DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS

For Construction in the Right-of-way & Connections to Public Utilities

(AKA "ROW Specifications")

PUBLIC WORKS DEPARTMENT
TOWN OF TELLURIDE, COLORADO

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PREFACE

This document, *Design Standards and Construction Specifications for Construction in the Right-of-way & Connections to Public Utilities,* has been promulgated by the Town based on input from local developers and contractors, Town of Telluride staff, the Planning and Zoning Commission, the Historic and Architectural Commission, the Town Council and others. Numerous public meetings were held prior to its adoption. These standards have been developed to provide for the orderly construction of those aspects of development typically referred to as "public improvements", e.g. water and sewer lines, curb and gutter, drainage, surfacing and paving, etc. It is also intended to provide for the orderly construction of those aspects of development that must occur in public right-of-ways. It is hoped that these standards will provide consistent quality construction of public improvements and connections to public systems throughout the community, and that they will serve as a useful tool for developers. This document should be used together with the Telluride's *Manual of Streetscape Standards (April 2007)*, where appropriate. (Reference: Telluride Municipal Code (TMC) §15-12)

The Town of Telluride's *Design Standards and Construction Specifications for Construction in the Right-of-way & Connections to Public Utilities* were adopted by ordinance to apply to all development and redevelopment that has a responsibility for public improvements, as well as a responsibility in connecting to public systems such as water, wastewater, stormwater, and roadways.

These standards and specifications are enforced in the same manner as the International Building Code; that is, the code is enforced by designated enforcement officials. The right to inspect and issue stop orders has been delegated to these officials. The adopting ordinance provides for code flexibility by allowing alternate materials and means of construction under appropriate circumstances. Finally, a property owner may appeal a decision or interpretation of an enforcement official to the board of adjustment/appeals.

Please remember, these standards and specifications are law and enforceable through fines and penalties under the Telluride Land Use Code (TLC) §1-303.A.

RIGHT OF WAY & UTILITY DESIGN STANDARDS

Section 00 - GENERAL DESIGN CRITERIA

INTENT

The Town of Telluride, by its adoption of these *Design Standards and Construction Specifications for Construction in the Right-of-way & Connections to Public Utilities*, intends that the Design Standards be used by the Developer and his Engineer/Architect in the design of the project and encourages the Construction Specifications to be included in the Contract Documents executed by and between the Developer and Contractor. Whether they are so used is at the discretion of the Developer, however, the Town will not accept the improvements provided by the Developer unless and until they conform to the requirements of these Standards and Specifications.

The terms “Owner,” "Contractor” and” Developer” are herein referred to as “Applicant” for the purposes of this document. An Applicant is someone who proposes to construct a connection to public systems (e.g., water, wastewater, roadways) for private use, and/or to construct and dedicate for public use improvements or additions to the Town's systems, “Public Works Representative” shall mean the Public Works Director or his/her designee.

The Standards and Specifications contained in this Document are considered to be a baseline. If conflicts exist between this Document and other Local, State, or Federal requirements, the more stringent requirement shall apply.

DESIGN CALCULATIONS

The Developer shall submit, for review, final design calculations for his proposed project to show that the design meets the minimum requirements contained in these Standards and Specifications. Submittal of the design calculations shall coincide with the submittal of the Project Drawings. Design calculations shall include the Engineer’s Seal, as required by State Statute. Review of the Project Drawings will not commence until receipt of the design calculations. The design calculations shall be submitted with the Project Drawings along with the Engineers Seal, as required by State Statute.

The Town Council and Planning and Zoning Commission reserve the right to require additional design calculations, certificates, affidavits, endorsements, dedications or data, as may be required to enforce these Standards and Specifications.

PROJECT DRAWINGS

All project drawings of proposed improvements or additions, which are to be submitted for approval in accordance with the provisions of this Document, shall be submitted to the Town in at least one of the following formats. A representative of the Public Works Department will specify which format is most useful and appropriate on a case-by-case basis.

(a) On sheets having overall dimensions of 24 inches in height by 36 inches in width and drawn to the scales required herein-after.
(b) On sheets having overall dimensions of 11 inches in height by 17 inches in width and drawn to the scales required herein-after.
(c) In an electronic format that can be read by the Town’s computer system.

It is the intent of this requirement to standardize Public Works’ records and facilitate its operation and maintenance programs.

The project drawings shall contain a note thereon that all materials and construction methods employed shall be in accordance with the latest adopted *Design Standards and Construction Specifications for Construction in the Right-of-way & Connections to Public Utilities* of the Town of Telluride.

The project drawings shall include thereon the following general items:

(a) Name of the Design Engineer.
(b) Name of the Project.
(c) Name and address of each Owner.
(d) Date.
(e) Engineer and/or Surveyor Certificate and signature.
(f) Scale(s) and North arrow(s). (Note: Scales to be written and graphic.)
(g) Deed or plat references for the project land and adjoining lands.
(h) Existing zoning classifications.
(i) Revision dates, if applicable.
(j) A location plan showing the general location of the project with respect to the Town and major streets and highways. No particular scale is required.

Plan Views

In the event that a project cannot be shown in plan view on a 24" x 36" sheet at a scale of 1" = 40', then an index map at a smaller scale (i.e.. 1" = 400') shall be provided showing the entire project on a 24" x 36" sheet. On small projects a 1" = 20' or a 1" = 10' scale is acceptable.

The index map shall reference the drawing number that shows the applicable portion of the project on a 24" x 36" sheet at a scale of 1" = 40' or 1" = 20', whichever is applicable.

In addition to the general items required, all plan views shall be drawn to a scale of 1" = 40' or 1" = 20', whichever is applicable.

Other scales may be approved in writing by a Public Works Representative

Profile Views

All profile views shall be drawn to a scale of 1" = 40' horizontal and 1" = 5' vertical on 24" x 36" sheets. All elevations shall be based on the United States Geological Survey Datum. A 1" = 20' horizontal scale may be used for small projects.

FINAL CONSTRUCTION DRAWINGS

Construction “Drawings” or “Plans” for all proposed improvements shall be required. Concurrent with Construction Drawings submittal, evidence shall be provided to show that all applicable Local, State, and Federal permits have been obtained.

Final Construction Drawings shall include the following:

(a) A composite development plan on a single plan sheet showing the following:

(1) Soil boring logs and groundwater elevations throughout the development.
(2) Locations of soil boring test holes.
(3) Overlot drainage pattern and lot corner elevations for each lot.
(4) A finished first floor elevation for each lot that facilitates proper site drainage and access to sanitary sewer service.
(5) Sanitary sewer tap elevation for each lot.
(6) Those lots that will be restricted in basement construction due to groundwater, drainage or soils conditions.

(7) The plan view layout of all lot lines, containing the number of square feet for each lot, water, sanitary sewer, curb lines and storm water management systems, and demonstrating the street drainage pattern.
(8) Typical section view of basement and crawl space construction showing relative elevations of curb, sanitary sewer, sewer service line, footer clearance, tap, and front of lot drainage.
(9) Any ditches, existing utility lines, drainages, required retaining walls, or other factors that will influence the development.

(b) Water system plans shall be in compliance with Colorado Department of Public Health and Environment (CDPHE) standards, Town of Telluride Cross-Connection Control Plan and the International Fire Code, latest adopted revision.

Minimum information shown on the plans shall include: stationing of all service taps, valves, fittings, fire hydrant assemblies, line junctions, property lines or lot lines and other system appurtenances with respect to all property lines, easement lines, street curb or edge of surfacing, and other planned or existing utilities and structures. Calculations of available pressure head shall be provided for the highest point in the system to demonstrate adequate available pressure (60 psi. recommended, 40 psi minimum).

When special permits are necessary to extend or expand the domestic water system, the permit will be obtained by and in the name of the Town. Until all permits have been obtained, no construction shall begin, nor will final construction drawings be approved, nor will a final plat be signed by Town Council

(c) Sewer system plans shall be in compliance with CDPHE standards.

Minimum information shown on the plan view shall be stationing and location of all manholes and service taps, lot lines, easement lines, existing or planned utilities and structures. The plan view shall also show right-of-way and easement widths, the location of the line with respect to curb or edge of pavement and right-of-way lines as well as the angular deflection at all changes of direction of the line. Profile view shall show all manhole flow line elevations; rim elevations and stationing; the length, slope and pipe size and pipe material between manholes, as well as finished and existing ground lines. Calculations of pipe capacity and velocities shall be provided for the service area.

At least one (1) reference bench mark shall be provided for each 800 feet of sewer line. The elevation location and description of each bench mark shall be shown on the plans.

For wastewater extensions to Town systems, all permits shall be in the name of the Town. Public Works may assist in applying for wastewater permits, but the responsibility for obtaining such permits rests with the Developer.

(d) Stormwater management plans shall show all elements of the stormwater management system for each lot and how the overall system works with finished street elevations. Calculations of pre-construction and post-construction runoff rates and volumes will be required to demonstrate that changes in the rate and volume of runoff due to development have been entirely mitigated on site. The Town will consider alternative approaches to managing runoff on a case-by-case basis, but only after the Applicant clearly demonstrates that s/he has minimized runoff to the greatest extent possible.

All stormwater management systems shall provide plan and profile drawings that show, according to the design, manhole and curb inlet locations, flow line elevations, all pipe sizes, types, lengths, and slopes and the finished street elevation at the outlet, in addition to the other requirements of (c) above. Infiltration galleries shall specify surface topography, infiltration media type, dimensions, and overflow path.

(d) Street plan and profile drawings showing the green space, drainage swale, and/or curb profile for each side of the street. Street names and lot line locations shall be shown on all plan views. If sidewalks are proposed, plan view shall show sidewalk location, width, degree of cross-slope, and degree of longitudinal slope. Final Construction Drawing submittals on existing Town streets that are part of Telluride's Manual of Streetscape Standards should conform in all aspects to the street plan and profile elements that have been approved and adopted.

- One typical section view of the planned street shall also be shown, and shall include locations of all utilities in relation to each other.

- Street travel way and parking width and treatment type shall be clearly shown.

- Each curb profile shall give stationing, top of curb elevations; vertical curve beginning, mid and end points, stationing and elevations, slope and existing ground line profile. Plan and profile views shall show curb return, curve P.C. and P.T. stations and elevations. Plan view shall show back of curb to back of curb width. Horizontal curve data at curb line shall show on the plans. One typical section view of the planned street shall also be shown, and shall include locations of all utilities in relation to each other. Bench mark references shall be provided as described on (c) above.

- Each drainage swale profile shall give stationing, bottom of swale and top of swale elevations; vertical curve beginning, mid and end points, stationing and elevations, slope and existing ground line profile. Horizontal curve data at curb line shall show on the plans. Bench mark references shall be provided as described on (c) above.

- All street designs shall meet applicable ADA (Americans with Disability Act) requirements when possible. If ADA requirements cannot be met due to site constraints, the Engineer must clearly document as a note on the designs the reason(s) why.

A copy of the filing plat should be included with the construction drawings for reference.

All of the above drawings shall be signed and stamped by a Professional Engineer, in good standing, licensed to practice in the State of Colorado.

Section 01 - MINIMUM DESIGN STANDARDS FOR SANITARY SEWER SYSTEMS

Reference: Telluride Municipal Code Chapter 13 Municipal Utilities

DESIGN FLOW

The design shall include the sizing and installation of trunk sewers for providing service to the entire area tributary to the outfall point. Estimates of residential sewage contribution shall be based on 75 gallons per capita per day with a peak hour factor of 4.0 for lateral sewer design and 2.5 for trunk sewer design. Population density shall be based upon 3.5 persons per dwelling unit. Dwelling unit density shall be based upon actual density planned for the development. Alternate per capita flow contributions and population densities may be considered provided that supportive engineering data is presented to substantiate the figures used. Institutional, commercial, and industrial sewage contribution estimates shall be reviewed with the Public Works Representative.

HYDRAULIC DESIGN

Sewers 10 inches in diameter and smaller shall carry the peak hour design flow at a maximum flow depth of 80% of the pipe diameter calculated using a Manning 'n' value of 0.013. Trunk sewers 12 inches in diameter and larger shall be designed to flow half full at the peak hour design flow rate. The minimum velocity at the peak hour design flow rate shall be 2.0 feet per second. Where actual flow will be much below normal for several years, the minimum velocity shall be achieved by suitable grades at the partial design flow rate. Care shall be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow. Maximum allowable velocity shall not exceed 10 feet per second unless special provisions are made to protect against displacement by erosion and shock.

DESIGN DETAILS

Sanitary sewer mains shall be 8 inches in diameter or larger. Service connections shall be 4 inches in diameter or larger. The design of all sewer lines shall comply in every way with CDPHE regulations. Tracer lines are recommended but not required. The following minimum grades shall apply. Pipe design shall be checked to ensure the minimum velocity is achieved for the peak hour design flow at the design grade. If actual flow will be much below peak hour design for several years; then a flow rate of 2.0 feet per second shall be achieved by suitable grades at the partial design flow rate.

TABLE 01-1. Maximum and Minimum Grades and Minimum Length of Vertical Curves for all Street Designs.

Sewer Diameter	Minimum Grade (Percent)
4 inches	2.0 or ¼ inch per foot
6 inches	0.64
8 inches	0.40
10 inches	0.29
12 inches	0.23
15 inches or larger	Min. velocity of 2 ft/sec

Manholes shall be provided at every change in direction, grade, size, dead-ends and at all intersections with other sewer mains; maximum spacing shall be 400 feet for lines 15 inches or smaller, or 500 feet for lines 18 inches and larger. Maximum change of direction in manholes for lines 18 inches and larger shall be 45 degrees. Sewer lines shall be straight and not curved between manholes, both in line and grade. Drop manholes will not be allowed, except by approval of the Public Works Representative.

In general, sewer mains shall have a minimum of 8 feet of cover between top of pipe and finished ground surface. Where this will provide less than 9 feet of elevation difference between the finished lot grade at building line and the top of the sewer main, it shall be indicated on the plans that the lot is served by a "shallow sewer" and appropriate elevation information shall be given. Where shallower sewers are approved, a minimum cover of 5 feet is required unless special procedures for insulation are approved by the Public Works Representative.

Sewer mains shall be extended to a point at least 15 feet uphill from the lowest lot corner adjacent to the sewer main of the uppermost lot to be served and terminate in a manhole. Four-inch diameter service connections shall not be made at manholes, but shall be provided between manholes as required unless approved by the Town Representative. Manholes shall be stubbed out with suitable size pipe and plugged and marked (record location to be filed with the Public Works Department) wherever future lateral extension of the sewer is anticipated.

Locate sanitary sewer mains in the street centerline. Mains in easements or alleys shall ordinarily be located in the center of the easement or alley. When sanitary sewer mains are placed along back lot lines, they shall be located in a manner that provides access for maintenance crews.

SERVICE CONNECTIONS

Minimum pipe size for services shall be 4 inches in diameter. Full body wyes shall be provided on the sewer main for service connections at each lot or building site and the service line extended to the lot line, and shall be shown on the plans. Service lines shall ordinarily be located at a minimum depth of 5 feet below the centerline of the lot and the designer shall demonstrate that gravity service can be achieved to the low point on the lot. Fittings shall be angled upwards so that the upper invert of a $1/8^{th}$ bend connected to the fitting will have an elevation equal to or higher than the inside crown of the sewer main. Manholes shall be used for service connections 6 inches in diameter and larger.

Each separate structure must have an individual sewer tap and service line unless a shared line is approved by the Public Works Representative in writing.

Section 02 - MINIMUM DESIGN STANDARDS FOR WATER DISTRIBUTION SYSTEM

Reference: Telluride Municipal Code Chapter 13 Municipal Utilities

GENERAL

The design of the water distribution system shall be based on the requirements of the Colorado Department of Public Health and Environment (CDPHE) and the Town of Telluride.

The Town reserves the right to require the Applicant to submit, for review, all calculations for flow and pressure requirements for the proposed system. The system shall comply with CDPHE standards, the International Fire Code, latest revision, and Town of Telluride specifications.

PIPE SIZE AND SPACING

The design shall include the sizing and installation of water transmission lines required to provide service to potential future development outside the limits of the planned project.

Distribution mains shall be a minimum of 6-inch pipe where the length of the main between branches is less than 800 feet; otherwise a minimum of 8-inch pipe shall be used. All piping shall be looped wherever possible. Where approved by the Public Works Representative, however, dead ends may be provided on cul-de-sacs less than 300 feet long with a permanent blow-off or fire hydrant at the dead-end. Dead-ends on any line that will be tapped for service shall be provided with a temporary blow-off or fire hydrant before being extended. Dead-ends on lines that will not be extended shall be provided with permanent blow-offs or fire hydrants. All properties to be served water shall have a main adjacent to the property.

In general, water mains shall have a minimum of 7 feet of cover between top of pipe and finished ground surface.

VALVE SPACING

Gate valves on all mains shall be placed so that the no more than 800 feet of line will be out of service at one time. Valves shall also be placed at each fire hydrant and permanent blow-off. Typically, every tee at an intersection will have valves at each branch to allow for the least number of homes being out of service at one time.

FIRE HYDRANTS

Fire hydrants shall be placed no more than 300 feet apart, as measured within the right-of-way, so that each hydrant is easily accessible to fire fighting equipment. In general, locate fire hydrants on street corners. The minimum allowable pipe sizes delivering water to fire hydrants shall be a 6-inch diameter line on a looped network, or an 8-inch diameter line on a dead-end system. Design calculations shall be submitted to demonstrate flow and residual pressure at each fire hydrant during a maximum day demand meets Fire Department requirements.

WATER MAIN LOCATION

Locate water mains in the <u>east or north side</u> of streets, no more than 3 feet or less than 2 feet west or south, respectively, from the edge of asphalt.

In all instances, the water mains shall extend to the extremities of the property or subdivision served or to the extremities of the street or road improvements, whichever is greater. A main serving one lot shall

extend all the way across the frontage for that lot. Mains serving a subdivision shall extend to the center of boundary streets or to boundary lines.

SERVICE CONNECTIONS

Each separate structure must have its own water tap and service line. Separately-owned units within a building must have individual shut offs and meters.

Water service lines shall be located 5 feet off of lot center-line, on the high side of the lot, with a minimum of 10 feet of separation (outside of pipe to outside of pipe) on the horizontal plane from the sanitary sewer service line. Tracer lines are recommended but not required.

Service stub-ins for residential installations shall terminate with a curb stop at the property line. The curb stop shall not be located in a sidewalk, driveway or parking area without prior approval by the Public Works Representative. Meter and yoke shall be located inside buildings with the remote reader on an outside wall designated by the Public Works Representative.

WATER METERS

A separate (SENSUS SRII or Metron-Farnier) water meter is required for each unit in a development. Meters shall be the type and model designated by the Public Works Representative and installed in compliance with the International Plumbing Code adopted by the Town (TMC§15-5). Meters shall have data transmitter devices (MXU's) which are compatible with the Invensys Radio Read System (IRRS) and may be purchased from the Town to ensure uniformity of installation and design. A meter's data transmitter device (MXU) shall be located on the exterior of the premises to allow unfettered and safe access for remote reading, removal, inspection, repair, maintenance and replacement. Meters shall be inspected and approved for operation by the Public Works Representative upon installation. Water meter specifications are provided in Section 02550 of this document. (Reference: TMC§13-1-120 and TMC§13-1-130.)

BACKFLOW PREVENTION DEVICES

An approved backflow prevention device(s) shall be installed in all buildings, structures or premises in which plumbing is installed. The backflow prevention device must be certified by the University of Southern California, Foundation for Cross-Connection Control and Hydraulic Research (USC FCCCHR) or the American Society of Sanitary Engineers (ASSE). The owner of the premises shall notify the Public Works Representative of all backflow prevention devices that are installed on the premises. The backflow prevention device shall be installed immediately inside the premises being serviced before the first branch line leading off the service line. Backflow prevention devices shall be of a model and size approved by the Public Works Representative. Backflow prevention devices shall be inspected and tested immediately upon installation and annually thereafter by a certified inspector and/or tester. The owner shall inform the Town in writing within 10 days of the results of the inspection and test. Backflow prevention device specifications are provided in Colorado Cross-Connection and Control Manual, 5th edition and in Section 02550 of this document. (Reference: TMC§13-3-110 and TMC§13-4.)

MATERIAL ADDITIONS

The Town reserves the right to require the addition of valves/hydrants, and other appurtenances by the Developer or Owner up until the time of trench backfill placement for the water construction project.

Section 03 - MINIMUM DESIGN STANDARDS FOR STREET CONSTRUCTION

References: Telluride Municipal Code Chapter 11 Streets, Sidewalks, and Public Places, Telluride Land Use Code Chapter 13 Division 3 Street and Utility Design Requirements

GENERAL

All curb, gutter, sidewalk, rights-of-way widths and street widths shall conform to the requirements of the Standard Drawings at the end of this section for new development or development in rights-of-way that are not specified in the Manual of Streetscape Standards. Care shall be taken to ensure continuity of grades, widths, etc., of proposed, existing and future installations.

GEOMETRICS

Grades

The following shall be the maximum and minimum grades and minimum length of vertical curves for all street designs. See Table 03-1 below. The Public Works Representative may permit deviations from these requirements when, in his or her judgment, terrain conditions are such that minimum or maximum grades as set forth are not feasible. Preferred minimum grade is 1 percent. Absolute minimum grade permitted shall be 0.6 percent and shall be carried in continuous intervals of not less than 100 feet along the curb line. Percentage of grade along the centerline through intersections shall not exceed 4 percent. Centerline street profiles shall be extended for future construction, beyond the limits of the project being designed, for a distance of 1000 feet or to connect to an existing improved street, whichever is less.

TABLE 03-1. Maximum and Minimum Grades and Minimum Length of Vertical Curves for all Street Designs.

	Maximum grade (percent)		Minimum grade (percent)	Minimum vertical curve length* (whichever is greater)
	Normal	Hillside		
Arterial street	5.0	7.0	0.4	100 ft or 100 ft/percent algebraic difference in grade change
Collector street	6.0	8.0	0.4	100 ft or 50 ft/percent algebraic difference in grade change
Residential, cul-de-sac and marginal access streets	10.0	12	0.4	60 ft or 50 ft/percent algebraic difference in grade change

* Where algebraic change in grades is less than one-half of one percent, vertical curves may be omitted.

Intersections

Intersections shall approximate right angles as closely as possible. Not more than 2 streets shall intersect at any one point.

Proposed new intersections along one side of an existing street shall coincide with an existing intersection on the opposite side of the street. Two streets meeting a third street from opposite sides shall meet at the same point or their centerlines shall be offset a minimum of 150 feet.

Cul-de-sacs shall not exceed 400 feet in length and surface drainage shall be either toward the intersecting street or toward an engineered detention, retention, or infiltration system. If neither of these alternatives is feasible, a drainage easement shall be provided through abutting lots to an approved drainage system. No on-street parking or driveways shall be allowed within 20 feet of the beginning of the curb radii at the approach to any intersection. For 25-foot wide lots being developed as a single unit, a driveway may be permitted adjacent to property line farthest from intersection.

Horizontal Curves

The following shall be minimum horizontal curve radii for all street designs. See Table 03-2 below. The Public Works Representative may permit deviation from these requirements when, in his or her judgment, conditions warrant such deviation.

TABLE 03-2. Minimum Horizontal Curve Radii for all Street Designs.

	Minimum Radius		
Curve Type	Residential	Collector	Arterial
Street centerline	150	275	400
Curb return	15	25	30
Drainage swale	10	20	25

Minimum cul-de-sac radius shall be 45 feet to the inside edge of curb and gutter and a right-of-way radius of at least 60 feet, unless special provisions for snow storage are provided. Curb returns for areas currently developed in Town may conform to historic standards.

Right-of-Way

Street right-of-way must be sufficient to accommodate vehicular traffic; pedestrians; all public utilities; on-street parking where provided; and in some cases bicycles, special storm drainage facilities, snow storage, or other special treatments such as medians, traffic channelization, or traffic calming devices.

In accordance with the street standards for all public ways hereafter dedicated and accepted, the minimum right-of-way widths for streets, alleys or pedestrian ways included in any subdivision shall not be less than the minimum dimensions for each classification, as shown in Table 03-3, or as otherwise specified in the Land Use Code, or as approved by the Planning and Zoning Commission through the Subdivision or Planned Unit Development process.

TABLE 03-3. Minimum Right-of-Way Widths for all New Street Designs.

Type	Local Example of Type (NOTE: Actual ROW widths may not comply with preferred standard)	Design Speed (mph)	Capacity Average Daily Traffic (ADT)	Minimum R.O.W. Width Standard
Major arterial (limited access)	Highway 145 Spur	35	8000 and up	≥100 feet
Minor arterial	W. Colorado Ave.	25	3500 - 8000	80 – 100 feet
Collector	E. Colorado Ave.	25	1500 - 3500	60 feet
Local	Pine Street	15	up to 1500	50 feet
Marginal access	Gregory Ave.	15	up to1000	40 feet
Cul-de-sac	Sunset Ridge Drive	15	up to 1000	65 foot radius
Alley		10		15 feet

Type	Local Example of Type (NOTE: Actual ROW widths may not comply with preferred standard)	Design Speed (mph)	Capacity Average Daily Traffic (ADT)	Minimum R.O.W. Width Standard
Bicycle way				15 feet
Pedestrian way				≥ 8 feet (per below)

A drainage easement, in addition to the provided street right-of-way width, may be required where streets parallel a stream or drainage area. The Public Works Representative shall determine the width of such a drainage easement

Pavement Widths

Street pavement widths shall be in accordance with Table 03-4. Alleys shall be dealt with on a case-by-case basis. Not all alleys shall be paved. Historic character shall be a consideration when determining pavement widths. Street turn lanes provided at intersections and acceleration/deceleration lanes shall be 11 feet wide. Travel lanes shall vary with street type from 8 feet wide to 12 feet wide. Bicycle ways shall have a minimum pavement width of 8 feet. Where bicycles and pedestrian paths are combined, the minimum width is 10 feet. Variations to these requirements can only be provided by the Town Manager, as defined in the Telluride Land Use Code §1-201.G, in writing, or as otherwise specified in the Land Use Code, or as approved by the Planning and Zoning Commission through the Subdivision or Planned Unit Development process.

The dimensions of lane width, parking width, turn lane width, curb and gutter width and island width shall be followed in all cases. Variations in paving widths are given to provide flexibility, reduce costs and reduce impervious area. However, consistency within a continuous right-of-way is required. The widest paving width will be required where the following conditions exist:

a. The accumulation of traffic as the street progresses through the development increases and the street is continuous without 90 degree turns.

b. The street is anticipated to serve adjacent properties in which case it shall be sized to serve the density of future build out deve1opment.

c. The street is required to be of a certain class to fit the overall transportation plan.

Any proposed variations from the standards shown must be approved by the Town. In general, a flexible pavement shall be used; however, under certain conditions concrete roadways will be considered.

TABLE 03-4. Minimum Pavement Widths (exclusive of curb and gutter)

		Low Density		Medium Density		High Density
Street Classification	Parking Allowed?*	Level <8%	Hill ≥8%	Level <8%	Hill ≥8%	Level <8%
Major arterial	No	--	--	32 feet	32 feet	32 feet
Minor arterial	Yes	--	--	42 feet	42 feet	42 feet
Minor arterial	No	--	--	30 feet	30 feet	30 feet
Collector	Yes	38 feet	40 feet	40 feet	40 feet	40 feet
Collector	No	20 feet	24 feet	22 feet	22 feet	22 feet

Marginal access	No	20 feet	24 feet	20 feet	20 feet	20 feet
Local	Yes	18 feet	32 feet	38 feet	38 feet	38 feet
Local	No	18 feet	18 feet	20 feet	20 feet	20 feet

* Assumptions: Parking = 9-foot wide paved parking space on both sides of the street. Two-way travel

CURBS, GUTTERS, SIDEWALKS AND CROSS PANS

All curbs, gutters, sidewalks and cross pans shall conform to the Construction Standards at the end of Section 02625 - Curbs, Gutters, and Sidewalks and/or Telluride's *Manual of Streetscapes Standards (April 2007)*.

Standard combination vertical curb, gutter, and sidewalk may be installed on local residential streets with approval by the Public Works Representative. Vertical curb and gutter shall be installed on collector and arterial streets.

In areas of the Town where vertical style curb and gutter is already in use, the same style of curb and gutter and sidewalk shall be constructed.

Where sidewalks or related concrete flatwork exceeds five (5) feet in width, the historic scoring pattern shall be constructed in the concrete. The developer may submit alternative or additional proposed decorative patterns and finish requirements for written approval to the Town Manager or the Planning and Zoning Commission through the Subdivision or Planned Unit Development process. Note, however, that the Streetscape Task Force agreed that decorative patterns and finish requirements in right of way sidewalks should be discouraged to provide a more uniform and cohesive pedestrian experience along all Town sidewalks. Replacement of existing sidewalks shall conform to the neighborhood's historic patterns.

HANDICAP RAMPS

Handicap ramps that comply with applicable requirements of the Americans with Disability Act (ADA) shall be provided at all curb returns and crosswalks. Truncated domes shall be of granite in a color that contrasts with the surrounding concrete. Truncated domes shall be sunk into concrete. Construction Specifications are provided at the end of Section 02625 - Curbs, Gutters, and Sidewalk. It is recognized that innovative solutions to meeting ADA requirements may be necessary under specific circumstances in this mountain environment. If no handicap ramp is possible at a specific pedestrian crossing, the applicant must provide a written explanation of why it is not possible and where the nearest accessibility crossing is located. The Town Manager may accept an alternative equivalent product to granite truncated domes.

BUS STOPS

Bus stops shall be provided as determined by the Town Manager. The goal is to ensure basic bus stop functionality, wherever a stop is to be located. Design of bus stops shall provide continuity and a level of performance similar to Town's existing facilities.

DRAINAGE

To the greatest extent possible, all streets shall be designed to minimize the volume of runoff generated and to minimize the concentration of runoff volumes by incorporating detention and/or infiltration within the right-of-way shoulder or in parks in the right of way. Street pavement and gutter grades shall permit flow without ponding. Drainage swales and infiltration galleries may pond water for no more than 5 days. Five-foot wide concrete drainage cross pans shall typically be installed across those streets at

intersections where traffic must stop. Installation of pans between intersections or across streets carrying through traffic at intersections shall be avoided unless authorized by the Public Works Representative.

A check shall be made to ensure continuity of drainage design between the proposed construction and existing or future construction. In no case shall surface drainage be disposed of by overland dumping.

FLEXIBLE PAVEMENTS

Flexible pavement shall consist of full depth asphaltic concrete or a combination of asphaltic concrete and untreated granular base course. Alternate sections may be considered provided that supportive engineering data are presented to substantiate the design used.

Pavement thickness shall be determined for subgrade strength values determined by one of the following standardized tests:

1. California Bearing Ratio (CBR)
2. Resistance (R) Value
3. Bearing Value Determination (Plate Bearing Test)

The subgrade soil evaluation shall use recognized soils testing laboratories under the direction of a Professional Engineer. Sufficient tests shall be made to evaluate fully each different soil type within the road alignment. Samples for determining these strength values shall be taken between gutter lip lines of proposed streets at a minimum of 300-foot intervals for all new streets. Where the length of the proposed new street is less than 300 feet, a minimum of 2 samples shall be taken. After the strength values are determined from these samples, the design subgrade strength value shall be the subgrade strength value that 90% of all test values in the section are equal to or greater than. When appreciable changes in the design strength values occur for different streets throughout a subdivision, thicknesses may vary but thicknesses shall remain constant throughout each street.

METHODS OF ANALYSIS

The determination of pavement section thickness shall be made by either the procedures presented in the Asphalt Institute Manual Series No. 1 (MS-1), latest edition, Thickness Design - Asphalt Pavements for Highway and Streets, or the Colorado Department of Highways Design Manual, latest edition, Section 600, Design of Pavement Structure - 600. Pavement and roadbase materials specification shall be per the Colorado Department of Transportation guidelines for the Telluride region.

SNOW REMOVAL AND STORAGE

Every proposed public improvement shall have sufficient area or an acceptable strategy to adequately handle snow storage and removal from all impervious areas that are to be dedicated to the Town for public purpose. “Sufficient” area shall be defined as no less than 25% of the parking, drives, and sidewalk areas. Snow storage and removal activities on private lots shall not encumber public rights-of-way, principal drainage channels, sidewalks, or other private properties. As well, snow storage shall not abut historic structures in a manner that can harm the structure. The snow storage and removal plan must be submitted to the Town Manager for review and approval in writing.

For new public right of ways, the Town will consider a variety of solutions for storing snow, including:

- adjusted uphill and downhill shoulder widths in the standard-size right-of-way; and
- storage areas on public ground.

STREET LIGHTING

Section 5, Streetscape Lighting Plan, in the Manual of Streetscape Standards (April 2007), shall be followed for all street light installations in the right of way. Applicants should consult the Manual of Streetscape Standards to determine whether their project is subject to those standards. If the designs and guidelines in the Manual of Streetscape Standards differ from those in these *Design Standards and Construction Specifications for Construction in the Right-of-way & Connections to Public Utilities* , the Manual of Streetscape Standards shall prevail.

Street lighting may be required for all streets in or on the periphery of all new developments. Applicants are encouraged to use solar-power for street lighting. However, if traditional electric lighting is selected, associated underground electrical supply circuits in conduits shall be required

If street lighting is required, the Applicant shall install street lights at approximately 150-foot intervals on both sides of the street with poles centered between poles on opposite side of street and with poles at intersections.

Figures 3.3 and 3.4 are specifications for all street lighting using the "historic design". Modifications to the exact historic design for the globe portion may be considered only if the modification is necessary to accommodate a more energy efficient lighting technology, and/or a technology that directs more light to the ground and less into the sky. Figures 3.5 through 3.7 are specifications for all street lighting using the contemporary residential design. Modifications to the exact residential design for the light fixture may be considered only if the modification is necessary to accommodate a more energy efficient lighting technology.

The Applicant shall submit a proposed street lighting plan at the time of subrnittal of composite utility and roadway plan. This plan will be reviewed by the Public Works Representative. The Town will determine the size of the illuminary. The developer will provide the cast iron lighting post, head adapter, globe and light fixture from a supplier approved by the Town.

STREET FURNITURE

Limited street furniture, such as benches, tables, kosks, art or other "furniture," may be allowed on public sidewalks. Tables, kiosks, art, bike racks, or other "furniture" shall be determined on a case-by-case basis by the Town Manager with recommendations from Town Staff, or as otherwise specified in the Land Use Code, or as approved by the Planning and Zoning Commission through the Subdivision or Planned Unit Development process. Bench dimensions shall be limited to no more than 75 inches long, 32 inches high, 16 inches from ground to top of the seat, and 24 inches deep/wide. The *Manual of Streetscape Standards (April 2007)*, provides guidelines for streets that were designed as part of that document.

When bicycle parking racks are placed on sidewalks, they shall be placed so that there is sufficient room for pedestrian flow which in all cases shall not be less than 5 feet in width. When bicycle parking racks are placed in the right of way as part of vehicle parking, they shall be placed in a manner that protects bicyclists and their bicycles from vehicles moving in the travel way and vehicles parking adjacent.

LANDSCAPING & IRRIGATION

All landscaping and irrigation installed in the right-of-way must conform to all of the requirements in Telluride's Municipal Code section 13.30.030. Section 4, Right of Way Landscaping Guidelines, in the Manual of Streetscape Standards (April 2007) shall be followed for all landscaping and irrigation installations in the right of way.

All plantings shall be drought tolerant native species that require minimal water irrigation. In addition, permanent irrigation systems are firmly discouraged. If an irrigation system is to be installed, even

temporarily, it must incorporate the most water-conserving type of equipment and devices commercially available at the time the system is submitted for approval to the Public Works Representative.

Soil

Initial installation of right of way green strips and pocket parks will require that the subsoil be scarified to 6 inches and that 6 to 12 inches of good, fertile topsoil be installed prior to planting. Amendments and mulch must be added over time to ensure plantings in these areas thrive.

Trees

Trees are not permitted in right of way green strips, especially on the south side, where they interfere with snow storage and create shadows that encourage street and sidewalk icing in winter. Pacific Avenue is recognized as an exception to this rule. Trees in Pacific Avenue green strips may be replaced at the discretion of Public Works and the Parks and Recreation Department, as the existing trees age and die. Trees may be planted as part of pocket park landscaping, but must be located 8 feet from the travel way and 3 feet from the sidewalk, at a minimum.

Shrubs

Shrubs may be planted in right of way landscaping green strips and parks located in the right of way. Shrubs must be situated so they do not block access to fire hydrants or prevent passengers from getting into or out of motor vehicles that are parked. This is especially important for spaces reserved for handicap parking. Shrubs should not block access along sidewalks when they are mature. Depending on the species, shrubs should be planted a minimum of 2 to 3 feet from the travel way and the sidewalk. They should also be hardy enough to withstand burial by plowed snow and the dry, heated conditions created by surrounding concrete sidewalks and paved travel ways.

BOLLARDS

Bollards in the public right-of-way that are required to protect utilities or other structures from damage by motor vehicles must be no less than 6-inches in diameter or on the diagonal, 4 feet in height above grade, and extend 2 feet below grade. To better protect against frost heave, a 1-foot base of washed ¾-inch gravel must be placed and compacted prior to pouring the concrete base. See Bollard Detail in Figure 3.8.

UTILITY BOXES

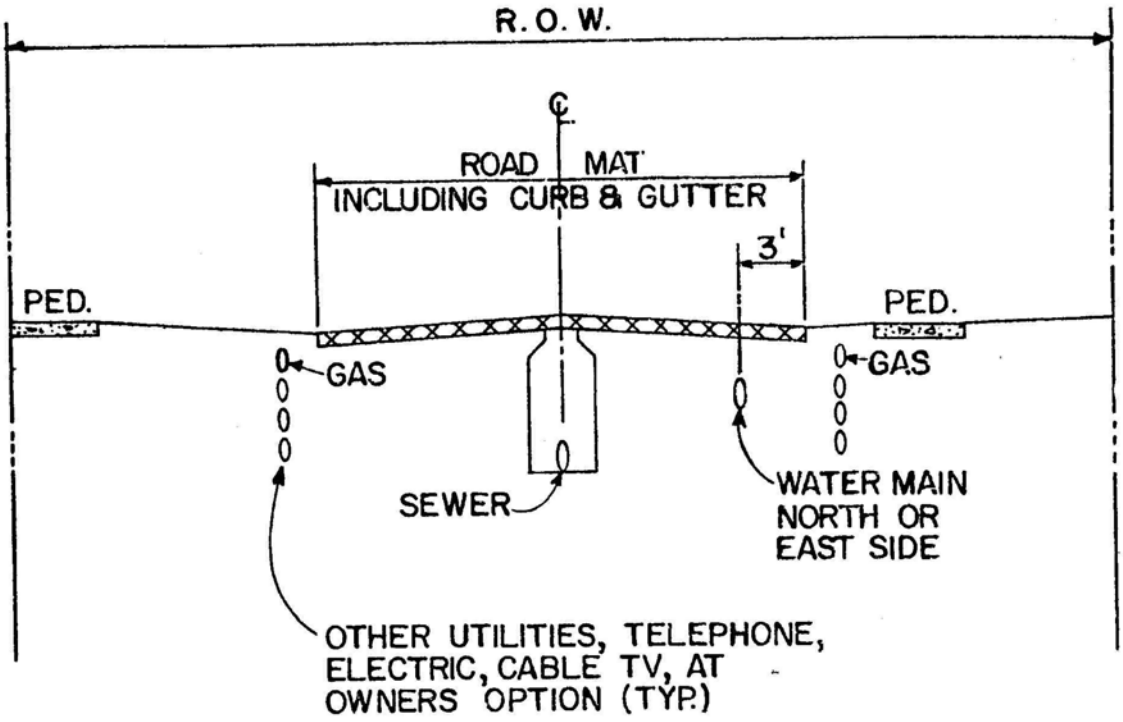
All boxes installed to house utilities in the right-of-way shall be constructed of materials suitable to the local climate. Metal housing is preferred, unless the utility company has prohibitions against using such material.

Utility boxes shall be placed in a manner that clusters utilities together in one place. This is intended to better protect the utilities from damage during snow management activities, improve use of space in the right-of-way, reduce roadside objective hazards, and improve right-of-way aesthetics.

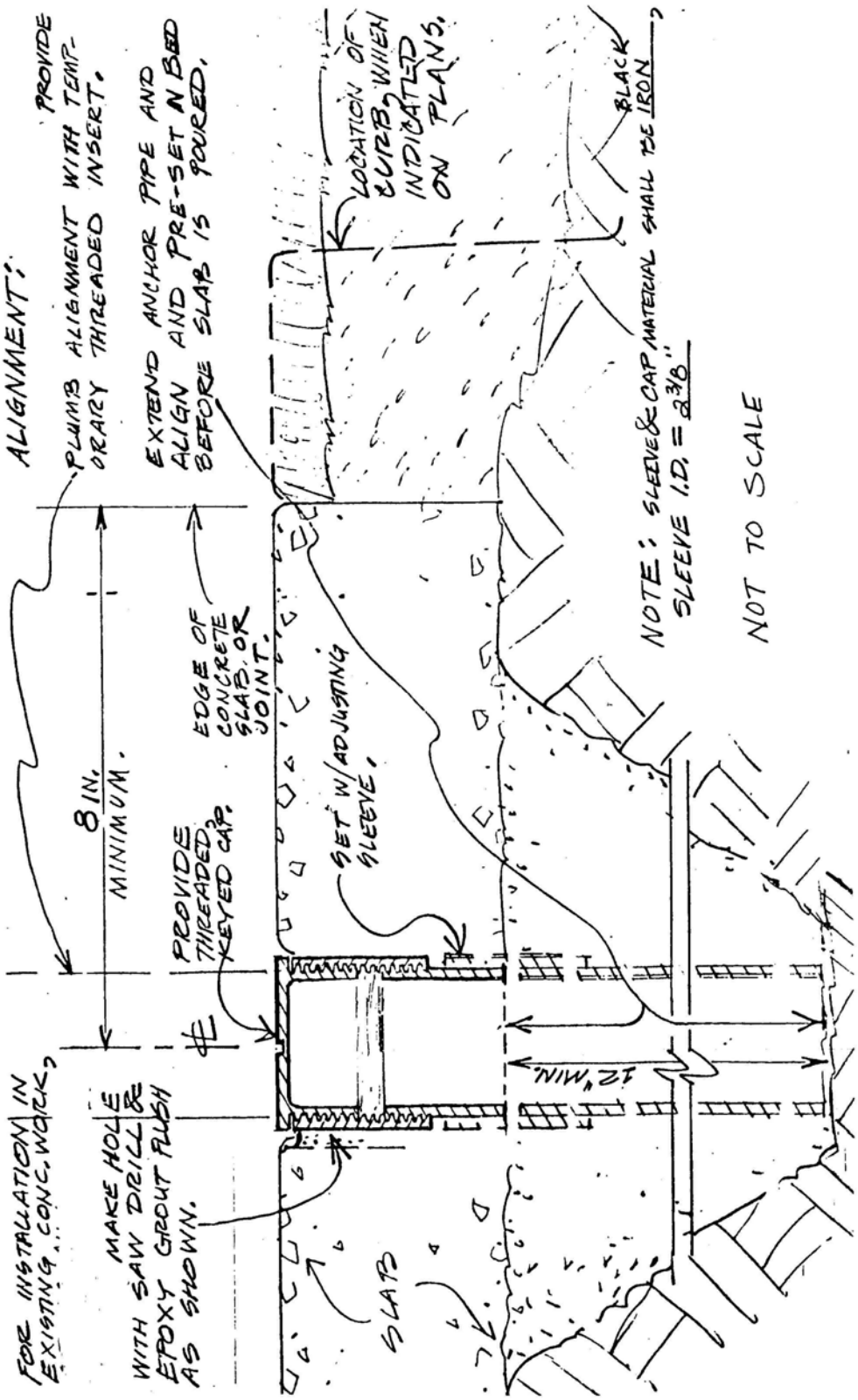
Utility boxes should be screened by plants and/or fencing to the greatest extent possible while also providing a functional access for servicing.

SURVEY MONUMENTS

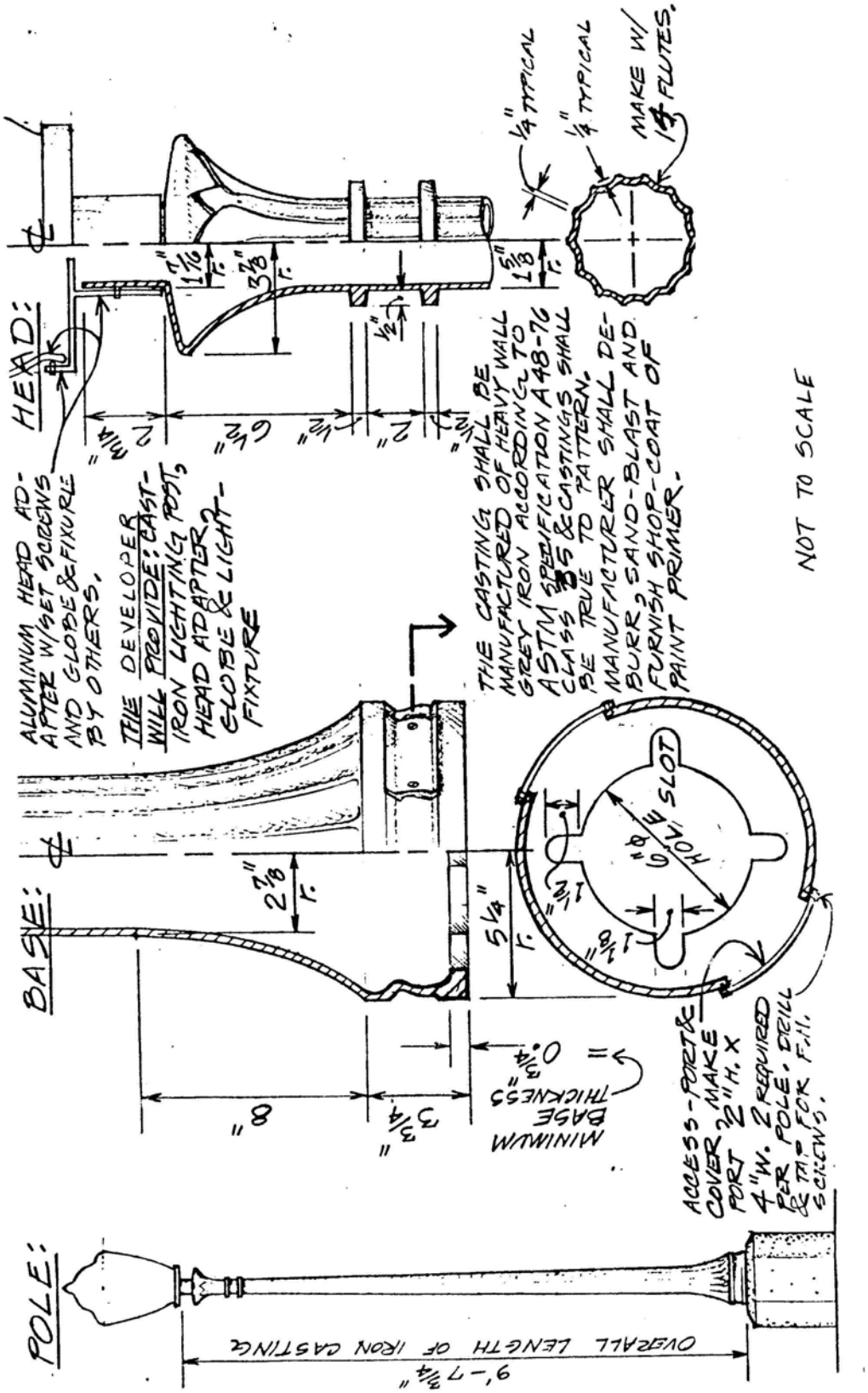
At midpoints of all street intersections a survey monument shall be embedded in a 3-foot deep by 6-inch diameter concrete block. Town will provide the survey monument cap(s) to be installed by the developer. A cross shall be stamped on the monument cap showing exact intersection of centerlines of street by a registered surveyor (see Figure 3.9).



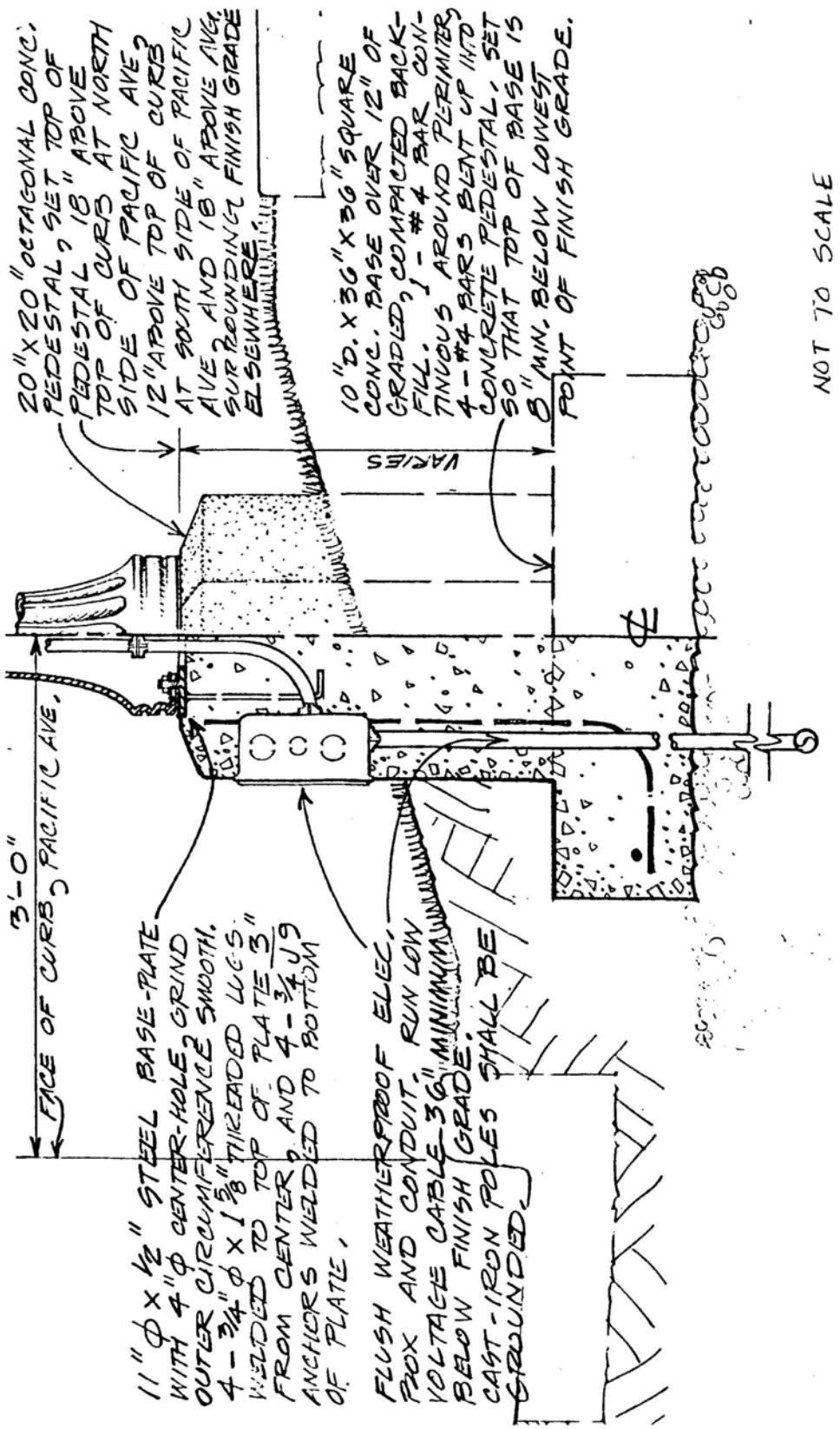
UTILITIES PLACEMENT TYPICAL ALL ROAD SECTIONS	SCALE: Not to scale	FIGURE 3.1
	DATE: July 2011	



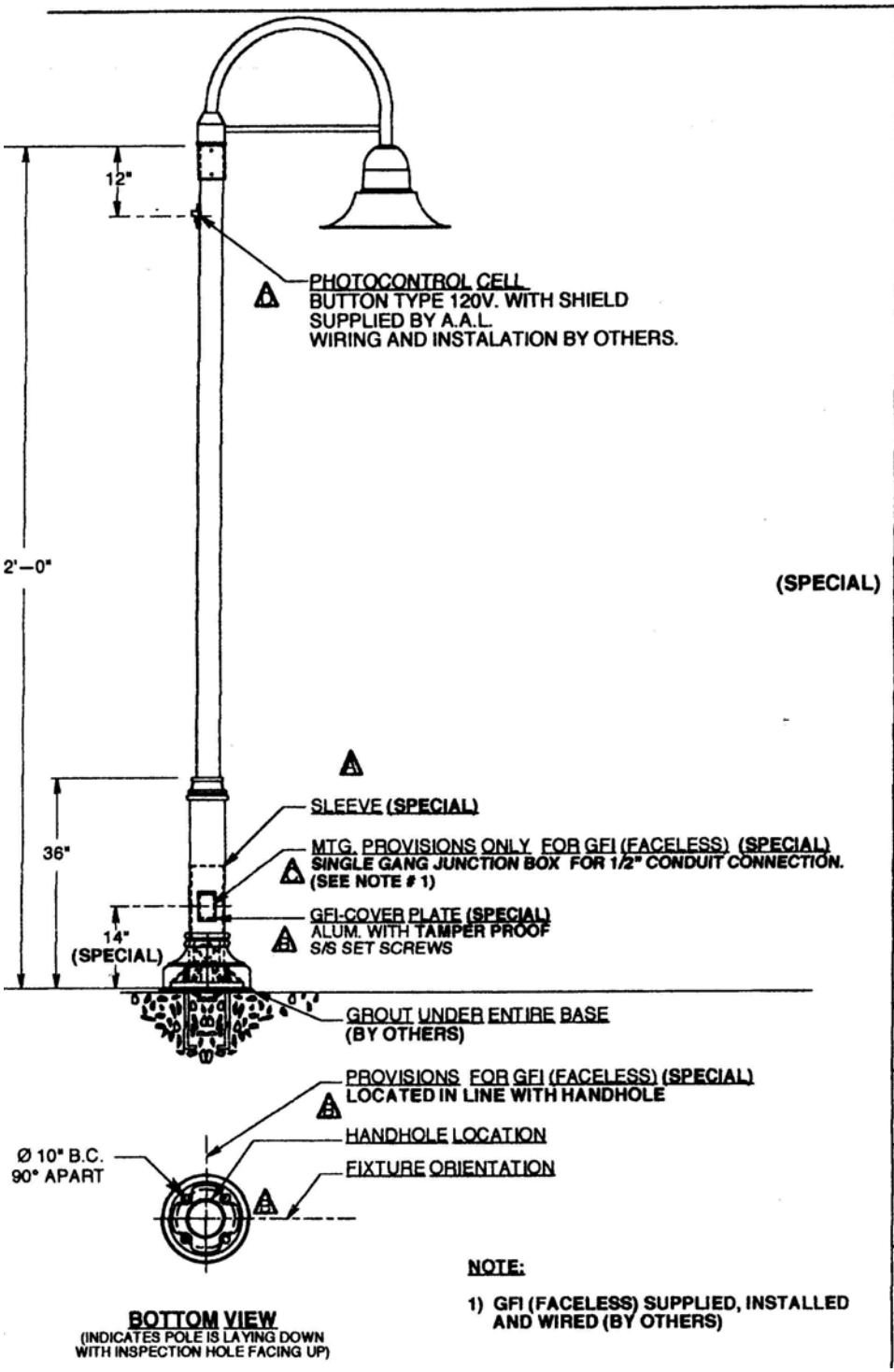
FLUSHED THREADED SLEEVE	SCALE: Not to scale	FIGURE 3.2
	DATE: July 2011	



COMMERCIAL STREET LIGHT CASTINGS	SCALE: Not to scale	FIGURE 3.3
	DATE: July 2011	

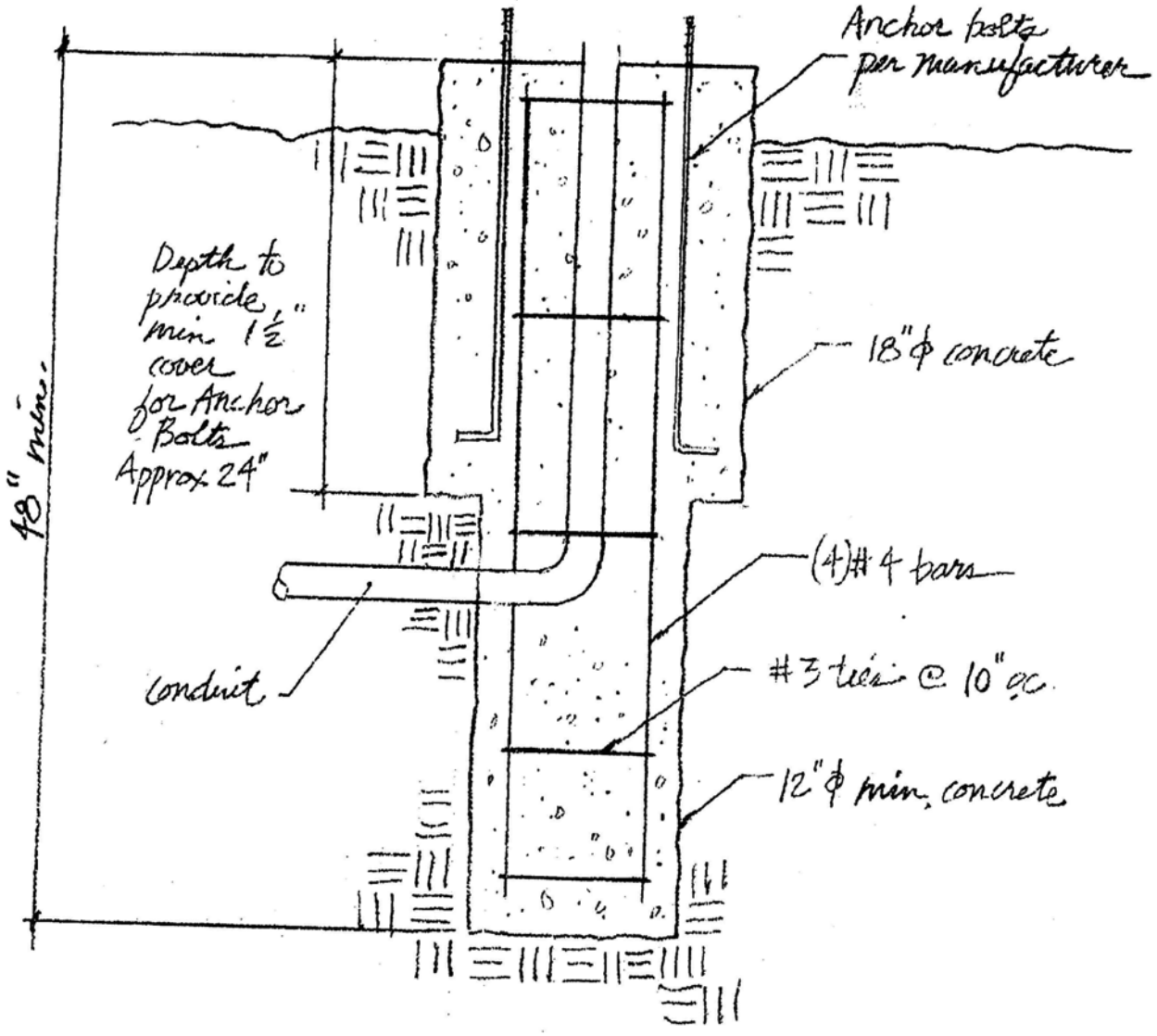


COMMERCIAL STREET LIGHT INSTALLATION	SCALE: Not to scale	FIGURE 3.4
	DATE: July 2011	

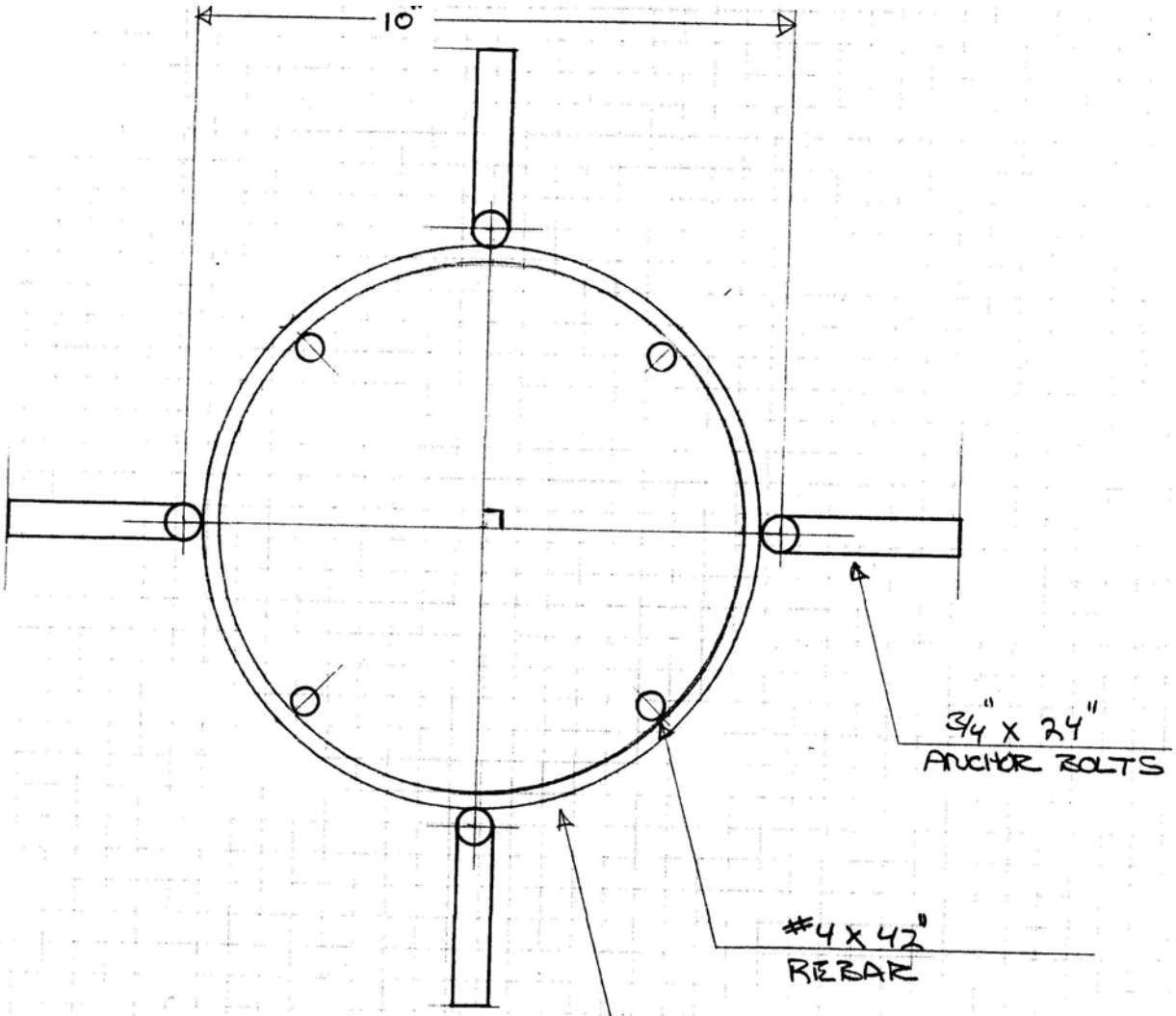


TYPE
CATALOG NUMBER **UCM-FLR-H3-FTG-FS1-** **SLA18-PHC-** ⚠ **DB6-4R12-125** ⚠ **07A-1165**
FINISH: POLYESTER POWDER COAT. AAL COLOR: DBZ ⚠ TO MATCH:
PROVIDE A SAMPLE COLOR CHIP
LAMPING (4-PIN) COMPACT
LAMP TYPE FLUOR. T-4
SOCKET GX24q-X
WATTAGE 42
VOLTAGE 120 ⚠
ALL BALLAST ARE HPF CONSTANT WATTAGE, -30 DEGREE STARTING. ALL SOCKETS ARE PORCELAIN, PULSE RATED 4KVA.
ANCHOR BOLTS
QTY 4
SIZE 3/4" x 24" x 3"
BOLT CIRCLE 10
PROJECTION 3 1/2"
FS1/FS2 OPTIONS: FUSE HOLDERS ONLY. FUSES BY OTHERS.
LEVELING NUTS AND WASHERS MUST BE INSTALLED UNDER ALL BASES
ONE APPROVED DRAWING MUST BE RETURNED TO A.A.L., BEFORE THIS PRODUCT CAN BE FABRICATED.
WARNING: THIS FIXTURE MUST BE GROUNDED IN ACCORDANCE WITH LOCAL CODES OR THE NATIONAL ELECTRICAL CODE. FAILURE TO DO SO MAY RESULT IN SERIOUS PERSONAL INJURY.

RESIDENTIAL STREET LIGHT INSTALLATION	SCALE: Not to scale	FIGURE 3.5
	DATE: July 2011	

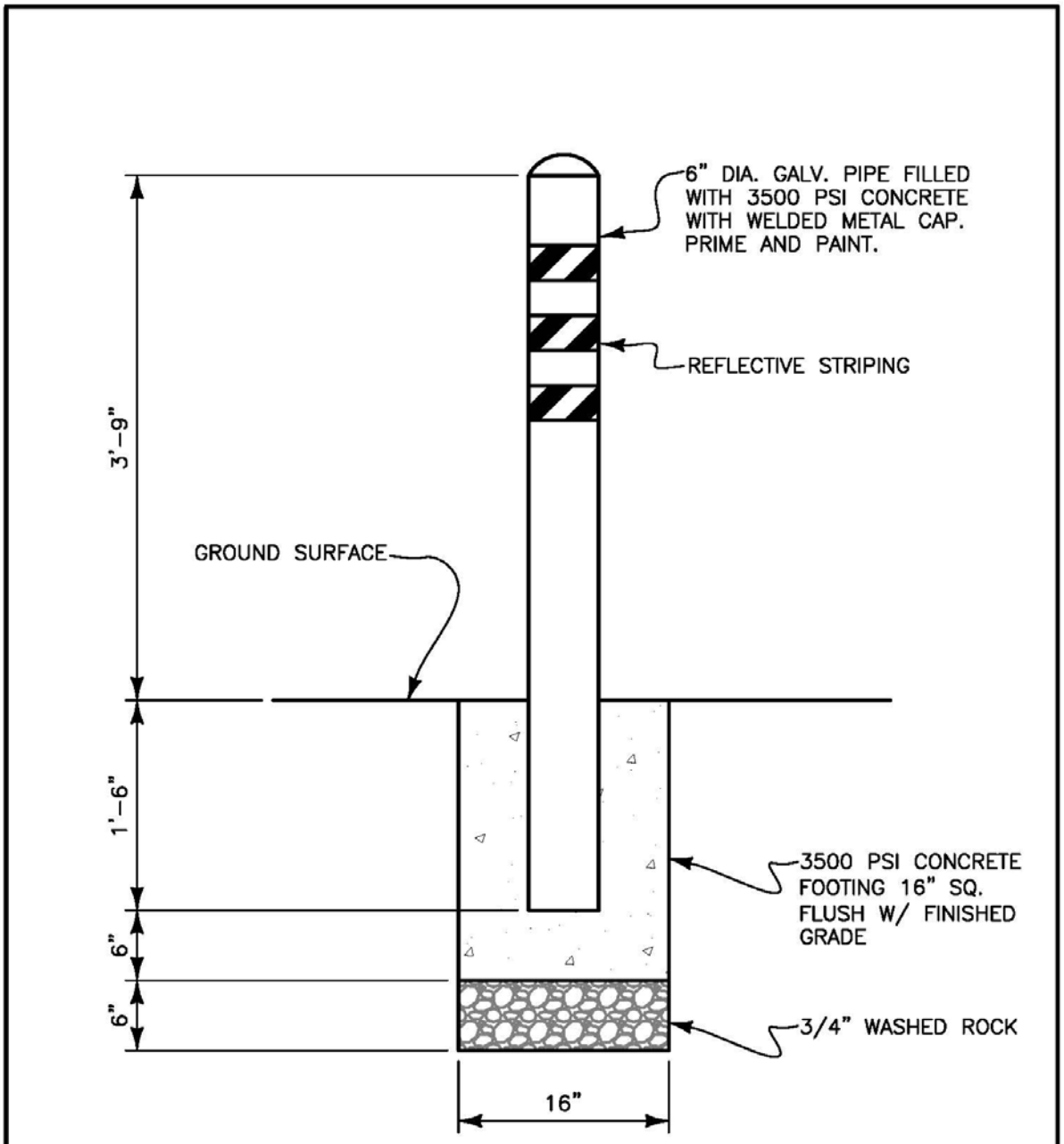


RESIDENTIAL STREET LIGHT FOUNDATION	SCALE: Not to scale	FIGURE 3.6
	DATE: July 2011	



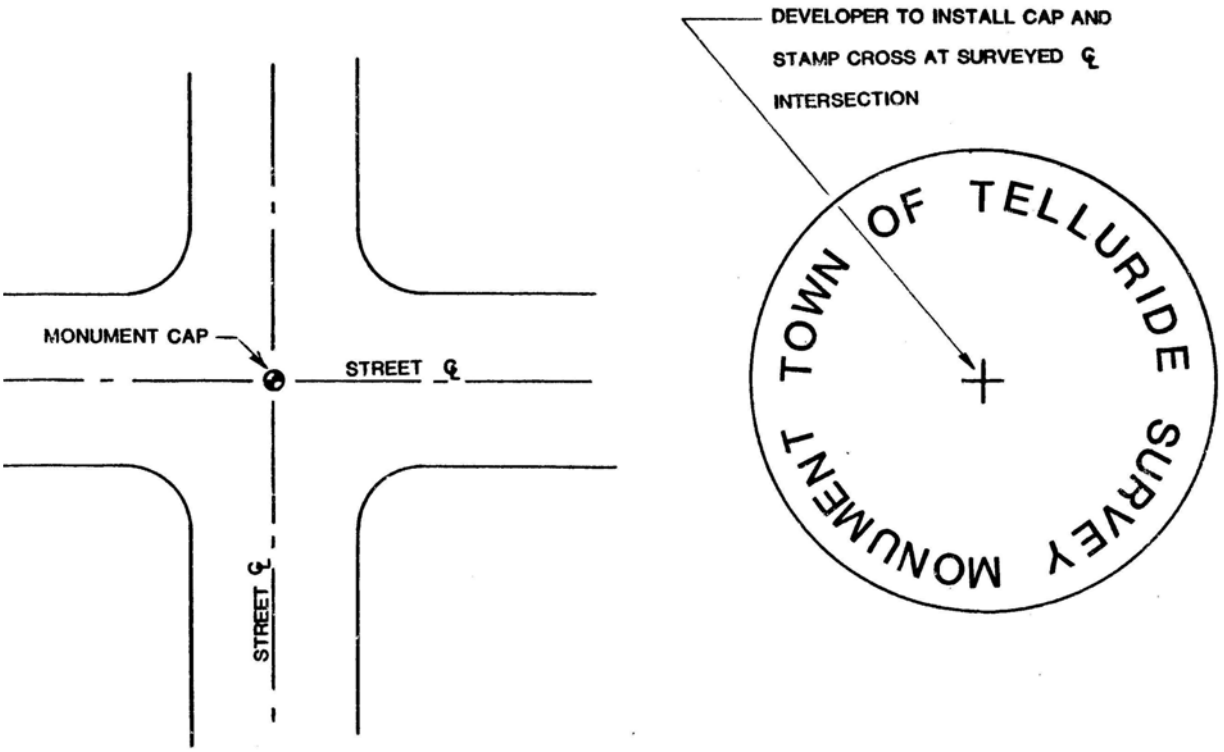
STEEL CAGE FOR CONCRETE STREETLIGHT BASE
PLAN VIEW
SCALE: 3/8 INCH EQUALS ONE INCH
DRAWN BY WILLIAM WATSON
7-24-2007

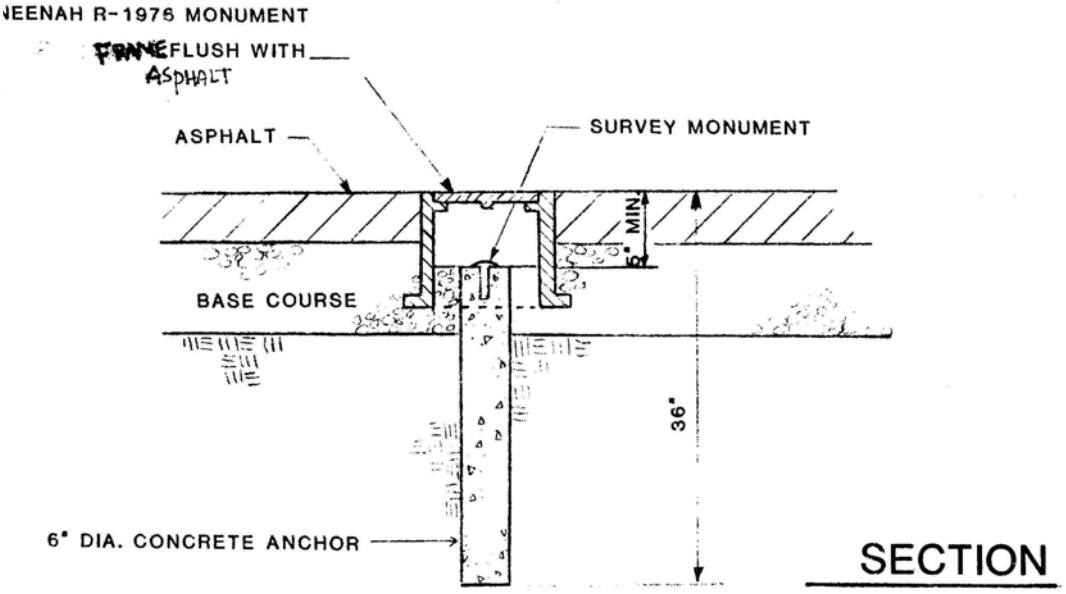
RESIDENTIAL STREET LIGHT STEEL CAGE	SCALE: Not to scale	FIGURE 3.7
	DATE: July 2011	



BOLLARD DETAIL

BOLLARD DETAIL	SCALE: Not to scale	FIGURE 3.8
	DATE: July 2011	





SURVEY MONUMENT	SCALE: Not to scale	FIGURE 3.9
	DATE: July 2011	

Section 04 - MINIMUM DESIGN STANDARDS FOR STORMWATER MANAGEMENT SYSTEMS

METHODS OF ANALYSIS

The determination of runoff magnitude shall be by either the Rational Formula, the Colorado Urban Hydrograph Procedure (CUHP), or statistical analyses based on actual measured flood occurrences.

Use the Rational Formula to compute the peak storm runoff for basins less than 200 acres in size. Use a triangular hydrogaph with falling limb at twice the rising limb (twice the time of concentration) to determine storm volume. Use the Manning equation for sizing of gravity storm sewer systems.

Use the Colorado Urban Hydrograph Procedure computing the peak storm runoff and storm volume for drainage areas over 200 acres in size. However, the sub-basins making up the total area, when less than 200 acres, may be studied using the Rational Formula.

Master Plan improvements and up-gradient runoff shall be considered when sizing storm sewer systems.

Wherever stream flow data are available and applicable, use these data in lieu of computational procedures involving the Rational Method or CUHP. Take care however, to evaluate the development potential of such basins because the data presented are valid only for present and/or natural drainage basin conditions. Use the log Pearson Type III method for the statistical analysis of runoff records.

FACILITY CAPACITY AND DESIGN

All stormwater management facilities must be approved by the Public Works Representative. All new development shall control storm water run-off to adjacent property and Town infrastructure to pre-developed conditions for the 2-year and 100-year event.

(1) Curb flow capacity is reached when the flow crosses the back of the curb or the crown of the street is reached, whichever is less.

(2) Transfer of water from one flow line to another, by flow over the crown, will not be allowed.

(3) Minimum size for storm drainage pipe shall be 15 inches, except that 12-inch pipe may be used from curb inlets to mainline manholes. Provide manholes at every change in direction, grade, and size, and at all pipe intersections. Space manholes at a maximum of 500 feet.

(4) Pipe under streets shall be designed for soil and live loads in accordance with acceptable highway design criteria. The D-Load method is an acceptable method of design.

(5) Drain collector and industrial streets so that the center 24 feet is clear of water during the 2-year storm.

(6) Drain major arterial streets so that the center 24 feet is clear of water during the 100-year storm.

(7) Residential streets shall have catch basins where either side of the street reaches its capacity for the 2-year frequency storm.

(8) Design culverts under streets for passing the 50-year storm with surcharge contained below street grade. If this is not possible due to physical constraints, design culverts to pass no less than the 10-year storm.

(9) Design major channels to safely pass the 100-year storm.

(10) Control velocities in any conduit or channel so that the conduit or channel will not be damaged by 100-year flows

Section 05 – WALKWAYS FOR BUILDING ACCESS, DRIVEWAYS, & PEDESTRIAN TRAILS

WALKWAYS FOR BUILDING ACCESS

Walkways for building access in green strips and at the interface with sidewalks in the right-of-way shall be no wider than 4 feet, unless approved by the Town Manager. All walkways shall be pervious or drain to a pervious surface that infiltrates runoff. Walkways shall not drain to the public right-of-way.

DRIVEWAYS

The minimum width of a driveway interface with the right-of-way shall be 8 feet for a single parking space, a single width tandem parking space, and/or a 1-car garage. It shall be 8 feet to 16 feet for side-by-side parking spaces, side-by-side tandem parking spaces, and/or a 2-car garage. The maximum width of a driveway interface with the right-of-way shall be 12 feet for a single parking space, a single width tandem parking space, and/or 1-car garage. It shall be 20 feet for side-by-side parking spaces, side-by-side tandem spaces, and/or a 2-car garage. Curb cut widths shall be minimized as much as is functionally possible because they reduce on-street parking and snow storage capacity.

The maximum slope of a driveway in the right of way at any point shall be no more than 12 percent, unless otherwise provided by the Town Manager, as defined in the Telluride Land Use Code §1-201.G, in writing, specified in the Land Use Code, or approved by the Planning and Zoning Commission through the Subdivision or Planned Unit Development process. All driveways in the right of way shall drain to a pervious area that infiltrates runoff and not to the public right-of-way. Exceptions must be reviewed and approved in writing by the Town Manager.

PEDESTRIAN TRAILS

Pedestrian trails for public use shall be no greater than 3 feet wide unless otherwise provided by the Town Manager in writing, specified in the Land Use Code, or approved by the Planning and Zoning Commission through the Subdivision or Planned Unit Development process. This excludes trails in Town Park and the River Park Corridor. Designs shall include precise location, drainage, a cross-section view of the walkway with materials specified, and a detailed revegetation plan. Four inches minimum of compacted road base is preferred. Modest signage to identify the public trail may be approved by the Town Manager.

RIGHT OF WAY & UTILITY CONSTRUCTION SPECIFICATIONS

Section 01010 - SPECIAL PROVISIONS TO THE CONSTRUCTION SPECIFICATIONS

INTENT

The Town of Telluride, by its adoption of these *Design Standards and Construction Specifications for Construction in the Right-of-way & Connections to Public Utilities (AKA "ROW Specifications")*, intends that they be used by the Developer and his Engineer/Architect and included in the Contract Documents executed by and between the Developer and his Contractor, whether they are so used is at the discretion of the Developer, however, the Town will not accept the improvements provided by the Developer unless and until they conform to the requirements of these Specifications or modifications are approved by the Town Manager, in advance, in writing.

The Owner or Developer is the person or entity that proposes to construct and to dedicate for public use, improvements or additions to the Town's systems. The Contractor is the person or entity that will perform the construction of the proposed improvements. The term, "Town Manager," shall mean the Town Manager or his/her designee, as defined in the Telluride Land Use Code §1-201.G.

REFERENCE STANDARDS

Reference in the specifications to standard specifications or publications or technical societies or governmental agencies, such as ASTM, ANSI, AISC, AMA, ACI, AWS, Colorado Department of Transportation (CDOT), Federal Specifications, or Commercial Standards shall refer to latest edition adopted and published 30 days prior to receiving bids, unless specifically noted otherwise in the Contract Documents. It shall be understood that all manufacturers, producers and their agents, of materials required shall have such reference standards available for reference and be fully familiar with their requirements as pertains to their product, material or equipment.

In case of conflict between reference standards and project specifications, project specifications shall govern. In case of conflict between reference standards and codes, the one having the more stringent requirements shall govern.

PERMITS AND APPROVALS

All construction shall be performed by a bonded General Contractor. Town permits shall be secured by the Contractor at least 72 hours (3 working days) before commencing construction. Permits from outside agencies shall be secured by the Contractor and the Contractor shall provide an electronic or paper copy to the Town Manager prior to issuance of Town permits. The Town Manager shall be notified 48 hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason.

INSPECTION

All work shall be inspected by the Town Manager who shall have the authority to halt construction when, in his opinion, these specifications or standard construction practices are not being adhered to. Whenever any portion of these specifications is violated, the Town Manager by written notice shall order further construction to cease until all deficiencies are corrected. The Town Manager will not be responsible for inspecting or approving work being performed under another agency permit, the Contractor or Owner shall be responsible for meeting permit requirements issued by other agencies.

A copy of the Stop Work Order shall be filed with the Contractor's bonding company for future review. If deficiencies are not corrected, performance shall be required of the Contractors' surety.

QUALITY CONTROL

The Developer shall employ and pay for the services of a qualified independent testing consultant to perform specified services for the conformance of materials, quality control, laboratory testing, and field quality control as required in the Construction Specifications. The Contractor shall notify the Town Manager in advance of conducting all such tests and inspections to afford him or her the opportunity to observe the tests and inspections.

If tests fail to meet specified requirements, the Contractor shall promptly remedy such deficiencies.

The independent testing consultant qualifications shall comply with "Recommended Requirements for Independent Laboratory Qualifications," latest edition, published by the American Council of Independent Laboratories, and basic requirements of ASTM E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction," latest edition.

The testing agency shall be instructed to submit directly to the Town Manager one copy in electronic or paper format of all reports of tests or inspections made, showing compliance, irregularities or deficiencies, identifying project, date of test, location in project, applicable specification section, applicable standard(s) for compliance, observations relating to compliance, name and signature of inspector.

The Contractor shall provide access to the work and furnish casual labor and facilities to accommodate inspections and tests. When tests fail to meet specified requirements, Contractor shall arrange for re-testing after conditions nave been corrected.

AS-BUILT DRAWINGS

As-built drawings shall contain the following information where applicable:

- Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
- Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
- Field changes of dimension and detail made during construction process.
- Details not on original Contract Drawings.

Also a set of Construction Specifications shall be marked, using a red pen, to record the following information for each section:

- Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
- Changes made during the construction process.
- Other matters not originally specified.

WARRANTY AND ACCEPTANCE

The Contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of written final acceptance by the Town Manager. Upon final inspection, if it is determined that the work is complete in accordance with the requirements of the Construction

Specifications, the Town Manager shall request the Contractor/Developer to make Project Closeout submittals. A 2-year warranty period is required for all street improvements installed, but not put into significant use during the first year. The Town Manager will determine prior to acceptance of improvements, whether or not significant use is imminent within this time frame. Significant use is defined as 50% build out of the development. The amount of the warranty shall be reduced to 50% for the second year.

If during said warranty period any work is found to be defective, Contractor shall promptly and in accordance with Town's written instructions, either correct such defective work, or, if it has been rejected by the Town, remove it from the site and replace it with non-defective work. If Contractor does not promptly comply with the terms of such instructions, the Town may have the defective work corrected or the rejected work removed and replaced, and all direct and indirect costs of such removal and replacement shall be paid by the Contractor. Contractor shall extend the terms of the warranty to cover repaired or replaced work performed under these warranty provisions for a period from the date of its installation equal to the terms of its original warranty.

The determination of the necessity during the warranty period for the Contractor to repair or replace the work in whole or in part shall rest entirely with the Town Manager whose decision in the matter shall be final and obligatory upon the Contractor.

The Contractor, upon notification by the Town of needed emergency repairs, shall start such work within twelve hours and complete such work within twenty-four hours of said notification by telephone and/or acknowledged email. The Contractor shall be held liable for any costs incurred by the Town for claims resulting from damage caused by defective work or neglected work by Contractor. If repairs are not started or completed within the above time limits, the Town at its option may make such repairs and invoice the Contractor for the actual cost of labor, equipment and materials.

PROJECT CLOSEOUT

Developer shall submit written certification that:

- Work has been completed in accordance with the Construction Plans and Specifications.
- Equipment and systems have been tested in the presence of the Town's Representative or appropriate agencies having jurisdiction over that particular work, and are operational.
- Project has been inspected for compliance with the Construction Plans and Specifications
- Satisfactory results of required tests (such as pressure tests, leakage tests, compaction tests, etc.) certified by his Engineer or an approved independent laboratory have been submitted to the Town.

The Developer shall also submit digital "as-built" construction drawings and a record hard copy at 24" x 36" on reproducible mylar or other suitable material. All "as-built" drawings shall be certified by a licensed Professional Engineer.

At the time of completion of the above requirements the Developer shall submit, in writing, to Telluride's Public Works Department a request for release from the Improvement Agreement(s), subject to the one-year warranty period. A letter of acceptance releasing the Developer from the Improvement Agreement(s) shall not be issued until all affected agencies have signed off on their acceptance of the improvements.

Section 02210 - STREET EXCAVATION AND EMBANKMENT

PART I – GENERAL

WORK INCLUDED

This section covers the excavation, embankment, finish grading, compaction and testing requirements for the subgrade preparation of pavements, curbs and gutters, sidewalks, and over lot grading.

JOB CONDITIONS

Existing Surface Improvements - Protect from damage or restore to their original condition all surface improvements encountered during construction, unless specified on the drawings to be removed. Improvements shall include, but not be limited to, the following: surfacing, sidewalks, curbs, gutters, valley gutters, trees and shrubs, other surface vegetation, driveways, utilities, signs and fencing.

Asphalt Removal - All asphalt not scheduled to be replaced during street improvements shall be saw cut at limits of asphalt to be removed. Remove bituminous pavement to neatly sawed edges with saw cuts made to full depth of existing pavement.

The Contractor may, at his or her option, eliminate the saw cut completely and remove the entire section of asphalt to the nearest joint or edge beyond the designated limits. In such cases, the additional asphalt removed beyond the designated limits will be removed and replaced at the Contractor's expense, unless there is written agreement from the Town Manager.

Concrete Removal - Remove concrete to neatly sawed edges with saw cuts made to full depth of the existing pavement

Make saw cuts for sidewalks and driveways in straight lines either parallel to the curb or at right angles to the alignment of the sidewalks.

Make saw cuts for curb and gutter to a full depth of the curb and gutter section on a neat line at right angles to the curb face.

Any section to remain, that would be smaller than 30 inches in either length or width, with the proposed saw cut falling within 30 inches of a construction joint, expansion joint or edge, or within 12 inches or a score mark, shall be removed to the joint/edge/scoremark and replaced.

The Contractor may, at his or her option, eliminate the saw cut completely and remove the entire section of concrete to the nearest joint beyond the designated limits. In such cases, the additional concrete removed beyond the designated limits will be removed and replaced at the Contractor's expense, unless there is written agreement from the Town Manager.

Drainage - Maintain subgrade and excavations free from water throughout work. Ditches and drains along the subgrade shall be maintained to drain effectively at all times.

Fences and Barricades - Fences, barriers, lights and barricades shall conform to the minimum requirements as set forth in the latest edition of the "Manual on Uniform Traffic Control Devices."

Underground Obstructions - Protect from damage any underground pipes, utilities or structures encountered during construction. If any damage occurs notify the Owner and affected Utility and

restore any damaged underground obstructions to their original condition at no additional expense without delay.

Before commencing work, obtain information concerning location, type, and extent of concealed existing utilities on the site and adjacent properties. Consult records and personnel of local utility companies, municipal utility departments, and telephone companies. File Notice of Excavation with these agencies, at least 48 hours prior to commencing work.

SEQUENCING

Full residential traffic shall be maintained whenever possible. Limited residential traffic shall be maintained on all streets except for periods of short duration whenever possible. Alternative routes of access shall be approved in advance by the Town Manager when motor vehicle access cannot be allowed. Pedestrian access to adjacent properties shall be maintained with minimum interference. Resource recovery (i.e., trash and recycling) service shall be accommodated or facilitated by the Contractors at all times. Notify the Town Manager and property Owner a minimum of 24-hours in advance of any street closures. Public Works may, at its discretion, require a Right-of-Way Obstruction Permit.

PART II – PRODUCTS

FILL MATERIALS

Roadway Embankment - Includes material composed of sound earth, sand, or gravel; free of debris, roots, organic or frozen material and stones having dimensions larger than four inches in the upper six inches of fill or larger than six inches in the remainder of the fill.

Excavation material or pit run material may be used upon approval of the Town Manager.

Back of Curb Embankment - Includes material composed of sound earth, sand, or gravel; free of debris, roots, organic or frozen material and stones having dimensions larger than four inches in the upper six inches of fill or larger than six inches in the remainder of the fill.

The upper six inches of fill shall be topsoil for areas that do not receive other surface treatments.

Spot Subgrade Reinforcement - Material includes sound, tough, durable, crushed stone, slag or gravel, consisting of pieces varying from one inch to three and one-half inches in diameter or other approved material with necessary filler, when a finer material is necessary for filler, screened gravel or sand may be used to completely fill all voids.

Topsoil - Selectively excavated native material or imported material representative of soils that produce heavy growth of crops, grass or other vegetation, and reasonably free from underlying subsoil, clay lumps, invasive weeds, litter, matted roots, or material harmful to plant growth. Topsoil shall not contain more than 5% by volume of stones or other objects larger than 1 inch in any dimension.

PART III - EXECUTION

PREPARATION

Field Measurements - Measurement of excavation and embankment will be in cubic yards in-place as calculated from existing ground cross-sections and design grades, recorded to the nearest tenth of a foot, and computed by the average end area method. Any additional excavation or fill beyond the limits as specified, indicated on the drawings, or as staked in the field, or made for the Contractor's convenience shall be at his expense.

PREPARATION OF SURFACES

Structure Removal - Before grading begins remove any pavement, curbs, gutters, sidewalks, driveways and miscellaneous objects as indicated on the plans or as otherwise specified.

Clearing and Grubbing - Remove all stumps, roots, brush, other vegetation and debris from areas that are within the construction limits. Mark and protect all areas outside the construction limits that are not to be disturbed with paint, construction fencing, and/or silt fence, as appropriate. Legally dispose of all cleared materials at public or private dumping sites.

Preservation of Trees - Refer to Construction Drawings for designation of all trees, shrubs, plants and other vegetation within the project site to remain. Do not remove trees outside of excavated or filled areas, unless their removal is authorized by the Owner on the Construction Drawings. Protect trees left standing from permanent damage by construction operations by fencing at the tree's drip line.

Removal of Water - Provide and maintain ditches and drains to divert or otherwise prevent surface water from entering excavated areas. Subgrade made unsuitable because of excessive moisture due to surface water may be reclaimed by manipulation and aerating or replaced with other suitable material.

EXCAVATION

Classification of Excavated Material - No classification of excavated materials will be made. Perform excavation of every description and of whatever substances encountered to the depths indicated or as otherwise specified.

Stockpiling Excavated Material - Contractor may use all suitable material removed from the required excavation in the formation of embankments and fill, base, and topsoil replacement for behind curbs. Stockpile suitable material for filling in an orderly manner and in areas designated by the Owner. Keep topsoil segregated from non-organic excavation materials and debris.

All suitable material removed from the excavation in excess of that used for the work and unsuitable material that is desired by the Owner will be stockpiled in an orderly manner in areas designated by the Owner. Any excess material not desired by the Owner shall be removed to an acceptable disposal site.

Unstable Subgrade - Excavate below the grade shown all wet or otherwise unsuitable materials encountered within the limits of the work and replace with subgrade reinforcement material.

Unauthorized Excavation - Complete excavation to line and grade as shown on the plans. If any areas are inadvertently over-excavated, such over-excavation shall be replaced with suitable embankment material at the Contractors expense.

Fill - Scarify areas to receive fill in such a manner that fill material will bond with existing surfaces. Embankments shall be placed only when ambient temperatures permit the placement and compaction of the materials to the specified densities. Sustained periods of freezing that induce frost into the previously-placed material or material being placed shall be cause for suspension of the work. Construct fills and embankments with suitable material to the lines and grades indicated on the drawings within a tolerance of plus or minus 0.08 feet.

Moisture condition upper scarified native subgrade and each lift of fill material per the moisture content specified for compaction. Place material in successive horizontal layers of not more than eight inches in loose depth for full width of cross-section, and compact per the compaction requirements. Test compacted lift according to the testing schedule.

HAUL

Haul for stockpiling or disposing of removed materials will not be paid for separately, but shall be included in the work of other items. All cross haul shall also be considered incidental to the work.

COMPACTION

For native subgrade to receive fill and for each lift, mechanically compact the soil with appropriate equipment and test as specified prior to placement of successive lift. After finished subgrade has been shaped to line, grade and cross-section, roll with an approved power roller until compacted as specified.

All fill operations—along with the rolling of the subgrade includes reshaping, aeration, and wetting or drying as required to obtain a moisture content between 2% below and 2% above optimum moisture or as determined by the Engineer for site specific soil.

No separate measurement of compaction will be made. It shall be considered incidental to the work of excavation and embankment.

Water - The Contractor shall be responsible for locating a water supply adequate to use for construction purposes, and for all connections, distribution facilities, and costs associated therewith.

Subgrade Areas - Compact upper 6-inch layer forming subgrade for pavements in cut areas as follows: Condition to a moisture content of 2% below to 2% above optimum moisture (or as determined by the Engineer for site specific soil) and compact to a density of 95% of maximum density.

Compact upper 6 inches of surface requiring fill as follows: Condition to moisture content of 2% below to 2% above optimum moisture (or as determined by the Engineer for site specific soil) and compact to a density of 95% of maximum density.

Following the same requirements, compact successive lifts up to subgrade.

Over-all or Overlot Areas (areas that are outside pavement and sidewalk) - Compact each layer of fill and embankment, except topsoil, as follows: Condition to a moisture content of 2% below to 2% above optimum moisture (or as determined by the Engineer for site specific soil) and compact to a density of 88% to 93% of maximum density.

Maximum Density Determination - Maximum density is to be determined from Proctor testing of the site specific soil or import material with the Proctor method as outlined under FIELD QUALITY CONTROL in this section.

FINISH GRADING

Uniformly smooth grade all areas covered by the project including excavated sections, filled sections, and adjacent transition areas. Make finished surface reasonably smooth, compacted, and free from irregular surface changes or depressions that may trap water. Where cuts occur in subgrade, bring subgrade to grade in compacted lifts as required above, reshape if required, and re-compact prior to placing surfacing. Proof roll all subgrade areas under the supervision of the Engineer or his designee, any soft areas observed are to be excavated and re-compacted with existing or import material and proof rolled again for Engineer's approval of subgrade. Subgrade areas that have been approved shall be covered with road base or pavement within 48-hours or before any significant precipitation (whichever occurs first) or the subgrade shall be proof rolled again and retested for compaction if deemed necessary by the Engineer or his designee.

Degree of finish shall be that ordinarily obtainable from either blade scraper or scraper operations. The surface of embankments or excavated areas for areas that will receive a surface or base course is not to

vary more than 0.08 feet from the established grade and cross-section. Under no circumstances shall pavement or base material be placed on a muddy subgrade. No base material shall be laid until the subgrade has been checked and approved by the Town Manager.

After completion of the paving operations, the areas between the curb or sidewalk and property lines, as the case may be, shall be brought to a uniform smooth grade, free from irregular surface changes, and shall be cleared of all logs, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Areas which are to receive topsoil shall be cleaned and stripped of all surface vegetation, sod, and rocks. These areas are to be scarified to a depth of 6 inches. Uniformly distribute topsoil on the areas and evenly spread to a minimum thickness of 6 inches. Spread so that planting can proceed with little additional soil preparation or tillage. Do not place topsoil when subgrade is frozen, excessively wet, or in a condition otherwise detrimental to proper grading or proposed planting.

Areas which are to receive surfacing other than topsoil shall be graded as required to allow installation of the specified surface treatment.

FIELD QUALITY CONTROL

Laboratory Compaction Tests - Conduct in accordance with requirements of ASTM D698-70 or AASHTO T-99-Standard Method of Test for Moisture Density Relations of Soils Using a 5.5 Lb. Rammer and a 12-inch Drop.

Use Method A, B, C or D as appropriate, based on soil and judgment of the testing laboratory. Samples tested shall be representative of materials to be placed (or altered). Obtain optimum moisture/density curve for each type of material or combination of materials encountered or used. Use test results as a basis for compaction control. Testing is to include Atterberg Limits, grain size determination, and specific gravity.

Field Density Control - Conduct tests for density control during compaction operations in accordance with the requirements of the following:

- ASTM 02922 - Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
- ASTM D1556 - Test for Density of Soil-in-Place by the Sand-Cone Method.

Conduct one test for each 12,000 square feet or less of subgrade, for each layer (lift) of fill conduct one test for each 12,000 square feet or less.

CLEAN-UP

Excess material occurring during subgrade finishing and other final operations will not be permitted to accumulate on existing improved surfaces and shall be removed concurrent with the finishing operations. Excess material on adjacent surfaces is to be removed by sweeping or shoveling, not by washing, to prevent sediment transport. Care shall be taken to prevent the entrainment and transport of this material into drainage structures or other waterways during or after the construction period.

Section 02220 - UTILITY TRENCHING, BACKFILLING AND COMPACTING

PART I - GENERAL

WORK INCLUDED

Work under this section includes clearing, grubbing, excavation, filling, compacting and surface restoration for underground utilities, manholes, vaults and similar buried structures as shown on the drawings and specified herein. Utilities shall include, but not be limited to, domestic water, irrigation, sanitary and storm sewers, gas, power, telephone and cable.

QUALITY ASSURANCE

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Society for Testing and Materials (ASTM)

ASTM C33	Concrete Aggregates
ASTM D698	Moisture-Unit Weight Relations of Soils and Soil-Aggregate Mixtures, using 5.5 Lb. Rammer and 12 inch Drop
ASTM 01556	Density of Soil-In-Place by the Sand Cone Method
ASTM 02049	Relative Densities of Cohesionless Soils
ASTM D2922	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T99	Moisture Density Relations of Soils Using a 5.5 Lb. Rammer and a 12 inch Drop

SUBMITTALS

Include the following:

- *Methods* - Submit the proposed sheeting and shoring methods to be employed by the Contractor.
- *Samples* - Test sample of granular bedding material, along with gradation test results from testing agency.

JOB CONDITIONS

Surface Improvements - Protect from damage or restore to their original condition all surface improvements encountered during trenching or construction unless specified on the drawings to be removed.

Improvements shall include but not be limited to surfacing, sidewalks, curbs, gutters, valley gutters, trees and shrubs, other surface vegetation, driveways, mailboxes, utilities, signs, and fencing.

Asphalt Removal - All asphalt not scheduled to be replaced during street improvements shall be saw cut at limits of proposed replacement. When trenching parallels a paved road and extends into the

asphalt, the asphalt shall be saw cut along the street centerline and the entire section of asphalt removed from shoulder to centerline.

Remove bituminous pavement to neatly sawed edges with saw cuts made to full depth of existing pavement.

The Contractor may, at his option, eliminate the saw cut completely and remove the entire section of asphalt to the nearest joint or edge beyond the designated limits. In such cases, the additional asphalt removed beyond the designated limits will be removed and replaced at the Contractor's expense, unless there is written agreement from the Town Manager.

Concrete Removal - Remove concrete to neatly sawed edges with saw cuts made to full depth of existing pavement.

Make saw cuts for sidewalks and driveways in straight lines either parallel to the curb or at right angles to the alignment of the sidewalks.

Make saw cuts for curb and gutter to a full depth on a neat line at right angles to the curb face.

Any section to remain, that would be smaller than 30 inches in either length or width, with the proposed saw cut falling within 30 inches of a construction joint, expansion joint or edge, or within 12 inches or a score mark, shall be removed to the joint/edge/score mark and replaced.

The Contractor may, at his option, eliminate the saw cut completely and remove the entire section of concrete to the nearest joint beyond the designated limits. In such cases, the additional concrete removed beyond the designated limits will be removed and replaced at the Contractor's expense, unless there is written agreement from the Town Manager.

Underground Obstructions - Protect from damage any underground pipes, utilities or structures encountered during construction. If any damage occurs notify the Owner and restore any damaged underground obstructions to their original condition at no additional expense and without delay.

Before commencing work, obtain information concerning location, type, and extent of concealed existing utilities on the site and adjacent properties. Pothole as necessary to determine utility depth and avoid conflicts. Consult records and personnel of local utility companies, municipal utility departments, and telephone companies. File Notice of Excavation with these agencies at least 48 hours prior to commencing work.

Sheeting, Shoring and Bracing - Except where trench banks are cut back on a stable slope, provide and maintain all sheeting and shoring necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage in accordance with applicable codes and governing authorities. Engineered design of bank slopes, sheeting, shoring and bracing may be required as determined by the Owner and site specific requirements.

Do not remove any sheeting unless the pipe strength is sufficient to support the trench loads based on trench width measured to the back of sheeting. Remove sheeting and shoring gradually as excavations are backfilled to protect the construction and other structures, utilities or property.

Blasting - No blasting will be permitted without written consent by the Town.

Drainage - Maintain the excavations and site free from water throughout the work. Remove any water encountered in the trench to provide firm subgrade, to permit joints to be made dry at the final grade and to prevent entrance of water into the pipeline. Accomplish dewatering by the use of sumps and

gravel blankets, well points, or drain lines. Obtain and administer a State of Colorado temporary construction dewatering permit, as necessary, for installation below or near groundwater. Minimize total suspended solids in pumped water prior to discharge using filtration, detention settling, or other approved methods.

Interruption of Service - Coordinate interruptions of utility services with the Town and affected neighbors. Make connections to the existing system requiring the interruption of service during the time (weekends, nights or holidays) designated by the Town.

Obtain permission to cut and replace existing service lines to facilitate trenching. Notify affected users two hours in advance of, and restore service within four hours after, any interruption. Repair all lines at no additional expense to the Owner.

No valve or other control on the existing domestic system shall be operated for any purpose by the Contractor. The Town's Public Works Department will operate all valves, hydrants, blow offs and curb stops.

Sequencing - Pipeline installation shall follow trench excavation within 100 lineal feet. Trench backfill shall follow pipe installation within 50 lineal feet. Cleanup shall follow trench excavation within 300 lineal feet. Open trench length shall be kept to a minimum and shall not exceed the length of utility that can be installed and backfilled within the working day. The Contractor shall be responsible for covering or barricading and signing trench excavation as necessary for safety. All trenches and excavations shall be backfilled at the end of each work day unless approved otherwise by the Town Manager.

Construction In Streets - When construction operations are located within streets, make provisions at cross streets and walks for free passage of vehicles and pedestrians by bridging or other approved methods. Do not block streets or walks without prior approval by the Town. Notify the Town Manager and property Owners a minimum of 24-hours in advance of any street closures.

CLASSIFICATION OF EXCAVATED MATERIALS

No classification of excavated materials will be made. Perform excavation of every description and of whatever substance encountered to the depths indicated or as otherwise specified. If rock is encountered, notify the Owner and Town Manager to determine means of excavation and associated payment.

WARRANTY

Trench Maintenance – Owner/Contractor shall warranty and maintain all trench backfill and resurfacing thereon for a period of one year after final acceptance by the Town.

PART II - PRODUCTS

Embedment Materials - Refer to Construction Standard No. 2220A.

Concrete - 2000 psi concrete as specified in Section 03300 - Cast-in-Place Concrete.

Granular Material - Well graded crushed stone or gravel meeting the requirements of ASTM C33, gradation 67 (3/4-inch to No. 4).

Fine Granular Material - Natural or manufactured sand meeting the requirements of ASTM C33, gradation for fine aggregate (3/8-inch to No. 100).

Select Backfill - Soil free from rocks, clods and stones greater than 1-1/2-inch in any dimension.

Backfill Materials

Suitable Material - All materials for construction fills, backfills and utility trenches shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free of frozen material, stumps, roots, brush, other organic matter, and debris. In addition, material shall meet requirements as detailed below.

Utility Trenching

Upper Portion of Trench - Material placed within 1 foot of pavement subgrade or the finished surface in unpaved areas shall be soil free from rocks and stones larger than 2-1/2 inches in any dimension.

Remainder of Trench - Soil may contain a limited number of stones smaller than 6 inches in any dimension, provided they are dispersed in the surrounding material in a manner to allow specified compaction.

Public Highways/Streets - Material placed within the limits of paved surfacing, gravel shoulders or shoulder slopes shall be approved by the agency having jurisdiction over highway/street maintenance.

Structural Fill and Backfill - Materials used for structural fill under or around structures shall consist of materials as described above and free of stones with any dimension greater than one-half of the specified loose layer thickness. Material shall also be capable of being compacted to specified density.

Unsuitable Materials - All material removed in stripping and all material containing perishable matter such as roots, sod, grass, decayed vegetable matter, debris, frozen material or materials having unsatisfactory compaction characteristics will be classified as unsuitable for use in the work. Materials which are unsuitable due to excessive moisture or incorrect gradation may be reclaimed if brought into specification by screening, manipulating, aerating, or blending with other suitable materials.

PART III – EXECUTION

PREPARATION

Field Measurements - Before commencing work, locate all base lines required for control of the work and establish required grade staking.

Pavement, Curb and Gutter and other Concrete Removal - Before trenching begins, remove any pavement, curbs, gutters, sidewalks, and driveways necessary to install the utility. Remove to neatly sawed edges with saw cuts made to full depth.

Clearing - Remove all stumps, roots, brush, other vegetation and debris from areas that will be disturbed by the construction operations. Grub all stumps. Legally dispose of all cleared materials at public or private dumping areas.

Sod Removal - In lawn areas, cut and roll back sod before trenching. Store sod and maintain moist for reinstallation after completion of backfilling operations.

Topsoiling - Strip existing topsoil from areas to be disturbed by construction operations. Stockpile in areas designated. Keep topsoil segregated from non-organic trench excavation materials and debris.

Preservation of Trees - Refer to drawings for designation of all trees, shrubs, plants and other vegetation within the project site to remain. Do not remove trees outside of excavated or filled areas, unless their removal is authorized by the tree's Owner and approved by the Town. Protect all trees left standing from permanent damage by construction operations by installing a fence at the drip line. If for trees that are to be preserved, roots must be cut for an excavation, an arborist shall be called in to hand cut the specific roots. Root structure shall never be torn using excavation equipment.

EXCAVATING

Trenching - Excavate trenches by open cut except where boring and jacking is indicated on the drawings. Conform to sheeting, shoring and bracing requirements of regulating agency or ruling authority.

Stockpiling Excavated Material - Stockpile suitable material for backfilling a minimum of 4 feet away from trench banks to avoid overloading and to prevent slides or cave-ins. Remove and waste excavated materials not suitable or not required for backfilling to an appropriate off-site location.

Excavation to grade - Accurately grade trench bottoms to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except portions of pipe sections where it is necessary to excavate for proper sealing of pipe joints. Remove stones as necessary to avoid point bearing.

Bell holes - Dig bell holes and depressions for joints after trench bottom has been graded. Bell holes and depressions shall be only of such length, depth, and width as required for properly making the particular type of joint. The use of earth mounds for bedding the pipe will not be allowed.

Removal of Water - Provide and maintain dewatering equipment to remove and dispose of all surface and groundwater entering trenching operations. Keep each trench dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or hydraulic action will result.

Dewater all trenches that extend down to or below static groundwater elevations by lowering and maintaining the groundwater surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation. A State of Colorado temporary construction dewatering permit must be obtained from the CDPHE prior to discharge to State waters. Provide a copy of the permit to Public Works prior to discharge.

Divert or otherwise prevent surface water from entering trenches.

Pipe Clearance In Rocks - Where rock excavation is necessary, over excavate the trench bottom a minimum of 6 inches below the bottom of the pipe for pipe 24 inches in diameter or less, and a minimum of 9 inches for pipe larger than 24 inches in diameter, backfill overdepths with lean concrete or granular material. Compact granular material to 95% of maximum density prior to pipe placement.

Unstable Pipe Subgrade - Whenever wet or otherwise unstable material that is incapable of supporting a main line or service line is encountered in the bottom of the trench, over-excavate such material to a depth suitable for construction of stable pipe bedding. Backfill trench to proper grade with granular material and compact to 95% of maximum density. Incorporate fabric or other reinforcement measures as required by the Project Engineer to attain long term bridging of the problem area.

Limiting Trench Widths - Excavate trenches to provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Provide a minimum clearance of 6 inches on each side of the pipe for pipe 12 inches in diameter or less, 8 inches for pipe between 14 inches and 30 inches in diameter, and 12 inches for pipe larger than 30 inches in diameter.

Maximum trench width measured at the top of the pipe shall not exceed the outside diameter of the pipe plus 24 inches for pipe 24 inches in diameter or smaller, and plus 30 inches for pipe larger than 24 inches.

Excavation for Appurtenances - Make excavations for manholes, vaults and similar structures sufficient to leave at least 12 inches clear space between outer surface of structure and the bank shoring material that may be used to hold and protect the banks.

Unauthorized Excavation - If any areas are inadvertently over-excavated, backfill such over-excavation with lean concrete or granular material at no cost to the Owner. Compact granular material to 95% of maximum density.

If the maximum trench width is exceeded, provide concrete encasement or a higher strength of pipe at no additional expense to the Owner.

PIPE EMBEDMENT

Placing Embedment Material - Place granular pipe bedding and select material to a cover depth of 1 foot over the pipe by hand to prevent damage or displacement of the pipe. Evacuate voids around the pipe and compact bedding by hand rodding or similar means. Refer to Construction Standard 2220A.

Embedment Classes

- Class A - Use where indicated on the drawings and where trench conditions require its use for stable pipe support.
- Class B - Use for all PVC pipelines.
- Class C - Use for all CMP, RCP and DIP pipelines.
- Class D - Impermissible bedding.

Bedding Options - Shaped bottom bedding will be conditionally acceptable for Class B and C embedment. However, if at any time the shaped bottom does not meet the requirements as set forth on Construction Standard 2220A, the Contractor shall provide granular bedding for the pipeline.

TRENCH BACKFILLING AND COMPACTING

Deposit material in layers of a thickness required to achieve the compaction specified below. Maintain moisture content of backfill material within plus or minus 2% of optimum condition (unless otherwise determined by the Engineer due to soil type).

State Highways - 100% of maximum density for paved areas and shoulder slopes, 95% of maximum density for all other areas.

Paved Roadways, Sidewalks and Other Areas to Receive Pavement -

- Top 1 foot: 100% of maximum density for paved areas and shoulder slopes
- Remainder of trench: 95% of maximum density.

Gravel Roadways and Alleys - 95% of maximum density.

Sodded or Lawn Areas - 68% of maximum density.

Fields and All Other Areas - 80% of maximum density or equal to the density of undisturbed adjacent material, whichever is greater.

Structural Fill Under and Around Structures - 98% of maximum density.

Method of Compaction - Mechanically compact trench backfill by means of tamping rollers, sheep foot rollers, pneumatic tire rollers, vibrating rollers or other mechanical tampers.

COMPACTION AND BACKFILLING

Do not begin backfilling until forms and shoring have been removed, construction below grade has been observed, underground utilities systems have been inspected, tested and meet specified requirements, bedding has been placed and rodded, and trash and debris have been cleaned from the excavation.

Do not cease dewatering operations until backfill is complete.

Place excavated material in successive uniform maximum loose layers not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of rollers or vibrators. Do not place fill on muddy or frozen subgrade.

Soil Compaction Tests - Conduct in accordance with requirements of ASTM 0698 or AASHTO T99. Tests for cohesionless soils shall be conducted in accordance with ASTM Standard D2049 if a well-defined moisture-density relationship curve is not obtainable by impact compaction methods.

Use method A, B, C or D as appropriate, based on soil condition and judgment of the testing laboratory. Samples tested shall be representative of materials to be placed (or altered). Obtain optimum moisture density curve for each type of material or combination of materials encountered or used. Use test results as a basis for compaction control. Testing includes Atterberg Limits, grain size determination, and specific gravity.

Density Control - Conduct tests for density control during compaction operations in accordance with the requirements of

ASTM 02922 - Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods, or ASTM D1556 - Test for Density of Soil In-Place by the Sand-Cone Method.

Conduct a minimum of 6 tests for every 1,000 lineal feet of trench at locations and depths designated by the Town Manager.

Conduct a minimum of 1 test for each area of excavation required for the addition of appurtenances to existing lines, such as fire hydrant installations, valves, etc., at locations and depths designated by the Town Manager.

Conduct a minimum of 1 test for each lift of structural fill required for the installation of vaults, manholes, etc., at locations and depths designated by the Town Manager.

Excavate to depths directed to accommodate testing. Backfill and compact test holes as specified herein.

If minimum compaction requirements are not met as determined by these tests, Contractor shall rip, moisture condition, and re-compact trench to the specified compaction. Such recompaction shall extend both upstream and downstream of the failed test a distance equal to half the distance from where the last compaction test was taken or 165 feet, whichever is least. Remedial compaction and retesting shall be conducted at no additional expense to the Owner.

SURFACE RESTORATION

Final Grading - Grade all areas disturbed by the construction operations after completion of backfilling and compacting. Areas which are to receive pavements, surfacing, topsoil, seeding or landscaping shall be graded as specified or shown on the drawings. Grade all other areas to match the existing ground line and to drain.

Topsoiling – Scarify surface up to 6 inches deep. Place 6 to 12 inches of suitable topsoil over all areas disturbed by the construction that do not receive other surface treatment. Do not compact topsoil during stripping, stockpiling or placing.

Grass or Sod Replacement – Grass or sod removed prior to excavation shall be transplanted within 24 hours after lifting unless wet or freezing conditions prohibit normal laying operations. Grass areas should be reseeded.

Prior to laying, till the grass or sod bed to a minimum depth of 4 inches. Soil texture after tillage shall be uniform, free of wet compressed or dry lumps.

Prior to laying, inspect the grass or sod for dead or otherwise damaged areas and replace any sections showing damage. Replacement grass or sod shall match existing sod as closely as possible.

For sod, lay sod smoothly edge to edge and press firmly into contact with underlying soil by rolling or tamping to eliminate air pockets. Where the sod and sod bed are too dry to produce specified results during rolling, water the dry sod and sod bed prior to commencement of rolling.

SURFACE IMPROVEMENT REPAIR AND REPLACEMENT

Replace and repair any surface improvements damaged or removed. Restore each disturbed improvement to original condition.

Construct replacement of all pavements in accordance with Construction Standard 2220B.

Materials used in pavement and surfacing replacement shall conform to the following specifications:

- *Aggregate for Base Course* - Conform to Standard Specification, Section 02605 - Untreated Granular Bases,

- *Aggregates for bituminous Pavement* - Conform to Standard Specification, Section 02600 - Paving and Surfacing, for surface course.

- *Bituminous Materials* - Conform to Standard Specifications, Section 02600 - Paving and Surfacing.

  Asphalt cement - AC-10
  Tack coat - SS-1 diluted with equal amount of water

- *Composition of Mixtures* - Composition of mixtures shall conform to Standard Specifications, Section 02600 - Paving and Surfacing, and meet the following criteria (Marshall Method):

  Compaction blows - 50
  Stability, lbs., minimum - 500
  Flow, 0.01 inch - 8 minimum, 18 maximum
  % air voids - 3 minimum, 5 maximum
  % voids, mineral aggregate - 14 minimum

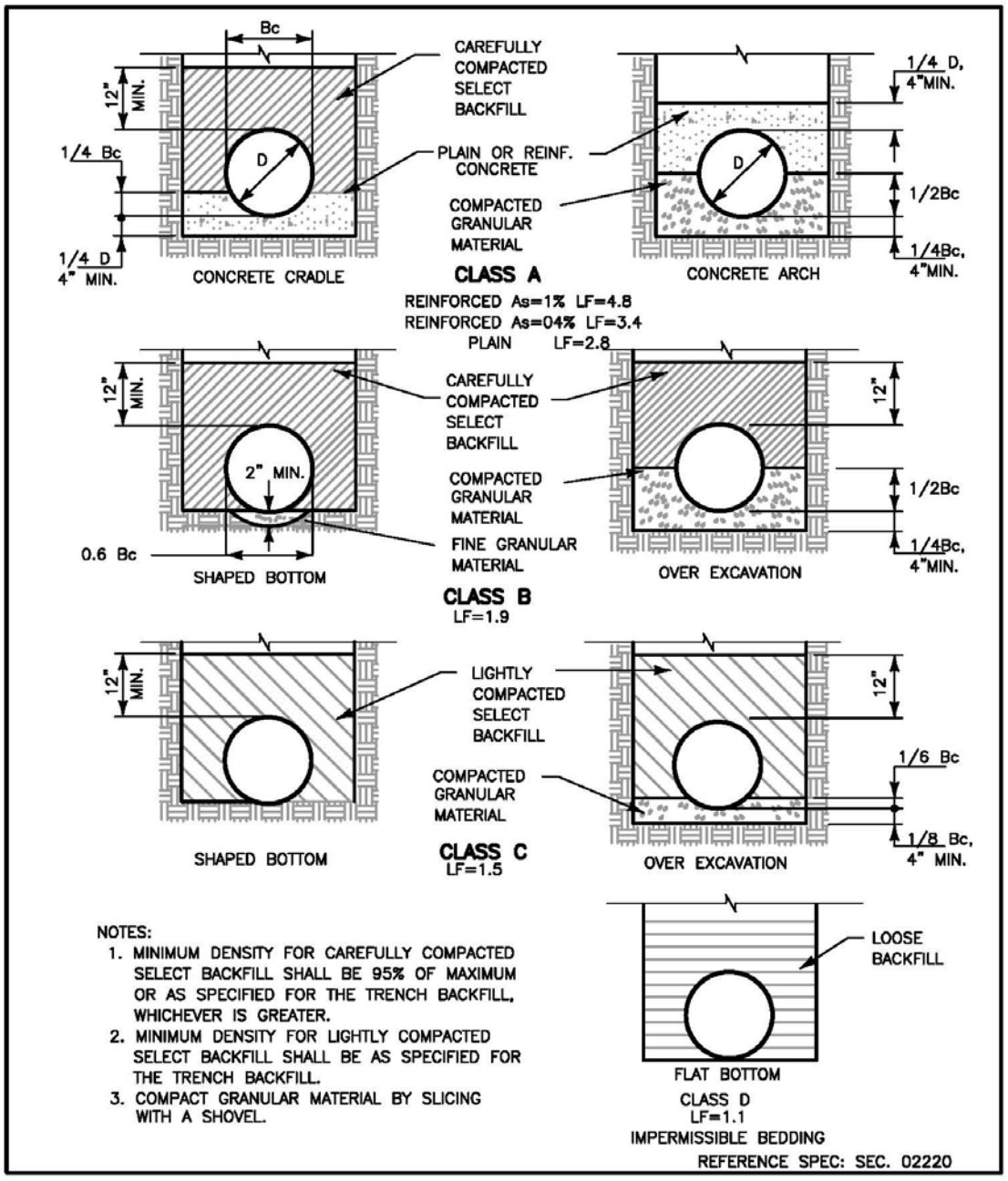
- *Concrete* - Conform to Standard Specifications, Section 03300 - Cast-in-Place Concrete.

Apply tack coat to existing pavements or surfaces against which asphalt is to be placed. Application shall be between 0.05 and 0.15 gallons per square yard. Apply no more tack coat than necessary for the day's operation.

Reshape and recompact backfilled trenches prior to pavement replacement so that roadway is smooth and accessible. Add water or dust palliative as required to prevent dusty conditions and maintain within ±1% of optimum moisture content.

If trenches cannot be patched with a hot mixed asphaltic concrete within 48 hours after backfilling, a pre-mixed cold applied asphaltic concrete shall be used as a temporary patch until a hot mixed asphaltic concrete is being produced.

Minimum pavement thicknesses shall conform to that shown in Construction Standard No. 2220B.



REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER
	FEB 1992	REDRAWN

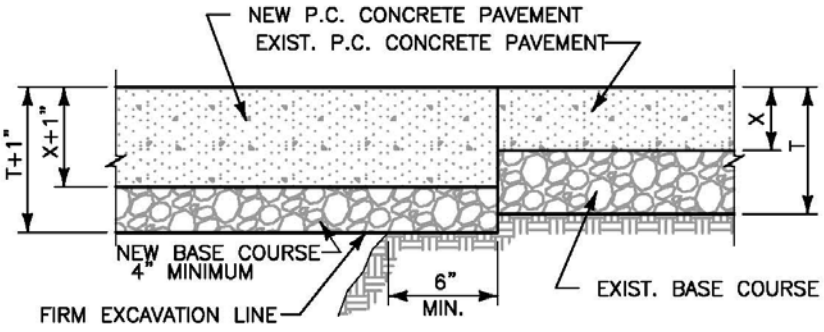
DRAWING BY: SCHUHEN

PIPE EMBEDMENT

Standard No. 2220A

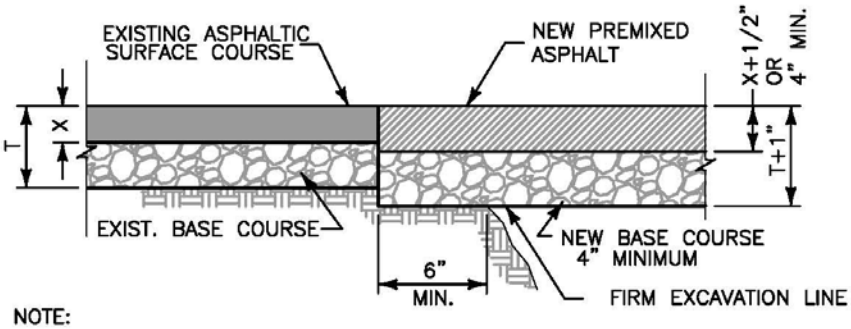
Sheet 1 of 1

Town of Telluride, Colorado



NOTE:
WHERE EXISTING PAVEMENT CONTAINS REINFORCING, THE REPLACEMENT SHALL BE REINFORCED AND DOWELED AS DIRECTED BY THE ENGINEER.

PORTLAND CEMENT CONCRETE SURFACE



NOTE:
WHERE EXIST. PAVEMENT IS CHIPSEAL, A PREMIXED HOT APPLIED ASPHALTIC CONCRETE WILL BE USED.

WHERE EXIST. PAVEMENT IS A MACHINE PLACED HOT MIXED ASPHALTIC CONCRETE, A PREMIXED HOT APPLIED ASPHALTIC CONCRETE WIL BE USED.

ALL REPLACEMENT MATERIAL SHALL BE AS APPROVED BY THE ENGINEER AND SHALL BE PLACED AND COMPACTED AS REQUIRED BY THE ENGINEER.

ASPHALTIC SURFACE

REFERENCE SPEC: SEC. 02220

REVISIONS

MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER
	FEB 1992	REDRAWN

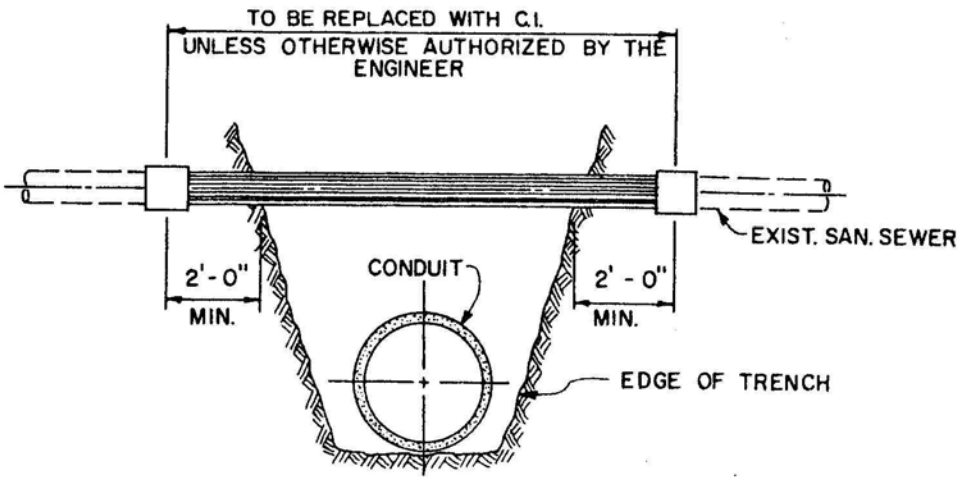
DRAWING BY: SCHUHEN

PAVEMENT REPLACEMENT

Standard No. 2220B

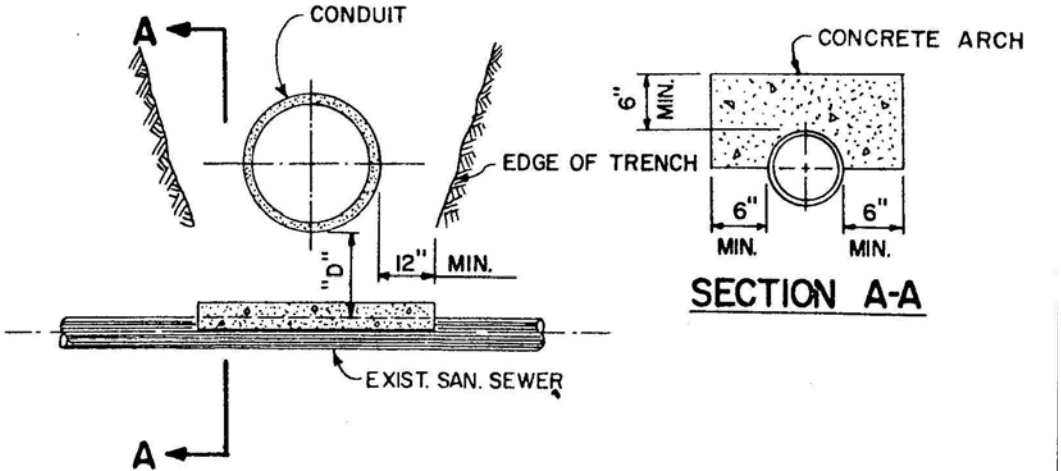
Sheet 1 of 1

Town of Telluride, Colorado



CONDUIT CROSSING UNDER SEWER

NOTE: SEWER BEDDING NOT TO BE DISTURBED. ANY OVER EXCAVATION SHALL BE REPLACED WITH LEAN CONCRETE AT THE CONTRACTOR'S EXPENSE.



CONDUIT CROSSING OVER SEWER

"D" < 2'-0"

REFERANCE SPEC: SEC. 02220

REVISIONS		
MARK	DATE	DESCRIPTION

SANITARY SEWER CROSSINGS

Standard No. 2220D

Sheet 1 of 1

Town of Telluride, Colorado

Section 02520 - STORM DRAINAGE SYSTEMS

PART I – GENERAL

WORK INCLUDED

Work under this section includes furnishing and installing storm drainage systems as shown on the drawings and as specified herein.

Definitions

Manhole Depth = Distance between invert of lowest pipe and top of cover.

Related Work Specified Elsewhere

Section 02220 - Utility Trenching, Backfilling and Compacting
Section 03300 - Cast-in-Place Concrete
Section 15071 - Reinforced Concrete Pipe

QUALITY ASSURANCE

Allowable Tolerances - Maximum horizontal deviation shall not exceed plus or minus five-tenths (0.5) of a foot from alignment shown on the drawings. Where the pipeline is to be laid at a specific elevation shown on the drawings, vertical deviations shall not exceed one-tenth (0.1) of a foot. Deviation from grades specified or shown on the drawings will not be allowed unless authorized by the Engineer in writing and are to be documented on the as-built plans.

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Society for Testing and Materials (ASTM)

ASTM A48	Gray Iron Castings
ASTM C14	Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C270	Mortar for Unit Masonry
ASTM C478	Precast Reinforced Concrete Manhole Sections

Federal Specifications

SS-S-00210 (GSA-FSS)	Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

SUBMITTALS

Include the following:

- *Product Data* - Submit catalog data or brochures on manufactured items specified and proposed for use.
- *Certificates of Compliance* - Furnish certification that standards specified herein are met.

PRODUCT DELIVERY, STORAGE AND HANDLING

Exercise care in unloading, handling, stockpiling, and installing to prevent damage to materials. Remove broken or damaged materials from the construction site and do not use in any portion of the construction.

Any broken, damaged, or otherwise defective materials which are included in the construction shall be removed and replaced at no additional expense to the Owner.

PART II – PRODUCTS

PIPE MATERIALS

Reinforced Concrete Pipe - Refer to Section 15071.

MANHOLE MATERIALS

Bases

Concrete	3000 psi strength as specified in Section 03300-Cast-in-Place Concrete
Precast	5000 psi strength concrete, cast integrally with riser section. Conform to ASTM C478.

Risers Cones and Tops

Material	Precast concrete
Conformance	ASTM C478
Cement	Type II Joints Tongue and groove
Joint Gaskets	Preformed flexible plastic gasket conforming to Fed. Spec. SS-S-00210 (GSA-FSS), Type I-rope form, 1-1/2" diameter for 48-inch manholes, 1-3/4" diameter for 60-inch manholes
Joint Filler	Cement mortar conforming to ASTM C270, Type M

Ring and Cover (Heavy Duty)

Material	Gray Iron
Conformance	ASTM A4b, Class 30
Cover Pattern	Non-slip surface with word "STORM" cast in top Bearing Surface Machined to insure good seating between the ring and cover
Combined Weight	Not less than 400 pounds

Steps

Material	Aluminum
Conformance	ASTM C478 and Fed. Spec. QQ-A-200/8
Capacity	1000 Lb. at 6-inch from wall 1500 Lb. at 4-inch from wall
Width	12 inches
Construction	Furnish with non-skid grooves and drop front design or safety nosings

Cement Mortar

Conformance	ASTM C270, Type M

Non-shrink Grout

Approved commercial factory mixed product made especially for Intended use, non-metallic type, conforming to Corps of Engineer Specifications CRD-C588.

STORM INLET MATERIALS

Box Structures

Concrete	3000 psi strength as specified in Section 03300 Cast-in-Place Concrete
Precast	Precast reinforced concrete structures may be used upon approval by the Town Manager.

Curb Inlet Frame, Grate, Curb Box (Heavy Duty)

Material	Gray iron

Conformance	ASTM A48, Class 30
Approved Mfgr.	Neenah R-3246 single inlet, R-3296-A double inlet
Curb Face	3" radius
Grate	Approximately 260 square inches
Total Weight	526 pounds single, 1000 pounds double

Steps

Material	Aluminum
Conformance	ASTM C478 and Fed. Spec. QQ-A-200/8
Capacity	1000 Lb. at 6 inch from wall 1500 Lb. at 4 inch from wall
Width	12 inches
Construction	Furnish with non-skid grooves and drop front design or safety nosings.

PART III - EXECUTION

PREPARATION

Excavation - Perform excavation in accordance with the requirements of Section 02220 - Trenching, Backfilling and Compacting

Cleaning and Inspection - Clean the interior of all pipe and fittings of all foreign material and inspect for cracks, flaws or other defects before installation and keep clean until the work is accepted. All joint contact surfaces shall be kept clean until the joint is completed. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from jobsite.

Take every precaution to prevent foreign material from entering the pipe and fittings. No debris, tools, clothing or other material shall be placed in the pipe. Plug ends of pipe left open during construction to prevent contamination/sedimentation of pipe.

Excavation of Existing Improvements - When connections are to be made to an existing pipe or appurtenance and the actual elevation of the connection cannot be determined without excavation, excavate and expose the existing improvement before laying any pipe or conduit and verify design lines and grades will work with existing elevation, notify Engineer of any discrepancy prior to proceeding. The Town Manager will inspect the existing improvement and approve the proposed type of connection before completion of the connection.

INSTALLATION

Pipe Laying - General

Begin pipe laying at the lowest point and install the pipe with the spigot ends pointing in the direction of flow. Lay all pipes straight between changes in alignment and at uniform grade between changes in grade or slope.

As each length of pipe is placed in the trench, complete each joint in accordance with the applicable portions of the pipe material specifications and bring to the correct line and grade. Secure the pipe in place with the specified bedding material tamped under and around the pipe. Do not walk on small diameter pipe or otherwise disturb any conduit after jointing has been completed.

Lay pipe true to line and grade and join in such a manner that the offset of the inside of the pipe at any joint is held to a minimum at the invert. Limit the maximum offset at the invert to 1% of the inside diameter of the pipe or 3/8 inch, whichever is smaller.

Reinforced Concrete Pipe - The pipe shall be laid up-grade beginning at the lower end of the pipe line. Lower sections of pipe into the trenches without dropping. Any pipe which has its grade or joint disturbed after laying shall be taken up and re-laid. Do not lay the pipe in water or when trench conditions or the weather prevents a stable installation. Any section of pipe already laid which is found to be out of alignment, defective or damaged shall be taken up and re-laid or replaced, at no additional expense to the Owner.

Bell and Spigot or Tongue and Groove Joints - The first pipe shall be bedded to the established grade line placing the bell end or groove end upstream. The gasket joint shall be installed in accordance with the manufacturer's recommendations. The gasket shall be fitted in place and care shall be taken in fitting the pipe units together to avoid twisting or otherwise displacing or damaging the gaskets. When the pipe is laid on tangent, the pipe units shall be fitted together so that an annular space of not less than 1/16 inch or more than 3/16 inch will exist between the spigot end of one pipe and the shoulder of the bell of the adjacent pipe.

Connections to Existing Manholes - Construct storm sewer pipe connections to existing manholes in such a manner that the finished work conforms to the requirements specified for new manholes. Where there is no existing provision for connection, core drill the smallest opening possible for the pipe connection needed into the wall of the existing manhole and insert the new pipe. Chip the existing foundation bench to the cross section of the new pipe and smoothly finish with cement mortar to form a smooth continuous invert. Use non-shrink grout both inside and outside the manhole to seal the connection of the new line to the manhole wall so the junction is watertight.

Backfill and Compaction - Backfill and compaction is to be in accordance with Section 02220 - Trenching, Backfilling and Compacting.

INSTALLATION OF MANHOLES, STORM DRAIN INLETS AND OTHER APPURTENANCES

General - Install all manholes and appurtenances at locations indicated on the drawings. Record "as-built" measurements prior to backfill to reference all appurtenances to the nearest permanent surface improvement,

Construction of Manholes and Storm Drain Inlets - Construct storm manholes in accordance with Construction Standard No. 2520A. Construct storm drain inlets in accordance with Construction Standards No. 2520D and 2520E.

Set stubs and mains before concrete is placed and recheck for alignment and grade before concrete has set. Where this is not possible, terminate pipe flush with interior manhole wall and construct transitions smooth and of proper radius for uninterrupted flow. Shape base with a wood float and finish with a steel trowel. Allow base to set a minimum of 24 hours before continuing construction.

Set each manhole or inlet section plumb and neatly point inside of joints. Use sections of various heights to bring ring and cover to established elevation. Cut openings in the field to receive entering pipes of sufficient size to provide 3/4 inch annular space around pipe. After pipe is in position, fill space solidly with non-shrink grout. Fill all lifting holes and other imperfections in the interior manhole wall with cement mortar.

Joint manhole sections using preformed flexible plastic gaskets or grout. Install gaskets in accordance with manufacturer's recommendations and only when all surfaces are clean, dry and

warm. Where mortar joints are used, set each section in a bed of mortar with a minimum thickness of 1 inch.

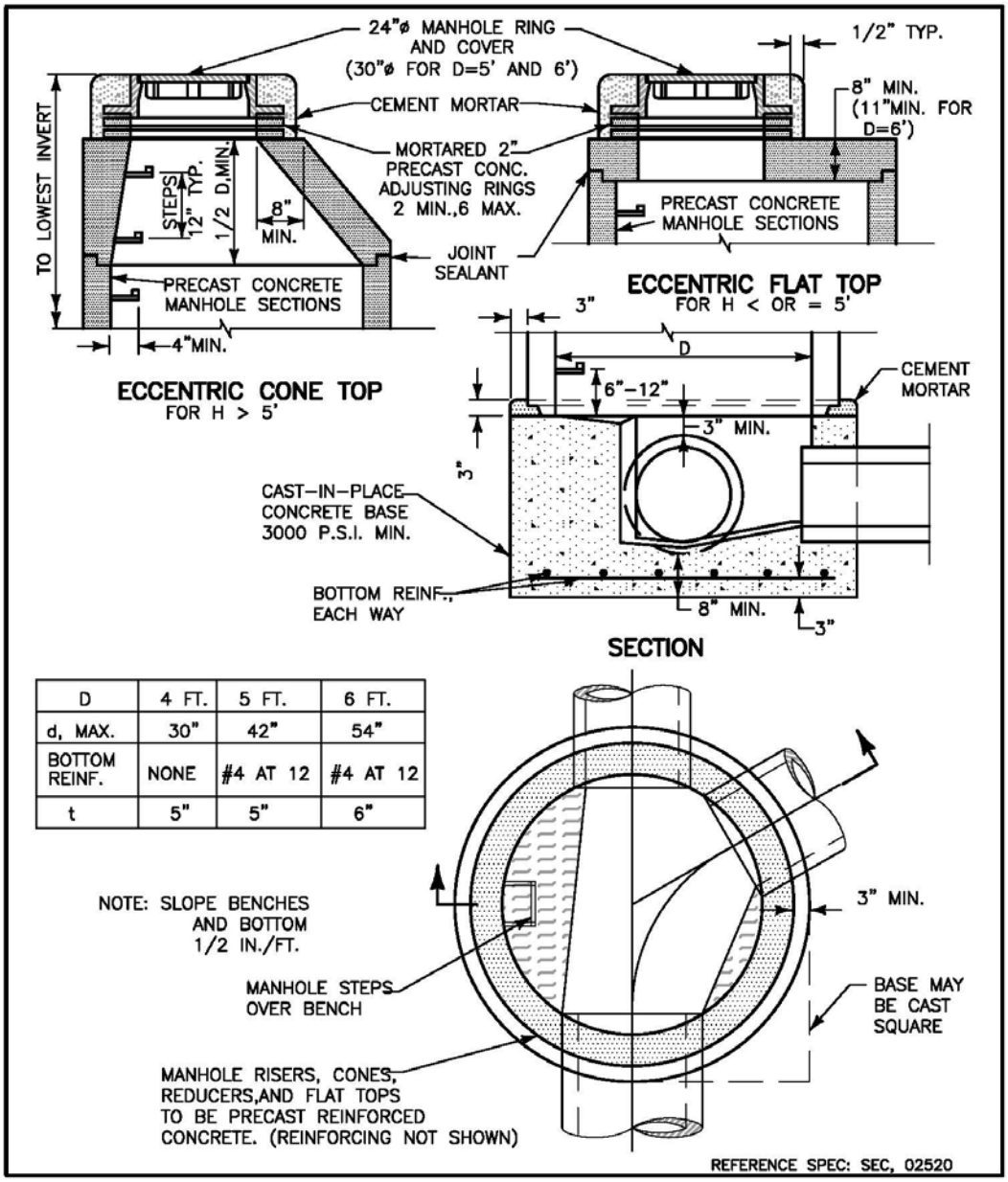
Use heavy duty ring and covers. Install cover rings on a minimum of two and a maximum of six 2-inch thick precast adjusting rings above the top or cone of the manhole. Set cover rings in a full bed of mortar and encase in mortar around the entire perimeter. Set the top of the rim 24 inches below finish grade in farmed fields, 6 inches below finish grade in gravel roadways and flush with finish grade in paved roadways and all other areas.

Backfill and Compaction - Backfill and compaction is to be in accordance with Section 02220 - Trenching, Backfilling and Compacting.

FIELD QUALITY CONTROL

Alignment Tests - Lamp each section of pipe between manholes, and between manholes and inlets, in the presence of the Town Manager to determine whether any displacement of the pipe has occurred. Repair any poor alignment, displaced pipe, or other defects discovered.

Backfill and Compaction - Backfill and compaction quality control is to be in accordance with Section 02220 - Trenching, Backfilling and Compacting.



D	4 FT.	5 FT.	6 FT.
d, MAX.	30"	42"	54"
BOTTOM REINF.	NONE	#4 AT 12	#4 AT 12
t	5"	5"	6"

REVISIONS

MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER
	FEB 1992	REDRAWN

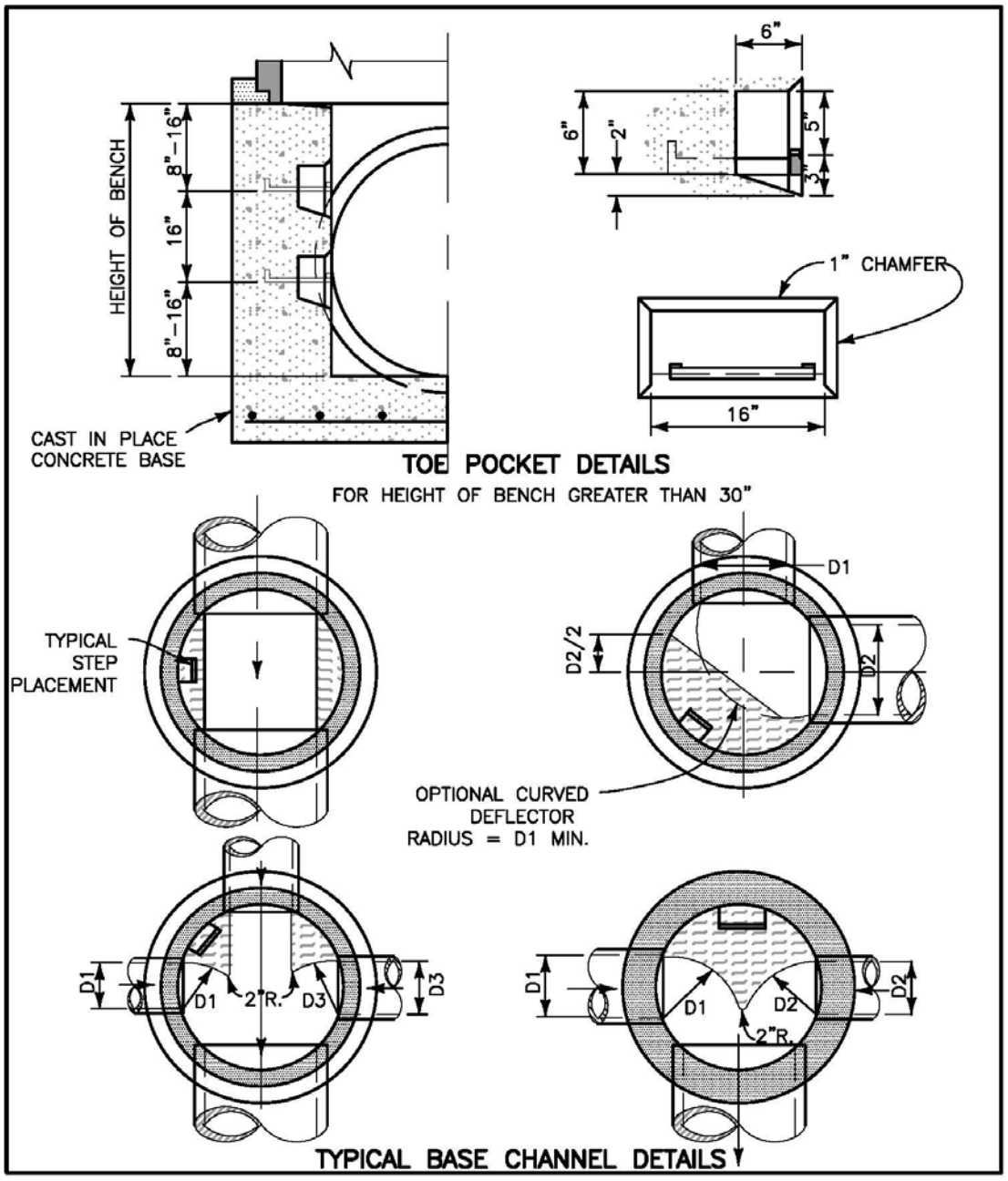
DRAWING BY: SCHUHEN

STORM MANHOLE

Standard No. 2520A

Sheet 1 of 2

Town of Telluride, Colorado



REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER
	FEB 1992	REDRAWN

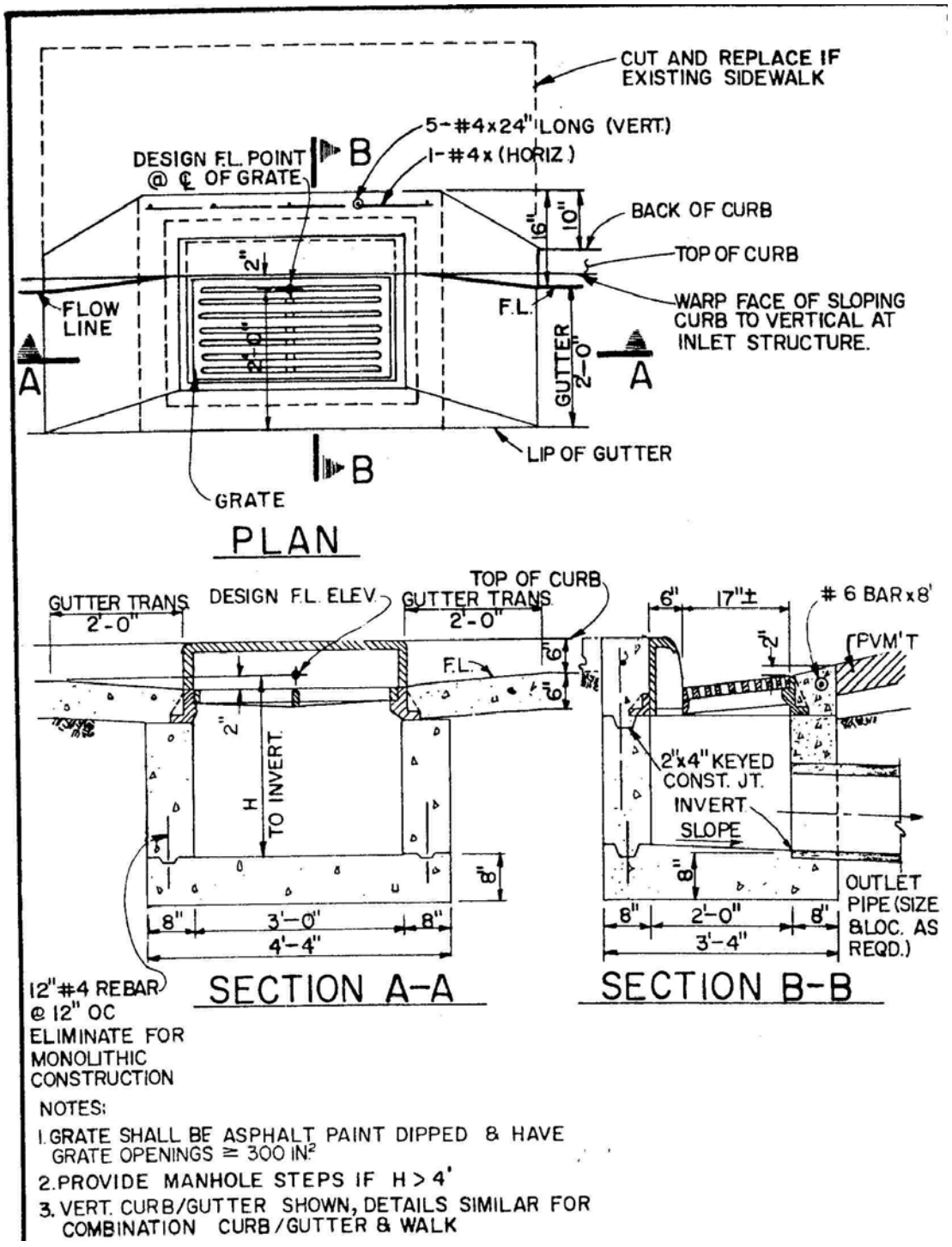
DRAWING BY: SCHUHEN

STORM MANHOLE

Standard No. 2520A

Sheet 2 of 2

Town of Telluride, Colorado



NOTES:

1. GRATE SHALL BE ASPHALT PAINT DIPPED & HAVE GRATE OPENINGS ≥ 300 IN²
2. PROVIDE MANHOLE STEPS IF H > 4'
3. VERT. CURB/GUTTER SHOWN, DETAILS SIMILAR FOR COMBINATION CURB/GUTTER & WALK

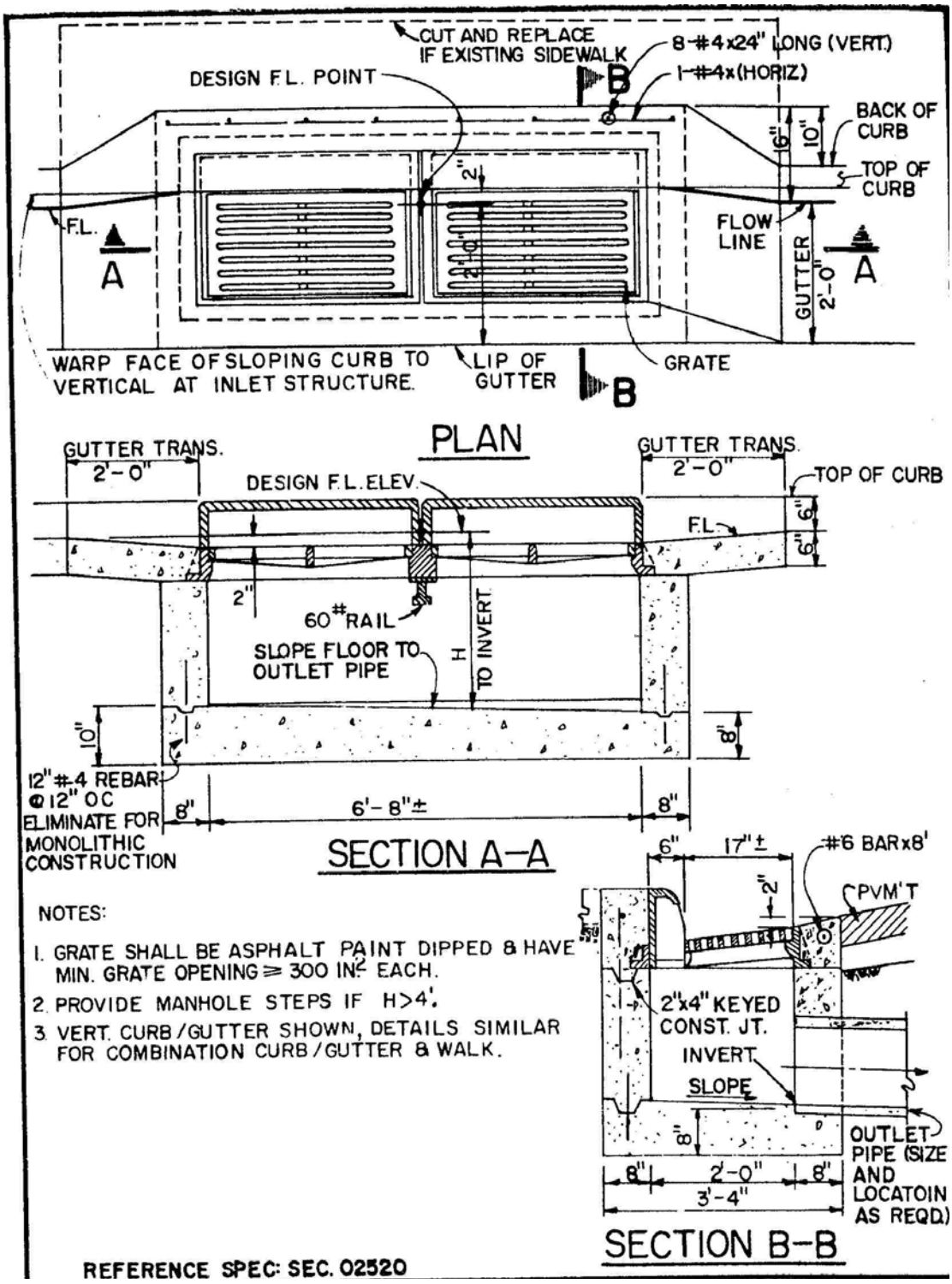
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

COMBINATION CURB/GUTTER INLET (SINGLE)

STANDARD No. 2520D

Sheet 1 of 1

Town of Telluride, Colorado



REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

COMBINATION CURB/GUTTER INLET (DOUBLE)

STANDARD No. 2520E

Sheet 1 of 1

Town of Telluride, Colorado

Section 02550 - WATER TRANSMISSION AND DISTRIBUTION LINES

PART I – GENERAL

WORK INCLUDED

Work under this section includes furnishing, installing, disinfecting, and testing water transmission and distribution pipeline systems as shown on the drawings and as specified herein.

Related Work Specified Elsewhere

Section 02220 - Utility Trenching, Backfilling and Compacting
Section 03300 - Cast-in-Place Concrete
Section 15062 - Ductile Iron Pipe
Section 15064 – Plastic Pipe

QUALITY ASSURANCE

Allowable Tolerances - Maximum deviation shall not exceed plus or minus five-tenths (0.5) of a foot from alignment shown on the drawings. Where the pipeline is to be laid to a specific grade shown on the drawings, deviation from elevation shall not exceed three-tenths (0.3) of a foot.

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Society for Testing and Materials (ASTM)

ASTM A48	Gray iron Castings
ASTM B88	Seamless Copper Water Tube
ASTM C14	Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C270	Mortar for Unit Masonry
ASTM C478	Precast Reinforced Concrete Manhole Sections

National Fire Protection Association

NFPA 194	Fire Hose Connections

Federal Specifications

SS-S-210A	Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
QQ-A-200/8	Aluminum Alloy Bar, Rod, Shapes, Tube and Wire, Extruded, and Structural Shapes, 6061

American Water Works Association (AWWA)

AWWA C502	Dry Barrel Fire Hydrants
AWWA C60l	Disinfecting Water Mains
AWWA C700	Cold-Water Meters - Displacement Type

SUBMITTALS

Include the following:

- *Product Data* - Catalog sheets and descriptive literature on all materials and equipment specified herein.
- *Certificates of Compliance* - Manufacturer's affidavit stating compliance with referenced published standards specified herein.

JOB CONDITIONS

Protection - Take every precaution to prevent foreign material from entering the pipe, fittings and valves during installation. Apply a protective cover over each end of the pipe until the connection is made to the adjacent pipe.

Coordinate pipe delivery closely with installation to minimize the possibility of contamination and exposure to sun and climate. Do not place debris, tools, clothing or other materials in the pipe.

Whenever pipe installation is interrupted, seal the open end of the pipe with a watertight plug to prevent trench water, debris or other material from entering the pipe. Follow procedures or techniques that will prevent pipe flotation.

Under no circumstances shall trench water be allowed to enter the pipeline. If water is present in the trench, the seal shall remain in place until the trench is pumped dry.

Unsuitable Conditions - No pipe shall be installed when trench or weather conditions prevent installation in accordance with standards specified herein.

PRODUCT DELIVERY, STORAGE: AND HANDLING

All pipe, fittings, valves and specials shall be handled, stored and protected to prevent damage to materials and protective coatings and linings. Under no circumstances shall such materials be dropped or dumped into the trench. Remove any broken or damaged materials from the construction site and do not use in any portion of the construction. Any broken, damaged, or otherwise defective materials that are included in the construction shall be removed and replaced at no additional expense to the Owner.

PART II – PRODUCTS

PIPE AND PIPE FITTINGS

Ductile Iron - Refer to Section 15062
Plastic - Refer to Section 15064

FIRE HYDRANTS

Type	Dry barrel
Conformance	AWWA C502
Outlet Size	One 4-1/2 inch, two 2-1/2 inch nozzles
Outlet Threads	Meet requirements of local fire department
Hydrant Size	5-1/4-inch
Inlet Size	6-inch
Bury Depth	7-feet to top of pipe
Operation	Open counterclockwise
Color	Red
Special Features	Provide traffic model hydrants with break away bolts and coupling
Acceptable Product	Mueller Centurion

VALVES

Gate Valves (3 inches and larger)

Location	As shown on drawings
Service	Buried
Conformance	AWWA C500
Size & Location	See drawings
Type	Double disc
Ends	Mechanical joint
Stem Seal	0-ring
Operator	2-inch operating nut
Operation	Open counterclockwise
Acceptable Product	Clow F5065

VALVE BOXES

Material	Cast iron
Size	5-inch diameter minimum
Type	Adjustable of the screw type
Cover	Deep socket type with the word "WATER" cast in the top
Accessories	Furnish at least one valve wrench for operating buried valves

MANHOLE MATERIALS

Bases

Concrete	3000 psi strength as specified in Section 03300 -Cast-in-Place Concrete or
Precast	5000 psi strength, concrete, cast integrally with riser section. Conform to ASTM C478.

Risers, Cones and Tops

Material	Precast concrete
Conformance	ASTM C478
Cement	Type II
Joints	Tongue and groove
Joint Gaskets	Preformed flexible plastic gasket conforming to Fed. Spec. SS-S-210A, Type I - Rope Form, 1-1/2" diameter for 48-inch manholes, 1-3/4" diameter for 60-inch manholes.
Joint Filler	Cement mortar conforming to ASTM C270, Type M

Ring and Cover (Heavy Duty)

Material	Gray iron, ASTM A48, Class 30
Cover Pattern	Non-slip surface with the word "WATER" cast in the top Bearing Surface Machined to insure uniform, even seating between the ring and cover Combined Weight Not less than 400 pounds

Ring and Cover

Material	Aluminum
Cover Pattern	Non-slip surface with the word "WATER" cast in the top
Bearing Surface	Machined to insure uniform, even seating between the ring and cover
Options	Provide cover lock
Combined Weight	Not less than 250 pounds

Steps

Material	Cast iron, ASTM A485 Class 35
Conformance	ASTM C478
Capacity	1,000 Lb. at 6-inch from wall

	1,500 Lb. at 4-inch from wall
Width	12-inch minimum
Construction	Furnish with non-skid grooves and safety nosings or drop front design

Steps

Material	Aluminum, Fed. Spec. QQ-A-200/8
Conformance	ASTM C478
Capacity	1,000 Ib. at 6-inch from wall
	1,500 Ib. at 4-inch from wall
Width	12-inch nominal
Construction	Furnish with non-skid grooves and drop front design or safety nosings

Cement Mortar

Conformance	ASTM C270, Type M

Non-Shrink Grout - Commercial factory mixed product made especially for intended use, non-metallic, conforming to Army Corps of Engineers Specifications CRD-C 588.

SERVICE LINE MATERIALS

Copper Water Tube

Conformance	ASTM B88, Type K

Corporation Stops

Inlet	I.P. thread
Outlet	Insulated coupling for copper pipe
Acceptable Product	Mueller H-15028 (3/4" and 1")
	Mueller H-15023 (1-1/2" and 2")

Curb Stops

Inlet & Outlet	Compression connection for copper pipe
Acceptable Mfgr.	Mueller

Curb Boxes

Material	Cast iron
Lettering	"WATER" cast in cover
Acceptable Mfgr.	Mueller

WATER SERVICE METERS

Type	Displacement
Conformance	AWWA C700
Size	3/4 inch
Casing	Frost proof type
Bottom Plates	Cast iron treated by hot dip galvanized or baked enamel with a plastic liner and gasket to prevent leakage
Register	Straight, reading in U.S. gallons with center sweep test hand and replaceable change gears
Drive	Magnetic coupled
Register Box	Designed to accommodate remote reader type register
Serial Number	Imprinted on case and the register box lid
Acceptable Product	Hersey Model MMDII
Accessories	Remote reading device required for all interior installed meters.

Meter Yoke

Type	Flexible copper with plain stop

Acceptable Product	Mueller H-14098 for meter pits; Mueller H-14174 or Mueller H-1421 for meters installed indoors

METER PIT MATERIALS

Risers

Material	Concrete pipe
Conformance	ASTM C14, standard strength

Cover

Type	Frost proof
Material	Cast iron or aluminum
Size	Minimum 11-inch diameter opening
Lettering	"WATER METER" cast in cover
Acceptable Product	Mueller H-10813 or approved equal

CONCRETE

Refer to Section 03300 - Cast-in-Place Concrete,

PART III - EXECUTION

PREPARATION

Excavation - Perform excavation in accordance with the requirements of: Section 02220 - Utility Trenching, Backfilling and Compacting

Verification - Verify dimensions, class, and condition of all existing and proposed pipe, valves, fittings and equipment prior to installation to insure a sound and continuous piping system.

Cleaning and Inspection - Clean all pipe, fittings, valves and related materials thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from jobsite.

INSTALLATION

Connections to Existing Pipelines - Make connections between new work and existing piping using suitable fittings for the conditions encountered. Make each connection at a time authorized by the Town which will least interfere with service to customers. Provide facilities for proper dewatering and disposal of all water from dewatered lines and excavations without damage to adjacent property.

The Telluride Public Works Department will operate all valves, hydrants, blowoffs, and curb stops, and no valve or other control unit shall be operated for any purpose by the Contractor.

Take all precautions to prevent contamination when making connections to existing potable water lines. No trench water, mud or other contaminating substances shall be permitted to enter the pipeline.

Swab the interior of all new pipe, fittings and valves installed in connection to the existing pipeline with a 5% (50,000 ppm) chlorine solution prior to installation. After the connection is completed, flush the main to reduce chlorine to a concentration of 1 mg/1 or less.

Pipe Laying - Install pipe with bell ends facing the direction of laying. Where pipe is laid on a grade of 10% or greater, proceed uphill with the installation with the bell ends facing upgrade.

The pipeline shall be installed so that a positive or negative grade is maintained between high and low points to avoid air pockets. If permanent air vents are not provided, record location of all high points so they may be readily located.

As each length of pipe is placed in the trench, the joint shall be completed in accordance with the applicable portions of the specifications and the pipe shall be brought to the correct line and grade. Secure the pipe in place with the specified bedding material tamped under and around the pipe except at the joints.

Depth of Pipeline - Unless otherwise shown on the drawings, minimum depth of cover from the finished surface to the top of the pipe shall be 7 feet.

Concrete Encasement - Install concrete encasement where indicated on the drawings or where required by other sections of the specifications. Block all pipe in place to prevent flotation.

Reaction Anchorage and Blocking - Provide thrust blocks, anchors, joint harnesses or other approved means for preventing pipe movement. Install at all push-on or mechanical joint plugs, tees, crosses; bends deflecting 11-1/4 degrees or more; reducers and valves installed in piping subjected to internal hydrostatic pressure in excess of 13 psi.

Thrust Blocks - Construct thrust blocks in accordance with Construction Standard 2550C, sized to accommodate the specified test pressure of the pipeline. Thrust blocks shall extend from the fitting to solid undisturbed earth and shall be constructed so the joints are accessible for repair. If adequate support against undisturbed earth cannot be obtained, provide joint harnesses.

Joint Harness - Provide joint harnesses or other supports for fittings installed in fills or other unstable soil, above grade, or exposed within structures as required by the drawings, as specified in other sections of the Project Manual or as necessary to prevent movement.

Protection of Metal Surfaces - Protect all ferrous metal rods, clamps, bolts, and other accessories in contact with earth or fill material and not encased in concrete, with two coats of coal tar paint. Apply the first coat to clean, dry metal surfaces and allow to dry before applying the second coat.

Sewer Crossings - Where water lines cross sewer mains, and the sewer pipe is above the water main or less than 24 inches clear distance vertically below the water main, construct the crossing by one of the following methods:

1. Install ductile iron pipe centered on the intersection with the sewer main of sufficient length to maintain 10-foot clear distance between any joint and the sewer line. Between the water pipe and the sewer pipe, use approved transition couplings for joints or encase the joints in a concrete collar at least 6 inches thick extending a minimum of six inches either side of the joints.

2. Encase sewer pipe with concrete at least 6 inches thick at all locations within 10 feet either side of the waterline. Minimum reinforcement shall consist of four No. 5 bars, one placed at each corner of the section and tied by No. 3 bars at 3-foot centers.

INSTALLATION OF PIPELINE APPURTENANCES

Install all valves, manholes and other equipment appurtenant to the pipeline at locations indicated on the drawings. Record "as-built" measurements prior to backfill, referencing all newly installed material and equipment to the nearest permanent surface improvement.

Installation of Valves - Install valves in the pipeline in the same manner specified for laying and jointing the pipe and in accordance with Construction Standard 2550A. Provide extended stems on valves where required so that the operating nut is not lower than 4 feet below finished grade.

Valve Boxes - Except where specified otherwise, install valve boxes on all buried valves in accordance with Construction Standard 2550A. Install boxes so that no stress is transmitted to the valve. Set boxes plumb and directly over the valve with the top of the box placed flush with the finished grade. Backfill and thoroughly compact around each box.

Blowoff Assemblies - Construct/blowoff assemblies in accordance with Construction Standard 2550F or 2550G

Air Relief Valve Assemblies - Construct air relief valve assemblies in accordance with Construction Standard 2550H.

Water Meter Assemblies - Construct water meter assemblies in accordance with Construction Standard 2550I.

Fire Hydrant Installation - Construct fire hydrants in accordance with Construction Standard 2550J.

Construction of Manholes - Construct manholes in accordance with ASTM C478 and ASTM C891, seal pipe connections at wall with nonshrink grout a minimum thickness of 1 inch, or use flexible plastic gaskets to make a watertight joint. Use sections of various heights to bring manhole ring and cover to established elevation. Fill all lifting holes and other imperfections in the interior manhole wall with cement mortar. Install pre-formed flexible plastic gasket joints in accord with manufacturer's recommendations and only when all surfaces are clean, dry and warm.

All rings and covers shall be heavy duty. Install cover rings on a minimum of two and a maximum of six 2-inch thick precast adjusting rings above the top or cone of the manhole. Set cover rings in a full bed of mortar and encase in mortar around the entire perimeter. Set the top of the ring 24 inches below finish grade in farmed fields, 6 inches below finish grade in gravel roadways, and flush with finish grade in paved roadways and all other areas.

FIELD QUALITY CONTROL

Hydrostatic Tests - After the pipe has been laid and the trench has been backfilled, all newly laid pipe or any valved section thereof shall be subjected to a pressure and leakage test. The Contractor shall provide all pumps, pipe, connections, gages, measuring devices, and all other necessary apparatus and shall conduct the test in the presence of the Town Manager.

Test Pressure - The required minimum test pressure shall be 1-1/2 times the working pressure, measured at the point of lowest elevation of the pipeline, or one 20 psi minimum, and corrected to the elevation of the test gage.

Duration of Test - Two hours minimum.

Air Removal - Prior to performance of the test, completely fill the pipeline with water for a period of 72 hours. Expel air by means of air relief valves, or hydrants. If permanent air vents or traps are not located at all high points, install corporation stops at such points so air can be expelled. After the tests are completed, plug all temporary taps.

Allowable Leakage - The allowable leakage, defined as the quantity of water that must be supplied to the test section to maintain the specified test pressure, shall not be greater than that determined by the formula

$$Q = \frac{N \times D \times (P)^{1/2}}{7{,}400}$$

in which Q is the allowable leakage in gallons per hour; N is the number of joints in the test section; P is the average test pressure in psig; and D is the nominal diameter of the pipeline in inches. Contractor shall calculate allowable loss and shall record amount of water added during the test period to maintain the required test pressure and shall submit results to the Town to show compliance with this requirement.

Repair of Leaks - If the test discloses leakage greater than the allowable leakage, the Contractor shall locate and repair the defective joints until leakage is within the specified limit. The Contractor shall repair any leaks regardless of the test results if they are serious enough to endanger the future serviceability of the pipeline.

DISINFECTION OF POTABLE WATERLINES

General - Flush and disinfect potable waterlines in accordance with the procedure set forth in AWWA C601 - Disinfecting Water Mains. Provide all temporary blowoffs, pumps, chlorination equipment, chlorine and all other necessary apparatus required.

Pipe Cleaning - If the pipe contains dirt or heavy encrusted matter that cannot be removed by flushing, clean and swab the interior of the pipe with a 1% (10,000 ppm) chlorine solution.

Preliminary Flushing - Flush pipeline prior to disinfection, except when the tablet method is used, to remove all remaining foreign material. The flushing operation shall develop a minimum velocity of 2.5 ft/sec

Chlorine Application - In general, chlorine shall be applied using the continuous feed method. However, on large diameter lines where this method is not practical, the slug method may be substituted. The tablet method may be used on short extensions (up to 2500 feet) of small diameter mains (12-inches and smaller).

Continuous Feed Method - At a point not more than 10 feet downstream from the beginning of the new main, introduce water into the line at a constant rate while adding chlorine at a minimum concentration of 25 mg/1. Maintain the chlorinated water in the pipeline for a minimum of 24 hours after which period the treated water shall contain no less than 10 mg/1 of chlorine throughout the entire length. Repeat the above procedure if the residual at the end of the 24 hours fails to meet the minimum concentration.

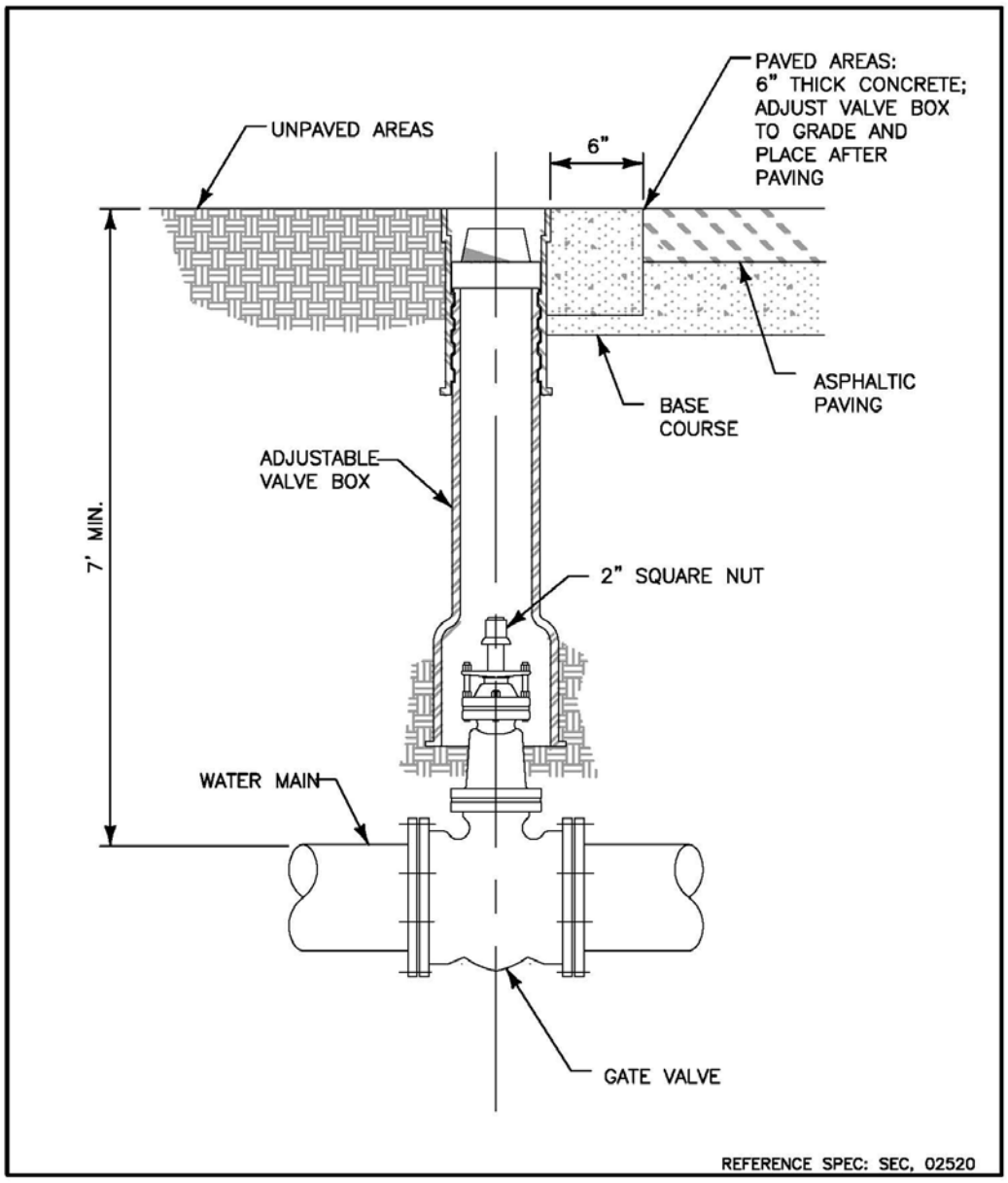
Slug Method - At a point not more than 10 feet downstream from the beginning of the new main, introduce water with a minimum chlorine concentration of 100 mg/1 at a constant measured rate into the pipeline. Apply the chlorine for a sufficient length of time to develop a solid column or slug of chlorinated water that will, as it passes along the line, expose all interior surfaces for a period of 3 hours. Check the application at the upstream end of the line.

Tablet Method - This method shall not be used if trench water or foreign material has entered the line or if the water is below 5°C (41°F). Because preliminary flushing cannot be used, this method shall only be used when scrupulous cleanliness has been exercised. Place tablets in each section of pipe in sufficient number to produce a dose of 50 mg/1. Refer to Table 2 of AWWA C601 for the required minimum number of tablets. All tablets within the main shall be attached at the top of the pipe. Introduce water into the pipeline at a rate no greater than 1 foot per second and retain the water in the pipeline for a period of 24 hours.

Final Flushing - After the required retention period, flush all heavily chlorinated water from the main until the chlorine concentration is no higher than that prevailing in the system, or less than 1 mg/1. Coordinate all flushing with the Town and contain all flushed water in appropriate manner until chlorine residual has dissipated before discharging to any ditch, storm drain or natural water course.

Bacteriologic Tests - After completion of the final flushing and prior to placing the pipeline in service, collect samples from the end of the line and test for bacteriologic quality to show the absence of coliform organisms. The number and frequency of samples shall conform to the requirements of the public health authority having jurisdiction but in no case shall the number be less than 1 for chlorinated supplies and 2 collected 24 hours apart for unchlorinated supplies. Collect samples in sterile bottles from a standard corporation stop furnished and installed by the Contractor in the main. Do not collect samples using a hose or fire hydrant.

Repetition of Procedure - If the original disinfection fails to produce satisfactory samples, repeat the disinfection procedure at no additional expense to the Owner until specified results are obtained.



REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER
	FEB 1992	REDRAWN

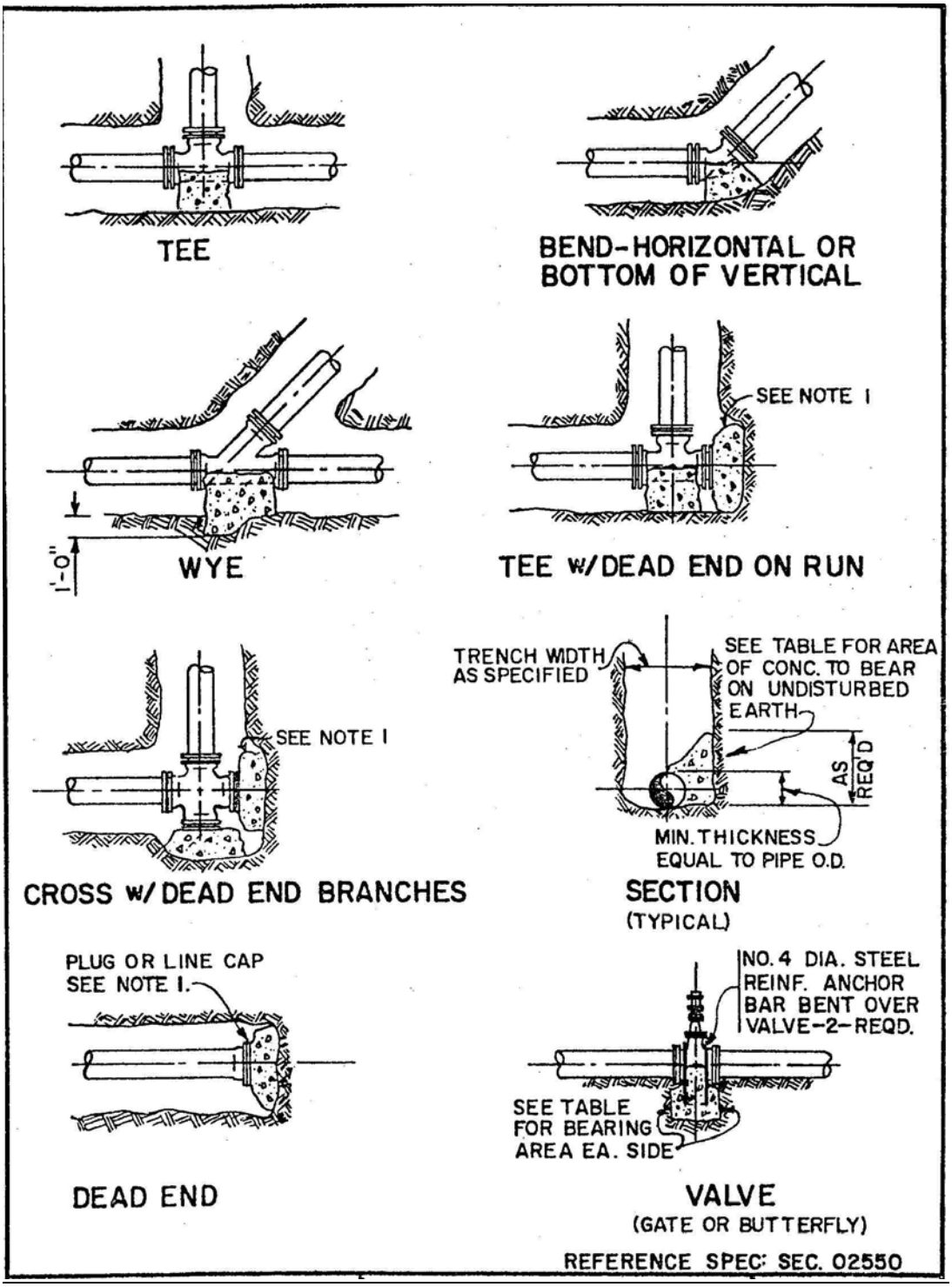
DRAWING BY: SCHUHEN

GATE VALVE AND VALVE BOX DETAIL

STANDARD No. 2550A

Sheet 1 of 1

Town of Telluride, Colorado



REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

THRUST BLOCKS

Standard No. 2550C

Sheet 1 of 3

Town of Telluride, Colorado

TABLE OF BEARING AREAS IN SQ. FT. FOR CONCRETE THRUST BLOCKING

FOR 100 P.S.I. INTERNAL STATIC PRESSURE AND 1000 LBS. PER SQ. FT. SOIL BEARING CAPACITY.

SIZE	BENDS				TEES *	GATE VALVES	DEAD ENDS	CROSS W/ 1 BRANCH PLUGGED	CROSS W/ 2 BRAN. PLUGGED
	90°	45°	22 1/2°	11 1/4°					
3	1.0	0.6	0.3	0	0.7	0.5	0.7	0.7	0.7
4	1.8	1.0	0.5	0	1.3	0.5	1.3	1.3	1.3
6	4.0	2.2	1.1	0	2.8	0.7	2.8	2.8	2.8
8	7.1	3.8	2.0	1.0	5.0	2.4	5.0	5.0	5.0
10	11.1	6.0	3.0	1.5	7.8	4.5	7.8	7.8	7.8
12	16.0	8.6	4.4	2.2	11.3	7.3	11.3	11.3	11.3
14	21.7	11.8	6.0	3.0	15.4	11.0	15.4	15.4	15.4
15	25.0	13.5	7.0	3.5	17.6	SPECIAL DESIGN	17.6	17.6	17.6
16	28.4	15.3	8.0	4.0	20.0		20.0	20.0	20.0
18	36.0	19.4	10.0	5.0	25.4		25.4	25.4	25.4
20	44.2	24.0	12.2	6.1	31.4		31.4	31.4	31.4
21	49.0	26.5	13.5	6.8	34.6		34.6	34.6	34.6
22	54.0	29.0	14.8	7.4	38.0		38.0	38.0	38.0
24	64.0	34.5	17.7	8.8	45.0		45.0	45.0	45.0
30	100.0	54.0	27.6	13.8	71.0		71.0	71.0	71.0
36	144.0	78.0	40.0	20.0	102.0		102.0	102.0	102.0

* SIZE IS BRANCH SIZE.

AREAS GIVEN IN TABLE ARE BASED UPON AN INTERNAL STATIC PRESSURE OF 100 P.S.I. AND A SOIL BEARING CAPACITY OF 1000 LBS. PER SQ. FT. BEARING AREAS FOR ANY PRESSURE AND SOIL BEARING CAPACITY MAY BE OBTAINED BY MULTIPLYING THE TABULATED VALUES BY A CORRECTION FACTOR "F".

$$F = \frac{\text{ACTUAL SPECIFIED TEST PRESSURE IN HUNDREDS OF LBS/SQ. IN.}}{\text{ACTUAL SOIL BEARING CAPACITY IN THOUSANDS OF LBS.}}$$

EXAMPLE: TO FIND BEARING AREA FOR 8"–90° BEND WITH A STATIC INTERNAL PRESSURE OF 150 P.S.I. AND WITH A SOIL BEARING CAPACITY OF 3000 LBS. PER SQ. FT.

F = 1.5 ÷ 3 = 0.5 TABULATED VALUE = 7.1 SQ. FT.

0.5 X 7.1 = 3.56 SAY 4 SQ. FT. OR 2 FT. LONG BY 2 FT. HIGH.

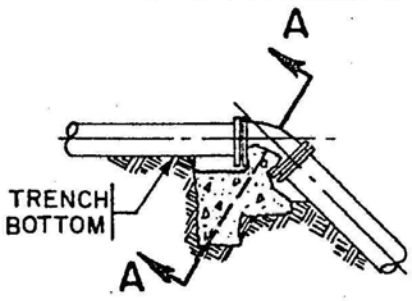
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

THRUST BLOCKS

Standard No. 2550C

Sheet 2 of 3

Town of Telluride, Colorado



TOP OF VERT. BEND

BAR SIZES FOR 100 PSI		MIN. LENGTH OF EMBED-MENT
LESS THAN	NO. OF BARS & SIZE	
60 CF	NO.4	8"
90 CF	NO.5	12"
133 CF	NO.6	16"

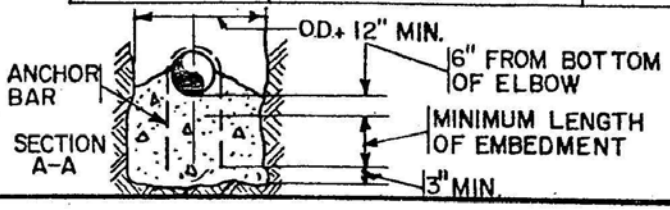


TABLE OF VOLUMES OF CONCRETE (IN CU. FT.)

REQ'D. FOR VERT. BEND ANCHOR BLOCKS FOR 100 P.S.I. PRESSURE ADJUST VOLUMES BY MULTIPLYING TABULATED VALUES BY A CORRECTION FACTOR "F."
F= ACTUAL SPECIFIED TEST PRESSURE ÷ 100

SIZE	BENDS		
	45°	22 1/2°	11 1/2°
3	3.7	1.9	1.4
4	6.5	3.3	1.7
6	14.6	7.5	3.7
8	26.0	13.2	6.6
10	40.5	20.7	10.3
12	585	30.0	14.8
14	79.5	40.7	20.2
15	91.0	46.6	23.2
16	104.0	53.0	26.5
18		67.3	33.4
20		83.0	41.0
21			45.5
22	SPECIAL		50.0
24	DESIGN		59.5
30	REQD.		
36			

NOTES FOR DRAWINGS

1. AT DEAD ENDS, WRAP FITTINGS WITH TAR PAPER, FELT, OR HEAVY KRAFT PAPER TO PROVIDE BOND BREAK BETWEEN CONCRETE AND FITTINGS.

2. ALL THRUST BLOCKING SHALL BE CAST-IN-PLACE CONCRETE HAVING A MINIMUM YIELD STRENGTH OF 2000 P.S.I.

3. THRUST BLOCKING SHALL BE CAST AGAINST UNDISTURBED EARTH. FORMS SHALL BE USED AS REQD. TO OBTAIN ADEQUATE BEARING AREA AND TO CONFINE THE CONCRETE. THRUST BLOCKING SHALL BEAR ON THE FITTING OR END CAP ONLY AND SHOULD NOT BE ALLOWED TO SPILL OVER THE JOINT OR AGAINST THE PIPE.

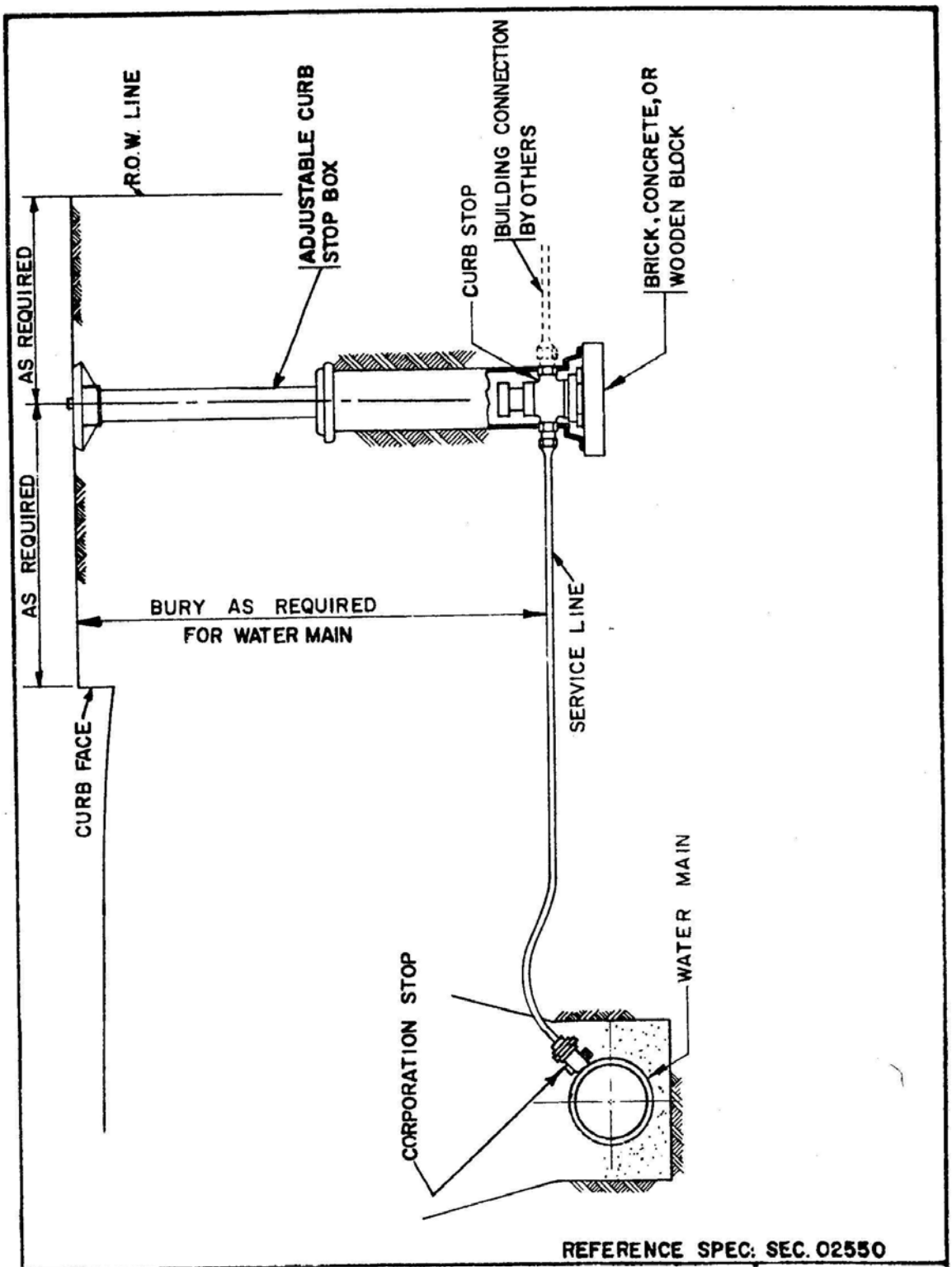
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

THRUST BLOCKS

Standard No. 2550C

Sheet 3 of 3

Town of Telluride, Colorado



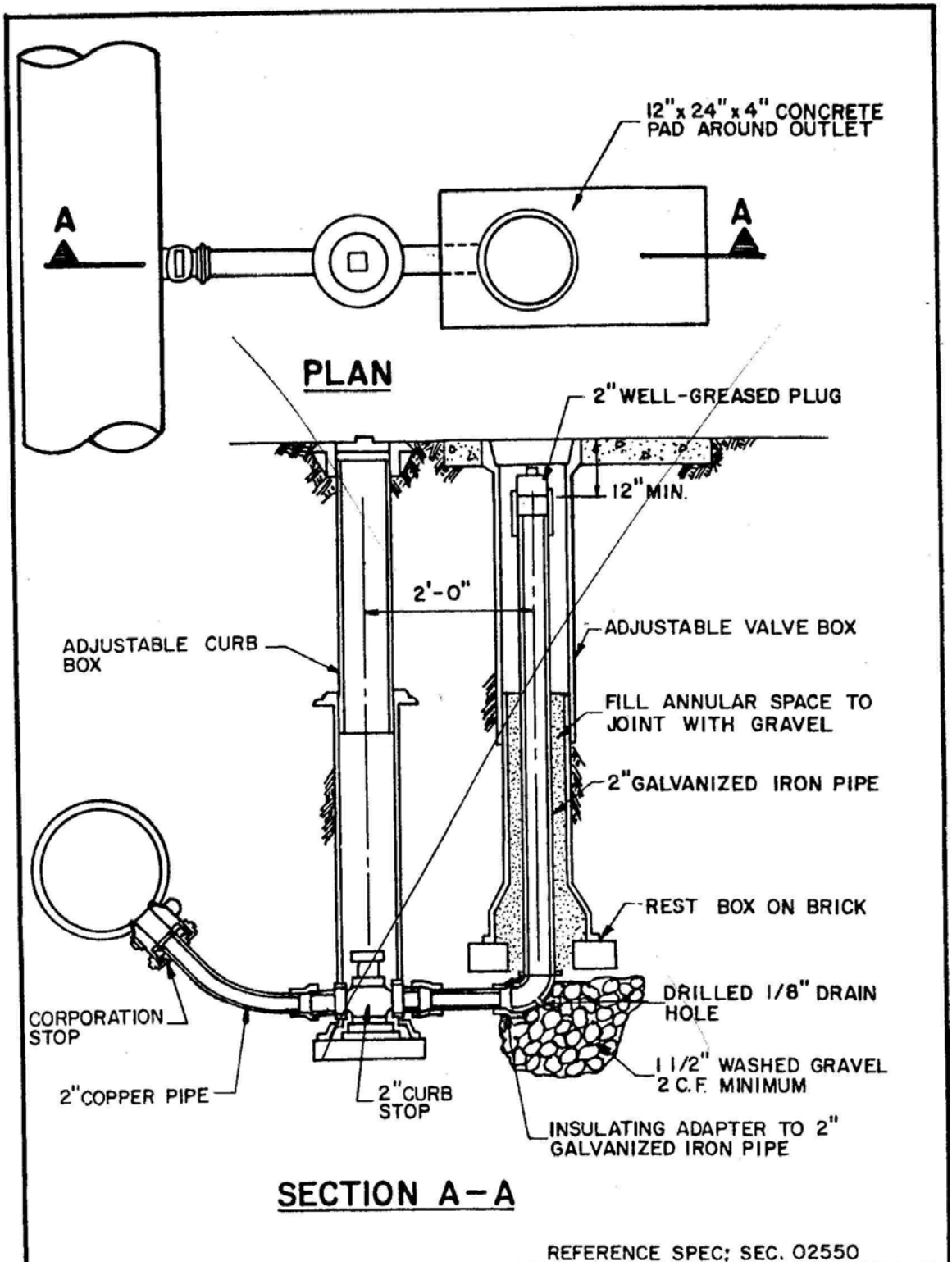
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

WATER SERVICE INSTALLATION

Standard No. 2550D

Sheet 1 of1

Town of Telluride, Colorado



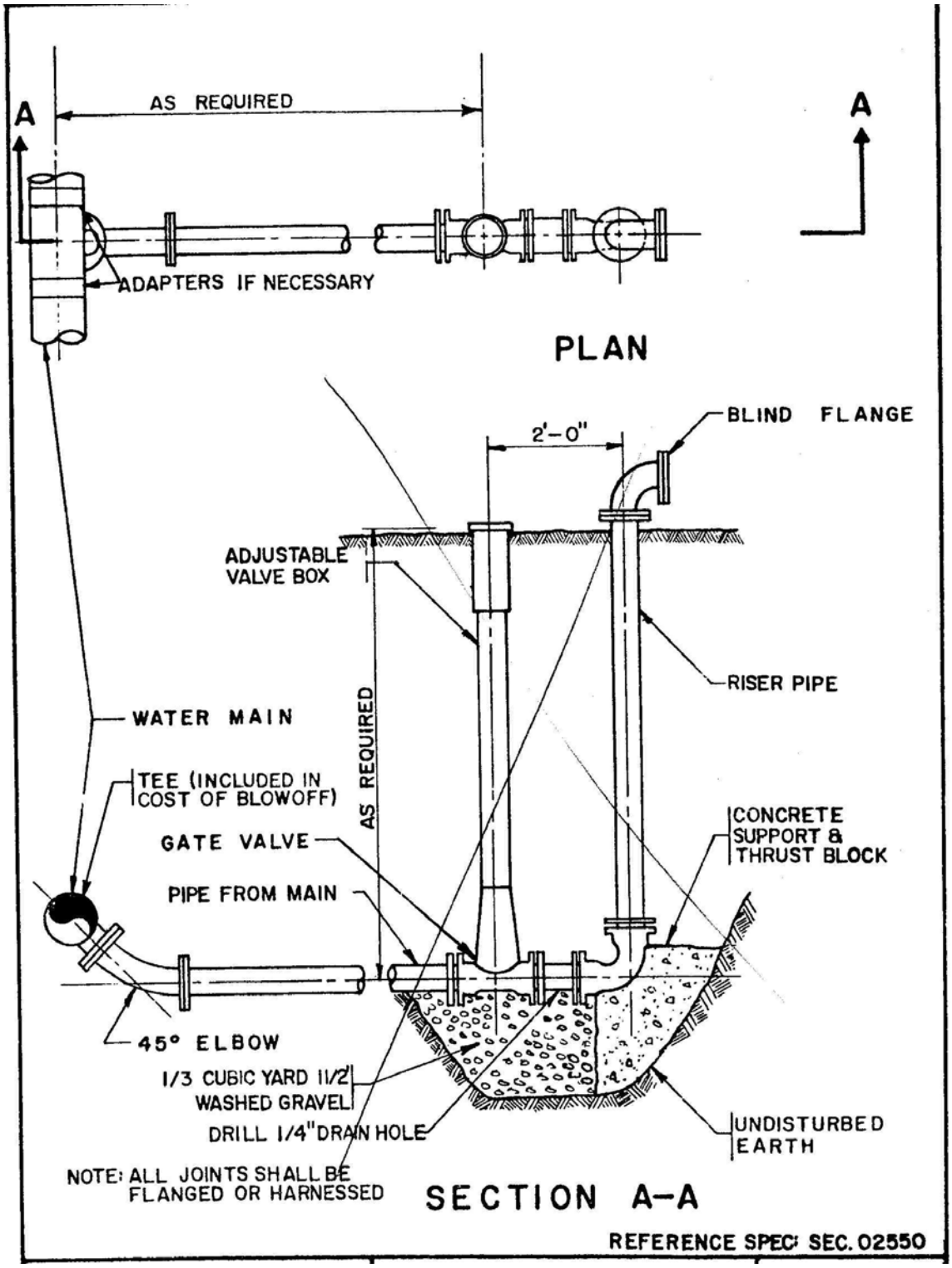
REVISIONS		
MARK	DATE	DESCRIPTION

2" BLOWOFF

Standard No. 2550F

Sheet 1 of1

Town of Telluride, Colorado



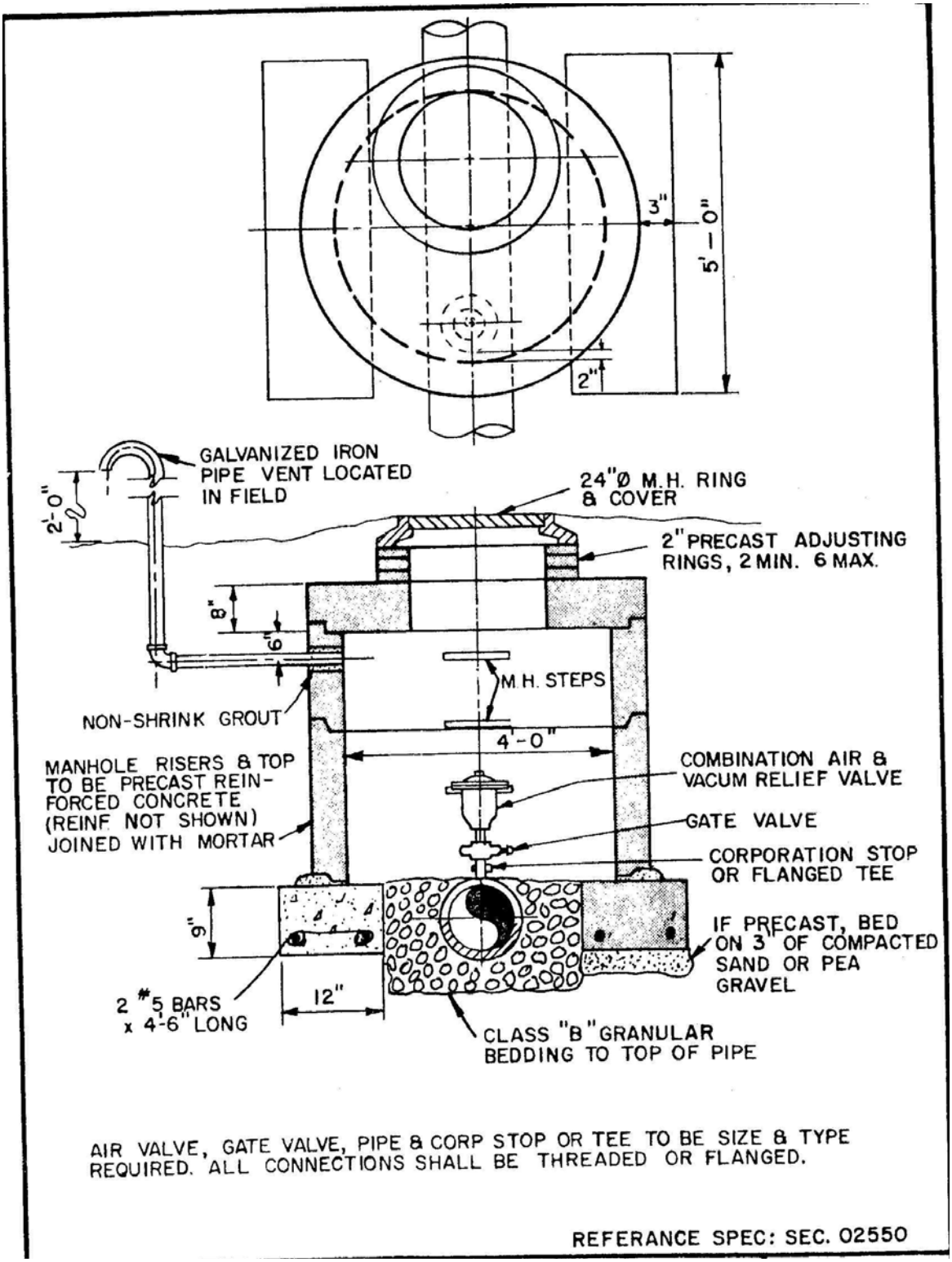
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

BLOWOFF
3" & LARGER

Standard No. 2550G

Sheet 1 of1

Town of Telluride, Colorado



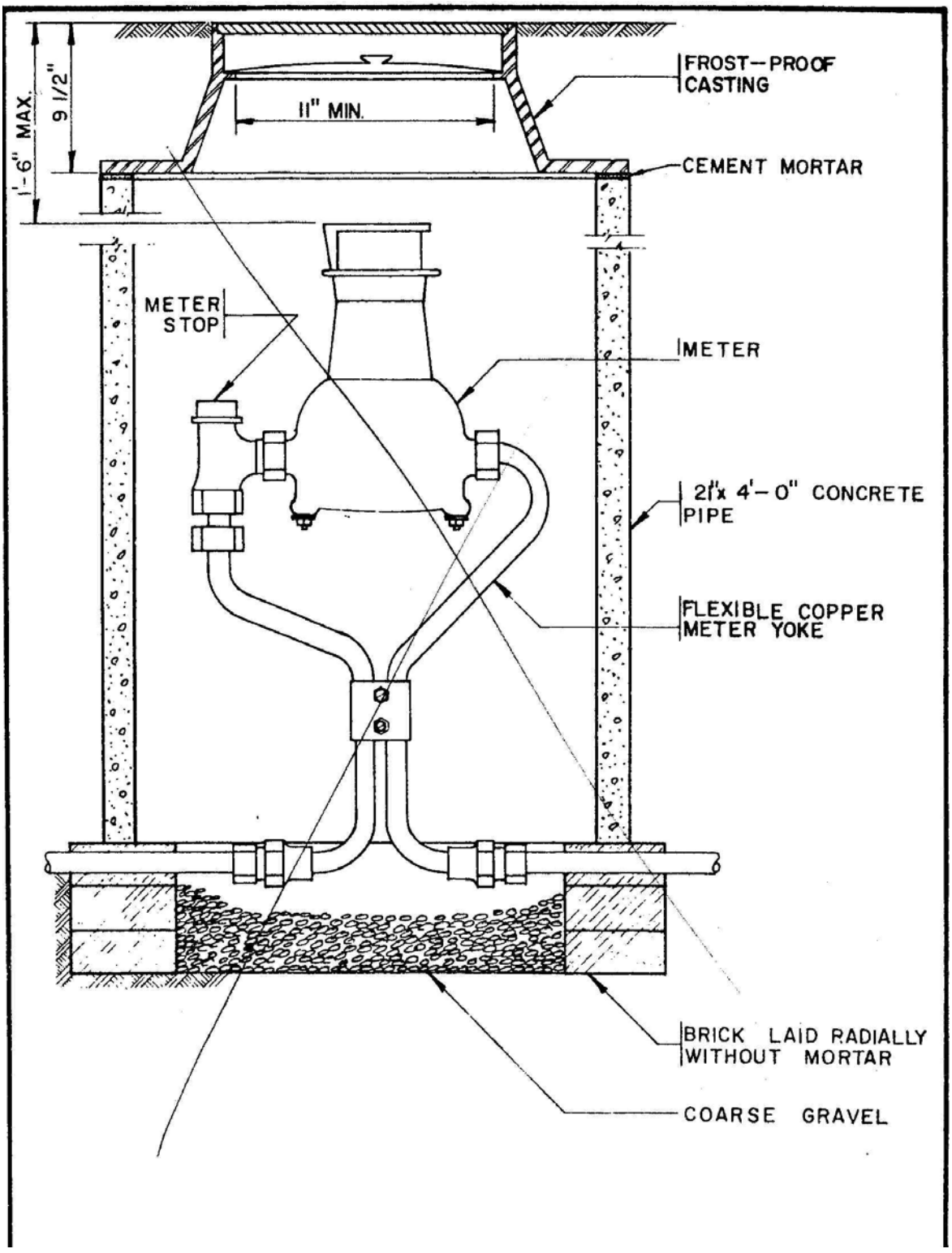
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

AIR RELIEF VALVE INSTALLATION

Standard No. 2550H

Sheet 1 of 1

Town of Telluride, Colorado



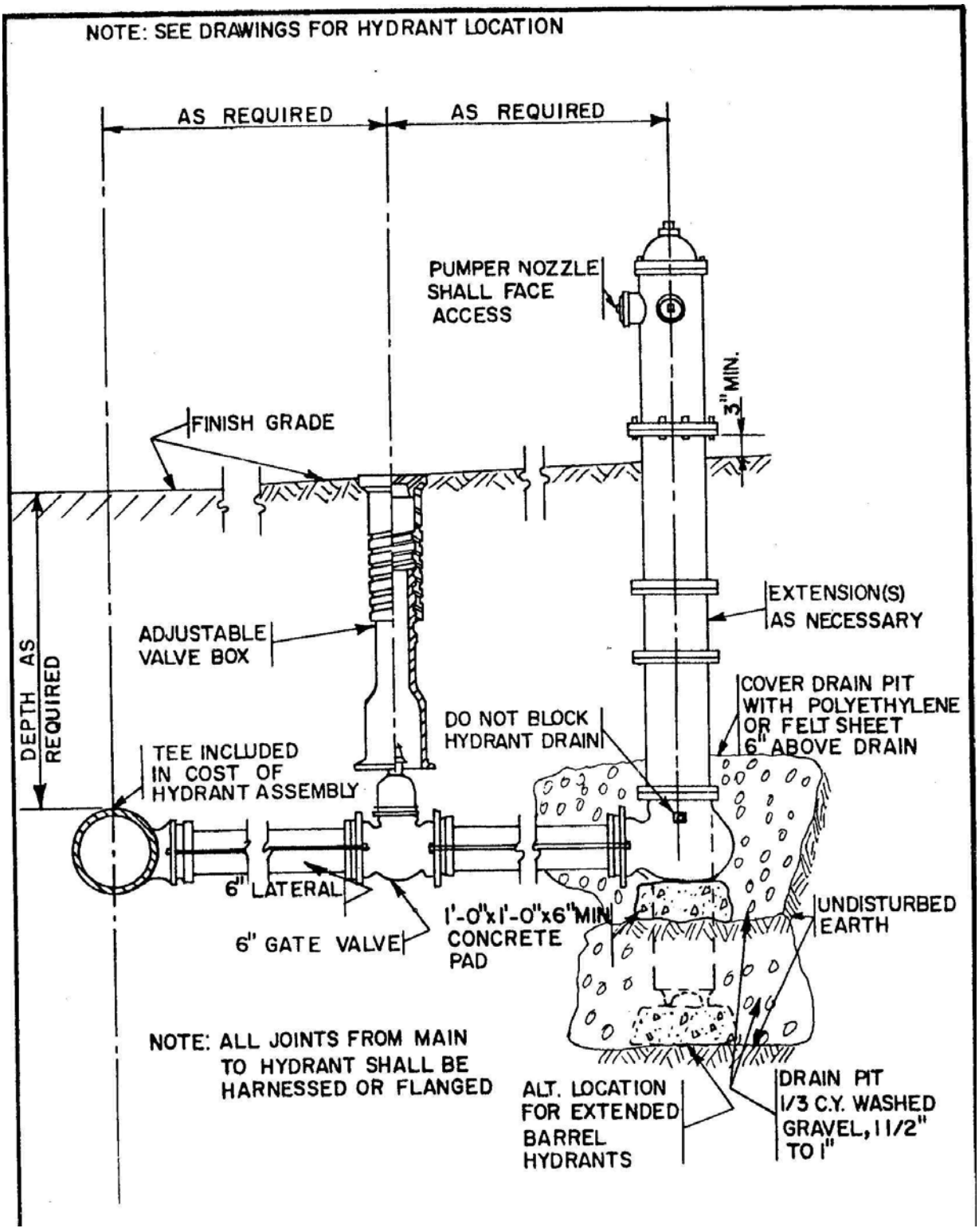
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

OUTSIDE METER SETTING

Standard No. 2550I

Sheet 1 of1

Town of Telluride, Colorado



REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

FIRE HYDRANT ASSEMBLY

Standard No. 2550J

Sheet 1 of1

Town of Telluride, Colorado

Section 02560 - WASTEWATER COLLECTION AND TREATMENT SYSTEM

PART I – GENERAL

DESCRIPTION

Work Included - Work under this section includes furnishing, installing and testing sanitary sewer pipelines, manholes and appurtenances for the wastewater collection and treatment system as shown on the drawings and as specified herein.

Related Work Specified Elsewhere

Section 02220 - Utility Trenching, Backfilling and Compacting
Section 03300 - Cast-in-Place Concrete
Section 15064 - Plastic Pipe

Definitions

Manhole Depth - Distance measured from invert of lowest pipe to top of manhole cover.

QUALITY ASSURANCE

Allowable Tolerances - Maximum deviation shall not exceed ±five tenths (0.5) of a foot from alignment shown on the drawings. Where the pipeline is to be laid at a specific elevation shown on the drawings, deviation from elevation shall not exceed one-tenth (0.1) of a foot. Deviation from grades specified or shown on the drawings will not be allowed unless authorized by the Town Manager in writing.

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Society for Testing and Materials (ASTM)

ASTM A48	Gray Iron Castings
ASTM C14	Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C270	Mortar for Unit Masonry
ASTM C478	Precast Reinforced Concrete Manhole Sections
ASTM C891	Standard Practices for Installation of Underground Precast Concrete Utility Structures

Federal Specifications

QQ-A-200/8	Aluminum Alloy Bar, Rod, Shapes Tube and Wire, Extruded and Structural Shapes, 6061
SS-S-00210 (FSA-FSS)	Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

SUBMITTALS

Include the following:

- *Product Data* - Catalog sheets and descriptive literature on all materials specified herein.
- *Certificates of Compliance* - Manufacturer's affidavit stating compliance with referenced published standards specified herein.

JOB CONDITIONS

Protection - Take every precaution to prevent foreign material from entering the pipe and fittings. No debris, tools, clothing or other material shall be placed in the pipe. Whenever pipe installation is interrupted, seal the open end of the pipe with a watertight plug to prevent trench water, debris or other material from entering the pipe. Follow procedures or techniques which will prevent pipe flotation.

Unsuitable Conditions - No pipe shall be installed when trench or weather conditions prevent installation in accordance with standards specified herein.

PRODUCT DELIVERY, STORAGE AND HANDLING

Exercise care in unloading, handling, stockpiling, and installation in order to prevent damage to materials. Remove any broken or damaged materials from the construction site and do not use in any portion of the construction. Any broken, damaged, or otherwise defective materials that are included in the construction shall be removed and replaced.

PART II - PRODUCTS

PIPE AND PIPE FITTINGS

Type: Plastic Pipe - Refer to Section 15064

MANHOLE MATERIALS

Bases

Concrete	3000 psi strength as specified in Section 03300 - Cast-in-Place Concrete OR
Precast Base	5000 psi strength concrete, cast integrally with riser section. Conform to ASTM C478.

Risers, Cones and Tops

Material	Precast concrete
Conformance	ASTM C478
Cement	Type II
Joints	Tongue and groove or bell and spigot
Joint Gaskets	Preformed flexible plastic gasket conforming to Fed. Spec. SS-S-00210 (GSA-FSS), Type I-rope form, 1-1/2" diameter for 48-inch manholes, 1-3/4" diameter for 60-inch manholes

Ring and Cover (Heavy Duty)

Material	Gray iron, ASTM A48, Class 30
Cover Pattern	Non-slip surface with word "SEWER" cast in top
Bearing Surface	Machined to insure good seating between the ring and cover
Combined Weight	Not less than 400 pounds

Steps

Material	Aluminum, Fed. Spec. QQ-A-200/8

Conformance	ASTM C478
Capacity	1,000 Lb. at 6-inches from wall 1,500 Lb. at 4-inches from wall
Width	12 inches
Construction	Furnish with non-skid grooves and drop front design or safety nosings

Steps

Material	Co-polymer polypropylene reinforced with 3/8-inch reinforcing steel rod
Conformance	ASTM C478
Capacity	300 Lb. impact without failure 1,500 Lb. pullout strength
Width	12 inches minimum
Construction	Furnish with non-skid grooves and safety nosings or drop front design
Acceptable Product	Manhole Step PS-2-PF as manufactured by M.A. Industries, Peachtree City, Georgia

Cement Mortar - Conform to ASTM C270, Type M

Nonshrink Grout - Approved commercial factory mixed product made especially for intended use, non-metallic, conforming to Army Corps of Engineers Specifications CRU-C 588; L&M "Crystex," U. S. Grout "5 Star Grout," or equal.

AIR RELIEF VALVE PIT MATERIALS

Risers

Material	Concrete pipe
Conformance	ASTM C14
Strength	Standard strength

Cover

Type	Frost proof
Material	Cast iron
Combined Weight	195 Lb.
Machined Surfaces	Top and inner covers
Cover Pattern	Non-slip with word "SEWER" cast in top
Size	15-inch diameter minimum opening

CONCRETE

Refer to Section 03300 - Cast-in-Place Concrete.

PART III – EXECUTION

PREPARATION

Excavation - Perform excavation in accordance with Section 02220 - Utility Trenching, Backfilling and Compacting

Cleaning and Inspection - Clean the interior of all pipe and fittings thoroughly of all foreign material and inspect for cracks, flaws or other defects before installation. All piping shall be kept clean until the work is accepted. Keep all joint contact surfaces clean until the joint is completed. Mark all defective, damaged or unsound materials with bright marking crayon or paint, and remove from jobsite.

Excavation of Existing Improvements - When connections to existing pipe or appurtenances are required and the actual elevation cannot be determined without excavation, excavate and expose the existing improvement before laying any pipe or conduit, verify design grades and elevations will accommodate the existing improvement and notify the Town Manager of any discrepancies prior to proceeding with installation. Obtain approval from the Town Manager before making any required adjustments in the design alignment or grade to accomplish the connection.

INSTALLATION

Pipe Laying, General - Prepare trench in accordance with Section 02220. As each length of pipe is placed in the trench, complete each joint in accordance with the pipe material specifications and bring to correct line and grade. Secure pipe in place with specified bedding material tamped under and around the pipe except at joints. Do not walk on pipe or otherwise disturb any conduit after jointing has been completed.

Gravity Flow Pipelines - Lay piping true to line and grade and joined so that the offset of the inside of the pipe at any joint is held to a minimum at the invert. The offset at the invert shall not exceed 1% of the inside diameter of the pipe or 3/8 inch whichever is smaller.

Begin pipe laying at the lowest point and install with the spigot ends pointing in the direction of flow.

Lay all pipe straight between changes in alignment and at uniform grade between changes in grade or slope.

Pressure Flow Pipelines (Force Mains)

Pipe Laying - Install pipe with bell ends facing the direction of laying. Where pipe is laid on a grade of 10% or greater, proceed uphill with bell ends facing upgrade.

Install pipe so that a positive or negative grade is maintained between high and low points to avoid air pockets. If permanent air vents are not provided, record location of all high points so they may be readily located.

Depth - Unless otherwise shown on the drawings, the minimum depth of cover from the finished grade to the top of the pipe shall be 4.5 feet.

Reaction Anchorage and Blocking - Provide thrust blocks, anchors, joint harness, or other approved means for preventing pipe movement at: all push-on or mechanical joint plugs, tees, crosses; bends deflecting 11-1/4 degrees or more; reducers and valves installed in piping subjected to internal hydrostatic pressure in excess of 13 psi.

Thrust Blocks - Construct thrust blocks in accordance with Construction Standard 2550C, sized to accommodate the specified test pressure of the pipeline. Thrust blocks shall extend from the fitting to solid undisturbed earth and shall be constructed so the joints are accessible for repair. If adequate support against undisturbed earth cannot be obtained, provide joint harnesses.

Joint Harness - Provide joint harness or other supports for fittings installed in fills or other unstable soil, above grade, or exposed within structures as shown on the drawings, or as necessary to prevent movement.

Connections to Existing Pipelines, Pressure Flow - Make connections between new work and existing piping using fittings for the conditions encountered. Make each connection at a time authorized by the Town Manager. Provide facilities for dewatering and disposal of water from

excavations without damage to adjacent property and in conformance with State and local regulations..

The Town will operate all valves and no valve or other control unit shall be operated for any purpose by the Contractor.

Prevent contamination when making connections to existing utility lines. Do not allow trench water, mud or other contaminating substances to enter the pipeline.

Waterline Crossings - Where sewer lines cross water mains with less than 24 inches clear distance vertical separation, or 10 feet horizontal separation, as measured from outside diameter to outside diameter, construct the crossing by one of the following methods:

1. *Sewer over waterlines* - When sewer lines cross over waterlines, one continuous length of cast iron or ductile iron sewer pipe, at least 18 feet in length, shall be centered over the waterline and the joints at each end of this special length of pipe shall be encased in a concrete collar 6 inches thick and extending a minimum of 6 inches either side of the joint.

2. *Sewer under waterlines* - When sewer lines cross under waterlines without proper separation, encase sewer pipe with reinforced concrete at least 6 inches thick at all locations within 10 feet either side of the waterline. Minimum reinforcement shall consist of four No. 5 bars, one placed at each corner of the section and tied by No. 3 bars at 3-foot centers.

3. *Sewer parallels water* - When sewer lines parallel waterlines with less than 10 feet horizontal separation and less than 24 inches vertical separation, the sewer line shall be encased in concrete, as in *#2* above, for the entire length of the violation.

In all cases, provide suitable backfill or other structural protection to preclude settling and failure of the higher pipe.

Connections to Existing Manholes - Construct sewer pipe connections to existing manholes so that the finished work conforms as specified for new manholes. Where there is no existing provision for connection, break out as small an opening in the existing manhole as necessary to insert the new pipe. Chip the existing foundation bench to the cross-section of the new pipe and smoothly finish with cement mortar to form a continuous invert. Use cement mortar to form a continuous invert. Use cement mortar to seal the new line so the junction is watertight.

INSTALLATION OF MANHOLES AND OTHER APPURTENANCES

Install all manholes and appurtenances at locations indicated on the drawings. Record "as-built" measurements prior to backfill. Reference all new structures to the nearest existing permanent surface improvement.

Construction of Manholes - Construct manholes in accordance with Construction Standards No. 2560A and 2560B.

Provide a flexible joint in the pipe within 18 inches of all manhole walls and other permanent structures. Flexible joint may be a bell and spigot with rubber "O" ring.

Set stubs and mains before concrete is placed and recheck for alignment and grade before concrete has set. Lay the main sewer continuously through manholes and split the pipe after construction of the concrete base. Where this is not possible, terminate pipe flush with interior manhole wall and construct transitions for smooth and uninterrupted flow. Shape concrete base with a wood float and finish with a steel trowel. Allow base to cure a minimum of 24 hours before continuing construction.

Connections to manholes shall be made using approved manhole couplings or rubber boots cast into the manhole. Secure pipe to rubber boot with a stainless steel clamp.

Set each manhole section plumb and neatly point inside of joints. Use riser sections to bring cast iron ring and cover to specified elevation. Cut openings in the manhole barrel for entering pipes leaving a 3/4-inch annular space around pipe. After pipe is in position, fill space solidly with non-shrink grout. Fill all lifting holes and other imperfections in the interior manhole wall with cement mortar or grout.

Joint manhole sections using preformed flexible plastic gaskets. Install gaskets in accordance with manufacturer's recommendations and only when all surfaces are clean, dry and warm.

All rings and covers shall be heavy duty. Install cover rings on a minimum of two and a maximum of six 2-inch thick precast adjusting rings above the top or cone of the manhole. Set cover rigs in a full bed of mortar and encase in mortar around the entire perimeter. Unless shown otherwise on the drawings, set the top of the cast iron ring rim 24 inches below finish grade in farmed fields, 6 inches below finish grade in gravel roadways and flush with finish grade in paved roadways and all other areas.

Wyes - Construct wyes in accordance with Construction Standard No. 2560G. Wyes shall be angled upwards so the upper invert of the one-eighth bend connected to the fittings will have an elevation equal to or higher than the inside crown of the sewer main. All wye connections shall be inspected and approved by the Town Manager prior to backfilling.

Stubs - Construct service lines to property lines and place watertight plug at service line stub. Mark end of service line stub with buried 2" x 4" treated timber extending from end of service line to 3 feet above ground level. Mark "Sewer Service" on exposed end of 2" x 4" reference marker. Maintain a minimum slope of 1/4-inch per foot for all service lines.

Plugs - Install removable watertight plugs in unused branch of each wye or stub and reference locations to nearest permanent surface improvements.

FIELD QUALITY CONTROL - GRAVITY FLOW PIPELINES

Alignment Tests - Each section of sewer between manholes shall be lamped by the Contractor in the presence of the Town Manager to determine whether any displacement of the pipe has occurred. The Contractor shall repair any misalignment, displaced pipe, or other conditions which deviate from those specified.

Pipe Deflection Tests - Whenever flexible pipe is installed, each section shall be measured for vertical ring deflection after installation and final backfill. Conduct tests no earlier than 30 days after final trench backfill to grade. Maximum allowable ring deflection of the pipeline shall be as specified in each individual pipe material section of the specifications under Section 15062 – Ductile Iron Pipe, Section 15064 – Plastic Pipe, Section 15071 – Reinforced Contrete Pipe, and Section 15078 – Corrugated Metal Pipe.

Provide all necessary equipment to conduct the tests. Equipment used shall be a pull-through type deflection gage (Mandrel) specially manufactured for the size and type of pipe installed.

The mandrel (Go/No-Go) device shall be cylindrical in shape and constructed with a minimum of nine (9) evenly spaced arms or prongs. Mandrels with fewer arms (in odd or even numbers) will be rejected. The minimum longitudinal contact length of the "mandrel's arms shall be equal the nominal

inside diameter of the pipe to be tested. The dimensions of the mandrel shall carry a tolerance of ± 0.0l inches.

Allowances for pipe deformation (from heat, shipping, or poor production) will be counted as part of the deflection allowance.

Should the deflection of installed pipe exceed the specified maximum at any location, the Contractor shall excavate and expose the line at that point and repair or replace the bedding to obtain, after back-filling, a deflection not exceeding the maximum specified. The maximum deflection is a condition of acceptance regardless of bedding method used or degree of compaction attained.

Leakage Tests - Furnish all equipment, labor and incidentals necessary and conduct the tests in the presence of the Town Manager. Complete all leakage tests prior to placing of permanent resurfacing. When leakage or infiltration exceeds the allowable amount, locate the source of infiltration, or leakage and make the necessary repairs or replacements to reduce the leakage or infiltration below specified limits. Repair any individually detectable leaks regardless of the results of the tests. Conduct tests as follows:

Gravity Systems

Air Test - Conduct air test on gravity sewers as specified here-under. The Contractor may conduct a preliminary air test of the sewer mainline after compaction of the backfill but prior to installation of any branch or lateral sewers. Preliminary tests will be considered to be for the Contractor's convenience and need not be performed in the presence of the Town Manager.

Groundwater Below Pipe System

Line Preparation - Flush and clean the system prior to testing. Plug and brace all openings in the main line and the upper end of any connections. The interior walls of porous pipe materials may be wetted to temporarily reduce the porosity of the material.

Equipment

Plug Design - Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor shall internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.

Singular Control Panel - To facilitate test verification by the Town Manager, all air used shall pass through a single, above ground control panel.

Equipment Controls - The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of ±0.04 psi.

Separate Hoses - Two separate hoses shall be used to (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) to constantly monitor air pressure build-up in the line and prevent over-pressurizing the line. If pneumatic plugs are used, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.

Plug Testing - Conduct a seal test on all plugs by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe shall be pressurized to 9 psi. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. Check all pipe plugs with a soap solution to detect any air leakage. If leaks are found, release the air pressure, eliminate the leaks and start the test procedure over again. No persons shall be allowed in the alignment of the pipe during plug testing.

Test Procedure

Plug Installation - After a manhole to manhole reach of pipe has been backfilled to final grade and prepared for testing, the plugs shall be placed in the line at each manhole and secured. Plug the upstream end of the line first to prevent any upstream water from collecting in the test line. When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. Such condition may cause leakage at the junction of the manhole and the pipe which is covered by the pipe plug and thus, would not be detected by the air test.

Line Pressurization - Add air until the internal pressure of the pipeline is raised to approximately 4 psi. Gage at which time the flow of air shall be reduced and the pressure maintained between 3.5 and 4.5 psi. Gage for a sufficient time to allow the air temperature to come to equilibrium with the temperature of the pipe.

After the temperature has stabilized, allow the pressure to drop to between 3.5 and 4 psi. A stop watch or a sweep second hand watch shall be used to determine the time lapse required for the air pressure to drop 1 psi.

Determination of Line Acceptance or Failure - If the time lapse exceeds that shown in Table I at the end of this section, the pipe will be considered within the acceptable limits for leakage. If the time lapse is less than that shown in Table I, the Contractor shall determine the source or sources of leakage, replace all defective materials and workmanship, and retest the repaired system until leakage requirements are met. The use of sealants to repair defective piping will not be allowed.

Plug Removal - Completely vent pipeline of pressurized air before attempting to remove plugs.

Groundwater Above Pipe System

General - The air testing requirements of these paragraphs shall only apply where the sewer line to be tested is totally submerged below groundwater. If monitoring wells are not used to determine groundwater level, the pipe nipple method described hereafter may be used. Except as noted otherwise, test procedures previously specified under "Groundwater Below Pipe System" shall apply.

Pipe Nipple Installation - During manhole installation, a 1/2-inch diameter threaded pipe nipple shall be installed horizontally through the manhole wall directly on top of one of the sewer pipes entering the manhole. The threaded end of the nipple shall extend no more than 2 inches on the inside of the manhole. The total length of the nipple shall exceed the manhole wall thickness by no less than 4 inches. The pipe nipple shall be non-corrosive and resistant to chemicals common to domestic sewage. Special attention shall be given to providing a permanent, watertight seal around the pipe nipple at the manhole wall. The pipe nipple shall be sealed with a threaded 1/2-

inch cap. Not every manhole needs a pipe nipple, a few key manhole locations should be sufficient to establish a groundwater profile for the test area.

Groundwater Level Determination - Immediately before air testing, the groundwater level shall be determined by removing the threaded cap from the nipple nearest the section to be tested, blowing air through the pipe nipple to remove any obstructions, and then connecting clear plastic tube to the pipe nipple. Each plastic tube shall be held vertically to allow groundwater to rise in it. After the water level in the tube has stopped rising, a measurement of the height in feet of the water over the invert of the sewer pipe shall be taken. If the section to be tested is not immediately adjacent to an installed pipe nipple, the groundwater height shall be estimated based upon nearby height readings and the pipe's invert elevation.

Air Pressure Adjustment - The air pressure correction which must be added to the 3.5 psig test starting pressure, shall be calculated by dividing the average vertical height, in feet of groundwater above the invert of the sewer pipe to be tested, by 2.31. The result gives the air pressure correction in pounds per square inch to be added. In no case shall the starting test pressure exceed 9.0 psig. If the average vertical height of groundwater above the pipe invert is more than 12.7 feet, the section so submerged may be tested using 9.0 psig as the starting test pressure.

Resealing of Pipe Nipples - After the groundwater height has been determined, each pipe nipple shall be recapped and sealed to prevent any future infiltration.

Test Data Record - The Contractor shall maintain a daily record of air test data results on the form "Air Test Data Sheet," a copy of which is included at the end of this section. Submit original and one copy to the Town Manager.

Exfiltration Test - Where groundwater is not present, a water exfiltration test shall be conducted (1) for manholes and (2) may be substituted for the air test on sewer lines except where the difference in elevation between inverts of adjacent manholes is greater than 10 feet. Test each section between successive manholes by plugging the pipe just above each manhole. Fill the upper manhole and pipe with water to a point 4 feet above the invert of the sewer at the center of the upper manhole.

Duration of Test - Two hours minimum.

Allowable Leakage - The maximum allowable leakage shall be determined by the formula:

$$Q = 0.0012 \text{ L x D x } (H)^{1/2}$$

where Q is the allowable leakage in gallons per hour; L is the length of sewer tested in feet; D is the nominal diameter of the pipe in inches; H is the difference in elevation between the water surface in the upper manhole and the invert of the pipe at the lower manhole; or if groundwater is present above the invert of the pipe at the lower manhole, the difference in elevation between the water surface in the upper manhole and the groundwater at the lower manhole.

FIELD QUALITY CONTROL - PRESSURE FLOW PIPELINES

Hydrostatic Tests - After the pipe has been laid and the trench has-been backfilled, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure and leakage test. The Contractor shall provide all pumps, pipe, connections, gages, measuring devices, and all other necessary apparatus and shall conduct the test in the presence of the Town Manager.

Test Pressure - The required minimum test pressure shall be 1-1/2 times the working pressure measured at the point of lowest elevation of the pipeline and corrected to the elevation of the test gage.

Duration of Test - Two hours minimum.

Air Removal - Prior to performance of the test the pipeline shall be completely filled with water for a period of 72 hours. Expel air by means of air relief valves, hydrants, or corporation stops. If permanent air vents or taps are not located at all high points, install corporation stops; at such points so air can be expelled. After the tests are completed, plug all temporary taps.

Allowable Leakage - Quantity of water that must be supplied to the test section to maintain the specified test pressure is determined by the formula:

$$Q = \frac{N \times D \times (P)^{1/2}}{7{,}400}$$

in which Q is the allowable leakage in gallons per hour; N is the number of joints in the test section; P is the average test pressure in psig; and D is the nominal diameter of the pipeline in inches.

Repair of Leaks - If the test discloses leakage greater than the allowable leakage, the Contractor shall locate and repair the defective joints until leakage is within the specified allowable. The Contractor shall repair any visible leaks regardless of the tests results.

TABLE I

SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED

1	2	3	4								
Pipe Diameter (in.)	Minimum Time (min: sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380L	3:46	3:46	3:46	3:46	3:16	3:46	3:46	3:46
6	5:40	398	.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

Safety: The air test may be dangerous if proper precautions are not taken. All plugs must be sufficiently braced to prevent blowouts and the pipeline must be completely vented before attempting-to remove the plugs.

AIR TEST DATA SHEET

Owner (Name of city, district, etc.)_____ Test No._____

Identification of Pipe Installation (Job name, location, contract number, etc.)_____

Field Test Data: (To be filled in by the Inspector)

Date:_____ Specified Maximum Pressure Drop:_____psig

Identification of Pipe Material Installed_____

Pipe Under Test				Specification Time	Field Test Operations Data					
Upstream MH sta #	Downstream MH sta #	Dia. D (in.)	Length L (ft.)	Refer to Table I (min:sec)	Pressure Initially Raised To (psig)	Time Allowed for Pressure to Stabilize (min)	Start Test Pressure (psig)	Stop Test Pressure (psig)	Elapsed Time (min:sec)	Pass or Fail (P or F

Inspector's Name and Title:_____

Signature of Inspector:_____

If a section fails, the following items shall be completed:

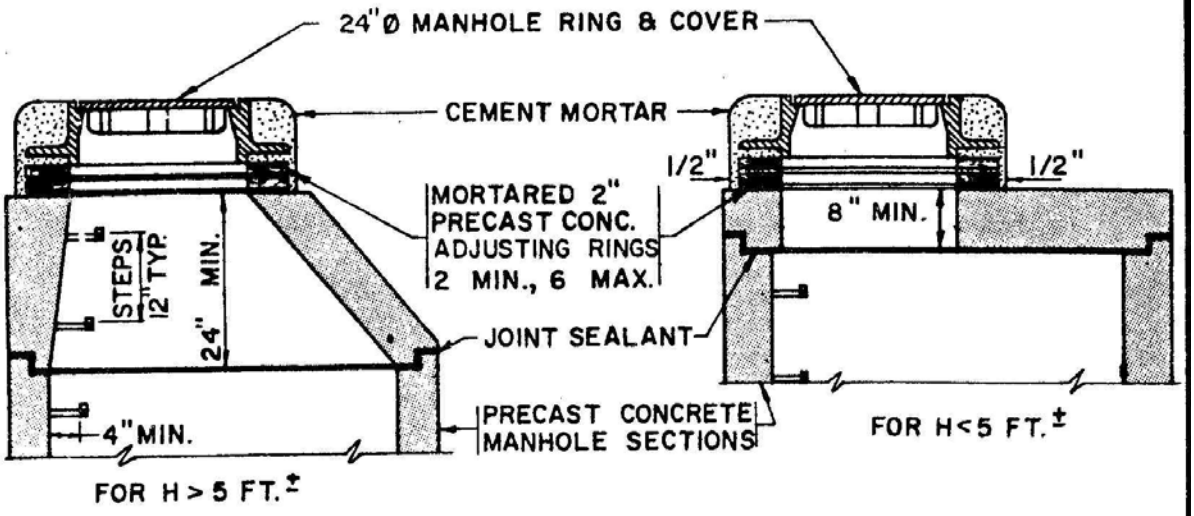
Identify section(s) that failed_____

Leak (was) (was not) located. Method used:_____

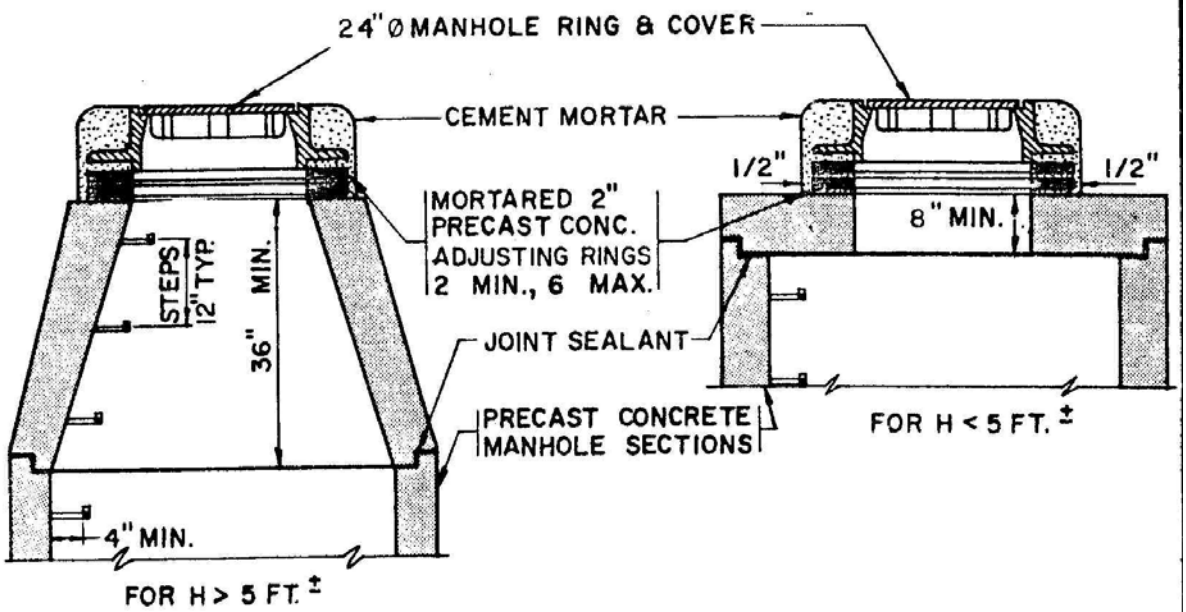
Description of leakage found:_____

Description of corrective action taken:_____

For test results after repair refer to Test No._____. Inspector_____



ECCENTRIC OPENINGS
STANDARD NO. 2560 A



CONCENTRIC OPENINGS
STANDARD NO. 2560 B

NOTE: DEPTH OF MANHOLE, H, MEASURED FROM LOWEST PIPE INVERT TO TOP OF RING AND COVER.

REFERENCE SPEC.: SEC. 02560

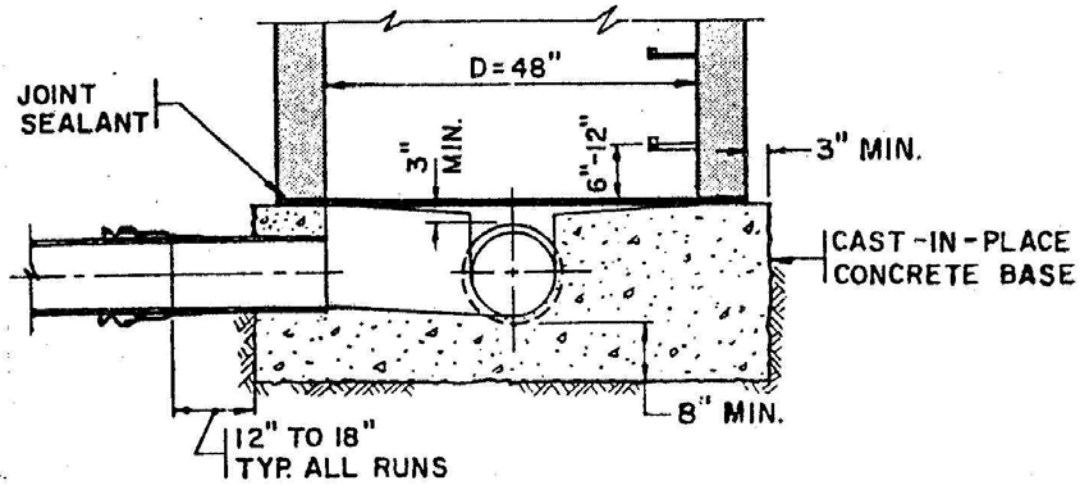
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

SANITARY SEWER MANHOLE

Standard No. 2560A and 2560B

Sheet 1 of 3

Town of Telluride, Colorado



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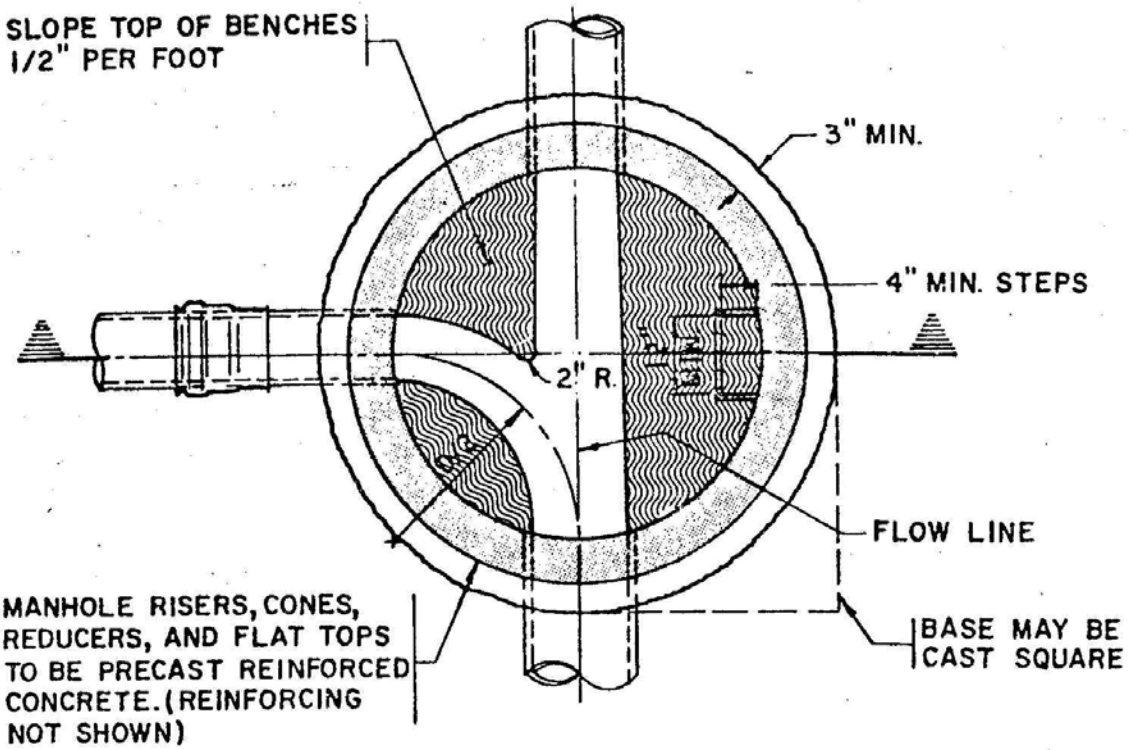


STANDARD CAST-IN-PLACE BASE

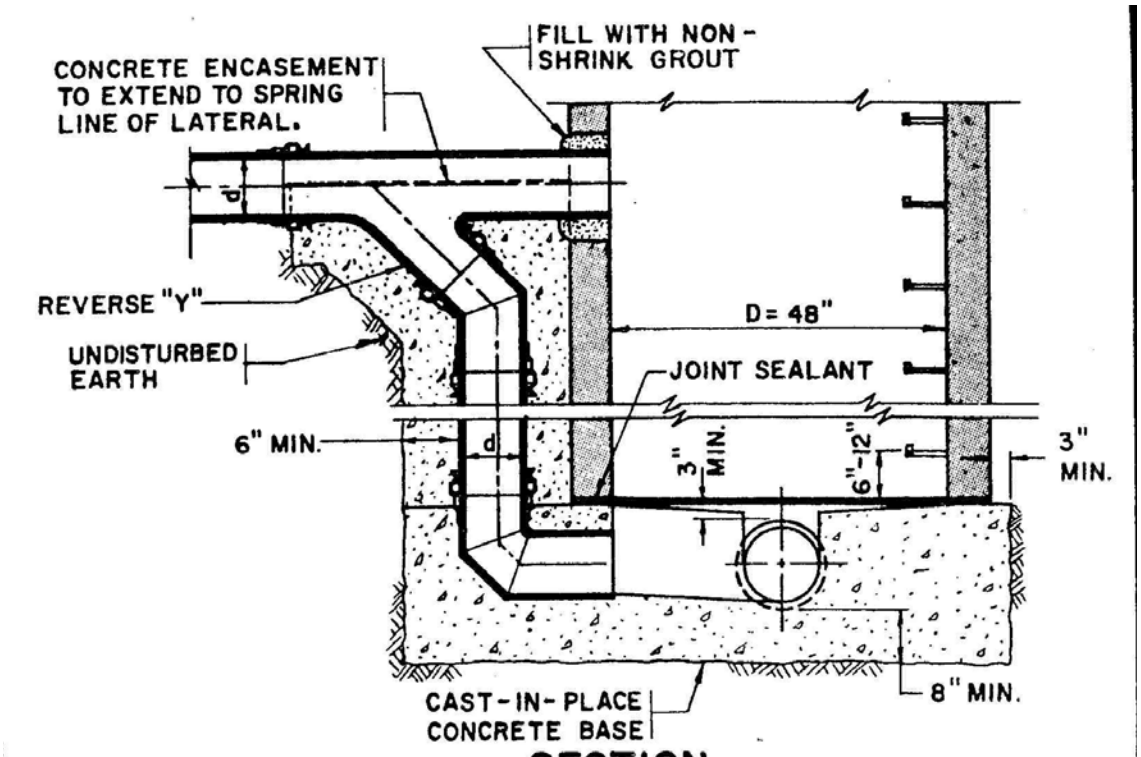
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

SANITARY SEWER MANHOLE

Standard No. 2560A and 2560B

Sheet 2 of 3

Town of Telluride, Colorado



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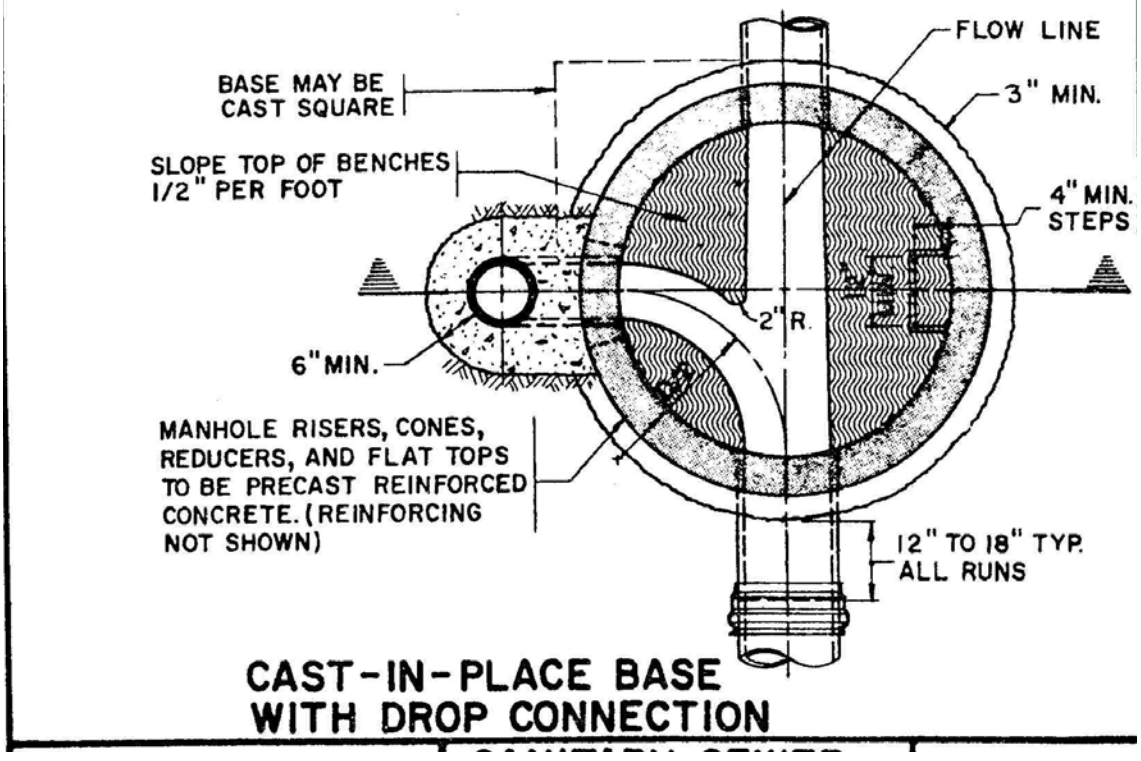


CAST-IN-PLACE BASE WITH DROP CONNECTION

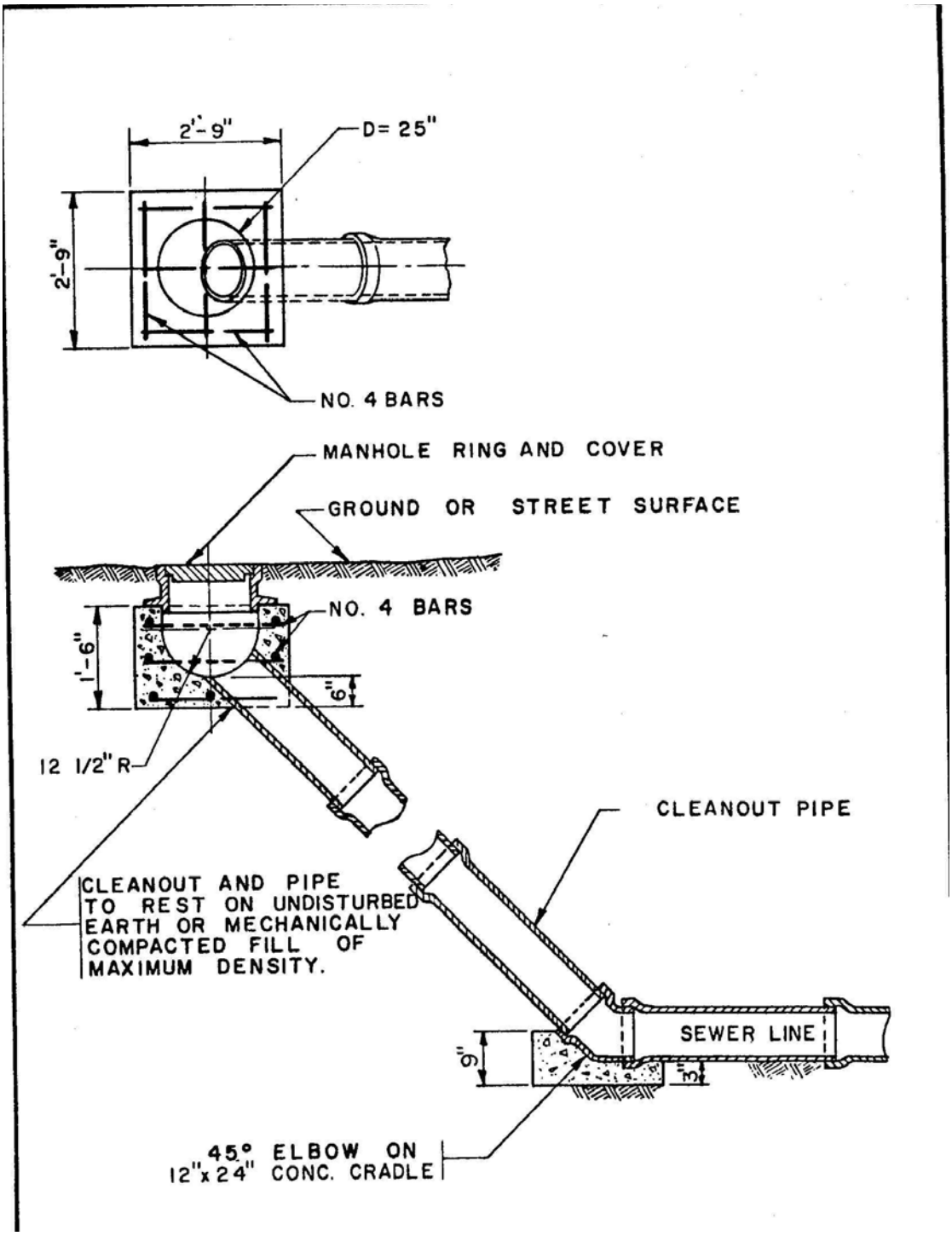
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

SANITARY SEWER MANHOLE

Standard No. 2560A and 2560B

Sheet 3 of 3

Town of Telluride, Colorado



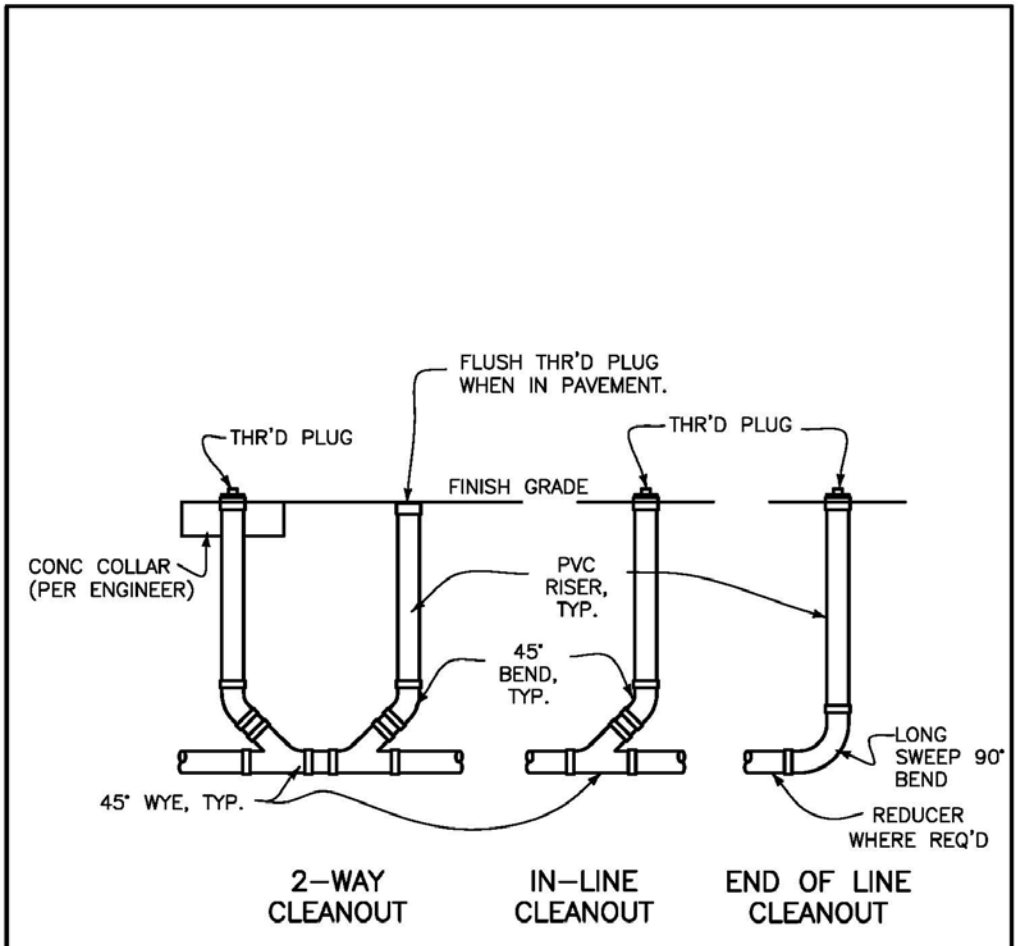
REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

SANITARY SEWER CLEANOUT

Standard No. 2560F.1

Sheet 1 of 2

Town of Telluride, Colorado



SANITARY SEWER SERVICE LINE CLEAN–OUT DETAIL

REVISIONS		
MARK	DATE	DESCRIPTION
	FEB 1976	CHANGE NUMBER

SANITARY SEWER CLEANOUT

Standard No. 2560F.2

Sheet 2 of 2

Town of Telluride, Colorado

Section 02600 - PAVING AND SURFACING

PART I - GENERAL

WORK INCLUDED

This section covers the furnishing, installation, and testing of hot mix asphalt (HMA) paving, surface and base course, and all items appurtenant to the construction of street or roadway (AKA "travel way") surfacing.

QUALITY ASSURANCE

Reference Standards - Wherever referred to hereafter, *Standard Specifications* shall be State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," latest edition.

Qualification of Asphalt Concrete Producer - Use only materials which are furnished by a bulk HMA producer regularly engaged in production of hot-mix, hot-laid asphaltic cement pavement.

Qualification of Testing Agency - A certified testing agency shall establish job-mix formulas and perform the quality control sampling and testing required during paving operations.

Design Criteria - Provide final surfaces of uniform texture, conforming to required grades and cross-sections and in compliance with the requirements for density, thickness and surface smoothness.

Maintain material within allowable tolerances of the governing standards as required under the sections for submittals and products.

Allowable Tolerances

Density - Compare density of in-place material against laboratory specimen of the same asphalt concrete mixture when subjected to 50 blows of a Standard Marshall Hammer on each side of the specimen. Minimum acceptable density of in-place materials shall be 95% of the recorded laboratory specimen density for any course.

Thickness - In-place compacted thicknesses will not be acceptable if exceeding the following allowable variations from thicknesses shown on the drawings:

1. Individual samples:
   Surface Course, 1/2 inch, plus or minus
   Base Course, 1/2 inch, plus or minus

2. Overall average of samples:
   The compacted average thicknesses of both base course and surface course, computed by summing the individual sample thicknesses and dividing by the total number of samples, shall, be no less than that specified on the drawings for each layer, respectively.

Surface Smoothness - Finished surfaces of each asphalt concrete course shall be checked for smoothness using a 10-foot straight edge applied parallel to and at right angles to the centerline of paved areas. Surfaces will not be acceptable if deviations in surface exceed the following:

Surface Course, 3/16 inch in ten feet

Base Course, 1/4 inch in ten feet

SUBMITTALS

Samples

Sampling of asphalt materials shall be in accordance with the latest revision of Sampling Asphalt Products for Specification Compliance, Manual Series 18 (MS-18), The Asphalt Institute.

Sampling of mineral aggregate shall be in accordance with the latest revision of AASHTO T-2 or ASTM D75.

Sampling of the asphalt mixture shall be in accordance with the latest revision of AASHTO T-168 or ASTM D979.

A job mix design, done specifically for this project, shall be required on the asphalt furnished for the surface and base course. Mix design shall conform to Colorado Department of Transportation (CDOT) requirements for the region.

Testing Methods - Submit laboratory reports for the following material tests.

	ASTM Designation	AASHTO Designation
Coarse and fine aggregates from each Material source and each required grading:		
Sieve analysis (aggregates)	C136	T-27
Sieve analysis (filler)	D546	T-37
Unit weight of aggregate	C29	T-19
Clay lumps and friable particles in aggregates		T-112
Soundness	C88	T-104
Abrasion of coarse aggregate	C131	T-96
Sand equivalent	D2419	T-176
Cohesion (stripping resistance of asphaltic concrete)	T-165	
Asphalt cement for each penetration grade:		
Penetration	D5	T-49
Viscosity (kinematic)	D2170	T-201
Flash point	D92	T-48
Ductility	D113	T-51
Solubility	D2042	T-44
Specific gravity	D70	T-228
Job-mix design mixtures for each material or grade:		
Bulk specific gravity (coarse aggregate)	C127	T-85
Bulk specific gravity (fine aggregate)	C128	T-84
Bulk specific gravity (filler)	D854 or C188	T-228
Uncompacted asphalt concrete mix:		
Maximum specific gravity	D2041	T-209
Compacted asphalt concrete mix:		
Bulk density	D1188	T-16
Marshall Stability and flow	D1559	

Provide a density and voids analysis for each series of test specimens, in accordance with the Asphalt Institute Manual MS-2, "Mix Design Methods for Asphalt Concrete."

Use the Marshall Method of Mix Design.

Report the quantity of absorbed asphalt cement in pounds of dry aggregate, percent air voids, and percent voids in mineral aggregate.

Asphalt concrete mixture, during paving operations, for quality control

	ASTM Designation	AASHTO Designation
Uncompacted asphalt concrete mix:		
Asphalt cement content	D2172	T-164
Aggregate grading		T-30
Compacted asphalt concrete mix:		
Bulk density	D1188	T-1
Marshall stability and flow	D1559	

Perform at least 1 test for each day's paving, or every 1200 square yards.

Additional Testing - Perform as may be required, if any of the previous tests indicate insufficient values. Continue testing until specified values have been obtained.

Asphalt concrete materials not complying with specified requirements will not be permitted in the work.

Certificates - Furnish certification by qualified testing laboratory that materials of each required test comply with specification requirements.

JOB CONDITIONS

Weather Limitations - Apply bituminous prime and tack coats only when the ambient temperature in the shade is a minimum of 60°F and when the temperature has not been below 36°F for 12 hours immediately prior to application.

Do not apply when the base surface is wet or contains an excess of moisture that would prevent uniform distribution and the required penetration.

Construct asphalt concrete surface course only when atmospheric temperature is above 40°F, when the underlying base is dry, and when weather is not rainy.

Grade Control - Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

Traffic Control - Maintain vehicular and pedestrian traffic during paving operations as required for other construction activities. Provide flagmen, barricades, warning signs, and warning lights for movement of traffic and safety to cause the least interruption to the work and inconvenience to the public.

PART II - PRODUCTS

BITUMINOUS MATERIALS

Aggregate - Surface Course - Aggregate shall be of uniform quality, crushed to size as necessary, and shall be composed of sound, tough, durable pebbles or fragments with or without natural or mineral fillers, as required. The aggregate shall be free from vegetable matter, lumps, or balls of clay, adherent films of clay or other matter that would prevent thorough coating with bituminous material and shall be free of an excess of flat or elongated pieces.

Coarse aggregate shall be crushed stone, crushed gravel or crushed slag conforming to ASTM D692.

Fine aggregate shall be crushed stone, crushed gravel, natural sand, or slag screenings conforming to ASTM D1073.

Aggregate shall be composed of coarse and fine aggregate combined in the proper proportions to meet the Standard Specifications, Grading C, of the Colorado Department of Highways, as follows:

	% Passing by Weight	
Sieve Designation	Minimum	Maximum
3/4 inch		100
1/2 inch	70	95
3/8 inch	60	88
No. 4	40	72
No. 8	28	58
No. 50	9	32
No. 200	3	4

Asphalt content 4% to 7% by weight of total mix.

The material shall have a percentage of wear of not more than 40, the soundness loss shall not exceed 12%, and the plasticity index shall not exceed 3.

Provide uniform quality combined aggregate with a minimum sand equivalent value of 45 for light and medium traffic areas.

Aggregate - Base Course - The base course shall be crushed stone or crushed gravel and an approved soil binder or natural filler, where required. Coarse aggregate shall consist of hard, durable particles or fragments of stone or gravel and fine aggregate shall consist of crushed stone, crushed gravel, or natural sand. The fraction passing the No. 200 sieve shall not be greater than two-thirds of the fraction passing the No. 40 sieve.

Gradation:

	% Passing by Weight	
Sieve Designation	Minimum	Maximum
1 inch		100
3/4 inch		100
No. 4	45	65
No. 8	33	53
No. 200	3	12

Liquid limit - not greater than 25
Plasticity index - not greater than 6
Percentage of wear - not greater than 50
When the plasticity index is non-plastic, the liquid limit shall not be more than 30.

Of the particles retained on a No. 4 sieve, at least 60% by weight shall have one or more broken faces.

Mineral Filler - Limestone dust, portland cement, or other inert material conforming to ASTM D242.

Asphalt Cement - Asphalt cement shall be viscosity graded AC-10 and shall comply with the requirements of ASTH U946 and Standard Specifications, Section 702.01.

Prime Coat - Prime coat shall be a cut-back liquid asphalt of the medium curing type, Grade Mc-70, and shall comply with the requirements of ASTM D2026 and Standard Specifications, Section 702.03.

Tack Coat - Tack coat shall be emulsified asphalt, Type SS-1 or SS-lh, and comply with the requirements of ASTM D977 and Standard Specifications, Section 702.04.

JOB-MIX CRITERIA

Provide job-mix formulae for each required asphalt-aggregate mixture.

Establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to aggregate, and a single temperature at which asphalt concrete is to be produced.

After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerance:

Passing No. 8 and larger sieves	plus or minus 8%
Passing No. 50 sieve	plus or minus 6%
Passing No. 200 sieve	plus or minus 3% bitumen plus or minus 0.5%
Temperature of mixture when emptied from mixer	plus or minus 20°F

Should a change in sources of material be made, a new job-mix formula shall be established and approved by the Engineer and the Town Manager in writing before the new material is used.

Prepare job-mix formula for each course to meet the following test criteria:

Marshall Method	Minimum	Maximum
Stability, Lb.	500	
Flow, units of 0.01 inch	8	18
% air voids - surface course	3	5
- base course	3	8
% voids in mineral aggregate - surface course		
Compaction blows		

PART III - EXECUTION

SURFACE PREPARATION

General - Inspect base surface for smoothness, compaction, moisture and general condition prior to commencing with pavement activities. If repairs are needed, follow the requirements of Section 02210. Paving Contractor is to sign-off on acceptability of subsurface prior to commencing paving activities.

Loose and Foreign Material - Remove loose and foreign material from compacted base surface immediately before application of asphalt surface course.

Use power brooms or blowers, and hand brooming as required. Do not displace base material.

Prime Coat - No prime coat will be required on the subgrade for asphalt treated base course.

No prime coat will be required if traffic has not been turned onto street and allowed to travel over compacted base course. If street is to be opened to traffic, uniformly apply prime coat at a rate of 0.20 to 0.50 gallons per square yard over compacted and cleaned base surface.

Apply enough material to penetrate and seal, but not flood, the surface.

Allow to cure and dry as long as required to attain penetration and evaporation of volatiles and in no case less than 24 hours.

Blot excess asphalt with just enough sand to prevent pick-up under traffic. Remove loose sand before paving.

Protect surfaces of curb and gutter, sidewalks and other structures, and storm drain inlets, to prevent any asphaltic oil from being sprayed on them. Any surfaces inadvertently sprayed will be thoroughly cleaned at the expense of the Contractor.

All spots unavoidably missed by the distributor or areas which are inaccessible to the distributor shall be hand sprayed.

All vertical contact surfaces of curbs, gutters, manholes and other structures projecting into or abutting asphalt concrete pavement shall be primed by brushing with hot asphaltic oil prior to placing the pavement.

Tack Coat - Apply tack coat to existing pavements or surfaces against which asphalt is to be placed. Apply tack coat to primed surfaces if "dusting" that will result in poor bonding between treated surface and bituminous pavement has occurred. Application shall be between 0.05 and 0.15 gallons per square yard. Apply no more tack coat than necessary for the day's operations.

FRAME ADJUSTMENTS

Set frames of subsurface structures to l/8 inch below final grade as a part of this work, including existing frames, and new frames furnished under other work of this project.

Existing frames are to be stored while a temporary cover is used to support equipment while the paving operation is being completed to finish grade. The temporary frame is to be removed and the existing or new frames are then installed and adjusted to finish grade and slope.

The area between the frames and existing pavement is then filled with hot asphaltic concrete and compacted with the use of a hand tamper.

The same sequence is to be followed for water valve boxes, except that no temporary frames are required.

STORM DRAIN PROTECTION

Provide appropriate means to protect all storm drain inlets and road side ditches from contamination during paving activities. Following completion of paving remove any temporary controls and clean drainage structures as necessary.

PREPARING THE MIXTURE

Bituminous Mixing Plant - Comply with ASTM C995 (AASHTU M-156) for material storage, control, and mixing, and for plant equipment and operation.

Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

For the verification of weights or proportions and character of materials, and determination of temperatures used in the preparation of the mixture, the Engineer shall have access at any time to all parts of the paving plant.

Stockpiles - Keep each component of the various sized combined aggregates in separate stockpiles. Maintain stockpiles so that separate aggregate sizes will not be intermixed.

Heating - Heat the asphalt cement at the mixing plant to a viscosity at which it can be uniformly distributed throughout the mixtures. Use the lowest possible temperature to suit the temperature viscosity characteristics of asphalt. Do not exceed 350°F.

Aggregate - Heat-dry aggregates to reduce moisture content to not more than 2%. Deliver dry aggregate to mixer at recommended temperature to suit penetration grade and viscosity characteristics of the asphalt cement, ambient temperature, and workability of the mixture. Accurately weigh or measure dry aggregate and weigh or meter asphalt cement to comply with the job-mix formula requirements.

Mix aggregate and asphalt cement so that aggregate has a retained bituminous film about 96% when tested in accordance with AASHTO T-182.

Transportation - Transport asphalt concrete mixtures from mixing site in trucks having tight, clean, smooth, metal beds. Coat hauling compartments with lime-water mixture to prevent asphalt concrete mixture from sticking. Elevate and drain compartment of excess solution before loading mix. When necessary, so that the mixture will be delivered on the project at the specified temperature and be protected from weather, provide covers of such size as to protect the mixture. During periods of cold weather or for long-distance deliveries, provide insulation around entire truck bed surfaces and provide covers securely fastened.

EQUIPMENT

Provide the size and quantity of equipment to insure a uniform continuity of operation and to complete the work specified within the project time schedule.

Asphalt Distributor - The distributor shall be in good mechanical condition and shall be capable of uniformly distributing the prime coat throughout a reasonable range of widths, pressures, temperatures, and application rates.

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

Bituminous Pavers - Pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, that shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture and control pavement edges to true lines and grades without the use of stationary forms.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation and shall be equipped with a distributor system to place the mixture uniformly in front of the screed.

Rolling Equipment - Rollers shall be self-propelled steel-wheeled rollers, pneumatic-tired rollers, or vibrating rollers, capable of reversing without backlash.

The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

Hand Tools - Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools to complete the work specified.

PLACING THE MIX

The asphalt concrete mixture will be placed by a paving machine as specified, capable of spreading the mixture true to line, grade, and crown. The mixture shall be spread at a temperature of not less than 250°F. The desired temperature shall be set by the Engineer and shall be maintained within plus or minus 30°F. Hand placing and spreading will be permitted in inaccessible and small areas. Place each course in one or more lifts to provide a nominal compacted thickness conforming to the indicated grade, cross-section, finish thickness, and density, as specified and shown on the drawings.

Continuity of Operations - It is essential to place the mixture in as continuous an operation as practicable to ensure good plant mix asphalt paving with good riding qualities and uniform density.

The paver speed will be maintained in balance with the plant production, and a sufficient number of trucks should be available to assure uniform capacity operation of the asphalt plant and pavers.

Defects caused by unnecessary stopping due to lack of coordination between mixing, hauling, and lay down shall be removed and replaced.

Pavement Placing - Paving operations shall begin along the concrete gutter or low side of street and in direction of traffic flow and work toward crown from both sides of the street.

After the first truckload of the day has been spread, the loose and compacted depths shall be checked so that a ratio can be established for the correction of loose depth.

If segregation of materials should occur, the spreading operation will be stopped immediately and not resumed until the cause is determined and corrected.

Any asphalt mix which clings to the sides of the hopper shall be continually loosened and pushed into the active mix. No mix shall be retained in the hopper when there is a delay in the asphalt concrete supply.

Immediately after any course is screed, and before roller compaction is started, the surface shall be checked. Any area showing an excess or deficiency of bituminous material shall be removed and replaced and all irregularities in alignment and grade shall be corrected by the addition or removal of mixture.

Complete base courses for a section before placing surface courses.

Hand Placing - Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperatures.

The mixture will be spread, tamped, and finished to a uniform density and to the correct depth. The surface will be checked as required under paver placing.

Joints - Carefully make joints between old and new pavements, or between successive days work, to ensure a continuous bond between adjoining work. Saw cut existing old pavement so that an even vertical surface is exposed. Apply tack coat and butt new pavement up to saw cut edge of existing pavement. Construct joints to have the same texture, density, and smoothness as the adjacent section of asphalt concrete course.

Clean contact surfaces free of sand, dirt or other objectionable material and apply tack coat. Also apply tack coat to contact surfaces of old pavement joints before placing mixture against them.

Offset transverse joints in succeeding courses not less than 24 inches.

Cut back edge of previously placed course to expose an even, vertical surface of full course thickness.

Offset longitudinal joints in succeeding courses not less than 6 inches.

When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface of full course thickness.

COMPACTING THE MIX

A minimum of two rollers will be required and as many additional rollers as necessary shall be used to compact the asphalt mixture at the proper temperature to obtain the specified pavement density.

Begin rolling operations as soon after placing when the mixture will bear weight of roller without excessive displacement. Delays in rolling of fresh mixture shall not be tolerated.

The roller wheels shall be kept moist with only enough water to avoid picking up the material. A detergent may be added to the water, but no oil will be permitted for this purpose.

Do not permit heavy equipment, including rollers, to stand on finished surface before it has thoroughly cooled or set.

Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

The lanes placed in the paving operation shall be rolled in the following order:

1. Transverse joints.
2 Longitudinal joints.
3. Outside edge.
4. Breakdown rolling. Start rolling longitudinally at extreme lower side of sections and proceed toward the high side. Roll to slightly different lengths on alternate roller runs.
5. Intermediate rolling. Same as breakdown rolling.
6. Finish rolling.

The line of rolling should not be suddenly changed or the direction of rolling suddenly reversed, thereby displacing the mix.

If rolling causes displacement of materials, the affected areas shall be loosened at once with lutes or rakes and restored to the original grade with loose material before being re-rolled.

Rolling Transverse Joints - The first pass shall be made with the steel-wheeled roller moving along the longitudinal joint for a few feet.

The surface shall then be straight-edged and corrections made, if necessary.

The joint will then be rolled transversely with the roller on the previously laid material, except for a 6-inch projection of the wheels. Continue with successive passes each covering 6 to 8 inches of fresh material until the entire width of the drive roll is on the new mix.

Unless boards of proper thickness are placed at the edge of the pavement to permit off the pavement movement, the transverse rolling shall stop 6 to 8 inches short of the outside edge with this edge being rolled out later when rolling longitudinally.

Rolling Longitudinal Joints - Rolling of longitudinal joints shall follow directly behind the paving operation.

The roller shall ride on the previously placed lane, except for a 6- inch projection of the roller wheel onto the new mix. The roller shall continue to roll along this line, shifting its position gradually across the joint, until a thoroughly compacted, neat joint is obtained.

The edges of the pavement shall be rolled concurrently with the longitudinal joint. The roller wheels shall extend 2 to 4 inches beyond the pavement edge.

After longitudinal joints and edges have been compacted, breakdown rolling shall follow immediately.

Breakdown Rolling - Accomplish breakdown rolling immediately following rolling of transverse and longitudinal joints and outside edge.

Operate rollers as close as possible to paver without causing pavement displacement.

The roller operation shall progress with the drive wheel forward in the direction of paving.

Check crown, grade, and smoothness after breakdown rolling and repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.

Intermediate Rolling - Follow the breakdown rolling as closely as possible while the asphalt mix is still plastic and at a temperature that will result in maximum density.

Pneumatic-tired rollers shall be used for the intermediate rolling unless otherwise acceptable to the Engineer.

Rolling shall be continuous, at least three complete coverages, after the breakdown rolling until all of the mix placed has been thoroughly compacted.

The turning of pneumatic-tired rollers on the paving mix, which causes undue displacement, will not be permitted.

Finish Rolling - Perform finish rolling while the mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and the course has attained specified density.

Patching - Remove and replace defective areas.

Cut-out and fill with fresh, hot asphalt concrete.

Compact by rolling to specified surface density and smoothness.

Remove deficient areas for full depth of course.

Cut sides perpendicular and parallel to direction of traffic with edges vertical.

Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.

FIELD QUALITY CONTROL

Density Control - Conduct tests for density control during compaction operations in accordance with the requirements of ASTM 02950 - Tests for Density of Bituminous Concrete In-Place by Nuclear Method.

Depth of Asphalt Control - Conduct tests of in-place compacted thickness to insure the required thicknesses are achieved as specified on the drawings and herein.

A minimum of one core sample for every 1200 square yards is required to measure thickness and Marshall stability and flow.

Conduct a minimum of one compaction test on bituminous pavement for every 1200 square yards at locations designated by the Engineer.

CLEANING AND PROTECTION

Cleaning - When paving is complete, clean surface of all spilled asphalt materials.

Protection - After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened and in no case sooner than 6 hours, unless the Town Manager allows.

Provide barricades and warning devices as required to protect pavement and the general public. Cover openings of structures in the area of paving until permanent coverings are placed.

Section 02605 - UNTREATED GRANULAR BASES

PART I - GENERAL

WORK INCLUDED

This section covers the furnishing, finish grading, compaction and testing requirements of the untreated granular bases constructed on a prepared subgrade in the preparation for paving and surfacing.

QUALITY ASSURANCE

Reference Standards - Wherever referred to hereinafter, Standard Specifications shall be State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," latest edition.

Design Criteria - Provide final surfaces conforming to the dimensions and typical cross-sections shown on the drawings and in compliance with the requirements for density, thickness, and surface smoothness.

A1lowable Tolerances - Base Course - The finished surface shall be tested for smoothness and accuracy of grade and crown. The maximum allowable variation for grade and crown shall be 1/4 inch, plus or minus.

Surfaces will be checked for smoothness using a 10-foot straight edge applied parallel to and at right angles to the centerline.

The in-place compacted thickness shall be tested for conformance to depth as shown on the drawings. The maximum allowable variation for individual samples is 1/2 inch, plus or minus. The average thickness of all samples shall be no less than that specified on the drawings.

SUBMITTALS

Samples - Sampling of aggregates shall be in accordance with the latest revision of AASHTO T-2 or ASTM D75.

Test Reports - Perform and submit test reports for the following materials in accordance with the specific standards set forth hereafter.

Coarse and fine aggregates from each material source and each required grading.

	ASTM Designation	AASHTO Designation
Sieve analysis (aggregates)	C136	T-27
Sieve analysis (filler)	D546	T-37
Unit weight of aggregate	C29	T-19
Clay lumps and friable particles in aggregates	C142	T-112
Abrasion of coarse aggregate	C131	T-96
Liquid limit	D423	T-90
Plasticity index	D424	T-91

Submit a Proctor curve for the material, test date is to be within 12 months of the work.

PRODUCT DELIVERY, STORAGE AND HANDLING

All work involved in obtaining a suitable material, such as haul, cross haul, pit clearing and stripping, crushing, handling unsuitable material and stockpiling and storage will be performed by the Contractor at his own expense.

JOB CONDITIONS

Weather Limitations - Base course may be placed when air temperature is not below 32°F and rising and free of ice and of frozen lumps. Under no circumstances shall base material be placed on wet, muddy, or frozen subgrade.

Dust Control - Water shall be used to minimize inconvenience from dust. When actual construction is not in progress, streets shall be properly maintained and appropriate dust control measures shall be employed.

Traffic Control - Provide flagmen, barricades, warning signs, and warning lights for movement of traffic and safety and to cause the least interruption to the work and inconvenience to the public.

PART II – PRODUCTS

MATERIALS

Base Course - The base course shall be crushed stone or crushed gravel and an approved soil binder or natural filler, where required. Coarse aggregate shall consist of hard, durable particles or fragments of stone or gravel and fine aggregate shall consist of crushed stone, crushed gravel, natural sand, or an equivalent product to natural sand such as crushed waste glass.

Gradation (Class 6, Standard Colorado Department of Highways 7 Specifications):

	% Passing by Weight	
Sieve Designation	Minimum	Maximum
3/4 inch		100
No. 4	30	65
No. 8	25	55
No. 200	3	12

Liquid limit - not greater than 30
Plasticity index - not greater than 6
Percentage of wear - not greater than 50
When the plasticity index is non-plastic, the liquid limit shall not be more than 30.
Of the particles retained on a No. 4 sieve, at least 60% by weight shall have one or more broken faces.

PART III - EXECUTION

PREPARATION

Check subgrade for conformance with specifications immediately before placing base material and make any necessary repairs in accordance with Section 02210. Do not begin placing any base material until unstable areas are corrected and under no circumstances shall base material be placed on a muddy surface.

MIXING

Aggregate mixing shall be by any one of the three following methods:

- *Stationary Plant Method* - Aggregate base course and water shall be mixed in an approved mixer. After mixing, the aggregate shall be transported to the job site while it contains the

proper moisture content and shall be placed on the roadbed by means of an approved aggregate spreader.

- *Travel Plant Method* - After the material for each layer has been placed through an aggregate spreader or windrow sizing device, it shall be uniformly mixed by a traveling mixing plant.

- *Road Mix Method* - After material for each layer has been placed, the materials shall be mixed while at optimum moisture by means of motor graders or other approved equipment until the mixture is uniform throughout.

PLACEMENT

Place base material in compacted layers not more than 4 inches thick, unless continuing tests indicate the required results are being obtained with thicker layers. In no case will more than 6 inches of compacted base be placed on one lift.

All base material deposited on the subgrade shall be spread, shaped and compacted during the same day.

Water shall be uniformly applied during compaction in the amount necessary for proper consolidation.

The material as spread shall be of uniform gradation with no pockets of fine or coarse materials. Areas of segregated material shall be corrected by removing, remixing, and relaying.

The area behind the curb and gutter shall be backfilled before any base course material is placed.

COMPACTION

Compaction shall be accomplished by an approved power roller and sufficient rollers shall be furnished to adequately handle the rate of placing and spreading.

Places inaccessible to rollers shall be tamped thoroughly with mechanical or hand tampers. Each hand tamper shall weigh not less than 50 pounds and have a face area of not more than 100 square inches. Water shall be uniformly applied during compaction in the amount necessary for proper consolidation. All base course material shall be compacted at a moisture content of 2% below to 2% above optimum moisture and to a density of 95% of maximum density.

FINISH GRADING

Base Course - After the final shaping, compaction, and curing of the base course, the surface shall be tested for smoothness and accuracy of grade and crown. If any portions are found to lack, they shall be scarified, reshaped, recompacted, and otherwise manipulated until the required smoothness and accuracy is obtained. Following the final shaping of the material, the base course shall be maintained smooth and moist until the bituminous prime coat is applied.

FIELD QUALITY CONTROL

Laboratory Compaction Tests - Conduct in accordance with requirements of ASTM D698 or AASHTO T-99, Standard Method of Test for Moisture Density Relations of Soils using a 5.5 Lb. Rammer and a 12-inch Drop.

Use Method A, B, C or D as appropriate, based on soil condition and judgment of the testing laboratory. Samples tested shall be representative of materials to be placed (or altered). Obtain optimum moisture density curve for each type of material or combination of materials encountered or used. Use test results as a basis for compaction control. Testing includes Atterberg Limits, grain size determination, and specific gravity.

Field Density Control - Conduct tests for density control during compaction operations in accordance with the requirements of:

- ASTM D2922 - Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
- ASTM D1556 - Test for Density of Soil In-Place by the Sand Cone Method

Conduct one test for each layer of specified depth of base material as follows: Base course material shall be tested for each 1200 square yards, but never less than once daily for each layer.

CLEAN-UP AND PROTECTION

Remove loose and foreign material from compacted base surface and curb and gutter immediately before application of prime coat or hot bituminous pavement. Use power brooms or blowers, and hand brooming as required. Do not displace base material. Protect new surface materials from vehicular and bicycle traffic. If the surface is to be open to traffic, treat with bituminous prime coat in accordance with Section 02600.

Section 02625 - CURBS, GUTTERS, WALKS, AND ACCESSIBILITY RAMPS

PART I – GENERAL

WORK INCLUDED

Work under this section includes construction of curbs, gutters, and walks as shown on the drawings and as specified herein.

QUALITY ASSURANCE

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Society for Testing and Materials (ASTM)

ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

SUBMITTALS

Include the following:

- *Product Data* - Submit catalog data or brochures on manufactured items specified and proposed for use.
- *Certificates of Compliance* - Furnish certification that standards for products specified herein are met.
- *Shop Drawings* - Furnish drawings showing cross-section of curb and gutter templates or forms to be used on the job.

JOB CONDITIONS

Environmental Requirements - Conform to applicable requirements of Section 03300 - Cast-in-Place Concrete.

Protection - Protect al1 walks, curbs and gutters, and other flat work from traffic by pedestrians and vehicles, and damage, until accepted.

PART II - PRODUCTS

MATERIALS

Concrete - Refer to Section 03300 - Cast-in-Place Concrete.

Asphalt - Refer to Section 02600 - Paving and Surfacing.

Welded Wire Fabric - Shall be 6" x 6" by #10 gauge wire mesh.

Reinforcing Bars - Conform to ASTM A615, Grade 40.

Expansion Joint Filler - Conform to ASTM D1751.

Bed Course Material - Cinders, slag, gravel, crushed stone or other approved material, all particles passing through sieve with 3/4" square openings.

Curing Materials - Refer to Section 03300 - Cast-in-Place Concrete.

PART III - EXECUTION

CAST-IN-PLACE CONCRETE CURBS, GUTTERS, WALKS, AND ACCESSIBILITY RAMPS

Excavation - Excavate to required depth and to width that will permit installation and bracing of forms. Shape and compact foundation to a firm, even surface as shown on the drawings and in accordance with Section 02210 of these specifications. Remove all soft and yielding material and replace with moisture conditioned, compacted material.

Compaction - Compact the top foot of the sub-surface to 96% of maximum density.

Forms - Install forms of wood or metal to accurate grade and alignment. Use formwork which is clean, straight, and free from warp. Extend all forms for entire depth of curb and brace to prevent deflection from grade and alignment during concrete placement. Install a separator template every 10 feet, true to the dimensions and cross-sections of the curb and gutter.

The elevations of the finished curb and gutter shall not vary by more than 1/4 inch, plus or minus, from the design elevations.

On short radii curves, steel plates which can be readily formed to the desired radii shall be used. Face forms, if used, shall be pre-formed to the proper radii.

All forms shall be cleaned thoroughly and greased or oiled before concrete is placed against them. Forms that have become bent, worn, or broken shall not be used.

Set and grade a minimum of 300 lineal feet of forms prior to placing concrete. Where one complete run is less than 300 feet in length, set and grade forms for entire length.

The forms shall be securely held to line and grade and shall at no time deviate more than 1/4 inch from an accurate template 10 feet in length.

Maintain forms in place until concrete has set up sufficiently to enable the removal of forms without damage to the concrete surface. Crowbars or other heavy tools shall not be used against green concrete in removing the forms. Forms shall be well cleaned before re-oiling and re-use.

The template shall be pulled prior to the concrete taking initial set. In those cases where initial set takes place prior to pulling of the template; the joint shall be sealed with asphaltic sealing compound.

Curb Machine - Curbs, gutters and walks may be constructed by use of a self-propelled automatic curber or curb machine. The machine shall form curb that is uniform in texture, shape and density.

Provide maximum allowable surface deviation on all surfaces of 1/4 inch in any 10 feet as determined by a ten foot metal straight edge.

The elevations of the finished curb and gutter shall not vary by more than 1/4 inch, plus or minus, from the design elevations.

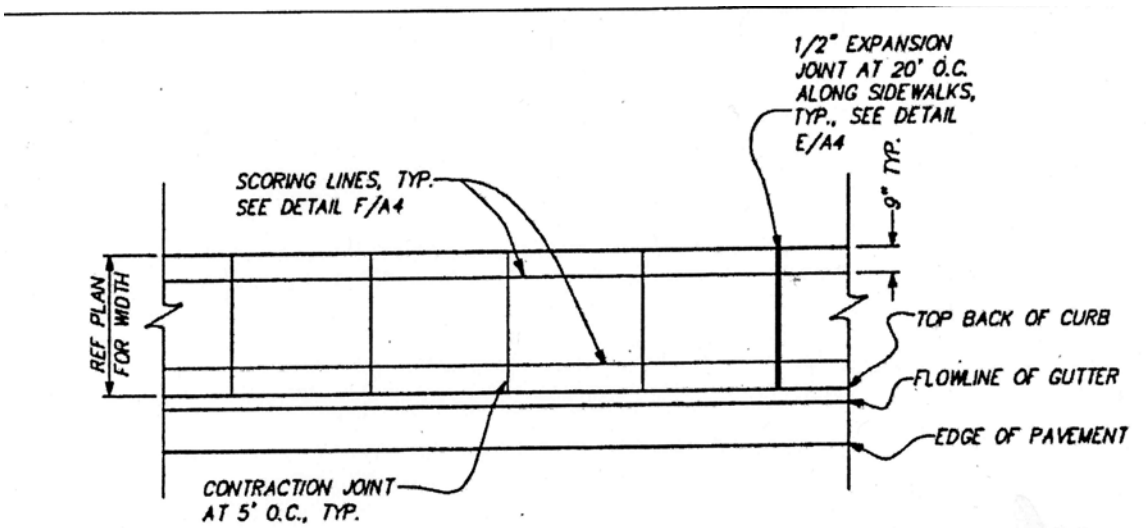
Grade lines used for controlling the line and grade of the machine-placed curb and gutter shall be securely fastened at sufficient intervals to insure proper grade and alignment as that required for form placed curb and gutter. The minimum length of grade line set shall be the same as that for forming.

Mixing and Placing - Refer to Section 03300 - Cast-in-Place Concrete. Terminate concrete pouring operations at construction or expansion joints. When unavoidable stoppage or interruptions in excess of 30 minutes occur, provide a construction joint at the point of work stoppage. The length of completed work between point of stoppage and last previous joint shall not be less than 5 feet. Remove any completed section less than this length.

Sections - Curbs shall be constructed in sections having a uniform length of 10 feet by the use of metal templates or dummy joints formed by a jointing tool. These dummy joints shall extend into the concrete for at least 1/3 of the depth and shall be approximately 1/8 inch wide. Immediately following finishing operation, round joint edges with an edging tool having a 1/4 inch radius. Refer to Standard No. 2625D.

Divide walks into rectangular areas by means of dummy joints, meeting same requirements as for curbs, as indicated in the following table and figure:

	Dummy Joint Spacing	
Walk Width	Transverse	Longitudinal
4'	5'	not required
6'	6'	not required
8'	4'	4'
10'	5'	5'
12'	6'	6'



SIDEWALK SCORING PATTERN – ALL WALKWAYS
N.T.S.

Note: Where curbs and walks abut, make joints aline.

Expansion Joints - Install at distances not to exceed 300 feet on center on sidewalks and curb and gutter. Provide expansion joints at the ends of curb returns on sidewalks and curb and gutter and around structures and features that project through, onto, or abut the walk or curb, such as manholes, valve boxes, poles and old sidewalk.

No expansion joints shall be constructed in cross gutters, alley intersections, or driveways except where approved by the Engineer.

Install so as to form a complete, uniform separation between the structure and to the full depth of the contact surface and within 1/4 inch of any concrete surface.

Width of expansion joint shall be 1/2 inch.

Hold filler strip rigidly and securely in the proper position during placing and tamping of concrete. Remove concrete over joint filler. Round edges with an edging tool having a 1/4 inch radius to form a recess for sealing compound where curbs and walks abut, make joints line up.

Curing and Protection - Immediately following finishing operations, cure exposed concrete surfaces in accordance with Section 03300 - Cast-in-Place Concrete. Protect concrete during curing from wind, rain and flowing water. Clean concrete that has discolored during construction or curing. Replace all damaged concrete by removing and reconstructing damaged portions between joints.

Backfilling - Backfill space in back of curb after concrete has cured for at least 3 days and forms have been removed. Carefully tamp backfill without damaging curbing.

CAST-IN-PLACE CONCRETE FINISHING

Curbs and Gutters - Finishing shall be done with a metal screed or "mule" designed to give proper shape to the section as detailed in Construction Standard No. 2625A or No. 2625B. Particular care shall be used to finish the gutter flow line to a true, uniform grade.

When face forms are not used, care shall be taken in forming the face of the curb to the proper cross-sections as detailed in Construction Standard No. 2625A or No. 2625B.

When face forms are used, they shall be left in place until the concrete has hardened sufficiently so that they can be removed without injury to the curb. The exposed surfaces shall then be finished smooth and even by means of a moist wood float or a moist brick.

Point up minor honeycombed areas and small defects with a 1:2 mix mortar.

Surfaces to be exposed shall be troweled smooth and given a fine brush finish with brush strokes parallel to the line of the curb.

Where new curb sections join existing curb sections with different cross-sections, a 5 foot transition section of curb and gutter will be constructed in such a manner that, when finished, the gutter will be free-flowing and the top of curb will be smooth and neat in appearance.

Driveway curb cuts and alley curb cuts shall be placed as shown on the approved Construction Drawings, unless an alternate location has been approved in the field and supported in writing by a Town Manager. The width of curb cuts shall be as follows:

Location	Minimum	Maximum
Residence - single garage or tandem parking	8’	12’
Residence - double garage or side-by-side parking	8’-16'	20'
Commercial establishments	8’-24'	40'
Specials	As determined by Town	

Correct surface irregularities which exceed 1/4 inch variance from testing edge of a 10-foot straight edge.

Valley Gutters - Size and thickness shall conform to the cross-sections as detailed in Construction Standard No. 2625A and 2625B. Install a 6" x 6" x #10 gauge wire mesh at a point 3 inches below the surface. The mesh shall be fully supported on precast mortar blocks or wire saddles prior to placing concrete. Joint types and spacing shall be as detailed on the drawings. Finish shall be the same as specified for concrete curb and gutter.

Walks - Sidewalks shall be four inches thick except at driveway crossings, alley crossings, or other motor vehicle crossings where the thickness shall be increased to no less than 6 inches as shown in Construction Standard No. 2625C.

Following placement in forms, bring surface to proper section, use strike-off guided by side forms or finished curbs, tamp and consolidate with wood or metal tamping bar, and finish to grade with wood float.

The surface of walks shall have a transverse slope of no less than 1/4 inch per foot (2%) in the direction of the adjacent curb and gutter, or in the direction of the most appropriate infiltration gallery, such as a right-of-way green strip. A transverse slope that is greater than 2% must be approved in writing by the Town Manager. The transverse slope shall never be more than 3%.

Handicap ramps that are compliant with ADA specifications shall be provided on every corner at street intersections as detailed in Construction Standard No. 2625D. Acceptable types of accessibility ramps are shown in Construction Standard Nos. 2625E through 2625J. If this is not possible during construction, Contractor must provide a written request to the Town Manager for a variance. The Town Manager must provide written approval or denial of the variance. All accessibility ramps will have detectable warning strips (AKA truncated domes) 2 feet tall by 5 feet wide whether or not truncated domes are shown in the Construction Standard.

Following the wood float finish, trowel smooth and finish with a fine hair push broom drawn over the surface transverse to the line of traffic.

Correct surface irregularities which exceed 1/4 inch variance from testing edge of a ten-foot straight edge.

When an increased thickness is required at driveways or drive-over walks, the quantity to be paid for will be computed by multiplying the actual area by the relationship of the increased thickness to the plan thickness.

FIELD QUALITY CONTROL

Concrete Tests - Refer to Section 03300 - Cast-in-Place Concrete under Field Quality Control, for responsibilities.

Laboratory Compaction Tests - Conduct in accordance with requirements of ASTM D698-70 or AASHTO T-99 - Standard Method of Test for Moisture Density Relations of Soils Using a 5.5 Lb. Rammer and a 12-inch Drop.

Use Method A, B, C or D as appropriate, based on soil condition and judgment of the testing laboratory. Samples tested shall be representative of materials to be placed (or altered). Obtain optimum moisture density curve for each type of material or combination of materials encountered or used. Use test results as a basis for compaction control. Testing includes Atterberg Limits, grain size determination, and specific gravity.

Field Density Control - Conduct tests for density control during compaction operations in accordance with the requirements of:

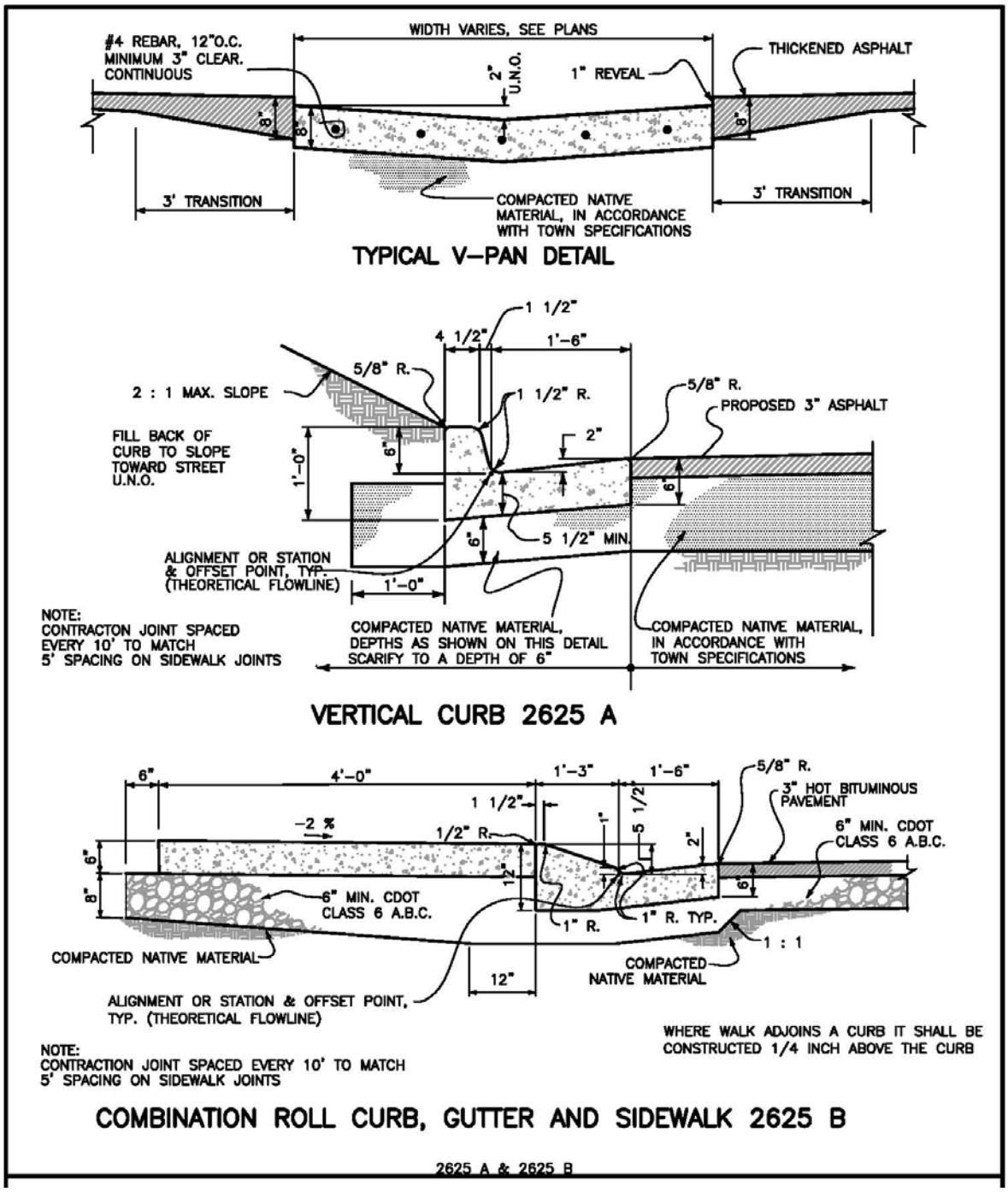
- ASTM 02922-71 - Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods,
- ASTM D1556 (1974) - Test for Density of Soil-in-Place by the Sand-Cone Method, or

Conduct a minimum of one test of base or subgrade where directed by the Town Manager as follows:

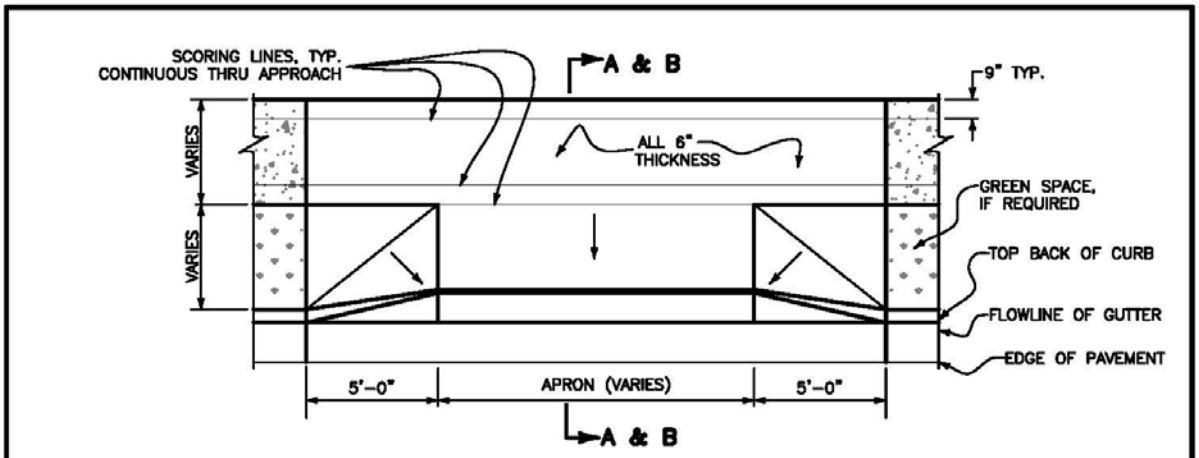
- *Curbs and gutter* - For each 300 lineal feet or less, but in no case less than one daily for each area prepared.
- *Sidewalks* - For each 1200 square feet or less, but in no case less than one daily for each area prepared.

CLEANUP

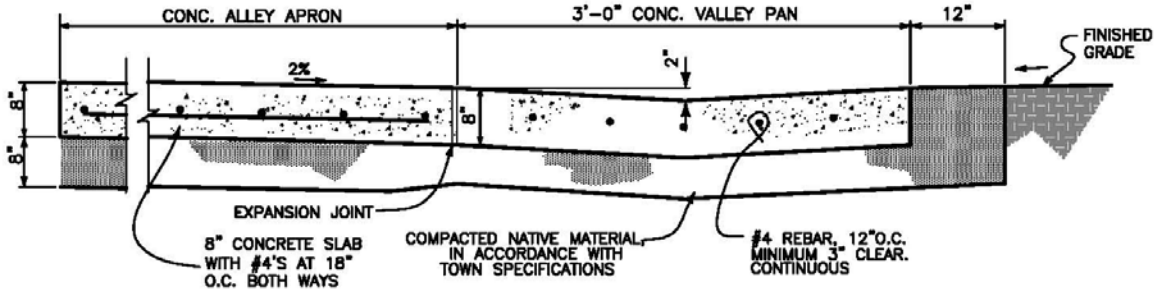
Excess material occurring during the concrete placing operations will not be permitted to accumulate and shall be removed concurrent with the finishing operations. Care shall be taken to prevent the entrance of this material into drainage structures or other waterways during the construction period. No concrete washout shall be allowed at project site unless properly contained to prevent discharge offsite and/or to roadside ditches and storm drainage system.



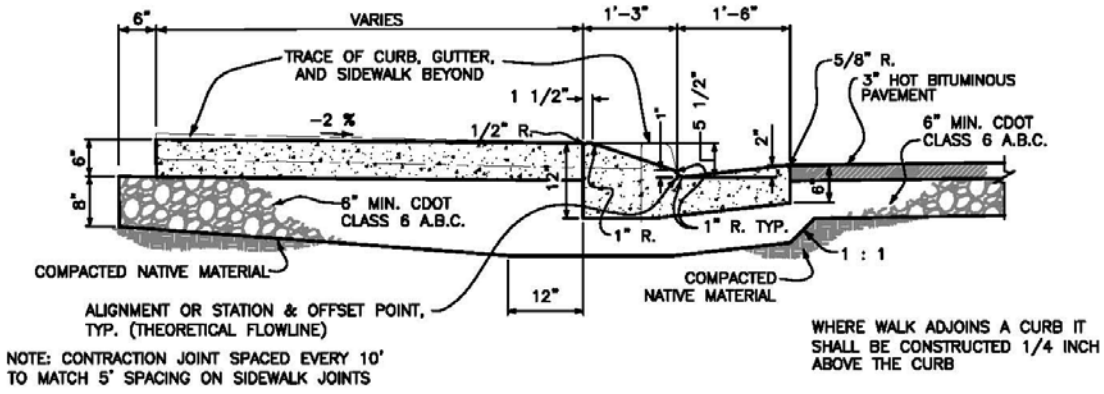
REVISIONS				
MARK	DATE	DESCRIPTION	**CURB & GUTTER DETAILS**	Town of Telluride, Colorado
			Standard No. 2625A & 2625B	
			Sheet 1 of 1	



NEW DRIVEWAY OR ALLEY APPROACH DETAIL



TYPICAL ALLEY APPROACH WITH V-PAN SECTION A



TYPICAL DRIVEWAY APPROACH SECTION B

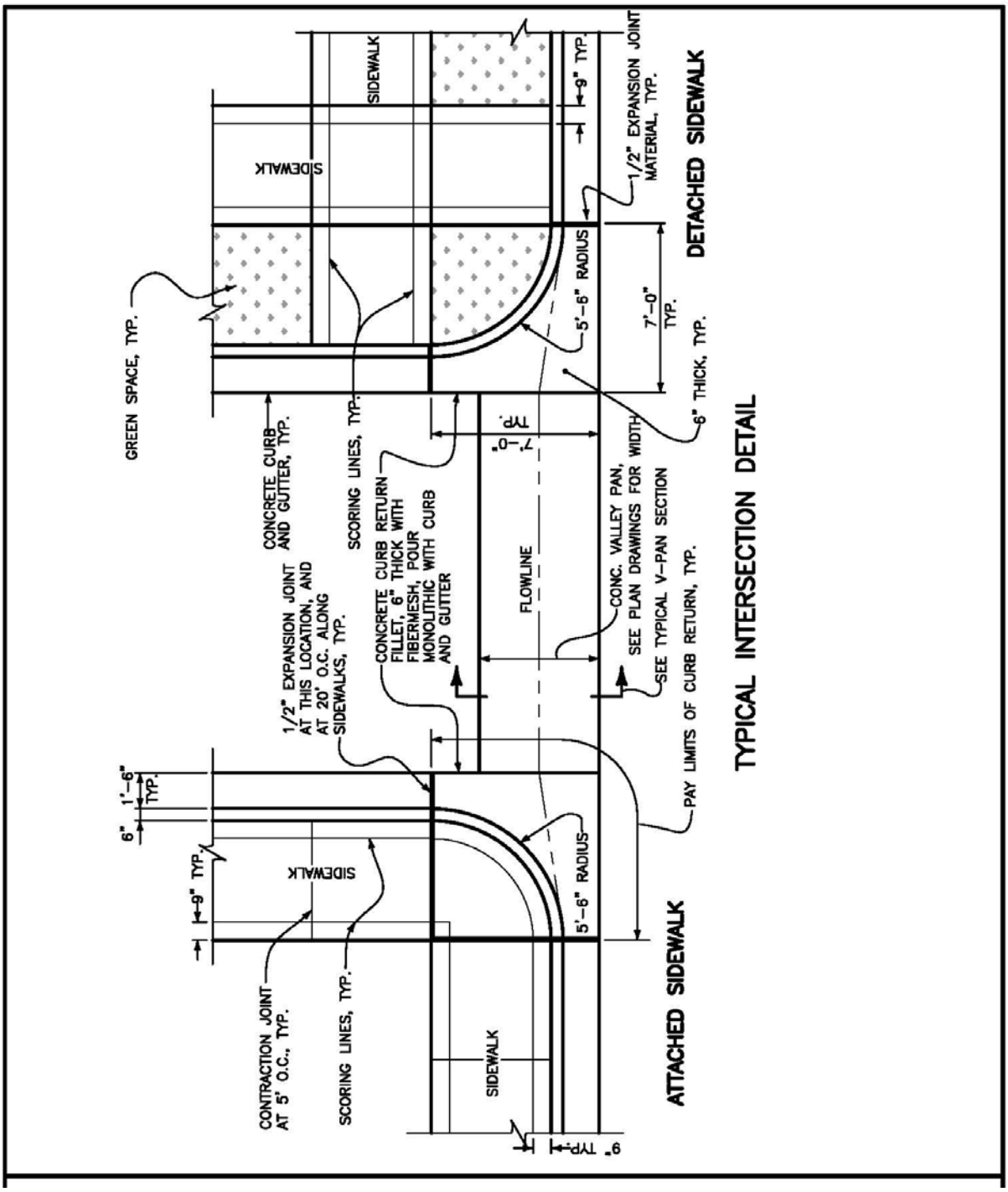
REVISIONS		
MARK	DATE	DESCRIPTION

DRIVEWAY & ALLEY DETAILS

Standard No. 2625C

Sheet 1 of 1

Town of Telluride, Colorado



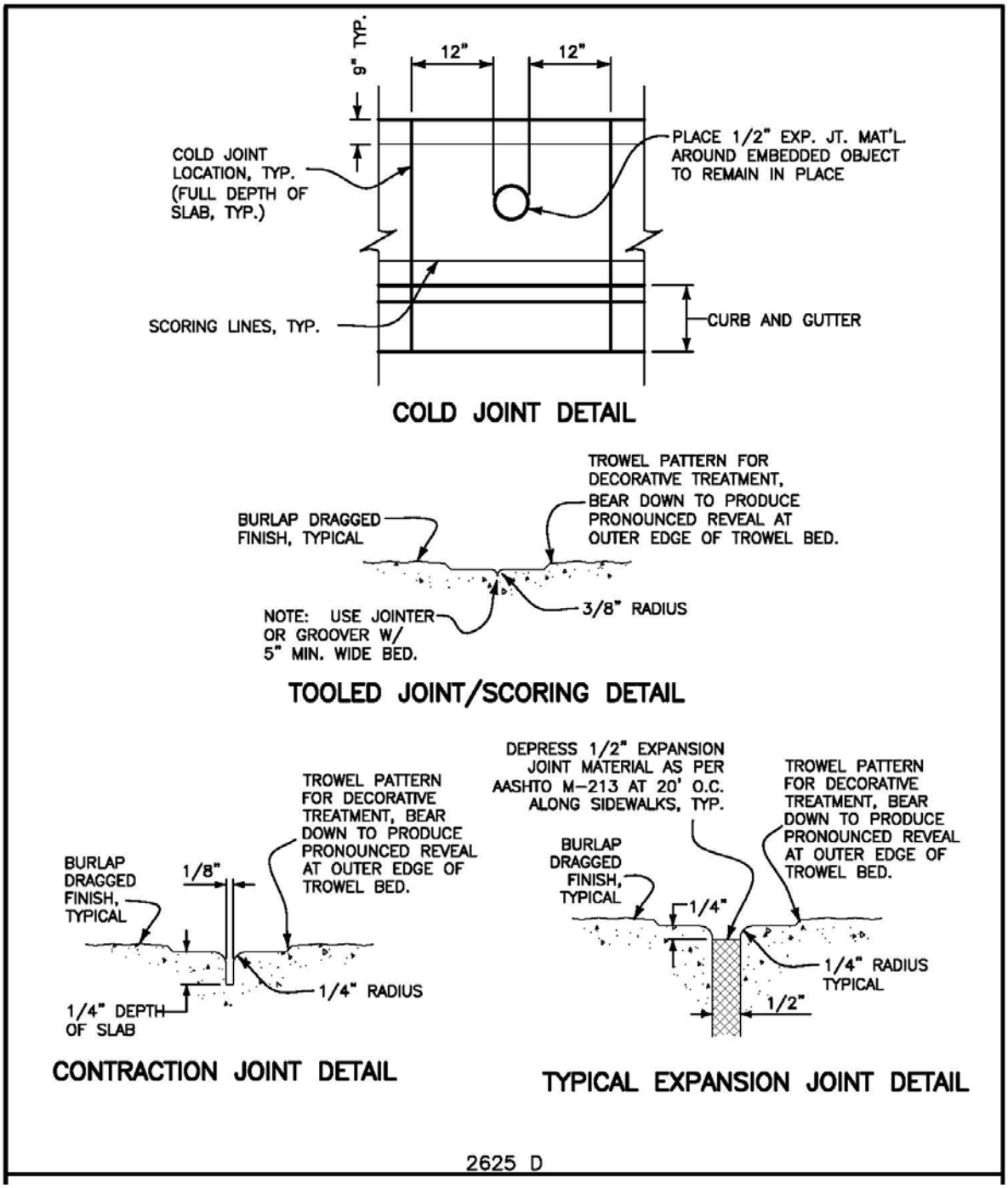
REVISIONS		
MARK	DATE	DESCRIPTION

STREET INTERSECTION

Standard No. 2625D

Sheet 1 of 2

Town of Telluride, Colorado



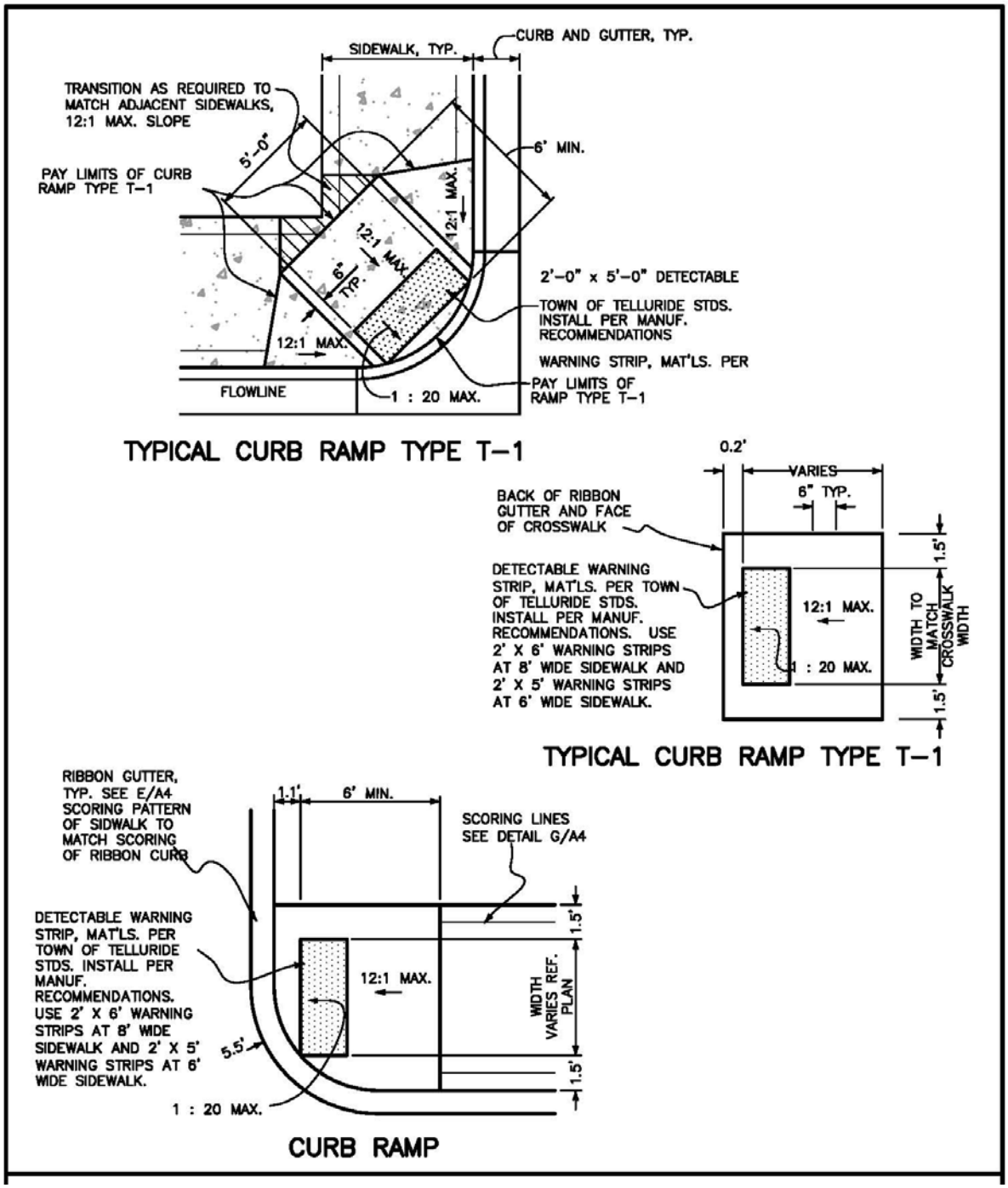
REVISIONS		
MARK	DATE	DESCRIPTION

STREET INTERSECTION

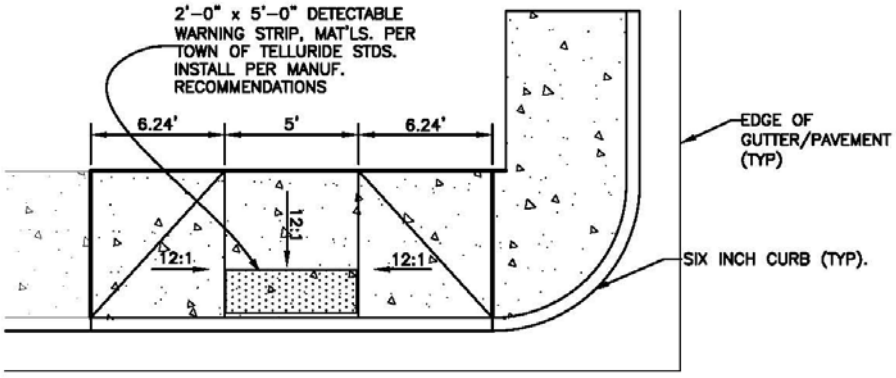
Standard No. 2625D

Sheet 2 of 2

Town of Telluride, Colorado



REVISIONS			**ACCESSIBILITY RAMP DETAILS**	Town of Telluride, Colorado
MARK	DATE	DESCRIPTION	**Standard No. 2625E**	
			Sheet 1 of 5	



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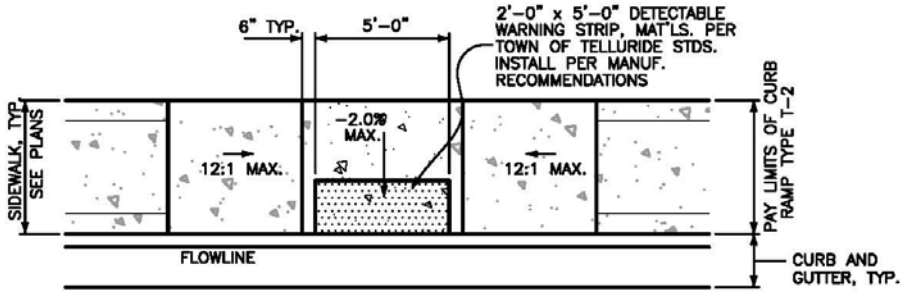


TYPICAL CURB RAMP TYPE T–2

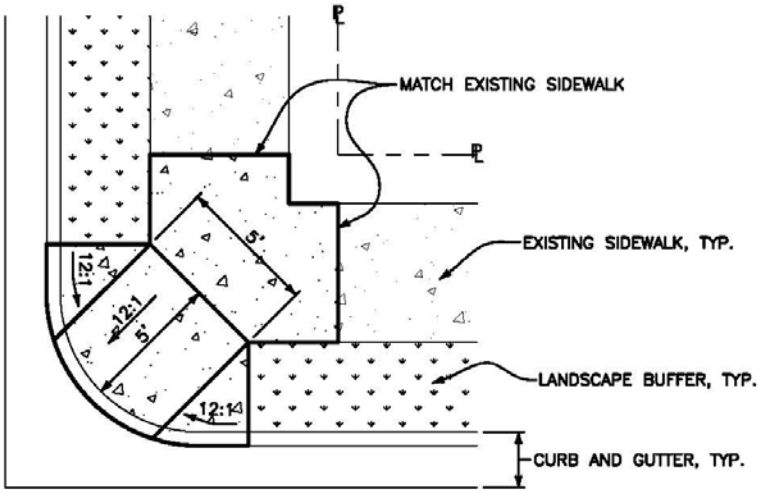
REVISIONS		
MARK	DATE	DESCRIPTION

ACCESSIBILITY RAMP DETAILS

Standard No. 2625F

Sheet 2 of 5

Town of Telluride, Colorado



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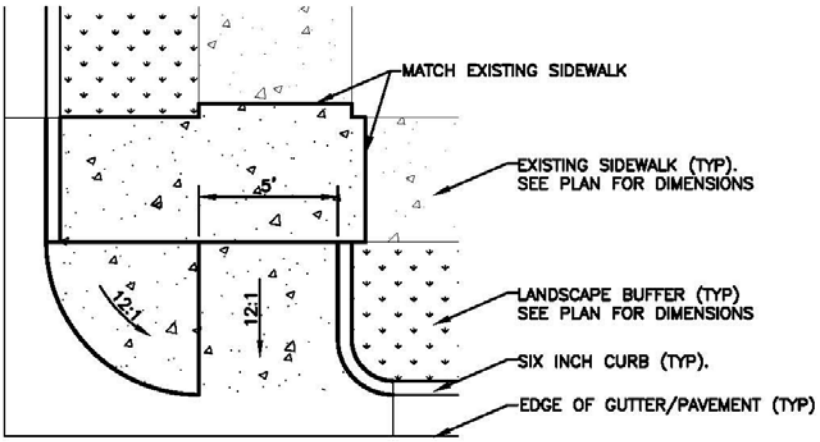


TYPE 2
ADA RAMP

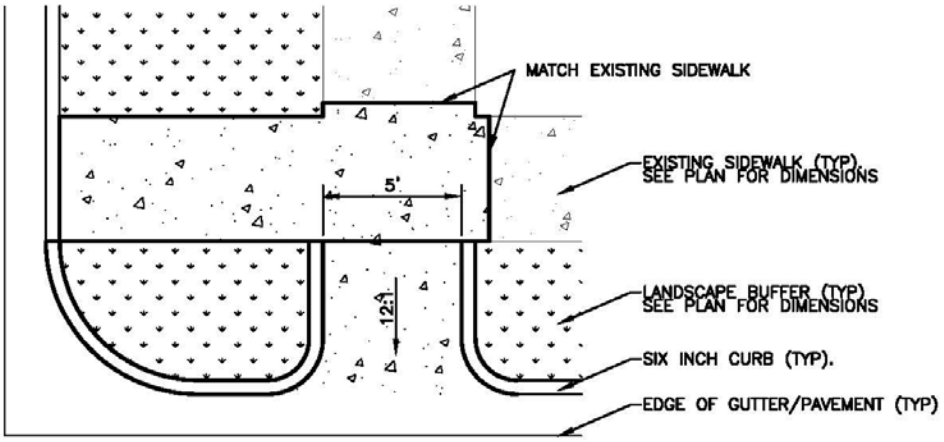
REVISIONS		
MARK	DATE	DESCRIPTION

ACCESSIBILITY RAMP DETAILS

Standard No. 2625G

Sheet 3 of 5

Town of Telluride, Colorado



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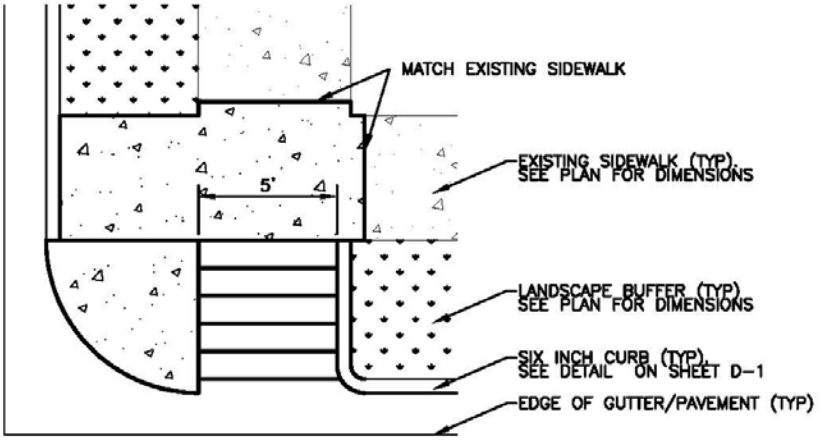

TYPE 4
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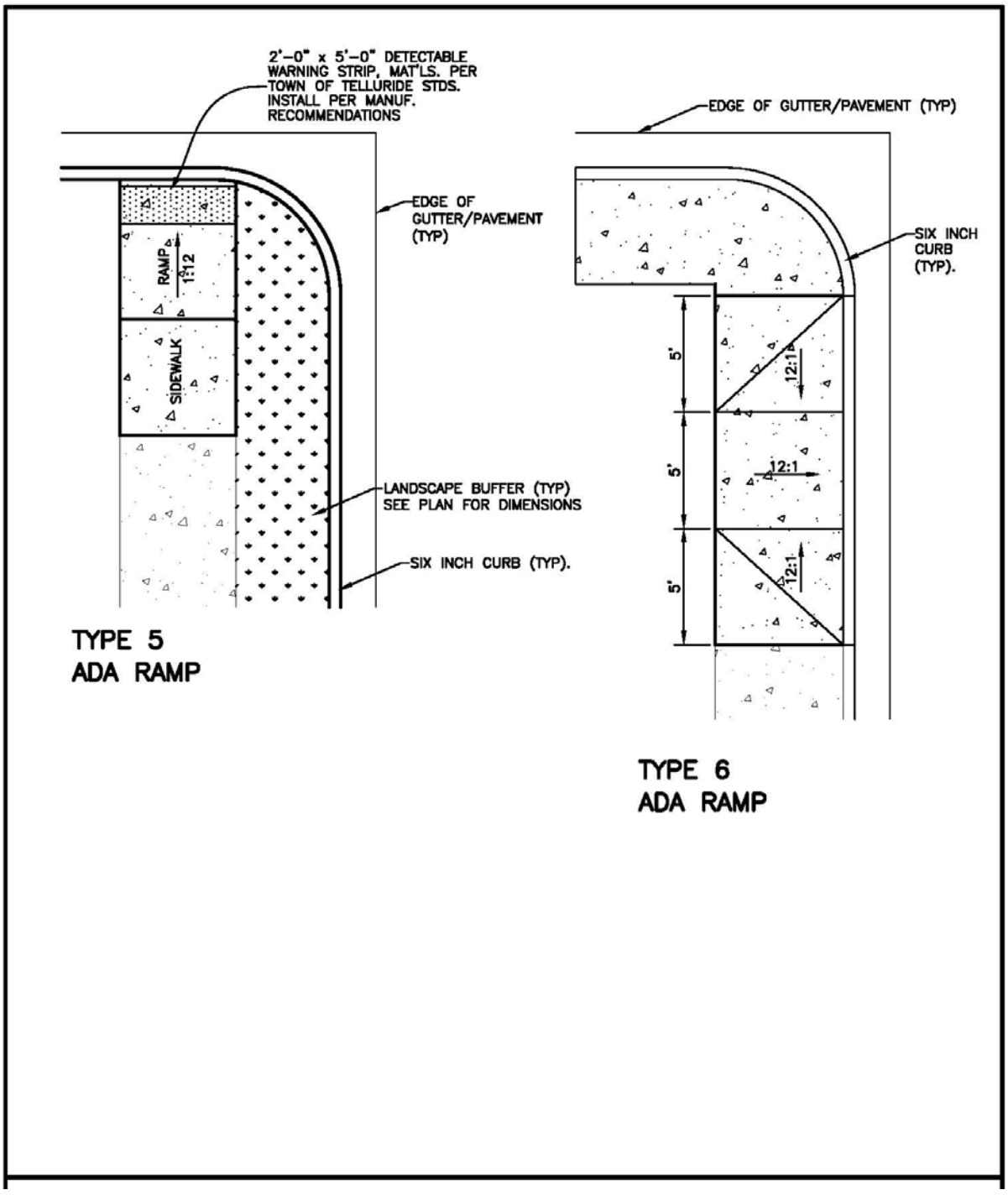
REVISIONS		
MARK	DATE	DESCRIPTION

ACCESSIBILITY RAMP DETAILS

Standard No. 2625H

Sheet 4 of 5

Town of Telluride, Colorado



REVISIONS		
MARK	DATE	DESCRIPTION

ACCESSIBILITY RAMP DETAILS

Standard No. 2625I

Sheet 5 of 5

Town of Telluride, Colorado

Section 03300 - CAST-IN-PLACE CONCRETE

PART I - GENERAL

WORK INCLUDED

Work under this section includes mixing, placing, finishing, and curing of cast-in-place concrete construction shown on the drawings and as specified herein.

QUALITY ASSURANCE

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Concrete Institute Standards (ACI)

ACI 301	Specifications for Structural Concrete for Buildings
Committee 305 Report	Hot Weather Concreting
Committee 306 Report	Cold Weather Concreting
ACI 309	Recommended Practice for Consolidation of Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete

American Society for Testing Materials (ASTM)

ASTM A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A616	Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A706	Low Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C33	Specification for Concrete Aggregates
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C88	Test for Soundness of Concrete Aggregates
ASTM C94	Ready Mix Concrete
ASTM C127	Specific Gravity and Absorption of Concrete Aggregate
ASTM C128	Specific Gravity and Absorption of Fine Aggregate
ASTM C150	Portland Cement
ASTM C171	Sheet Materials for Curing Concrete
ASTM C260	Air Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM C685	Concrete Made by Volumetric Batching and Continuous Mixing
ASTM D994	Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1190	Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D1751	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)
ASTM 01752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D1850	Concrete Joint Sealer, Cold Application Type

Corps of Engineers Specifications

CRD-C 572	Polyvinylchloride Waterstop
CRD-C 588	Nonshrink Grout

U.S. Dept. of Commerce, National Bureau of Standards Publications

PS 1	Construction and Industrial Plywood
PS 17	Polyethylene Sheeting

Concrete Reinforcing Steel Institute (CRSI-WCRSI)

Placing Reinforcing Bars

American Welding Society (AWS)

D1.4	Structural Welding Code - Reinforcing Steel

Federal Specifications (Fed Spec.)

SS-A-694	Asphalt Coating
TT-S-00230	Sealants

SUBMITTALS

Include the following:

Test Reports - Perform and submit test reports for the following products in accordance with above general reference standards and specific standards set forth hereafter.

Proposed Mix Design - Prior to commencing concrete work, submit certified test report describing proposed concrete mix selected in accordance with paragraph 3.8 of ACI 301. Use either Method 1 or Method 2, and include the following:

- Fine Aggregates - Source, type, gradation, deleterious substances and saturated surface dry specific gravity (ASTM C128).
- Coarse Aggregates - Source, type gradation, deleterious substances and saturated surface dry specific gravity (ASTM C127); Soundness (ASTM C88).
- Ratio of fine to total aggregates.
- Weight (surface dry) of each aggregate per cubic yard.
- Total water content (gallons) per cubic yard and proposed source.
- Slump on which design is based.
- Brand, type and quantity of cement.
- Brand, type and quantity of admixtures.
- Seven-day and 28-day compressive strength results from each of two sets of test cylinders for each proposed mix.

Cylinder Compression Test Reports - Submit 1 electronic or paper copy of certified test reports indicating results of tests required in PART III hereof.

Ready-Mix Delivery Tickets - Submit 1 electronic or paper copy of ready-mix delivery ticket for each load delivered to the project. Include:

- Weights of fine and coarse aggregate; maximum size coarse aggregate.

- Mix identification and quantity of concrete supplied.
- Type and brand of cement and admixtures.
- Time loaded and time unloaded.
- Total water content by producer.
- Amounts of initial and supplemental water added, and name of individual authorizing supplemental water.
- Certification by ready mix supplier that load complies with approved design mix.
- Signature or initials of ready mix representative

JOB CONDITIONS

Environmental Requirements - Do not place concrete during rain, sleet, snow, and high temperatures, or any condition which will impair the quality of fresh or hardened concrete unless protective measures are taken that allow placement and curing to take place under conditions specified hereafter. Prevent rainwater from increasing mixing water or damaging surface finishes.

Cold Weather - Cold weather measures shall be undertaken when the mean daily temperatures at the job site falls below 40°F for more than one day in a row, except when temperatures above 50°F occur during at least 12 hours in any 24-hour period.

Mixing Requirements - Minimum temperatures of concrete as mixed shall conform to the following:

	Minimum Concrete Temperature			
Air Temp	Section Thickness			
F°	Under 12"	12" to 36"	36" to 72"	Over 72"
Above 30°F	60°F	55°F	55°F	45°F
0° to 30°F	65°F	60°F	55°F	50°F
Below 0°F	70°F	65°F	60°F	55°F

Concrete temperatures as mixed shall not be greater than 10°F above values given above. Refer to ACI 306 for recommended methods for heating concrete mixtures.

Placing Requirements - Minimum temperatures of concrete as placed and maintained shall conform to the following:

Section Thickness	Minimum Concrete Temperature
Under 12"	55°F
12" to 36"	50°F
36" to 72"	45°F
Over 72"	40°F

Duration of Maintained Concrete Temperatures - Maintain temperatures specified above for the following periods and classifications:

TABLE A

Classification	Period	
	For Durability	For Safe Stripping
Lightly stressed, no exposure*, favorable moist-curing	2 days	2 days
Lightly stressed, exposed, but later has favorable moist-curing	3 days	3 days
Moderately stressed, exposed*	3 days	6 days
Fully stressed, exposed*	3 days	See TABLE B

TABLE B

Required percentage of design strength	Days at 50°F (10°C)			Days at 70°F (21°C)		
	Type of Portland cement			Type of Portland cement		
	I	II	III	I	II	III
50	6	9	3	4	6	3
65	11	14	5	8	10	4
85	21	28	16	16	18	12
95	29	35	26	23	24	20

Hot Weather - Hot weather procedures shall be undertaken when temperatures at the job site exceeds 75°F or at a limiting temperature established for conditions at the job site based on trial batch tests at the limiting temperature selected.

Cooling Concrete Materials - The ingredients may be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered. Refer to Committee 305 Report for recommended procedures.

Mixing and Delivery Procedures - Hold mixing time to a minimum to insure concrete quality and uniformity. Keep the period between mixing and delivery to a minimum. With ready-mixed concrete operations, coordinate the dispatching of trucks with the rate of placement to avoid delays in delivery. When elapsed time from batching to placement results in increase in mixing water demand or slump loss, delay mixing in the trucks so that only that time remains to accomplish mixing before the concrete is placed.

Shorten time between introduction of mixing water and discharge of concrete to 1 hour maximum.

Cover concrete surfaces exposed to the air as soon as the concrete has attained initial set and keep continuously wet during the curing period.

Keep formed surfaces completely and continuously wet for the duration of curing period (prior to, during, and after form removal).

If moist curing is discontinued before the end of the curing period, apply white pigmented curing compound immediately.

Prevention of Plastic Cracking - Take following precautions to minimize plastic cracking of structures caused by high concrete temperature, low humidity, high winds, or other conditions that increase evaporation:

- Moisten the subgrade and forms.
- Moisten aggregates that are dry and absorptive.
- Erect temporary windbreaks to reduce wind velocity over the concrete surface.
- Erect temporary sunshades to reduce concrete surface temperatures.
- Keep the fresh concrete temperature low by cooling the aggregates and mixing water.
- Protect the concrete with temporary coverings, such as polyethylene sheeting, during extended delay between placing and finishing.
- Reduce time between placing and start of curing by eliminating delays during construction.

To minimize evaporation, protect the concrete immediately after finishing. Apply moisture to the surface by fog spray to prevent evaporation from the concrete. Fogging shall be continued until curing compound, wet burlap, or curing paper can be applied.

If plastic cracks appear in the fresh concrete, close cracks by striking each side of the crack with a float.

Do not place concrete when the evaporation rate (actual or anticipated) equals or exceeds 0.20 pounds per square foot per hour, as determined by Figure 2.1.4. of ACI 305.

Set-retarding and water reducing admixtures may be used with Engineer's written approval when the ambient air temperature is 90°F or above to offset the accelerating effects of high temperatures.

PART II – PRODUCTS

CONCRETE MATERIALS

Cements - Portland, ASTM C150, type as specified below. Use consistent type and brand for exposed surfaces throughout.

Type I (Normal) - Use for all concrete work except as otherwise specified below.

Type II (Moderate) - Use for all concrete to remain in contact with the earth or wastewater with under 1500 mg/l sulfates.

Type III (High Early Strength) - Use only with prior written approval of the Engineer.

Type IV (Low Heat of Hydration) - Use only with prior written approval of the Engineer.

Type V (Sulfate Resisting) - Use for concrete in contact with waste-water with over 1500 mg/1 sulfates or earth with over 0.2% soluble sulfates in soil.

Admixtures - Use only as specified. Admixtures causing accelerated setting of cement shall not be used. Calcium chloride is not permitted. Fly ash conforming to the requirements of ASTM C 618, Class F, is permitted up to 15% of total cement by dry weight, with a substitution ratio of fly ash to cement of 1.25 to 1.0 (dry weight).

Air-Entraining Admixtures - Conform to ASTM C260.

Water Reducing and Retarding Admixtures - Conform to ASTM C494.

Water - Conform to requirements of ASTM C94.

Aggregates - Conform to ASTM C33 and ACT 301. Sections 2.4.1 and 2.4.3, Maximum size of coarse aggregate shall not exceed 3/4 inches (Grading Size No. 67). Use only natural material for fine aggregates. Stockpiled natural or manufactured sand shall be allowed to drain to insure a relatively uniform moisture content throughout the stockpile prior to incorporation into the mix. For liquid containing structures, pozzolan or other additives shall not be used to compensate for alkali reactivity. Following limitations shall apply to coarse aggregates:

Item	Maximum Percent by Weight
Soft particles	2.0
Chert as soft impurity	1.0
Total of above	2.0
Flat and elongated particles	15.0

CONCRETE PRODUCTION

Ready-Mixed and Site Mixed

Concrete - Conform to ASTM C94 for ready mixed. Plant equipment "Check List for Certification of Ready-Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association. Conform to ASTM C685 for concrete produced by on-site volumetric batching and continuous mixing.

All Other Concretes - Conform to ACI 301, Section 7.2.

Proportioning

Strength - Proportion ingredients to produce a well-graded mix of high density and maximum workability consistent with approved mix design. Conform to the following minimum 28-day compressive strengths:

3000 psi for manhole bases and valve vaults
4000 psi for all liquid containing structures
4000 psi for curbs, gutters and pavement
4000 psi for drives and sidewalks
2000 psi for pipe encasement and thrust blocks

Entrained Air - Conform to the following for exterior exposed concrete, liquid containing structures and watertight structures:

7% for 1/2-inch coarse aggregates
6% for 3/4-inch and 1-inch coarse aggregate
5-1/2% for 1-inch coarse aggregate

Maximum Water-Cement Ratio By Weight

0.45 for structures containing wastewater with over 1500 mg/L sulfates
0.50 for structures containing wastewater with under 1500 mg/L sulfates
0.50 for all other liquid containing structures
0.45 for all other concrete

The above criteria apply only when lower water cement ratio or higher strength is not required to meet 28 day compressive strength requirements specified above.

Cement Content - 564 lbs/cy minimum

Slump

1 inch minimum.
4 inches maximum
3 inches maximum for footings, substructure walls of liquid containing structures, and structural foundations.
4 inches maximum for all other concrete

Maximum Chloride Ion Content - The maximum soluble chloride ion concentration in the concrete contributed from the ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the limits in the following Table, expressed as a percent by weight of the cement. Use of calcium chloride as an admixture is prohibited.

Construction Environment	Maximum chloride ion (CL-) in concrete,% by Wt. of cement
Conventional reinforced concrete in a moist environment and exposed to chloride (salt water)	0.10
Conventional reinforced concrete in a moist environment but not exposed to chloride	0.15

Mixing - Minimum mixing time:

Central Mixed Concrete - 1 minute for mixer capacities one cubic yard or less plus 15 seconds for each cubic yard or fraction thereof of additional capacity.

Truck Mixed Concrete - 100 revolutions after the introduction of all ingredients,

Tempering and Control of Mixing Water - Mix concrete only in quantities for immediate use. Do not use concrete which has stiffened due to initial set or concrete which cannot be discharged within 1-1/2 hours or 300 revolutions of the mixer drum after the introduction of the mixing water. Water may be added to concrete arriving at the site, provided neither the maximum slump nor the maximum water cement ratio is exceeded. If either is exceeded the load will be rejected. Incorporate any added water by additional mixing equal to half the total mixing required.

CONCRETE ACCESSORY MATERIALS

Curing Materials - Conform to ASTM C171

Formwork

Plywood	Product Standard PS1, waterproof, resin bonded exterior type Douglas Fir.
Lumber	Straight, uniform width and thickness, free from loose knots, offsets, holes, dents and other surface defects.
Form Ties	Commercially manufactured permanently embedded type. Provide removable polyethylene cone washer ends such that the permanently embedded portion terminates not less than 1 inch from the face of the concrete.
Form Coating	Non-staining chemical release agent that will not damage the concrete surface, conforming to Corps of Engineers Specification CE 204, Section 3-03-K, L&M "DeBond", W.R. Meadows "Duoguard", or equal.

Reinforcing Steel

Welded Wire Fabric	ASTM A185
Deformed Billet Steel	ASTM A615 Grade 60 (main reinforcement) Grade 40 (stirrup reinforcement)
Deformed Rail Steel	ASTM A616, Grade 60. The bend test requirements for all bar sizes #3 through #11 shall be based on 180 degree bends of full-size bars around pins with diameters specified in Table 5.2.2, ACI 301.
Low Alloy Steel Deformed Bars	ASTM A706, Grade 60

Bond Break Material - Bituminous material, brush-on grade conforming to Federal Specification SS-A-694.

Calking and Sealants

Joint Sealant

Type	One-part self-priming urethane sealant
Conformance	Fed. Spec. TT-S-00230, Type II, Class A
Consistency	Gun-grade

Backup Material - Extruded closed cell polyethylene or polyurethane foam rod or other closed cell resilient material recommended by approved sealant manufacturer. Material to be non-absorbent, non-staining, and compatible with sealant.

Bond Preventive Material - Polyethylene tape with pressure sensitive adhesive one side.

Primer - Nonstaining primer where recommended by sealant manufacturer.

Expansion Joint Filler

Bituminous Type	ASTM D994
Fiber Type	ASTM D1752

Joint Sealers

Cold-Application Type	ASTM D1850
Hot-Poured Elastic Type	ASTM 01190

Waterstop - Conform to Corps of Engineer's Specification CRD-C 572, serrated type, 3/16" x 4".

Vapor Barrier Material - Polyethylene sheet, 6 mil, conforming to Product Standard PS 17, 6 mil.

Curing, Sealing and Hardening Compounds - Conform to Fed. Spec. TT-C-800.W. R. Grade "Clear Seal," Master Builder's "Master Seal," L&M Dress and Seal," or equal.

Non-Shrink Grout - Commercial factory-mixed product, conforming to Corps' of Engineers Standard CRD-C 621 non-metallic type, Chem-Masters "Kemset" L&M "Crystex", U.S. Grout "5 Star Grout", or equal.

Precast Splashblock Units - Provide precast concrete splashblock units at locations shown on the drawings. Units shall be 12" wide x 36" long x 3" deep and equal to Model SB-36 as manufactured by ARCO Concrete, Inc., Arvada, Colorado, or Aguilar's Concrete Products, Evans, Colorado, or equal.

Non-Slip Abrasive - Aluminum oxide specialty product as L&M "Grip-it," Gifford-Hill "Non-slip Aggregate," or equal.

PART III - EXECUTION

FORMWORK

Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Brace or tie to maintain the desired position, shape, and alignment during and after concrete placement. Conform to ACI 301, Chapter 4.

Do not remove or disturb forms until the concrete has attained sufficient strength or bracing is provided to safely support all dead and live loads. Retain shoring in place and reinforce as necessary to carry any construction equipment, materials or other loads in excess of cured strength. Take care in form removal to prevent surface gouging, corner or edge breakage, and other damage to the concrete.

Provide moldings or bevels to produce a 3/4 inch chamfer on all equipment base edges and exposed projecting corners unless otherwise shown on the drawings.

Set slab forms and intermediate screed strips accurately to produce the designated elevations and contours of the finished surface and which will support vibrating screeds or roller pipe screeds if used. The concrete surface shall be aligned to the contours of screed strips by the use of strike-off templates or approved compacting type screeds. When formwork is cambered, screeds shall be set to maintain the specified concrete thicknesses.

Ensure all formwork is set to provide adequate drainage of flatwork when finished, with a 2% slope preferred on all flatwork.

REINFORCING STEEL

General - Remove all mud, oil, loose rust or mill scale and other foreign materials that may reduce bond prior to placing concrete. "Tight" rust or mill scale will be permissible without cleaning or brushing, provided weights and dimensions are not less than the minimum specified. Conform to ACI 301, Chapter 5.

Allowable Tolerances

Fabrication Tolerances - Unless otherwise required by ACI 315, conform to the following:

Sheared length:	±1 inch
Stirrups and ties:	±1/2 inch
All other bends:	±1 inch

Placement Tolerances - Conform to the following:

Concrete cover to form surface:	±1/4 inch
Minimum spacing between bars:	-1/4 inch
Top bars in slabs and beams:	
Members 8 inches deep or less	± 1/4 inch
Members between 8 inches and 2 feet	±1/2 inch
Members 2 feet deep or greater	±1 inch
Crosswise of members:	Spaced evenly within 2 inches
Lengthwise of members:	±1 inch

Maximum bar movement to avoid interference with other reinforcing steel or embedded items: 1 bar diameter.

Bar Placement - Conform to CRSI-WCRSI "Placing Reinforcing Bars". Position bars in accordance with above tolerances and secure in place.

Bar Supports - Support and fasten all reinforcement to prevent displacement by construction loads or the placing of concrete. Reinforcement supported from the ground shall rest on precast concrete blocks not less than 4 inches square, and having a compressive strength equal to the specified compressive strength of the concrete being placed.

Reinforcement supported from formwork shall rest on bar supports and spacers made of concrete, metal, plastic, or other approved materials. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories within 1/2 inches of the concrete surface shall be noncorrosive or protected against corrosion.

Reinforcing Adjustment - Move only within allowable tolerances to avoid interference with other reinforcing steel or embedded items. Do not move bars beyond allowable tolerance. Do not heat, bend, or cut bends.

Splices - Bars up to No. 11 inches size may be spliced by overlapping them and wiring them together. The length of lap shall be sufficient to transfer the entire computed stress from bar to ¾ the allowable bond stress. Also, bar without exceeding the length of lap shall be at least that given in the following table:

Minimum Lap Diameters for Splicing Deformed Bars

Type of splice	fy = 40,000	fy = 50,000	fy = 60,000	fy = 75,000	But not less than
Tension	24	30	36	…	12 in.
Compression:					
f'c = 3,000 or more	20	20	24	30	12 in.
f'c less than 3,000	26.7	26.7	32	40	16 in

Welding of reinforcing steel shall conform to "Structural Welding Code - Reinforcing Steel" (AWS D1.4). No welding shall be done at the bend in a bar. Welding of crossing bars (tack welding) will not be permitted.

Welded Wire Fabric - Overlap welded wire fabric designated as load-carrying reinforcement wherever successive mats or rolls are continuous so that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches. Support as required for reinforcing bars.

Overlap welded wire fabric not specifically designated as load-carrying reinforcement wherever successive mats or rolls are continuous so that the overlap measured between outermost cross wires of each fabric sheet is not less than 2 inches. The fabric shall extend across supporting beams and walls and to within 4 inches of concrete edges. It may extend through contraction joints. Support during placing of concrete to insure its proper position in the slab.

INSPECTION

Assure that excavations and formwork and reinforcement are completed and that dirt, mud, encrusted concrete, debris, and ice, frost, and excess water is removed. Verify that embedded items are secured in position. Verify that all required tests for pipes under slabs have been completed. Assure that all hardened concrete and foreign material is removed from the inner surface of conveying equipment.

PREPARATION

General - Prior to placing concrete, all ice, snow, and surface and subsurface frost shall be removed, and the temperature of the surfaces to be in contact with the new concrete shall be raised to the temperature specified for placing. Do not place concrete on frozen ground. Remove any hardened concrete and foreign material from the inner surface of conveying equipment. Designate the limits of each placement and advise the Engineer when installation is ready for check-out prior to each pour. Allow a minimum of 2 hours for Engineer's check-out before first concrete is placed.

Preparation of Subgrade for Slabs on Ground - Ensure that the subgrade is well drained and compacted. Verify that in-place density of the subgrade soils is at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade.

Ensure that the subgrade is free of frost before concrete placing begins. If the temperature where concrete is to be placed is below freezing, raise and maintain above 50°F long enough to remove all frost from the subgrade.

Ensure that the subgrade is moist at the time of concreting. If necessary, dampen with water in advance of concreting, but not to the extent that free water is standing on the subgrade nor any muddy or soft spots exist when the concrete is placed.

Expansion and Contraction Joints - Provide expansion joint filler at locations shown on the drawings. Do not extend reinforcement continuously through joints. Form "break bond" or "isolation" joint where indicated using 30-pound asphalt saturated felt extending full depth of joint or approved metal keyed joint.

Construction Joints - Locate joints perpendicular to main reinforcement and where they will least impair the strength of the structure.

Columns and Walls - Locate at the underside of beams, girders, floors, slabs and at the tops of footings or floor slabs. Beams, girders, brackets, column capitals, haunches and drop panels shall be placed concurrently with slabs.

Beams and Girders - Locate at the middle of the span except where a beam intersects a girder; in such case, offset the joint a distance equal to twice the width of the beam.

Slabs - Locate at or near the center of the span. Construct slabs on grade as a system of independent slabs formed by construction joints and expansion joints as shown on the drawings, or if not shown, divide the slab into approximate squares not exceeding 625 square feet in area. Slab division lines shall coincide with column lines when practicable. Place slabs in a checkerboard fashion with a minimum time of 24 hours between adjacent placements. If saw-cut joints are specified, cutting shall be coordinated with the set of the concrete. Start cutting as soon as the concrete has hardened. Prevent aggregates from being dislodged by the saw and complete before shrinkage stresses produce cracking.

Reinforcement - Continue all reinforcement across joints. Provide keys and inclined dowels as shown on approved shop drawings. Provide longitudinal keys at least 1-1/2 inches deep in all joints in walls and between walls and slabs or footings.

Construction Joint Bonding

General

Clean the surface of the concrete at all joints and remove all laitance prior to placing adjoining concrete.

Concealed Joints

Dampen (do not saturate) the hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls. Dampen immediately prior to placing of fresh concrete.

Exposed Joints

Dampen (do not saturate) the hardened concrete of horizontal construction joints in exposed work; horizontal construction joints in the middle of beams, girders, joists, and slabs; and horizontal construction joints in work designed to contain liquids. Then, thoroughly cover with a coat of cement grout of similar proportions to the mortar in the concrete. Place the fresh concrete before the grout has attained its initial set

Special Bonding Methods - The following bonding methods may be used:

- The use of an approved adhesive.
- The use of an approved chemical retarder which delays but does not prevent setting of the surface mortar. Retarded mortar shall be removed within 24 hours after placing to produce a clean exposed aggregate bonding surface.
- Roughening the surface of the concrete to expose the aggregate uniformly to prevent laitance, loose particles of aggregate or concrete damage at the surface shall be removed..

Use of adhesives or retarders shall be applied in accordance with manufacturer's recommendations.

EMBEDDED ITEMS

Waterstops

Each piece of premolded waterstop shall be of maximum length to minimize the number of end joints.

Butt splice waterstop with an electrical welding iron in accordance with manufacturer's printed instructions. Joints shall develop effective water tightness fully equal to that of the continuous waterstop material, permanently develop not less than 50% of the mechanical strength of the parent section, and permanently retain flexibility.

Provide waterstop at construction joints in the following locations where shown on the drawings and in the following locations:

- Walls and bottom slabs of dry pit rooms below finished grade and in contact with backfill on the opposite side.
- Walls in contact with liquid where the opposite face is above finished grade or exposed in a dry pit or room.
- Slabs in contact with liquid where the opposite face is exposed in a dry pit or room.

Other Embedded Items

Place all sleeves, inserts, anchors, and embedded items required for adjoining work or for its support prior to concreting.

Position expansion joint material, waterstops, and other embedded items accurately and support against displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent the entry of concrete into the voids.

Install conduits between reinforcing steel in walls or slabs with reinforcing in both faces and below reinforcing in slabs with only one layer of reinforcing steel on the surface. Plan the size of finishing crews with due regard for the effects of concrete temperature and atmospheric conditions on the rate of hardening of the concrete. Do not start placement of concrete in supported elements until the concrete previously placed is no longer plastic and has been in place at least 2 hours.

Embedments shall be clean when installed. Remove concrete spatter from all surfaces not in contact with concrete.

INSTALLATION

Conveying

Placement - Convey concrete from mixer to final position without segregation or loss of material. Assure that specified quality of concrete is maintained.

Equipment - Use conveying equipment of a size and design which prevents setting of concrete before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operations shall conform to the requirements of "Specification for Ready-Mixed Concrete" (ASTM C94).

Belt Conveyors - Prevent mortar from adhering to the return length of the belt discharge long runs into a hopper or through a baffle.

Chutes - Chutes shall be metal or metal-lined with a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 ft. long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

Pumping - Use pumping or pneumatic conveying equipment with adequate pumping capacity. Control pneumatic placement to prevent segregation. The loss of slump in pumping or pneumatic conveying equipment shall not exceed 2 inches. Do not convey concrete through pipe made of aluminum or aluminum alloy.

Depositing

General - Deposit concrete in a continuous operation until the section is completed. Do not deposit on concrete which has attained initial set. If a section cannot be placed continuously, locate construction joints as shown in the contract documents or as approved. Concrete which has partially hardened or has been contaminated by foreign materials shall not be deposited. Remove temporary spreaders in forms when the concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in the concrete only if made of metal and if prior approval has been obtained.

Placing - Coordinate mixing and placing with finishing. Do not place concrete on the subgrade or forms more rapidly than it can be spread, straight edged, and darbied or bull floated. Perform these operations before bleeding water has an opportunity to collect

Segregation

Deposit concrete as closely as possible to its final position to avoid segregation. Maximum height of concrete free fall shall not exceed 4 feet. Use an elephant trunk or tremie for placing concrete through a reinforcing cage or in large structures where reinforcement or other objects will cause segregation.

Consolidation

Consolidate concrete by vibration, spading, rodding or forking so that the concrete is thoroughly worked around embedded items, and into corners of forms, eliminating all air or stone pockets. Internal vibrators used shall be the largest size and the most powerful that can be properly used in the work, as described in Table 5.1.4 of ACI 309. Use of vibrators to transport concrete within forms is prohibited. Insert vibrators at points approximately 18 inches apart. Vertically insert vibrators at points 18 inches apart to a depth penetrating 6 inches into the preceding layer. Vibrate each location approximately 5 to 15 seconds. Thoroughly consolidate concrete in slabs. Use internal vibration in beams and girders of framed slabs and along the bulkheads of slabs on grade. Consolidate slabs with vibrating screeds, roller pipe screeds, or internal vibrators. Provide a spare vibrator on the job site during all concrete placing operations. A full surface of mortar shall be brought against the form by the vibration process supplemented by spading to work the coarse aggregate back from the formed surface.

Concreting Under Water - Permitted only with approval in writing, by the Engineer. When approved, deposit concrete so that the fresh concrete enters the mass of previously placed concrete from within, displacing the water with minimum disturbance to the concrete.

Finishing

Formed Surface Finishes - Provide the following finish unless indicated or shown otherwise on the drawings.

Rough Form Finish - Applies to all surfaces not exposed to view such as surfaces in contact with earth backfill. Repair defects and patch tie holes. Remove fins exceeding 1/4 inch in height. Otherwise leave surfaces with the texture imparted by the forms.

Smooth Form Finish - Applies to all exposed surfaces and interior surfaces of vaults and pits. Use form facing material to produce a smooth, hard, uniform surface. Support with backing capable of preventing specified deflection. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface. Keep the number of seams to a minimum. Repair and patch all tie holes and defects. Remove all fins.

Rubbed Finishes - The following finishes shall be produced on concrete with a smooth form finish. Where smooth rubbed finish is to be applied, remove forms and complete patching as soon after placement as possible without damaging the structure,

Smooth Rubbed Finish - Produce smooth rubbed finish on newly hardened concrete no later than the day following form removal. Wet and rub surfaces with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process,

Grout Cleaned Finish - Do not begin cleaning until all contiguous surfaces are completed and accessible. Cleaning as the work progresses will not be permitted. Mix 1 part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having the consistency of thick paint. Substitute white Portland cement for a part of the gray portland cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. Wet the surface of the concrete to prevent absorption of water from the grout and apply the grout uniformly with brushes or a spray gun. Immediately after applying the grout, scrub the surface vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, sack, or other means. After the surface whitens from drying (about thirty minutes at normal temperatures), rub vigorously with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.

Cork Floated Finish - Remove forms at an early stage, within 2 to 3 days of placement where possible. Remove ties. Remove all burrs and fins. Mix one part portland cement and one part fine sand with sufficient water to produce a stiff mortar. Dampen wall surface. Apply mortar with firm rubber float or with trowel, filling all surface voids. Compress mortar into voids using a slow-speed grinder or stone. If the mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with a fog sprayer. Produce the final texture with a cork float using a swirling motion.

Related Unformed Surfaces - Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and floated to a texture consistent with that of the formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

Slab Finishes - Unless specified or otherwise shown on the drawings, apply finishes to slabs as follows:

Scratched Finish - Use for exterior surfaces to receive bonded cementitious applications. Strike and level concrete to 1/4 inch in 2 feet tolerance. Roughen surface with stiff brushes or rakes before final set.

Floated Finish - Use for surfaces to receive roofing, water-proofing membranes, ceramic tile, or quarry tile to be trowel finished, to be broom finished, or to be given a non-slip finish. After the concrete has been placed, consolidated, struck off, and leveled, do not work further until water sheen has disappeared and the surface has stiffened. When water sheen has disappeared and surface has stiffened, float with a hand float or with a bladed power trowel equipped with float shoes, or with a powered disc float. During or after the first floating, planeness of surface shall be checked with a 10-ft. straightedge applied at not less than two differed angles. Cut down all high spots and fill all low spots to produce a surface level tolerance of 1/4 inch in 10 feet throughout. Then refloat immediately to a uniform sandy texture.

Troweled Finish - Use for floors intended as walking surfaces or to receive floor coverings. The surface shall first be float-finished as specified above. Next, power trowel followed by hand troweling. The first troweling after power floating shall produce a smooth surface which is free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened. Accomplish final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate surface by the hand troweling until the finished surface is free of trowel marks, uniform in texture and appearance and level within a tolerance of 1/2 inch in 10 feet in all directions. On surfaces intended to support floor coverings, defects which show through the floor covering shall be removed by grinding.

Broom or Belt Finish - Use for sidewalks, garage floors, ramps, curbs, gutters and driveways. Immediately after the concrete has received a float finish as specified above, provide a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

Non-Slip Finish - Use for exterior platforms, steps, landings, and exterior and interior pedestrian ramps. Use a "dry shake" of crushed ceramically bonded aluminum oxide or other specified selected abrasive particles. The rate of application of such materials shall be not less than 25 pounds per 100 square foot. The surface shall be given a float finish as specified above. Apply approximately two-thirds of the blended material for required coverage to the surface by a method that insures even coverage without segregation. Begin floating immediately after application of the first "dry shake" followed by application of the remainder of the blended material to the surface at right angles to the previous application. Follow immediately with a second floating. After the "dry shake" has been embedded by the two floatings, complete the operation with a broomed, floated, or troweled finish as specified.

Sealed Surface - Use for all floors subject to foot traffic not required or specified to receive floor coverings, hardeners or other special finishes. Apply two coats of clear floor sealer in addition to any coat applied as a membrane curing compound. Apply the first coat at the end of the curing period before any traffic is permitted on the floor and the second coat after the floor has been cleaned in preparation for final inspection,

CURING AND PROTECTION

General - Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Assure minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete.

Preservation of Moisture - For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing:

- Ponding or continuous sprinkling.
- Application of absorptive mats or fabric kept continuously wet.
- Application of waterproof sheet materials, conforming to "Specifications for Waterproof Sheet Materials for Curing Concrete" (ASTM C171)
- Application of a curing compound conforming to "Specification for Liquid Membrane-forming Compounds for Curing Concrete" (ASTM C309). Apply compound in accordance with the recommendations of the manufacturer immediately after any water sheen after finishing has disappeared from the concrete surface. Do not use any surface against which additional concrete or other material is to be bonded unless it is certified that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.

Minimize moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun by keeping the forms wet until removed. After form removal, the concrete shall be cured for time period below by methods previously specified.

Cure all concrete for at least 7 days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70% of the specified strength, f'c. Moisture retention measures may also be terminated when the temperature of the concrete is maintained at least at 50 degrees Fahrenheit for the same length of time that laboratory-cured cylinders, representative of the concrete in-place, require to achieve 85% of f'c. If one of the curing procedures previously specified is used initially, it may be replaced by one of the other listed methods after the concrete is 1 day old and the concrete is not permitted to become surface dry during the transition.

Temperature, Wind and Humidity

Cold Weather - When the mean daily outdoor temperature is less than 40°F, the temperature of the concrete shall be maintained between 50 and 70*F for the specified curing period or 7 days minimum. Arrange for heating, covering, insulating, or housing the concrete work in advance of placement and maintain the required temperature. Prevent damage from concentration of heat. Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide. Heated enclosures shall be strong and wind-proof to protect corners, edges and thin sections. Do not permit heating units to locally heat or dry the concrete. Do not use combustion heaters during the first 24 hours unless the concrete is protected from exposure to exhaust gases which contain carbon dioxide.

Hot Weather - Make provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material in advance of placement.

Rate of Temperature Change - Protect from changes in temperature of the air immediately adjacent to the concrete for 10 days after the curing period. Do not allow temperature fluctuations to exceed 5°F in any 1 hour or 50°F in any 24 hour period. Provide a "high-low" thermometer to record temperature extremes.

Protection From Mechanical Injury - During the curing period, protect concrete from damaging mechanical disturbances such as load stresses, heavy shock, and excessive vibration. Protect all finished concrete surfaces from damage by construction equipment, materials, rain or running water. Do not load self-supporting structures to overstress the concrete.

Protection from De-icing Chemicals - Protect concrete from de-icing chemicals for a minimum of 30-days after the curing period.

REPAIR OF SURFACE DEFECTS

General - Repair immediately after form removal all surface defects, including tie holes.

Repair of Defective Areas - Remove honeycombed and other defective concrete to sound concrete. If chipping is necessary, square cut edges perpendicular to the surface or slightly undercut. No featheredges will be permitted. Dampen the area to be patched including an area at least 6 inches beyond. Prepare a bonding grout with a mix of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream. Brush well into the surface. Use patching mixture of same materials and proportions used for the concrete, except that the coarse aggregate shall be omitted. Mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume. Substitute white Portland cement for a part of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing. Mix the patching mortar in advance and allowed to stand, frequently manipulating with a trowel. Do not add water until mixture has reached the stiffest consistency that will permit placing.

After surface water has evaporated from the area to be patched, brush bond coat well into the surface. When the bond coat begins to lose the water sheen, apply the premixed patching mortar. Consolidate mortar thoroughly into place and strike off so the patch is slightly higher than the surrounding surface. To permit initial shrinkage, leave undisturbed for at least 1 hour before being finally finished. The patched area shall be kept damp for 7 days. Do not use metal tools for finishing a patch in a formed wall which will be exposed.

Tie Holes - After being cleaned and thoroughly dampened, fill the tie holes solid with patching mortar.

Proprietary Materials - Proprietary compounds used for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be non-metallic, non-shrink products. Apply in accordance with the manufacturers recommendations.

CAULKING AND SEALANTS

Sealants and caulking shall be applied in strict accord with manufacturer's printed instructions. Clean all joints of dust, dirt, moisture, loose aggregate, paint, protective coatings, or other contaminants. Immediately after cleaning, mask joint and thoroughly prime all porous joint surfaces by brush if recommended by the sealant manufacturer.

Make joint width 1/4 inches minimum to 3/4 inches maximum. Make depth of joint equal to width, except do not exceed 1/2 inches in depth. Use backup material or bond preventive material to control depth of joint and to assure that sealant will bond on two sides only, not on back of joint.

Use guns with proper nozzle size for indicated joint width. Apply sealant under sufficient pressure to expel air and fill joint solidly to indicated depth. Work from bottom to top or from inside to outside to avoid entrapping air. Immediately tool joints slightly concave to compress sealant into joint and assure complete contact for good bond.

Remove masking and clean surfaces adjoining joints of all smears or other soiling resulting from caulking operations.

FIELD QUALITY CONTROL

Concrete Tests - Conduct the following minimum tests in accordance with the requirements of ACI 301, Section 16.3.

Strength Test - Mold and cure three cylinders from each sample. Test one at 7 days for information and two at 28 days for acceptance.

Collect the following minimum number of samples per class of concrete for each day's placing:

- 50 cubic yards or less 1 sample
- 50 to 100 cubic yards 2 samples
- 100 cubic yards or more 2 samples plus 1 sample for each additional 100 cubic yards

Air Content and Slump Test - Conduct one test for air content and slump for each strength test sample or on each truckload of ready-mix concrete, whichever is greater.

ACCEPTANCE OF STRUCTURE

General - Completed concrete work which meets all specified requirements will be accepted without qualification.

Completed concrete work that fails to meet specified requirements but has been repaired to bring it into compliance will be accepted without qualification.

Completed concrete work that fails to meet specified requirements and cannot be brought into compliance shall be rejected.

Dimensional Tolerances - Formed surfaces resulting in concrete outlines smaller than permitted by the specified tolerances will be considered potentially deficient in strength and subject to the provisions stated hereafter.

Formed surfaces resulting in concrete outlines larger than permitted by the specified tolerances may be rejected and the excess material shall be subject to removal. If removal of the excess material is required, accomplish in a manner to maintain the strength of the section and meet all other applicable requirements of function and appearance.

Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or misplaced items interfere with other construction.

Inaccurately formed concrete surfaces exceeding the specified limits and which are exposed to view, may be rejected. If rejected, repair or remove and replace in conformance with these Specifications.

Finished slabs exceeding the specified tolerances shall be repaired provided that strength or appearance is not adversely affected. Remove high spots with a terrazzo grinder and fill low spots with a patching compound.

Appearance - Architectural concrete with surface defects shall be removed and replaced. Other concrete exposed to view with defects which adversely affect the appearance of the specified finish shall be repaired to restore the specified finish. Concrete not exposed to view will not be subject to rejection for defective appearance.

Strength of Structure - The strength level of concrete will be considered acceptable as long as the average of all sets of three consecutive strength test results equals or exceeds the specified 28-day strength and no individual strength test result falls below the specified strength by more than 200 psi.

The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions:

- Low concrete strength.
- Reinforcing steel size, quantity, strength, position, or arrangement at variance with the requirements of the Contract Documents.
- Concrete which differs from the required dimensions or location which will reduce the strength. Curing less than specified.
- Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
- Mechanical injury, construction fires, accidents or premature removal of formwork.
- Poor workmanship.

Structural analysis or additional testing may be required when the strength of the structure is considered potentially deficient.

Upon failure of cylinder test results, the Contractor shall obtain and test at least three 2-inch diameter core samples from the potentially deficient area. The Engineer will designate locations to be cored to least impair strength of the structure. Conform to ASTM C42. Concrete will be considered acceptable if the average of the three cores is at least 85% of, and if no single core is less than 75% of the specified 28-day strength. Fill all core holes as specified for repairing defective concrete. When conducted due to failure of test results, coring and testing shall be performed at no additional expense to the Owner.

If core tests are inconclusive or impractical to obtain or in structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with Chapter 20 of "Building Code Requirements for Reinforced Concrete" (ACI 318).

Concrete work determined deficient by structural analysis or by results of a load test shall be reinforced with additional construction or replaced at no additional expense to the Owner. The Contractor shall bear all expense incurred in providing the additional testing and analysis required to detect extent of verified construction deficiencies.

The Owner will assume responsibility for additional testing and analysis which is not required by these Specifications.

Section 15062 - DUCTILE IRON PIPE

PART I - GENERAL

WORK INCLUDED

Work under this section includes furnishing and installing ductile iron pipe, fittings, flanges, specials and accessories shown on the drawings and as specified herein.

Related Work Specified Elsewhere

Section 02220 - Utility Trenching, Backfilling and Compacting
Section 02550 - Water Transmission and Distribution Lines
Section 02560 - Wastewater Collection and Treatment System

QUALITY ASSURANCE

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Water Works Association (AWWA)

AWWA C104	Cement-Mortar Lining for Cast-iron and Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Gray and Ductile Cast-iron Piping for Water or Other Liquids
AWWA C106	Cast Iron Pipe Centrifugally Cast in Metal Molds for Water or Other Liquids
AWWA C110	Gray Iron and Ductile Iron Fittings 3 inches through 48 inches for Water and Other Liquids
AWWA Clll	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Cast-iron and Ductile-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds.
AWWA C600	Installation of Gray and Ductile Cast Iron Water Mains and Appurtenances
AWWA C602	Cement-Mortar Lining of Water Pipelines - 4 in. and larger - In Place.
AWWA C606	Grooved and Shouldered Type Joints

American National Standards Institute (ANSI)

ANSI B2.1	Pipe Threads
ANSI Bl6.l	Cast-iron Pipe Flanges and Flanged Fittings
ANSI 616.4	Cast-iron Threaded Fittings, 125 Lb. And 250 Lb.

SUBMITTALS

Include the following:

- *Shop Drawings* - Submit general piping layout and marking diagram. Show details within structures and exterior plant piping.
- *Certificate of Compliance* - Furnish manufacturer's certification that piping and components meet or exceed specification requirements.

PRODUCT DELIVERY, STORAGE, AND HANDLING

Handle pipe, fittings and accessories using lifting hoists or skids to avoid shock or damage. Do not allow pipe unloaded on skids to be rolled into pipe previously unloaded. Protect the pipe coatings and linings from damage during delivery and handling.

PART II - PRODUCTS

DUCTILE IRON PIPE (DIP)

Conformance	AWWA C151
Thickness Class	53 minimum

FITTINGS

Type	As shown on the drawings or otherwise required by the specifications
Conformance	AWWA C110 for flanged, mechanical joint and push-on joints. ANSI B16.4 for threaded fittings
Material	Gray iron or ductile iron
Pressure Rating	250 psi, 12 inches and under; 150 psi, over 12 inches; 175 psi, threaded fittings

JOINTS

Mechanical or Push-On	Conform to AWWA C110 and Clll
Flanged	AWWA C110 or ANSI B16.1, Class 125
Flange Gaskets	1/16 inch red sheet rubber or cloth inserted rubber

PROTECTIVE COATINGS

Underground Service

Shop Coating	Manufacturer's standard asphaltic coating approximately 1 mil thick
Field Protection	Polyethylene Encasement, AWWA C105, Class A or C, Method A or b

Exposed Service

Refer to Section U9925 - Industrial Coatings.

PROTECTIVE LINING

Type	Cement mortar
Conformance	AWWA C104
Thickness	Standard

MECHANICAL COUPLINGS

Type	Mechanical compression sleeve
Manufacturer	Dresser Style 38, Smith Blair Type 431, or equal
Pipe Stop	Omit on couplings installed within structures and other locations where used as closures or union connections

PART III – EXECUTION

INSPECTION

Examine the pipe and fittings for cracks, flaws or other defects. Remove all defective pipe and fittings from the site. Pipe and fittings in which the lining has been broken or loosened shall be replaced. Damaged piping which can be restored to original condition may be repaired and used in the work

providing that the Contractor can demonstrate that latent defects do not remain. All corrective work shall be performed at no additional expense to the Owner.

INSTALLATION

Cutting Pipe - Make all cuts without damage to the pipe or cement lining leaving a smooth end at right angles to the axis of the pipe. Perform all pipe cutting with mechanical pipe cutters. When machine cutting is not available for cutting pipe 20 inches in diameter or larger, the electric arc cutting method using a carbon or steel rod will be permitted. Do not flame cut using an oxyacetylene torch. File or grind field cut ends of push-on joints to resemble the spigot end of the pipe as manufactured.

Jointing the Pipe

Mechanical Joints - Thoroughly clean the inside of the bell and the outside of the spigot to remove oil, excess coating, and other foreign matter from the joint. Apply a thin film of lubricant to the inside of the bell, the outside of the spigot and the gasket. Do not use lubricant other than that furnished with the pipe or approved by the manufacturer.

Tighten all nuts with a torque limiting wrench. Do not exceed the maximum torque values listed in AWWA C600, Table 4 or as recommended by the manufacturer. Overtightening to compensate for misalignment will not be permitted. Alternately tighten nuts spaced 180 degrees apart to produce uniform pressure on all parts of the gland.

Push-On Joints - Thoroughly clean the inside of the bell and the outside of the spigot to remove oil, grit, excess coating and other matter. Insert the gasket and apply a thin film of lubricant to the inside surface of the gasket and the spigot end of the pipe. Take care to prevent contact of the jointing surfaces with dirt or debris. Mark pipe that is not furnished with a depth mark before assembly to assure the spigot end is inserted full depth of the joint. Push plain end into bell of the pipe maintaining straight alignment. Make any deflection required after joint is assembled.

Flanged Joints - Threaded flanges shall be assembled with pipe extending completely through the flange. Flange faces shall be flat and perpendicular to the pipe centerline and the pipe end and flange face shall be finished in a single operation. Remove any raised face before connecting to a flange having a plain face.

Take care during bolting operations to insure no restraints are present on the pipe which would prevent uniform gasket compression or which would cause uneven stress in the flanges. Do not assemble mechanical connections until all flanged joints affected thereby have been tightened. Alternately tighten bolts, spaced 180 degrees apart at a uniform rate to assure uniform gasket compression.

Joint Deflection - Maximum allowable joint deflection shall not exceed that shown in Tables 5 and 6 of AMA C600 for push-on joints and mechanical joints, respectively.

Installation of Polyethylene Encasement - Conform to procedures specified in Section 5.4 of AWWA C105.

Joint Bonding - Bond all mechanical coupled and bell and spigot joints using a No. 4 bare copper wire and Cadweld brazing cartridges. Clean pipe to bare bright metal at points where bond is to be installed. Recoat bare metal with coal tar after completion of the bond.

FIELD QUALITY CONTROL

Pressure and Leakage Tests - Refer to specific piping system specifications for requirements.

Section 15064 - PLASTIC PIPE

PART I - GENERAL

WORK INCLUDED

Work under this section includes furnishing and installing plastic pipe and fittings. Furnish pipe and fittings complete with all jointing materials as shown on the drawings and as specified herein.

QUALITY ASSURANCE

Pipe and Fittings Marking - Mark pipe with the following information applied at intervals of not more than 5 feet:

- Nominal size and O.D. base.
- Material code designation.
- Applicable dimension ratio, pressure class or schedule number.
- Applicable standard designation number.
- Manufacturer's name or trade mark.
- Seal of the testing agency that verified the suitability of the pipe material for potable water service.

Reference Standards

American Water Works Association (AWWA)

AWWA C900	PVC Pressure Pipe, 4 in. through 12 in., for Water

American Society for Testing and Materials (ASTM)

ASTM C443	Joints for Circular Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM D124	Polyethylene Plastic Molding and Extrusion Materials
ASTM D1784	Rigid PVC Compounds and CPVC Compounds
ASTM D1785	PVC Plastic Pipe, Schedules 40, 80, and 120
ASTM D2235	Solvent Cement for ABS Plastic Pipe and Fittings
ASTM U2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2464	Threaded PVC Plastic Pipe Fittings, Schedule 80
ASTM D2466	PVC Plastic Pipe Fittings, Schedule 40
ASTM 02467	Socket Type PVC Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvent Cements for PVC Plastic Pipe and Fittings
ASTM D2665	PVC Plastic Drain, Waste and Vent pipe and Fittings
ASTM D2680	ABS Composite Sewer Piping ASTM D2683 Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe
ASTM D2737	Polyethylene Plastic Tubing
ASTM D2855	Making Solvent-Cemented Joints with PVC Pipe and Fittings
ASTM E679	Large Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM D3034	Type PSM PVC Sewer Pipe and Fittings
ASTM D3035	Polyethylene Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
ASTM D3036	Socket-Type PVC Plastic Line Couplings
ASTM D3139	Joints for Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3261 Butt Heat Fusion Polyethylene Plastic Fittings for Polyethylene Plastic Pipe and Fittings

American National Standards Institute (ANSI)

ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings

SUBMITTALS

Include the following:

- *Certificates* - Submit manufacturer's certification that materials meet specification requirements.

PRODUCT DELIVERY, STORAGE AND HANDING

Protect pipe from impact, bending, compression or abrasion during handling and storage.

Store pipe on flat surface which provides even support for the pipe barrel with bell ends overhanging. Do not stack pipe higher than 5 feet. Do not store pipe and fittings in direct sunlight for periods greater than two weeks.

Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun.

Use nylon sling to handle pipe. The use of hooks or bare cables shall not be permitted.

PART II – PRODUCTS

POLYVINYL CHLORIDE (PVC) PIPE

Non-Pressure Sewer Pipe and Fittings

Service	Buried
Material	ASTM D1784, Class 12454B
Conformance	ASTM D3034, Type PSM, SDR 35 (4" to 15") ASTM F679, wall thickness T-l (18" to 27")
Joints	ASTM D3212, push-on

INSPECTION

Examine the pipe and fittings for cracks, dents, abrasions or other flaws prior to installation. Mark rejected piping with a yellow crayon and remove from the project within 24 hours.

INSTALLATION

Cutting Pipe and Tubing - Cut pipe and tubing square with saws or pipe cutters designed specifically for the material. Protect the pipe and fittings from serrated holding devices and abrasion.

Bevel or flare the ends in accordance with the manufacturer's recommendations. Locate a depth mark with a pencil or crayon to assure the spigot end is inserted to the recommended depth.

Remove burrs and wipe off all dust and dirt from the jointing surfaces and remove cuttings from interior of pipe or tubing.

Jointing the Pipe - Joints in underground pipelines shall be gasket or solvent cement. Joints in exposed piping shall be solvent cement. Perform all jointing operations in accordance with manufacturer's printed instructions.

Gasketed Joints - Remove all dirt and foreign material from the spigot and bell end gasket and gasket groove. Apply lubricant furnished by the pipe manufacturer to the spigot end of the pipe. Insert the spigot to the reference mark. Take care during jointing to avoid disturbing previously installed joints.

Solvent Cement Joints - Remove all dirt, foreign material and moisture from the jointing surfaces. Apply solvent cement to the inside of the socket and the outside of the spigot and push the coated surfaces snugly together. Rotate the pipe approximately 1/2 turn to insure uniform distribution of the cement. Remove excess cement.

FIELD QUALITY CONTROL

Pipe Deflection (Underground Pipelines) - Test each section of under-ground pipe for vertical ring deflection. Maximum allowable ring deflection shall be 5% of the outside diameter.

Pressure and Leakage Tests - Refer to Section 02560 - Wastewater Collection and Treatment System for gravity pipe requirements.

Section 15071 - REINFORCED CONCRETE PIPE

PART I - GENERAL

WORK INCLUDED

Work under this section includes furnishing and installing reinforced concrete pipe, fittings, and jointing materials as shown on the drawings and specified herein.

Related Work Specified Elsewhere

Section 02220 - Utility Trenching, Backfilling and Compacting
Section 02b20 - Storm Drainage Systems
Section 02560 - Wastewater Collection and Treatment System

QUALITY ASSURANCE

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before-date of invitation shall apply.

American Society for Testing and Materials (ASTM)

ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C270	Mortar for Unit Masonry
ASTM C443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C506	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C361	Reinforced Concrete Low-Head Pressure Pipe
ASTM C655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C789	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers ASTM C850 Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with less than 2 feet of cover subject to highway loadings

American Water Works Associations (AWWA)

AWWA C300	Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
AWWA C302	Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids AWWA C303 Reinforced Concrete Pressure Pipe - Steel Cylinder Type Pretensioned, for Water and Other Liquids

Federal Specifications (Fed. Spec.)

SS-S-Z10A Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

SUBMITTALS

Include the following:

- *Certificates of Compliance* - Furnish certification that standards for piping specified herein are met.

PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver piping to the site on skids or other means to protect materials. Unload pipe adjacent to trench areas clear of traffic areas. Exercise care in handling materials to avoid damage. Remove damaged or defective materials and replace at no additional expense to the Owner.

PART II - PRODUCTS

PIPE AND FITTINGS

Conformance - ASTM C76, wall B or C thickness

Class - As shown on drawings. Design pipe so that class requirement is met after 50% of initial cover over interior steel has corroded away, assuming uniform corrosion of entire interior.

Joints

Joints	Tongue and groove, bell and spigot
Gaskets	Rubber, conforming to ASTM C443 0-ring, conforming to Bureau of Reclamation Type R-4

Manufacture - The interior cover over the reinforcing steel shall be not less than 1-1/2". Additional concrete cover shall not encroach upon the nominal inside diameter of the pipe as specified in ASTM C76. Portland cement shall be Type II and conform to the requirements of ASTM C150.

PART III – EXECUTION

Examine pipe and fittings for damage and defects. Remove pipe which cannot be repaired to original condition.

INSTALLATION

Install pipe in accordance with requirements of the system specified. Follow manufacturer's recommendation for assembly of pipe. Allow no cement mortar joints to be made under water.

Section 15078 - CORRUGATED METAL PIPE

PART I - GENERAL

WORK INCLUDED

Work under this section includes furnishing and installing corrugated metal pipe, fittings, jointing materials and appurtenances as shown on the drawings and specified herein.

Related Work Specified Elsewhere

Section 02220 - Utility Trenching, Backfilling and Compacting
Section 02520 - Storm Drainage Systems
Section 03300 - Cast-in-Place Concrete

QUALITY ASSURANCE

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M36	Zinc Coated Corrugated Iron or Steel Culverts and Underdrains
AASHTO M190	Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Corrugated Aluminum Alloy Culverts and Underdrains
AASHTO M218	Zinc-Coated (Galvanized) Iron or Steel Sheets for Culverts and Underdrains
AASHTO M243	Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe Arches, and Arches
AASHTO M245	Precoated, Galvanized Steel Culverts and

American Society for Testing and Materials (ASTM)

ASTM A444	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, for Culverts and Underdrains
ASTM C443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

Federal Specifications (Fed. Spec.)

Fed. Spec. TT-P-641 Zinc Dust-Zinc Oxide Primer Coating

SUBMITTALS

Include the following:

- *Product Data* - Submit catalog data or brochures on manufactured items specified and proposed for use.
- *Certificates of Compliance* - Furnish certification that standards specified herein are met.

PRODUCT DELIVERY, STORAGE AND HANDLING

Handle pipe and accessories carefully to protect from damage. Use nylon slings or rope for handling pipe. Store pipe in an orderly manner to prevent damage to coatings and linings.

PART II – PRODUCTS

PIPE AND FITTINGS

Conformance	AASHTO M36, Type I - Circular, Type II - Non-circular, zinc coated steel, and as specified below.
Seam Construction	Fabricated with helical corrugations and a continuously welded seam from end to end of each length of pipe section.
Corrugations	The configuration of the pipe corrugations shall be helical with a pre-formed end finish. The corrugations shall form smooth continuous curves and tangents. The radii of curvature profile shall be at least one-half the depth of the corrugation. Corrugation for pipe furnished shall be 1/2" deep and 2-2/3" pitch.
End Finish	Each end of each length of welded seam helical pipe shall be reformed to provide a minimum of two (2) annular corrugations, along with a 90° invert projecting flange of 1/4" to 3/8" to reinforce the end corrugation.
Pipe Gauge	The nominal thickness of any steel pipe used shall be a minimum 16 gauge.
Repair of Damaged Spelter Coating	Units on which the spelter coating has been burned by welding or otherwise damaged in fabrication shall be regalvanized, or wire brushed and painted with a zinc dust oxide paint conforming to Federal Specification TT-P-641. Regalvanizing shall be done by the hot dip process or by the metalizing process.
Dimensional Tolerance	Dimensional tolerance of pipe furnished shall conform to Section 8, AASHTO M218, except for the size and shape of the pipe ends. Adjacent ends of pipe shall be within 1/2 inch of each other in diameter or 1%, whichever is greater.
Fittings & Specials	Fittings and specials shall be of the same materials and of the same structural qualities as the adjoining pipe, and shall be in accordance with all applicable specifications, or as otherwise modified herein. Pipe materials, fabrications, repair of coating, and acceptance shall be in accordance with AASHTO M190, Type A. Any bituminous coating or interior lining damaged in fabrication of fittings and specials shall repaired to original condition at no addition to the Owner.
Joint Coupling Bands	Coupling bans shall be used to field join sections of pipe and fittings. Field joints for welded seam pipe shall provide circumferential and longitudinal strength to preserve the pipe alignment, prevent pipe separation, and prevent infiltration of side fill materials. Bands shall conform to the requirements of ASTM A444 for chemistry, weight of galvanizing, and permissible variations and dimensions. Bands shall be so constructed as to lap on an equal portion of each pipe length to be connected. Corrugations in the band shall engage and conform to the second annular corrugation on the pipe ends. "0" ring gaskets shall be installed in the first corrugation of each pipe end. Gaskets

shall conform to ASTM C443 and shall be 13/16-inch diameter for 18-inch diameter pipe through 66-inch diameter pipe, inclusive, and 7/8-inch diameter for 72-inch diameter pipe through 96-inch diameter pipe, inclusive. Bands 54" diameter and larger shall have a double bolt, bar and strap requiring 8 bolts, 4 bars, and 4 straps. A sealant strip of mastic material such as Ram-Nek, ARMCO TC-40, or equal shall be installed in the longitudinal seam at the point of band lap.

PART III – EXECUTION

INSPECTION

Examine pipe and coatings for damage. Repair damaged pipe, coatings, and fittings. Materials which cannot be repaired to original condition will be rejected by the Engineer and shall be removed from the site by the Contractor.

INSTALLATION

Install pipe in accordance with requirements of the system specified. Follow manufacturer's recommendations for assembly of pipe. Limit vertical or horizontal deflection to 5 percent. Correct excessive deflection by removal of backfill, correcting to original position, backfilling and compacting so that deflection limit is not exceeded. Such corrective action shall be taken at no additional expense to the Owner.

Section 21000 – RUSTIC ROADWAYS

PART I - GENERAL

WORK INCLUDED

Work under this section includes furnishing and installing all materials to improve or create an unpaved roadway, as shown on Construction Standard Nos. 21000A and 21000B and specified herein.

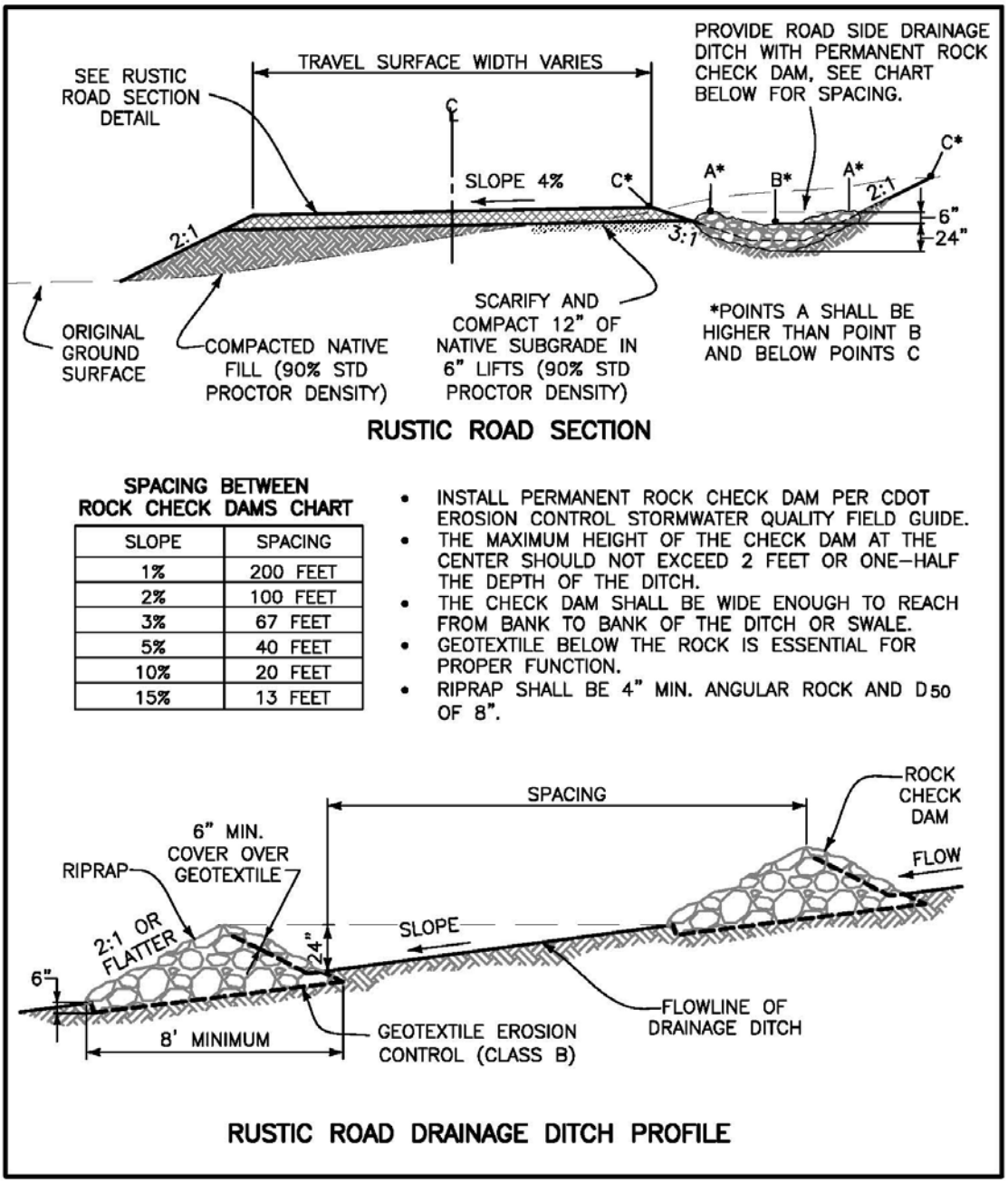
QUALITY ASSURANCE

Reference Standards - Standards listed hereunder and referenced elsewhere in these specifications shall become a part of this specification and are incorporated herein by reference. The latest edition, amendment or supplement thereto in effect 30 days before date of invitation shall apply.

SUBMITTALS

Include the following:

- *Product Data* - Submit catalog data or brochures on manufactured items specified and proposed for use.
- *Certificates of Compliance* - Furnish certification that standards specified herein are met.



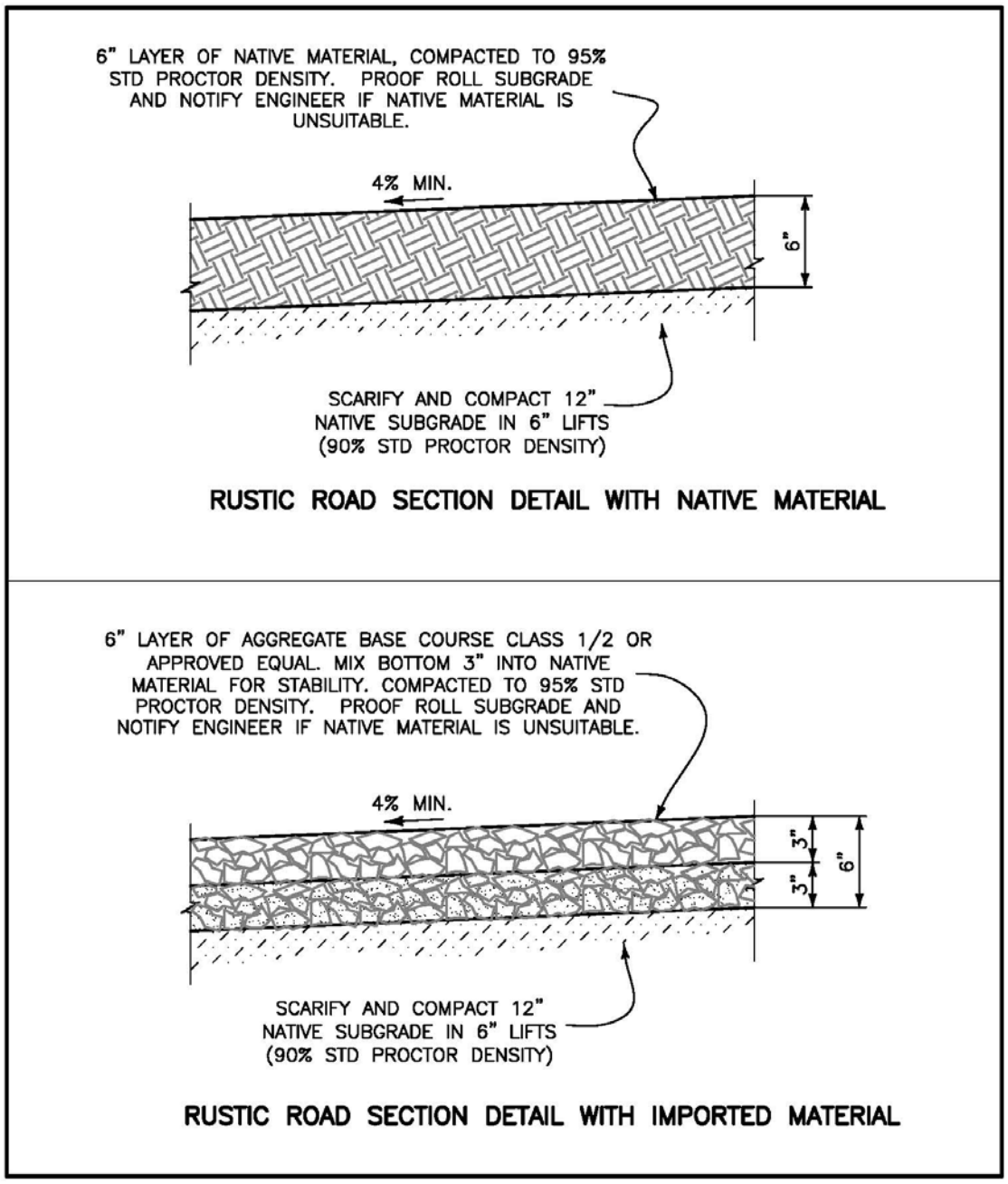
REVISIONS		
MARK	DATE	DESCRIPTION

RUSTIC ROAD SECTION AND PROFILE

Standard No. 21000A

Sheet 1 of 1

Town of Telluride, Colorado



REVISIONS		
MARK	DATE	DESCRIPTION

RUSTIC ROAD SECTION DETAILS

Standard No. 21000B

Sheet 1 of 1

Town of Telluride, Colorado

Section 22000 – REVEGETATION

The formula used for determining the quantity of pure live seed (PLS) is:

Pounds of Seed x (Purity x Germination) = Pounds of Pure Live Seed (PLS)

The required application rate for revegetation seeding is 1.5 pounds PLS per 1,000 square feet (65 pounds PLS per acre) for all surface seeding (i.e., broadcasting or hydroseeding). One of the two seed mixes that follow shall be used at the following rates for broadcasting or hydroseeding.

Option 1:

Species	Variety	Origin	Lbs/Ac
Wild-Canada ryegrass	VNS	CO	3.34
June grass	VNS	CO	3.74
Western wheatgrass	ARRIBA	CO	3.30
White yarrow	ACHUILLEA MILLEF	CA	3.31
Rocky Mountain Penstemon	BANDERA	CO	3.60
Tufted hairgrass		CAN	4.63
Mountain brome	BROMAR	WA	17.65
Beardless wheatgrass	WHITMAR	WA	3.41
Slender wheatgrass	PRYOR	MT	15.53
Alpine bluegrass	VNS	CAN	6.49
			65.00

Option 2:

Species	Origin	Lbs/Ac
White yarrow	CA	3.31
Rocky Mountain Penstemon	CO	3.65
Slender wheat, Pryor	WA	10.24
Mountain brome, Bromar	WA	11.80
Tufted hairgrass	CAN	3.07
Big bluegrass, Sherman	WA	11.82
Streambank wheat, Sodar	WA	9.00
Alpine bluegrass	CAN	3.00
Arizona fescue, Redondo	CO	5.82
Wildrye, Elkton	WA	3.29
		65.00

Seeding may be accomplished using standard hydromulch procedures. Alternatively, seed may be hand broadcast and raked in after soil has been properly scarified to no less than 6 inches. Cover the seeded area with biodegradable matting. Secure matting edges with metal landscaping stakes (1 inch by 6 inches) placed every two feet on all sides. Begin installation at the base of the slope and continue to the top so that overlapping sections are shingled. Overlaps should be no less than 4 inches. No plastics are permitted for permanent installations. Certified, weed-free loose straw may only be used if the slopes are less than 3-to-1 and the site is artificially irrigated so that the straw will be wet and cannot blow.

After one year, reseed area and rework where vegetation has not emerged.