENT FOR A MAXIMUM OF FIVE (5) DAYS WHILE SIZING THE PIPING.** WATER METERS MUST BE RETURNED TO THE WATER DEPARTMENT AFTER THE FIVE (5) DAY LOAN PERIOD.

**- WATER METERS MAY NOT BE INSTALLED ON A TEMPORARY OR PERMANENT BASIS UNTIL THERE HAS BEEN APPROVAL FROM THE CITY ENGINEER'S OFFICE AND A BILLING PAYMENT AGREEMENT HAS BEEN SIGNED AT THE PARK CITY FINANCE DEPARTMENT

BUILDING DEPT.: 645-5040 CITY ENGINEER'S OFFICE: 645-5020
FINANCE DEPT.: 645-5032 WATER DEPT.: 645-5126

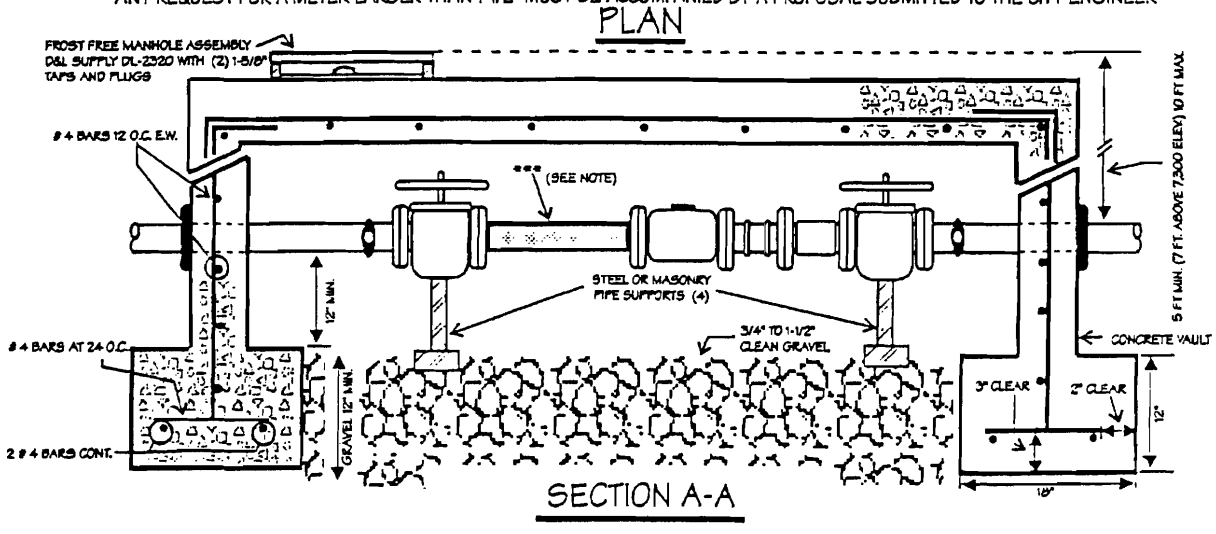
*** A DUCTILE IRON SPOOL OF THE SAME DIAMETER AS THE LINE AND FIVE (5) TIMES THE DIAMETER OF THE PIPE IN LENGTH (FLANGE BY FLANGE) SHALL BE INSERTED BETWEEN THE HOT SIDE GATE VALVE AND THE WATER METER

NTS



*ANY REQUEST FOR A METER LARGER THAN 1-1/2" MUST BE ACCOMPANIED BY A PROPOSAL SUBMITTED TO THE CITY ENGINEER

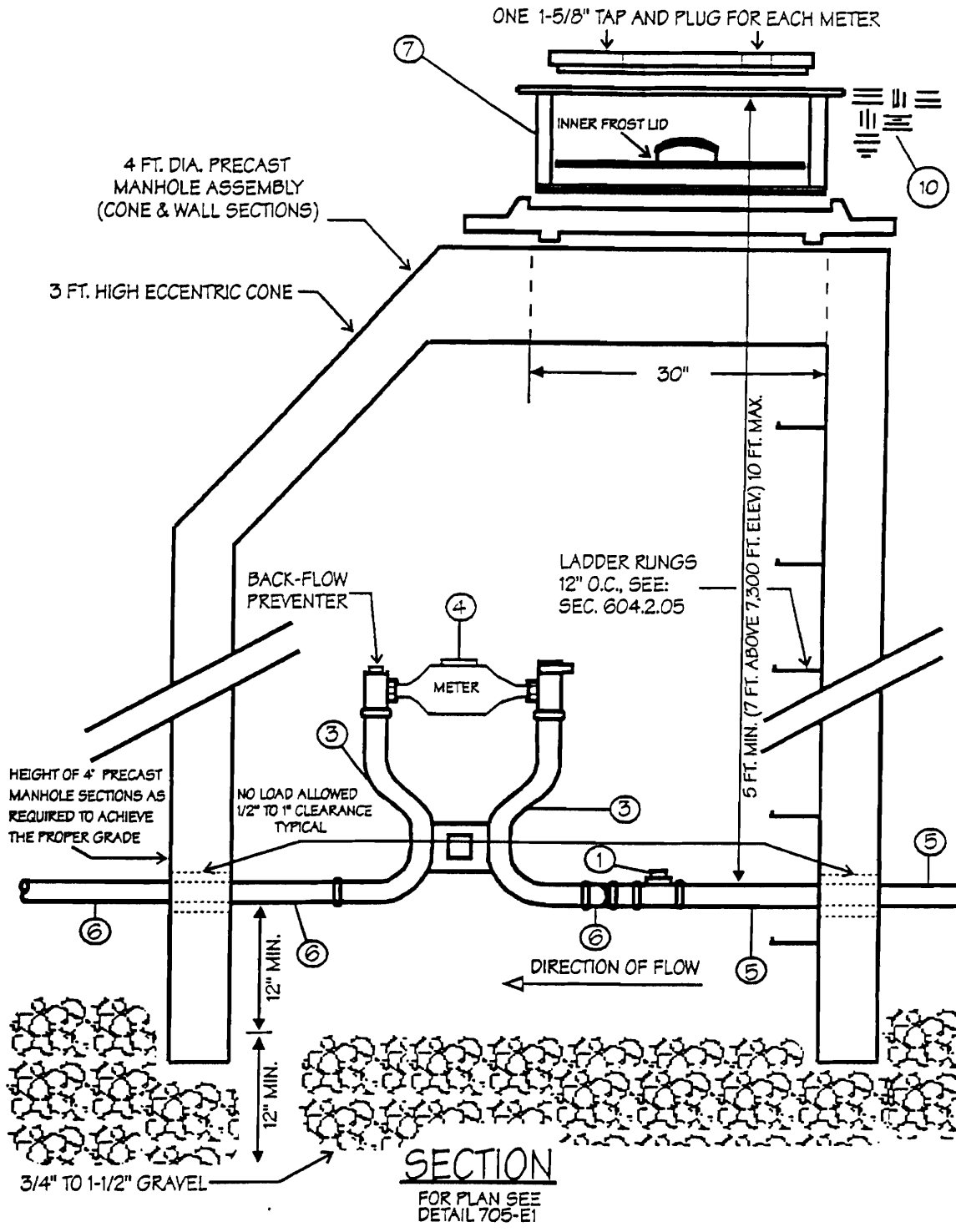
PLAN



SECTION A-A

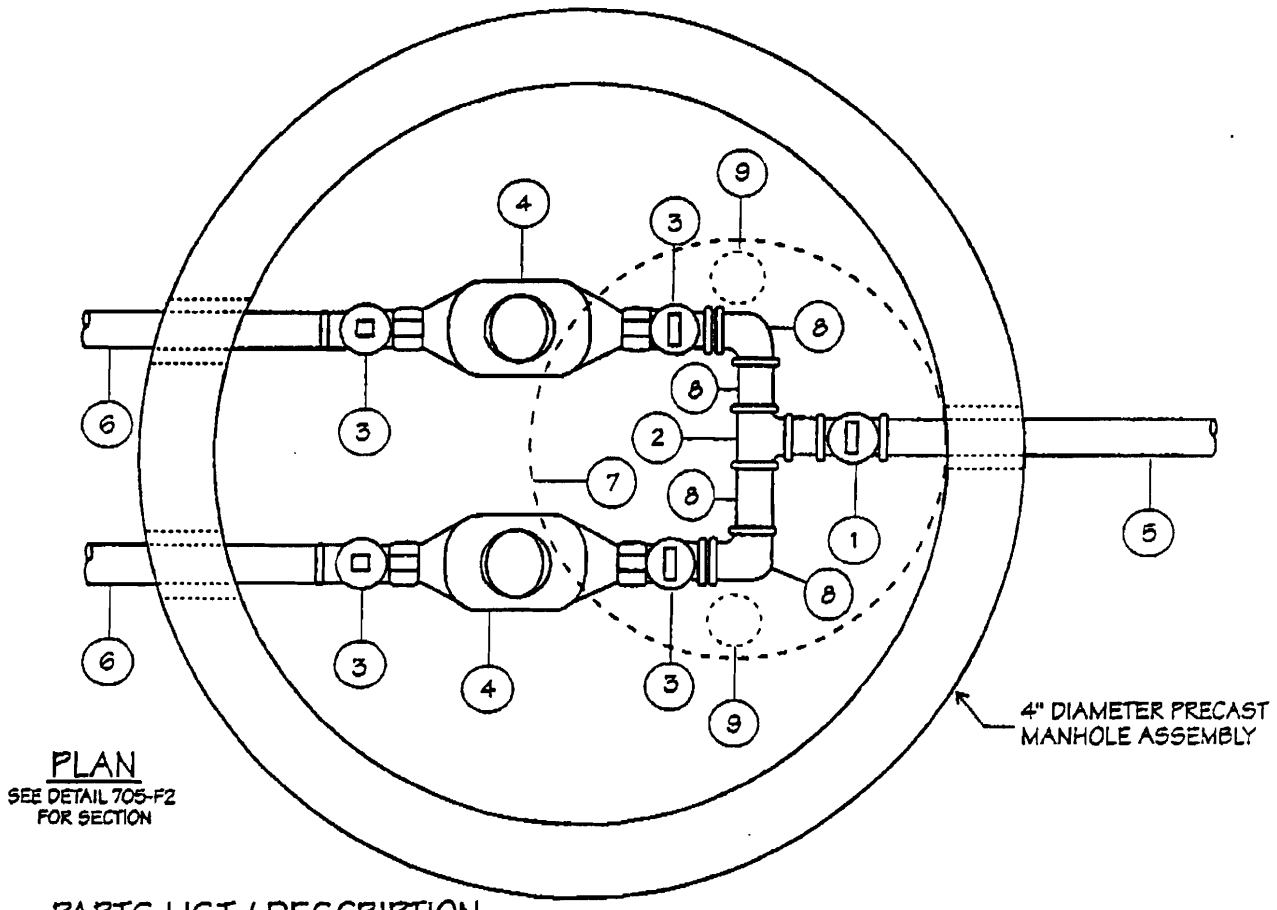
REV. 1/98 TFA

STANDARD DRAWING **705-D**	**METER VAULT & BY-PASS DETAIL** FOR 4" & 6" METERS ONLY*
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER



REV. 4/98 TFA

STANDARD DRAWING 705-E2	METER VAULT FOR MULTIPLE METERS DUAL 3/4" METERS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION



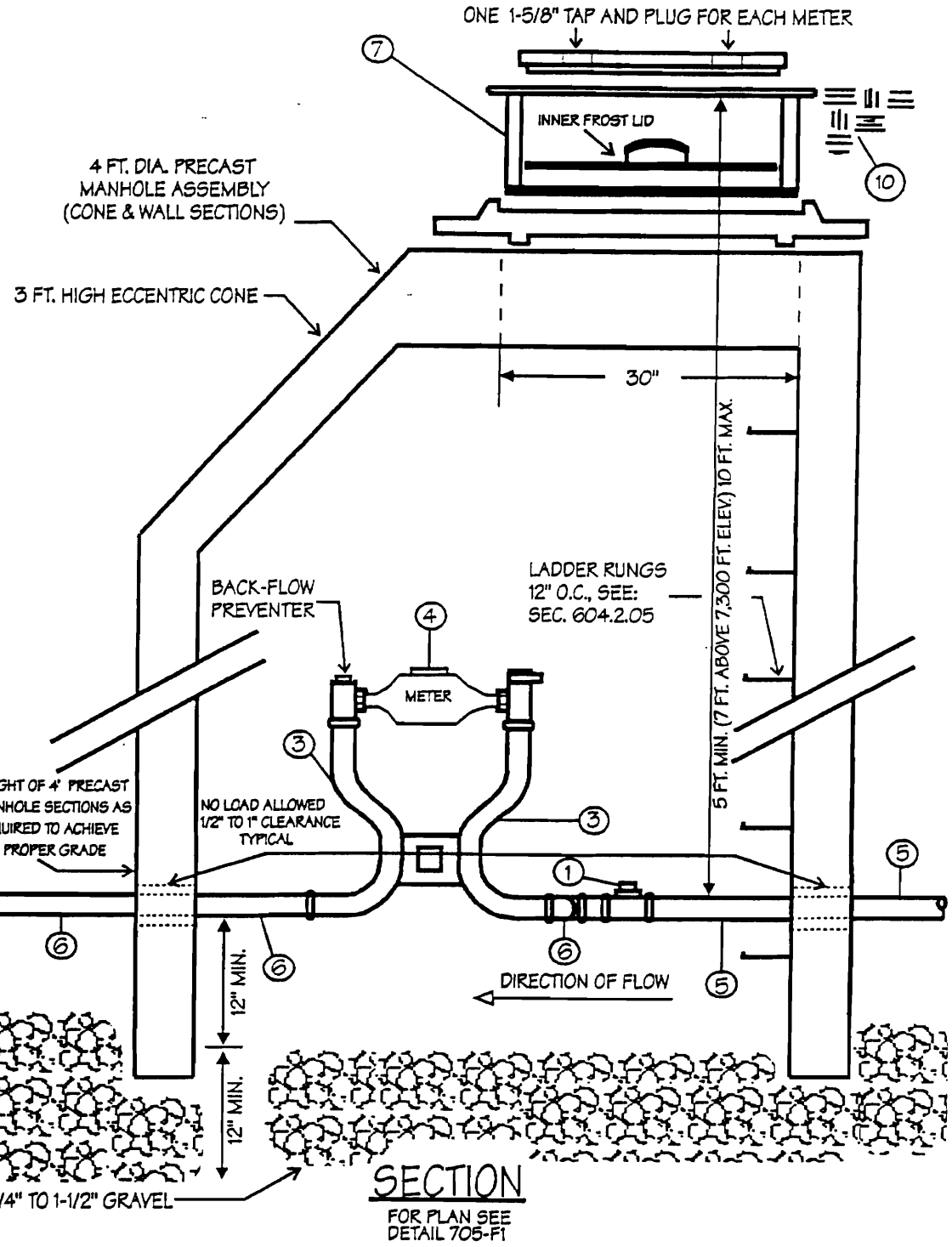
PLAN
SEE DETAIL 705-F2
FOR SECTION

PARTS LIST / DESCRIPTION

1. MUELLER 1" MARK II ORASEAL VALVE # H-15209
2. BRONZE 1" X 1" X 1" TEE
3. FORD VBHH74W-18 OR VBHC74W-18 METER SETTER
4. 1" METER BY PARK CITY MUNICIPAL
5. 1" Type K copper or polyethylene from main line
6. 1" Type K copper or polyethylene service line
7. D & L SUPPLY L-2320 FROST FREE LID ASSEMBLY
8. 1" BRONZE NIPPLES AND 90° ELBOWS
9. 1-5/8" TAP AND PLUG
10. COMPACTED SOIL EVEN WITH THE TOP LID, RADIALLY OUT THREE FEET MINIMUM AND PROVIDING DRAINAGE AWAY FROM THE LID

REV. 4/96 TFA

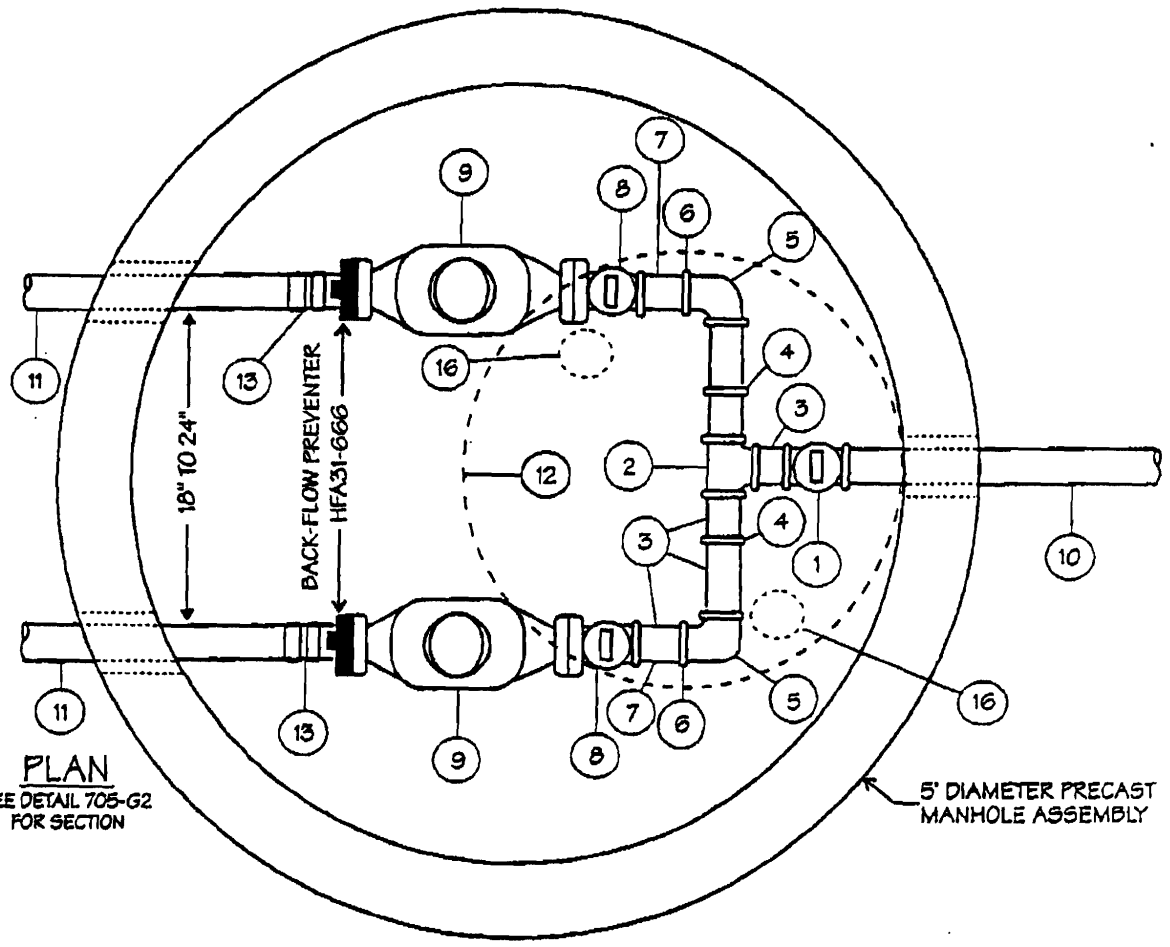
STANDARD DRAWING 705-F1	METER VAULT FOR MULTIPLE METERS DUAL 1" METERS
DRAWN BY: T. FREED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION



REV 4/98 TFA

STANDARD DRAWING 705-F2	METER VAULT FOR MULTIPLE METERS DUAL 1" METERS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION

2" COMPONENTS MAY BE REDUCED TO 1-1/2"
WITH THE APPROVAL OF THE CITY ENGINEER



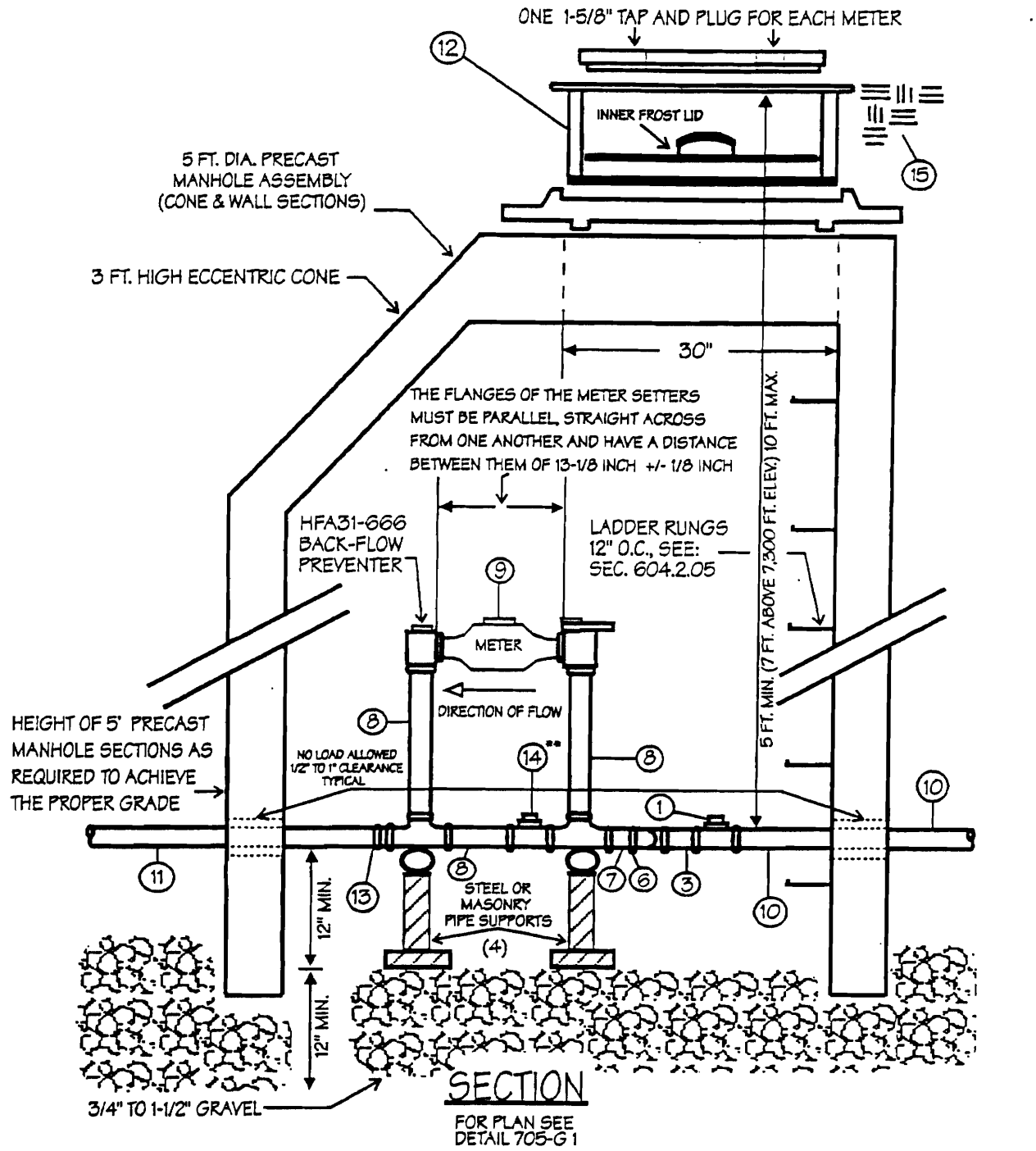
PARTS LIST / DESCRIPTION

1	MUELLER 2" MARK II ORASEAL VALVE # H-15172	9	1-1/2" METER BY PARK CITY MUNICIPAL
2	2" X 2" X 2" BRONZE TEE	10	2" Type K copper or polyethylene from main line
3	2" BRONZE NIPPLE (CENTER SETTERS IN VAULT)	11	1 1/2" Type K copper or polyethylene service line
4	2" BRONZE UNION	12	D & L Supply L-2320 Frost-Free Lid Assembly
5	2" BRONZE 90° ELBOW	13	1-1/2" COMPRESSION FITTING: MUELLER 110 or FORD C44-66G
6	2" X 1-1/2" BRONZE BUSHING	14**	LOCKABLE BY-PASS FOR COMMERCIAL SERVICES ONLY *(NO BY-PASS ON RESIDENTIAL SERVICES)*
7	1-1/2" X 2" BRONZE NIPPLE	15	COMPACTED SOIL EVEN WITH THE TOP LID, RADIALLY OUT THREE FEET MINIMUM AND PROVIDING DRAINAGE AWAY FROM THE LID
8	FORD VFH66- (18 or 21) X 13 METER SETTER WITH HFA31-666 BACK-FLOW PREVENTER	16	1-5/8" TAP AND PLUG

ANY REQUEST FOR A METER LARGER THAN 1-1/2" MUST BE ACCOMPANIED BY A PROPOSAL SUBMITTED TO THE CITY ENGINEER

REV. 4/98 TFA

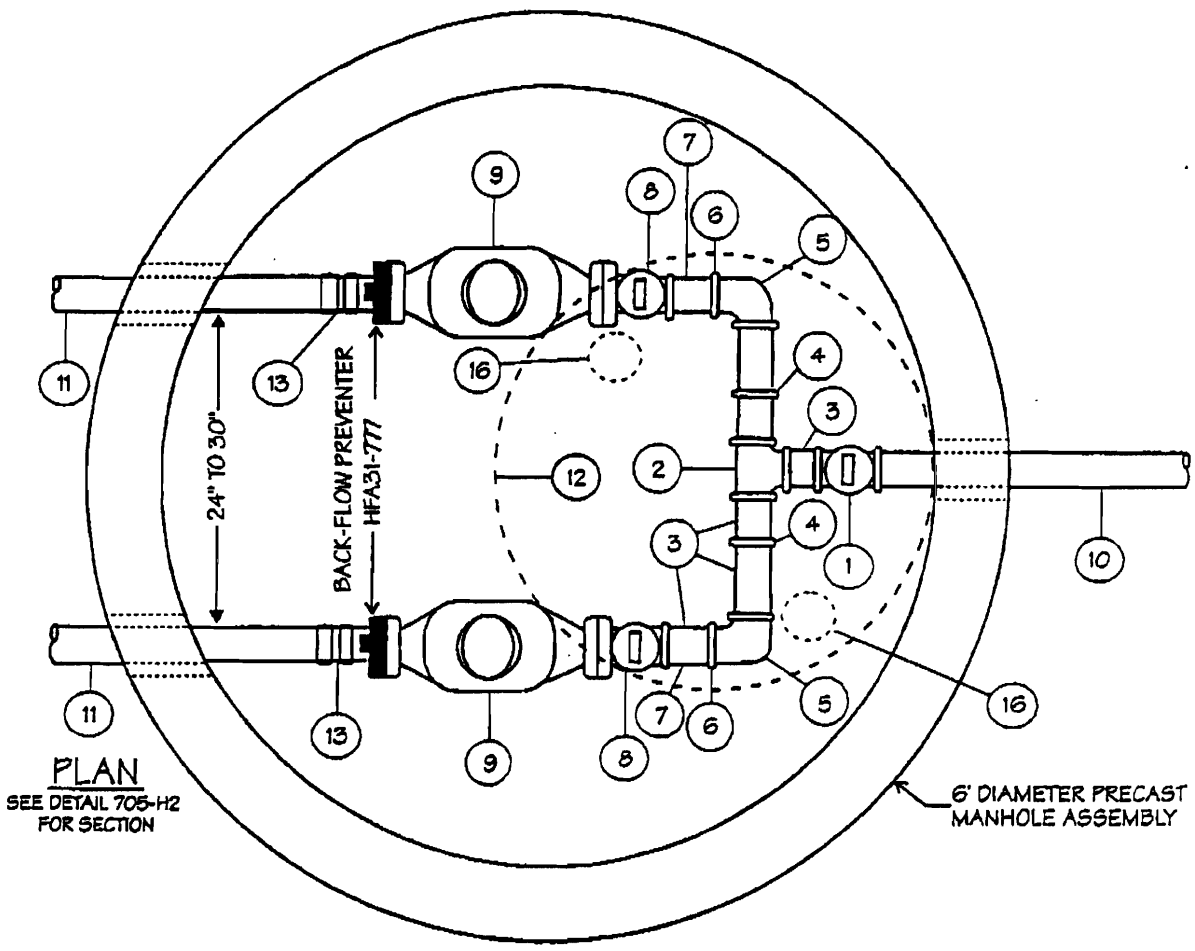
STANDARD DRAWING 705-G1	METER VAULT FOR MULTIPLE METERS DUAL 1-1/2" METERS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION



*ANY REQUEST FOR A METER LARGER THAN 1-1/2" MUST BE ACCOMPANIED BY A PROPOSAL SUBMITTED TO THE CITY ENGINEER

REV. 4/96 TFA

STANDARD DRAWING 705-G2	METER VAULT FOR MULTIPLE METERS DUAL 1-1/2" METERS*
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION



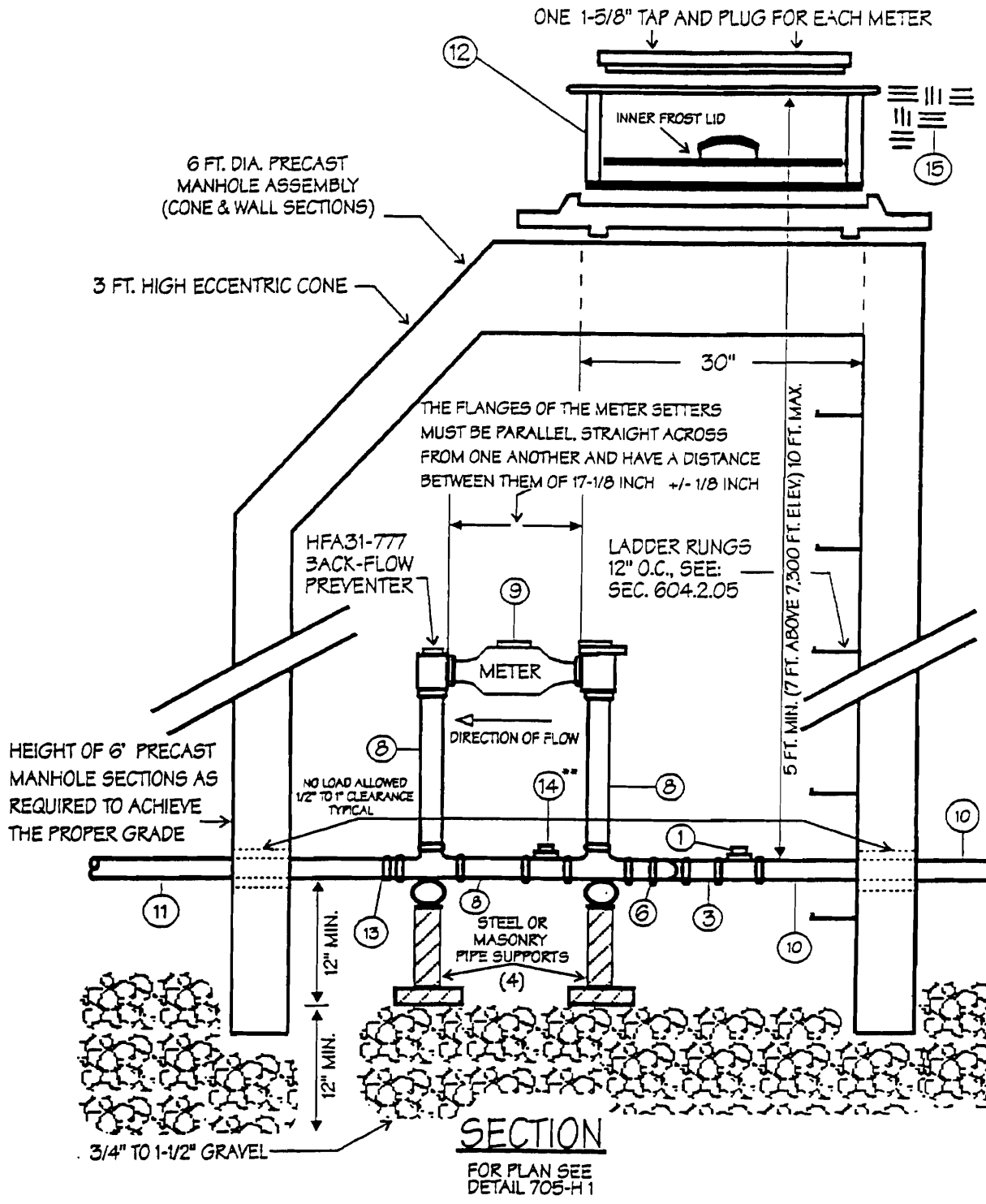
PARTS LIST / DESCRIPTION

1	MUELLER 2" MARK II ORASEAL VALVE # H-15172
2	2" X 2" X 2" BRONZE TEE
3	2" BRONZE NIPPLE (CENTER SETTERS IN VAULT)
4	2" BRONZE UNION
5	2" BRONZE 90° ELBOW
6	2" BRONZE BUSHING
7	2" X 2" BRONZE NIPPLE
8	FORD VFH77- (18 or 21) X 17 METER SETTER WITH HFA31-777 BACK-FLOW PREVENTER
9	2" METER BY PARK CITY MUNICIPAL
10	2" Type K copper or polyethylene from main line
11	2" Type K copper or polyethylene service line
12	D & L SUPPLY L-2320 FROST FREE LID
13	2" COMPRESSION FITTING: MUELLER 110 or FORD C44-77G
14**	LOCKABLE BY-PASS FOR COMMERCIAL SERVICES ONLY *(NO BY-PASS ON RESIDENTIAL SERVICES)*
15	COMPACTED SOIL EVEN WITH THE TOP LID, RADIALLY OUT THREE FEET MINIMUM AND PROVIDING DRAINAGE AWAY FROM THE LID
16	1-5/8" TAP AND PLUG

ANY REQUEST FOR A METER LARGER THAN 1-1/2" MUST BE ACCOMPANIED BY A PROPOSAL SUBMITTED TO THE CITY ENGINEER

REV. 4/98 TPA

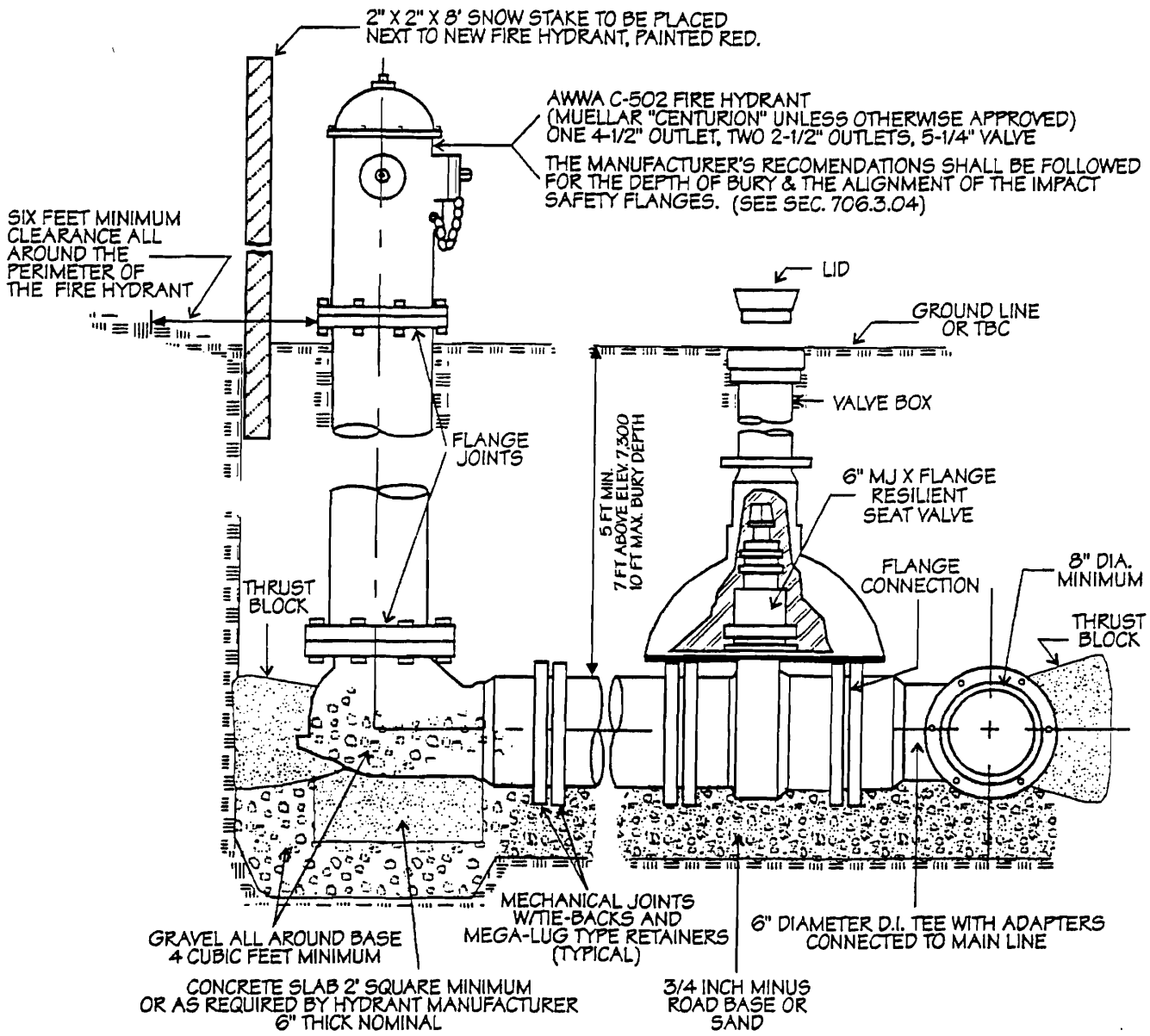
STANDARD DRAWING 705-H1	METER VAULT FOR MULTIPLE METERS DUAL 2" METERS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION



*ANY REQUEST FOR A METER LARGER THAN 1-1/2" MUST BE ACCOMPANIED BY A PROPOSAL SUBMITTED TO THE CITY ENGINEER

REV 4/08 TA

STANDARD DRAWING 705-H2	METER VAULT FOR MULTIPLE METERS DUAL 2" METERS*
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION

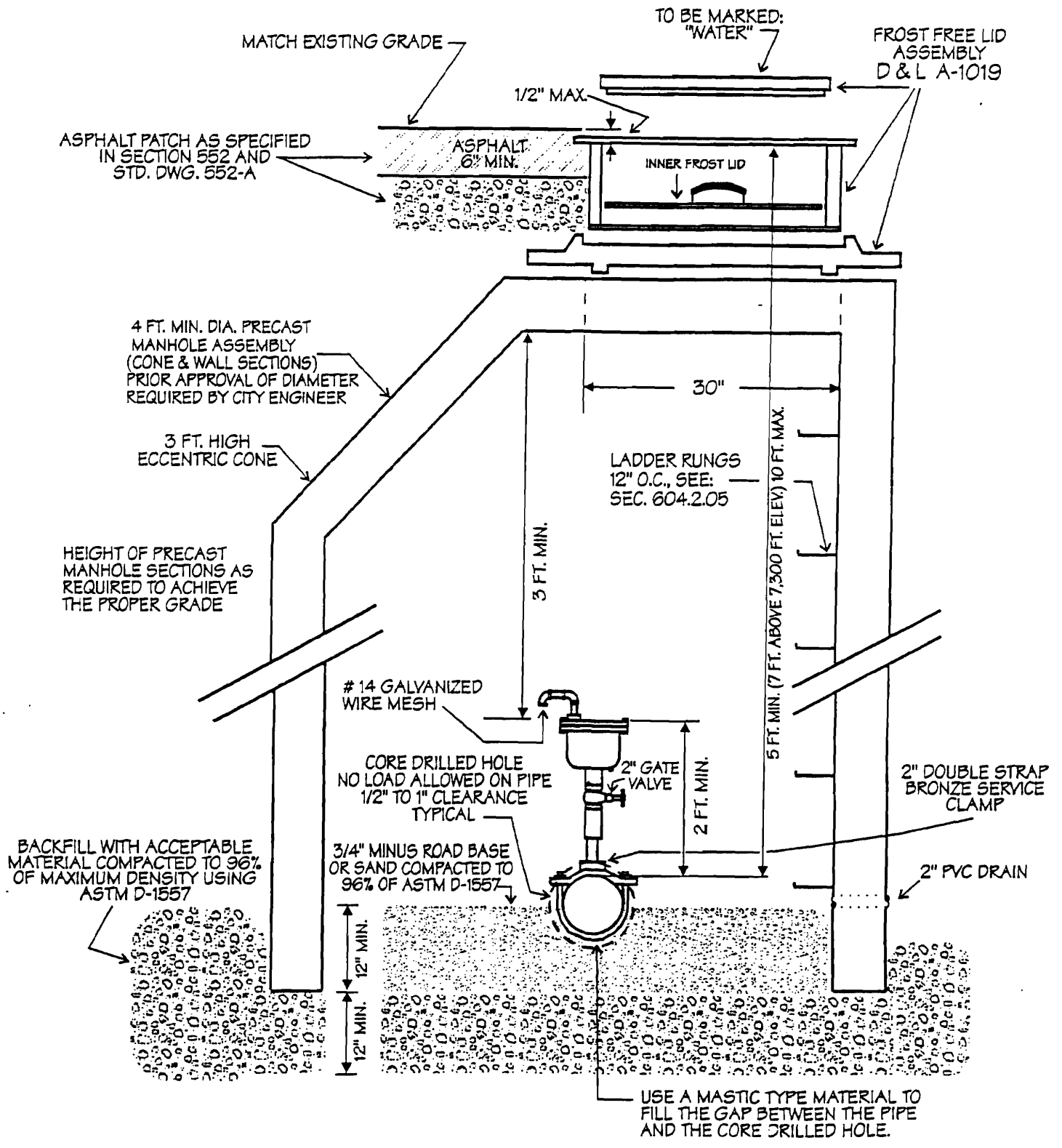


NOTES:

1) ALL FIRE HYDRANTS SHALL BE LOCATED AS SHOWN ON THE APPROVED PLANS
2) ALL FIRE HYDRANTS SHALL STAND PLUMB WITH THE PUMPER NOZZLE FACING THE STREET.
3) HYDRANT WEEP HOLES SHALL BE PLUGGED IN AREAS OF FLUCTUATING GROUND WATER.
4) FOR DETAILED INFORMATION SEE THE SPECIFICATION TEXT.
5) THE VALVE WILL BE LOCATED AT THE TEE FROM THE MAIN. PIPE MATERIAL SHALL BE DUCTILE IRON.

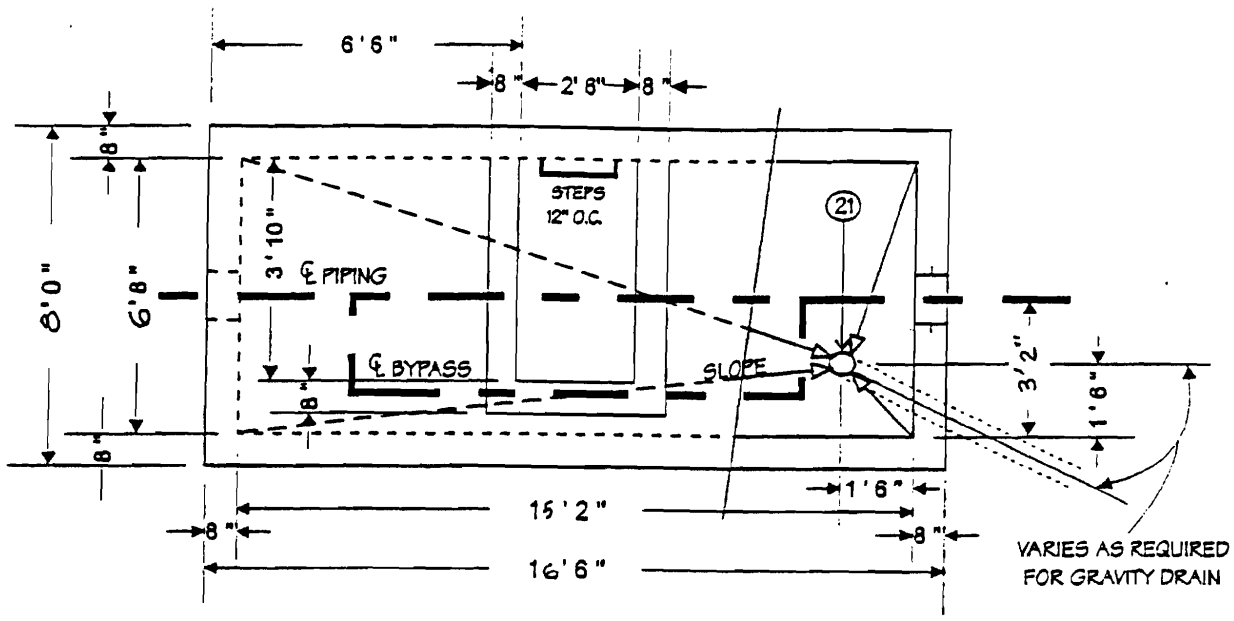
REV. 2/97 TFA

STANDARD DRAWING 706-A	FIRE HYDRANT DETAILS
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER

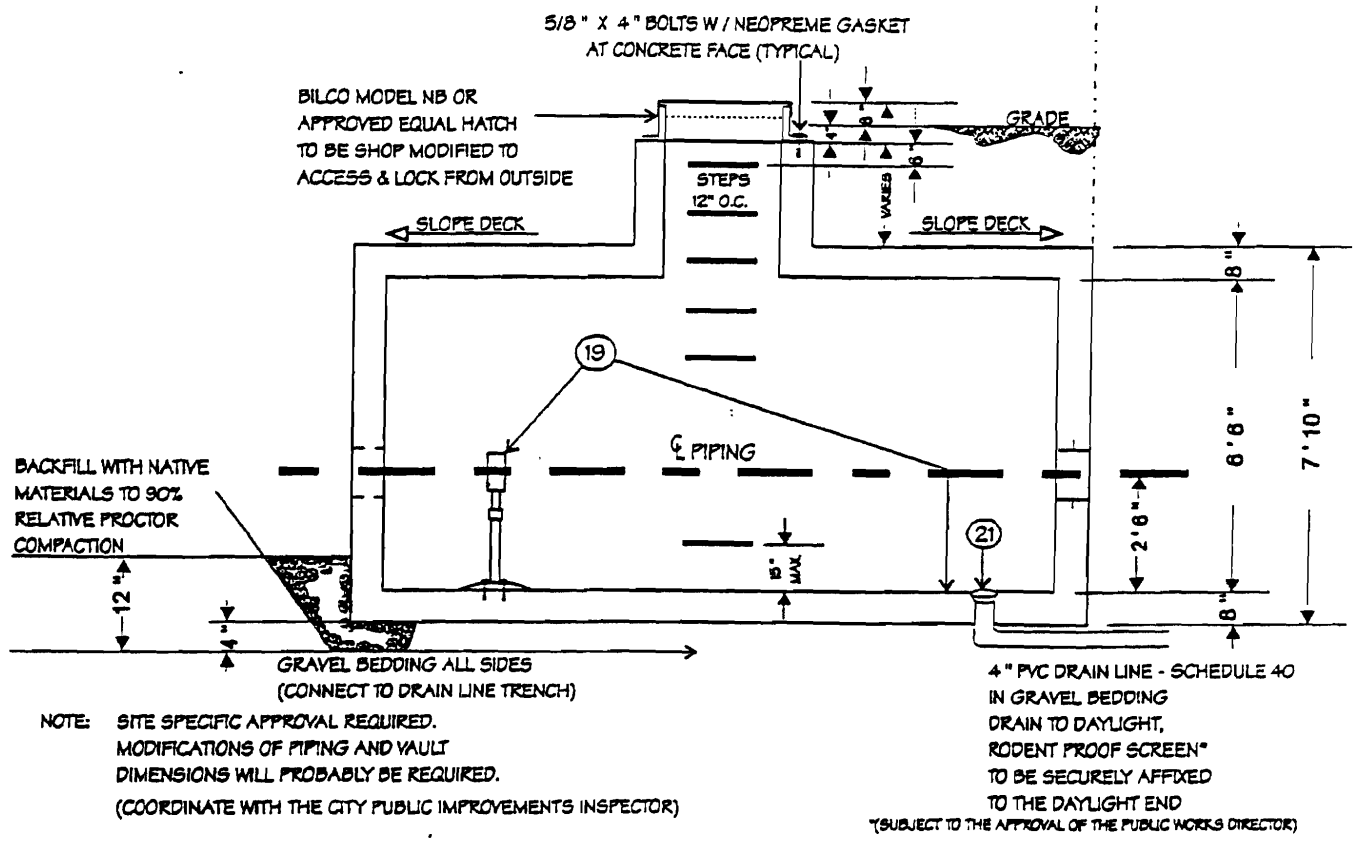


REV 2/87 TFA

STANDARD DRAWING 707	AIR RELEASE VALVE MANHOLE DETAIL
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER



VAULT - PLAN VIEW

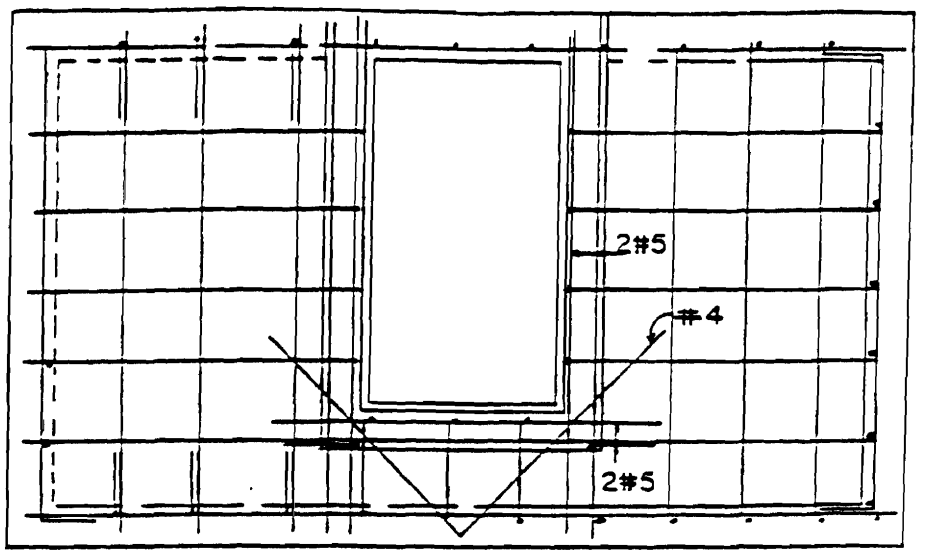


NOTE: SITE SPECIFIC APPROVAL REQUIRED.
MODIFICATIONS OF PIPING AND VAULT
DIMENSIONS WILL PROBABLY BE REQUIRED.
(COORDINATE WITH THE CITY PUBLIC IMPROVEMENTS INSPECTOR)

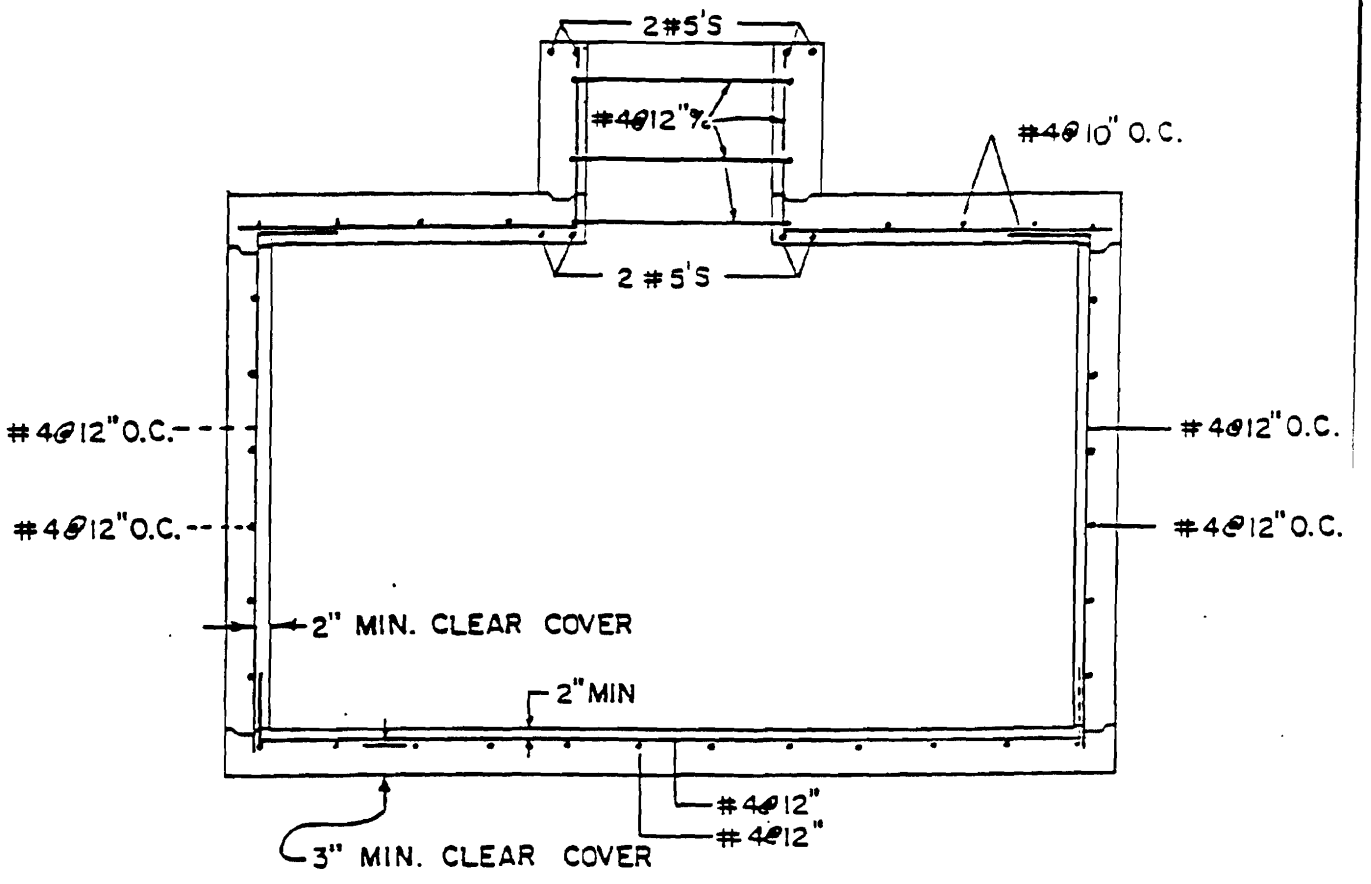
VAULT - SECTION

REV. 4/96 TFA

STANDARD DRAWING 708-A	PRESSURE REDUCING VALVE VAULT
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION REV 4/01



1. 2" MIN CLEAR TO CONCRETE SURFACE
2. INSTALL PER UBC CODE
3. SPLICES & LAPS TO BE 30 ϕ

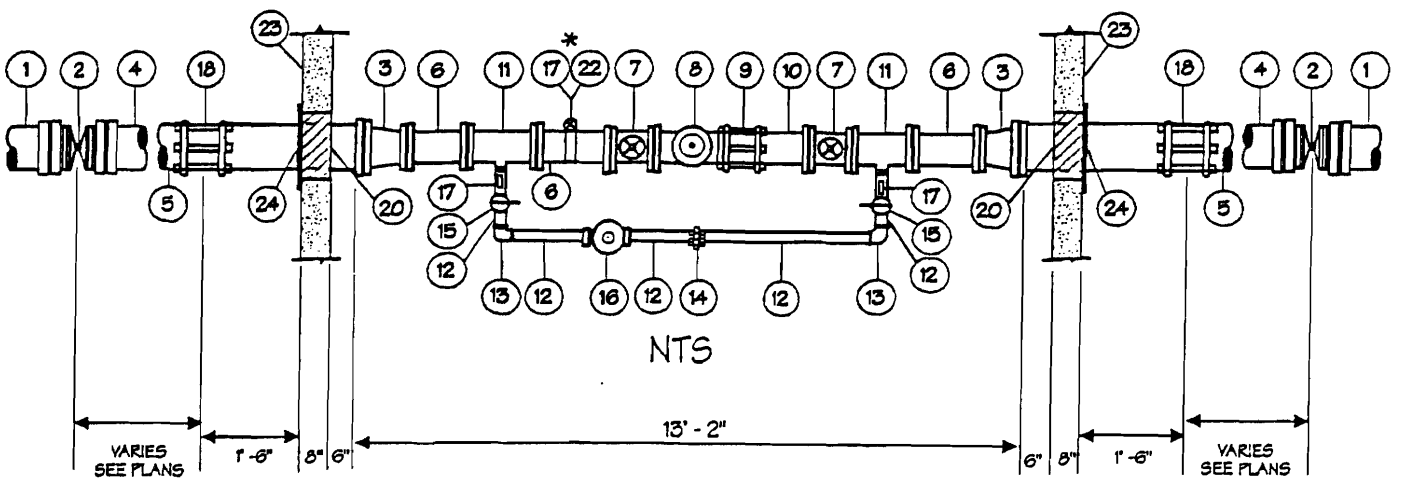


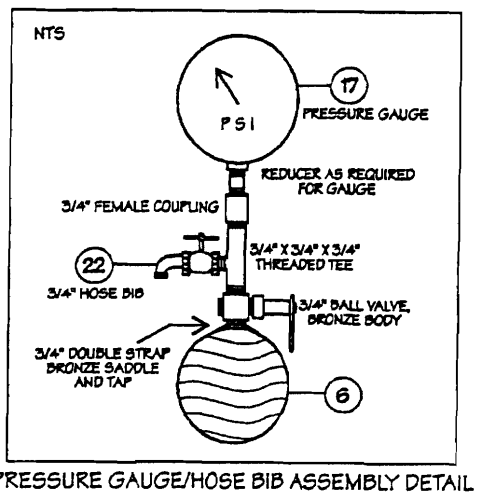
REINFORCING

STANDARD DRAWING	PRESSURE REDUCING VALVE VAULT
708-B	PARK CITY MUNICIPAL CORPORATION REV 4/01

HIGH PRESSURE

LOW PRESSURE





* PRESSURE GAUGE/HOSE BIB ASSEMBLY DETAIL

THE USE OF FABRICATED LADDERS IS NOT ACCEPTABLE.
STEPS AS OUTLINED IN SECTION 604.2.05 ARE TO BE USED.

REV. 3/98 TFA

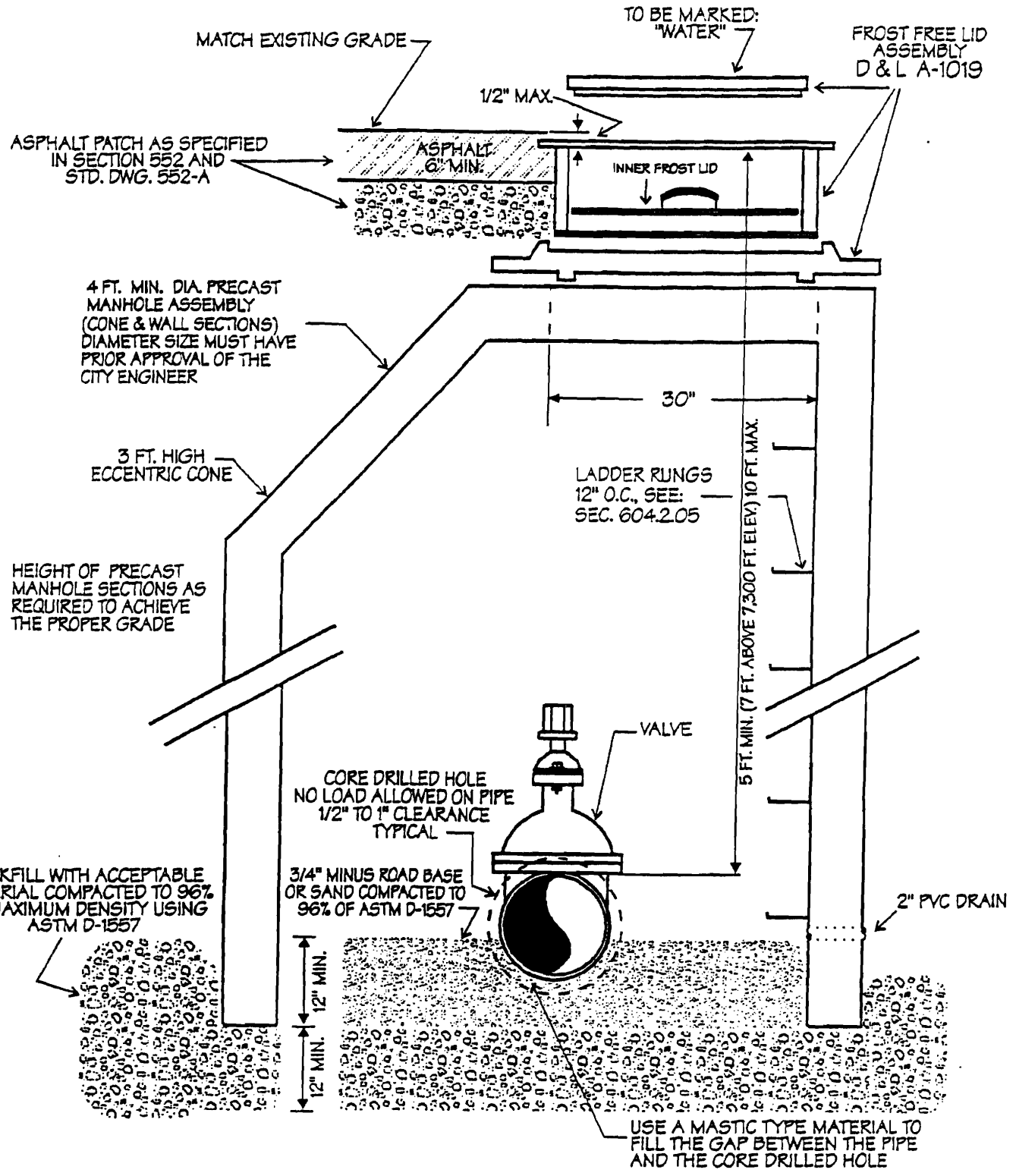
STANDARD DRAWING 708-C	PRESSURE REDUCING VALVE VAULT
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER

PRESSURE REDUCING VALVE VAULT LEGEND

1) INSTALL 8" WATER MAIN
2) INSTALL 8" RESILIENT SEAT VALVE, MJ, W/ RETAINER GLANDS ON EXISTING WATER MAIN
3) 8" X 6" DI PRESSURE CLASS 250 REDUCER FLANGE X FLANGE
4) 8" D I CLASS 250 WATER MAIN, USE DRESSER COUPLINGS AS NECESSARY TO LEVEL EXISTING LINES
5) 8" D I CLASS 250 PIPE, FLANGE X MJ W/RETAINER GLAND
6) 6" D I CLASS 250 SPOOL, FLANGE X FLANGE
7) 6" RESILIENT SEAT VALVE, FLANGE X FLANGE W/HAND WHEEL
8) 6" PRESSURE REDUCING VALVE AND PRESSURE SUSTAINING VALVE, CLA-VAL MODEL 92-01 WITH STRAINERS, FLOW CONTROL SHUT OFF COCKS, FLOW STABILIZER, STAINLESS STEEL TRIM, FLANGE X FLANGE (SUBMITTAL REQUIRED)
9) 6" FLANGED COUPLING ADAPTER, BAKER 601-915, 150 PSI, W/ANCHOR PINS
10) 6" D I CLASS 250 FLANGE X PE
11) 6" X 6" X 3" DI TEE FLANGE X FLANGE X I P THREAD
12) 3" GALVANIZED STEEL PIPE, SCHEDULE 40, THREADED, TYPICAL
13) 3" 90° ELBOW, SCHEDULE 40, GALVANIZED STEEL, THREADED
14) 3" UNION COUPLING, SCHEDULE 40, GALVANIZED STEEL, THREADED
15) 3" THREADED BALL VALVE W/HANDLE
16) 3" PRESSURE REDUCING VALVE AND PRESSURE SUSTAINING VALVE MODEL CLA-VAL 92-01 WITH STRAINERS, FLOW CONTROL SHUT OFF COCKS, FLOW STABILIZER, STAINLESS STEEL TRIM, THD X THD (SUBMITTAL REQUIRED)
17) 4-1/2" PRESSURE GAUGE, GRADE B, 0-200 PSI, THREADED, W./STEM VALVE - SEE DETAIL
18) 8" DRESSER COUPLING
19) 2" GALVANIZED STEEL PIPE SUPPORT STAND, ADJUSTABLE (2 REQUIRED ON 6" PIPE SYSTEM, 2 REQUIRED ON 3" PIPE SYSTEM); SUBMIT SHOP DRAWINGS FOR APPROVAL BY THE CITY ENGINEER (SEE 708-A)
20) CORE DRILL OPENING WITH LINK-SEAL PIPE-TO-WALL SEAL
21) 4" FLOOR DRAIN, C. I. WITH REMOVABLE GRATE (SEE 708-A)
22) 3/4" HOSE BIB, WITH HAND WHEEL, I. P. THREAD - SEE DETAIL
23) VAULT IN ACCORDANCE WITH 708-A AND 708-B
    A. CONCRETE IS TO BE 6-1/2 BAG MIX, 4000 PSI
    B. REINFORCING STEEL IS TO BE ASTM A615, GRADE 40
    C. WATERPROOF OUTSIDE WALLS AND TOP SLAB PER UBC CODE FOR BURIED FOUNDATIONS
24) MECHANICAL JOINT DUCTILE IRON RETAINER GLAND

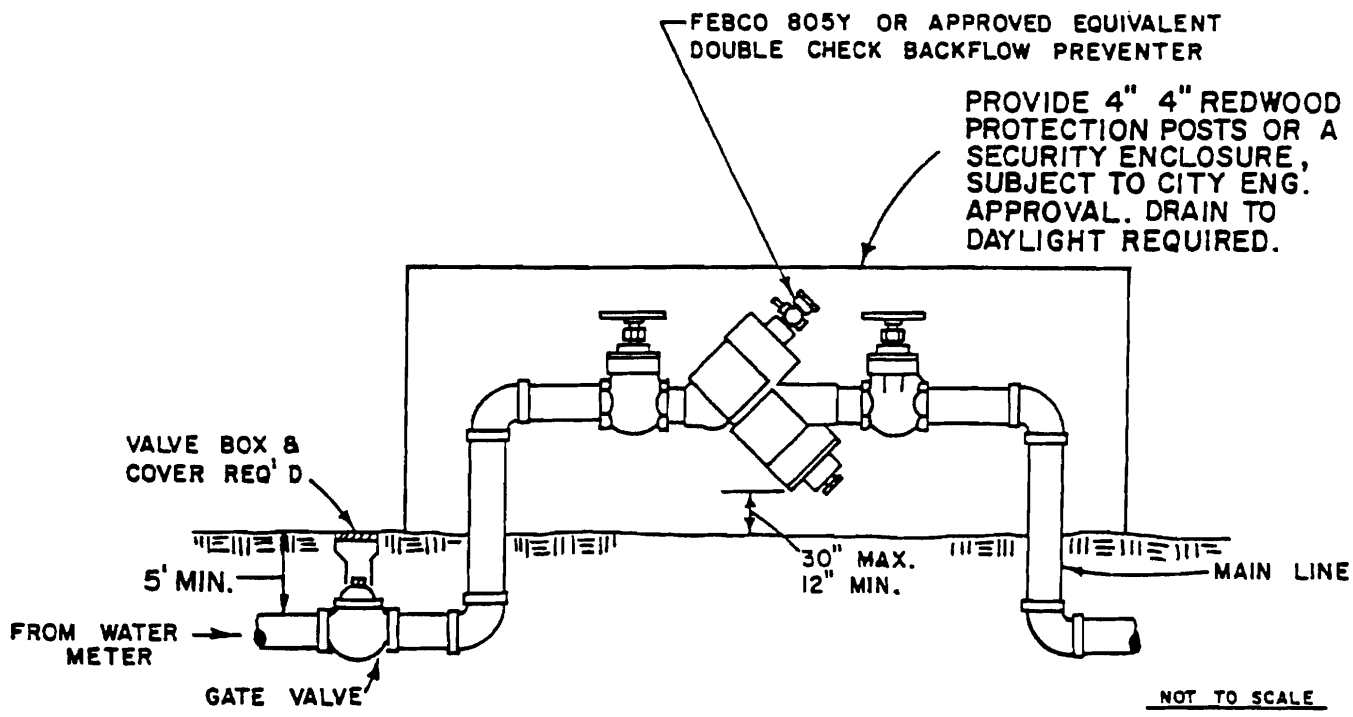
- *ALL WORK SHALL CONFORM WITH PARK CITY DESIGN STANDARDS, CONSTRUCTION SPECIFICATIONS, AND STANDARD DRAWINGS.*
- *SHOP DRAWINGS TO BE SUBMITTED TO DESIGN ENGINEER AND THE CITY ENGINEER FOR APPROVAL PRIOR TO CONSTRUCTION.*
- *ALL PIPING WITHIN THE VAULT IS TO BE PRIMED AND PAINTED WITH MATERIALS SUITABLE FOR FERROUS SURFACES. ALL COMPONENTS ON THE HIGH PRESSURE SIDE SHALL BE PAINTED BLUE. ALL COMPONENTS ON THE LOW PRESSURE SIDE SHALL BE PAINTED WHITE.*

STANDARD DRAWING	PRESSURE REDUCING VALVE VAULT
708-D	PARK CITY MUNICIPAL CORPORATION
DRAWN BY: T. FRED ASAY- REVIEWED BY ERIC W. DEHAAN	OFFICE OF THE CITY ENGINEER



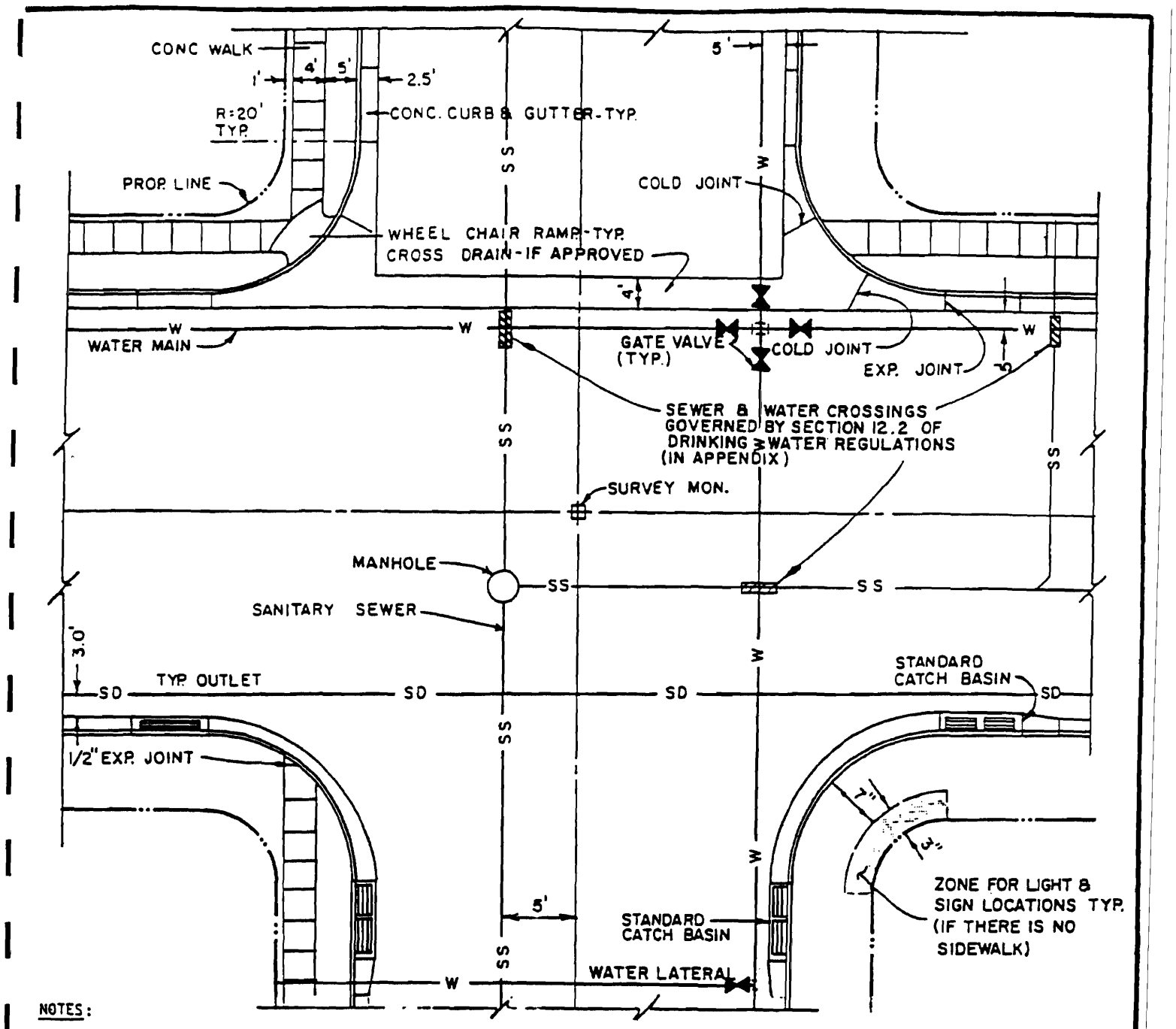
REV 2/97 TFA

STANDARD DRAWING 709	VALVE IN MANHOLE DETAIL
DRAWN BY: T. FRED ASAY CHECKED BY: ERIC W. DeHAAN	PARK CITY MUNICIPAL CORPORATION OFFICE OF THE CITY ENGINEER



BACKFLOW PREVENTER DETAIL

STANDARD DRAWING 710	TYPICAL BACKFLOW PREVENTER INSTALLATION
	PARK CITY MUNICIPAL CORPORATION



NOTES:

1. Sanitary sewer lines may vary from the location shown. In no case shall the sanitary sewer or lateral be layed less than 10 feet from a paralleling potable water line (including service lines). All sewer lines and manholes shall be installed at a minimum of 4 feet from the edge of all curbs and gutters wherever possible. Sanitary sewer shall be installed on the downhill side of the street.

2. When a sanitary sewer and a water line cross, the top of the sanitary sewer shall be no less than 18 inches below the bottom of the water line. See Section 12.2 of Utah's Public Drinking Water Regulations (in appendix) for additional requirements when this cannot be accomplished.

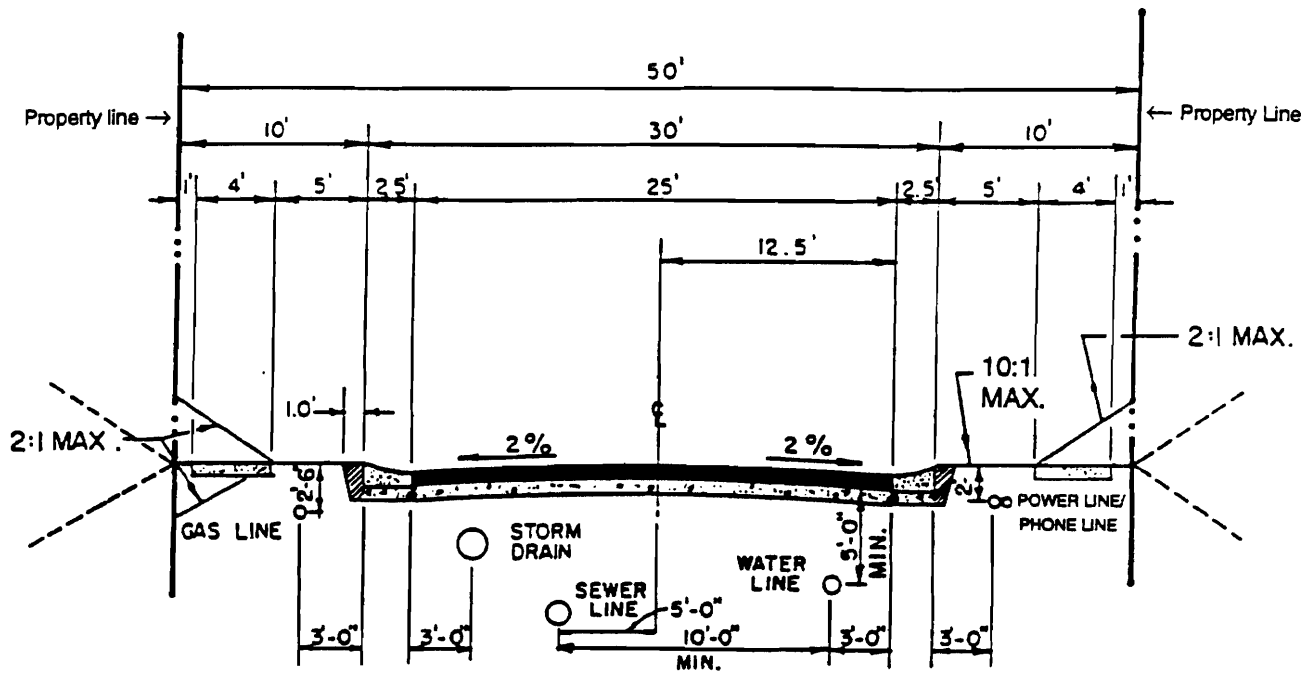
3. Water valves and fire hydrants shall be located as approved by the City (5 foot minimum separation between water line and any other utility).

4. No water line smaller than 8-inch diameter shall be installed without approval of the City Engineer. No water connection shall be made without approval of the Public Works Director.

5. Sidewalk on both sides of the street may be required by the City.

STANDARD DRAWING 800-A	TYPICAL INTERSECTION LOCATIONS FOR UTILITIES
	PARK CITY MUNICIPAL CORPORATION

RIGHT OF WAY GRADING SECTION



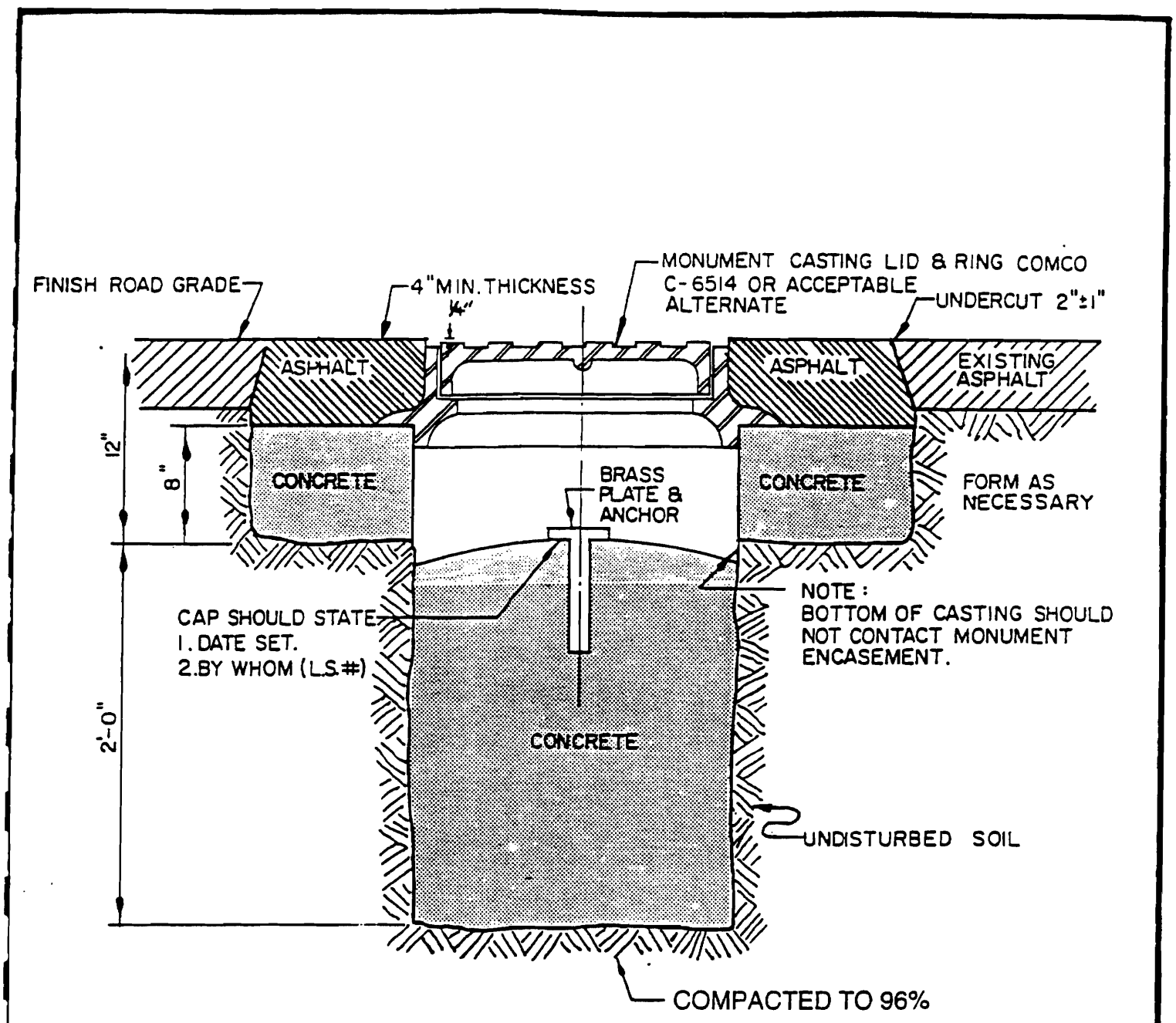
TYPICAL STREET SECTION

NOTE: WATER LINE TO BE LOCATED ON THE NORTH & EAST SIDE OF STREETS. GAS LINE TO BE LOCATED ON THE SOUTH & WEST SIDE OF STREETS OR WHERE DESIGNATED BY THE CITY ENGINEER AND/OR THE DIRECTOR OF PUBLIC WORKS

PAVEMENT SECTION TO BE DESIGNED BY A PROFESSIONAL CIVIL ENGINEER.

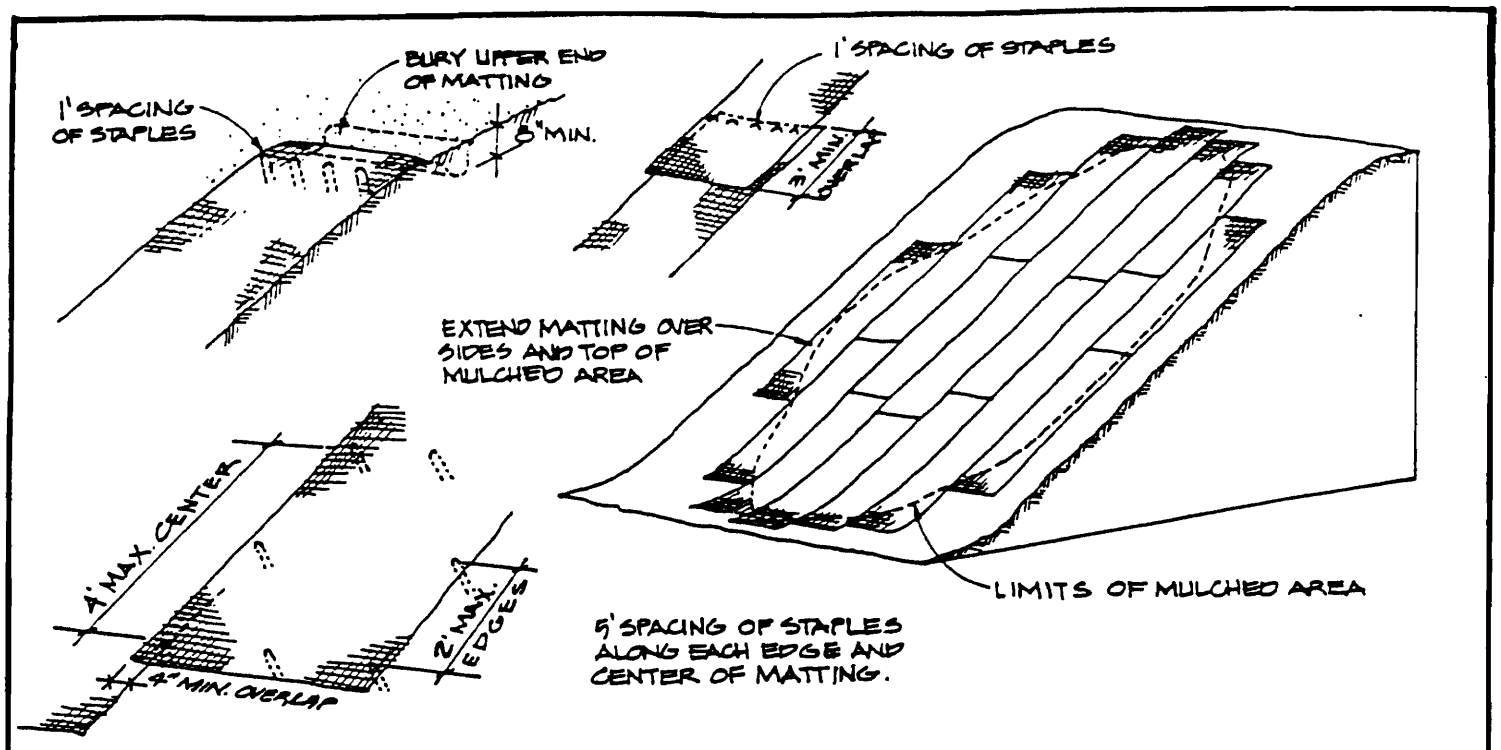
Revised: 5/95

STANDARD DRAWING 800-B	STREET SECTIONS
EDITED BY: T. FRED ASAY CHECKED BY: ERIC W. DEHAAN	PARK CITY MUNICIPAL CORPORATION



NOTE:
CASTINGS, CAST IRON PIPE, BRASS PLATE AND ANCHOR TO BE FURNISHED AND INSTALLED BY THE DEVELOPER UNDER CITY SUPERVISION.

STANDARD DRAWING 800-C	STANDARD CITY STREET MONUMENT
	PARK CITY MUNICIPAL CORPORATION

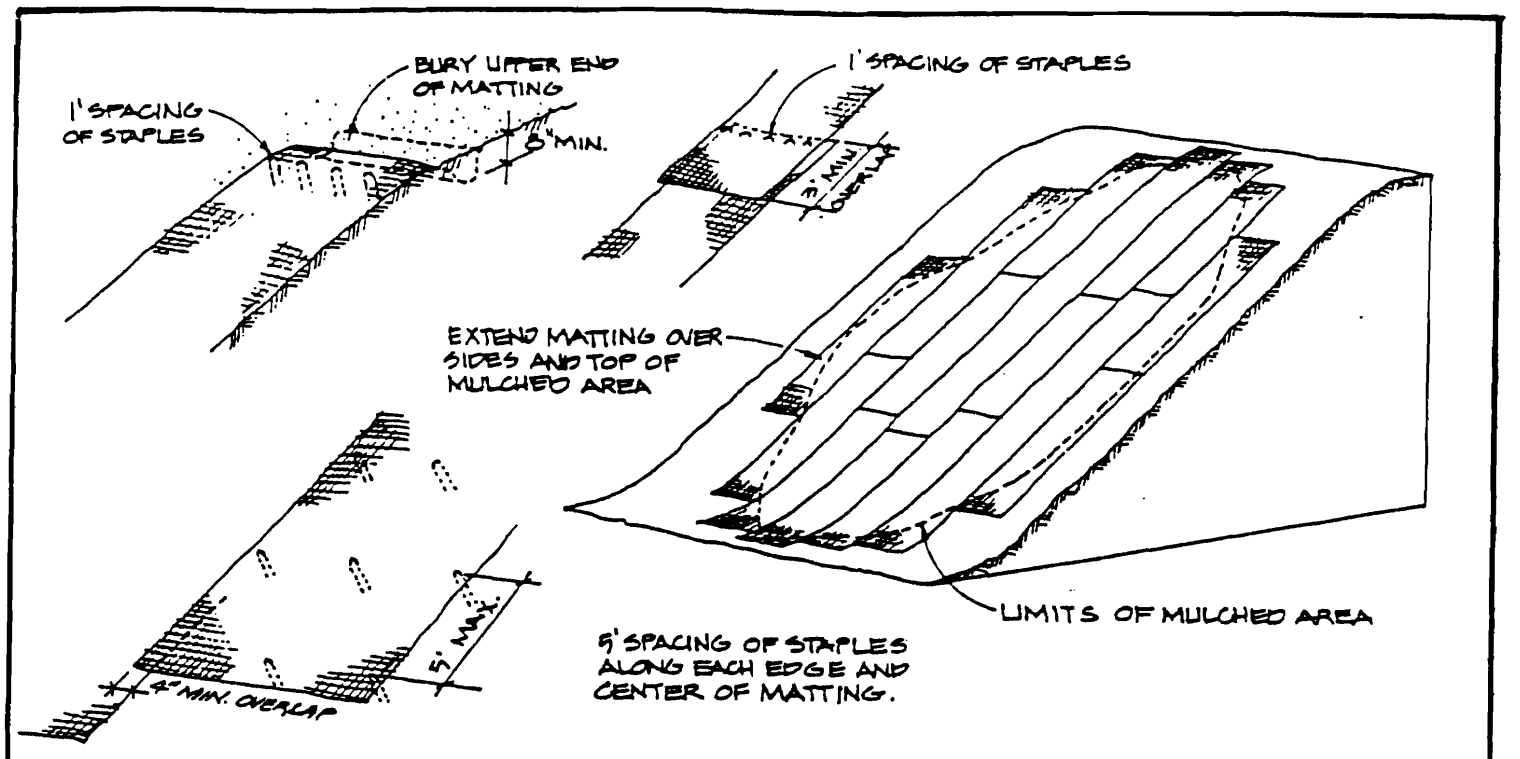


The soil must be reasonably smooth. Gullies and rills must be filled and compacted. Rocks or other obstructions which rise above the level of the soil or mulch must be removed.

Due to the difficulty of placing wood excelsior matting and its less predictable results in controlling erosion, jute matting is preferred.

- Excelsior blankets shall consist of machine-produced mats or curled wood excelsior, 80 percent of which have an 8-inch or longer fiber length. It shall be of consistent thickness with the fiber evenly distributed over the entire area of the blanket. The top side of each blanket shall be covered with a 3-inch by 1-inch weave of twisted Kraft paper or biodegradable plastic mesh that has a high wet strength. Blankets shall be fire and smolder resistant and contain no chemical additives. Blankets shall be in 3-foot by 150-foot rolls or in 4-foot by 180-foot rolls.
- If the wood excelsior mat is to be applied without other mulches, the minimum thickness of mat shall be 1½ inches.
- If the wood excelsior mat is to be applied over other mulches, the minimum thickness shall be ½-inch.
- After site preparation and seeding (if any), the rolls of wood excelsior matting shall be rolled onto the surface from the top of the slope to the bottom of the slope, never along the contour.
- The upper end of each blanket shall be buried in a trench at least 8 inches deep, and the trench shall be backfilled and tamped.
- Staples shall be applied at 2 feet on center along the sides of the blanket and 4 feet on center along the center of the blanket.
- Blankets placed side-to-side shall be snugly butted together to prevent rilling and gullying along the joint.
- Blankets placed end-to-end shall be overlapped. The top of the lower blanket shall be placed in an 8-inch deep trench which shall then be backfilled and tamped. The lower end of the upper blanket shall be overlapped onto the lower blanket, and staples shall be placed through both blankets.
- Staples shall be of heavy gauge wire, 0.091 inches in diameter or greater, which have been bent into a "U" shape, with legs at least 8 inches long, and a 1-inch crown. Longer staples are required in loose or sandy soil.

STANDARD DRAWING 901	EXCELSIOR MAT INSTALLATION
	PARK CITY MUNICIPAL CORPORATION

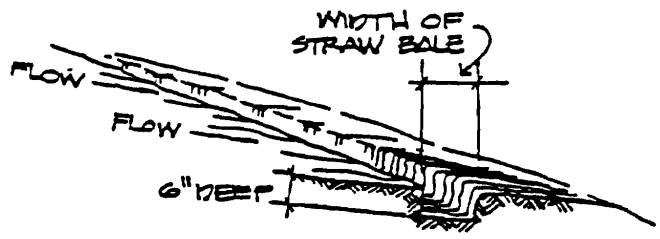


- Jute mat shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 inches in width plus or minus 1 inch and weighing an average 1.2 pounds per linear yard of cloth with a tolerance of plus or minus 5 percent, with approximately 78 warp ends per width of cloth and 41 weft ends per linear yard of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than 1/2 of its normal diameter.
- Individual rolls should be applied up and down the slope, never along the contour.
- Sides of rolls shall overlap at least 4 inches, and rolls shall have at least a 3-foot overlap when an uphill roll joins to a downhill roll. The uphill roll shall overlie the downhill roll.
- Staples shall be made of wire, 0.091 inches in diameter or greater, "U" shaped with legs at least 6 inches in length and a 1-inch crown. Longer staples are required in loose or sandy soils.
- Staples shall be driven perpendicularly into the slope face, and shall be spaced approximately 5 feet apart down the sides and center of the roll. Spacing between staples at the upper end of a roll or at the end overlap of two rolls shall not exceed 1 foot.
- Matting shall be continued beyond the edge of the mulched or seeded area at least 1 foot at the sides and 3 feet at the top and bottom of the area. If existing vegetation or structures mark the boundaries of the area, the matting shall be continued into the stable vegetated area or to the edge of the structure.
- The upper end of the matting at the top of the area shall be buried in a trench at least 8 inches deep.
- The matting shall make uniform contact with the slope face underneath. No "bridging" of rills or gullies is allowed.

STANDARD DRAWING 902	JUTE MESH INSTALLATION
	PARK CITY MUNICIPAL CORPORATION

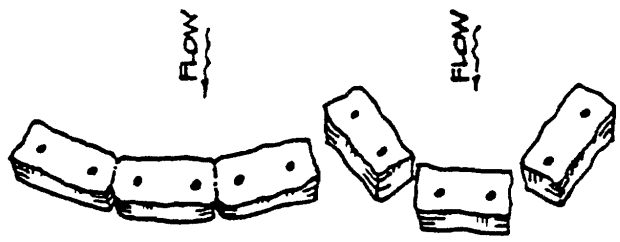
MATERIALS:

- STRAW BALES BOUND WITH WIRE OR TWINE.
- WOOD OR STEEL STAKES 4' LONG MIN. (2"x2" WOOD, RE-BAR OR STEEL PICKETS, 2 STAKES PER BALE).

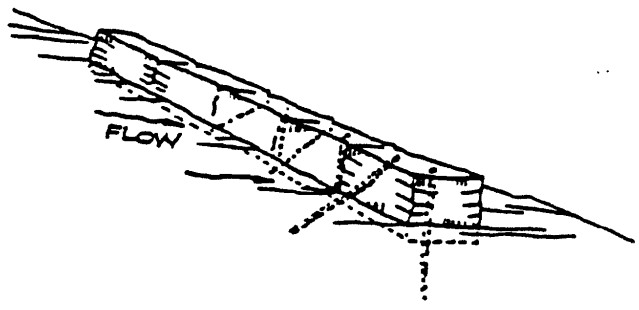


1. DIG A 6" X 2' TRENCH. ALIGN TRENCH ALONG CONTOUR BUT CURVED SLIGHTLY UPHILL SO RUNOFF CANNOT ESCAPE AROUND THE END BALES (SEE (2.) BELOW)

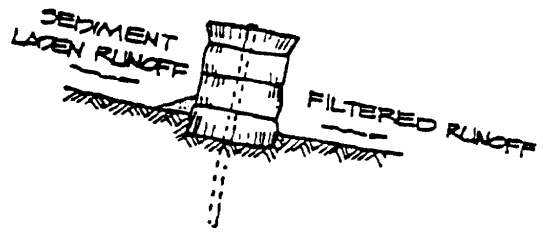
2. PLACE BALES IN TRENCH WITH ENDS TIGHTLY ABUTTED.



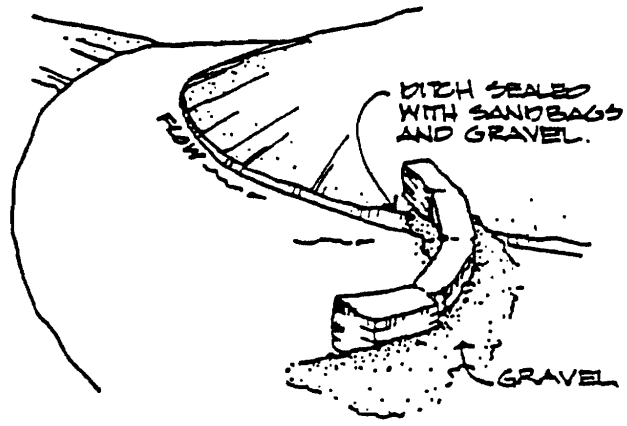
3. ANCHOR EACH BALE WITH 2 STAKES HAMMERED 1½' TO 2' INTO GROUND. ANGLE FIRST STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE.



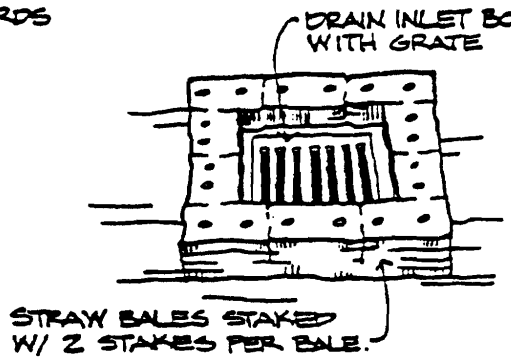
4. WEDGE LOOSE STRAW BETWEEN BALES. BACKFILL AND COMPACT THE EXCAVATED SOIL AGAINST THE UPHILL SIDE OF BARRIER.



WHEN INSTALLING BALES ON PAVEMT, FILE GRAVEL OR ROCK BEHIND THE BALES TO HOLD THEM IN PLACE



- INSPECT PERIODICALLY AND AFTER EACH STORM. REPLACE DAMAGED BALES; RE-ANCHOR DISPLACED ONES.
- CLEAN OUT SEDIMENT BEFORE IT REACHES THE TOP OF BALES.
- DEPOSIT THE SEDIMENT WHERE IT WILL NOT ENTER A DRAINAGE WAY.



STRAW BALE / DRAIN INLET SEDIMENT FILTER

STANDARD DRAWING 903	STRAW BALE INSTALLATION FOR EROSION CONTROL
	PARK CITY MUNICIPAL CORPORATION

CITY ENGINEER'S OFFICE

To schedule an appointment or an inspection

TWO WORKING DAYS IN ADVANCE

(435) 615-5077

Notes:

PARK CITY, UTAH
DESIGN STANDARDS
CONSTRUCTION SPECIFICATIONS
AND
STANDARD DRAWINGS

APRIL 2007 EDITION

THE OFFICE OF THE CITY ENGINEER
PARK CITY MUNICIPAL CORPORATION
PARK CITY, UTAH 84060

Edited by: Eric Anderson
Approved by: Eric W. DeHaan, M.S., P.E.