PUBLIC WORKS STANDARDS

FOR

YUMA COUNTY

VOLUME II

SPECIFICATIONS

July, 1993

YUMA COUNTY DEPARTMENT OF DEVELOPMENT SERVICES

2703 AVENUE B

YUMA, ARIZONA
85364

RESOLUTION NO. 93- 58

Resolution by the Board of Supervisors amending existing Yuma County Standard Specifications,

WHEREAS, Roger A. Patterson, County Engineer; filed with the Board of Supervisors of Yuma County, The Public Works Standards for Yuma County-Volume II Specifications,

WHEREAS, such Public Works Standard Specifications consist of the following:

- General Conditions
- Earthwork
- Roadway and Related Work
- Traffic Control, Right-of-Way Development and Incidentals
- Structures and masonary
- Pipe Work
- Material Specifications

and,

WHEREAS, the Standard Specifications adopted in the Public Works Standards supersede and replace previous Yuma County Standards Specifications and,

WHEREAS, the County Engineer has requested the Board of Supervisors adopt these Public Works Standard Specifications and,

WHEREAS, there exists a need within Yuma County for orderly development and growth, and public safety and welfare and,

WHEREAS, it appears to the Board that the adoption of the said Public Works Standards Volume II, Specifications are necessary in the orderly development of Yuma County and in providing public safety and welfare and,

NOW, THEREFORE BE IT RESOLVED that the herein above described Public Works Standards Volume II Specifications for Yuma County, are hereby adopted for use in Yuma County, and the County Engineer is hereby authorized and directed to amend the said Specifications from time to time as need may arise so that said Specifications will comply with current standardized and recognized civil engineering practice.

BE IT FURTHER RESOLVED, that the effective date of this resolution shall be the date approved.

Approved this 7th day of September, 1993.

Kathryn Prochaska

Kathryn "Casey" Prochaska, Chairman
Board of Supervisors
Yuma County, State of Arizona

ATTEST:

James R. Stahle

James R. Stahle, Clerk
Board of Supervisors

INTRODUCTION

The **Public Works Standards for Yuma County** are intended to provide a consistent policy for the orderly development of improvements within the County. This Volume II, contains the following County specifications:

- General Conditions
- Earthwork
- Roadway and related work
- Traffic Control, Right-Of-Way Development and Incidentals
- Structures and Masonry
- Pipework
- Material Specifications

A companion document, Volume I, contains Public Works Construction Standards for Yuma County.

These Standard and Specifications are prepared to fulfill the need for uniform rules governing Public Works construction performed for Yuma County and other public agencies in Yuma County who use thesestandards and specifications.

Copies of the Public Works Standards, Volume I and II, are available from the Yuma County Department of Development Services, 2703 So. Avenue B, Yuma, AZ. 85364 - telephone 602-329-2300.

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ABBREVIATIONS AND DEFINITIONS

101.1 ABBREVIATIONS:

Wherever the following abbreviations are used in these specifications, construction standards or on the plans, they are to be construed the same as the respective expressions represented.

AA	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
AB	Aggregate Base
ABC	Aggregate base course
AC	Asphalt cement or concrete
ACB	Asphalt concrete base
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ACWS	Asphalt concrete wearing surface
ADOT	Arizona Department of Transportation
AEC	Arizona Electric Code
AFRB	Arizona Fire Rating Bureau
AGC	Associated General Contractors of America, Inc.
Agg	Aggregate
Ahd	Ahead
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APA	American Plywood Association
Approx	Approximate
APWA	American Public Works Association
ARS	Arizona Revised Statutes
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
Asph	Asphalt
ASTM	American Society for Testing Materials
Ave	Avenue
AWG	American Wire Gage
AWPA	American Wood Preservers Association
AWSC	American Welding Society Code
AWWA	American Water Works Association
BC	Beginning of curve
BCR	Beginning of curb return
Beg	Beginning
Blvd	Boulevard
BM	Bench Mark or Board Measure
Brg	Bearing
BST	Bituminous Surface Treatment
BTB	Bituminous Treated Base
BTU	British Thermal Units
BVC	Beginning of vertical curve
C&G	Curb and Gutter
CB	Catch Basin
CC or C/C	Center to Center
CE	City or County Engineer
Cem	Cement
Cent	Centigrade
cfs	Cubic Feet per second
CIP	Cast Iron Pipe
CIPP	Cast-in-place concrete pipe
CL	Centerline
Cm	Centimeter
CMP	Corrugated metal pipe

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CO	Clean Out
Col	Column
CO	Clean Out
Col	Column
Conc	Concrete
Const	Construct
CP	Concrete pipe (non-reinforced)
CPI	Clay Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
CTB	Cement Treated Base
Cu	Cubic
Deg	Degree
DF	Douglas Fir
DG	Decomposed granite
Dia	Diameter
Dim	Dimension
DIP	Ductile Iron Pipe
Div	Division
Dwy	Driveway
E	East
Ea	Each
Ease	Easement
EC	End of Curve
ECR	End of curb return
Elev.	Elevation
Equa or Eq	Equation
EVC	End of vertical curve
Ex or Exist	Existing
F	Fahrenheit
F&C	Frame & Cover
FH	Fire Hydrant
FHWA	Federal Highway Administration
Fl El	Floor Elevation
FL or F	Floor line or flow line
Fnd	Found
Fps	Feet per second
FS	Finished surface
FSS	Federal Specifications and Standards
Ft	Foot or feet
G	Gutter
Galv	Galvanized
gpm	Gallons per minute
H	High or height
Hdwl	Headwall
Horiz	Horizontal
Hwy	Highway
ICA	Industrial Commission of Arizona
ID	Improvement District or inside diameter
IEEE	Institute of Electrical and Electronic Engineers
In	Inch
Inv	Invert
Inv. Elev	Invert Elevation
IP	Iron Pipe
IPS	Iron Pipe Size
Irrig	Irrigation
L	Length
Lb	Pound
LF	Linear Feet

Lin	Linear
Long	Longitudinal
Lt	Left
MAG	Maricopa Association of Governments
Max	Maximum
Meas	Measured
MH	Manhole
MHF&C	Manhole frame and cover
Min	Minutes or minimum
Misc	Miscellaneous
Mm	Millimeter
Mon	Monolithic or monument
MUTCD	Manual on Uniform Traffic Control Devices
N	North
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NE	Northeast
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
No	Number
NPI	Non pay item
NSC	National Safety Council
NSF	National Sanitation Foundation
NW	Northwest
OD	Outside diameter
OSHA	Occupational Safety and Health Administration
Oz	Ounces
PC	Point of curvature
PCA	Portland Cement Association
PCC	Portland Cement Concrete or point of compound curve
PI	Point of intersection or plastic index
PL	Property of line
POT	Point on Tangent
PP	Power Pole
PPM	Parts per million
PRC	Point of reverse curve
Prop	Proposed or property
psf	Pounds per square foot
psi	Pounds per square inch
PT	Point of Tangency
PVC	Polyvinyl Chloride
Pvmt	Pavement
Q	Rate of flow
R	Radius
RC	Reinforced concrete
RCP	Reinforced concrete pipe
Rd	Road
Rdwy	Roadway
Reinf	Reinforced, Reinforcing
Ret Wall	Retaining Wall
RGRCP	Rubber Gasket Reinforced Concrete Pipe
rpm	Revolutions Per Minute
Rt	Right
R/W	Right-of-Way
S	South or slope
SAE	Society of Automotive Engineers
San	Sanitary

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SC	Spiral to Curve
SCCP	Steel Cylinder Concrete Pipe
SD	Storm drain or Sewer District
SE	Southeast
Sec	Seconds
Sect	Section
Spec	Specification
SPR	Simplified Practice Recommendation
Sq Ft Yd	Square Foot, Yard
SS	Sanitary sewer
St	Street
Sta	Station
Std	Standard
Struct	Structure or structural
SW	Southwest
Tan.	Tangent
Tel	Telephone
Temp	Temporary
TH	Test hole
TP	Telephone pole
Trans	Transition
TS	Traffic signal or Tangent to spiral
TSC	Traffic signal conduit
Typ	Typical
UBC	Uniform Building Code
UL	Underwriter's Laboratories Inc.
UPC	Uniform Plumbing Code
USC&GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
V	Velocity of flow
VC	Vertical curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
WI	Wrought iron
Wt	Weight
Yd	Yard
'	Feet or minutes
"	inches or seconds
°	degrees
%	percent
#	number or pound
@	at
/	per
=	equals

SECTION 101

101.2 GENERAL DEFINITIONS AND TERMS:

Whenever in these Specifications, Construction Standards, plans or in any document of instruction where these Specifications govern, the following terms or pronouns in place of them are used, the intent and meaning shall be as interpreted as follows:

ADDENDUM: A supplement to any of the contract documents issued, in writing, after advertisement of but prior to the opening bids for a contract.

ADVERTISEMENT: The public announcement inviting bids for work to be performed or materials to be furnished.

The governmental agency for which the construction is being done, either by permit or contract.

AWARD: The formal action of the Agency in accepting a proposal.

BIDDER: Any individual, firm or corporation, qualified as herein provided, legally submitting a proposal for the work contemplated, acting directly or through an authorized representative.

BIDDING SCHEDULE: The prepared schedule, included as part of the proposal, containing the estimated quantities of the pay items for which unit bid prices are invited.

BOARD OF DIRECTORS: The governing body of the Flood Control District, acting under authority of the laws of State of Arizona.

BOARD OF SUPERVISORS: The Yuma County Board of Supervisors, acting under the authority of the laws of The State of Arizona.

CALENDAR DAY: Every day shown on the calendar.

CALL FOR BID: The standard form inviting proposals or bids.

CAREFUL AND PRUDENT MANNER: Means conducting excavation in such a way that when it approaches the underground facility located and marked by the owner or operator, by stakes, paint or in some customary manner, the exact location is manually determined, and the uncovered facility is supported and protected.

CERTIFICATIONS: A document stating that the material or item supplied complies and meets in all respects with the cited specification, as per Section 106.4.

CHANGE ORDER: A written order issued by the Engineer to the Contractor to make changes in the work or to perform extra work, and setting forth conditions for payment and/or adjustment in time of completion.

CODE AND/OR REGULATION: Those rules and statements adopted by a governing agency.

COMPLETION AND/OR CONTRACT TIME: The number of calendar days for completion of the work, including authorized time extensions. In case a calendar date of completion is shown in the proposal in lieu of the number of calendar days, the contract shall be completed by that date. The time within which an act is to be done shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

CONFLICTING UTILITY LINE: An existing utility line, shown or not shown on the plans, is a conflicting line when any part falls within the trench widths or within the dimensions, as shown on the plans, for structures or appurtenances.

CONSTRUCTION PROJECT: The erection, installation, remodeling, alteration of durable facilities upon, under or over the ground. This shall include, but is not limited to buildings, roadways and utility pipes, lines, poles, drainage and flood control facilities or other structures.

CONSTRUCTION STANDARDS: Drawings approved for repetitive use that show the dimensions and detail requirements of construction within the agencies jurisdiction. The Yuma County Construction Standards are bound within the Public Works Standards publication and is available from the Yuma County Department of Development Services, 2703 South Avenue B, Yuma, AZ, (602) 329-2300.

GENERAL CONDITIONS

SECTION 101

CONSULTING ENGINEER/CONSULTANT: The firm, corporation, partnership or individual who provides professional engineering services to a developer, or a contracting agency. They may prepare reports, plans and specification and provide construction management on projects.

CONTINGENT BID ITEM: This is a minor bid item which is likely, but not certain, to occur during the course of work. If the Engineer determines that this work is required, the Contractor will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the Engineer may vary materially from this.

CONTRACT: The written agreement getting forth the obligation of the parties, including but not limited to, covering the performance of the work and the furnishing of labor, equipment and materials and the basis of payment. The Contract includes the advertisement, addenda, performance bond, payment bond, certificate of insurance, proposal, plans, general conditions, specifications, construction standards, standard specifications, special provisions, contract supplementary agreements, and all written requirements which reasonably could be required to insure the proper completion of the work in a substantial and acceptable manner including authorized extensions there of, all of which constitutes one instrument.

CONTRACT DOCUMENTS: All the integral documents of the Contract, including but not limited to advertisement, addenda, performance bond, payment bond, certificate of insurance, proposal, plans, general conditions, specifications, special provisions, contract supplementary agreements, and all written requirements which reasonably could be required to insure the proper completion of the work in a substantial and acceptable manner.

CONTRACTING AGENCY: The legal entity that has contracted for the performance of the work or for whom the work is being performed.

CONTRACTOR: The party of the second part who undertakes to execute the work, acting directly or through an authorized lawful agent or employee.

COUNTY: Yuma County organized and existing under and by virtue of the laws of the State of Arizona.

COUNTY CLERK: The duly authorized Clerk of the Board of who performs the duties of the Clerk for the Contracting Agency.

DAYS: Unless otherwise designated, days will be understood to mean calendar days.

DIRECTOR OF DEVELOPMENT SERVICES: The official representative and agent of the Board of Supervisors.

DISTRICT: Yuma County Flood Control District, organized and existing under and by virtue of the laws of the State of Arizona.

EMERGENCY: That condition as determined by the Engineer which will or is threatening to the public health, safety or welfare.

ENGINEER: The County Engineer or Flood Control District Engineer and authorized assistants, duly authorized by the Director of Development Services to act for him.

EQUIPMENT (Construction): All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) - All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

EXTRA WORK: Work, including materials, for which no price agreement is contained in the contract and which is deemed necessary for the proper completion of the work.

FIELD ORDER: An order issued by the Engineer to the Contractor to make minor changes, clarifications and provide supplemental instruction to the work. If the work involves adjustments to payment or time of completion, a written supplemental agreement is to follow the issuance of a field order.

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GENERAL CONDITIONS: The conditions and requirements pertaining to the method and manner of performing the work, quality and quantities of materials to be furnished and the measurement and payment of same.

INSPECTOR: An authorized representative of the Engineer assigned to make detailed inspection of any work performed and material furnished by the Contractor.

GENERAL MANAGER: The official representative and agent of the Board of Directors of the Flood Control District.

LABORATORY: The established laboratory of the Department or other laboratories authorized by the Engineer to test materials and work involved in the Contract.

MAJOR ITEM: An item on the bidding schedule whose total cost is greater than 5 percent of the total contract pri ce.

MATERIALS: Any substance specified in the project, equipment and other material used or consumed in the performance of the work.

NON PAY ITEM: An item of work for which no separate payment will be made under the proposal, but which must be included as an incidental cost for payment on an associated item included in the proposal.

NOTICE OF AWARD: A letter from the Contracting Agency advising the Contractor that the is the successful bidder and the Agency has accepted his proposal.

NOTICE TO PROCEED: A directive issued by the Contracting Agency, authorizing the Contractor to start the work or improvements required in the Contract.

OWNER: The County or the District acting through its legally constituted officials, officers or employees.

PAY ITEM: A detail of work for which separate payment made under the Contract, as specified as a bid item in the proposals bid schedule.

PAYMENT BOND: The security provided by the Contractor and his surety solely for the protection of claimants, supplying labor and materials to the Contractor or his Subcontractors.

PERFORMANCE BOND: The security provided by the Contractor and his surety solely for the protection of the Contracting Agency and conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions thereof.

PERMIT: The license to do construction in public rights-of-way and/or easements; issued by an Agency to a Contractor working for another party or issued to the owner.

PLANS: The contract drawings which includes project plans, construction standards, shop drawings and supplemental drawings or exact reproductions thereof, which show the location, character, dimensions and details of the work to be performed.

PLANT: The Contractors and/or Subcontractors facilities, including but not limited to small tools and mobile equipment, located on and/or off site, necessary for preparation of materials and prosecution of work for the project.

PRINCIPAL: The individual, firm or corporation primarily liable on an obligation, as distinguished from a surety.

PROJECT: A specific coordinated construction or similar undertaking identified by a single project number and bid and awarded as one contract. On occasion two or more projects may be bid and awarded as a single contract.

SECTION 101

PROJECT PLANS: Specific drawings which show specific details and dimensions particular to the work to be performed and which are supplemented by the construction standards in so far as they may apply.

PROPERTY: The strip of land or any other area which is secured for or acquired for project purposes.

PROPOSAL: The offer of the bidder for the work when properly made out on forms containing the bidding schedule supplied by the Agency and properly submitted, signed and guaranteed.

PROPOSAL FORMS: The approved form on which the Contracting Agency requires bids to be prepared and submitted for the work.

PROPOSAL GUARANTEE: The security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

PROPOSAL PAMPHLET: The pamphlet pertaining to a specific project, containing proposal and bid schedule, contract, bond forms, certificate of insurance, and other information necessary for and pertinent to the preparation of the proposal or bid.

REFERENCED DOCUMENTS: On all work authorized by the Contracting Agency, any referenced documents in the specification, i.e.: bulletins, standards, rules, methods of analysis or test. Codes and specifications of other agencies, engineering societies or industrial associations, refer to the latest edition thereof, including amendments, which are in effect and published at the time of advertising for bids or the issuing of a permit for the work, unless otherwise stated.

RIGHT-OF-WAY: A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to a street, highway, or other public improvement.

ROAD, ALSO KNOWN AS A STREET: A general term denoting a public way for purposes of vehicular travel, and utility locations including the entire area within the right-of-way.

ROADWAY: The portion of the right-of-way intended primarily for vehicular traffic, and including all appurtenant structures and other features necessary for proper drainage and protection. Where curbs exist, it is that portion of roadway between the faces of the curbs.

SEWER: Usually a closed pipeline or conduit, that transports waste or stormwater toward points of discharge.

SHOP DRAWINGS: Drawings or reproduction of drawings, detailing, fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, pipe layouts, installed equipment and installation of systems or any other supplementary plans or similar data, which the Contractor is required to submit for approval.

SPECIAL PROVISIONS: The special conditions, additions and/or requirements or revisions of the plans and specifications, applicable to the work to cover conditions or requirements peculiar to the project under consideration.

SPECIFICATIONS: The descriptions, provisions and requirements for a project contained in a book and termed Specifications supplemented by such special provisions as may be necessary, pertaining to the method and manner of performing the work, quality and quantities of materials to be furnished and the measurement and payment of same.

STANDARD SPECIFICATIONS : A book of approved specifications pertaining to the method and manner of performing work, for general application and repetitive use.

STORM DRAIN : Any pipeline, sewer or conduit including appurtenance intended for the reception and transport of stormwater.

SECTION 101

STRUCTURE: Bridges, retaining walls, box culverts, large headwalls, vaults, pump stations, inlet and outlet structures, buildings, and other features which may be encountered in the work are considered structures. Catch basins, drop inlets and manholes are handled separately in these specifications.

SUBCONTRACTOR: Those having direct contracts with the Contractor and those who furnish material worked into a special design according to the plans and specifications for the work, but not those who merely furnish material not so worked.

SUBMITTAL: Those shop drawings, stress sheets, certifications, erection plan; Equipment Installation plan, catalog cuts, and similar data required to be submitted to the Contracting Agency to adequately control the work.

SUPERINTENDENT: The Contractor's authorized representative in responsible charge of the work.

SUPPLEMENTAL DRAWINGS: Drawings that show detailing and clarification, those that supplement to the project plans and those prepared by the Engineer.

SUPPLEMENTARY AGREEMENT: A written agreement executed by the Contractor and the Engineer, covering alterations to the project. A change order or a force account work request prepared on the approval form of the Agency is a supplementary agreement.

SUPPLEMENTARY GENERAL CONDITIONS: Requirements, or revisions, to the Standard General Conditions, applicable to the work, and to cover conditions or requirements peculiar to the project under consideration.

SURETY: The corporate body which is bound with and for the Contractor, who is primarily liable, and which engages to be responsible for his payment of all debts pertaining to and for his acceptable performance of the work for which he has contracted.

TITLES OR HEADINGS: The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

UNDERGROUND FACILITIES: Means any item which shall be buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephone or telegraphic communications, electric energy, oil, gas or other substances, and shall include, but not be limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments and those portions of poles and their attachments below ground.

UTILITY: Pipe lines, conduits, ducts, transmission lines, overhead or underground wires, railroads, storm drains, sanitary sewers, irrigation facilities, street lighting, traffic signals, and fire alarm systems, and appurtenances of public utilities and those of private industry, businesses or individuals solely for their own use or use of their customers which are operated or maintained in, on, under, over or across public right-of-way or public or private easement.

WORK: Any or all of the improvements mentioned and authorized to be made, and the construction, demolition, reconstruction, and repair of all or any portion of such improvements, and all labor, services, incidental expenses, and materials necessary or incidental thereto.

WORKING DAY: A calendar day, exclusive of Saturdays, Sundays and Contracting Agency recognized legal holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

SECTION 101

101.3 BY OR TO THE ENGINEER:

In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where contemplated required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected or condemned, it shall be understood as if the expression were followed by the words by the Engineer or to the Engineer.

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.1 ELIGIBILITY AND PREFERENCE: The employment of Contractors and Subcontractors on Public Works shall be governed by the provisions of Section 34-241 of the Arizona Revised Statutes.

102.2 CONTENTS Of PROPOSAL PAMPHLET: The Proposal Pamphlet supplied with the specifications contains the proposal and bidding schedule, contract, bond forms and certificate of insurance forms together with the advertisement for bids and any other papers (except large plans and specifications) pertinent to the contract. The standard specifications, construction standards, plans, specifications, construction details, general conditions, special provisions, and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy or conflict, plans will govern over standard specifications and construction standards; special provisions will govern over standard specifications, construction standards, general conditions, and supplemental general conditions.

Each and every provision of law and clause required by law to be inserted in the contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein.

102.3 COPIES OF STANDARD SPECIFICATIONS AND CONSTRUCTION STANDARDS: Copies of standard specifications and construction standards are available from the Contracting Agency for a nominal fee.

102.4 INTERPRETATION OF QUANTITIES IN BIDDING SCHEDULE: The quantities appearing in the proposal are approximate only and are to be used for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted on materials furnished in accordance with the Contract at the unit bid price in the proposal. After the contract is awarded the quantities of work listed by any pay item, or all pay items, may be increased or decreased a reasonable amount at the discretion of the Contracting Agency, without in any way invalidating the unit bid price.

102.5 EXAMINATION OF PLANS, SPECIAL PROVISIONS AND SITE OF WORK: The Contracting Agency will prepare plans and special provisions in accordance with acceptable engineering standards, giving such directions as will enable any competent Contractor to carry them out.

The bidder shall examine the site of the proposed work and all documents pertaining to the work. It is mutually agreed that the submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is familiar with the character, quality and quantity of the work to be performed and material to be furnished.

Logs of test holes, ground water levels, and any accompanying soil reports as furnished by the Contracting Agency are furnished for general information only. The field conditions so set forth shall not constitute a representation or warranty, expressed or implied, that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions.

After the submission of the proposal, no complaint or claim that there was any misunderstanding as to the quantities, conditions or nature of the work will be entertained.

102.6 PREPARATION OF PROPOSAL: The bidder shall submit his proposal on the forms obtained from the Contracting Agency. The bidder shall specify a unit bid price and extension in words, figures or both, whichever is required, for each pay item where units and approximate quantities are given.

The proposal total will be obtained by adding the extension amount or lump sum indicated for the individual pay items. If there is a conflict between words and figures, the words shall apply. If there is a conflict between the unit bid price and the extension for a particular pay item, the unit bid price shall govern. In either case, the Contracting Agency shall correct the discrepancy in accordance with the above procedure and the corrected proposal total will apply.

In addition, the following shall be completed by the bidder on the proposal:

(A) Acknowledge receipt of and agree that the proposal is based on the listed Addenda received with and/or after receipt of the proposal pamphlet.

(B) Listing of bidders Arizona State Contractor's license Number and Classification.

(C) Signatures in ink and attested or witnessed as applicable. If the proposal is made by an individual, his name and post office address must be shown. If made by a firm or partnership, the name and post office address of each member of the firm or partnership must be shown. If made by a corporation the proposal must show the name of the State under the laws of which the corporation was chartered and if a foreign corporation, who has authority to do business in Arizona, the names, titles and business addresses of the President, Secretary and Treasurer must be shown, and evidence of the authority of the signing officer to submit a proposal on behalf of the corporation shall be submitted or be on file with the Department.

102.7 SALES AND OTHER TAXES: The bid shall be for all work to be performed. The Contracting Agency will not pay any additional sums such as sales, business or transaction privilege taxes.

102.8 SUBCONTRACTORS LIST: When required, the List of Subcontractors form will be attached to the proposal pamphlet. The bidder shall submit this form with his proposal, listing the firm name and business address of each specialty subcontractor to whom he proposes to subcontract any portion of the work. Only one name shall be listed for each category. The bidder may list himself to perform one or more of the listed categories of work for which he has any requisite State licenses when required.

102.9 IRREGULAR PROPOSALS: Proposals will be considered irregular and may be rejected for the following reasons:

(A) If the proposal is on a form other than that furnished by the Contracting Agency; or if the form is altered or any part thereof is detached.

(B) If there are unauthorized additions, statements, conditional or alternate bids, or irregularities of any kind.

(C) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.

(D) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items.

(E) If, when required, the bidder fails to accomplish and submit the List of Subcontractors' form.

102.10 PROPOSAL GUARANTEE: No proposal will be read unless accompanied by a proposal guarantee in the form and amount stated in the advertisement. A company or companies providing surety bonds shall be duly licensed and possess a certificate of authority to transact surety business in the State of Arizona. The guarantee shall be made payable to the Contracting Agency as a guarantee that the bidder, if awarded the contract, will execute the contract documents and furnish the required bonds and certificates of insurance, to be forfeited if the Contractor fails or refuses to enter into a contract as required by the bid documents.

102.11 SUBMISSION OF PROPOSAL: The proposal and guarantee shall be submitted in a sealed envelope. The outside, lower right-hand corner of which shall be marked as follows:

Bid for_____

To he opened at_____

Proposals will be received until the hour and date set for the opening thereof and must be by that time in the hands of the Clerk of the Board.

102.12 WITHDRAWAL OR REVISION OF PROPOSAL: Any bidder may withdraw or revise a proposal after it has been deposited with the Contracting Agency, provided his request is received, in writing or by telegram, before the time specified for opening proposals or as stipulated herein.

102.13 PUBLIC OPENING OF PROPOSALS: Proposals will be opened and read publicly at the time and place specified in the Advertisement/Call for Bids or any Addenda. Bidders, their authorized agents and other interested parties are invited to be present.

When proposals for more than one project are to be opened at the same time, any bidder may, after the time set for opening proposals, request to withdraw his second or succeeding proposal prior to the opening of proposals for that project. Should this occur, there will be a brief delay in the opening of proposals to permit the bidder to submit his request. Upon receipt of the bidder's written request, by the Contracting Agency, his proposal will be returned unopened.

102.14 DISQUALIFICATION OF BIDDERS: Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal:

(A) Receipt of more than one proposal for the same work from an individual, partnership or corporation under or different names.

(B) Evidence of collusion among bidders or assistance from any officer of the Contracting Agency, of any Department thereof.

102.15 PROJECTS PLANS FOR SUCCESSFUL BIDDER: Unless otherwise specified herein, the successful bidder may obtain 7 sets of project plans and specifications from the Contracting Agency, at no cost.

SECTION 103

AWARD AND EXECUTION OF CONTRACT

103.1 CONSIDERATION OF PROPOSALS: After the proposals, for the contemplated work, have been opened and read as provided in these specifications, the respective totals will be checked and compared by the Contracting Agency. The basis of comparison will be to verify the accuracy of the total proposal by checking the extensions and additions. In the event of a discrepancy, in the amount bid for a pay item, the unit bid price will govern unless obviously in error. The results of such comparison will be considered public information.

The right is reserved to award the contract to the lowest and/or best responsible bidder, or to reject all proposals and to re-advertise for any reason the Contracting Agency determines.

In case all proposals are rejected, any subsequent changes, additions, addenda, or new sets of plans and special provisions will be provided to all purchasers of the first issue of the plans and special provisions at no additional charge, except that out-of-town bidders will pay shipping charges.

103.2 RETURN OF PROPOSAL GUARANTEE: All proposal guarantees, except those of: the two lowest responsible bidders will be returned immediately following the opening and checking of proposals. The retained proposal guarantee or guarantees will be returned immediately after the contract documents have been executed by all parties and required bonds are filed with the agency.

103.3 AWARD OF CONTRACT: The Contracting Agency, through its duly authorized body or agent will award the contract to the lowest and/or best responsible bidder, or all proposals will be rejected, as soon as practicable after the date of opening proposals.

No proposal shall be withdrawn for a period of 50 days after opening without consent of the Contracting Agency through the body or agent duly authorized to accept or reject the proposal except that in the case or Federally-assisted projects, or other projects award of which is conditioned on the approval of an agency not under the control of the Contracting Agency, withdrawal shall not be made within a period of 50 days after opening without such consent.

If written notice of the acceptance of a proposal is delivered to the successful bidder within the times noted above, or at any time thereafter before such proposal has been withdrawn, the bidder shall execute and deliver a contract in the prescribed form, and shall furnish the required bonds, within 10 days after receipt of such notice or his proposal guarantee shall be forfeited as provided elsewhere herein.

103.4 CANCELLATION OF AWARD: The Contracting Agency reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties, without any liability against the Contracting Agency.

103.5 REQUIREMENT OF CONTRACT BONDS: Concurrently with the execution of the contract, the Contractor shall furnish the Contracting Agency the following bonds, which shall become binding upon the award of the contract to the Contractor:

(A) A Performance Bond in an amount equal to the full contract amount conditioned upon the faithful performance of the contract in accordance with plans, specifications and conditions thereof. Such bond shall be solely for the protection of the Contracting Agency awarding the contract.

(B) A Payment Bond in an amount equal to the full contract amount solely for the protection of claimants supplying labor or materials to the Contractor or his Subcontractors in the prosecution of the work provided for in such contract.

Each such bond shall include a provision allowing the prevailing party in a suit on such bond to recover as a part of his judgment such reasonable attorney's fees as may be fixed by a judge of the court.

Each such bond shall be executed by a surety company or companies duly authorized to do business in the State of Arizona. The bonds shall be made payable and acceptable to the Contracting Agency. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in this State, as by law required, and the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official.

103.6 CONTRACTOR'S INSURANCE:

103.6.1 General: The Contractor shall agree to carry all insurance which may be required by Federal and State Laws, County and City Ordinances, Regulations and Codes. Neither the Contractor nor any subcontractor shall commence work under a contract until the Contracting Agency has approved the insurance. The entire project covered by the contract will be at the Contractor's risk until final acceptance by the Contracting Agency.

Concurrently with the execution of the contract, the Contractor shall furnish the Contracting Agency the following:

(A) Public Liability and Property Damage Insurance: The Contractor shall provide and maintain, during the life of the contract, General Liability, Automobile Liability and Worker's Compensation Insurance as follows:

Type of Insurance	Minimum Limits of Liability
General Liability	$1,000,000 Combined single Limit --
Comprehensive Form Premises/Operations Underground Explosion and Collapse Hazard Exclusions Deleted (Where applicable) Products/Completed Operations Contractual Independent Contractors (OCP) Broad Form Property Damage Personal Injury With Exclusion C Deleted	
Automobile Liability	$1,000,000 Combined Single Limit
Owned Hired Non-Owned	
Excess Liability	As required
Umbrella Form	
Workers Compensation & Employers' Liability	Statutory Limits
Builder Risk/Course of Construction	As required

The Contracting Agency shall have no responsibility of liability for such insurance coverage.

SECTION 103

The Contractor shall furnish a Certificate of Insurance on a form approved by the Contracting Agency. The Certificate shall be issued by an insurance company authorized to transact business in the State of Arizona or be named on the list of Unauthorized Insurers maintained by the Arizona Department of Insurance. Insurance coverage shall not expire until all the work has been completed and the project has been accepted by the Contracting Agency. If an insurance policy does expire during the life of the contract, the Contractor shall provide a renewal certificate of the required insurance coverage to the Contracting Agency not less than thirty (30) days prior to the expiration date.

(B) Worker's Compensation and Employer's Liability: A Letter of Certification, from the Industrial Commission of Arizona, that the Contractor is insured by the State Compensation Fund or is an authorized by the Arizona Department of Insurance to provide Workmen's Compensation and Employer's Liability Insurance in the State of Arizona.

(C) Builders Risk/Course of Construction: When the project includes construction of a new building or addition to an existing building, the Contractor shall also obtain insurance coverage for at least, as a minimum the perils of fire, extended coverage, vandalism and malicious mischief for the full amount of the contract. The Contractor shall be responsible for any deductibles, mutual waiver of subrogation and any co-insurance for the construction that is the subject of this contract.

(D) Additional Insured: The Contracting Agency, its officers, agents and employees shall be named as insured on policies listed in (A) and (C) and this shall also be indicated on the Certificates of Insurance issued to the Contracting Agency. The Contractor's coverage shall be primary for any and all losses arising out of the performance of this contract.

103.7 INDEMNIFICATION OF THE CONTRACTING AGENCY AGAINST LIABILITY:

The Contractor agrees to indemnify and save harmless the Contracting Agency, the Director of Development Services, the Engineer and assistants and any jurisdiction or agency issuing permits for any work included in the project, their officers, agents and representatives from all suits, including attorney's fees and costs of litigation, of the work done in fulfillment of the construction of the improvement under the terms of this contract or on account of any act, claim or amount arising or recovered under the Workmen's Compensation Law, or arising out of the failure of the Contractor or those acting under the Contractor to conform to any statues, ordinance, regulation, law or court decree. It is the intent of the parties of this contract that the Contracting Agency shall, in all instances, be indemnified against all liability, losses and damages of any nature whatever for or on account of any injuries to or death of persons or damages to or destruction of property belonging to any person arising out of or in any way connected with the performance of this contract, regardless of whether or not the liability, loss or damage is caused by or alleged to be caused in part by the negligence, gross negligence or fault of the indemnitee. It is agreed that the Contractor will be responsible for primary loss investigation, defense and judgment costs where this contract of indemnity applies.

103.8 EXECUTION AND APPROVAL OF CONTRACT: The Contractor shall execute and return the contract to the Contracting Agency within 10 calendar days after the date of award of the contract from Contracting Agency. If objections to the award are received, the signing shall occur within 5 days after any hearing over rules and objections. The Contracting Agency will approve and execute the contract within 10 calendar days following receipt of signed contract and acceptable bonds and certificates of insurance.

No contract shall be considered in effect until it has been fully executed by all parties concerned, bonds and Certificate of Ins. have been filed with the contracting agency.

Information relative to the execution of contract documents may be obtained from the Engineering Office of the Contracting Agency advertising for bids.

103.9 FORFEITURE OF PROPOSAL GUARANTEES: If the Contractor fails or refuses to enter into the contract, within the time stated, then the Contracting Agency may declare a forfeiture of his proposal guarantee as liquidated damages for failure to enter into the contract.

SECTION 104

SCOPE OF WORK

104.1 WORK TO BE DONE:

104.1.1 GENERAL: The Contractor shall perform all work as may be necessary to complete the contract in a satisfactory and acceptable manner in full compliance with the plans, specifications and terms of the contract.

Unless other specified in the special provisions, he shall furnish all labor, materials, equipment, transportation, utilities, services and facilities required to perform all work for the construction of the project within the time specified.

104.1.2 MAINTENANCE OF TRAFFIC: The Contractor's operations shall be in accordance with the Manual on Uniform Traffic Control Devices and/or policies of the appropriate public agency having jurisdiction over the project. These operations shall cause no unnecessary inconvenience to the public and public access rights shall be considered at all times. Unless otherwise authorized in the specifications or on a temporary basis by the Engineer, traffic shall be permitted to pass through the work area. The Contractor shall coordinate with the various agencies both commercial and public, involved in the collection and removal of trash and garbage, so that adequate services are maintained.

Safe and adequate pedestrian and vehicular access shall be provided and maintained to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, motels, hospitals, fire stations, police stations, and establishments of a similar nature. Access to residential properties shall be in accordance with Section 107 "Legal Relations and Responsibility to the Public".

Grading operations, pipeline and roadway excavation and fill construction shall be conducted and maintained in such a manner as to provide a reasonably satisfactory and safe surface for vehicular and pedestrian traffic. When rough grading is completed, the roadbed shall be brought to and maintained in a reasonably smooth condition, satisfactory and safe for vehicular traffic at the posted speed limit. Pedestrian walkways shall be provided and maintained in a like manner. The Contractor shall accomplish any additional grading operations and/or repairs, including barricade replacement or repairs during working and non-working periods which, in the opinion of the Engineer, are required.

In the event of abnormal weather conditions, such as windstorms, rainstorms, etc., the Contractor shall immediately inspect his work area and take all necessary actions to insure that public access, safety and adequate barricading is maintained.

The Contractor shall provide a Traffic Control Plan to the Engineer for review and approval prior to construction on arterial and collector roadways.

The Contractor shall provide the Engineer with the emergency phone numbers of his representatives.

104.1.3 CLEANUP AND DUST CONTROL: Throughout all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work area clean and free from rubbish, excess materials and debris generated by construction activities.

The Contractor shall take whatever steps, procedures or means required to prevent any dust nuisance due to his construction operations. The dust control measures shall be maintained at all times to the satisfaction of the Engineer and in accordance with the requirements of the Yuma County Health Department.

Failure of the Contractor to comply with the Engineer's cleanup and dust control orders may result in an order to suspend work until the condition is corrected. No additional compensation or time will be allowed as a result of such suspension and the Engineer has the authority to take such other measures as may be necessary to remedy the situation.

104.2 ALTERATION OF WORK:

FINAL CLEANING UP: Before final acceptance, all private or public property and grounds occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures and equipment, and all parts of the work area shall be left in an acceptable condition.

104.2.1 BY THE CONTRACTING AGENCY: The Contracting Agency reserves the right to make, at any time during the progress of the work, such alterations in the details of construction and such increases or decreases in quantities as may be found necessary or desirable. Such alterations and changes shall not invalidate the contract nor release the surety and the Contractor agrees to perform the work as altered, the same as if it had been a part of the original contract. The Engineer will issue Change Orders to cover unforeseen circumstances which make it impossible to carry out the work in accordance with the original contract plans and specifications. If the alterations or changes made by the Contracting Agency increases or decreases the total cost of the contract or the total cost of any major item by more than 20 percent, either party may request an adjustment in payment in accordance with Section 109.

104.2.2 DUE TO PHYSICAL CONDITIONS :
(A) Should the Contractor encounter or discover during the process of the work, unknown physical conditions at the site, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract, the Engineer shall be promptly notified in writing of such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions and, if he finds they do so materially differ and cause an increase or decrease in the cost of or the time required for performance of the contract, an equitable adjustment will be made and the contract modified accordingly. Failure to notify the Engineer of the conditions described above prior to doing any work may be just cause to reject any claims for additional monies and/or time.

(B) Material used in the project that contains moisture in an amount considered excessive by the Engineer shall be removed and shall be aerated to the extent required by the Engineer before compaction is effected. No measurement or direct payment for the removal and aeration of such material will be made.

(C) After any portion of the work has been opened up, saturation of material caused by irrigation water, storm drainage, weather or such similar causes will be considered as within the responsibility of the Contractor.

104.2.3 DUE TO EXTRA WORK: The Contractor shall perform unforeseen work, for which there is no unit bid price in the proposal, whenever it is deemed necessary or desirable by the Engineer in order to fully complete the work as contemplated. Such work shall be governed by all applicable provisions set forth in Section 109.

Should the Contractor claim that any instructions received involve extra work under the contract, he shall give the Engineer written notice thereof within 48 hours after receipt of such instructions, and in any event before proceeding to execute the work, except in emergencies endangering life or property. No claim shall be valid unless written notice is given.

If this extra work is performed by others, the Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the contract or release the surety.

104.2.4 AT THE CONTRACTOR'S REQUEST: Changes in the plans or specifications, which do not materially affect and are not detrimental to the work or to the interests of the Contracting Agency, may be granted to facilitate the work. Requests shall be in writing and submitted to the Engineer for approval. These changes, if approved and when resulting in a saving to the Contractor, will be made at an equitable reduction in cost or in no case at any additional cost to the Contracting Agency.

104.2.5 DUE TO THE FAILURE OF THE CONTRACTOR TO PROPERLY MAINTAIN THE PROJECT :

(A) If the Contractor fails to provide adequate maintenance of traffic or cleanup and dust control or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to suspend the work wholly or in part until this condition has been corrected.

(B) If the Contractor fails to comply with the Engineer's written order to provide adequate maintenance of traffic, cleanup, dust control, or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to have this work accomplished by other sources.

(C) The Contractor agrees to cooperate fully with the other source accomplishing this work and agrees action shall not invalidate the Contract or release the surety.

SECTION 105

CONTROL OF WORK

105.1 AUTHORITY OF THE ENGINEER: The work shall be done under the direct supervision of the Engineer and he will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the Contract on the part of the Contractor. The Engineer's estimates and decisions shall be final and conclusive. In case any question should arise, relative to the Contract Documents, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive final approval of the work being questioned under the Contract.

In giving instructions, the Engineer may make minor changes in the work, not involving extra work and not inconsistent with the purpose of the work, except in emergencies endangering life or property.

The Engineer will suspend the work wholly or in part due to the failure of the Contractor; to correct conditions unsafe for the workers or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

105.2 SHOP DRAWINGS AND SUBMITTALS: Plans are to show details of all structures, utilities, lines, elevations, grades, typical cross sections, and location and design of all work.

The Contractor shall submit for review and obtain approval of shop drawings. Shop drawings are to supplement the plans as necessary to adequately control the work. Shop drawings for structures and utilities shall be furnished by the Contractor and shall consist of such detailed plans as may be required to adequately control the work and are not included in the plans furnished by the Contracting Agency. They shall include stress sheets, shop drawings, erection plans, false-work plans, cofferdam plans, bending diagrams for reinforcing steel, computations, pipe work layouts, system installation plans, equipment installation plans or similar data and any other supplemental data required to adequately control the work.

Drawings, detailed plans, diagrams, etc. shall not be prepared until the elevations, lengths, geometric, etc. have been verified with the Engineer.

Drawings for false-work, shoring, soldier piles, and other major temporary support structures shall be prepared by and bear the seal and signature of a licensed, Professional Civil or Structural Engineer. Minor support structures are exempt from this requirement.

The Contractor shall submit for review and obtain approval of product data on all manufactured equipment & material items including material lists, catalog data, description of all parts showing type of materials, dimensions and conformance to specifications.

On all construction, the Contractor shall submit for review and obtain approval of material and product catalog data. Where product data is not supplied, a Certification of Compliance shall be submitted for review and approved in accordance with Section 106.3 of the General Conditions. On concrete and asphalt mixes, mix designs shall be submitted and approved before construction begins.

The Contractor shall submit three (3) copies of each certification, shop drawings, product data or mix design to the Engineer for review in accordance with this condition and the individual specifications. Each submittal shall be numbered sequentially and shall be submitted in a timely manner so as to cause no delay in the work schedule. The contractor shall certify, by stamp or letter, that he has reviewed and approved the submittal and that it conforms to the requirements of the contract documents. If this certification is not included, the submittal will be returned without action.

SECTION 105

At the time of each submittal, the Contractor shall define and delineate in writing, separate from the certification, any deviations from the contract documents. If the Engineer accepts this deviation, he will authorize the deviation by issuing a change order or if the deviation is minor by endorsement to the letter.

The Engineer will review and return the submittals in a timely manner. The review will be only for conformance with the design concept of the work and for compliance with the information contained in the contract documents. The review of a specific item, as such, will not indicate review of the assembly in which the item functions. Review by the Engineer will not relieve the contractor from responsibility for any errors or omissions in the submittals nor from his responsibility for complying with the contract documents. The only exception is deviations accepted in accordance with the preceding paragraph.

If the submittal is acceptable, two (2) copies checked "Approved" will be returned to the Contractor.

If the submittal is acceptable with minor corrections made by the Engineer, two (2) copies checked "Furnish as Corrected" will be returned by the Contractor.

If the Engineer determines that the submittal requires correction or is to be rejected, two (2) copies checked "Rejected" and/or "Revise and Resubmit" will be returned to the Contractor. The Contractor will revise the information and resubmit copies.

The copy stamped "Approved or Furnish as Corrected", returned to the Contractor, will become a part of the contract documents and will be kept at the job site. Any work done prior to the receipt of this approval will be at the Contractor's risk and expense.

105.3 CONFORMITY WITH PLANS AND SPECIFICATIONS: All work performed and all materials furnished shall be in conformity with the lines, elevations, grades, cross sections, dimensions and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the Engineer finds the materials or the finished product in which the materials are used not in conformity with the plans and specifications, but that reasonably acceptable work has been produced, he shall then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgment.

In the event the Engineer finds the materials or the finished product in which the materials are used or the work performed are not in conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by the Contractor at no additional cost to the Contracting Agency.

In all instances wherein the items and/or specifications require installation or construction in accordance with either manufacturers' or suppliers' recommendations and/or instructions, said recommendations and/or instructions shall be submitted with the applicable portion clearly marked for approval prior to the commencement of work on that item or portions of the contract.

105.4 DEVIATIONS FROM PLANS OR SPECIFICATIONS: No deviation from the approved Plans, Specifications or approved working drawings will be permitted without written order of the Engineer, such order to be in the form of a Supplementary Agreement (Change Order) or (Field Order).

105.5 COORDINATION OF PLANS AND SPECIFICATIONS: The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications. In case of discrepancy or conflict, plans will govern over standard specifications, and construction standards; Special Provisions will govern over Standard Specifications, Specifications, Construction Standards, general conditionsand supplementary general conditions; and figured dimensions shall govern over scaled dimensions.

105.6 COOPERATION OF CONTRACTOR: The Contractor will be supplied with a minimum of seven sets of approved plans and special provisions, one set of which the Contractor shall keep available on the work site at all times.

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, his inspectors, and other contractors in every way possible.

The Contractor shall at all times be present at the work in person or represented by a competent superintendent authorized to receive and fulfill instructions from the Engineer and who shall supervise and direct the work irrespective of the amount of work sublet. Instructions and information given by the Engineer to the Contractor's superintendent shall be considered as having been given to the Contractor.

(A) All phases of the project such as concrete work, pipe work, etc., shall be under the direct supervision of a foreman or his designated representative on the site who shall have authority to accept instructions, with respect to that particular phase of the project, and take action required to properly carry out the work.

(B) In the event of noncompliance with the above, the Engineer may require the contractor to stop work on that part of the project until the required supervision is present.

The Contractor shall file with the Engineer, the names, addresses, and telephone numbers of representatives who can be contacted, at any time, in case of emergency. These representatives must be fully authorized and equipped to correct unsafe or excessively inconvenient conditions on short notice.

105.7 COOPERATION WITH UTILITIES: The Contracting Agency will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe line, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

The Contractor shall comply with the requirements of ARS -40-360.21 through 40-360.29 (one call system, Blue Stake) in notification to the interested utility owners prior to start of construction. The Contractor shall resolve all problems with the utility owners concerned.

Where water users association facilities obstruct construction of the work, the Contractor shall contact officials of the association relative to the shutdown of irrigation water and shall acquaint himself with and conform to the requirements of the association.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners at their expense except as otherwise provided for in the special provisions or as noted on the plans. In the event an existing home or business service is found to be in a materially different location than shown on the plans and required additional or more costly work on the part of the Contractor, the procedures in Section 104, will apply.

It is understood and agreed that the Contractor has considered in his proposal all of the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenance or the operation of moving them. If delays are encountered because utility owners have not relocated or adjusted their facilities, the contract time will be adjusted in accordance with Section 108.

It shall be the responsibility of the Contractor to ascertain the need for bracing or shoring of utility poles during the construction of the project and no additional compensation will be allowed for such bracing or shoring.

In general, the contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner and others by the Contractor. Any work performed by the Contractor for any utility company, separate from the contract, shall be paid for by the utility company and will not be part of the agency contract.

SECTION 105

105.7.1 Notifications Requirement in the Event of Any Damage to or Dislocation of Underground Facilities: In the event of any damage to or dislocation of any underground facility, the Contractor responsible for the excavation operation shall immediately notify the owner of such facility and shall not attempt to repair any facility, except those intended for the conveyance or storage of water and sewage. The excavation shall be left open until the arrival of representatives of the owner. The owner will dispatch its representative promptly to examine the underground facility and, if necessary, make repairs.

105.7.2 Work Within a Railroad Right of Way: When a railroad right of way in included in the work, the Contractor shall:

(A) Comply with the rules and regulations of the railroad company relative to the required manner of constructing said portion of the work; and shall perform the work so as not to endanger or interfere with the safe operation of the track(s) and property of the railroad company and of the traffic moving on such track(s).

(B) Carry the kinds and amounts of insurance and bonds required by the railroad company for the period of time in which work is performed on or adjacent to the railroad company's property, and until such work has been satisfactorily completed and all tools, equipment and materials have been removed from the railroad company's property and such property is left in a clean and presentable condition.

(C) Contact the railroad company at least 48 hours in advance of performing any construction within the right of way of any track(s).

105.8 COOPERATION BETWEEN CONTRACTORS: The Contracting Agency reserves the right at any time to contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Contracting Agency from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other contractors within the limits of the same project. He shall join his work with that of others in an acceptable manner and shall perform it in proper sequence to that of the others.

The Contracting Agency will not honor any claim for extra compensation due to delays, extra work, or extension of time caused by any other contractors working within the limits of the same project.

105.9 CONSTRUCTION STAKES, LINES, AND GRADES: When the Contracting agency is a public agency the Engineer will provide property control or a control line and a benchmark. These stakes and markings are to be used as a basis from which construction lines and grades will be set to perform the work.

Unless noted otherwise in the Special Conditions, the Contractor with Agency approval will employ an Arizona registered professional engineer to set the construction stakes for establishing lines, grades, elevation control and supply the Engineer with a copy of all cut or fill sheets. All new right-of-way monuments and lines shall be established by a registered land surveyor. A submittal is to be provided to the Engineer by the Contractor that shows detail and method of staking in accordance with Specification 402.3.

SECTION 105

The Contractor shall perform the work in accordance with stakes and markers, and shall be charged with full responsibility for conformity and agreement of the work with the plans and specifications.

The Engineer may check the Contractor's construction stakes to verify conformance to plans and specifications.

105.10 DUTIES OF INSPECTOR: Inspectors employed by the Contracting Agency shall be authorized to check all construction stakes and to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of the contract. The inspector will not be authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

The inspector will, however, have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

105.11 INSPECTION OF WORK: Inspection of the work by the Engineer or his authorized representative shall not be considered as direct control of the individual worker and his work. The direct control shall be solely the responsibility of the Contractor's foreman and superintendent.

The Engineer shall be permitted to inspect all materials, and each part or detail of the work at any time for the purpose of expediting and facilitating the progress of the work. He shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection, including removal or uncovering portions of the finished work as the Engineer may direct.

Any work done or materials used without supervision and inspection by an authorized Contracting Agency representative may be ordered removed and replaced at no additional cost to the Contracting Agency. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered nor obligate the Engineer to final acceptance.

When any unit of government or political subdivision has a legal interest in the work covered by the contract, its respective representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision a party to the contract, and shall in no way interfere with the rights of either party to the contract.

105.12 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK: Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been provided. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or as given, or any extra work done without authority, will be considered as unauthorized and will not be paid for under provisions of the contract. Work so done may be ordered removed or replaced at no additional cost to the Contracting Agency.

105.13 MAINTENANCE DURING CONSTRUCTION: The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end so that roadways and construction is kept in satisfactory conditions at all times.

All cost of maintenance work during construction and before the project is accepted shall be included in the unit bid price on the various pay items.

SECTION 105

105.14 FAILURE TO MAINTAIN ROADWAY OR CONSTRUCTION: If the Contractor, at any time, fails to perform maintenance during construction, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project. The entire cost of this maintenance will be deducted from monies due or to become due the Contractor on his contract.

105.15 PARTIAL USE OR OCCUPANCY: Should an urgent or unforeseen need occur, the Contractor agrees to let the Contracting Agency use or occupy a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, prior to final acceptance.

Prior to such use or occupancy the Contracting Agency and the Contractor will accomplish a partial acceptance inspection, with agreement on a revised construction schedule, responsibilities for maintenance of the partial acceptance and continued construction of the original project to final acceptance, payments, and other requirements.

105.16 ACCEPTANCE :
(A) PARTIAL ACCEPTANCE: If at any time during the prosecution of the project the Contractor substantially completes a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, he may request the Engineer to make final inspection of that work. If the Engineer finds, upon inspection, that the work has been satisfactorily completed in compliance with the contract he may accept the work as being completed and the Contractor may be relieved of further responsibility for that work. Such partial acceptance shall in no way void or alter any terms of the contract.

(B) FINAL ACCEPTANCE: Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction that inspection shall constitute the final inspection and the Engineer will make the final acceptance. The Contractor will be notified in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of the final inspection.

SECTION 106

CONTROL OF MATERIALS

106.1 SOURCE OF MATERIALS AND QUALITY: All construction materials to be used on the work or incorporated into the work, equipment, plant, tools, appliances, or methods to be used on the work shall be subject to the inspection and approval or rejection of the Engineer.

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

Unless otherwise noted, all materials used in the project shall be new and unused. Additionally, any new materials used in this project that are damaged during the construction of the project and prior to final acceptance, as determined by the Engineer, shall be replaced by the Contractor with new material at no additional cost to the Contracting Agency.

106.2 TESTS AND ACCEPTANCE OF MATERIALS: Some material will be sampled and tested as specified in the specifications and defined as normal tests and all materials to be incorporated in the work are subject to sampling, testing and approval, and samples furnished shall be representative of the materials to be used. The Engineer may select samples, or may require that samples be delivered by the Contractor to a laboratory designated by the Engineer.

The Contracting Agency will pay for the initial or normal test required by the Engineer to guard against unsuitable materials or defective workmanship. Additional tests, required due to failure of the initial or normal test(s), shall be paid for by the Contractor. The Engineer will approve the laboratory which will accomplish the additional testing.

The procedures and methods used to sample and test materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with either; the Materials Testing Manual of the Contracting Agency; or standard methods of ASTM, which were in effect and published at the time of advertising for bids.

The laboratory responsible for the test shall furnish at least two copies of the test results to the Contracting Agency or his designated representative, one copy to the Contractor, and to the appropriate material supplier.

106.3 CERTIFICATIONS :

(A) **General**: Prior to the use of any material the Contractor shall submit to the Engineer a Certificate of Compliance or Certificate of Analysis on all construction material products to be used on the project in accordance with Section 105 of these special conditions.

The Engineer may permit the use of certain materials or manufactured assemblies prior to sampling and testing if accompanied by a Certificate of Compliance, as herein specified.

(B) **Certificate of Compliance:** The Certificate of Compliance shall contain the following information:

(1) Project number to which the material is consigned.

(2) Name of Contractor to whom the material is supplied.

(3) Kind of material supplied.

(4) Quantity of material represented, such as lot, batch, etc.

(5) Means of material identification, such as label lot number, marking.

(6) Statement that the material complies in all respects with the specific requirements of the cited specifications.

(7) The original signature of a person having legal authority to bind the manufacturer or supplier of the material. A reproduction is not acceptable. The signature shall be notarized.

The person signing the certificate shall be in one of the following categories:

(a) An officer of a corporation.
(b) A partner in a business partnership or an owner.
(c) A general manager.
(d) Any person having been given the authority by one of the above.

This must accompany the certificate of compliance in writing.

Each of the first six items specified above, shall be provided by the firm or organization that is certifying the material prior to the signing as defined in item seven, and all of the first six shall be in one type style or handwriting. No certificate will be accepted that has been altered, added to, or changed in any way after the authorized original signature of the person that has legal authority to bind the firm or organization has been affixed to be original certificate. Materials or assemblies will not be incorporated into the project without a valid certificate of compliance or proper testing.

Materials or assemblies used on the basis of a Certificate of Compliance may be sampled and tested at any time and if found not in conformity with the requirements of the plans and the specifications will be subject to rejection whether in place or not.

The Contracting Agency reserves the right to refuse to permit the use of material on the basis of a Certificate of Compliance.

106.4 ITEMS OF SPECIAL MANUFACTURER: At the preconstruction conference, the Contractor shall furnish the Engineer a list of all items of special manufacture or items which are or may be in short supply which will be incorporated into the work. Items of special manufacture shall include, but shall not be limited to, materials and equipment for traffic signal and lighting systems, steel bridge members, precast, prestressed concrete bridge members, structural components, compressors, pumps, sewage treatment plants, water treatment plants, electrical control centers, and materials related thereto.

The items of special manufacture which have been agreed upon by the Engineer and the Contractor shall be ordered by the Contractor promptly so that they will be available as required and will not delay the work.

The Contractor shall advise the Engineer about the dates of the orders and the dates that the items are expected to be received.

If there is any delay in the prosecution of the work because of any delay in the delivery of items of special manufacture, an extension of the contract time will only be granted in accordance with the provisions of section 108 if the Engineer is completely satisfied that the Contractor has made every effort to obtain the items in a timely manner.

106.5 PLANT INSPECTION: The Engineer may undertake the inspection of materials at the source. In this event, the following conditions shall be met:

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

(B) The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

It is understood that the Contracting Agency reserves the right to retest all materials, prior to their use in the work, upon delivery.

106.6 TRADE NAMES AND SUBSTITUTIONS: Plans and specifications may contain references to equipment, materials or patented processes by manufacturer, trade name, make or catalog number. Such references shall be regarded as establishing a standard of quality, finish, appearance, performance or as indicating a selection based upon compatibility with existing equipment or materials. It shall not be construed as limiting the selection to a specified item or source.

The use of an alternate or substitute, item or source will be permitted, subject to the following:

(A) No consideration will be given a request for substitution prior to award of the contract.

(B) After the award, and to permit consideration and approval without delaying the work, the Contractor shall submit a written request for substitution. The request shall include all information necessary for proof of quality and suitability for substitution. The Contractor shall submit samples when required.

(C) The Engineer will evaluate the information submitted, perform tests when necessary and make comparisons. The Engineer will then make the final decision as to the acceptability of the proposed substitution.

106.7 STORAGE OF MATERIALS: The Contractor shall provide storage facilities and exercise such measures as will insure the preservation of the quality and fitness of all materials and/or equipment to be used in the work. Stored materials and/or equipment, even though approved before storage, may again be inspected prior to their use in the work. Stored items shall be located so as to facilitate their prompt inspection. That portion of the property easements not required for the project may be used for storage purposes, when approved by the Engineer. Any additional storage area required must be provided by the Contractor. Private property shall not be used for storage purposes without written permission of the owner or lessee. If requested, by the Engineer, copies of such written permission shall be made available.

106.8 HANDLING MATERIALS: All materials and/or equipment shall be handled in such a manner as to preserve their quality and fitness for the work.

106.9 UNACCEPTABLE MATERIALS: All materials and/or equipment not conforming to the requirements of the specifications, whether in place or not, may be rejected. Rejected materials and/or equipment shall be removed immediately from the site of work unless otherwise permitted by the Engineer. No rejected material and/or equipment, the defects of which have been subsequently corrected, shall be used until approved in writing by the Engineer.

106.10 FURNISHED MATERIALS: Materials and/or equipment, furnished by the Contracting Agency, will be delivered or made available to the Contractor as indicated in the special provisions. The cost of handling and placing shall be considered as included in the contract price for the pay item with which they are used.

The Contractor will be held responsible for all materials and/or equipment accepted by him and will make good any shortages, deficiencies and damages which may occur after such acceptance.

106.11 WARRANTIES AND GUARANTIES: The Contractor shall obtain such manufacturer's or producer's warranties or guaranties on all items, materials, electrical or mechanical equipment consistent with those provided as customary trade practice. The form in which such warranties or provision that they are subject to transfer to the Contract Agency and shall be accompanied by proper validation of such fact. Transfer of warranties or guaranties shall occur at the time of final acceptance of the work.

In addition, a Contractor's warranty or guaranty shall be furnished providing for satisfactory in-service operation of the mechanical and electrical equipment and related components for a period of one year following project acceptance.

Should any defect develop during this one year period, the malfunction or defect shall be corrected by and at the expense of the Contractor, including all labor, material and associated costs.

GENERAL CONDITIONS

LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

107.1 LAWS TO BE OBSERVED: The Contractor shall keep fully informed of all Federal and State laws, County and City ordinances, regulations, codes and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, ordinances, regulations, codes, orders and decrees; and shall protect and indemnify the Contracting Agency and its representatives against any claim or liability arising from or based on the violation of such, whether by himself or his employees.

The attention of the Contractor is directed to the provisions of the following sections of the Arizona Revised Statues:

(A) 23-373. Contracts negotiated between public contractors and public employers shall contain the following contractual provisions:

In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, religion, color or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to provide by the contracting officer setting forth the provision of the nondiscrimination clause.

The Contractor further agrees to insert the foregoing provision in all subcontracts, except subcontracts for standard commercial supplies or raw materials.

(B) When Federal-aid funds are used on a project, the prevailing basic hourly wage rates and fringe benefit payments, as determined by the Secretary of Labor pursuant to the provisions of the Davis-Bacon Act, shall be the minimum wages paid to the described classes of laborers and mechanics employed to perform the contract.

(C) ARS 40-360.22 Excavations: determining location of underground facilities; providing information. This statute requires that no person shall begin excavating before the location and marking are complete or the excavator is notified that marking is unnecessary and requires that upon notification, the owner of the facility shall respond as promptly as practical, but in no event later than two working days. The "Blue Stake Center" (263-1100) was formed to provide a more efficient method of compliance with this statue.

(D) ARS-40-360.23 Making excavations in careful, prudent manner; liability for negligence. This statue states that obtaining information as required does not excuse any person making any excavation from doing so in a careful and prudent manner nor shall it excuse such persons from liability for any damage or injury resulting from his negligence.

(E) ARS-40-360.28 Civil penalty; liability. If the owner or operator fails to locate, or incorrectly locates the underground facility, pursuant to this article, the owner or operator becomes liable for resulting damages, costs and expenses to the injured party.

(F) ARS 32-2313, Business license; business name; branch office registration; renewal. No person partnership, corporation or association shall engage in the business of general pest or weed control without being duly licensed/certified by the Structural Pest Control Board.

This section is applicable to an excavation made during an emergency which involves danger to life, health or property if reasonable precautions are taken to protect underground facilities.

107.2 PERMITS: Permits, bonding and insurance requirements shall be as required by the Contracting Agency's statutes, codes, ordinances of regulations.

The Public Agency, when acting as the Contracting Agency, will attempt to obtain the required permits, but it is the duty of the Contractor to determine that all necessary permits have been obtained. The Contractor shall, at his own expense, obtain all the required permits which have not been furnished.

SECTION 107

In all cases, the Contractor or the person supervising the authorized work shall notify the appropriate permit agency so as to insure proper inspection by the agency concerned.

107.3 PATENTED DEVICES, MATERIALS AND PROCESSES: If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the surety shall indemnify and save harmless the Contracting Agency, any affected third party or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Contracting Agency for any costs, expenses, and damages which it may be obligated to pay by reason of any infringement, at any time during the prosecution or after the completion of the work.

107.4 ARCHAEOLOGICAL REPORTS: Attention is directed to Sections 41-844 and 41-846 of the Arizona Revised Statutes. In view of the above, it shall be a provision of every contract that when archaeological features are encountered or unearthed in an excavation, the Contractor shall report promptly to the Director of the Arizona State Museum and the Contracting Agency. The Contractor will be allowed extra time as appropriate in accordance with the provisions of Section 108.

107.5 SAFETY, HEALTH AND SANITATION PROVISIONS: The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health or as specified by the Yuma County Health Department Sanitary Code.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Engineer may determine, reasonably necessary to protect the life and health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated thereunder.

107.5.1 Asbestos Materials: If asbestos materials are encountered during any remodeling work, the Contractor will take the appropriate safety and health precautions and promptly notify the Engineer/Architect. An extension of Contract time will be granted in accordance with Section 108.

107.5.2 Paint Containing Lead: Paint and similar surface coating materials that contain lead compounds and in which the lead content exceeds 0.06 percent of the total weight of the non-volatile content of the paint or the weight of the dried paint film is declared a banned hazardous product and will not be used. (Consumer Product Safety Act Part 1303 dated 9-1-77).

107.6 PUBLIC CONVENIENCE AND SAFETY: The contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic and adjacent residents. The safety, convenience, and the protection of persons and property, of the general public and residents along the street, highway, and areas adjacent to the work area shall be provided for by the Contractor.

107.7 BARRICADES AND WARNING SIGNS: The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Roads, partially or fully closed to traffic, shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the Manual of Uniform Traffic Control Devices.

SECTION 107

107.8 USE OF EXPLOSIVES : The use of explosives or blasting agents is controlled by the Uniform Fire Code, which is generally administered by the Fire Department. The Contractor shall obtain a special permit from the Fire Department for the use of explosives. A copy of this permit shall be delivered to the Engineer prior to the use of explosives. If the Agency does not use the Uniform Fire Code or have a department for enforcement of this Code, the Contractor shall use explosives only when authorized in writing by the Engineer.

Explosives shall be transported, stored, handled and used in accordance with the provisions and requirements of all applicable laws, ordinances and regulations. Work shall be done in accordance with recommendations of the AGC Manual of Accident Prevention in Construction and the Institute of Makers of Explosives.

The approval by the Engineer for the use of explosives shall not relieve the Contractor from his responsibilities. When explosives are used the Contractor shall:

(A) Exercise the utmost care not to endanger life or damage property.

(B) Be responsible for any and all damages resulting from their use.

(C) Furnish and erect special signs to warn the public of his blasting operations. They shall be located and maintained so as to be clearly evident to the public during all critical periods of blasting operations.

(D) Notify each public utility company, having structures adjacent to the work, of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to advise the Contractor of any precautions that should be taken to protect their structures from damage.

(E) Make a survey of adjacent properties, before commencing blasting operations, locating on drawings and by photographs all existing cracks and damages to structures. A copy shall be filed with the Engineer, including a report of any property owners who refused to cooperate and permit entry and inspection.

(F) Blasting mats shall be used at all times and shall be in good repair. Steel mats shall not be allowed within 2,000 feet of power lines.

(G) Blasting shall be accomplished in such a manner that nearby houses and buildings will be safe from rocks and other projectiles and the Contractor shall be held responsible for any damage to life and property. The Contractor at the time of firing shall station men along the road at a sufficient distance from the blasting operations to flag down vehicles.

The Contracting Agency reserves the right to order the discontinuance of blasting operations at any time.

107.9 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE: The Contractor shall be responsible for the preservation of all public and private property and shall carefully protect from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the non-execution thereof by the Contractor, he shall restore, at no cost to the Contracting Agency, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner.

SECTION 107

The Contractor shall not dump spoil or waste material on private property without first obtaining from the owner written permission for such dumping.

Access to private property shall be maintained to keep inconvenience to the property owner to a minimum. Prior to any construction in front of driveways the Contractor shall notify the property owner 24 hours in advance. Inconvenience caused by construction across driveways and sidewalks shall be kept to a minimum by restoring the serviceability as soon as possible. If it is necessary to leave open excavation for a long period of time the Contractor shall provide structurally adequate steel plates to bridge the excavation.

107.10 CONTRACTOR'S RESPONSIBILITY FOR WORK: The Contractor shall properly guard, protect, and take every precaution necessary against injury or damage to all finished or partially finished work, by the action of the elements or from any other cause until the entire project is completed and accepted by the Engineer. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work before final acceptance at no cost to the Contracting Agency. Partial payment for completed portions of the work shall not release the Contractor from such responsibility.

In case of suspension of the work for any cause whatever, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project and shall erect any necessary temporary structures, signs, or other facilities at no cost to the Contracting Agency.

107.11 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES: It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities. Omission from, or the inclusion of, utility locations of the plans is not to be considered as the non-existence of, or a definite location of, existing underground utilities.

At points where the Contractor's operations are adjacent to properties of utility firms or other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until all arrangements necessary for the protection thereof have been made.

It shall be the Contractor's responsibility to provide three days notice to all appropriate governmental agencies and utility companies prior to starting work affecting their area of concern.

The Contractor shall cooperate with the owners of any underground or overhead utilities in their removal and re-arrangement operations in order that these operations may progress in a reasonable manner, that duplication of work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

If any utility service is interrupted as a result of accidental breakage, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

The Contractor shall expose all underground utilities and structures which might interfere with the construction of the project, in order to permit survey location prior to construction.

The Contractor shall assume full responsibility for damages to any underground facility/utility as a result of failing to obtain information as to its location, failing to excavate in a careful, prudent manner or failing to take measures for protection of the facilities/utilities due to his operation. The Contractor is liable to the owner of the underground facility/utility for the total cost of the repair.

107.12 PREVENTION OF AIR AND NOISE POLLUTION: The Contractor shall control, reduce, remove or prevent air pollution in all its forms, including air contaminants, in the performance of the Contractor's work.

SECTION 107

The Contractor shall comply with the applicable requirements of Title 36-Public Health Safety, Chapter 6, Article 8, Air Pollution, and Chapter 14, Article 1, Air Pollution of the Arizona Revised Statutes and with the Arizona Administrative Rules and Regulations for Air Pollution Control, Chapters 3 and 4, adopted by the Arizona Department of Health Services pursuant to the authority granted by the Statutes.

The Contractor shall comply with all local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the contract.

Each internal combustion engine used for any purpose on the work or related to the work shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the work without its muffler in good working condition.

107.13 FURNISHING RIGHT-OF-WAY: The Contracting Agency will provide right-of-way and property for all work in advance of construction. Any exceptions will be indicated in the special provisions.

107.14 PERSONAL LIABILITY OF PUBLIC OFFICIALS: In carrying out any provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Contracting Agency, Engineer, or their authorized representatives, either personally or as officials of the Contracting Agency, it being understood that in all such matters they act solely as agents and representatives of the Contracting Agency.

107.15 NO WAIVER OF LEGAL RIGHTS: Upon completion of the work, the Contract-ing Agency will expeditiously make final inspection and notify the Contractor of acceptance. Such final acceptance, however, shall not preclude or stop the Contracting Agency from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Contracting Agency be precluded or stopped from recovering from the Contractor or his surety, or both, such overpayment as it may sustain, or by failure on the part of the Contractor to fulfill his obligations under the contract. A waiver on the part of the Contracting Agency of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract and in addition to any specific remedy provided the Contracting Agency in the contract documents, shall be liable to the Contracting Agency for latent defects, fraud or such gross mistakes as may amount to fraud, or as regards the Contracting Agency's rights under any warranty or guarantee or remedy required by law.

SECTION 108

COMMENCEMENT, PROSECUTION AND PROGRESS

108.1 PRE-CONSTRUCTION CONFERENCE: After award of a contract and prior to the issuance of the Notice to Proceed, a pre-construction conference will be held. The time and place will be established by the Engineer. A representative of the Contractor will be required to provide the following information:

(A) Names and emergency telephone numbers of key personnel involved in the project.

(B) Have present at the meeting the person who will be doing construction staking with written outline detailing the method of staking, marking stakes, grade control and other operations.

(C) Verification of all subcontractors and major suppliers proposed for use on the project.

(D) A construction progress schedule showing the estimated time for start and completion of the major items of work.

(E) A traffic control plan if required.

(F) A de-watering plan if required.

(G) Shop drawing and product data submittal list.

(H) List of items of special manufacture and short supply.

108.2 NOTICE TO PROCEED: After the pre-construction conference, and permits are received, a notice to proceed will be issued by the Contracting Agency.

Neither the Contractor nor any Subcontractor shall commence work on a project prior to receipt of the written Notice to Proceed from the Contracting Agency. The Contractor shall commence work as soon as practicable after the starting date specified in the Notice to Proceed. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus extensions, beginning with the day following the starting date specified in the Notice to Proceed.

The Contractor shall notify the Engineer 24 hours in advance of the time and place where work will begin.

108.3 SUBLETTING OF CONTRACT: The Contractor shall not sublet, sell, transfer, assign or otherwise dispose of the contract or contracts, or of his right, title, or interest therein, without written consent of the Contracting Agency.

Subcontracts shall be in accordance with and the Contractor shall be bound by the following provisions:

(A) All subcontracts shall be subject to the approval of the Engineer.

(B) All subcontracts shall be in writing and shall provide that all work to be performed thereunder shall be performed in accordance with the terms of the contract.

(C) Subcontractors shall conform to the regulations governing employment of labor.

(D) The subcontracting of any portion of the work will in no way release the Contractor of his liability under the contract and bonds.

(E) On all contracts for roadway construction or roadway maintenance, the Contractor shall perform, with his own organization, work amounting to not less than fifty (50) percent of the total contract cost.

108.4 CORRESPONDENCE TO THE CONTRACTOR: A written notice, to the Contractor from the Contracting Agency, shall be considered delivered and the service thereof completed, when said notice is posted, by certified mail to the said Contractor at his last given address, or delivered in person to the Contractor or his authorized representative on the work.

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108.5 CONTRACTOR'S CONSTRUCTION SCHEDULE: The Contractor, at the pre-construction conference shall furnish the Engineer a construction schedule for his approval. In the event the schedule does not meet the necessary program schedule, as determined by the Contracting Agency, he may be required to resubmit a schedule that shall conform to an approved program of construction operation. The right to direct the sequence of the work is a function vested solely in the Engineer and the construction schedule, when approved, shall not be changed, without the written consent of the Engineer. The orderly procedure of all work to be performed shall be the full responsibility of the Contractor.

108.6 LIMITATIONS OF OPERATIONS: The Contractor shall conduct the work at all times in such a manner and sequence that will assure the least interference with traffic and inconvenience to the public. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

All traffic affected by the construction will be regulated in accordance with the current Manual of Uniform Traffic Control Devices.

Except in emergencies endangering life or property, written permission shall be obtained from the Engineer to perform any work after regular working hours, on weekends, or legal holidays. Prior to the start of such work, the Contractor shall arrange with the Engineer for the continuous or periodical inspection of the work, surveys and tests of materials, when necessary.

If, in the opinion of the Engineer, the Contractor has fallen behind the approved progress schedule, the Contractor shall take such steps as may be required by the Engineer, including but not limited to, increasing the number of personnel, shifts, and/or overtime operations, days of work, and/or amount of construction equipment until such time as the work is back on schedule. He shall also submit for approval no later than the time of submittal of the next request for partial payment, such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the approved rate of progress will be regained, all at no additional cost to the Contracting Agency.

108.7 CHARACTER OF WORKERS; METHODS AND EQUIPMENT: The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the specifications.

All workers shall be competent and have sufficient skill, knowledge and experience in their class of work and in the operation of equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed from the work by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer. The Contractor or Subcontractor shall keep the Contracting Agency harmless from damages or claims for compensation that may occur in the enforcement of this section.

Should the Contractor or Subcontractor fail to remove such person as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet the requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that it will not damage property adjacent to the work area.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed, the Contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the Engineer will accomplish the work in conformity with the requirements of the specifications.

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When the specifications state the construction shall be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing construction work in conformity with the specifications. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet the specifications, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as a result of authorizing a change in methods or equipment under these provisions.

108.8 TEMPORARY SUSPENSION OF WORK: The Engineer shall have authority to suspend the work wholly or in part by written order for such period or periods as he may deem necessary due to the failure on the part of the Contractor to carry out orders given or to perform any or all provisions of the Contract.

When under suspension, the work shall be put in proper and satisfactory condition, carefully covered and properly protected as directed. In all cases of suspension of construction operations the work shall not again be resumed until authorized by written order of the Engineer.

108.9 DETERMINATION AND EXTENSION OF CONTRACT TIME: The number of calendar days allowed for the completion of the work included in the contract will be as stated in the proposal and will be known as the contract time.

When the contract time is on a calendar day basis it shall consist of the number of calendar days specified, including all weekends and legal holidays. All calendar days elapsing between the effective dates of any written notice from the Engineer to suspend work and to resume work following suspensions, not the fault of the Contractor, shall be excluded.

When the contract completion time is a fixed calendar date, it shall be the date on which all work on the project shall be completed and meet final inspection.

If the Contractor finds it impossible for reasons beyond his control to complete the work within the contract time as specified or as extended, he shall immediately submit a written request to the Engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer finds that the work was delayed because of conditions beyond the control and through no fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

108.10 GUARANTEE AND WARRANTY PROVISIONS: The Contractor shall guarantee the work against defective workmanship or materials for a period of 1 year from the date of its final acceptance under the contract, ordinary wear and tear and unusual abuse or neglect excepted.

Any omission on the part of the Engineer to condemn defective work or materials at the time of construction shall not be deemed an acceptance, and the Contractor will be required to correct defective work or materials at any time before final acceptance and within 1 year thereafter.

Should any defects develop within 1 year from the date of final acceptance due to faults in workmanship or materials the Contractor shall, within 14 calendar days of receipt of written notice from the Contracting Agency, begin making the necessary repairs to the satisfaction of the Engineer. Such work shall include the repair or replacement of other work or materials damaged or affected by making the above repairs or corrective work, all at no additional cost to the Contracting Agency.

If defects develop which are determined by the Engineer to be an emergency, the Engineer shall notify the Contractor, via the most expedious means, regarding the nature and condition of the defects. In turn, the Contractor shall immediately dispatch necessary forces to correct the defect or the emergency condition. If the Contractor, in his initial action, resolves the emergency condition but not the defect, a letter as discussed above will follow and normal procedures for corrections will be employed. If immediate or appropriate action, satisfactory to the Engineer, is not taken by the Contractor, or if the Contractor cannot be contacted, the Engineer will deploy necessary forces to correct and/or secure the deficiency. Costs of the Engineer's action shall be paid by the Contractor and/or his bonding agency. Should it later be determined that the defects requiring such emergency action are not the responsibility of the Contractor, the Contractor will be paid for all costs incurred as a result of these demands in accordance with Subsection 109.5. Such action by the Engineer will not relieve the Contractor of the guarantees required by this section or elsewhere in the Contract Documents.

In case of work, materials, or equipment for which written warranties are required by the special provisions, the Contractor shall provide or secure from the appropriate Subcontractor or supplier such warranties shall not relieve the Contractor from any obligation assumed under any other provisions of the contract.
The warranties and guarantees provided in this subsection of the contract documents shall be in addition to and not in limitation of any other warranties, guarantees or remedies required by law.

108.11 FAILURE TO COMPLETE ON TIME: For each and every day that work shall remain incomplete after the time specified for completion of the work in the proposal, or as adjusted by the Engineer, the sum per calendar day shown in the following table, unless otherwise specified in the proposal form, may be deducted from monies due to or to become due to the Contractor, not as a forfeit or penalty but as liquidated damages. This sum is fixed and agreed upon between the parties because the actual loss to the Contracting Agency and to the public caused by delay in completion will be impractical and extremely difficult to ascertain and determine.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time fixed for its completion may have been extended, will in no way operate as a waiver on the part of the Contracting Agency of any of its rights under the contract.

SCHEDULE OF LIQUIDATED DAMAGES

Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Date
$ 0	$ 25,000	$ 210.00
25,000	50,000	250.00
50,000	100,000	280.00
100,000	500,000	430.00
500,000	1,000,000	570.00
1,000,000	2,000,000	710.00
2,000,000	5,000,000	1,070.00

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108.12 FORFEITURE AND DEFAULT OF CONTRACT: It is further agreed to by the Contractor that if he:

(A) Fails to begin the work under the contract within a reasonable time, or

(B) Fails to perform the work with sufficient workers and equipment or with sufficient materials to assure the prompt completion of said work, or

(C) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

(D) Discontinues the prosecution of work, or

(E) Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

(F) At any time colluded with any party or parties, or

(G) Allows any final judgment to stand against him unsatisfied for a period of 14 calendar days, or

(H) For any cause whatsoever, fails to carry on the work in an acceptable manner, the Engineer will give notice in writing to the Contractor and his surety of such delay, neglect, or default, and advise them that the work must be resumed immediately.

If the Contractor or surety, within a period of 14 calendar days after such notice, has proceeded in accordance therewith, then the Contracting Agency will, upon written notification from the Engineer of the fact of such delay, neglect or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract to take the prosecution of the work out of the hands of the Contractor. The Contracting Agency may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All cost and charges incurred by the Contracting Agency, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due said Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Contracting Agency the amount of such excess.

108.13 TERMINATION OF CONTRACT: The Contracting Agency may terminate the contract or a portion thereof if conditions encountered during the progress of the work make it impossible or impracticable to proceed with the work; or if a local or national emergency exists.

When contracts, or any portion thereof, are terminated before completion of all work in the contract, adjustments in the amount bid for the pay items will be made on the actual quantity of work performed and accepted, or as mutually agreed for pay items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the contract or any portion thereof shall not relieve the Contractor of his responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the work performed.

SECTION 109

MEASUREMENTS AND PAYMENTS

109.1 MEASUREMENT OF QUANTITIES: All work completed under the contract will be measured by the Engineer according to United States standard measures. The methods of measurement and computation to be used in determination of quantities of materials furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

A station, when used as a definition or term of measurement, will be 100 linear feet.

Unless otherwise specified, longitudinal measurements will be made along the grade line.

Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

The term ton will mean the short ton consisting of 2,000 pounds avoirdupois.

Unless otherwise specified, structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

In computing volumes of excavation or fill, the average end area method or other acceptable methods as determined by the Engineer will be used.

Volumes will be computed at 60°F. using ASTM D-1250 for Asphalt or ASTM D-633 for Tars.

Lumber will be measured by the thousand board foot measure actually used in the work. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term lump sum, when used as a pay item, will mean complete payment for the work described.

Sundry items which have a basis for measurement and payment herein and which are incidental to or required in the construction of the work but are not included as items in the bid schedule shall be considered an integral part of the contract, and all labor, materials, etc. required for such items shall be furnished by the Contractor and the cost of same included in the unit price bid.

109.2 SCOPE OF PAYMENT: Measurement and payment for pay items in the proposal will be as indicated in the applicable standard specification or in the special provisions.

When payment is specified to be made on the basis of weight, the weighing shall be done on certified platform scales sealed by the State Inspector as defined by ARS Sections 44-2112 and 44-2116. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates showing the actual net weights together with the information required by ARS Section 44-2142. The Contracting Agency will accept the certificates as evidence of the weight delivered.

Payment for the various items in the proposal will be made at the unit price bid in the proposal, and shall be compensation in full for furnishing all labor, materials, equipment and appurtenances necessary to complete the work in a satisfactory manner as shown on the plans and as required in the specifications, with all connections, testing, and related work completed. Each item, fixture, piece of equipment, etc., shall be complete with all necessary connections and appurte-nances, for the satisfactory use and operation of said item. No additional payment will be made for work related to any item unless specifically called for in the proposal. This compensation shall also cover all risk, loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject the provisions of Section 107.

109.3 ASSIGNMENT OF PAYMENTS: The Contractor shall not assign payments of a contract or any portion thereof without approval of surety and written consent of the Contracting Agency.

Claims for monies due or to become due the Contractor may be assigned to a bank, trust company, or other financing institution, and may thereafter be further assigned and reassigned to any such institution. Any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing. Any assignment of money shall be subject to all proper set offs and withholdings in favor of the Contracting Agency and to all deductions provided for in these specifications.

109.4 COMPENSATION FOR ALTERATION OF WORK :

109.4.1 By the Contracting Agency :

(A) For a decrease greater than 20 percent in either the total cost of the contract or the total cost of a major item and when a reasonable cost analysis supports an increase in the prorated share of fixed cost chargeable to this item in total, an increase adjustment in the monies due the Contractor may be made. This adjusted compensation will not exceed 80 percent of the original extended unit bid price. This does not apply to items labeled as contingent bid item in the bid proposal.

(B) For an increase greater than 20 percent, any adjustment made will only apply to that cost in excess of 120 percent of the original bidding schedule. If either party presents a reasonable cost analysis that shows a change in the pro rata share of fixed costs chargeable to this item in total, an increase or decrease adjustment will be made. This increase or decrease adjustment will be made on such basis as is necessary to cover a reasonable estimate of cost, plus an allowance, not to exceed 15 percent, for overhead and profit. If the parties are unable to reach an agreement, the Engineer has the authority to order the excess work done on an actual cost basis as specified in Section 109, Subsection "ACTUAL COST WORK".

(C) For either an increase or decrease in cost, no claim shall be made by the Contractor for any loss of anticipated profits.

109.4.2 Due to Physical Conditions :

(A) If the Engineer, after his investigation of the site conditions, agrees that they materially differ from those indicated in the contract and would cause an increase in the Contractor's bid cost of accomplishing the work, new unit bid prices or a lump sum cost (for the additional work only) may be negotiated. If the parties are unable to reach an agreement on price, the Engineer has the authority to order this additional work accomplished on an actual cost basis as specified herein.

(B) If the Engineer, after his investigation of the site conditions, finds that these conditions do not materially differ from those indicated in the contract, he has the authority to order the work to be accomplished at the original bid price(s).

109.4.3 Due to Extra Work: If the contractor can present valid, factual evidence, satisfactory to the Engineer, that the work in question is an item not provided for in the contract as awarded then a unit bid price or lump sum cost, for this item only, may be negotiated. If the parties are unable to reach an agreement on price or cost, the Engineer has the authority to order the extra work accomplished on an actual cost basis as specified herein.

109.4.4 Made at the Contractor's Request: Any alterations, if approved, will be a reduction in cost or at no additional cost to the Contracting Agency.

109.4.5 Due to Failure of Contractor to Properly Maintain the Project :

(A) For any suspension of work during normal working hours due to failure of the Contractor to properly maintain the project, there will be no additional compensation or time allowed.

(B) If the Engineer provides the Contractor with a written order to provide adequate maintenance of traffic, adequate cleanup, adequate dust control or to correct deficiencies resulting from abnormal weather conditions and the Contractor fails to comply in the time frame specified, the Contracting Agency may have the work accomplished by other sources.

The Contracting Agency will deduct the cost of accomplishing the work from monies due or to become due to the Contractor. Computation of the cost will be in accordance with Subsection 109.5.4.2.

109.4.6 Allowable Mark-Ups: Only the allowable mark-ups as defined in Subsection 109.5 shall be allowed. Additional compensation for other items shall not be considered or allowed.

109.5 ACTUAL COST WORK: The compensation for actual cost work performed by the Contractor (Subcontractor) shall be determined by the Engineer in the following manner.

109.5.1 Equipment: For all equipment, the use of which has been authorized by the Engineer, except for small tools and manual equipment, the Contractor will be paid in accordance with the Rental Rates Bluebook published by the Nielson/Dataquest Inc. Unless prior written agreement has been made, the Contracting Agency will pay move in/move out costs and standby equipment rates.

109.5.2 Material: For all material, accepted by the Engineer and used in the work, the Contractor will be paid the actual cost of such material including transportation cost, to which total cost will be added a sum equal to 15 percent thereof.

109.5.3 Labor: For all labor and for the foreman, when he is in direct charge of the project, the Contractor will be paid.

(A) The actual wages paid plus the current percentage thereof as determined by the District which is deemed to cover the Contractor's cost incurred as a result of payment imposed by State or Federal Law and payments that are made to, or on behalf of, the worker other than the actual wage. Actual wage is defined as the required current hourly wage paid to the labor classification concerned and does not include any fringe benefits or dislocation allowances. If the Contractor is not required to pay fringe benefits an equitable deduction will be made.

(B) For the first $50,000 of labor cost computed under paragraph (1) above, the Contractor will be paid an amount equal to (15%) fifteen percent for overhead and profit.

(C) For all labor cost computed under paragraph (A) above, in excess of $50,000 but not exceeding $100,000, the Contractor will be paid an amount equal to (12%) twelve percent for overhead and profit.

(D) For any labor cost computed under paragraph (A) above, in excess of $100,000, the Contractor will be paid an amount equal to (10%) ten percent for overhead and profit.

109.5.4 Work Performed By Subcontractors or Other Sources:

109.5.4.1 Work Performed by Subcontractors: If it is determined by the Engineer that portions of the Actual Cost Work to be performed requires specialized labor or equipment not normally used by the Contractor and such work is then authorized to be performed by a subcontractor(s), the subcontractor(s) will be paid by the Contractor in accordance with the actual cost work procedures outlined herein. The Contractor will be paid by the Contracting Agency the full amount of the subcontract(s) plus the following percentages for administration and supervision.

(A) For the first $10,000.00 accumulated total of work performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is $3,000 or less, the Contractor will paid $300 for administration and supervision.

(B) For all change order work in excess of $10,000 accumulated total performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to 5 percent of the accumulated total for administration and supervision.

109.5.4.2. Work Performed by Other Sources: If the Contracting Agency has work performed by other sources, in accordance with Subsection 109.4.5 (B), the Contracting Agency will deduct, from monies due or to become due to the Contractor, the full amount of the cost of accomplishing the work by other sources plus the following percentages for administration and supervision:

(A) For the first $10,000 accumulated total of work performed by other sources, the Contracting Agency will deduct an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is $3,000 or less, the Contracting Agency will deduct $300 for administration and supervision.

(B) For all work in excess of $10,000 accumulated total performed by other sources, the Contracting Agency will deduct an amount equal to 5 percent of the accumulated total for administration and supervision.

109.5.5 Documentation :

(A) Except in emergency situations, the Contracting Agency will not be liable for any Actual Cost Work performed by the Contractor prior to written authorization by the Engineer or prior to full execution of a written agreement by all parties concerned.

(B) Payment for work performed on an actual cost basis will not be made until the Contractor has furnished the Engineer, on forms agreed to by the Contracting Agency, duplicate itemized statements of such work, including subcontractor(s) costs, detailed as follows:

1. Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

2. Designation, dates, daily hours total hours, rental rates and extension for each unit of equipment, and machinery.

3. Quantities of material, prices, extension, and transportation cost on a daily basis. These charges shall be substantiated by vendor vouchers.

(C) The Engineer will compare his records with the statement furnished by the Contractor, resolving any differences and making the required adjustments. This statement when agreed upon and signed by both parties, shall be the basis of payment for the work performed.

109.5.6 Bonds and Insurance: The Contractor shall be paid for the actual cost plus (10%) ten percent for the administrative cost when the Contractor can provide evidence of payment for premiums on required payment and performance bonds, premiums on railroad and/or airport extended liability insurance, and premiums for property damage and/or public liability insurance. No duplication of payment for Contractor's costs included will be allowed.

109.5.7 Authority of Engineer : The Engineer is in charge of Actual Cost Work and has the authority to direct which labor and equipment will be used, to suspend operations, and to refuse to pay for any labor or equipment which he feels is not doing productive work.

109.6 PAYMENT FOR WORK ON PROJECTS :

109.6.1 Partial Payments: Partial Payments: The contracting Agency will make a partial payment tot he Contractor on the basis of an estimate prepared by the Contractor or Engineer for work completed through the last day of the preceding calendar month. Payment will be within 14 calendar days after the estimate has been certified and approved by the Engineer and received by the owner.

The Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the contract in accordance with ARS Section 34-221, unless the Contractor elects to deposit securities in accordance with ARS Section 34-221, Paragraph 5.

When the Contractor is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided he is making satisfactory progress on the contract and there is no specific cause or claim requiring a greater amount to be retained. After the contract is fifty percent completed, no more than five percent of the amount of any subsequent progress payments made under the contract will be retained providing the Contractor is making satisfactory progress on the project. Except that, if at any time the owner determines satisfactory progress i s not being made, ten percent retention shall be reinstated for all progress payments made under the contract subsequent to the determination.

Any material or equipment which will become an integral part of the completed project will be considered for partial payment in the Contractor's monthly progress payments. The intent of making partial payments is to provide the Contractor payment for direct material or equipment purchased. The purpose is to minimize the effect of escalating costs by procuring key materials. It is not the intent to apply for all materials but only those meeting the following conditions:

(1) A total value of all items requested for payment must be greater than $20,000. No payment will be processed until the material or equipment has been observed, reviewed or verified by the Contracting Agent representative. Only the material or equipment meting the requirements of the plans and specifications will be paid. Payment for material or equipment does not constitute final acceptance.

(2.) Materials or equipment must be stored or stockpiled either on site, in a warehouse, or secured storage area. The Contractor assumes all responsibility for protection of these materials or equipment and shall insure them to cover loss or damage to same without additional liability or added costs to the Agency for providing this security, insurance and storage.

(3) The Contractor will provide access to the storage area or warehouse upon request of the Contracting Agent's representative for the purpose of verifying the inventory of items paid for under this section. None of the materials or equipment paid for under this section will be removed from the storage site until incorporated into the work of the project. The storage site shall be within the general geographical area of the project.

(4) The Contractor shall provide a paid invoice and/or lien waiver for items paid for under this section. The Agency will not pay more than the invoice price for the item or items, less retention.

(5) The Engineer may exclude individual payment requests which in the Engineer's judgement do not warrant storage and prepayment under the intent of this section.

109.6.2 Final Payment: When the project has been accepted as provided in Section 105, and within 30 calendar days after final inspection of the work completed under the contract, the Engineer will render to the Contracting Agency and the Contractor, a final estimate which will show the amount of work performed and accepted under the contract. All prior estimates and partial payments will be subject to correction in the final estimate for payment.

Within sixty (60) calendar days after final acceptance, the Contracting Agency will pay the Contractor all amounts due him under the contract, except that before final payment will be made, the Contractor shall satisfy the Contracting Agency by affidavit that all bills for labor and materials incorporated in the work have been paid. The Contractor's Affidavit may be obtained from the Engineering Office of the Contracting Agency.

If payment will be longer that sixty (60) days after final completion and acceptance, the owner will provide the Contractor specific written findings for reasons justifying the delay in payment.

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The acceptance of the project and the making of the final payment shall not constitute a waiver by the Contracting Agency/Owner of any claims arising from faulty or defective work appearing after the completion or from failure of the Contractor to comply with the requirements of the contract documents.

*Not applicable to Improvement District Projects.

109.7 PAYMENT FOR DELAY:

The procedures contained in this Subsection shall not be construed to void any provision of the contract which require notice of delays, provides for negotiation of other procedures for settlement or provide for liquidated damages.

109.7.1 Failure to Locate or Incorrect Location of Utilities: ARS 34-221 states "that if the owner or operator fails to locate or incorrectly locates the underground facility, pursuant to this article, the owner or operator becomes liable for resulting damages, costs and expense to the injured party." The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

109.7.2 Contracting Agency Delays: ARS-221 states "A contract for the procurement of construction shall include a provision which provides for negotiations between the Agent and the Contractor for the recovery of damages related to expenses incurred by the Contractor for a delay for which the Agent is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract."

Compensation for such damages will be negotiated as follows:

(A) The Engineer shall be satisfied that the Contractor has made every reasonable effort to prosecute the work despite any delays encountered or revisions in the Contractor's scheduling of work.

(B) The Compensation paid to the Contractor shall be in accordance with Section 109.

109.7.3 Extension of Contract Time: For any such delays, the contract time will be adjusted in accordance with Subsection 108.7.

PART 200
EARTHWORK

SECTION	TITLE
201	Clearing and Grubbing.....
202	Removal of Structures and Obstructions.....
204	Earthwork.....
205	Roadway Excavation.....
210	Borrow.....
211	Fill and Embankment Construction.....
218	Subgrade Preparation.....
225	Watering.....
227	Dust Palliative.....

SECTION 201

CLEARING AND GRUBBING

201.1 DESCRIPTION:

Unless otherwise specified clearing and grubbing shall consist of removing trees, stumps, brush, roots, rubbish, debris, and other undesirable and objectionable material from the site and right-of-way and other areas as may be specified, and hauling and disposal of the material off the site. Clearing and grubbing shall be performed in advance of grading operations.

201.2 PRESERVATION OF PROPERTY:

Existing improvements, adjacent property, utilities and other facilities, and trees and plants not to be removed, shall be protected from injury or damage resulting from the Contractor's operations, see these Specification, Section 107. Barricades for existing facilities to remain shall be erected by the Contractor to any clearing operation and shall consist of 4 to 6 foot wire or wood fencing supported by posts on 10 to 12 foot intervals and located as directed by the Engineer. If existing improvements or utilities are damaged during construction they shall be repaired or replaced at the Contractor's expense.

201.3 DUST CONTROL:

The Contractor shall apply a dust palliative to those areas causing dust as a result of the construction operation or traffic. The frequency of the dust palliative shall be enough to eliminate all dust from the project. In addition, the Contractor shall apply palliative when directed by the Engineer.

201.4 CONSTRUCTION METHODS:

The construction site and areas within the right-of-way and areas on each side of the roadway from centerline to the toe of an embankment, the top of a cut slope, the slope rounding limit or to a line 10 feet outside the edge of the surfaced area, whichever is greater, but not beyond the limits of the right-of-way, shall be cleared of all trees, stumps, brush, roots, rubbish, debris and other objectionable matter, except as follows:

The Contractor shall notify property owners that small trees and shrubs within the street right-of-way are to be removed so that the individual property owner may transplant said trees and shrubs, if he so wishes. If the property owner indicates that he does not wish to save these small trees and shrubs, the Contractor may proceed with removal as specified here. The property owner should be given a minimum of 20 days to move the trees.

All trees and shrubs found suitable for improvement and beautification, which will not interfere with excavation or embankment or cause disintegration of the improvements shall not be disturbed. In any event, the Contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing outside of the clearing limits. The dragging and the piling of materials of various kinds and the performing of other work which may be injurious to vegetation shall, in so far as practicable, be confined to areas which have no vegetation or which will be covered by embankment or disturbed by excavation during grading operations.

For the full width of all water courses within the site and the right-of-way lines, no stump, root or other obstruction shall be left higher than the natural stream bed.

From excavated areas, all stumps, roots and other obstructions 3 inches or over in diameter shall be grubbed to a depth of not less than 18 inches below finished grade.

In embankment areas or other areas to be cleared outside the road prism slope lines, all stumps, roots and other obstructions shall not be left higher than specified in the following table:

Table 201.1

Height of Embankment Over Stump	Height of Clearing and Grubbing
0 Feet	All stumps and roots grubbed out to 24" below finished grade.
0 Feet to 2 Feet	All stumps or roots 6 inches or over in diameter shall be grubbed to 18 inches below original grade. All others shall be cut flush with the ground.
2 Feet to 3 Feet	All stumps 1 foot and over in diameter cut flush with the ground.
Over 3 Feet	No stumps shall be left higher than the stump top diameter, and in no case more than 18 inches.

Also included shall be any other obstruction to construction which is not specifically mentioned under a separate pay item for removal. No objectionable materials from clearing or grubbing operations will be allowed in fills. Cavities left below subgrade elevation by removal of stumps or roots shall be carefully backfilled and compacted in accordance with specification herein entitled "Fill and Embankment Construction".

Tree branches extending over the roadway, which hang within 12 feet of the profile grade or that restrict sight distance shall be cut off close to the trunk or stem of the tree in a neat and workmanlike manner. The Contractor shall remove tree branches as directed by the Engineer, in such a manner that the tree will present a balanced appearance. Scars resulting from the removal of branches shall be treated with a heavy coat of an approved tree sealant.

All tree trunks, stumps, brush, limbs, roots, vegetation and other debris removed in clearing and grubbing shall be removed to locations outside of the right-of-way, or otherwise disposed of so as to leave the construction project site and adjacent areas in a neat and finished condition, free from unsightly debris. All burning shall be done under permit and shall be done at such a manner as to prevent the fire from spreading to or damaging areas adjoining the project site.

201.5 REMOVAL AND DISPOSAL OF SALVAGEABLE ITEMS:

Items and materials of salvage value as determined by the Engineer, unless incorporated in the new work, shall remain the property of the Contracting Agency and shall be stored in adjacent areas as directed by the Engineer. Such items and materials shall be carefully removed and in such a manner as to permit reuse.

201.6 METHOD OF MEASUREMENT:

(A) If the proposal includes separate estimate of quantities for the removal of trees, the tree will be classified by size as follows:

(1) Trees 12 inches or less in diameter at 2-foot above the original ground surface will be included in the bid price for clearing and grubbing or excavation and therefore, no additional compensation will be allowed.

(2) Trees greater than 12 inches in diameter at 2-foot above the original ground will be included as separate bid item and payment will be made at the unit bid price quoted in the proposal.

(B) Measurement for clearing and grubbing shall be in accordance with the terms of the contract and shall be based as set forth in the proposal.

201.7 BASIS OF PAYMENT:

(A) CLEARING AND GRUBBING:

Unless otherwise provided in the special provisions or bid proposal, no payment will be made for clearing and grubbing as such; the cost thereof shall be included in the bid price for the construction or installation of the items to which said clearing and grubbing are incidental or appurtenant.

(B) REMOVAL AND DISPOSAL OF TREES:

If the proposal includes separate estimates of quantity for removal and disposal of trees, payment for removal of trees will be on a unit price for each tree measured and removed, in accordance with the above classifications, at the unit price stipulated in the proposal.

SECTION 202

REMOVAL OF STRUCTURES AND OBSTRUCTIONS

202.1 DESCRIPTION:

Except for public and private utility company underground and overhead facilities, pipelines and other appurtenances, Removal of Structures and Obstructions shall consist of the removal, wholly or in part, and satisfactory disposal off the site of all structures and obstructions within the construction site and right-of-way which have not been designated to remain. Salvaging designated materials shall be included.

202.2 REMOVAL AND DISPOSAL OF SALVAGEABLE:

Items and materials of salvage as determined by the Engineer, unless incorporated in the new work, shall remain the property of the Contracting Agency and shall be stored in adjacent areas as directed by the Engineer. Such items and materials shall be carefully removed and in such a manner as to permit reuse.

202.3 PRESERVATION OF PROPERTY:

Existing improvements, adjacent property, utilities and other facilities, trees and plants not to be removed, shall be protected from injury or damage resulting from the Contractor's operations. See these Specifications, Section 107.

If the plans do not show existing improvements to be removed, existing structures, pavement, sidewalks, curbs, gutters and other existing improvements that are to become an integral part of the planned improvements shall be considered to mean that such designated improvements are to remain even though not specifically noted to remain.

202.4 CONSTRUCTION METHODS:

The Contractor shall raze, remove and dispose of all structures and obstructions as required and shown on the plans including, but not limited to, the following; buildings, sheds, walls, slabs, foundations, inlets, catch basins, culverts, headwalls, trash racks, bridges, piers, abutments, retaining walls, irrigation structures, standpipes, manholes, valves, ditch lining, pipelines, tanks, pool lining, posts, poles, columns, signs, fences, gates, planters, concrete and A.C. pavement, sprinkler systems, mail boxes, curbs, gutters, sidewalks, driveways, feed pens, corrals, cattle guards.

Holes, cavities, trenches or depressions left by the removal of structures or obstructions shall be backfilled with acceptable material to the grade required in accordance with the requirements of standard specification entitled "Fill and Embankment Construction".

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work.

202.5 REMOVAL OF BRIDGES, CULVERTS AND OTHER DRAINAGE STRUCTURES:

Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

202.6 REMOVAL OF PIPE:

All pipe to be removed and either salvaged or relaid shall be carefully removed and every precaution taken to avoid breaking or damaging the pipes. The pipe shall be stored when necessary so that there will be no loss or damage before relaying. The Contractor will be required to replace sections lost from storage or damage by negligence or by the use of improper methods in their removal.

202.7 REMOVAL OF CONCRETE PAVEMENT, SIDEWALKS, SLABS, CURBS, GUTTERS & FOOTINGS:

The removal of concrete pavement, sidewalks, driveways, miscellaneous slabs, curbs, gutters etc., shall include the breaking or cutting as necessary for removal and the hauling and disposing of all debris.

When a portion of the concrete sidewalk, driveway or slab is to be removed to other than an existing joint, a joint with a minimum depth of one inch shall be sawed so that a neat edge remains after the removal of the concrete. Sidewalks shall be removed to a distance required to maintain a maximum slope of one inch per foot for the replaced portions of the sidewalk and all driveways shall be removed to a distance as required to match standard details.

202.8 RELOCATION OF FENCES, WALLS AND IMPROVEMENTS OWNED BY OTHERS:

It shall be the Contractor's responsibility to contact all property owners, who have improvements within the site and right-of-way that must be moved to clear for construction, at least 20 days prior to any construction in that area. If the property owners do not remove the improvement, the Contractor shall do so, and relocate the fence or wall in accordance with the plans or special conditions and rebuilt equal to or better in quality than existing. Existing materials are to be reused where not damaged in the process of removal. The Contractor is to furnish any additional material necessary.

The Contractor shall remove existing fencing, wall and improvements in such manner as to prevent damage and shall reconstruct the improvement at the locations specified by the Engineer. When completed, the improvement shall be in proper alignment and plumb and all wire taut, where used and shall be in all respects equal in service-ability to the original improvement.

202.9 MISCELLANEOUS REMOVALS ANY OTHER WORK:

This work shall include, but is not limited to, the following where called for in the plans or in the special conditions. Any other miscellaneous removal not listed or not shown on the plans will be considered incidental and no additional payment will be made.

(A) Mailboxes in the way of construction are to be removed, temporarily reset and permanently reset after construction. Any mailbox damaged is to be replaced by the Contractor.

(B) Traffic control signs or any other signs in the way of construction are to be removed, temporarily reset, as necessary or as directed by the Engineer, and permanently reset after completion of construction. Any damaged signs are to be replaced by the Contractor.

(C) Sprinkler systems owned by others are to be plugged before removal at that portion within the project property limits.

(D) Existing berms on the site that control irrigation or water flow from adjacent properties are to be reconstructed as directed by the Engineer.

202.10 METHOD OF MEASUREMENT:

Removal of Structures and Obstructions will be measured on a lump sum basis except that when the bidding schedule contains specific items under this section on a unit basis, measurement will be made by the unit specified in the bidding schedule.

When removal of pipe is specified by an item, the length of pipe removed will be measured by multiplying the number of commercial lengths removed, or fractions thereof, by the nominal laying length, or by measuring parallel to the centerline of the pipe in place, prior to removal, if practicable.

202.11 BASIS OF PAYMENT:

The accepted quantities of Removal and/or Relocation of Structures and Obstructions will be paid for at the contract lump sum price, which price shall be full compensation for removing, disposing or relocating of the obstructions in accordance with the contract and proposal.

Specific obstruction items, including pipe, specified for relocation and/or removal and disposal under unit price pay items will be paid for at the contract unit price per unit specified in the proposal, which price shall be full compensation for such items, including excavation and subsequent backfill incidental to their removal. The price shall also include salvage of materials removed, their custody, preservation, storage on site, and disposal as provided herein.

There will be no separate payment for excavating for Removal of Structures and Obstructions.

SECTION 204

EARTHWORK

204.1 DESCRIPTION:

The work under this section shall consist of performing all operations necessary to excavate all materials, regardless of character and sub-surface conditions from the construction site; to strip topsoil when specified; to excavate drainage and irrigation ditches, channels, basins, and water ways; to excavate all materials except for pipeline, roadway and structure excavation; to excavate borrow material for use as specified; to construct embankments, levees and other facilities; to backfill holes, pits and other depressions; to remove and replace unsuitable material; to excavate and grade, driveways and connections; to construct dikes and berms; to apply water for compaction; to compact; to roll and to remove and haul excess material as shown on the plans and to perform all earthwork necessary to bring the sites to the required grade and cross section as specified herein and as directed by the Engineer.

204.2 PRESERVATION OF PROPERTY:

Operations shall be conducted in such a manner that existing facilities, utilities, and other facilities which are to remain in place will not be damaged. The Contractor, at his expense, shall furnish and install sheet piling, cribbing, bulkheads, shores or whatever materials may be necessary to adequately support material carrying such facilities, or to support the facilities themselves and shall maintain such supports until they are no longer needed. Temporary pavements, facilities, utilities and installations shall also be protected until they are no longer required. When temporary supports and other protective means are no longer required, they shall be removed and disposed of by the Contractor.

204.3 LINE AND GRADE:

Earthwork shall be constructed to line and grade stakes. Adequate staking shall be accurately located to allow the Contractor to perform the earthwork as per the plans. Maintenance of the survey points and stakes shall be the sole responsibility of the Contractor until completion of the work.

204.4 DUST CONTROL:

The Contractor shall apply sprinkled water and dust palliatives to those areas causing dust as a result of the construction operation and traffic. The frequency of water sprinkling shall be determined by the Engineer.

204.5 STRIPPING:

When stripping is indicated on the plans or specified in the special provisions, the Contractor shall strip the soil from the designated areas to the depths shown or specified or as directed by the Engineer.

The material obtained from stripping operations shall be disposed of away from the site unless otherwise specified, shown on the plans or authorized by the Engineer.

Soil loosened below the stripping depth specified or designated by the Engineer, shall be compacted. Soil removed below stripping depth shall be replaced with approved material and compacted up to the designated grade. All such filling and compacting shall be done by the Contractor at no additional cost to the Contracting Agency.

204.6 EXCAVATION:

All excavation shall be finished to a reasonably smooth and uniform surface and in reasonably close conformity to the lines, grades, dimensions and cross sections shown on the project plans or established by the Engineer.

Excavation in open cut for lined channels may be made so as to place concrete directly against the excavated surfaces providing the faces of the excavation
are firm and unyielding; are such as will stand or can be made to stand without sloughing and are, at all points outside the concrete lines shown on the plans.

Excavation to provide a subgrade for lined channels, or subdrainage material, shall be to the lines indicated on the plans; and excavation made below subgrade shall be backfilled and compacted to a uniform density of not less than 90 percent or, if approved by the Engineer, with concrete or other materials being placed. However, no payment will be made for such over excavation or material used for backfill.

Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, the voids remaining after the removal of such boulders or interfering objects shall be backfilled as specified below, or as otherwise approved by the Engineer.

(A) When the void is below the subgrade for reinforced concrete channel, it shall be filled with a suitable material as approved by the Engineer, and compacted to a uniform density of not less than 90 percent. With the approval of the Engineer, concrete of the same mix as used in the concrete channel, may be used.

(B) When the void is in the side of the excavation, it shall be filled, with suitable material as approved by the Engineer, placed in the manner and to the same uniform density as the backfill in the vicinity of the void. With the approval of the Engineer, concrete of the same mix as used in the concrete channel may be used. If concrete is placed prior to lining, a lower grade concrete may be used only if approved by the Engineer.

It shall be understood that the removal of boulders or other interfering objects and the backfilling of voids caused by such removals shall be done by the Contractor at no additional cost to the Contracting Agency. The cost of such work shall be included in the prices bid for the various items of work.

If during the progress of excavation, material is encountered, which, in the opinion of the Engineer, is unsuitable for subgrade for a concrete channel to be constructed on, the Engineer may direct the Contractor to excavate beyond the lines shown on the plans. However, the suitability of subgrade shall be determined by the Engineer on the basis of its ability to withstand the load the proposed channel and not upon the capacity to withstand the loads which may placed upon it by the Contractor's equipment.

Materials used for work performed by the Contractor to stabilize the subgrade so it will withstand loads which may be placed upon it by his equipment, shall be accomplished by the Contractor at no additional cost to the Contracting Agency.

All suitable material removed from excavation shall be used as far as practicable in the construction of embankments and other designated areas.

No excavated material shall be wasted without the approval of the Engineer. Wasted material shall be disposed of by the Contractor in a manner approved by the Engineer.

When excavation is made in rock, the excavated area shall be over excavated to a minimum of one half foot below grade. The over excavated area shall be filled with embankment material and finished in accordance with the requirements of these specifications.

204.7 SLOPES:

Earth slopes shall be finished to within 3 inches of grade and to reasonably smooth surfaces and shall be free of all debris and loose material.

All shattered or loosened material shall be removed from rock cut slopes. Adjustment in slopes shall be made, as directed by the Engineer, to avoid injury to standing trees, marring weathered rock or to harmonize with existing landscape features. The transition of such adjusted slopes shall be gradual. At the intersections of cuts and fills, slopes shall be adjusted and warped to flow into each other or into the natural ground surfaces without noticeable break.

Except in solid rock, the intersection of cut slopes with the ground surfaces shall be rounded as shown on the project plans. Rock that is disintegrated to such an extent that it will work and handle as earth, shall be considered as earth overlaying a rock cut and shall be rounded above the rock in the same manner as earth slopes.

Where directed by the Engineer, the top six inches of topsoil, including duff, within the limits of the rounding, shall be removed and windrowed outside of the rounding limits. After completion of the rounding of the slope, the windrowed materials shall be uniformly spread over the rounded area.

204.8 SHORING:

Where necessary, all trenches and other excavations shall be properly sheeted and braced, to furnish acceptable working conditions. The bracing shall be so arranged as not place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength. Any damage to structures occurring through settlements, water or earth pressures, slides, caves, or other causes, due to failure or lack of sheeting or bracing, or improper bracing, or through negligence or fault of the Contractor in any other manner shall be repaired by the Contractor at his own expense.

204.9 BLASTING:

Over shooting or any method of blasting that might cause damage to the existing facilities or structures, or that might be dangerous or destructive to adjacent property or landscape will not be permitted. In any event, the Contractor shall provide and install suitable guards and barricades for adjacent trees, shrubbery, pole lines or other objects; the purpose being to prevent damage rather than to control the amount of damage.

When controlled blasting is specified, all blasting in connection with excavation shall be performed in accordance with requirements of these specifications utilizing pre-splitting methods when the design slope is steeper than 3/4 to one and when cut slopes have a depth greater than 15 feet.

Prior to any blasting operations that requires controlled blasting, the Contractor shall furnish a written statement setting forth details and materials he proposes to use in connection with pre-splitting operations. If the results obtained are satisfactory in relation to the character of the material being pre-split, the procedures shall be continued. Otherwise, the details of the operation to be modified in a written statement of the modifications and shall be furnished to the Engineer. The amount of explosives used, the method of loading and method of stemming shall be modified until the results obtained in pre-splitting operations are satisfactory in relation to the character or the material being pre-split.

Drill holes for pre-splitting shall be spaced at centers not exceeding three feet and shall be drilled as near to the design slope lines and as parallel to one another as possible. Pre-drilling and pre-splitting to depths greater than one lift (approximately 20 feet) will be permitted only if satisfactory hole alignment is maintained.

Explosive charges placed in slope-drilled holes shall be uniformly spaced along the length of hole and shall be as light as possible to effect clean splitting of the rock along the plane of the slope and to reduce to a minimum the fracturing of the remaining rock face or cut.

Loading of slope-drilled holes shall be by string charges so connected that all charges in a hole and all holes in the designated section are exploded simultaneously. Explosives for pre-splitting shall be detonated at least several milliseconds in advance of primary blasting. Primary blasting shall be accomplished by means of millisecond delay excavation blasting methods.

204.10 FILL AND BACKFILL:

Unless otherwise specified in the special provisions, material obtained from the project excavations may be presumed to be suitable for use as fill or backfill provided that all organic material, rubbish, debris, and other objectionable material is first removed. However, stone, broken portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the backfill or fill with the limitations as specified in Section 211. All fill and embankment construction shall conform with the requirements of the specification entitled "Fill and Embankment Construction". Unless otherwise specified in the special provi-sions, the density of fills and backfills shall be at least 90 percent.

204.11 GRADING:

All work shall be constructed to the lines and grades as shown on the plans and may not vary by more than 0.04 of a foot above or below grade.

Grading of unlined channels, ditches, levees and access roads shall conform to the following tolerances:

(A) A vertical tolerance of none above and 3 inches below the specified grade will be allowed on:

(1) Channel and ditch bottom
(2) Channel and ditch side slopes in both cut and fill
(3) Levee and access road side slopes in cut

(B) A vertical tolerance of none below and 3 inches above the specified grade will be allowed on:

(1) Top surfaces of levee and access road in both cut and fill
(2) Levee and access road side slopes in fill

Regardless of the construction tolerance specified, excavation and grading shall be performed so that finished surfaces are in uniform planes with no abrupt breaks in the surface.

Construction tolerances specified above for grading are solely for purposes of field control.

204.12 UNSUITABLE MATERIAL:

Material below the natural ground surface in embankment areas and below the grade in excavation areas that is unsuitable for the planned use shall be excavated and disposed of as directed by the Engineer.

When suitable material is removed and disposed of, the resulting space shall be filled with material suitable for the planned use. Such suitable material shall be placed and compacted in accordance with embankment compaction requirements herein.

204.13 SURPLUS MATERIAL:

Unless otherwise specified in the special provisions, after all fill and embankment construction has been completed, surplus excavated material shall be removed from the job site and disposed of by the Contractor in a manner satisfactory to the Engineer and in accordance with the requirements of the Special Conditions. Shortages of material caused by the premature disposal of any material by the Contractor shall be replaced by the Contractor without compensation.

204.14 TESTING:

Density tests shall be determined by ASTM D-2922 and D-3017 with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, in accordance with Figure 204.1 to compensate for the rock content larger than that which will pass a No. 4 sieve. A minimum of one test shall be taken on each layer and every 300 feet.

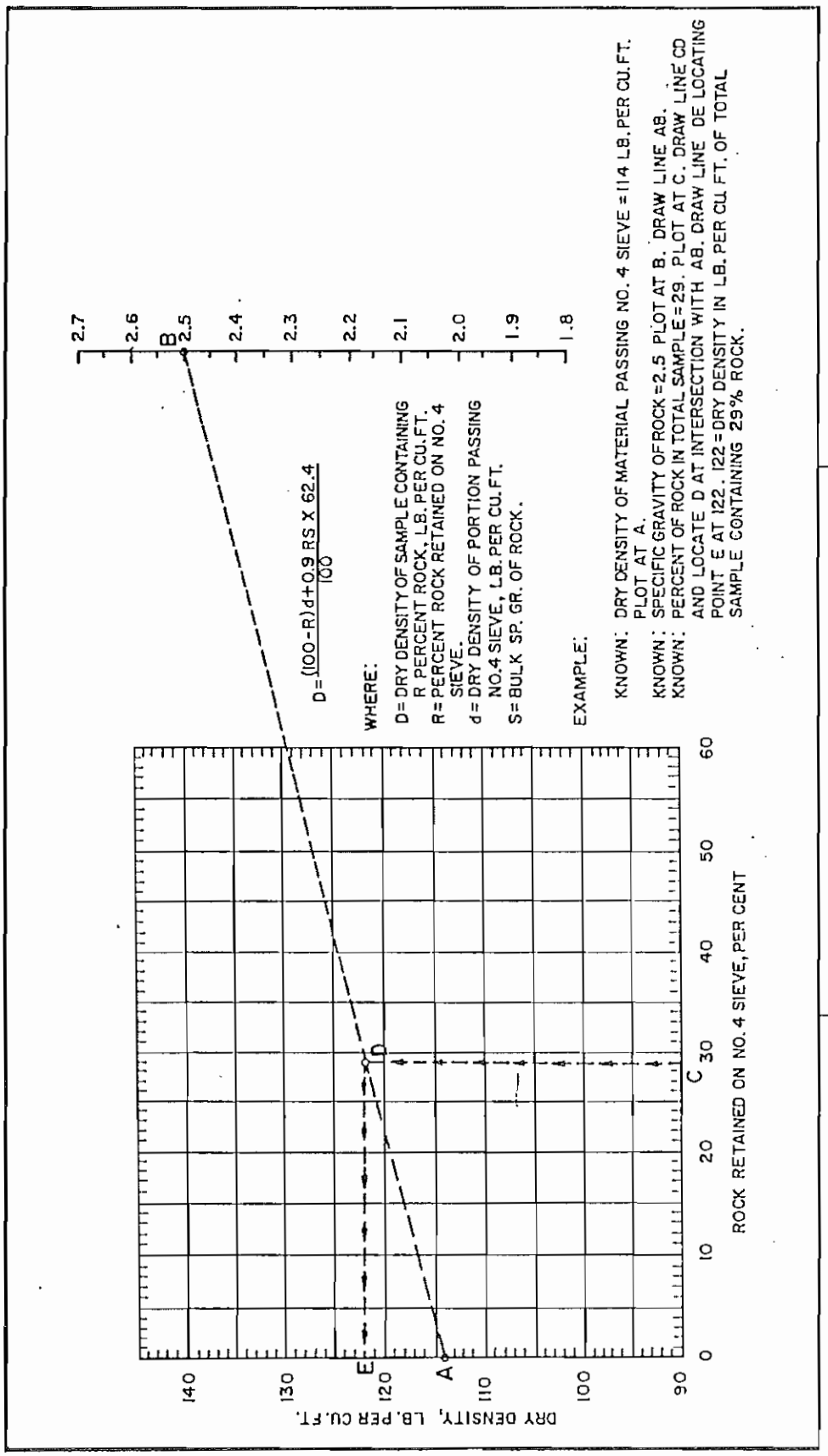
204.15 METHOD OF MEASUREMENT:

Measurement shall be in accordance with the terms of the contract and shall be based as set forth in the proposal.

204.16 BASIS OF PAYMENT:

If provided for in the proposal, payment for earthwork will be made in conformity with the terms of the contract, for each site this specification applies to, and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, and doing all work required to complete the job in conformity with the plans and specifications.

Figure 204-1



ROCK CORRECTION PROCEDURE
FOR MAXIMUM DENSITY DETERMINATION

SECTION 205

ROADWAY EXCAVATION

205.1 DESCRIPTION:

The work under this section shall consist of performing all operations necessary to excavate and grade all types of materials, regardless of character and sub-surface conditions, from the roadway or adjacent thereto; to backfill holes, pits and other depressions within the roadway area; to remove and replace unsuitable material; to excavate and grade road approaches, driveway entrances, turnouts, parking areas, cut ditches adjacent to the roadway, to apply water for compaction, to compact, to roll and to remove and haul excess material as shown on the plans and to perform all earthwork necessary to bring the right-of-way to the required grade and cross section as specified herein and as directed by the Engineer.

Roadway excavation will not include trench excavation or structural excavation when these items are designated as separate items of work in the bidding schedule.

205.2 PROJECT OF EXISTING FACILITIES:

Operations shall be conducted as such that existing highway facilities, utilities, railroad tracks and other non-highway facilities which are to remain in place will not be damaged. The Contractor, at his expense, shall furnish and install sheet piling, cribbing, bulkheads, shores or whatever materials may be necessary to adequately support material carrying such facilities, or to supports until they are no longer needed. Temporary pavements, facilities, utilities and installations shall also be protected until they are no longer required. When temporary supports and other protective means are no longer required, they shall be removed and disposed of by the Contractor.

205.3 LINE AND GRADE:

Earthwork shall be constructed to line and grade stakes. Adequate staking shall be accurately located to allow the Contractor to perform the earthwork as per the plans. Maintenance of the survey points and stakes shall be the sole responsibility of the Contractor until completion of the work.

205.4 DUST CONTROL:

The Contractor shall keep dust to a minimum and apply dust palliatives to the areas causing dust as a result of the construction operation and traffic. The frequency of water sprinkling shall be determined by the Engineer.

205.5 BORROW:

Any necessary borrow of material shall conform to the standard specifications herein entitled "Borrow".

205.6 FILL AND EMBANKMENT AND COMPACTION:

The placement and compaction of fill and embankment shall conform to the standard specification herein entitled "Fill & Embankment".

205.7 EXISTING PAVEMENT:

All existing pavement shall be removed as designated on the project plans. Where new asphaltic concrete is to match existing bituminous surfaces, the edges of the existing bituminous surfaces abutting the new paving shall be either saw cut or wheel cut to a minimum depth of 1 1/2 inches to form a neat true line with straight vertical edges free from irregularities. Should the Contractor elect to wheel cut the edges, the cutter wheel shall be adequate for the work, in the opinion of the Engineer, to produce the desired result. If at the time of removing any portion of the existing roadway, in-place materials from which the new subgrade is to be con-structed contain an excess of moisture, so that the required compaction cannot be obtained with reasonable and customary aeration and manipulation, the Engineer will determine the cause of such condition and will determine whether the material shall be further aerated or removed and replaced. Excess moisture caused by irrigation water, storm drainage, weather, breakage of mains, or other similar cause will be considered the responsibility of the Contractor.

205.8 EXCAVATION:

All roadway excavation shall be finished to a reasonably smooth and uniform surface and shall not vary by more than 0.04 foot above or below the grade established and in reasonable close conformity to the lines, dimensions and cross sections shown on the project plans or established by the Engineer; however, in rock, the surface of the excavation shall not vary by more than 0.08 of a foot above or below the grade established by the Engineer.

All suitable excavated material shall be used as far as practicable in the construction of embankments and in other designated areas.

No excavated material shall be wasted without the approval of the Engineer. Wasted material shall be disposed of by the Contractor in a manner approved by the Engineer.

During construction, the roadway shall be maintained in a well-drained condition at all times.

The top six inches of the subgrade shall be compacted to a density of not less than 95 percent of the maximum density, except that when asphaltic concrete or portland cement concrete is to be placed directly on subgrade, the required density shall be 100 percent of the maximum density.

When excavation is made in rock, the excavated area shall be over excavated to a minimum of one half foot below grade. The over excavated area shall be filled with embankment material and finished in accordance with the requirements of these specifications.

205.9 SLOPES:

Excavation slopes shall be finished in conformance with the lines and grades shown on the plans. Debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope, except where excavation is in rock no point shall vary more that 2 feet from the designated plane of the slope. In no case shall any portion of the slope encroach on the roadbed.

Tops of excavation slopes and ends of excavations shall be rounded as shown on the plans and these quantities will not be included in the quantities of excavation to be paid for. This work will be considered as a part of finishing slopes and no additional compensation will be allowed therefore.

Embankment slopes shall be finished in conformance with lines and grades shown on the plans. When completed, the average plane of slopes shall conform to slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope.

205.10 SLIDES AND SLIPOUTS:

Material outside the planned roadway or ditch slopes which in the opinion of the Engineer is unstable and constitutes potential slides, material which has come into the roadway or ditch, and material which has slipped out of new or old embankments shall be excavated to designated lines or slopes either by benching or in such manner as directed by the Engineer. Such material shall be used in the construction of the embankments or disposed of as directed by the Engineer.

The removal and disposal of slide and slipout material as specified above, not resulting from overshooting as specified above, will not be paid for at the contract prices for roadway excavation; however, if due to the character of the work, the removal and disposal of such material is not properly compensable at the contract prices for roadway excavation, the work may be paid for as extra work provided that Contractor requests in writing such payment prior to performing any such work.

Only those quantities of slide or slipout material which are actually removed as ordered by the Engineer will be paid for.

205.11 CONTROLLED BLASTING:

When controlled blasting is specified, all blasting in connection with roadway excavation shall be performed in accordance with the requirements of these specifi-cations, utilizing pre-splitting methods when the design slope is greater than 15 feet, or as indicated on the plans.

Prior to any blasting operations that require controlled blasting, the Contractor shall furnish a written statement setting forth the details and materials he proposes to use in connection with pre-splitting operations. If the results obtained using the proposed method are satisfactory in relation to the character of the material being pre-split, the procedures shall be continued. Otherwise, the details of the operation shall be modified and a written statement of the explosives used, the method of loading and the method of stemming shall be modified until the results obtained in pre-splitting operations are satisfactory in relation to the character of the material being pre-split.

Drill holes for pre-splitting shall be spaced at centers not exceeding three feet and shall be drilled as near to the design slope lines and as parallel to one another as possible. Pre-drilling and pre-splitting to depths greater than one lift (approxi-mately 20 feet) will be permitted only if satisfactory hole alignment is maintained.

Explosive charges placed in slope-drilled holes shall be uniformly spaced along the length of hole and shall be as light as possible to effect clean splitting of the rock along the plane of the slope and to minimize the fracturing of the remaining rock face or cut.

Loading of slope-drilled holes shall be by string charges connected so that all charges in a hole and all holes in the designated section are exploded simultaneously. Explosives for pre-splitting shall be detonated at least several milliseconds in advance of primary blasting. Primary blasting shall be accomplished by means of milliseconds delay excavation blasting methods.

205.12 OVERSHOOTING:

Overshooting or any method of blasting that might cause damage to the roadway section or highway structures, or that might be dangerous or destructive to adjacent property or landscape will not be permitted. In any event, the Contractor shall provide and install suitable protection for adjacent trees, shrubbery, pole lines or other objects, the purpose being to prevent damage rather that to control the amount of damage.

Material outside the authorized cross section which may be shattered or loosened because of blasting shall be removed by the Contractor at no additional cost to the Contracting Agency. The Contractor shall discontinue any method of blasting, which in the opinion of the Engineer, is hazardous to the general public or destructive to property or to natural features.

205.13 UNSUITABLE MATERIAL:

Material shall be considered unsuitable for fill, subgrade, shoulders and other uses if it contains organic matter, soft spongy earth, or other matter of such nature that compaction to the specified density is unobtainable.

Material that is unsuitable for the intended use, shall be excavated and removed from the site or otherwise disposed of as directed by the Engineer.

The removal and disposal of such unsuitable material will be paid for as roadway excavation.

205.14 SURPLUS MATERIAL:

Unless otherwise shown on the plans, specified in the special provisions, or approved by the Engineer, no surplus excavated material shall be disposed of within the right-of-way. The Contractor shall make all arrangements for disposal of the material at off-site locations as may be approved by the Engineer, and shall upon request, file with the Engineer the written consent of the owner of the property upon which he intends to dispose of such material.

If the quantity of surplus material as shown on the plans or specified in the special provisions, that quantity shown or specified is approximate only. The Contractor shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any indicated surplus material inside or outside the right-of-way. Any shortage of material caused by premature disposal of surplus material by the Contractor, shall be replaced by the Contractor without compensation.

205.15 RELATIVE COMPACTION & TESTING:

Unless otherwise provided in the plans or special provisions, all areas shall be thoroughly compacted to a uniform density of not less than the stated densities when tested and determined by ASTM D-2922 and D-3017 with percent of density adjusted in accordance with the rock correction procedure for maximum density determina-tion, in accordance with Figure 204.5 to compensate for the rock content larger than that which will pass a No. 4 sieve. A minimum of one test shall be taken on each layer and every 500 feet.

205.16 HAULING:

When hauling is done over highways or city streets, the loads shall comply with legal load requirements, all material shall be removed from shelf areas of vehicles in order to eliminate spilling of material, and loads shall be watered or covered to eliminate dust.

205.16 METHOD OF MEASUREMENT:

Roadway excavation will be measured by the cubic yard in the original space occupied and the volume of material removed will be computed in cubic yards by the average end area method.

Roadway excavation originating outside of the neat lines of cut slopes as a result of necessary blasting operations will be measured in cubic yards and the quantity to be allowed for payment will be the volume in cubic yards determined in the following manner: The areas of cut faces that result from the blasting of roadway excavation, which faces are determined to be cut substantially to or beyond the slope line, will be measured in square yards and multiplied by 0.4 yards.

205.17 BASIS OF PAYMENT:

When provided for in the bid schedule the accepted quantities of roadway excavation, measured as provided above, will be paid for at the contract unit price per cubic yard. The price shall include full compensation for the work completed, including slope rounding, blasting, hauling, stockpiling, placing embankment, disposal of surplus and unsuitable material, and the preparation of the subgrade in accordance with the requirements of these specifications.

Payment for removal of slides which are not deemed to be the result of carelessness on the part of the Contractor will be made in accordance with the requirements of Section 104 of these Specifications.

No adjustment to the contract unit price will be made because of increased excavation quantities resulting from the removal of unsuitable material.

SECTION 210

BORROW

210.1 DESCRIPTION:

The work under this section shall consist of performing all operations necessary to supply and provide borrow material, obtain all permits and approvals, pay all costs, excavate and transport all material, process material as required, deposit, place and compact material in accordance with line and grade as shown on the plans and as directed by the Engineer.

210.2 LOCAL BORROW:

Local borrow shall consist of material excavated and used in the construction of fills or for use as selected material or for other construction purposes. Local borrow shall be obtained by widening cuts or by excavating from other sources outside the planned or authorized cross section within the right-of-way and within the limits of the project. Local borrow shall be excavated to the lines and grades established by the Engineer.

210.3 IMPORTED BORROW:

Imported borrow shall consist of material required for construction and unless other-wise designated in the special provisions, the Contractor shall make his own ar-rangements for obtaining imported borrow and he shall pay all costs involved. Imported borrow shall be obtained from sources indicated on the plans, designated in the special provisions, or approved by the Engineer.

The material shall be free from wood, vegetation or other deleterious matter. The maximum size of this material shall not be greater than 2/3 the compacted thickness of the course placed in the subgrade.

The Contractor shall notify the Engineer sufficiently in advance of opening any material sites so that cross section elevations and measurements of the ground surface after stripping may be taken and sufficient time for testing the material will be allowed. No imported borrow shall be removed from material site before all local borrow has been used on the project.

Borrow pits shall be excavated to regular lines to permit accurate measurement; depth of excavation throughout the areas of borrow pits shall be as uniform as practicable and the side slope shall be dressed to such slope as may be directed, leaving the borrow pit area in a clean and safe condition.

210.4 PLACING AND COMPACTING:

Local borrow and imported borrow shall be placed and compacted as specified in specification entitled "Fill and Embankment Construction".

The Contractor shall satisfy himself that there is sufficient space available in fill locations for placing any excavated material, before placing borrow. Any excess excavation which develops as a result of placing borrow in advance of completing excavations shall be disposed of by the Contractor at no additional cost to the Contracting Agency in accordance with the provisions in Section 204 of these Specifications and a corresponding reduction in the quantity of borrow to be paid for will be made, for which the Contractor will have no claim for compensation.

210.5 METHODS OF MEASUREMENT:

When specifically provided for in the proposal, quantities of borrow will be measured by the cubic yard in the original space occupied and the volume of material removed will be computed in cubic yards by the average end area method.

Material excavated at the borrow site and not used on the work will be deducted from the computed quantities and will not be paid for.

210.6 BASIS OF PAYMENT:

When specifically provided for in the proposal, quantities of borrow excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping and cleaning of borrow area, hauling, depositing, spreading and compacting the material complete in place, and disposal of surplus material, unless an alternate basis of payment is stipulated in the proposal.

SECTION 211

FILL AND EMBANKMENT CONSTRUCTION

211.1 DESCRIPTION:

Fill construction shall consist of constructing embankments except as may otherwise be specified, including the preparation of the areas upon which they are to be placed, the construction of dikes and levees, the placing and compacting of approved material within areas where unsuitable material has been removed and the placing and compacting of material in holes, pits, and other depressions.

211.2 PLACING:

Rocks, broken concrete or other solid materials, which are larger than 4 inches in greatest dimension shall not be placed in fill areas where piles are to be placed or driven.

When fill is to be made and compacted on hillsides or where new fill is to be compacted against existing fill or where embankment is built 1/2 width at a time, the slopes of original hillsides and old or new fills shall be benched a minimum of 4 feet horizontally as the fill is placed. A new bench shall be started wherever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the Contractor at no additional cost to the Contracting Agency, unless the width of the bench required exceeds 4 feet, in which case the excavated material in excess of 4 feet will be measured and paid for as excavation.

Clods or hard lumps of earth of 6 inches in greatest dimension shall be broken up before compacting the material in embankment, except as provided in the following paragraph:

When the fill material includes large rocky material or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the fill. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact fill. However, such material shall not be placed within 2 feet of the finished grade of the fill.

211.3 COMPACTING:

Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exception:

Where fills are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping successive loads of suitable material in a uniformly distributed layer of a thickness not greater than that necessary to support the equipment while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

Unless specified herein, or in the special provisions, the construction of dikes, the placing and compacting of approved material within the right-of-way where unsuitable material has been removed, and the filling of holes, pits and other depressions within the right-of-way, shall conform to all of the requirements herein specified for compacting fills. Trenches, holes, depressions and pits outside of areas where fills are to the constructed shall be graded to provide a presentable and well-drained area.

Areas over which fills are to be placed shall be cleared and scarified to a depth of 6 inches to provide a bond between the existing ground and the material to be deposited thereon. Unless otherwise specified, the original ground area upon which fills are to be constructed shall be compacted to a uniform density of not less than 95 percent.

The loose thickness of each layer of fill material before compacting shall not exceed 8 inches, except as provided in the following paragraph for rocky material. Each layer shall be compacted in accordance with the following requirements: to a uniform density of not less than 90 percent, except that where a new or widened roadway or dike and appurtenances are required, density of the upper 2 feet and when the fill is within 2 feet of the above shall be not less than 95 percent.

When fill material contains by volume over 25 percent of rock larger than 6 inches in greatest dimension, the fill below a plane 3 feet below finished grade may be constructed in layers of a loose thickness before compaction, not exceeding the maximum size of rock in the material but not exceeding 3 feet in thickness.

The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the fill with the following limitations:

(A) The maximum dimension of any piece used shall be 6 inches.

(B) Pieces larger than 4 inches shall not be placed within 12 inches of any structure.

(C) Pieces larger than 2 1/2 inches shall not be placed within 12 inches of the subgrade for paving.

(D) Nesting of pieces will not be permitted.

At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill be firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the contract price paid and no additional compensation will be allowed therefore.

Embankments shall be constructed so that each layer shall have a cross fall of at least 2 percent but no more than 5 percent.

211.4 TESTS:

Unless otherwise provided in the plans or special provisions, the fill shall be thoroughly compacted to not less than the stated densities when tested and determined by ASTM D-2922 and D-3017 with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, in accordance with Standard Figure A to compensate for the rock content larger than that which will pass a No. 4 sieve. A minimum of one test shall be taken on each layer and every 500 feet.

211.5 MEASUREMENT:

The quantities of fill material used to construct embankments or dikes will be those of the completed bid item, in place, within the limits of the dimensions shown on the plans.

The Engineer will compute the quantities of fill by a method which in his opinion is best suited to obtain an accurate determination.

211.6 PAYMENT:

When specifically provided for in the proposal, quantities of fill construction will be paid for at the contract unit price per cubic yard of fill as stipulated in the proposal. Such price shall include placing, compaction and all related work as specified above, unless an alternate basis of payment is stipulated in the proposal.

Unless otherwise provided for in the special provisions, no payment will be made for fill material to replace unsuitable material or to fill holes, pits and other depressions. The cost thereof shall be included in the price bid for the construction of the items to which such fill is incidental or appurtenant.

SECTION 218

SUBGRADE PREPARATION

218.1 DESCRIPTION:

This section shall govern the preparation of natural, or excavated areas prior to the placement of aggregate material for pavement matching and surface replacement, prior to the placement of concrete, curbs and gutters, pavement border, driveway entrances, sidewalks, concrete linings, other slab type concrete construction and prior to aggregate base material surfacing except grading for roadways. It shall include removal and disposal of pavement, excavation, removal and disposal of excess and unsuitable material, furnishing and placing of fill material, all grading, shaping, hauling, wetting and compacting of materials, rolling and other operations necessary to construct the subgrade to the lines and grades shown on the plans and in accordance with these standards.

218.2 ROAD EXCAVATION/AND EARTHWORK:

Roadway excavation shall conform to the specification entitled "Roadway Excavation". Earthwork shall conform to specification entitled "Earthwork".

218.3 LINE AND GRADE:

Subgrade preparation shall be built in accordance with line and grade stakes placed at a minimum every 25 feet in an offset line parallel to the edge of the improvement.

218.4 FILL AND EMBANKMENT:

The placement and compaction of fill and embankment shall conform with the requirements of the specification entitled "Fill and Embankment Construction".

218.5 PREPARATION OF SUBGRADE:

With the exception of areas where compacted fills have been constructed as specified in Section 211 of these Specifications, the areas where new construction is required, the moisture content shall be brought to that required for compaction by the drying of existing material. The material shall then be compacted to the specified relative density.

218.6 RELATIVE COMPACTION AND TESTING:

The subgrade shall be scarified and loosened to a depth of 6 inches. When fill material is required, a layer of approximately 3 inches may be spread and compacted with the subgrade material to provide a better bond. The top 6" of the subgrade areas shall achieve a uniform soil structure having density of 90% when tested in accordance with ASTM D-2922 and D-3017 with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, in accordance with Figure 204.1 to compensate for the rock content larger than that which will pass a No. 4 sieve. A minimum of one test shall be taken every 500 feet and a minimum of one test per site.

218.7 SUBGRADE TOLERANCES:

Subgrade upon which sidewalk, curb and gutter, driveways, or other structures are to be directly placed shall not vary more than 1/4 inch from the specified grade and cross-section and be graded so that the finished surface is a uniform plane with no abrupt breaks. The surface of the subgrade shall be finished to a reasonably smooth and uniform surface and in reasonably close conformity to the lines, grades, dimensions and cross section shown on the project plans or established by the Engineer. The finished surface of the subgrade shall not vary by more than 0.04 of a foot above or below the grade established by the Engineer except when Portland Cement Concrete Pavement or Asphaltic Concrete are placed directly on the subgrade it shall not vary by more than 0.04 foot above or 0.02 foot below the established grade.

218.8 PROTECTION OF FACILITIES:

Work shall be conducted in such a manner that existing facilities, utilities, and other improvements which are to remain in place will not be damaged. Any improvements damaged will be replaced by the Contractor.

The Contractor shall exercise extreme caution to prevent debris from falling into manholes or other structures. In the event that debris should fall into a structure it shall immediately be removed.

218.9 METHOD OF MEASUREMENT:

No measurement will be made for subgrade preparation unless otherwise provided for in the special provisions or proposal.

218.10 BASIS OF PAYMENT:

The cost for subgrade preparation will be included in the price bid for this item of construction to which subgrade preparation is done for and is incidental unless otherwise provided for in the special conditions.

SECTION 225

WATERING

225.1 DESCRIPTION:

Watering shall consist of furnishing, hauling and applying all water required in construction, including embankments, constructing subgrade, placement of screened gravel and crushed surfacing and shall be applied in the amounts and places as directed by the Engineer.

225.2 WATER SUPPLY:

The Contractor shall develop or obtain an adequate water supply and furnish all water required for the work.

The Contractor shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense.

If the Contractor purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment made direct to the water utility as agreed upon.

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

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

225.3 CONSTRUCTION EQUIPMENT:

The tank truck and/or trailer shall meet all safety and licensing regulations. The use of pressure pumps and spray bars on all sprinkling equipment used on the road-way will be required. The use of gravity flow spray bars and splash plates will not be permitted.

225.4 MEASUREMENT:

No measurement will be made of water, unless otherwise provided for in the special provisions or proposal.

225.5 PAYMENT:

The cost of watering will be included in the price bid for the construction operation to which such watering is incidental or appurtenant, unless otherwise provided for in the special provisions or proposal.

SECTION 227

DUST PALLIATIVE

227.1 DESCRIPTION:

The work under this section shall consist of applying all water required for the control of dust as considered necessary for the safety and convenience of the public, for the reduction of the dust nuisance to adjacent property, for the allaying of dust in crusher and pit operations and on roads used to haul materials, and for other purposes as directed by the Engineer.

227.2 CONSTRUCTION REQUIREMENTS:

The use of pressure pumps and spray bars on all sprinkling equipment used for the application of dust palliative will be required. The use of gravity flow spray bars and splash plates will not be permitted.

When it is required that chemical additives be mixed with the water for the suppression of dust, the additive shall conform with the requirements of Section 792. The cost of such chemical additives and the cost of adding them to the water, unless a separate bid item is included in the proposal, will be paid for in accordance with the provisions of Section 109.5, "Actual Cost Work".

Unless otherwise permitted by the Engineer, at least one mobile unit with a minimum capacity of 1,000 gallons shall be available for applying water on the project at all times.

227.3 METHOD OF MEASUREMENT:

When specifically provided for in the proposal, measurement shall be in accordance with the terms of the contract and be based as set forth in the proposal.

227.4 BASIS OF PAYMENT:

Payment for dust palliative will be made in conformity with the terms of the proposal.

PART 300

ROADWAY AND RELATED WORK

SECTION	TITLE
302	Grading Roadway for Pavement.....
310	Untreated Base.....
315	Bituminous Prime Coat.....
320	Road-Mixed Surfacing.....
321	Asphaltic Concrete Pavement.....
322	Asphaltic Concrete Overlay.....
329	Tack Coat.....
330	Chip Seal Coat.....
333	Fog Seal Coats.....
334	Preservative Seal for Asphaltic Concrete.....
336	Pavement Matching and Surface Replacement .....
340	Concrete Curb, Gutter, Sidewalk, Driveway, Alley Entrances and Pavement Border.....

SECTION 302

GRADING ROADWAY FOR PAVEMENT

302.1 DESCRIPTION:

The work under this section shall consist of removing and disposal of pavement, excavating, removal and disposal of excess and unsuitable material, furnishing and placing fill material, and all grading, shaping and compacting of materials necessary to construct the subgrade to the lines and grades shown on the plans and as depicted by the new pavement section specified and in accordance with the requirements of these specifications.

302.2 EXISTING PAVEMENT:

All existing pavement shall be removed as designated on the project plans. Where new asphaltic concrete is to match existing bituminous surfaces, the edges of the existing bituminous surfaces abutting the new paving shall be either saw-cut or wheel cut to a minimum depth of 1-1/2 inches to form a neat true line with straight vertical edges free from irregularities. Should the Contractor elect to wheel cut the edges, the cutter wheel shall be adequate for the work, in the opinion of the Engineer, to produce the desired result.

If at the time of removing any portion of the existing roadway, in-place materials from which the new subgrade is to be constructed contains an excess of moisture, so that the required compaction cannot be obtained with reasonable and customary aeration and manipulation, the Engineer will determine the cause of such condition and will determine whether the material shall be further aerated or removed and replaced. Excess moisture caused by irrigation water, storm drainage, weather, breakage of mains, or other similar causes will be considered as within the responsibility of the Contractor.

302.3 EXCAVATION AND GRADING:

Excavation and grading shall conform to Section 205.

302.4 LINE AND GRADE CONTROL:

Roadway grading shall be built in accordance with line and grade controls established by means of line and grade stakes placed every 50 feet minimum, in lines parallel to the centerline of the roadway.

302.5 PROTECTION OF EXISTING IMPROVEMENTS:

The Contractor shall exercise extreme caution to prevent debris from falling into manholes or other structures. In the event that debris should fall in a structure, it shall immediately be removed. The Contractor shall exercise care to prevent gouges and damage to concrete curbs, gutters and other improvements. Any improvements damaged shall be replaced.

302.6 PREPARATION OF SUBGRADE:

With the exception of areas where compacted fills have been constructed as specified in the specification entitled "Fill and Embankment Construction" in the areas where new construction is required, the moisture content shall be brought to that required for compaction by the addition of water, by the addition and blending of dry suitable material or by the drying of existing material. The material shall then be compacted to the specified relative density.

302.7 RELATIVE COMPACTION AND TESTING:

The subgrade shall be scarified and loosened to a depth of 6 inches. When fill material is required, a layer of approximately 3 inches may be spread and compacted with the subgrade material to provide a better bond. The subgrade cut and fill areas shall be constructed to achieve a uniform soil structure having a density not less than 95 percent of maximum density when tested in accordance with ASTM D-2922 and D-3017, with the percent of density adjusted in accordance with the rock correction procedures for maximum density determination Standard Figure A, to compensate for the rock content larger than that which will pass a No. 4 sieve. One compaction test shall be performed per 500 feet of roadway with at least one test per street.

302.8 SUBGRADE TOLERANCES:

The surfaces of the subgrade shall be finished to a reasonably smooth and uniform surface and in reasonably close conformity to the lines, grades, dimensions and cross section shown on the project plans or established by the Engineer. The finished surface of the subgrade shall not vary by more than 0.04 of a foot above or below the grade established by the Engineer.

302.9 GRADING OPERATION:

The Contractor's grading operation will proceed in an orderly sequence and shall be followed directly with the placement of base course. At no time shall the Con-tractor's total grading operations precede the placement of base course by more than 1,200 feet without specific written approval of the Engineer. At the end of each day's operation, the first lift of base course shall have been placed to within a maximum distance of 300 feet behind the finished subgrade area. Drop-offs on opposite sides of the pavement at the same time will not be allowed.

302.10 GRADING OF AREAS NOT TO BE PAVED:

Areas where grade only is called for on the plans shall be graded to meet the tolerances for the subgrade where sub-base or base material is to be placed. The surface shall be constructed to a straight grade from the finished pavement elevations shown on the plans to the elevation of the existing ground at the extremities of the area to be graded.

302.11 METHOD OF MEASUREMENT:

Measurement of grading roadway for pavement will be made by the square yard of the area between curbs and gutters prepared and subsequently covered with a base, asphaltic concrete or portland cement concrete; however, when raised median islands are constructed, the area occupied by these islands will be included in the area measured for payment. Where the new pavement is not bounded by curb and gutter and additional shoulder work is necessary to construct the typical section shown in the project plans, such work shall be considered as included in the cost of the contract bid item "Grading Roadway for Pavement".

302.12 BASIS OF PAYMENT:

The accepted quantities of grading roadway for pavement, measured as provided above, will be paid for at the contract unit price per square yard for the work complete as specified herein and as shown on the project plans.

SECTION 310

UNTREATED BASE

310.1 DESCRIPTION:

The work under this section shall consist of furnishing placing and compacting aggregate bases in accordance with the details shown on the project plans and the requirements of these specifications.

310.2 MATERIAL:

Untreated base, i.e., select or aggregate base course, shall conform to the requirements of Section 702 unless the use of a different type of material is specifically authorized in the special provisions.

310.3 PREPARATION OF SUBGRADE:

Prior to constructing the aggregate base course, the previously constructed subgrade shall be cleaned of all foreign substances. The subgrade shall be inspected by the Engineer for conformance to the requirements specified in "Subgrade Preparation" and/or "Grading Roadway for Pavement".

310.4 LINE AND GRADE CONTROL:

Untreated base shall be built in accordance with line and grade stakes placed a minimum of every 50 feet in lines parallel to the centerline of the area to be paved and spaced so that string lines may be stretched between the stakes.

310.5 PLACING AND COMPACTION:

Untreated base shall have water added to it and shall be mixed and processed to produce a uniform blend of material before final placement. After processing, the material shall be placed and spread on the prepared subgrade or subbase in a uniform layer or layers not to exceed six inches in compacted depth, unless otherwise approved in writing by the Engineer. The quantity of water applied shall be that amount which will assure proper compaction resulting in a relative density of not less than 100 percent in accordance with the requirements of subsection 205.15 and 310.6 of these standard specifications. Care shall be exercised in connection with watering operations to avoid wetting the subgrade or any lower base course to detrimental extent.

Upon completion, the base surface shall be true, even and uniform conforming to the grade and cross-section specified.

310.6 SAMPLING AND TESTING:

Samples of non-compacted base material shall be taken at the locations and in the manner directed by the Engineer. The Contractor shall allow said samples to be taken. A test shall be taken of each material to determine gradation, percent passing the No. 200 sieve and the P.I.

If, in the opinion of the Engineer, there is a question as to the character of the fraction passing the No. 200 sieve, he shall have the right to have an appropriate qualitative analysis of said material at the Contractor's expense.

Untreated base may vary not more than 1/2 inch above or below required grade and cross-section.

The number of tests required shall be a minimum of one (1) for each location and one for each 1,000 tons of each aggregate material used.

A minimum of one compaction test shall be taken every 500 feet and a minimum of one test per site.

310.7 DEFICIENCY:

When, in the opinion of the Engineer, there is reason to believe that a deficiency in thickness or an excess of plasticity exists, cores will be taken in the same pattern as that defined in Section 321. If the base has been covered or it is otherwise impractical to correct the deficiency, the following corrective measures shall be taken by the Contractor at no additional cost to the Contracting Agency:

Type	Deficiency	Corrective Measure
I	1/2" or more but less than 1" in thickness	Place asphalt chip seal using coated chips in accordance with Section 330 for the full roadway width over the area involved but for not less than 660 feet in length.
II	1" or more in thickness	Place an additional asphalt concrete overlay, Type E-3/8 of half the thickness of the deficiency for the full roadway width over the area involved, not less than 660 feet in length.
III	A plasticity index of 5	Place an asphalt concrete overlay 1/2 inch in thickness over the same total area as required for Type I and II.
IV	A plasticity index of over 7	Remove deficient material from affected area and replace with material complying with the specifications.

310.8 MAINTENANCE:

The finished base course shall be maintained by the Contractor in a condition satisfactory to the Engineer until the asphaltic concrete surfacing is placed.

310.9 MEASUREMENT:

This item will be measured by the square yard complete in place.

310.10 PAYMENT:

The amount of completed and accepted work, measured as provided above, will be paid for at the contract price for "Aggregate Base Course", which price shall include full compensation for furnishing all labor, materials, tools, equipment, compaction, water and incidental expenses necessary to complete the work as shown on the plans and as specified herein.

Payment is not to include cuts for untreated base used in pavement matching and surface replacement. Payment for untreated base used for that work is to be charged to the pavement matching and surface replacement pay item.

SECTION 315

BITUMINOUS PRIME COAT

315.1 DESCRIPTION:

Bituminous prime coat shall consist of furnishing bituminous material and applying this bituminous material to a prepared base course, in accordance with these specifi-cations.

315.2 MATERIALS:

Bituminous material shall conform to the requirements of Section 712 of these Specifications for the type and grade specified.

315.3 CONSTRUCTION METHODS:

315.3.1 Preparation of Surface: The surface on which the bituminous prime coat is to be placed shall be uniformly smooth and firm and reasonably true to grades and cross-sections as shown on the plans, and shall be so maintained throughout the period of placing the prime coat. In no event shall a prime coat be placed on a soft, uneven base. Any holes, depressions or irregularities shall be repaired by the removal of all loose and unsuitable material and replacement by suitable material, which shall be compacted to produce a dense surface conforming to the adjacent area. Uniformity of surface texture is of the utmost importance.

When required, the surface on which the prime coat is to be placed shall be lightly bladed, watered and compacted immediately prior to the application of bituminous material. For extremely dry areas, a light application of water may be required prior to the application of bituminous material.

315.3.2 Application of Bituminous Material: The approximate quantity of bituminous material to be used will be specified; however, the exact amount used will be determined by the Engineer at the time of application. The bituminous material shall be uniformly applied to the prepared surface at the rate so designated and in one application.

The application of bituminous material and distributing equipment shall conform to the requirements of Section 330.

When it is deemed necessary, areas having excess bituminous material shall be blotted with material as directed.

When it is directed, the surface of the completed prime coat shall be rolled with a pneumatic-tired roller.

315.3.3 Maintenance of Surface: Traffic shall be kept off the bituminous material until it has penetrated the base or subgrade and cured sufficiently.

The integrity of the prime coat shall be maintained at all times until the next course is placed or until final acceptance. In the event traffic has caused holes or breaks in the surface, such holes or breaks shall be satisfactorily repaired by the Contractor.

315.4 MEASUREMENT:

The accepted quantities of bituminous material for bituminous prime coat will be measured by the ton undiluted for the bituminous material used.

No measurement or direct payment will be made for rolling.

315.5 PAYMENT:

(A) Payment for the bituminous material will be on the basis of the price bid per ton, undiluted, complete in place based on certified weight slips supplied by each truck driver on each delivery and placement on the site.

(B) Payment for furnishing, applying and removing blotter material will be paid for as an extra work item.

SECTION 320

ROAD-MIXED SURFACING

320.1 DESCRIPTION:

Road-mixed surfacing shall consist of a mixture of mineral aggregate and bituminous binder mixed on the roadbed or other area, spread and compacted on a prepared subgrade or base course in conformity with the lines, grades and dimensions shown on the plans or typical cross-section, or as specified in the special provisions.

320.2 MATERIALS:

Materials shall conform to the requirements of Sections 710 and 712 of these Specifications for the type and grade specified on the special provisions.

320.3 PRIME COAT:

When a prime coat is required it shall be applied as specified in Section 315 of these Specifications.

320.4 SPREADING AGGREGATE:

The mineral aggregate shall be deposited in a windrow along one side of the roadbed or other approved area by means of approved spreader box equipped with a readily adjustable strike-off device or other suitable equipment. The maximum lift for blade mixing and laying shall not exceed 1 cubic yard per running foot. If the mineral aggregate is delivered to the roadbed in separate sizes, each size of aggregate shall be spread in a windrow of the required quantity for that size of material, after which the windrows of various sizes shall be blended into one windrow along side of the roadbed.

The aggregate shall be so spread that the windrows will be uniform and equal in size and will contain the proper quantity of material to provide surfacing of the required width and thickness. Care shall be exercised to prevent the aggregate from becoming mixed with earth or shoulder material. Preparatory to applying the liquid asphalt, a portion of the material from the windrow shall be spread uniformly over 1/2 the width of the roadbed.

Unless permitted by the Engineer, no more aggregate shall be spread on any one day than can be mixed with liquid asphalt within 72 hours. If traffic conditions require, the Engineer may require spread or flattened windrows.

320.5 APPLICATION OF LIQUID ASPHALT:

The temperature of the liquid asphalt, when applied, shall be in accordance with Section 712, and 16 to 22 gallons shall be applied for each cubic yard of road-mix material, in not less than 2 approximately equal applications.

Unless otherwise approved by the Engineer, no liquid asphalt shall be spread when weather conditions are unsuitable, or when the moisture content of the mineral aggregate exceeds 3 percent by weight of the dry aggregate. When the aggregate is unusually porous, the permissible moisture content may be increased and liquid asphalt spread at the discretion of the Engineer, when laboratory tests indicate that such increased moisture content will not produce an unstable mixture.

Liquid asphalt shall be prevented from spraying upon adjacent pavements, structures, guard rails, guide posts, culvert markers, trees and shrubbery, adjacent property and improvements and other highway improvements or facilities not specifically mentioned herein, or that portion of the traveled way being used by traffic.

320.6 MIXING:

Immediately following each successive application of liquid asphalt, the surfacing material shall be thoroughly mixed by means of a blade. After the final application, the material shall be bladed into a windrow and the windrow bladed back and forth between the center and the edge of the area to be surfaced with a heavy blade grader having a wheel base not less than 16 feet long, until a satisfactory mixture of uniform appearance is obtained.

Should the mixture show an excess or deficiency of liquid asphalt, or uneven distribution thereof, prior to spreading and compacting, the condition shall be corrected by adding mineral aggregate or liquid asphalt, as the need may be and remixing the material to produce a satisfactory mixture. If necessary, all compressed masses of material shall be broken up.

After mixing, the material shall be placed in a windrow prior to spreading.

After the material has been mixed as above specified all of the mixed material shall be bladed into a single windrow in the center of the roadbed and the entire mass of treated material turned not less than 4 complete times by blading first to one side of the road and then to the other.

In lieu of mixing the material as above specified, a road-mixing machine or any equipment other than that required above may be employed which will produce a completed mixture equal to that which would be produced by means above specified. The Engineer reserves the right to order the use of any equipment discontinued which, in his opinion, fails to produce a satisfactory mixture.

Road-mixing machines shall be of the pug mill or auger type or other suitable equipment capable of picking up the loosened material completely from the roadbed, leaving practically no loose material on the ground, and which will introduce the liquid asphalt through a metering device at the time of mixing. The machine shall be equipped with the positive control of the amount of liquid asphalt introduced into the mix which can be readily adjusted to changes in grading of the road material.

The rate of movement of the machine along the roadway, the amount of material mixed and the amount of mixing shall be so regulated that a uniform mixture of unchanging appearance is obtained and all particles of aggregate are thoroughly coated with liquid asphalt. Before mixing on the roadbed the loosened material shall be placed in windrows or in a blanket of uniform cross-section and of such size that all the material in the windrow or blanket can be passed through the mixing machine at each mixing operation. Sufficient material, as determined by the Engineer, shall be placed in windrows or in a blanket in advance of mixing.

No mixed material shall be spread and compacted until the mixture has been approved by the Engineer.

The amount of material mixed on any one day shall not be more than can be spread and compacted on the following day, except that when directed by the Engineer mixed material shall remain in the windrow for a longer period.

Mixing the liquid asphalt with the mineral aggregate prior to delivery on the roadbed will be permitted, provided that the complete mixture is uniform in character and the same consistency with respect to grading, asphalt content and moisture as that specified for road-mixing.

Liquid asphalt added to mineral aggregate at a central mixing plant shall be accurately weighed by means of dial scales or other approved weighing devices. Liquid asphalt added to mineral aggregate in a traveling mixing plant shall be accurately measured by means of meters or other approved measuring device. Weighing or measuring liquid asphalt being added to mineral aggregate at mixing plants in accordance with the above specified methods shall be for the purpose of properly proportioning the material and not for determining the pay quantities of liquid asphalt.

320.7 SPREADING AND COMPACTION:

Spreading shall be in increments not exceeding 1 inch in thickness.

Rolling shall be continuous throughout the spreading operations until all the loose material has been laid and consolidated.

Segregation of coarse or fine particles shall be avoided and the surfacing as spread shall be free from lumps or pockets of coarse or fine material. Segregated materials or lumps shall be remixed by blading.

After spreading on the roadbed, should the moisture content of the mixture exceed 3 percent it shall be reduced by blading and reblading the mixture and allowing it to dry before the final spreading. Should blading and reblading of the mixture fail to reduce the moisture content below that above specified, the mixture shall be scarified, turned and re-spread until the moisture content does not exceed 3 percent by weight of the dry aggregate, with the exception, however, that in certain special cases when the mineral aggregate is unusually porous, the permissible moisture content may be increased at the discretion of the Engineer, when laboratory tests indicate that such increase will not result in an unstable mixture.

During blading and rolling, all lumps or compressed masses of the mixture shall be remixed and again rolled. On completion of the blading operations all loose stones shall be swept to the outside of the surfaced area and incorporated with the shoulder material or picked up and disposed of.

The edges of the completed surfacing shall be trimmed uniformly to the required cross-section and width before the shoulders are finally rolled and shaped.

The completed surface, when ready for acceptance, shall be thoroughly compacted, smooth and even, true to grade and cross-section, and free from ruts, humps, depressions or inequalities. When a 10 foot straightedge is laid on the finished surface and parallel with the centerline of the road, the surface shall vary in no place more than 1/8 inch from the lower edge of the straightedge.

Should pneumatic-tired rollers be used, the final finishing shall be accomplished with a tandem roller. Sufficient blading and rolling equipment shall be furnished.

Where shown on the plans or specified in the special provisions, road-mixed material shall be placed and compacted around spillway assemblies, drop inlets and manholes outside the area to be surfaced, upon road approaches and connections, over gutter, ditch and dike areas, and over other areas, to the thickness shown on the plans or ordered by the Engineer.

At locations where the surfacing is to be placed over areas inaccessible to the required spreading and compacting equipment or over areas where the use of re-quired spreading and compacting equipment would be impractical, the mixed material may be spread and compacted by other methods when approved or so ordered by the Engineer. Road-mixed surfacing placed on road approaches and connections shall be placed to the thickness and as specified for surfacing to be placed on the roadbed.

320.8 COMPACTION AND TESTING:

After final rolling, the finished surface course shall have a density of at least 92 percent compaction of the theoretical maximum density possible to obtain with the same materials in like proportions when computed without voids by specific gravity tests. One compaction test per 500 linear feet of roadway with at least one test per street shall be performed.

320.9 MEASUREMENT:

Road mixed surface will be measured by the square yard, using plans dimensions, unless otherwise specified.

320.10 PAYMENT:

The accepted quantities of road mixed surface, measured as provided in subsection 320.9, will be paid for at the contract unit price. The price bid per square yard shall include the furnishing of all labor, materials, tools, compaction, asphalt and the dressing of the subgrade, or base course necessary to complete the work.

SECTION 321

ASPHALTIC CONCRETE PAVEMENT

321.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials, mixing at a plant, hauling and placing a mixture of an aggregate material and an asphalt cement to form a pavement surface and/or base course or curb or to be used for other specified purposes, placed previously prepared base in accordance with the project plans and the requirements of these specifications.

321.2 MATERIALS AND MANUFACTURE:

Materials and manufacture shall conform with Section 710 of these Specifications for the type specified.

321.3 WEATHER AND MOISTURE CONDITIONS:

Asphaltic concrete shall be placed only when the surface is dry and when the atmos-pheric temperature in the shade is 40°F or above. No asphaltic concrete shall be placed when the weather is foggy, rainy or when the base on which the material is to be placed contains moisture in excess of the optimum. Asphaltic concrete shall be placed only when the Engineer determines that weather conditions are suitable.

321.4 APPLICATION OF TACK COAT:

A tack coat shall be applied to all existing and to each new course of bituminous surfaces prior to the placing of a succeeding layer of bituminous mixed material. The tack coat may be deleted when a succeeding layer of asphaltic concrete is being applied over a freshly laid course that has been subjected to very little traffic when approved by the Engineer.

The application of the tack coat shall comply with Section 329 of these Specifications. The grade of emulsified asphalt shall be SS-1h as specified in Section 713.

The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs and gutters against which asphaltic concrete is to be placed.

The surface to be covered may require repair or patching as directed by the Engineer.

321.5 PLACING, SPREADING, AND FINISHING:

Asphaltic concrete shall be delivered and placed at a temperature no higher than necessary for placing, finishing and spreading, but shall be high enough to accom-plish this work. Tarpaulins shall be furnished and used to cover all loads during transportation if difficulties in spreading, finishing or compacting, as determined by the Engineer, are experienced and the temperature of the mixture taken at a point 6 inches below the exposed top surface is below 200°F at the point of delivery in the truck. No free treating fluid shall be present in the truck bodies at the time of asphaltic concrete loading. Diesel fuel shall not be used as a treating fluid.

The handling of the completed mixture shall at all times be such as to prevent segregation, and the material as spread shall be free from areas of excess coarse, or fine material. Float rock developed in the process of raking shall be placed on an underlying course or otherwise disposed of. In no case shall it be scattered over the surface of a final course.

Placing shall begin on pavement at points farthest from the source of supply, and progress continuously toward the source of supply, unless otherwise ordered by the Engineer, and no more than 1/2 day's delivery to the project shall be placed in any one lane in advance of the other lanes. The end of each lane shall be staggered in relation to the adjacent lane.

At locations where the mixture is to be placed over areas inaccessible to the required spreading or compacting equipment or over areas where the use of the required spreading and compacting equipment would not be practicable, the mixture may be spread or compacted by other methods as approved by the Engineer.

321.5.1 Base Preparation: The base prepared by the Contractor, on which the asphaltic concrete is to be placed shall be smooth, firm and true to grade and cross-section as shown on the plans and shall be so maintained throughout the period of placing asphaltic concrete. If necessary, in order to obtain the above specified base condition and if ordered by the Engineer, a leveling course of asphaltic concrete compacted in layers not exceeding 2 inches in thickness or aggregate base shall be spread to level irregularities such as dips, depressions and sags. All irregularities, such as humps or high spots, shall be removed in order to provide a smooth base of uniform grade and cross-section, so that subsequent surfacing will be of uniform thickness.

No additional compensation will be allowed for furnishing and placing these materials, and full compensation for all materials and for all work incidental to the correcting of irregularities will be considered as included in the contract price for asphaltic concrete.

321.5.2 Spreading and Finishing Equipment: Self-propelled mechanical spreading and finishing equipment shall be provided with a screed or strike-off assembly capable of distributing not less than the full width of a traffic lane. The term screed includes any strike off device operated by tamping or vibrating action which is effective without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. The forward speed of operation of self-propelled mechanical spreading and finishing equipment shall be so regulated that no irregularities will result in the surface texture or smoothness of the mat due to excessive forward speed of the spreading machine. The forward speed of operation shall not exceed 55 feet per minute unless the Contractor can demonstrate to the satisfaction of the Engineer that higher speeds will not affect the smoothness of the mat.

Self-propelled mechanical spreading and finishing equipment shall be equipped with a control system capable of automatically maintaining the screed elevation as specified herein.

The control system shall be automatically actuated from either a reference line or surface through a system of mechanical sensors or sensor directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. When directed, the trans-verse slope control system shall be made inoperative and the screed shall be controlled by sensor directed automatic mechanisms which will independently control the elevation of each end of the screed from reference lines or surfaces.

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

(A) Ski-type device of not less than 30 feet in length.

(B) Taut stringline or wire set to grade.

(C) Short ski or shoe.

The Contractor shall furnish the long ski, the short ski or shoe and all required stakes and wire required for 5000 feet of taut stringline. Should the automatic control system become inoperative during the day's work, the Contractor may be permitted to finish that day's work using manual controls; however, work shall not be resumed thereafter until the automatic control system has been made operative.

When trucks are backed into the paver, it shall be in such a manner that the paver will not be jarred excessively or moved out of line and the trucks shall be securely attached to the paver during spreading and finishing.

When the Engineer deems that the automatic screed control operation is not practical under a particular set of conditions, he may order the use of manual control in lieu thereof. However, the machine shall be equipped with the automatic device.

Motor graders shall have a wheel base of not less than 16 feet and be equipped with a blade not less than 12 feet long. Motor graders shall be free from appreciable lost motion in the blade control.

Use of spreader boxes will be permitted only under certain conditions, such as in alleys and on narrow paving projects where it is not practical to use a standard blade or laydown machine.

321.5.3 Leveling Course: A leveling course shall be used when specified, or as directed in writing by the Engineer, to bring existing pavement to a uniform grade prior to placing an overlay or other course.

After the prime coat or tack coat has been applied, the leveling course mixture shall be spread to the proper width and to such depth as will compact to the required thickness. Actual quantities of the mixture required will be determined by the Engineer.

The distance to which a leveling course may be spread in advance of covering it with the following course shall be as ordered by the Engineer.

The leveling course material shall be placed in layers, 2 inches maximum thickness, prior to finishing, by a motor grader, by means of approved spreader boxes equip-ped with readily adjustable strike-off blades or by means of self-propelled spreading equipment.

Finishing by means of a motor grader shall be done in accordance with the following:

The leveling course shall be placed with a self-propelled pneumatic-tired blade grader equipped with an automatic leveling device capable of accurately maintaining the transverse slope of the blade at a pre-set angle. In lieu of this, the Contractor shall be permitted to use any method at his discretion as long as the finished surface does not vary from the designed surface by more than the amount specified below.

The placing of the leveling course shall be for not less than 1/2 the street or roadway width at a time and for the longest practical length for any one lay, preferably not less than 1,200 feet.

The spreading of the leveling course in any one lane in this 1/2 width shall not proceed in advance of the adjacent lane to the extent that cooling of material will not permit proper manipulation with the motor grader.

A pneumatic-tired roller shall be operated concurrently with the operation of the blade during the laydown of the leveling course. Finishing by means of self-propelled mechanical spreading and finishing equipment shall be done in accordance with the following:

In order to obtain a smooth surface, manipulation of controls of the paver shall be at a minimum. Unless otherwise permitted by the Engineer, adjustments shall not be made in less than 50 foot intervals and any adjustment shall not result in a change in thickness of the pavement in excess of 1/8 inch, except where the machine is equipped with electronic grade controls.

Finishing by means of approved spreader box shall be done in accordance with the following:

In order to obtain a smooth surface, manipulation of controls of the spreader box shall be held to a minimum.

Trucks shall be backed into the spreader box in such a manner that the spreader box will not be jarred excessively or moved out of line and the trucks shall be securely attached to the spreader box during spreading and finishing.

Rolling shall be accomplished by use of a pneumatic-tired roller and shall proceed concurrently with the laydown of the leveling course.

The leveling course shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/2 inch from the lower edge of a 25 foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the Contractor and shall be constructed of such lightweight materials that it can be handled by the inspector without assistance.

When deviations in excess of the above tolerance are found, such places as humps; or depressions shall be corrected to meet the specified tolerance. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

321.5.4 Asphaltic Concrete Base and Surface Course: Asphaltic concrete base and surface courses shall be spread and finished by means of self-propelled mechanical spreading and finishing equipment as described and specified above, except that base course material may be laid with a motor grader, if approved in writing by the Engineer. The compacted thickness of layers placed shall not exceed 4 inches for base course or 2 inches for surface course except as otherwise provided in the plans and specifications if approved in writing by the Engineer.

The cross section of the asphaltic concrete pavement shall be in accordance with Yuma County Construction Standards 2-010 through 2-090 and 2-100 as specified on the plans.

When more than one course is placed, longitudinal joints of each course shall be staggered not less than 6 inches with relation to the longitudinal joints of the underlying course.

Before a surface course is placed adjacent to cold transverse construction joints, such joints shall be trimmed to a vertical face by cutting the material back for its full depth so as to expose a fresh surface. The joint formed when the fresh mixture is placed shall be dense and well sealed. The transverse surface joints shall be tested with a 25 foot straightedge and shall conform to the requirements herein for surface smoothness. An approved joint heater shall be used on cold transverse or longitu-dinal joints where conditions are such that it is deemed necessary by the Engineer. The joint heater shall be capable of heating the joint to a minimum temperature of 200°F for a minimum depth of 1/4 inch at a speed commensurate with that of the laydown machine.

If it is deemed necessary by the Engineer to seal the joints, a light coat of asphalt emulsion shall be applied to the exposed edge before the joint is made.

Sufficient rolling equipment shall be furnished to compact and finish satisfactorily the amount of mixture being placed. A minimum of 2 rollers and 2 operators shall be provided for production of 150 tons or less per hour where the thickness of layer to be placed is over 1 inch. Where the thickness of lift to be placed is 1 inch or less, the minimum pieces of rolling equipment shall be 3 rollers consisting of 1 smooth wheel and 2 pneumatic rollers, and 3 operators, unless otherwise directed by the Engineer. In all cases 1 additional roller and operator shall be provided for each additional 100 tons or fractional part thereof, per hour. All rollers shall be operated continuously from the breakdown through finish rolling.

In lieu of smooth steel wheel and pneumatic rollers specified herein, the Contractor may utilize one (1) vibratory steel wheel compactor in compaction of asphaltic concrete for production of 325 tons or less per hour. In all cases, one (1) additional vibratory roller and operator shall be provided for each additional 300 tons, or fractional part thereof, per hour. Vibratory steel wheel compactor shall be self-propelled, with a minimum weight of 8 tons, equipped with an automatic device capable of properly moistening the wheel or wheels without adding an excess of water or other approved material. Vibratory compactor shall be operated with the larger wheel in the forward position. Rolling procedures, surface tolerance and compactive results when utilizing vibratory compactor shall be as specified herein.

The 6 inch strip adjacent to the area on which future material is to be laid shall not be rolled until such material has been placed but shall not be left unrolled more than 2 hours after being placed, unless the 6 inch unrolled strip is first heated with a joint heater.

After the first strip or width has been compacted, the second width shall be placed, finished, and compacted as provided for the first width, except that rolling shall be extended to include the 6 inches of the first width not previously completed.

All rollers used in compaction of asphaltic concrete shall be self-propelled and reversible, with a minimum weight of 8 tons. All rollers shall be equipped with an automatic device or devices capable of properly dispensing an approved releasing agent on the wheels to prevent the wheels from picking up the asphaltic concrete.

Diesel fuel shall not be used as a releasing agent.

A releasing agent to prevent pick-up by the roller wheels shall be used as approved by the Engineer. This is a non-pay item. Pneumatic-tired rollers for use in breakdown rolling shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the rolling process.

Pneumatic-tired rollers shall be of the 2 axle tandem type, having a rolling width of not less than 5 feet. All tires shall be of the same size and shall have treads satisfactory to the Engineer. The roller shall be so constructed that the operating weight per tire shall not be less than 2,000 pounds and the tires shall be spaced so that the entire gap between adjacent tires will be covered by the tread of the following tire. Except as otherwise specified, each tire shall be inflated to 90 psi and at all times the air pressure in each tire shall not vary more than 5 psi from the specified pressure.

There shall be 1 pneumatic-tired roller and 1 smooth-wheel power roller on the project at all times. The required rollers shall be on the project and in acceptable operating condition, prior to the placement of any asphalt material.

Breakdown rolling shall begin as soon as the mixture will bear the roller without undue displacement. Rolling shall be longitudinal, overlapping on successive trips by at least 1/2 but not more than 3/4 the width of the rear wheels. Alternate trips of the roller shall be of slightly different lengths. The motion of the roller shall at all times be slow enough to avoid displacement of the mixture. Final compaction and finish rolling shall be done by means of a tandem power roller. Rolling shall continue until the specific gravity of the compacted mixture is not less than 95 percent of the specific gravity of specimens composed of the same materials in similar proportions or composed of the same mixture compacted in the laboratory by the 75 blow method of ASTM D-1559.

At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers and finished, where necessary, with a hot smoothing iron to provide a uniform and smooth layer over the entire area compacted in this manner.

The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/4 inch from the lower edge of a 25 foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the Contractor and shall be acceptable to the Engineer.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

In order to alleviate the problem of raveling resulting from oil drippings between wheel paths of automobiles adjacent to stop lights, the surface of the Open Grade G-3/8 course shall be made denser by an application of sand at each traffic signal or stop sign on a major street.

The sand application shall be in the amount of 10 to 15 pounds per square yard, and shall be applied immediately after initial rolling of the Open Grade G-3/8 course and then rolled, concurrent with final rolling. The application shall extend through the intersection for the full width, and for 200 feet on each side of the centerline of the intersecting street. Throughout other areas a light application of 2 to 3 pounds of sand shall be applied, after final rolling, to minimize pickup by traffic. The grading for sand shall be as follows:

TABLE 321-1

Sieve Size	Percent Passing
No. 4	100%
No. 8	90-100%
No. 30	40-75%
No. 200	0-10%

321.5.5 Preservative Seal: An asphaltic concrete preservative seal shall be used on all new asphaltic concrete pavement and shall comply with Section 334. The Engineer will make a field determination and provide the actual application rate or delete the requirement. This seal is not required for pavement matching and surface replacement over pipe trenches, etc., unless specified in the special provisions.

321.6 TESTING:

In order to determine the gradation and asphalt cement percent of the asphaltic concrete paving mix, a minimum of one sample for each site and each 1,000 ton on each of the binder and surface course mix shall be taken and tested according to ASTM Designation D2172. Sampling shall be done during the laydown operation. Compaction test shall be taken every 500 feet of roadway with at least one test per street and in accordance with ASTM D-2950.

The specific gravity of specimens composed of the same materials in similar proportions or composed of the same mixture compacted in the laboratory shall be by the 75 blow method of ASTM D-1559.

321.7 CORRECTIVE REQUIREMENTS FOR DEFICIENCIES:

When in option of the Engineer, there is reason to believe that the pavement may be deficient in thickness, cores will be taken by the Engineer at random locations, with 1 core for every 500 feet of lineal distance, with a minimum of 1 core between intersecting streets or portions there of for each strip of paver width. When a deficiency of more than 1/4 inch is found, 2 additional cores will be taken not closer than 100 feet apart nor closer than 100 feet to the original core, and the average of these 3 cores will be used to determine the amount of the deficiency. Further cores may be taken by the Contractor if he so chooses, to determine the limits of the deficiency, and shall be at no additional cost to the Contracting Agency but shall not be used in determining the average thickness of the pavement. Thickness of the cores shall be determined by average caliper measurement. Where pavement thickness is deficient by 1/4 inch or less, it will be paid for at contract price.

Where the pavement is deficient in thickness by more than 1/4 inch but not more than 1/2 inch, as directed by the Engineer either payment will be reduced in accordance with Table 321-2 or the pavement shall be overlaid with a minimum 3/8" thick in the affected areas.

TABLE 321-2

Specified Mat Thickness	Reduction in Payment
1"	50%
1-1/2"	33%
2"	25%
2-1/2"	20%
3" or over	17%

When the deficiency of the pavement thickness exceeds 1/2 inch, the pavement shall be overlaid on the area affected, but in no case less than one City block or 660 feet whichever is less in length, for the full width of pavement, with a new mat of material specified by the Engineer, equal in thickness to the deficiency but not less than 1/2 inch in any instance. This is to be done at no additional cost to the Contracting Agency.

When the pavement is deficient in thickness by more than 1/4 inch, all coring done to establish this premise shall be at the expense of the Contractor.

When, in the opinion of the Engineer, there is reason to believe that the compaction of the mixture is deficient, cores will be taken in the same pattern as that defined here in of this subsection, except that the figure 1 percent will be substituted for 1/4 inch, and tested for specific gravity.

Where the specific gravity is deficient by 1 percent point or less, it will be paid for at the contract price.

Where the specific gravity is deficient by more than 1 percent point, and the Con-tractor is unable to correct the deficiency, payment will be reduced as follows:

TABLE 321-3

Deviation Below Specification	Reduction in Payment
2% points	2%
2 to 3% points	5%
3 to 5% points	10%

When the deviation is more than 5 percent points, the Contractor shall place an 1/4" thick minimum overlay over the area involved but for not less than one City block or 660 feet whichever is less.

When the asphalt cement content exceeds the limits established in Section 710, 2 additional core tests will be made for each deficient test taken, and the average of all 3 tests made shall be used to determine the asphalt cement content.

When the asphalt cement content is in excess of that permitted, the Contractor shall remove any areas of bleeding, but in no case less than the specified roller width, as directed by the Engineer, and replace the affected material with new material meeting the specification requirements for the mix type involved. This shall be done, any time within a period of 1 year until the bleeding has been corrected, at no additional cost to the Contracting Agency. Should the stability of the mix be effected by the excess asphalt cement to such an extent that the pavement is displaced under normal traffic loads, within a period of 1 year, the areas affected shall be removed and replaced with new material, at no additional cost to the Contracting Agency.

When the asphalt cement content is from 0.0 to 0.2 percent points, weight of the total mixed material less than the minimum permitted in Section 710, payment to the Contractor for asphaltic concrete pavement will be reduced as follows:

TABLE 321-4

Deviation From that Permitted	Payment Reduction
0.0 to 0.1% points	2%
Over 0.1 to 0.2% points	5%

When the deviation is more than 0.2 percent points, greater than the permitted deviation, the Contractor shall place a asphalt chip seal using precoated chips complying with Section 330 over the area involved but not for less than one City block or 660 feet whichever is less.

The monetary compensation shown in Table 321-4 will apply when a public agency is the Contracting Agency. When the contract is directly with a party other than a public agency, as in the case of permits, etc., the following penalties apply in lieu of the monetary considerations listed in Table 321-4. When the deviation is in the range of 0.0 to 0.2% points, not inclusive, greater than the permitted deviation, a separate absorption test shall be made to determine the proper application rate for the preservative seal for this specific section. The Engineer shall make the decision as to the rate of application for this section. When the deviation is 0.2% points or more greater than the permitted deviation, the Contractor shall place a asphalt chip seal using precoated chips in accordance with Section 330 over the area involved for not less than one City block or 660 feet, whichever is less.

When the mineral aggregate gradation, or plastic index of the aggregate, deviates from the requirements of this specification in an amount which, in the opinion of the Engineer will affect the stability or durability of the mix, the Contractor shall, as directed by the Engineer, either; remove the asphaltic concrete and replace it with material which meets the requirements of this specification, or place an additional mat of such thickness and gradation as required by the Engineer which will, in the opinion of the Engineer, correct the deficiency.

The above corrective work, due to deviations from the requirements for mineral aggregate, shall be done at no additional cost to the Contracting Agency.

321.8 CURBS:

Asphaltic concrete curbs when required on the plans, shall he placed by an approved extrusion type machine. In the event the Contractor wishes to utilize a template which varies from the cross-section shown on the plans, such change must meet the approval of the Engineer. Mineral aggregate shall be Dense Grade E-3/8, except that the asphalt cement content shall not be more than 7-1/2 percent or less than 7 percent by weight of the total mixture. One percent by weight of the total mixture shall consist of a granulated synthetic resin stiffener, Lexite or equal, complying with the following characteristics:

Softening Point (Ring & Ball)	ASTM D-2398	210°F minimum
Acid Number	ASTM D-465	Less than 1.00
Saponifiable matter	ASTM D-464	Less than 1%
Iodine Number	ASTM D-29	175-185

321.9 MEASUREMENT:

(A) Asphaltic concrete pavement will be measured by the square yard, computed to the nearest 0.5 or square yard, of the area actually paved as allowed above, which shall include the required quantities of mineral aggregates, filler material, asphalt cement and sand. Measurement shall include construction of intersections, road-ways, streets or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.

The bid price per square yard for asphaltic concrete shall include the cost of the asphalt cement in the percentages as specified in Section 710.

(B) Asphaltic concrete curbs will be measured by the linear foot, parallel to the base or foundation, unless otherwise specified.

(C) Preservative seal for asphaltic concrete pavement will be measured by the ton diluted, unless otherwise indicated in the special provisions.

321.10 PAYMENT:

(A) The asphaltic concrete measured as provided above, will be paid for at the contract price per square yard, of thickness specified which price shall be full compensation for the item complete, as herein described and specified.

(B) Payment for tack coat will be by the ton diluted, based on the rate of application as directed by the Engineer.

(C) The quantities of preservative seal, measured as provided above will be paid for at the contract bid price per gallon diluted or as specified, which price shall be full compensation for the item complete as herein described or as specified.

Payment for asphaltic concrete curbs will be at the contract unit price bid per linear foot, which price shall be full compensation for the curb complete in place, including all necessary labor, equipment and material.

Payment is not to include costs for asphaltic concrete pavement used in pavement matching and surface replacement. Payment for asphaltic concrete pavement used for that work is to be charged to the pavement matching and surface replacement pay item.

Except as otherwise specified in the special provisions, no separate payment will be made for work necessary to construct miscellaneous items or surfaces of asphaltic concrete.

SECTION 322

ASPHALTIC CONCRETE OVERLAY

322.1 DESCRIPTION:

Asphaltic concrete overlay consists of the placing and compaction of plant mix asphaltic concrete over existing asphaltic concrete paving. The thickness of the overlay shall be as shown on the plans or as specified in the special provisions. Preliminary preparation of existing surfaces will be required except when accomplished by the Contracting Agency, and it is so stipulated in the special provisions. With the exception of those which have been preheated and remixed only, existing surfaces shall receive a tack coat.

322.2 MATERIALS:

The tack coat, asphaltic concrete mix and transportation of the mix shall be as specified in Sections 710 and 321 of these Specifications, except for the maximum size of aggregate and percentage of binder which shall be as specified in the following paragraph.

322.3 ASPHALTIC CONCRETE:

The aggregate gradation and percentage of asphalt binder shall be in accordance with Section 710 using Type D-1/2 for overlay more than 1 inch in thickness and Type E-3/8 for overlay 1 inch or less in thickness, unless otherwise shown or specified in the special provisions.

322.4 PREPARATION OF SURFACES:

Except when they have been preheated and remixed, surfaces shall be prepared as follows:

Before placing asphaltic concrete overlay, severely raveled areas or cracked areas that are depressed more than 3/4 inch from the adjoining pavement shall be cut out and patched at least 48 hours prior to the resurfacing operation. Over-asphalted areas or rough high spots shall be removed by burning or blading. Large shrinkage cracks shall be filled with asphalt sealing compound acceptable to the Engineer. The entire surface shall be cleaned with a power broom. Raveled areas that do not require removing shall be cleaned by hand brooming. The above are incidental, and the cost thereof shall be included in the bid items.

After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat as specified in Section 321. Traffic will not be permitted over surfaces which have received a tack coat. When the overlay is to extend onto the concrete gutter, the gutter shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

322.5 CONSTRUCTION METHODS:

Placing and rolling of the asphaltic concrete and the smoothness of the surface shall be as specified in Section 321. Compaction and testing shall be in accordance with Section 321.

322.6 MANHOLES:

Manholes shall be built up and the frames set flush with the finished surface of the new paving and tops of valve boxes, clean-outs and other existing structures shall be adjusted to finish grade. In the event the base course and original paving have been removed or disturbed in order to build up the manhole, they shall be replaced with approved materials which shall be thoroughly compacted. The asphaltic concrete around the manhole frame shall be completed and made flush with the adjacent overlay.

322.7 MEASUREMENT AND PAYMENT:

Measurement and payment for tack coat and asphaltic concrete overlay will be as specified in Section 321 of these Specifications except as noted above.

SECTION 329

TACK COAT

329.1 DESCRIPTION:

Tack coat for bituminous paved surfaces shall consist of the application of emulsified asphalt as specified in Section 713 of these Specifications.

329.2 PREPARATION OF SURFACE:

Immediately before applying the bituminous material, the area to be surfaced shall be cleaned of dirt and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms.

The bituminous material shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

329.3 APPLICATION:

Tack coat shall be diluted in the proportion of 50 percent water and 50 percent emulsion and applied at the rate of 0.05 to 0.10 gallons per square yard. Application shall be made in advance of subsequent construction as ordered by the Engineer.

The Engineer may either reduce the rate to be applied or eliminate the use of tack coat in any part of the work if, in his judgment, the bituminous mixed material to be placed will be effectively bonded to the underlying surface.

329.4 EQUIPMENT:

Tack coat shall be applied by distributor trucks designed equipped, maintained and operated in accordance with Section 330. Hand spray by means of hose or bar through a gear pump or air tank shall be acceptable for resurface work corners or tacking of vertical edges. Care shall be taken to provide uniform coverage. Equipment that performs unsatisfactory shall be removed from the job.

329.5 PROTECTION FOR ADJACENT PROPERTY:

Care shall be taken to prevent the spraying of asphalt emulsion on adjacent pave-ments, including that portion of the pavement being used for traffic, on structures, guard rails, guide posts, markers, trees, shrubs and property of all kinds.

329.6 MEASUREMENT:

Bituminous emulsion that is diluted prior to application will be measured by the ton of diluted material. Any conversion from volumetric quantities shall be in accordance with Section 713.

329.7 PAYMENT:

When provided for in the bid schedule, payment for the emulsified bituminous tack coat will be by the ton; diluted, complete-in-place based on certified weigh slips supplied by each truck driver on each delivery and placement on the site.

SECTION 330

ASPHALT CHIP SEAL

330.1 DESCRIPTION:

This work shall consist of the application of a bituminous material followed by the application of a cover material.

330.2 MATERIALS:

330.2.1 Asphalt: The type of grade of the bituminous material will be specified in the contract documents.

Paving grade asphalt shall meet the requirements of Section 711.

Liquid grade asphalt shall meet the requirements of Section 712.

Emulsified asphalt shall meet the requirements of Section 713.

330.2.2 Aggregate: The cover material (chips) shall meet the requirements of Section 716. Gradation of the chips shall be as specified in Table 716-1 or Table 716-2.

The Contractor shall submit a minimum 75 pound sample of cover material to the Engineer at least 10 calendar days prior to beginning application of cover material, for testing.

330.3 TIME OF APPLICATION AND WEATHER CONDITIONS:

Chip seal shall not be applied for at least 7 days after completion of new bituminous paving.

The chip seal shall be placed only when the roadway surface is dry and there is no imminent threat of rain. The ambient temperature must be at least 60°F and rising.

Chip seal coat shall be placed between the dates shown: March 15 to May 31 and September 1 to November 15.

330.4 CONSTRUCTION METHODS:

330.4.1 Preparation of surfaces: Immediately before applying the bituminous material, the area to be surfaced shall be cleaned of dirt and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pickup sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms.

The bituminous material shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

For chip seals using paving grade asphalt as the binder, a bituminous tack coat shall be applied prior to sealing. The tack coat shall comply with Section 329. The exact rate shall be determined by the Engineer.

330.4.2 Application of Bituminous Material: The bituminous material shall be applied as soon as possible after preparation of surfaces. At the time of application, temperatures of the asphalt shall be within the ranges specified in the following tables and in Sections 711, 712 and 713 for each specific asphalt type. The Engineer may require a specific temperature within the ranges.

APPLICATION TEMPERATURE OF PAVING ASPHALTS

Grade of Paving Asphalts	Distributor Application Temperature, Degrees F	
	Min.	Max.
AC-40	325	375
AC-30	300	350
AC-20	300	350
AC-10	250	345
AC-5	260	325

TABLE 330-2

APPLICATION TEMPERATURES OF LIQUID ASPHALTS

Grade of Paving Asphalts	Distributor Application Temperature, Degrees F	
	Min.	Max.
70	105	175
250	140	225
800	175	255
3000	215	290

TABLE 330-3

APPLICATION TEMPERATURE OF EMULSIFIED ASPHALTS

Grade of Paving Asphalts	Distributor Application Temperature, Degrees F	
	Min.	Max.
RS-1, CRS-1, CRS-1h	75	140
RS-2, CRS-2, CRS-2h	125	185
SS-1, CSS-1	75	130
SS-1h, CSS-1h	75	130

The quantity of liquid or emulsified asphalts will be between the range of 0.20 and 0.40 gals/sq. yd. The quantity of paving grade asphalt will be between the range of 0.17 and 0.31 gals/sq. yd. The exact rate of application will be determined by the Engineer.

The bituminous material shall be placed using a distributor as specified in Section 330. Application methods shall insure that a uniform distribution is obtained over the area to be sealed.

The chips shall be spread before the bituminous material sets. The maximum distance that the bituminous material is applied in advance of the chips will be determined by the Engineer.

The surfaces of structures, trees and shrubbery adjacent to the areas being seal coated shall be protected in such a manner as to prevent their being spattered with bituminous material or marred. The Contractor shall be responsible for all damage to such structures or landscaping.

330.4.3 Application of cover material: Immediately following the application of the bituminous material, the chips shall be spread with a self-propelled mechanical spreader. The chip spreading equipment shall be capable of applying a uniform application of cover material. The self-propelled requirement may be waived for projects under 10,000 sq. yds.

At the time of application, pre-coated aggregate shall be within the temperature range of 250°F and 350°F measured at a point 6 to 12 inches below the top of the load.

At the time of application, uncoated chips shall not contain moisture in excess of a saturated surface dry condition when liquid or paving grade asphalt are used as the seal coat binder.

At the time of application, chips shall be surface wet but free from running water when emulsified asphalt is used as the seal coat binder.

The precise application rate for cover material will be determined by the Engineer within the ranges of 15 to 25 lbs./sq. yd. for the 1/4 in. size and 20 to 30 lbs./sq. yd. for the 3/8 in. size.

When so directed by the Engineer and within 48 hours after application of the pre-coated chips, all chipped surfaces on major streets shall receive a flush coat in accordance to Section 333. The exact rate of application shall be as directed by the Engineer.

330.4.4 Rolling: Immediately following the application of the cover material, the surface shall be rolled with self-propelled pneumatic-tired rollers. Three coverages shall be made with a pneumatic roller. Each roller shall carry a minimum of 5000 pounds on each wheel and a minimum of 60 psi in each tire. The roller shall not travel in excess of 12 miles per hour. A minimum of 3 self-propelled pneumatic rollers shall be required for projects over 10,000 sq. yds. On projects under 10,000 sq. yds., one roller may be used provided it performs the same number of cover-ages.

330.4.5 Joints: All joints shall be constructed as approved by the Engineer such that there be a uniform application of cover material and bituminous material.

330.4.6 Surplus Aggregate Removal: Surplus aggregate shall be removed from the surface using methods specified in subsection 330.4.1 and stockpiled in the location indicated on the plans or as directed by the Engineer. In no event shall surplus aggregate be left on the pavement for more than 1 day (24 hours).

330.4.7 Distributing Equipment: Distributor trucks shall be of the pressure type with insulated tanks. Gravity distributors will not be permitted.

Spray bars and extensions shall be of the full circulating type. The spray bar shall be adjustable to permit varying height above the surface to be treated.

The nozzle spacings, center to center, shall not exceed 6 inches. The valves shall be operated so that one or all valves may be quickly opened or closed in one operation. The valves which control the flow from the nozzles shall be of a positive acting design so as to provide a uniform, unbroken spread of bituminous material on the surface.

The distributor shall be equipped with devices and charts to provide for accurate, rapid determination and control of the amount of bituminous material being applied. The distributor shall be equipped with a tachometer of the auxiliary wheel type registering speed in feet per minute. The distributor shall also be equipped with pressure gauges and an accurate thermometer for determination of the temperature of bituminous material. The spreading equipment shall be designed so that uniform application of a bituminous material can be applied in controlled amounts ranging from 0.05 to 2.0 gallons per square yard. Transverse variation rate shall not exceed ten (10) percent of the specified application rate. The distributor shall be equipped with a nose and nozzle attachment to be used for spotting skipped areas and areas inaccessible to the distributor. Distributor and booster tanks shall be maintained as to prevent dripping of bituminous material from any part of the equipment.

Equipment that fails to perform satisfactorily shall be removed from the job.

330.5 TRAFFIC:

Traffic will not be permitted on the surface until the cover aggregate has set. Traffic control shall be in accordance with Section 401 and as supplemented by the Contracting Agency.

When using paving grade or liquid grade asphalt chip seal, the speed limit must be maintained at 25 mph for all equipment and traffic until the cover material is swept.

When using emulsified asphalt chip seals, only emergency or local access traffic will be allowed until the seal coat has had time to set.

330.6 MEASUREMENT:

Certified weight slips of all material shall be delivered to the Engineer before the materials are applied. Certified weight slips of any material being weighed back in for credit shall be delivered to the Engineer the next day.

330.7 PAYMENT:

Quantities of materials for this work will be paid for at the contract unit price.

(A) Asphalt Cement, Liquid Asphalt, Emulsion, Diluted Emulsion - Ton.

(B) Chips, less moisture - Ton.

There will be no payment for materials not placed in accordance with this specification.

SECTION 333

FOG SEAL COATS

333.1 DESCRIPTION:

Fog seal coats on bituminous paved surfaces shall consist of the application of emulsified asphalt and a sand blotter when necessary.

333.2 TIME OF APPLICATION AND WEATHER CONDITIONS:

Fog seal coats on new pavements shall be applied within 24 hours. This time restriction may be extended by the Engineer.

Emulsified asphalt shall not be applied when the surface is wet or when there is a threat of rain. The ambient temperature shall be at least 50°F and rising and the application shall cease when the temperature is 55°F and falling.

333.3 MATERIALS:

333.3.1 Emulsified Asphalt: Unless otherwise specified in the special provisions, emulsified asphalt may be a grade SS-1h, CSS-1h, or CQSH, as specified in Section 713. The emulsified asphalt shall be diluted in proportions of 50% water and 50% emulsified asphalt.

333.3.2 Sand Blotter: The sand shall be as specified in Section 701 and shall be graded in accordance with following sieve analysis:

TABLE 333

Sieve size	Percentage Passing (by weight)
3/8"	100%
No. 4	90 - 100%
No. 200	0 - 12%

333.4 TESTS, TEST REPORTS AND CERTIFICATIONS:

Asphalt emulsion shall meet requirements of Section 713.

Test reports and certifications shall be as specified in Section 711.

333.5 PREPARATION OF SURFACES:

Immediately before applying the emulsion to the area to be surfaced shall be cleaned of dirt and loose material by means of power brooms, or pick-up brooms supple-mented by hand brooms, if necessary. The fog seal shall not be applied until an inspection of the surfaces has been made by the Engineer and he has determined that the surfaces are suitable.

333.6 APPLICATION OF ASPHALT EMULSION:

The diluted material shall be well mixed before application. It shall be applied by a distributor track equipped with fog nozzles at the approximate rate of 0.10 gallon per square yard. The exact rate shall be as directed by the Engineer. The distributor truck shall be as specified in Section 330.

333.7 SAND BLOTTER:

A sand blotter shall be applied as directed by the Engineer where there is an excess of asphalt emulsion. After the treated area has been opened to traffic, any excess asphalt emulsion that comes to the surface shall be immediately covered with additional sand.

333.8 PROTECTION FOR ADJACENT PROPERTY:

Care shall be taken to prevent the spraying of asphalt emulsion on adjacent pavements, including that portion of the pavement being used for traffic, on structures, guard rails, guide posts, markers, trees, shrubs and property of all kinds.

333.9 PROTECTION OF TREATED SURFACE:

The treated surface shall be protected by barricades until the asphalt emulsion will not be picked up by traffic. Traffic control shall be in accordance with Section 401 of these Specifications.

333.10 MEASUREMENT AND PAYMENT:

(A) Payment for asphalt emulsion in place will be by the ton, diluted, complete in place based on certified weight slips supplied to the Engineer by each truck driver on each delivery.

(B) Payment for furnishing and applying sand blotter in place will be paid for by the ton complete in place based on certified weight slips supplied to the Engineer by each truck driver on each delivery.

SECTION 334

PRESERVATIVE SEAL FOR ASPHALTIC CONCRETE

334.1 DESCRIPTION:

The asphaltic concrete preservative seal shall be composed of a petroleum resinoid base uniformly emulsified with water.

Preservative seal shall be on all new asphaltic concrete pavement construction except when deleted by the Engineer or contract documents.

Preservative seal is not required where asphaltic concrete pavement is replaced over trenches, pavement cuts, or other similar pavement repairs.

334.2 MATERIALS:

The preservative seal shall be as specified in Section 718 of these Specifications.

334.3 CONSTRUCTION METHODS:

The material shall be diluted in the proportion of 50 percent water and 50 percent petroleum resin-oil emulsion. The diluted material applied to the newly constructed asphaltic concrete surface shall be at the rate of .05 to .10 gallon per square yard. The actual amount shall be determined by tests on the pavement. Distribution equipment shall be in accordance with Section 330.

The application on residential streets shall be made within 1 week after the placing of the asphaltic concrete surface course. Application on major streets or residential streets subject to heavy traffic shall be made within 24 hours after the placing of the asphaltic concrete surface course. The Engineer may authorize limited extensions of these periods in order to meet essential conditions.

Before opening a treated area to traffic, it shall be checked for slipperiness on the surface. If the treated portion of the roadway must be opened to traffic prior to the disappearance of slipperiness, the surface shall be sanded with a minimum of 1-1/2 pounds per square yard of sand to eliminate this slippery condition. No more sand shall be used than necessary and the amount specified shall not be increased without prior approval of the Engineer. All approaches to high volume signalized inter-sections shall be lightly sanded before opening to prevent pick up by waiting vehicles. Sand blotter shall comply with Section 333.

334.4 MEASUREMENT:

Preservative seal for asphaltic concrete will be measured by the ton diluted unless otherwise indicated in the special provisions.

334.5 PAYMENT:

Payment will be based on certified weight slips supplied to the Engineer by each driver on each delivery.

(A) Payment will be made by the ton for preservative seal complete in place. Pay-ment shall be full compensation for this preservative seal complete and in place, including furnishing, hauling and placing the material and all other work incidental thereto for which specific pay items are not provided in the proposal.

(B) Sand blotter, when required by the Engineer, will be paid by the ton.

SECTION 336

PAVEMENT MATCHING AND SURFACING REPLACEMENT

336.1 DESCRIPTION:

That portion of roads, streets, alleys, driveways and other areas where the sur-facing has been damaged, broken into or has been removed by construction activities or to be widened or matched in connection with an improvement, it shall be resur-faced as shown on the plans and applicable standard details, in accordance with this specification and/or the special provisions.

Asphaltic concrete pavement replacement shall be constructed in accordance with the requirements of Yuma County Construction Standard Detail 5-070, Type A or B, and as indicated on the plans and as required by Sections 321 and 710.

ABC or decomposed granite surface replacement shall be constructed in accordance with the requirements of Yuma County Construction Standard Detail 5-070, Type C, and as indicated on the plans and in Section 702.

Concrete pavement surface replacement shall be in accordance with the details as shown on the construction plans.

Temporary pavement replacement shall be constructed as required below.

Pavements and concrete to be matched by new construction adjacent to or at the ends of a project shall be saw cut in accordance with these specifications and where shown on the plans.

Pavement and surfacing replacement within Arizona Highway rights-of-way shall be constructed in accordance with their permits and/or specification requirements.

336.2 MATERIALS AND CONSTRUCTION METHODS:

Materials and construction methods used in the replacement of pavement and sur-facing shall conform to the requirements of all applicable standard details and specifications, latest revisions.

336.2.1 Pavement Widening or Extensions: Existing pavements which are to be matched by pavement widening or pavement extension shall be trimmed to a neat true line with straight vertical edges free from irregularities with a saw specifically designed for this purpose. The minimum depth of cut shall be 1-1/2 inches or D/4, whichever is greater.

The existing pavement shall be cut and trimmed after placement of required ABC and just prior to placement of asphaltic concrete for pavement widening or extension, and the trimmed edges shall be painted with a light coating of asphalt cement or emulsified asphalt immediately prior to constructing the new abutting asphaltic concrete pavements. No extra payment shall be provided for these items and all costs incurred in performing this work shall be incidental to the widening or pavement extension.

336.2.2 Pavement or Concrete to be Removed: Existing asphalt pavement or concrete to be removed for trenches or for other underground construction or repairs shall be cut by a device capable of making a neat, straight and smooth cut without damaging adjacent pavement that is not to be removed. The Engineer's decision as to the acceptability the cutting device and manner of operation shall be final. If saw cutting only is to be utilized, it will be so specified in the plans or special provisions.

Pavement replacement for cuts on major arterials and essentially parallel to the street centerline and greater than 50 feet in length shall be two course pavement replace-ment as hereinafter specified. For cuts greater than 600 feet in length the entire area shall then be fog sealed in accordance with Section 333 or as otherwise specified. This seal shall extend from the edge of pavement or lip of gutter to the street centerline except that on residential streets less than 36 feet face to face of curb or where the pavement patch straddles the centerline, the entire width of street shall be sealed.

Pavement replacement for cuts parallel to the street centerline less than 50 feet in length, transverse cuts, bell holes and similar small areas shall match gradation and thickness of the existing pavement. These one course pavement patches shall be compacted with a vibratory roller to the same density specified for asphaltic concrete pavements.

Concrete replacement shall conform to the applicable standard construction detail.

In lieu of cutting pipe trenches across driveways, curbs and gutters, sidewalks, alley entrances and other types of pavements the Contractor may, when approved by the Engineer, elect to tunnel or bore under such structures and pavements.

336.2.3 Temporary Pavement Replacement: Temporary pavement replacement as required in Section 601 may be with cold-mix asphaltic concrete of an MC-70 or MC-250 oil, with a minimum thickness of 2 inches, using aggregate grading in accordance with Section 710. The amount of liquid asphalt required will be 5.0 to 6.0 percent.

Temporary pavement replacement shall be used in lieu of immediate placement of single course permanent replacement or the first course of two course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

Rolling of the temporary pavement replacement shall conform to the following:

(A) Initial or breakdown rolling shall be followed by rolling with a pneumatic-tired roller. Final compaction and finish rolling shall be done by means of a tandem power roller.

(B) On small areas or where equipment specified above is not available or is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors, provided comparable compaction is obtained.

The surface of the temporary pavement shall be finished off flush with the adjacent pavement.

336.2.4 Permanent Pavement Replacement: Laying of single course or the base course of the asphaltic concrete pavement replacement where a two course replacement is applicable shall never be more than 600 feet behind the ABC placed for the pavement replacement.

The trench must be compacted to its required density in accordance with Section 601; ABC, when required must be placed in accordance with Sections 218 and 702; or concrete, when required must be placed in accordance with Sections 505 and 725, prior to the placement of the asphaltic concrete.

Single course replacement shall consist of Type D-1/2 or C-3/4 dense grade mixes placed and finished as directed by the Engineer.

The base course of two course A.C. pavement replacement shall consist of Type C-3/4 dense graded asphaltic concrete material in accordance with Section 710.

Where the base course is to be placed with non-compactive equipment, it shall be not less than 2 inches in thickness and the material shall be immediately rolled with a pneumatic-tired roller. The surface course shall be of sufficient depth to provide the total required compacted thickness of the two courses, but not more than 1 inch.
Where the trench is 6 feet or more in width all courses, single or both courses of the two course pavement replacement shall be laid with a self-propelled compacting spreading equipment. When the trench is from 6 to 8 feet in width the self-propelled compacting spreading equipment shall not be wider than 8 feet. All courses, except the surface course, shall be of a compacted thickness of not less than 1-1/2 inches.

The surface course shall consist of either Type E-3/8 dense graded or Type G-3/8 open graded asphaltic concrete material in accordance with Section 710 as specified by the Engineer to match the existing surface. The surface course shall not be placed sooner than 2 weeks after the base course, except where the trench crosses a signalized intersection. In this case the surface course shall be placed within 48 hours or the crossing pavement replacement shall be single course as specified above.

Placement of the surface course is to be by means which will result in a surface texture satisfactory to the Engineer and flush with the existing pavement.

Where deep lift asphaltic concrete (asphaltic concrete base and asphaltic concrete wearing course) exists, the base course replacement shall be made in lifts not exceeding 6 inches in compacted thickness to within 1/2 inch of the finish grade.

336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT:

Normally, the type of pavement replacement and backfill required will be noted on the plans or specified in other portions of the contract documents and construction will be in accordance with Construction Standard 5-070. This detail requires that 12-inch "T" Top be utilized.

If a type is not noted on the plans or specified in the special provisions, the following criteria will govern:

Type A pavement replacement, including the "T" Top, will he utilized on all streets and road excavation other than on major arterials.

Type B pavement replacement will be utilized on excavations in major arterials roads.
Type C pavement replacement will be utilized to match existing ABC or decomposed granite roadways.

Concrete pavement replacement will be utilized to match existing concrete surfacing.

Where a longitudinal trench is partly in pavement, the pavement shall be replaced to the outside edge of the existing pavement, on a straight line, as indicated on the plans. Measurements for payment shall be from the inner limit of pay width allowed below, to the outside edge of the existing pavement as defined herein.

Where no part of a trench is in pavement, surfacing replacement will only be speci-fied where existing surfacing materials have been removed.

When a trench cut is in aggregate surfaced area, the surfacing replacement shall be of a like type and depth as the existing material, compacted to the densities required in Section 601.

336.4 MEASUREMENT:

Measurement for payment of Type A and Type B pavement replacement will be by the square yard upon actual field measurement of area replaced. The entire pavement structure including subgrade preparation, aggregate base, concrete and asphaltic concrete is to be included in the payment. The maximum calculations and payment for trench work is to be based upon pay widths listed below:

(A) In computing pay quantities for Types A and B pavement replacements, the product of the length of pavement or surface replacement measured along the centerline of the trench and the Maximum pay width listed below will be used:

TABLE 336-1

Size of Pipe (I.D.)	Maximum Pay Width Internal Diameter of Pipe Plus
Thru 10"	18"
12" to 21"	24"
24" to 33"	30"
36" to 51"	36"
54" to 63"	46"
66" to 75"	54"
78" to 87"	64"
90" to 99"	72"
102" and Over	82"
Add 24" for T-Top Pavement Replacement	

(B) Where a longitudinal trench is only partly in pavement, computations of pay quantities shall be based on only the area replaced.

(C) Measurement of Type C surfacing replacement will be measured by the square yard in accordance with the width above including the additional 24" for T-Top Replacement.

(D) Measurement of concrete pavement replacement shall be measured by the square foot and include subgrade preparation.

(E) When special provisions allow deviations from the trench widths specified in Section 601, the above allowed pay widths for pavements remove replacement may be altered where so specified.

(F) Measurement of all pavement and surfacing replacement shall be made along the finished surface of the ground to the nearest foot and, where stated, shall be computed to the nearest square yard.

336.5 PAYMENT:

Direct payment for the type of pavement or surfacing replacement will be made in accordance to the proposal. It will include the entire pavement structure including subgrade preparation, aggregate base, concrete and asphaltic concrete surfacing.

Payment for temporary pavement replacement shall be included in the cost of the excavation.

SECTION 340

CONCRETE CURB, GUTTER, SIDEWALK, DRIVEWAYS, ALLEY ENTRANCE AND PAVEMENT BORDER

340.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and constructing portland cement concrete curb, curb and gutter, pavement border, cross gutters, sidewalk, driveway, alley entrances and medians at the locations shown on the project plans in accordance with the details shown on the plans, county construction standards and the requirements of these specifications.

340.2 MATERIALS:

Concrete shall be Class B, conforming to the applicable requirements of Section 725 of these Specifications.

Expansion joints filler shall comply with Section 729.

Curing compound shall comply with Section 726.

340.3 LINE AND GRADE:

Concrete construction under this section shall be built in accordance with line and grade stakes placed every 25 feet minimum in an offset line parallel to the edge of the improvement.

340.4 CONSTRUCTION METHODS:

Existing pavements and concrete, that are joined by new construction, shall be cut in accordance with Section 601.

The subgrade shall be constructed and compacted true to grades and lines shown on the plans and as specified in Section 218. All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with material satisfactory to the Engineer. When the Engineer determines that the existing subgrade consists of soils with swelling characteristics, the moisture content shall be brought as close as possible to the optimum required for compaction. This shall be done by the addition of water, by the addition and blending of dry suitable material or by the drying of existing material. The subgrade shall then be compacted to a relative density as specified in Section 218.

Material displaced in the construction shall not be placed on the base and/or surfacing material already in place on the roadway nor shall the excavated material be placed in such a manner as to interfere with access to property or traffic flow in the street.

Concrete curb and gutter shall be constructed in accordance with Yuma County Construction Standards 3-120, 3-130, 3-140 and 3-150, as specified on the plans.

Pavement border shall be constructed in accordance with Yuma County Construction Standard 3-160.

Concrete sidewalks and sidewalk ramps shall be constructed in accordance with Yuma County Construction Standards 3-270 and 3-280.

Driveway entrances shall be constructed in accordance with Yuma County Construction Standards 3-210, 3-220 and 3-225, as applicable.

Alley entrances shall be constructed in accordance with Yuma County Construction Standard 3-050.

Cross gutters shall be constructed in accordance with Yuma County Construction Standards 3-170 and 3-180.

Medians shall be constructed in accordance with Yuma County Construction Standard 3-110.

Concrete sidewalks and driveways which are necessarily disturbed by construction shall be removed to a distance required to maintain a slope as indicated by standard details or not to exceed 1 inch per foot where sidewalks are concerned. Sawcutting is required at the match lines and payment will be made under the respective pay items as provided in the proposal.

SECTION 340

Concrete curbs, gutters, pavement border and sidewalks shall be constructed by the conventional use of forms, or may be constructed by means of an appropriate machine when approved by the Engineer.

If machines designed specifically for such work and approved by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory to the Engineer, the use of the machine shall be discontinued and the Contractor shall make necessary repairs at his own expense. All applicable requirements of construction by use of forms shall apply to the use of machines.

Forms conforming to the dimensions of the curb, gutter, pavement border, sidewalk, driveway and alley entrance shall be carefully set to line and grade, and securely staked in position. The forms and subgrade shall be watered immediately in advance of placing concrete.

Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil, or other releasing agent of a type which will not discolor the concrete.
The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface and the coarse aggregate is below the concrete surface.

Expansion joints, unless otherwise specified, shall be constructed in accordance with the construction standard of the appropriate agency, in a straight line and vertical plane perpendicular to the longitudinal line of the sidewalk or curb and gutter, except in cases of curved alignment, when they will be constructed along the radial lines of the curve. They shall be constructed to the full depth and width of the concrete and shall match the joints in the adjacent pavement sidewalk or curb and gutter. Joints shall be constructed at all radius points, driveways, alley entrances and at adjoining structures with a maximum interval of 50 feet between joints.

Contraction joints, unless otherwise specified, shall be constructed in accordance with the standard details of the appropriate agency, in a straight line and vertical plane perpendicular to the longitudinal line of the sidewalk or curb and gutter, except in cases of curved alignment when they will be constructed along the radial lines of the curb. They shall be constructed to a depth of 1", and at 10' intervals on sidewalk widths of five feet and 8' intervals on sidewalks of 4' width.

Sidewalk score marks, at least 1/2 inch deep, are required every 4 feet or every 5 feet matching the width of the sidewalk.

All edges shall be shaped with a suitable tool so formed as to round the edges to a radius as indicated on the standard details.

The front face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight, gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Special care shall be taken to prevent any damage. Any portion of concrete damaged while stripping forms shall be repaired or if the damage is severe, replaced at no additional cost to the Contracting Agency. The face, top back, and flow line of the curb and gutter shall be tested with a 10-foot straightedge or curve template, longitudinally along the surface. Any deviation in excess of 1/4 inch shall be corrected at no additional cost to the Contracting Agency.

The surface of concrete sidewalk shall be tested with a 5-foot straightedge. Any deviation in excess of 1/8 inch shall be corrected at no additional cost to the Contracting Agency.

When required by the Engineer, gutters having a slope of 0.8 foot per hundred feet or less, or where unusual or special conditions cast doubt on the capability of the gutters to drain, they shall be water tested. Water testing shall consist of establishing flow in the length of gutter to be tested by supplying water from a hydrant, tank truck or other source. One hour after the supply of water is shut off, the gutter shall be inspected for evidence of ponding or improper shape. In the event water is found ponded in the gutter to a depth greater than 1/2 inch, or on the adjacent asphalt pavement, the defect or defects shall be corrected in a manner acceptable to the Engineer without additional cost to the Contracting Agency.

Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency.

Finishing and curing of the concrete shall be done in the manner specified in Section 505.

The Contractor shall stamp his name and year on all work done by him, on each end of the curb, gutter, or sidewalk. The letters shall not be less than 3/4 inch in height.

340.5 TESTING:

Testing of concrete construction shall be performed in accordance with specification entitled "Portland Cement Concrete".

340.6 BACKFILLING:

Unless otherwise specified, the Contractor shall backfill behind the curbs or sidewalks with soil native to the area to the lines and grades shown on the plans.

340.7 MEASUREMENT:

(A) Concrete curbs and gutters and pavement border of the various types shown on the plans and in the proposal, will be measured along gutter flow line deleting inlets, catch basins, etc., by the lineal foot to the nearest foot for each type, complete in place.

(B) Concrete sidewalks, driveways, alley entrances, medians, valley gutters and aprons will be measured to the nearest square foot complete in place. When concrete sidewalk, driveways, alley and driveway aprons, valley gutters, and other concrete surfaces are cut during trenching operations, the square foot measurement for pay-ment will be in accordance with Section 336.

340.8 PAYMENT:

Payment for the above named items will be made in accordance with the unit prices or lump sums as set forth in the proposal. Such payment shall include full compen-sation for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the contract documents.

PART 400
TRAFFIC CONTROL, RIGHT-OF-WAY DEVELOPMENT AND INCIDENTALS

SECTION	TITLE
401	Traffic Control.....
402	Construction Surveying and Layout.....
403	Mobilization.....
405	Monuments.....
406	Relocating Water Meters and Boxes.....
407	Adjusting Frame and Covers and Valve & Water Meter Boxes.....
408	Relocate and Adjust private Mail Boxes.....
410	Precast Safety Curbs.....
413	Miscellaneous Metals.....
415	Flexible Metal Guardrail.....
420	Chain link Fences.....
423	Bank Protection (Riprap).....
424	Parkway Grading.....
425	Top Soil.....
430	Landscaping and Planting.....
440	Sprinkler Irrigation System Installation.....
442	Damp Proofing and Water Proofing Concrete Surfaces.....
443	Protective Coating.....
445	Disinfecting Water Lines.....
447	Dewatering.....

SECTION 401

TRAFFIC CONTROL

401.1 DESCRIPTION

Traffic control shall consist of traffic control devices, flaggers and /or pilot cars. All traffic control devices, the application of traffic control measures and traffic regulation in these specifications are to supplement and are not intended to delete any of the provisions of the Manual on Uniform Traffic Control Devices (MUTCD) or any agency's Supplements to these Uniform Standard Specifications.

401.2 TRAFFIC CONTROL DEVICES:

The contractor shall provide for the adequate protection of all vehicular and pedestrian traffic and workmen, through any portion of the work where construction operations interfere with, obstruct or create a hazard to the normal movement of traffic.

The name of the contractor's employee who is responsible for implementing, monitoring and altering, as necessary, the traffic control plan shall be made known to the local law enforcement agency of jurisdiction. furthermore, the name of the Department employee who will be responsible to see that the traffic control plan and any alteration thereto, is implemented and monitored such that the traffic is carried through the work in an effective manner and that the motorists, pedestrians and workmen are protected from potential hazards and accidents shall also be made known to the local law enforcement agency of jurisdiction. The contractor's designee shall also be available at any time to respond to calls involving damage to barricades, lights, signs and other devices resulting from vandalism, traffic accident or other causes.

If at any time the Engineer determines that proper provisions for safe traffic control are not being provided or maintained, he may order suspension of the work until the proper level of traffic control is achieved. In cases of serious or willful disregard for safety of the public or his employees by the contractor, the Engineer may proceed forthwith to place the traffic control measures in proper condition and deduct the cost thereof from monies due or becoming due the contractor.

All contractor's personnel, equipment, machinery, tools and supplies shall be kept clear of active traffic lanes, except as necessary for the prosecution of the work. The contractor shall promptly remove any material or debris that is spilled or tracked onto the traveled roadway as a result of the prosecution of the work. Materials, vehicles and parked equipment or store materials within 30 feet of the edge of a traveled way. Equipment may be parked and materials may be stored in the right-of-way only at locations approved by the Engineer and may require protection.

Any devices provided under this section which are lost, stolen, destroyed or are deemed unacceptable by the Engineer, while their use is required on the project, shall be replaced by the contractor and except as hereinafter specified for temporary impact attenuators, additional cost to the Department.

Traffic control devices shall consist of providing, erecting, and maintaining necessary and adequate devices for the protection of the work, the workers and the public.

(A) Temporary traffic control devices shall be used to guide traffic through construction areas. They include but are not limited to traffic cones to channelize traffic, portable barricades for warning, vertical panel channelizing devices to divert traffic, and lighting devices between the hours of sunset and sunrise.

(B) Advance warning devices shall be used to alert the motorist of an obstruction in the roadway. They include diamond-shaped signs, flags, and flasher type high level warning devices mounted 8 feet above the roadway.

(C) All traffic control devices shall be kept clean, free from dirt, mud and roadway grime.

(D) All traffic control devices including warning lights shall be kept in good working order or be replaced.

401.3 FLAGGERS, PILOT CARS:

Providing sufficient flaggers, uniformed off-duty law enforcement officers or pilot cars to expedite safe passage of vehicular traffic.

401.4 TRAFFIC CONTROL MEASURES:

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic, sufficient and adequate devices and measures shall be provided and erected as directed by the Engineer. These devices shall be immediately removed when no longer needed.

401.5 GENERAL TRAFFIC REGULATIONS:

A traffic lane shall be a minimum of 10 feet of clear street width with a safe motor vehicle operating speed of at least 25 miles per hour.

An intersection shall be all of the area within the right of way intersecting streets plus 300 feet beyond the edge of the intersected right of way on all legs of the intersection.

A minimum of two traffic lanes, one for each direction, shall be maintained open to traffic at all times on all major streets.

All existing traffic lanes on major streets shall be maintained open to traffic at signalized intersections between the hours of 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM weekdays unless otherwise specified in the special provisions.

All work that enters or crosses a major street must be done at times other than 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM unless otherwise specified in the special provisions.

Local access shall be maintained to all properties on the project at all possible times. When local access cannot be maintained, the Contractor must notify the affected property owner at least 24 hours in advance and restore access as soon as possible.

A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt paving if surrounded by or adjacent to existing pavement. Where pavement did not previously exist or where all of the existing pavement has been removed, a traffic lane shall not be considered as satisfactorily open to traffic unless it is graded reasonably smooth and maintained dust free as directed by the Engineer.

Arrangements for partial or complete street closure permits shall be handled through the Engineer. An advance notice of 48 hours for major streets and 24 hours for local streets and alleys is required from the Contractor. It shall be the contractor's responsibility to notify all emergency service agencies (i.e. Police and Fire Departments, etc.) of all street closures and re-openings.

The Contractor shall provide and maintain all necessary traffic controls to protect and guide traffic for all work in the construction area.

The Contractor shall maintain all existing and temporary STOP, YIELD, and street name signs erect, clean, and in full view of the intended traffic at all times. If these signs interfere with construction, the Contractor shall temporarily relocated the signs away from construction but still in full view of the intended traffic & notify the Engineer of his actions.

The contracting Agency will reset all STOP, YIELD and street names signs to permanent locations.

Existing traffic signs shall be maintained by the Contractor until such time as construciton renders them obsolete. At that time the Contractor shall remove signs and posts without damage and deliver them as directed by the Engineer. The traffic Engineering Department will reinstall all traffic signs.

At the request of the Contractor, subject to the approval of the Engineer, the Contractor may install CONSTRUCTION ZONE SPEED LIMIT 25 MPH signs in the construction area. The Contractor shall maintain the signs erect, clean, and in full view of the intended traffic at all times. Should the signs interfere with construction, the Contractor shall relocate the signs as necessary.

At any time project construction shall require the closure or disruption of traffic in any roadway, alley, or refuse collection easement such that normal refuse collection will be interfered with, the Contractor shall prior to causing such closure or disruption, make arrangements with the Local Sanitation Department in order that refuse collection service can be maintained.

Special traffic regulation will be listed in the special provisions.

401.6 TRAFFIC CONTROL PLAN:

When a traffic control plan is included in the project plans, this plan shall govern unless an alternate plan acceptable to the Engineer is submitted by the contractor. If no traffic control plan is provided or if the contracotr desires to deviate from the provisions for maintaining traffic as described in this section, he shall submit to the Engineer for approval a proposed sequence of operations and a compatible method of maintaining traffic . The proposal shall be submitted early enough to allow at least two weeks for review and approval before use of the proposed traffic control plan.

The traffic control and safety plan of the contractor, along with his work schedule and actual operations, shall be such that no condition that is considered to be unsafe shall exist. As a result of effective planning and efficient scheduling of the work, the duration, degree, length, amount, size, etc., of any potentially unsafe condition shall be adequately protected at all times within the project limits.

401.7 MEASUREMENT:

Measurement will be by lump sum for all traffic control required for completion of the project.

When a separate pay item is provided, flaggers, uniformed off-duty law enforcement officers with vehicle, will be measured by the hour for each individual, including vehicle and equipment, required to perform traffic control. When an officer is used less than 2 hours, a minimum of 2 hours will be charged. Anything over 2 hours will be measured by the hour.

401.8 PAYMENT:

Payment will be made at the contract bid price in the proposal for all traffic control for the duration of the project.

If no separate pay item is provided for flaggers, off duty officers and pilot car, then it must be included in the lump sum for traffic control.

If a separate pay item is not provided in the proposal, no payment will be made for traffic control devices and flaggers and the cost there of shall be included in the price bid for the construction or installation of the item to which such work is incidental or appurtenant.

SECTION 402

CONSTRUCTION SURVEYING AND LAYOUT

402.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials, personnel, and equipment necessary to perform all surveying, staking, construction layout, property boundary and right-of-way monuments, centerline monuments, establishment of pit boundaries, laying out of haul roads, and verification of the accuracy of existing control points which have been provided. Included in this work shall be all calculations required for the satisfactory completion of the project, including pipeline cut sheets, grade and drain, overlay, safety, landscape, rest areas, structures, surfacing projects, or combinations thereof, in conformance with the plans and these specifications. The work shall include establishing and marking 'As-built' elevations on structures and bridges. The work shall be done under the direction of a registered professional engineer employed by the contractor. All right-of-way monuments and lines shall be established by a registered land surveyor, employed by the contractor.

The contractor is to provide all survey monuments as required.

Measurement of all pay quantity items will be the responsibility of the Contracting Agency.

When utility adjustments are a part of the contract, the contractor shall perform all layout work and set all control points, stakes and references necessary for carrying out all such adjustments.

402.2 MATERIALS, PERSONNEL AND EQUIPMENT:

Materials and equipment shall include, but shall not necessarily be limited to, vehicles for transporting personnel and equipment, properly adjusted and accurate survey equipment, straightedges, stakes, flagging, and all other devices necessary for checking, marking, establishing and maintaining lines, grades and layout to perform the work called for in the contract. The contractor shall furnish competent personnel to perform the survey work and layout.

Right of way and centerline monuments shall conform to these Specifications Section 405.

The contractor shall furnish all traffic control, including flagging for survey and staking operations. Traffic control shall be in accordance with the requirements of Section 401 of the Specifications.

The contracting agency will furnish field books to be used by the contractor for recording survey data and field notes. These books shall be available for inspection by the engineer personnel at any time and shall become the property of the contracting agency upon completion of the work.

402.3 SUBMITTAL:

Prior to beginning any survey operations, the contractor shall furnish to the Engineer, for his approval, a written outline detailing the method of staking, marking of stakes, grade control for various operations, referencing, structure control, and any other procedures and controls necessary for survey completion. A part of this outline shall also be a schedule which will show the sequencing of the survey and layout work, throughout the course of the contract, listing a percentage of completion for each month.

402.4 CONSTRUCTION REQUIREMENTS:

Control points for establishing construction survey control and bench marks for establishing the proper elevations of the work are provided on the plans.

Each control point and bench mark provided shall be referenced by the contractor and protected through out the project. Control points shall be present at construction completion. Control points and bench marks are to be checked for accuracy.

After the contractor has verified the accuracy of the control points established by the Engineer, the contractor shall set all stakes including, but not necessarily limited to centerline stakes, offset, curb lines and grade stakes, stakes for pipelines, under drains, clearing, paved gutter, guardrail, fence, right-of-way monuments, centerline monuments, blue tops for subgrade, subbase and base courses; control points for bridges, bridge piers, structures abutments, footings, pipe cutoff, pile

layout, pier caps, bridge seats, bridge beams, girder profiles and screen elevations; supplemental bench marks and permanent as-built elevation marks as well as all other horizontal or vertical controls necessary for complete and accurate layout and construction of the work.

If errors are discovered during the verification process, and control points do not agree with the geometric shown in the plans, the contractor shall promptly notify the Engineer in writing, and explain the problem in detail. The Engineer will advise the contractor of any corrective actions which may be deemed necessary.

The contractor shall be responsible for the proper layout and accuracy of all property markers and right-of-way monuments which are required by the project plans.

Structure sites shall be accurately profiled and cross-sections, and structure control points shall be set and checked to assure the proper construction or installation of each structure. Profiles shall be approved by the Engineer prior to constructing or installing each structure. All profile survey data shall be entered in furnished field books and preserved as a permanent project record.

The contractor shall exercise care in the preservation of monuments, stakes, references and bench marks and shall reset them when any are damaged, lost displaced or removed.

On all projects, the centerline layout for the final surface course shall be established by instrument survey by the contractor and shall serve as marks for permanent traffic centerline striping. On projects requiring contractor striping, points of 50 foot intervals shall be set for each traffic lane, crossroad, ramp, frontage road or any other area where striping will be required.

On projects where traffic is being carried through the work zone, pavements shall be marked for traffic centerline delineation before the end of each work shift. Marks shall be nominal 12 inch by 4 inch strips of reflective tape. This tape shall be furnished by the contractor and applied to the surface at 40 foot intervals.

Any discrepancies in grade, alignment, earthwork quantities, locations or dimensions detected by the contractor shall immediately be brought to the attention of the Engineer. No changes in the project plans will be allowed without the approval of the Engineer.

The contracting agency reserves the right to make inspections and random checks of any portion of the staking and layout work. If, in the Engineer's opinion, the work is not being performed in a manner that will assure proper controls and accuracy, he will order any or all of the staking and layout work redone at no additional cost to the contracting agency.

If any portion of the contractor's staking and layout work is ordered redone, resulting in additional rechecking by the contracting agency, it shall be reimbursed for all costs for such additional checking. The amount of such cost will be deducted from the contractor's monthly estimate.

Inspection of the contractor's layout by the Engineer and the acceptance of all or any part of it shall not relieve the contractor of his responsibility to secure the proper dimensions, grades and elevations of the several parts of the work.

402.5 METHOD OF MEASUREMENT:

Construction surveying and layout will be measured as a single complete unit of work. When a separate pay item is provided, two, three and four person survey party will be measured by the hour to the nearest half hour.

402.6 BASIS OF PAYMENT:

Payment for all construction surveying and layout will be by the lump sum and will be made as follows:

The approved schedule showing the sequencing and percentage of the survey and layout work, as submitted under subsection 402.3, shall be the basis on which monthly progress payments shall be made. This schedule shall be subject to periodic review, at the request of either party, if the survey and layout work lags or accelerates. If necessary the schedule will be revised to reflect changes in survey and layout progress. When approved, the revised schedule will become the basis of payment.

If additional staking and layout are required as a result of an additional work order by the Engineer, payment will be made at the respective predetermined unit prices specified in the Contract Special Conditions. The Engineer will be the sole judge as to whether the additional work shall be performed by the Contractor or by County forces.

When provided for in the bid schedule, the amount per hour for a two, three or four person survey party includes the cost of all work necessary to complete the extra work.

No payment will be made for the resetting of stakes, references, bench marks, and other survey control.

SECTION 403

MOBILIZATION

403.1 DESCRIPTION:

The work under this section shall consist of preparatory work and operations, including but not limited to, the movement of personnel, equipment, supplies and incidentals to the project site; the establishment of an office, buildings and other facilities necessary for work on the project, and for all other work and operations that must be performed and costs incurred prior to beginning work on the various items on the project site.

403.2 METHOD OF MEASUREMENT:

Mobilization will be measured for payment by the lump sum as a single complete unit of work.

403.3 BASIS OF PAYMENT:

Payment for mobilization, measured as provided above, will be made at the contract lump sum price, which shall be full compensation for supplying and furnishing all materials, facilities and services and performing all the work involved as specified herein.

Partial payments under this item will be made in accordance with the following provisions. Reference herein to the original contract amount shall mean the original contract amount exclusive of mobilization:

When five percent of the original contract amount is earned, either 50 percent of the amount bid for mobilization, or five percent of the original contract amount, whichever is the lesser, will paid.

When ten percent of the original contract amount is earned, either 100 percent of the amount bid for mobilization, or ten percent of the original contract amount, whichever is the lesser, will be paid.

Upon completion of all work on the project, payment of any amount bid for mobilization in excess of ten percent of the original contract amount will be paid.

The total sum of all payment shall not exceed the original contract amount bid for mobilization, regardless of the fact that the contractor may have, for any reason, shut down his work on the project or moved his equipment away from the project and back again.

The adjustments provisions in Section 104 and the retention of funds provisions in Section 109 shall not apply to the item of mobilization.

When other contract items are adjusted as provided in Section 104, and if the costs applicable to such item of work include mobilization costs, such mobilization costs will be considered as recovered by the contractor in the lump sum price paid for mobilization, and will be excluded from consideration in determining compensation under Section 104.

When mobilization is not included as a contract item, full compensation for any necessary mobilization required will be considered as included in the prices paid for the various contract items involved and no additional compensation will be paid.

SECTION 405

MONUMENTS

405.1 DESCRIPTION:

This work shall consist of furnishing and installing portland property boundary and right-of-way monuments and centerline survey monuments in concrete at the locations shown on the plans and as directed by the Engineer. Monuments for subdivisions and roads are to be placed as required in Construction Standard 4-020.

Monuments shall conform to the Yuma County Construction Standard details or details shown on the plans.

405.2 MATERIALS:

The concrete portion of monuments shall be constructed in accordance with the requirements of Sections 725 and 786.

Concrete shall be Class B.

Brass caps for survey monuments will be furnished by the Contractor unless otherwise specified in the special provisions and conform to the Yuma County Construction Standard 4-080.. Frame and covers will be furnished by the Contractor and conform to the Yuma County Construction Standard 4-050 or 4-060.

Three copies of Product Data shall be submitted and approval obtained from the engineer before installation.

405.3 CONSTRUCTION:

In constructing precast monuments, the forms shall not be removed until after the concrete has hardened. Monuments that are warped will be rejected. The exposed surface of the finished monuments shall be uniform, of even texture, and shall be free from holes, cracks and chipped edges. The precast monuments shall not be transported to the work site until the concrete has cured.

Cast in place monuments shall be cast in drilled holes without the use of forms.

Brass caps shall be placed in survey monuments before the concrete block has acquired its initial set and shall be firmly bedded in the concrete. The concrete block shall be so located that, the reference point will fall within a 1 inch circle in the center of the brass cap.

405.4 INSTALLATION:

Right-of-way monuments shall be set firmly and vertically in the ground to a depth of at least 3 feet.

The tops of survey monument covers shall be set 1/8" below the pavement surface.

Survey monuments shall be set in position after the final course of asphalt concrete.

405.5 MEASUREMENT AND PAYMENT:

If a separate pay item is provided for in the proposal, measurement and payment for monuments will be made on the basis of the prices bid for each type and shall include full compensation for furnishing all labor, materials for each type, tools, equipment and incidentals, and for doing all the work involved in constructing the monuments, complete in place, including asphalt seal and necessary excavation and backfill, as shown on the plans or as directed by the Engineer.

SECTION 406

RELOCATING WATER METERS AND BOXES

406.1 SCOPE:

The Contractor shall furnish all labor, material and equipment necessary to relocate water meters and meter boxes as shown on the drawings and in accordance with Yuma County Construction Standard 5-150.

406.2 GENERAL:

The work shall include the extension or shortening of the existing water service lines in and out of the right of way and the relocation and replacement if necessary of the water box and the relocation of the water meter so that water can be restored to the customer.

406.3 MATERIALS:

New piping material shall be either copper tubing TYPE K and conform to ASTM Designation B-88 latest revision or as defined on water service connection detail as shown on the drawings.

Water meter boxes when required to be replaced, shall be in accordance with Yuma County Construction Standards 5-151 through 5-154, as applicable or as shown on the drawing.

All fittings shall conform to Yuma County Construction Standards No. 5-150.

406.4 CONSTRUCTION METHODS:

Water meters shall be relocated to behind sidewalk but within right of way. They shall be adjusted to grade to match finished grade.

The Contractor shall coordinate all water service interruptions with the appropriate water utility and shall and notify in writing all water users forty-eight (48) hours in advance of any and all interruptions of their water service. Water service interruptions shall be done on Tuesday, Wednesday and Thursday, between 9:00 A.M. and 4:00 P.M.

406.5 MEASUREMENT AND PAYMENT:

406.5.1 Measurement: This item will be measured as the actual number of water meters and boxes relocated.

406.5.2 Payment: The amount of completed and accepted work, measured as provided above, will be paid for at the contract price for "Relocating Water Meters and Boxes", which price shall be full compensation for all labor, material, and incidentals necessary to complete the work as shown on the drawings and as specified herein.

SECTION 407

ADJUSTING FRAME & COVERS, VALVE BOXES AND WATER METER BOXES

407.1 DESCRIPTION:

The Contractor shall furnish all labor, materials, and equipment necessary to adjust all frame & covers and valve boxes as indicated on the plans in accordancewith Yuma County Construction Standards or as designated by the Engineer after the finished coarse of pavement or concrete. The frames shall be set to finished grades.

The Contractor may elect to remove old frames, covers and valve boxes and to install new frames and/or boxes without any additional cost to the Contracting Agency, in accordance with construction standards.

407.2 ADJUSTING FRAMES:

The Contractor shall loosen frames in such a manner that existing monuments, clean outs or valve boxes will not be disturbed or manholes damaged. Debris shall not be permitted to enter sanitary or storm sewer conduits. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames.

Frames shall be set 1/8 inch below finished pavement grade and shall, be firmly blocked in place with masonry or metal supports. Spaces between the frame and the old seat shall be sealed on the inside to prevent any concrete from entering the hand hole or manhole. Class B concrete shall be placed around and under the frames to provide a seal and properly seat the frame at the required elevation and slope. Concrete shall be struck off flush with the top of the existing pavement or in accordance with the standard details.

407.3 ADJUSTING VALVE AND WATER METER BOXES:

Valve boxes shall be adjusted to the new elevations indicated on the plans and in Yuma County Construction Standards.

Adjustable cast iron boxes shall, if possible, be brought to grade by adjustment of the upper movable section. Any excavated area shall be filled with Class B concrete to the level of the existing pavement, or as directed by the Engineer.

Concrete pipe valve boxes shall be adjusted to grades by installing a cast iron valve box and cover in accordance with construction standards.

In areas where the existing valve box is a water meter frame and cover, the adjustment to the new elevation shall be made by installing a new frame and cover in accordance with the standard detail for installation of valve boxes.

Where existing frame and covers can be salvaged and are acceptable by the Engineer adjustment of existing valve boxes to the new elevation can be done and will be acceptable instead of providing new frame and covers.

Water meter boxes shall be adjusted so they are flush with sidewalks if located in sidewalks or are 1" above finished grade if located in parkways. All adjusted boxes shall meet the Yuma County Construction Standards. If existing boxes do not, they are to be replaced.

407.4 MEASUREMENT:

The quantities measured will be the actual number of frame & covers, valve boxes and meter boxes of each type, adjusted and accepted.

407.5 PAYMENT:

The quantities, as determined above will be paid for at the contract price per unit of measurement respectively, for each of the particular items listed in the proposal. The payment shall be compensation in full for all materials, labor, equipment and incidentals necessary to complete the work.

SECTION 408

RELOCATE AND ADJUST PRIVATE MAIL BOXES

408.1 SCOPE:

The contractor shall furnish all labor, materials, and equipment necessary to relocate and adjust private mail boxes within street right-of-way where necessary to clear construction.

408.2 CONSTRUCTION METHOD:

The contractor shall contact the U.S. Postal Service, serving the area prior to any construction and ascertain the rules and regulations for mail delivery and private mail boxes and the requirements for temporary relocation during construction.

At least 15 calendar days prior to the start of construction the contractor shall notify the affected property owners and/or resident on whose property the private mail boxes are adjacent to and within the right-of-way, so that adequate time may be afforded to those parties who so desire to remove and temporarily relocate the mail boxes during construction.

If at the end of the 14 days, the owner has not relocated or made arrangements to relocate the conflicting mailbox to a temporary location, the contractor shall , in accordance with the applicable U.S. Postal regulations, remove and temporarily relocate the mail box, exercising care and caution during the operation.

As soon as possible after completion of construction of the new roadway the contractor shall reconstruct the mail boxes to their original state or design at/or near the locations prescribed on the project plans detail and in accordance with the requirements of the U.S. Postal regulations and/or as directed by the Engineer.

408.3 MATERIAL:

Existing materials are to be reused where not damaged in the process of removal. The contractor is to furnish any additional material necessary in accordance with the U.S. Postal Service regulations.

408.4 MEASUREMENT AND PAYMENT:

408.4.1 Measurement: This item will be measured as the actual number of mail boxes, in place before relocating, necessary to be relocated to clear the construction area.

408.4.2 Payment: The amount of completed and accepted work, measured as provide above, will be paid for at the contract price for "Relocate and Adjust Private Mail Boxes", which price shall be full compensation for all labor, material, and incidentals necessary to complete the work as shown on the drawings and as specified herein.

SECTION 410

PRECAST SAFETY CURBS

410.1 DESCRIPTION:

This work shall consist of furnishing and installing precast safety curbs as shown on standard details or as detailed on the plans, or as directed by the Engineer.

410.2 MATERIALS:

Portland cement concrete shall be Class A, conforming to the applicable requirements of Section 725.

Steel reinforcing shall conform to the requirements of Section 727. The dimensions of the precast curb shall be as indicated on the plans and standard details.

Dowels shall conform to ASTM A-615 plain, intermediate grade, 1/2 inch round by 24 inches.

Mastic may be either a fiberized mastic cement or an epoxy cement. The Contractor shall submit 3 copies of the product data to the Engineer, which indicates the type of mastic and manufacturer's recommended procedures for use, approval is to be obtained before manufacture.

410.3 SUBMITTAL:

Three copies of Product Data along with certificate of compliance shall be submittal and approval obtained from the Engineer before installation. Three certified copies of mill test reports of each heat from which the rail element is formed shall be furnished to the Engineer.

410.4 CONSTRUCTION METHOD:

Back of safety curbs shall be set at the property line unless otherwise shown on the plans. Curbs shall be kept a minimum distance of 5 feet from driveways.

Precast safety curb installed on natural earth or gravel surfaces shall be secured in place with a minimum of 2 steel dowels through each curb. A minimum 12 inch diameter by 12 inches deep Class B concrete cylinder or approved equal shall be poured in place around each dowel.

Precast safety curb installed on portland cement concrete or asphalt concrete surfaces shall be bedded in a continuous layer of mastic cement under its complete base area and secured with a minimum of 2 steel dowels driven through the safety curb.

Dowels shall extend into the sub-surface and/or concrete cylinder a minimum of 18 inches. When installed, the top of each dowel shall be flush with the top of the safety curb.

The Engineer will verify locations of all safety curbs in the field at time of construction.

410.5 MEASUREMENT:

Measurement will be the number of safety curbs furnished and installed, complete in place.

410.6 PAYMENT:

The accepted quantity of safety curb measured as provided above will be paid for at the contract unit price for each installation complete in place.

The contract unit price paid for each type of installationas noted below and on the bid schedule shall include full compensation for furnishing all labor, materials and equipment and installing safety curbs complete in place.

(A) Safety curbs installed on natural earth or gravel

(B) Safety curbs installed on portland cement concrete

(C) Safety curbs installed on asphalt concrete

SECTION 413

MISCELLANEOUS METAL

413.1 DESCRIPTION:

The Contractor shall furnish all the material, labor & equipment and install and construct all miscellaneous metal to make a complete job including all grates and grilles as shown on the plans and as shown in County Construction Standards and as specified herein.

413.2 MATERIAL:

Components not sized on the plans or in Yuma County Construction Standards shall be proportioned to provide ample strength and stiffness for the loads expected. All steel shall meet the requirements of ASTM A36. All cast iron shall meet the requirements of ASTM A48. All pipe for handrails shall conform to the requirements of ASTM-A-53. All steel fasteners shall be zinc coated in accordance with ASTM A153.

413.3 SUBMITTAL:

Before fabrication 3 copies of shop drawings shall be submitted to the Engineer and approval obtained. Shop drawings shall indicate the materials, type, size, connections, dimensions, coatings, welding, and other details. Fabrication and installation shall be in accordance with the approved shop drawings.

413.4 CONSTRUCTION:

413.4.1 General:

(A). Dimensions: The Contractor shall field verify all dimensions, locations, and elevations of anchors, bolts, plates, openings, and other miscellaneous metal items and be responsible for their proper fit. All items shall be straight and true to dimensions. For structures on curves, either horizontal or vertical, the unit shall conform closely to the curvature of the structure.

(B). Coordination: Schedule and coordinate work with other trades to avoid delays, errors, and omissions.

(C). Fasteners: Fasteners shall be concealed where practical. All bolts shall be countersunk, properly sized, and of proper length to permit full thread in the nut and project not more than 1/4 inch beyond the nut. Provide lock washers at all nuts and nick the bolt to prevent loosening. All welds shall be smooth and regular, solid, and homogenous throughout and free from pits, slag, scale, and other defects. Joints exposed to weather shall be made watertight with gaskets or continuous welding. All welds in exposed finished work shall be ground smooth.

(D). Holes: All holes shall be drilled or punched with clean, true lines and surfaces.

(E). Galvanizing: Where galvanized or zinc coated is called for, it shall be hot dipped in accordance with the specifications of the American Hot Dip Galvanizers Association and standard specification #771.

(F). Castings: All castings shall be free of warp, gas and pit holes, and other defects that might impair strength or appearance.

(G). Welding: Welding shall be performed by the electric arc process and shall be done in conformance with Specifications of the American Welding Society as modified by AISC Specifications. All butt welds on exposed surfaces shall be ground flush with adjacent surfaces.

413.4.2 Grating: Unless provided for otherwise on the project plans grating shall conform to the following:

(A).1 STEEL. Steel grating shall be galvanized, rectangular pressure lock type. Bearing bars shall be not less than 3/16 inch thick with a minimum depth of 1 inch and spaced not greater than 1 3/16 inches on center. Cross bars shall be 3/4 inch by 1/8 inch spaced 4 inches on center.

(A).2 ALUMINUM. Aluminum grating shall be Type 6063 aluminum, rectangular pressure lock type. Bearing bars shall be not less than 3/16 inch thick with a minimum depth of 1 1/4 inches and spaced not greater than 1 3/16 inches on center. Cross bars shall be 3/4 inch by 1/8 inch spaced 4 inches on center.

(A).3 FIBERGLASS. Fiberglass grating shall be square mesh or T bar type composed of polyester resins and continuous glass fibers with integral grit safety surface. Grating shall meet ASTM E84 tunnel test for fire retardancy, have a Class I flame rating with a flame spread rate of less than 25. Grating shall be not less than 1 1/2 inches thick with all components corrosion resistant.

(B). DESIGN LOADING. Gratings shall be designed for a uniform load of 250 pounds per square foot with a deflection of not more than 1/160 of the span, unless otherwise shown.

(C). SUPPORTS. Gratings shall be supported on all four sides by an angle of the same material as the grating. Angle supports shall be securely anchored. Where the support angle extends across an opening, the support angle shall be supplemented with a structural channel. Channel shall be of the same material as the grating and not less than 3 inches in depth.

(D). BANDING. Edges and openings in the gratings shall be banded with a bar equal to the bearing bar.

(E). SETTING. Gratings shall be set flush with the finished surface and the gratings shall be of uniform depth in any one area. Gratings shall be secured to their supports by removable anchors.

413.4.3 Ladders: Unless provided for otherwise on the project plans, ladders are to be fabricated aluminum and conform to standard dimensions, spacing and anchoring. Ladders shall be equal to those manufactured by Tri-Tech Inc.

413.4.4 Covers And Frames: Covers and frames for access openings shall be cast iron, steel, or mill finish aluminum of the size, type, and style noted on the plans. All hardware for aluminum access doors shall be Type 316 stainless steel.

413.4.5 Railings: Unless otherwise provided for in the project plans, railings shall conform to the following:

(A). TYPE

(A)1. STEEL. Steel railing shall be 1 1/2 inch Schedule 40 pipe of the size and shape shown with all joints welded and ground smooth. The completed unit shall be galvanized.

(A)2. ALUMINUM. Aluminum railings shall be Type 6063-T5 or T6 extruded aluminum, 1 1/2 inch Schedule 40 pipe as per the Aluminum Alloy Association Standard for handrails. All fittings shall be one piece, extrusion machined to final shapes for a tight, flush fit. All fasteners shall be Type 305 stainless steel, set flush or hidden. Railings shall be a brush satin anodized 215R1 finish.

(A)3. STAINLESS STEEL. Stainless steel railings shall be Type 304, 1 1/2 inch Schedule 10 pipe. All fittings shall be machined to final shapes for a tight, flush fit. All fasteners shall be Type 305 stainless steel, set flush or hidden. Railings shall have a brush satin finish.

(B). WEEP HOLES. Provide weep holes at all posts, gates, and where recommended by the manufacturer. Location and size of holes shall be as recommended by the manufacturer.

(C). ANCHORING. Railings shall be anchored as shown on the plans and meet all local, state and OSHA requirements.

(D). EXPANSION. Provide for expansion of rails where and as recommended by the manufacturer.

(E). CHAINS. Chains, where shown, shall be a double row of 1/4 inch, Type 304, all welded stainless steel. Chains shall come complete with stainless steel swivel safety snap at each end and a stainless steel eye bolt anchored to the railing or wall.

413.4.6 Trash Racks: Trash racks shall be built according to the project plans of steel conforming to ASTM A-36 and be galvanized. The racks shall be fastener in accordance with the plans and in such a way as to provide adequate support alignment and rigidity.

413.4.7 Structural Shapes:

(A). LINTELS. Lintels shall have not less than 8 inch bearing on each side of the opening, where possible.

(B). OTHER. All structural shapes other than lintels shall be as required to complete the work. All anchors, connections, bearing plates, and fabrication details shall be standard, unless otherwise noted.

413.4.8 Access Door: Access doors shall be furnished and installed as required on the plans and be a minimum of 36" x 36" Flygt access door complete with steel hardware throughout or approved equal. Door leaf shall be 1/4 inch aluminum diamond pattern plate reinforced to withstand a live load of 300 pounds per square foot. Channel frame shall be 1/4 inch aluminum with an anchor flange around the perimeter. A 1-1/2 inch drainage coupling shall be located in the front right corner of the channel frame. Drain piping shall be extended to outside of pump structure. Locking and latching device shall consist of a recessed hasp covered by a hinged lid flush with surface. Factory finish shall be mill finish with bituminous coating applied to exterior of the frame. Manufacturer shall guarantee against defects in material or workmanship for a period of 10 years. Door shall be provided with a padlock with a master interchangeable cylinder.

413.5 ERECTION AND FASTENING:

The metal work shall be carefully erected, true to line and grade. Parts, balusters, and ladders shall be vertical and parallel with deviation from the vertical for the full height of the unit not exceeding 1/8 inch. All metal work shall be properly anchored & attached to provide secure rigidity and support for its use. Appropriate type and numbers of fasteners shall be used to provide the support, rigidity and over stressing.

413.6 PROTECTIVE COATINGS AND PAINTING:

(A). PAINTING: All shop fabricated miscellaneous metals except aluminum and stainless steel shall receive a shop coat of paint before being delivered to the job site and all surfaces as defined on the drawings and these specifications shall be painted in accordance with standard spec. #443. All abraded areas, welds, or holes drilled in the field shall be coated with zone rich paint.

(B). ALUMINUM. All aluminum in contact with concrete, masonry, or dissimilar metals shall be isolated by coating the contact surfaces with a bituminous material. Care shall be utilized to keep bituminous coating from coming in contact with caulking.

413.7 MEASUREMENT & PAYMENT:

Unless provided for otherwise in the proposal, no separate measurement or payment will be provided for miscellaneous metals. The cost of these items of work shall be included in the unit or pay item miscellaneous metals are appurtenant and incidental there to.

SECTION 415

FLEXIBLE METAL GUARDRAIL

415.1 DESCRIPTION:

This work shall consist of constructing metal beam guard railing, at the location and in accordance with the details shown on the plans, and as specified in the special provisions.

415.2 SUBMITTAL:

Three copies of Product Data along with certificate of compliance shall be submittal and approval obtained from the Engineer before installation. Three certified copies of mill test reports of each heat from which the rail element is formed shall be furnished to the Engineer.

415.3 MATERIALS AND CONSTRUCTION:

Materials and construction for the railings shall conform to the following requirements:

The rail elements, terminal sections, bolts, nuts and other fittings shall conform to the specifications of AASHTO M-180, except as modified in this specification. The edges and center of the rail element shall contact each post or block. Rail element joints shall be lapped not less than 12 1/2 inches and bolted. The rail metal shall be open hearth, electric furnace, or basic oxygen steel and, in addition to conforming to the requirements of AASHTO M-180, shall withstand a cold bend, without cracking, of 180 degrees around a mandrel of a diameter equal to 2 1/2 times the thickness of the plate.

The ends of each length of railing shall be fitted with terminal sections.

Workmanship shall be equivalent to good commercial practice and all edges, bolt holes and surfaces shall be free of torn metal, buns, sharp edges and protrusions.

Bolts shall have shoulders of such shape as will prevent the bolts from turning.

The rail element shall have full bearing at joints. When the radius of curvature is 150 feet or less, the rail element shall be shaped in the shop.

Unless otherwise specified the rail elements, terminal sections, bolts, nuts, and other fittings shall be galvanized in accordance with Section 771.

Posts, including blocks, shall be construction grade, Douglas Fir, free of heart center.

The posts and blocks shall be pressure treated after fabrication with oil borne pentachlorophenol, or coppernaphthenate, as provided in Section 779.

The posts shall be firmly placed in the ground. The space around posts shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted.

Posts shall be placed at equal intervals, as shown on the plans, except that the end posts may be spaced closer to adjacent posts if directed by the Engineer.

The bolted connection of the rail element to the post shall withstand a 5,000 pound pull at right angles to the line of the railing. The metal work shall be fabricated in the shop, and no punching, cutting or welding will be permitted in the field. Rail elements shall be lapped so that the exposed ends will not face approaching traffic. Terminal sections shall be installed in accordance with the manufacturer's recommendations.

Surplus excavated material remaining after the guard railing has been constructed shall be disposed of.

Railing parts furnished under these specifications shall be interchangeable with similar parts regardless of source.

415.4 PAINTING:

All metal surfaces of the guard rails shall have a zinc chromate prime coat and two coats of white enamel. The exposed portions of the wood posts shall have a wood primer and two coats of finish paint. Materials and application shall be as specified in Sections 790 and 443. Colors shall be as directed by the Engineer.

415.5 MEASUREMENT:

The railing will be measured by the linear foot from end to end along the face of the railing including terminal sections.

415.6 PAYMENT:

Payment for furnishing materials and installing guard rails complete, in place, including excavation and backfill for posts and painting will be made on the basis of the price bid per linear foot, unless an alternate basis of payment is specified in the proposal.

SECTION 420

CHAIN LINK FENCES

420.1 DESCRIPTION:

This work shall consist of constructing chain link fences at the locations shown on the plans in accordance with the Yuma County Construction Standard 3-320, the details shown on the plans, and as provided in these specifications and the special provisions

420.2 MATERIALS:

Chain link fence material shall conform to the requirements of Section 772. Portland cement concrete shall conform to the requirements of Section 725.

420.3 CONSTRUCTION METHODS:

420.3.1 Fence Construction: Before any fence is installed, the Contractor shall submit to the Engineer for approval, shop drawings showing the details of all fittings and gates proposed to be furnished.

Posts shall be spaced at not more than 10 foot intervals, measured from center to center of posts, and shall be placed in a vertical position.

Changes in line or grade where the angle of deflection is 30 degrees or more shall be considered as corner and slope points, respectively, and corner or slope posts shall be installed at these points.

All posts shall be set in Class B concrete footings, which footings shall be crowned at the top to shed water. Footings for line posts for 60 inch fabric or less shall not be less than 30 inches deep and 8 inches in diameter, and footings for line posts for fabric more than 60 inches shall not be less than 36 inches deep and 8 inches in diameter. All other footings, unless otherwise indicated on the plans or in the special provisions, shall be not less than 36 inches deep and 12 inches in diameter.

End, corner, slope and gate posts shall be braced to the midpoint of the nearest line post or posts with horizontal braces used as compression members and the said line posts trussed from the brace back to the bottom of the end, corner, slope or gate post with 3/8 inch steel truss rods with turnbuckles used as tension members.

Unless otherwise specified all fence shall be installed with a top rail and a bottom tension wire and the post tops shall be secured to the post by bolts or rivets. When the top rail is omitted, a top and bottom tension wire shall be used.

The fabric shall be placed on the outward facing side of the posts and shall be installed so that the top edge projects above the top rail of the fence to form a knuckled or barbed projection. The fabric shall be stretched taut and securely fastened to the posts, the top rail, and the bottom tension wire. The tension wire shall be installed on a straight grade between posts by excavating the high points of ground and in no case will filling of depression be permitted. Unless otherwise specified the bottom of the fence shall be on a line approximately 2 inches above the ground surface.

The fabric shall be fastened to end, corner, slope and gate posts with 3/16 inch x 3/4 inch high carbon steel tension bars and not less than 12 gage x 1 inch steel tension bar bands spaced at 16 inch intervals; and to line posts, top rail and tension wire with 11 gage or heavier tie wires or metal bands. Tie wires or metal bands shall be placed on line posts at intervals of approximately 16 inches, and on top rail and tension wire at intervals of approximately 18 inches.

Barbed wire shall be installed on the fence only when specifically required by the plans or special provisions. When required, it shall be installed on extension arms of a type specified under Section 772.

420.3.2 Construction of Gates; The widths of any gates to be installed will be indicated on the plans or in the special provisions. Gates in which the width of the leaf is greater than 6 feet shall be constructed with an internal horizontal or vertical stiffener of the same diameter as the frame; the frame shall be trussed with a 3/8 inch adjustable tension rod. Gates in which the width of the leaf is 6 feet or less will not require a stiffener and will require only 1 truss rod.

The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Chain link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified for fence construction, and suitable tension connectors spaced at approximately 16 inch intervals.

The swing gates shall be hung by at least 2 steel or malleable iron hinges, so designed as to securely clamp to the gate post and permit the gate to be swung back against the fence.

Semi-cantilever gates shall be provided with a combination steel or malleable iron catch and locking attachment of approved design, and shall be subject to approval of the Contracting Agency Stops to hold gates open and a center rest with catch shall be provided on all double drive gates and on all other gates where required.

420.3.3 Repair of Damage Coating: Welds made after galvanizing shall be ground smooth, then wire brushed to remove loose or burned zinc coating, after which the cleaned areas shall be repaired to the satisfaction of the Engineer in accordance with Section 771. Repairs to abraded or otherwise damaged zinc coating shall be made in a similar manner.

420.4 MEASUREMENT:

Chain link fence shall be measured on the fence line along the bottom strain wire from center to center of end posts, deducting the widths of gates and openings.

420.5 PAYMENTS:

(A) The price bid and paid per linear foot for chain link fence shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in constructing the fence complete in place as specified on the plans, and in the special provisions, except for furnishing and installing gates.

(B) Gates will be paid for at the unit price bid for each size of gate required by the plans or special provisions, which price shall include full compensation for furnishing the gates, together with all necessary gate posts, fittings and hardware, and doing all the work involved in installing the gates complete in place as specified. If double gates are required, each double gate will be paid for at the unit price bid and such unit price shall include furnishing and installing both leaves.

Full compensation for clearing the line of the fence and disposing of the resulting material, excavating high points in the existing ground between posts, excavating and furnishing and placing concrete footings, connecting new fences to structures and existing fences, and any other related work shall be considered as included in the price bid per linear foot of fence and no additional allowance will be made therefor.

SECTION 423

BANK PROTECTION: (RIP RAP)

423.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and constructing bank protection in accordance with the details shown on the plans and the requirements of these specifications and Yuma County Construction Standard 5-390.

Bank protection shall be dumped riprap, grouted riprap, wire tied riprap, riprap in wire baskets or gabions, and other typed of bank protection and shall be constructed at the locations and as detailed on the project plans.

423.2 SAMPLING:

The contractor shall provide a sample of rock of at least one ton, meeting the gradation specified. The sample shall remain at the construction site and be a part of the finished riprap covering. This sample shall be used as a frequent reference for judging the gradation of the riprap supplied. Any difference of opinion between the Engineer and the contractor shall be resolved by comparing the sample to the rock supplied.

423.3 MATERIALS:

423.3.1 Rock:

(A) General:

Rock shall be sound and durable, free from clay or shale seams, cracks or other structural defects and shall have a specific gravity of at least 2.40. Rock used to construct dumped riprap shall be angular in shape. Rock used to construct other typed of bank protection may be rounded stones or boulders. Rock shall have a least dimension not less than one-third of its greatest dimension and a gradation in reasonable conformity with that shown herein for the various types of bank protection. Control of the gradation will be by visual inspection.

When a source of rock is designated, it shall be the contractor's responsibility to negotiate for the material, obtain the right-of-way and pay all cost, royalties and damages.

The source from which the stone will be obtained shall be selected well in advance of the time when it will be required in the work. The acceptability of the stone will be determined by the Engineer. If testing is required, suitable samples of stone shall be taken in the presence of the Engineer at least 25 days in advance of the time when it will be required in the work. The acceptability of the stone will be determined by the Engineer. If testing is required, suitable samples of stone shall be taken in the presence of the Engineer at least 25 days in advance of the time when its use is expected to begin. The approval of some rock fragments from a particular quarry site shall not be construed as constituting the approval of all rock fragments taken from that quarry.

(B) Grouted Riprap:

Gradation of the rock for grouted riprap shall be if not specified on the plans weigh not less than 10 pounds and at least 50 percent of the rock shall weight not less than 100 pounds.

(C) Wire Tied Riprap:

Rock for wire tied riprap shall be well graded with at least 95 percent, by weight, exceeding the least dimension of the wire mesh opening. The maximum size stone, measured normal to the mat, shall not exceed the mat thickness.

(D) Dumped Riprap:

Gradation of the rock for dumped riprap shall be as specified above in grouted riprap.

(E) Gabions:
Rock for gabions shall be well graded, varying in size from four to eight inches.

(F) Riprap (Slope Mattress):

Rock for slope mattress shall be well graded with 70 percent by weight, exceeding four inches. The maximum dimension of a single stone shall not exceed the least dimension of the gabion.

Broken concrete may be used upon approval of the Engineer.

(G) Rail Bank Protection:

Rock used to construct rail bank protection shall be as specified in the special provisions or as shown on the plans.

423.3.2 Metal Items:

(A) Wire Fabric:

Welded wire fabric shall be galvanized and shall conform to the requirements of AASHTO M 55, except that the minimum weight of the zinc coating shall be 0.15 of an ounce per square foot of actual surface.

Woven wire fabric shall conform to the requirements of ASTM A 116, except that the minimum weight of zinc coating shall be 0.3 of an ounce per square foot or ASTM A 585, Class 1.

Wire fabric shall be of the gauge, spacing, pattern, and dimensions shown on the plans. The selvedge on each sheet of mesh shall be galvanized steel wire two gauges heavier than that used in the body of the mesh.

(B) Miscellaneous Fittings and Hardware:

Miscellaneous fittings and hardware shall be of the type and size provided by the manufacturer of the major item to which they apply and shall be galvanized in accordance with the requirements of AASHTO M 232.

(C) Tie Wires:

Tie wires shall be of good commercial quality and the gauge shall be as shown on the project plans, except that the minimum weight of the zinc coating shall be 0.30 of an ounce per square foot. At the option of the contractor, hogs rings may be used on gabions in lieu of tie wires.

(D) Steel Cable:

Steel cable shall be zinc-coated steel structural wire rope conforming to the requirements of ASTM A 475, Utilities Grade, Type 1 for the diameter shown on the plans.

(E) Railroad Rail:

Railroad rails may be new or used. If used rails are furnished, they shall be free from rust and equal to at least 95 percent of the original section.

(F) Soil Anchor Stakes:

Soil anchor stakes shall be steel and of the length called for the plans. When not specified to be railroad rails, the following items may be used: crane rails with a weight of at least 40 pounds per linear foot, two inch diameter steel pipe conforming to the requirements of ASTM A 120, or 3" X 3" X 3/8" structural steel angles conforming to the requirements of ASTM A 36. Used rails, pipe or angles may be used provided the material is not rusted or damaged to the extent that the strength of the item is reduced to less than 90 percent of new item of the same type and nominal size.

423.3.3 Bedding Material: Bedding material shall consist of granular material having maximum dimension of two inches and shall be free of clay or organic material.

423.3.4 Grout: Grout shall consist of one part portland cement, three parts fine aggregate and one-fifth part hydrated lime, by volume. These materials shall be thoroughly dry mixed and sufficient water shall be added to provide a mixture of thick workable consistency.

Portland cement, fine aggregate and water shall conform to the requirements of Section 725 and as herein specified. The aggregate may be pit runs material, at least 80 percent of which shall pass a 1 1/2 inch square mesh screen. Separating aggregates by primary sizes will not be required. Hydrated lime shall conform to the requirements of ASTM C 207, Type N.

Grout that has been mixed more than one hour shall not be used. Retempering of grout will not be permitted.

423.3.5 Filter Fabric: Filter fabric shall conform to the requirements of AASHTO M 288.

423.3.6 Sacked Concrete: Sacked concrete shall be utility concrete Class C, except that the minimum cement content shall be 376 pounds per cubic yard; the slump shall be from three to five inches; and the aggregate shall conform to the following gradation.

Sieve Size	Percent Passing
2 inch	100
1/4 inch	45-89
No. 200	0-12

Sacks for sacked concrete riprap shall be made of at least ten ounce burlap and shall be approximately 19 1/2 inches X 36 inches measured inside the seams when the sack is laid flat, with an approximate capacity of 1.25 cubic feet. Sound, reclaimed sacks may be used.

423.4 CONSTRUCTION REQUIREMENTS:

423.4.1 General: Areas on which bank protection is to be constructed shall be cleared, grubbed, and excavated or backfilled in accordance with requirement of the appropriate sections of Division II to produce a ground surface in reasonable conformance with the lines and grades shown on the project plans or established by the Engineer.

Placement through water will not be permitted unless otherwise approved by the Engineer.

423.4.2 Filter Fabric: When filter fabric is required, it shall be placed in the manner and at the locations shown on the project plans. The surface to receive the fabric shall be free of obstructions, depressions and debris. The filter shall be loosely laid and not placed in a stretched condition.

The strips shall be placed to provide a minimum 24 inches of overlap for each joint. On horizontal joints, the uphill strip shall overlap the downhill strip. On vertical joints, the upstream strip shall overlap the downstream strip. The fabric shall be protected at all times during construction from extensive exposure to sunlight.

When the maximum size of the rock to be placed on filter fabric exceeds 18 inches, the fabric shall be protected during the placement of the rock by a layer of bedding material. The bedding material shall be spread uniformly on the fabric to a depth of four inches and shall be free of mounds, dips or windows. Compaction of the bedding material will not be required.

Rock shall be carefully placed on the bedding material and filter fabric in such a manner which will produce a reasonably well graded mass with a minimum amount of voids and with the larger rock evenly distributed throughout the mass.

423.4.3 Dumped Riprap: The rock shall be placed to its specified thickness in one one operation and in a manner which will produce a reasonably well graded mass with a minimum amount of voids and with the larger rock evenly distributed throughout the mass.

No method of placing the rock that will cause segregation will be allowed. Hand placing or rearranging of individual rock may be necessary to obtain the specified results.

423.4.4 Wire-tied Riprap: After installation of the lower portion of the wire mesh, rock shall be placed in accordance with the requirements of Subsection 423.4.3.

After placement of the rock, the upper portion of the wire mesh shall be placed, laced, and tied in accordance with the details shown on the project plans.

423.4.5 Grouted Riprap: Rock for grouted riprap shall be placed in accordance with the requirements of Subsection 423.4.3. The stones shall be thoroughly moistened and any excess of fines shall be sluiced to the underside of the stone blanket before grouting.

The grout may be delivered to the place of final deposit by any means that will insure uniformity and prevent segregation of the grout. If penetration of grout is not obtained by gravity flow into the interstices, the grout shall spaded or rodded to completely fill the voids in the stone blanket. Pressure grouting shall not unseat the stones; and during placing by this method, the grout shall be spaded or rodded into the voids.

Penetration of the grout shall be to the depth specified on the project plans. When a rough surface is specified, stone shall be brushed until from one-fourth to one-half of the depth of the maximum size stone is exposed. For a smooth surface, grout shall fill the interstices to within a 1/2 inch of the surface.

Grout shall not be placed when the descending air temperature falls below 40 degrees F. nor until the ascending air temperature rises above 35 degrees F. Temperatures shall be taken in the shade away from artificial heat.

At the option of the contractor, shotcrete conforming to the requirements of these standard specifications may be furnished in lieu of grout.

423.4.6 Slope Mattress Riprap: The mattress bed shall be excavated to the width, line and grade as shown on the plans. The mattress shall be founded on this bed and laid to the lines and dimensions required.

Excavation for toe or cut-off walls shall be made to the neat lines of the wall.

Mattresses shall be fabricated in such a manner that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular units of the specified sizes. Mattresses are to be woven into a single unit or one edge of these members connected to the base section of the unit in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

All perimeter edges of the mattresses are to be securely selvedged or bound so that the joints formed by tying the selvedges have at least the same strength as the body of the mesh.

Mattresses shall be placed to conform with the details shown on the project plans. Stone shall be placed in close contact within the unit so that maximum fill is obtained. The units may be filled by machine with sufficient hand work to accomplish the requirements of this specification.

Slope mattresses shall be filled with at least two layers of stone. Broken concrete may be placed in the bottom layer with approval of the Engineer.

Before the mattress units are filled the longitudinal and lateral edge surfaces of adjoining units shall be tightly connected by means of wire ties placed every four inched or by a spiral tie having a complete loop every four inches. The lid edges of each unit shall be connected in a similar manner adjacent units. The slope mattress shall be anchored as shown on the project plans. Each anchor stake shall be fastened to the cover mesh with a tie wire.

423.4.7 Gabions: The gabion bed shall be excavated to the width, line and grade as shown on the plans. The gabions shall be founded on this bed and laid to the lines and dimensions required.

Excavation for toe or cut-off walls shall be made to the neat lines of the wall.

Gabions shall be fabricated in such a manner that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular units of the specified sizes. Gabions are to be of single unit construction, the base ends and sides either to woven into a single unit or one edge of these members connected to the base section of the unit in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

Where the length of the gabion exceeds its horizontal width the gabion is to be equally divided by diaphragms, of the same mesh and gauge as the body of the gabions, into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base section in such a manner that no additional tying at this juncture will be necessary.

All perimeter edges of gabions are to be securely selvedged or bound so that the joints formed by tying the selvedges have at least the same strength as the body of the mesh.

Gabions shall be placed to conform with the project plan details. Stone shall be placed in close contact in the unit so that maximum fill is obtained. The units may be filled by machine with sufficient hand work to accomplish requirements of this specification.

The exposed face or faces shall be hand-placed using selected stones to prevent bulging of the gabion cell and to improve appearance. Each cell shall be filled in three lifts.

Two connecting tie wires shall be placed as shown on the project plans between each lift in each cell. Care shall be taken to protect the vertical panels and diaphragms from being bent during filling operations.

The last lift of stone in each cell shall be level with the top of the gabion in order to properly close the lid and provide an even surface for the next course.

All gabion units shall be tied together each to its neighbor along all contacting edges in order to form a continuous connecting structure.

Empty gabions stacked on filled gabions shall be laced to the filled gabion at the front, side and back.

423.4.8 Sacked Concrete Riprap: The sacks shall be filled with concrete, loosely packed so as to leave room for folding or tying at the top. Approximately one cubic foot of concrete shall be placed in each sack. Immediately after filling, the sacks shall be placed according to the details shown on the project plans and lightly trampled to cause them to conform with the earth face and with adjacent sacks in place.

The first two courses shall provide a foundation of double thickness. The first foundation course shall consist of a double row of stretchers laid level and adjacent to each other in a neatly trimmed trench. The trench shall be cut back into slope a sufficient distance to enable proper subsequent placement of the riprap. The second course shall consist of a row of headers placed directly above the double row of stretchers. The third and remaining courses shall consist of stretchers and shall be placed in such a manner that joints in succeeding courses are staggered.

All dirt and debris shall be removed from the top of the sacks before the next course is laid thereon. Stretchers shall be placed so that the folded ends will not be adjacent. Headers shall be placed with the folds toward the earth face. Not more than four vertical courses of sacks shall be placed in any tier until initial set has taken place in the first course of any such tier.

When there will not be proper bearing or bond for the concrete because of delays in placing succeeding layers of sacks, a small trench shall be excavated back of the row of sacks already in place, and the trench shall be filled with fresh concrete before the next layer of sacks is laid. The size of the trench and the concrete used for this purpose shall be approved by the Engineer. The Engineer may require header courses at any level to provide additional stability to the riprap.

Stacked concrete riprap shall be cured by being covered with a blanket of wet earth or by being sprinkled with a fine spray of water every two hours during the daytime for a period of four days.

423.4.9 Rail Bank Protection: Excavation, where required for rock fill, shall be performed in reasonably close conformity to the lines and grades established or shown on the plans.

Rails shall be driven at the locations and to the minimum penetrations shown on the plans. Driving equipment shall be capable of developing sufficient energy to drive the rails to the specified minimum penetration and be approved by the Engineer.

If hard material is encountered during driving before minimum penetration is reached and it has been demonstrated to the satisfaction of the Engineer that additional attempts at driving would result in damage to the rails, the Engineer may order additional work to be performed, such as jetting or drilling, in order that minimum penetration may be obtained or he may order the minimum penetration to be reduced as required by the conditions encountered.

Wire fabric shall be securely fastened to the rails, placed in the trenches and laid on the slopes. The rock backfill shall then be carefully place so as not displace the wire fabric or rails. The wire fabric shall entirely enclose the rock backfill.

The completed rock fill shall be backfilled as necessary and the waste material disposed of as directed by the Engineer.

423.5 METHOD OF MEASUREMENT:

(A) Riprap, except gabions and sacked concrete will be measured by the square yard of protection constructed by computing the surface area measured parallel to the protection surface and the thickness of the riprap as specified on the plans.

(B) Riprap (gabions) will be measured by the cubic yard by computing the volume of the rock filled wire baskets used.

(C) Riprap (sacked concrete) will be measured by the square yard of concrete placed in the completed work. The measurement will be based on a three course thickness.

(D) Rail bank protection will be measured by the linear foot. Measurement will be made from top of rail to top of rail (longest rail where rails of two or more lengths are used) and the distance measured will be from end rail to end rail.

Where two parallel rows of vertical rails are used, the measurement for payment will be the average of the distance along two rows. Rail bank protection will be measured along the bank protection control line from end rail to end rail.

423.6 BASIS OF PAYMENT:

The accepted quantities of riprap and rail bank protection, measured as provided above, will be paid for at the contract unit price, which shall be full compensation for the work complete in place, including excavation, preparing the ground area, furnishing and installing the rock, filter fabric, bedding material, metal items, concrete, sacks and grout.

Materials, labor and equipment necessary to perform additional work such as jetting or drilling, as specified in this section, will be paid for in accordance with the provisions of Section 109.

SECTION 424

PARKWAY GRADING

424.1 DESCRIPTION:

This grading shall include all work necessary to bring the surface of the parkway, between the back of curbs or edge of roadway to the right-of-way line, to the grade and cross-sections shown on the plans, Yuma County Construction Standard 3-060, or as directed by the Engineer. It shall also include median islands between divided roadways.

424.2 ROUGH GRADING:

Fill material shall contain no rocks over 3 inches in diameter, broken concrete, or debris of any nature.

Backfill behind curbs and along the edges of the sidewalk shall be made immediately upon the completion of those items. The parking area shall be graded at a variable slope from 1 inch below the sidewalk to meet the existing surface at the right of way.

424.3 FINE GRADING:

The finished surface shall be free from stone and all debris and be true to grade and cross-sections after compaction to not less than 85% of maximum density, as determined by test methods specified in Section 218.

Where existing parkways are planted in grass, flowers, or shrubs and the level is somewhat above the top of the curb, or sidewalk, the parkway shall be graded back on a 4:1 slope from the edge of curb or sidewalk, with the least possible damage to the planted area.

424.4 MEASUREMENT AND PAYMENT:

Unless otherwise provided in the special provisions or proposal, no measurement and payment will be made for parkway grading as such; the cost thereof shall be included in the price bid for construction or installation of the items to which such grading is incidental or appurtenant.

SECTION 425

TOPSOILS

425. 1 DESCRIPTION:

This work shall consist of furnishing and hauling topsoil from an approved source and placing the topsoil as shown on the plans, in accordance with this specification and special provisions.

425.2 MATERIALS:

Topsoil shall conform to the requirements of these Specifications Section 795.

425.3 CONSTRUCTION METHODS:

Prior to the excavation of topsoil, all grass, weeds, brush, stumps, loose rocks and other objectionable material shall be removed from the surface of the area from which the topsoil is to be removed.

The topsoil source shall be excavated in such a manner that all material excavated will be of the same composition and structure throughout.

Topsoil shall be spread over the areas and to the depths as specified, and shall be water settled.

After the topsoil has been spread, stumps, roots and other objectionable matter shall be removed from the surface of the area and disposed of in a matter satisfactory to the Engineer.

425.4 MEASUREMENT:

Unless otherwise specified, topsoil shall be measured by the square yard with the given thickness in place after watering and settling.

425.5 PAYMENT:

The quantities measured as provided above, will be paid for at the contract unit price per square yard for furnishing and placing topsoil, which price shall be full compensation for the item complete, as described and specified.

SECTION 430

LANDSCAPING AND PLANTING

430.1 DESCRIPTION:

This section shall govern the preparation and planting of landscape areas required in the Plans or Specifications. Materials will be in accordance with these Specifications Section 795.

Existing utilities and improvements not designated for removal shall be protected in place. Any damages will be repaired by the Contractor at no additional cost to the Contracting Agency.

Unless otherwise provided, walls, curbs, planter boxes, irrigation systems, and other improvements shall be constructed after rough grading has been completed and prior to finish grading.

430.2 GENERAL:

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods.

Prior to any grading the areas shall be cleared and grubbing in accordance with these Specifications entitled, "Clearing and Grubbing".

Finish grade for these areas shall not vary more than 1 inch from the specified grade and cross-section and shall be a smooth uniform surface, free of any abrupt grade changes or depressions. Unless otherwise specified, finish grade below adjacent paving, curbs, or headers shall be 1 inch for lawn and granite areas and 3 inches for planting areas.

Unless otherwise specified, in-place soil will be prepared and conditioned for utilization as topsoil. If imported topsoil is specified or has to be used, the existing soil, before subgrade, shall be scarified to a depth of 6 inches prior to placing the topsoil and the thickness of the topsoil layer shall be at least 6 inches.

All landscape and planting areas, except those intended for lawns, shall be treated with a pre-emergent control, such as "Dacthal" or equal, applied in accordance with the manufacturer's recommendations.

430.3 LAWN AREAS:

430.3.1 Preparation of In-Place Soil: After clearing and grubbing has been completed, the existing surface shall be scarified and cultivated to a minimum depth of 8 inches; then brought to finish grade. During the operation, debris, including all stones over 1 inch in any dimensions, shall be removed and disposed of off-site.

After clearing and grabbing and initial cultivation has been completed, chemical fertilizer, 16-20-0 composition, shall be mechanically spread over the entire area at an average rate of 10 pounds per 1000 square feet. After spreading, the fertilizer shall be cultivated into the top six inches of soil using suitable equipment. The resulting soil shall be in a friable condition, suitable for planting.

The Engineer shall inspect and approve the area prior to seeding.

430.3.2 Seeding: If a bermuda summer lawn has not been established during its normal planting season, April through September, then rye grass (Sodium Multifolium) seed will be planted.

The rate of seeding shall be 3 1/2 pounds of bermuda seed or 15 pounds of rye seed per 1000 square feet. Seeding is to be uniformly applied in two directions.

After seeding has been completed, the entire area shall be rolled with a lawn roller for leveling and seed retention. Immediately after rolling, the area shall be watered until the soil is wet to a depth of 2 inches.

The Contractor shall provide the necessary safeguards to protect the planted areas from damage by erosion or trespass. Any damaged areas or any areas, greater than 2 feet in diameter, which fail to show a good stand shall be reworked and replanted until an acceptable stand of grass is obtained.

430.3.3 Maintenance: The Contractor shall be responsible for maintenance of the lawn areas until they are accepted by the Contracting Agency. This shall include watering, mowing, weeding and removal of all debris for a minumum of 30 days from first watering.

430.4 DECOMPOSED GRANITE AREA:

Decomposed granite shall be in accordance with Section 795. The Contractor shall confirm that a sufficient quantity is available so that the entire area will be of the same composition and appearance, and shall furnish a sample to the Engineer for approval as to color.

After preliminary grading is completed and the area has been cleared and grabbed, a pre-emergent control, such as Dacthal, or equal, shall be applied over the entire area, in accordance with the manufacturer's recommendations. In flat areas, a 10 mm black polyethylene film shall be placed prior to spreading the granite. The decomposed granite shall be evenly distributed over the area with a minimum depth of 2 inches. Finish grading will be accomplished and the granite will be lightly watered and then compacted to an extent satisfactory to the Engineer. After compaction, a second treatment with the pre-emergent control will be accomplished.

430.5 TREE, SHRUB, AND GROUND COVER PLANTING:

The species, sizes, the manner in which to be furnished, and the approximate number are as shown in the plant list. The quantities, as listed, are approximate and the Contractor shall furnish and install all plant material necessary to complete the plantings as shown on the landscape plan. Change order adjustment will be made for unit price proposals, but not for lump sum proposals.

430.5.1 Substitutions: All requests for substitutions must be submitted in writing to the Contracting Agency prior to commencement of work on the project. The Contractor shall not take any further action concerning his request until a written approval or denial is received from the Contracting Agency. Plants of kinds other than those indicated on the plant list will be considered by the Contracting Agency only upon submission of proof that the specified plant is not reasonably procurable in the local region. Substitutions will resemble the specified plant in regards to appearance, ultimate height, shape, habit of growth, and general soil requirement.

Substitution of a larger size of the same specie may be made by the Contractor without written approval. However, the Contracting Agency will not be responsible for any additional costs incurred by the Contractor; either for the additional cost of the plants or for any additional planting costs.

430.5.2 Plant Inspection Prior to Delivery to the Project Site: Prior to delivery of any species to the project site, the Contractor shall make the necessary arrangement with the Engineer for an inspection of the plant material at the off-site location. Any plants found to be unsuitable in growth or condition or which are not true to name shall be removed and replaced with acceptable plants.

430.5.3 Plant Protection After Delivery to the Project Site: Plants transported to the site shall be planted as soon as possible. During any interim storage period, they shall not be exposed to excessive sun or drying winds. Any stock, that in the opinion of the Engineer, has deteriorated due to exposure or has been damaged during transporting, will be removed and replaced at the Contractor's expense.

430.5.4 Plant Location: The Contractor shall stake out the location of planting areas and plantings pit prior to any excavation. Subject to the Engineer's approval, minor relocations may be accomplished at this time to avoid unsuitable conditions, such as utilities, rocky areas, poor soil, etc. If major relocations are necessary, the Engineer will provide revised plans.

430.5.5 Ground Cover Areas: The planting beds shall be brought to finish grade before spreading the fertilizer or conditioning material specified. Fertilizing and conditioning material shall be mechanically spread at a uniform rate over the entire bed area. After spreading, this material shall be uniformly cultivated into the upper 6 inches of soil using suitable equipment. The resulting soil shall be in a friable condition suitable for planting. A pre-emergent control application is required prior to planting.

Ground cover shall be planted in moist soil with the spacing as indicated on the plans. Each plant shall be planted with its proportionate amount of soil so as to minimize root disturbance. After planting, the area shall be raked to restore a smooth finish grade and to provide drainage. Watering will begin immediately.

The Contractor is responsible for maintaining these areas until acceptance by the Contracting Agency. Maintenance will include protection from trespass or damage, weeding, watering, and removal of all debris. It may be necessary to install a protective fence or barrier around these areas until growth is assured.

430.5.6 Shrub and Tree Pits: Planting pits shall be approximately circular with a diameter and depth at least twice the size of the plant ball or container. It must be large enough to permit handling and planting without injury or breakage of the root ball or root system. Unless otherwise specified, the excavated soil will be conditioned and used as prepared soil mix for backfill. Plants will not be allowed to stand in these pits without watering.

Prepared soil mix shall consist of one part organic soil conditioner (Section 795), two parts excavated soil and one pound of gypsum and four ounces of soil sulphur per tree or one-half pound of gypsum and two ounces of soil sulphur per shrub. The backfill shall be produced by thoroughly combining these components into a homogeneous mixture. The Contractor shall notify the Engineer prior to mixing prepared soil so that he may observe the mixing process. In addition, during backfilling, slow release fertilizer tablets, Agriform 21 gram tablets with a 20-10-5 analysis, shall be added in the following quantities:

For one-gallon container	1 tablet
For five-gallon container	2 tablets
For fifteen-gallon container	4 tablets
For twenty-four inch or larger box	6 tablets

All containers shall be opened and removed in such a manner that the roots of the plant are not damaged. Balled plants wrapping shall be loosened or cut back after the plant is positioned in the pit.

A layer of prepared soil mix shall be placed in the pit and the plant shall be set approximately in the center of the hole with the root crown at its natural growing depth with respect to finish grade. The plant shall be faced so as to present the best appearance and relationship to adjacent plants or structures. It shall be rigidly constrained until backfilling with prepared soil mix and slow release fertilizer tablets is completed. The backfill will be thoroughly settled by tamping and watering so that all voids are filled.

Trees shall be supported by tree stakes as directed by the Engineer with a top tie placed for maximum support and a second tie placed midway between top tie and ground level.

After planting, the plants shall be pruned as directed by the Engineer.

430.6 HEADER INSTALLATION:

Headers shall be installed at the location and grades as shown on the plans prior to planting operations. Stakes shall be located at corners and at intervals not to exceed 5 feet and shall be driven to slightly below the top of the header. Headers shall be nailed to the stakes with two nails, clinched 1/2 inch. Splice plates shall be used at butt joint; centered on the joint and nailed with four nails.

430.7 CLEAN UP:

Any debris or other material dropped onto paved or graded area during excavation or hauling operation shall be promptly removed and these areas shall be kept neat and clean at all times. Upon completion of planting operation, all remaining soil, stones, and other debris shall be removed from the site and disposed of to the satisfaction of the Engineer.

430.8 PLANT GUARANTEE AND MAINTENANCE:

The Contractor shall insure that all plant materials are in a sound, healthy, vigorous condition free from insects, bark abrasions, or other objectionable disfigurements and shall immediately replace any plant which is unacceptable at any time up to and including final acceptance of the project or completion of the plant establishment period whichever occurs later. When the termination of the plant establishment period extends beyond the final acceptance date for the project, this additional period of time for plant establishment may be considered as a special warranty period within the standard 1-year guarantee period and the Engineer may authorize final payment in

accordance with Section 109. Unless otherwise authorized by the Engineer, the Contractor shall maintain all landscaped areas on a continuous basis as they are completed during the course of work and until final project acceptance or the termination of the plant establishment period, whichever occurs later. Maintenance shall include keeping the landscape areas free of debris and weeding and cultivating the planted areas at intervals acceptable to the Engineer. The Contractor shall provide adequate personnel to accomplish the required maintenance. Pruning and restaking of plants shall be as directed by the Engineer.

430.9 PLANT ESTABLISHMENT PERIOD:

The Contractor shall request an inspection by the Engineer whenever substantial completion of the planting and related work has been accomplished. After this initial inspection, and subject to his approval of the work, the Engineer will issue a written field notification to the Contractor setting the effective, beginning date for plant establishment. The plant establishment period shall be for a period of 60 calendar days, but is subject to extension by the Engineer if the landscape areas are improperly maintained, appreciable plant replacement is required, or other corrective work becomes necessary.

At final project acceptance or at the end of the plant establishment period, a final acceptance inspection of the planted areas will be made by the Engineer.

430.10 MEASUREMENT AND PAYMENT:

Measurement and payment shall be a lump sum or unit price in accordance with the proposal.

430.11 PAYMENT:

The lump sum or unit prices established on the bidding schedule shall be full compensation for furnishing all labor, material, tools, and equipment and for performing all work necessary to complete the landscaping operation to include planting of trees, shrubs, and ground cover.

SECTION 440

SPRINKLER IRRIGATION SYSTEM INSTALLATION

440.1 GENERAL:

The Contractor shall furnish all the necessary labor, materials, and equipment required to complete the installation of the automatic sprinkler irrigation system providing full coverage to all plants and shrubs in accordance with the project plans. Unless otherwise specified, the automatic sprinkler irrigation system layout as shown on the plans shall be considered schematic. The Contractor shall lay out the entire system using stakes to indicate the location of the various components. Preliminary adjustments to conform to actual site condition shall be accomplished at this time and the approval of the Engineer obtained prior to any actual work being performed. Utility connections, both water and electrical, shall be as shown on the plans or as designated by the utility concerned. Unless specifically exempted in the plans or specifications, the Contractor shall pay all costs concerned in providing these services.

Prior to the acceptance of the project, the Contractor shall furnish the Engineer 4 copies of the manufacturer's instruction and maintenance manual for each component or group of components to include parts listings and source of supply.

Prior to final inspection, the Contractor shall submit one set of corrected, as-built drawings showing the location of all pipe, valves, wiring, and utility services.

All permits for installation or construction of any of the work included under this section, which are required by legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

440.2 TRENCH EXCAVATION AND BACKFILL:

Trenches and other excavations shall be sized to accommodate the irrigation system components, conduit, and other required facilities. Additional space shall be provided to assure proper installation and access for inspection. Unless otherwise specified, the minimum depth of cover over pipe lines and conduits shall be as follows:

(A) Electrical conduit -- 18 inches

(B) Water lines continuously pressurized -- 18 inches

(C) Lateral sprinkler lines -- 12 inches

(D) Plastic lines under pavement -- 24 inches

The bottom of trenches shall be true to grade and free of protruding stones, roots or other matter which would prevent proper bedding of pipe or other facilities.

Trenches and excavations shall be backfilled so that the specified thickness of topsoil is restored to the upper part of the trench. Compaction shall be in accordance with Section 218.

Water settling of trench backfill will not be permitted unless approved by the Engineer.

440.3 PIPE INSTALLATION:

(A) General. Pipe fittings shall be installed in accordance with the manufacturer's recommendations and these specifications. When requested by the Engineer, the Contractor shall furnish the manufacturer's printed installation instructions before pipe installation.

Pipe shall be bedded in at least 2 inches of finely graded native soil or sand to provide a firm, uniform bearing. After laying, the pipe shall be surrounded with additional finely graded native soil or sand to at least 2 inches over the top of the pipe. Trench backfill, sufficient to anchor the pipes, may be deposited before the pipeline pressure testing, except that joints shall remain exposed until satisfactory completion of testing.

When two or more pipelines are installed in the same trench, they shall be separated by a minimum horizontal clear distance of 6 inches and they shall be installed so that each pipeline, valve, or other pipeline component may be serviced or replaced without disturbing the other.

Piping under concrete or asphalt shall normally be installed by jacking, boring, or hydraulic driving. When any cutting or removal of asphalt and/or concrete work is necessary it shall be saw cut in accordance with Section 601. Permission to cut asphalt and/or concrete shall be obtained from the Engineer. Where piping on the drawings is shown under paved areas, but running parallel and adjacent to planted areas, the intent of the drawings is to install the piping in the planted area.

When plastic to steel pipe connectors are required, these connections shall be accomplished first. A non-hardening, non-oil base pipe compound or liquid teflon shall be used on the male threads only. The joint shall be hand-tightened with final tightening as necessary to prevent leaks accomplished with a strap wrench.

Threads shall be cut with clean sharp dies and shall conform to American Standards Association Specification B2.

Joints shall be made with a non-toxic non-hardening joint compound applied to the male threads only.

(B) When wrapped pipe is specified, joints and connectors shall not be wrapped until completion of the pressure test.

(C) Plastic Pipe. Plastic pipe shall be cut square, externally chamfered approximately 10-15 degrees, and all burrs and fins removed. It shall be joined utilizing threaded fittings or socket type, solvent welded fittings. Schedule 80 pipe only will be used for threaded joints. Field threading will be accomplished in the same manner as specified for steel pipe, except that a plug will be installed in the bore of the pipe prior to threading to prevent distortion. Threaded pipe joints shall be made using teflon tape on the male threads. Solvent will not be used for threaded joints. Threaded joints shall be band tightened with final tightening as necessary to prevent leaks with a strap wrench. Solvent welded joints shall be made in accordance with ASTM D-2855, and the type of solvent recommended by the pipe manufacturer shall be used. Solvent shall be applied to the pipe ends in such a manner that no material is deposited on the interior surface or forced into the interior of the pipe during insertion. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly.

The pipe shall be protected from damage during assembly. All vises shall have padded jaws and only strap wrenches shall be used. Any plastic pipe which has been nicked, scarred, or otherwise damaged shall be removed and replaced. Care shall be exercised so that stresses on a previously made joint are avoided. Movement of the pipe following assembly, such as lowering the pipe into the trench, shall not occur prior to the set time recommended by the manufacturer of the solvent cement used.

The plastic pipe will be snaked from side to side within the trench so as to provide approximately 1 foot of slack per each 100 feet of pipe.

The pipeline will not be exposed to water for at least 12 hours after the last solvent welded joint has been made.

440.4 VALVES, VALVE BOXES, AND SPECIAL EQUIPMENT INSTALLATION:

Valves, backflow preventers, pressure regulators and related accessories shall be furnished and installed as specified.

All valves and other equipment shall be installed in a normal upright position unless otherwise recommended by the manufacturer, and shall be readily accessible for operation, maintenance and replacement. Sectional control valves shall not be located within range of sprinklers they control.

Gate valves and sectional control valves shall be installed below ground. Gate valves shall be housed in a covered concrete or plastic box that will permit access for servicing. Sectional control valves shall be equipped with a sleeve and cap centered on the valve stem.

Quick-coupler valves and garden valves projecting above grade shall be installed a minimum of 3 feet from curbs, pavement and walks. In non-irrigated areas, quick coupler valves shall be set flush with finish grade, and in irrigated areas at or just above water level. They shall be installed on a double swing joint riser assembly. Garden valves shall be set 12 inches above finish grade, and shall be installed on a galvanized riser. In non-irrigated areas all valve boxes, valve access sleeves, and caps shall be set to finish grade, and in irrigated areas set adjacent to curbs,

sidewalks or pavement at or just above water level. Valves shall be set at sufficient depth to provide clearance between the cover and the cap, valve handle, or key when the valve is in the fully open position. Backflow preventers shall be provided with pipe supports and the accessories necessary to properly secure the assembly. All backflow preventers shall be assembled with pipe, fittings, and risers of galvanized steel.

440.5 SPRINKLER HEAD INSTALLATION AND ADJUSTMENT:

In accordance with the requirements of Subsection 440.7 all mains and laterals, including risers, shall be flushed and pressure tested before installing sprinkler heads. A water coverage test shall be performed after the sprinkler heads are installed.

(A) Location, Elevation and Spacing. Sprinkler head spacing shall not exceed the maximum shown on the drawings or recommended by the manufacturer. They shall be installed with at least 4 inches clearance from adjacent vertical elements projecting above grade such as walls, planter boxes, curbs and fences. Bubbler heads shall be installed a minimum of 2 inches above finish grade. The Engineer will notify the Contractor in writing when the planted beds are sufficiently planted and settled to make the necessary adjustments to the bubbler heads. Any adjustments are to be made within sixty (60) calendar days after this notification is received and at no additional cost to the Contracting Agency.

(B) Riser Assembly. A top outlet riser assembly shall consist of a pipe riser threaded into a top outlet ell or tee installed in the lateral supply line. Double-swing joint and single-swing joint riser assemblies shall utilize a horizontal 6-inch pipe nipple threaded into a side outlet ell or tee installed in the lateral supply line. For a double-swing joint, 3 ells shall be used in the remaining assembly ahead of the vertical riser pipe. For a single-swing joint, one ell shall be used.

(C) Sprinkler Head Adjustment. After all sprinkler heads are installed and the irrigation system is operating, each section or unit shall be adjusted and balanced, with all section control valves fully open to obtain uniform and adequate coverage. Sprinkler heads having adjustable pin nozzles or orifices shall have the pins adjusted to provide adequate distribution of water over the coverage pattern. The Contractor shall substitute larger or smaller nozzle cores in non-adjustable sprinkler heads as necessary.

440.6 AUTOMATIC CONTROL SYSTEM INSTALLATION:

The Contractor shall install a complete automatic irrigation control system including the automatic controller, remote control valves and wiring, and all necessary accessories and utility service connection including the junction box and any work required from the stub-out provided by the power company.

The automatic controller shall be installed outside of the coverage pattern of the irrigation system at the location designated in the contract documents. The foundation for the controller shall be Class C concrete of the size shown on the plan or recommended by the manufacturer. The control components in the controller shall be fused and the chassis shall be grounded. The controller shall be installed in a steel security cabinet with metal hasp and padlocks unless the controller is to be placed within a building or walled enclosure.

Remote control valves shall be compatible with the automatic controller. The valve is to be housed in a plastic box with locking cover, and it shall be installed with at least a 6-inch clearance below the plastic cover. The box shall be set to finish grade in non-irrigated areas and adjacent to curbs, sidewalks or pavement at or just above high water elevation in irrigated areas.

All service wiring shall be installed in rigid conduit from the service point to the controller at the minimum depth specified in Subsection 440.2. A separate disconnect switch or combination meter socket, as required, shall be installed between the source of power and the controller. The minimum service wire shall be No. 12 AWG copper 600 volt type, TWH or larger as required by the contract documents or controller manufacturer. Wire splices shall be located only in specified pull boxes and shall be made with a packaged kit approved for underground use. Pull boxes shall be plastic with locking covers set to proper elevations on a 12-inch layer of crushed rock or washed gravel.

All wiring issuing from the controller shall be direct burial installed in main or lateral waterline trenches wherever practicable. The wiring shall be bundled and secured to the lower quadrant of the irrigation pipeline at 10 foot intervals with plastic electrical tape. Sufficient slack shall be left in the wiring or tubing to provide for expansion and contraction. When the control wiring or tubing cannot be installed in a pipe trench, it shall be installed a minimum of 18 inches below finish grade.

All pilot or "hot" wires are to be of one color and all common wires are to be of another color.

Unless otherwise required, all control wiring shall be direct burial Type UF, No. 14 AWG copper. Splices in control wire shall be made in accordance with the requirements for service wire. Sufficient slack shall be left at each splice and point of connection in pull boxes and valve boxes so that in case of repair the valve bonnet or splice may be brought to the surface without disconnecting the wire. No splices shall be permitted under pavement.

All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting the equipment.

Upon completion of the work the control system shall be in operating condition with an operational chart mounted within the controller cabinet.

440.7 FLUSHING AND TESTING:

After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove all foreign material. After flushing, the following tests shall be conducted in the sequence listed below. All equipment, materials, and labor necessary to perform the tests shall be furnished by the Contractor and all tests shall be conducted in the presence of the Engineer.

(A) Pipeline Pressure Test. A water pressure test shall be performed on all pressure mains and laterals before any couplings, fittings, valves, and the like are concealed. All open ends shall be capped after the water is turned into the lines in such a manner that all air will be expelled. Pressure mains shall be tested with all control valves to lateral lines closed. After the pressure main test, all valves shall be opened to test lateral lines. The constant test pressure and the duration of the test are as follows:

Mains.....6 hours at 125 psi
Laterals.....2 hours at 100 psi

(B) Sprinkler Coverage Test. The coverage test shall be performed after sprinkler heads have been installed and shall demonstrate that each section or unit in the irrigation system is balanced to provide uniform and adequate coverage of the areas serviced. The Contractor shall correct any deficiencies in the system.

(C) Operational Test. The performance of all components of the automatic control system shall be evaluated for manual and automatic operation.

During the maintenance period specified and at least 9 days prior to final acceptance, the Contractor shall set the controller on automatic operation and the system shall operate satisfactorily during this period. All necessary repairs, replacement and adjustment shall be made until all equipment, electrical work, controls and instrumentation are functioning in accordance with the contract documents.

440.8 MEASUREMENT:

Measurement shall be lump sum or unit price in accordance with the proposal.

440.9 PAYMENT:

Payment shall be lump sum or unit prices established in the proposal and shall be full compensation for furnishing all labor, materials, tools and equipment, and performing all work necessary to complete the sprinkler irrigation system described or specified in the contract documents.

SECTION 442

DAMPPROOFING AND WATERPROOFING

CONCRETE SURFACES

442.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials, labor, equipment and perform all necessary work to dampproof concrete surfaces or waterproof concrete structures and joints at the locations shown on the project plans and in accordance with the requirements of the plans and these specifications.

442.2 MATERIALS:

442.2.1 General Requirements: The materials furnished by the contractor to dampproof or waterproof concrete structures as shown on the plans shall conform to the requirements of this section unless otherwise specified on the project plans or in the special provisions. Certificates of Compliance shall be submitted.

Product data and a Certificate of Compliance shall be submitted and approval obtained before use of the material.

All materials shall be delivered in the original packages bearing the manufacturer's brand and label. The kind of saturant used on the fabric shall be indicated. Materials shall be delivered on the work site a sufficient time before they are to be used to permit testing and analyzing, if required by the Engineer. The fabric shall be stored in a dry place, and the rolls shall not be stored on end.

442.2.2 Prime Coats: When tar is to be furnished for the mop coats, a creosote primer conforming to the requirements of AASHTO M 121 shall be used.

When asphalt is to be furnished for the mop coats, an asphaltic primer conforming to the requirements of AASHTO M 116 shall be used.

442.2.3 Mop Coats: When the fabric to be furnished is saturated with tar, a tar which conforms to the requirements of AASHTO M 118, TYPE II, shall be used for the mop coats.

When the fabric to be furnished is saturated with asphalt, an asphalt which conforms to the requirements of AASHTO M 115, TYPE III, shall be used for the mop coats.

442.2.4 Fabric: Fabric shall be a bituminized cotton fabric conforming to the requirements of AASHTO M 117.

442.3 CONSTRUCTION REQUIREMENTS:

442.3.1 General: Bituminous coats shall not be applied in wet weather nor when the ambient temperature is below 50 degrees F. Concrete shall be dry and clean before the prime coat is applied. If bituminous material is used for curing, it may also serve as a priming coat, except that additional primer may be necessary before application of the mop coat. The material for mop coats shall be heated as necessary to aid application, but not above 250 degrees F. for tar or 350 degrees F. for asphalt.

The bitumen shall be heated in kettles equipped with armored thermometers, and stirred frequently.

Primer shall be allowed to cure properly before applying the mop coat. The primer shall be applied without heating at the approximate rate of one gallon per 100 square feet of surface with a three or four knot roofing brush. If asphalt primer is too thick to allow easy brushing, the materials may be thinned by the addition of a small quantity of gasoline or naptha.

Work shall be so regulated that at the end of the day all fabric that has been applied will have received a mop coat.

Concrete surfaces not to be dampproofed or water proofed shall be protected from the spilling or otherwise marring of the surface with the bituminous materials.

442.3.2 Dampproofing: Concrete surfaces to be dampproofed shall be given either an asphalt primer and an asphalt mop coat or a creosote primer and a tar mop coat.

In the use of either method, each coat shall be applied uniformly, fully covering the surface, and shall be thoroughly worked into the surface.

After the primer has cured, the mop coat shall be applied at the rate of approximately 50 pounds per 100 square feet of surface to obtain a thickness of approximately 5/64 inch for the dampproof coating.

Within the areas to be treated, all expansion or construction joints that are not protected with metal seals and which will be covered with earth in the completed structure shall be protected with a single layer or strip of bituminized cotton fabric not less 12 inches in width. The fabric shall be laid evenly over the joints and in a fresh mopping of asphalt or tar. The fabric shall be pressed into place and shall be smooth and free of creases. Joints in the fabric shall lap 12 inches. After placing, the fabric shall be sealed with a mop coat.

Sections dampproofed shall be protected against mechanical injury and high temperature as soon as possible after application and until final acceptance of the work.

442.3.3 Membrane Waterproofing:

(A) Surface Preparation: Waterproofing may be used in conjunction with slab protection, sheet metal seals or other protective devices.

Surfaces of concrete to be waterproofed shall be smooth and free from projections which might injure the waterproofing membrane. The surfaces shall be cleaned of dust, dirt, grease and loose particles or any foreign substances and shall be dry prior to placing waterproofing.

The use of compressed air may be required in order to remove dust and loose dirt from corners and joints. Damp surfaces may be dried by covering with a layer of hot sand. The sand shall remain in place one or two hours, after which it shall be removed from enough surface to allow the work to proceed.

After the surfaces of concrete to be waterproofed have been thoroughly cleaned and prior to the first hot mop coat, one coat of primer shall be applied. The primer shall be thoroughly worked into the concrete to give a uniform coating.

(B) Application of Membrane: Two or three-ply membrane waterproofing, as specified on the project plans, shall be applied after the primer has cured.

Two-ply membrane waterproofing for the protection of footing construction joints or other designated areas shall consist of two layers of bituminized cotton fabric and three mop coats, placed alternately over the concrete surface previously treated with one coat of primer.

Three-ply membrane waterproofing for the protection of decks and sides of structures or other designated areas shall consist of three layers of bituminized cotton fabric and four mop coats, placed alternately over the concrete surface previously treated with one coat of primer.

The layers of the treated cotton fabric shall be laid so that all edges will lap at least two inches. The lines of lap shall in every case be broken with that of the preceding layer of membrane. Each strip shall be laid in a fresh hot mop coat and when the specified number of layers has been laid, the entire surface shall be mopped. If practicable, the laying of the fabric shall begin at the lowest part of the surface to be waterproofed. The surface shall be completely covered with heavy mop coat before the strip of fabric is put down. The mopping shall be so done that there will be no air bubbles, pockets or spots where the surface shows through. As soon as a strip of fabric has been laid, it shall be pressed into the coat to eliminate air bubbles. Creases in

the fabric shall be smoothed out carefully by pulling the fabric. The top mopping shall be of such thickness and be so applied as to seal and cover the fabric completely.

Waterproofing shall be free from punctures, pockets or folds.

Special care shall be taken so that the fabric is completely sealed down at the laps. The waterproofing membrane shall be continuous and unbroken.

At joints in the membrane, the laps shall be at least 12 inches. The fabric for making the lap shall be left unmopped until the joint is completed.

On horizontal surfaces, not less than four gallons in each mop coat shall be used for each 100 square feet of surface, and on vertical surfaces, not less than five gallons in each mop coat shall be used for each 100 square feet of surface.

Expansion and contraction joints shall be covered with membrane waterproofing as required by the plans.

Sections waterproofed shall be protected against mechanical injury, high temperature and chemical action, as soon as possible after application and until final acceptance of the work.

442.4 METHOD OF MEASUREMENT:

The project plans will show the estimated quantity of surface area to be dampproofed and/or waterproofed and the contractor shall assure himself that this estimated quantity is substantially correct.

442.5 BASIS OF PAYMENT:

No direct payment will be made for Dampproofing and Waterproofing Concrete Surfaces. The cost of furnishing and applying all materials shall be considered as included in the contract price paid for the concrete structure treated.

SECTION 443

PROTECTIVE COATING

443.1 DESCRIPTION:

This work shall consist of furnishing all labor, equipment and materials necessary to provide protective coatings including preparation of surfaces, shop coating of paint or applications of other shop protective coatings, field coats and protections, and all other related work in accordance with these specifications and the plans.

472.2 MATERIALS:

Materials used are as specified herein and as specified in these specifications Section 790.

443.3 SUBMITTALS:

Submit the following for obtaining approval before any protective coating or painting. Manufacturers product data sheets shall show the following:

A. Percent solids by volume.

B. Minimum and maximum recommended dry-film thickness per each coat.

C. Recommended surface preparation.

D. Recommended thinner.

E. Statement verifying that the specified shop coat or prime coat is recommended by the manufacturer for use with the specified intermediate and finished coats.

F. Application instructions including recommended method and temperatures.

G. Curing requirements and instructions.

H. Color swatches.

I. Certificate of compliance stating that materials provided meets the requirements of these specifications.

443.4 PREPARATION OF SURFACES:

443.4.1 General: All surfaces which are to be painted or treated shall first be thoroughly cleaned of all dust, dirt, moisture, grease, form oil, rust or any other deleterious material before the paint is applied. All surfaces to be painted must be clean and dry as determined by sight or touch.

Rust, welding slag, and mill scale shall be removed from metal surfaces by wire-brushing, chipping, or sand blasting. Grease or oil shall be removed from all surfaces by thoroughly wiping the surfaces with mineral spirits or xylol. Except xylol shall be used for surfaces which require coal tar coatings.

All surfaces shall be scraped clean and free of mortar droppings and spatter. All surfaces shall have the dust removed from them by wiping before and between paint coats.

Manual or powered wire brushes, hand scraping tools, power grinders or sandpaper shall be used to remove all dirt, loose rust, mill scale, or paint which is not firmly bonded to the surfaces. Blast cleaning shall be sufficient to give the surface the appearance of unpolished sandcast aluminum and shall leave all surfaces with a dense, uniform anchor pattern of not less than one mil, as measured with an approved surface profile comparator.

Abrasives used for blast cleaning shall be clean dry sand, mineral, grit, steel shot, or steel grit and shall be graded to produce satisfactory results. The use of other abrasives will not be permitted unless approved in writing by the Engineer.

When blast cleaning is being performed near machinery, all journals, bearings, motors and moving parts shall be sealed against entry of abrasive dust.

Blast cleaned surfaces shall be primed or treated the same day blast cleaning is done, unless otherwise authorized by the Engineer. If cleaned surfaces rust or are contaminated with foreign material before painting is accomplished, they shall be recleaned by the contractor at his expense.

All surfaces of new steel or other metals which are to be painted shall be blast cleaned, unless otherwise specified or approved in writing by the Engineer.

443.4.2 Steel: Surface preparation for painting steel shall conform to the surface preparation specifications of the Steel Structures Painting Council.

Unless otherwise specified the commercial blast method shall be used.

443.4.3 Galvanized Surfaces:

(A) Hand Cleaning: Concrete spatter, heavy grease, and other foreign matter shall be removed from galvanized surfaces by hand scraping or wire brushing.

(B) Solvent Cleaning: After hand cleaning, all galvanized surfaces shall be cleaned by the solvent cleaning procedures prescribed under steel above to remove oil, grease and other detrimental foreign matter.

(C) Pretreatment: After hand solvent cleaning, the cleaned areas shall then be painted by brushing on at least 1 full coat of paint No. 1 Unless otherwise directed by the Engineer, the second coat shall be applied within 24 hours after the primer is applied.

443.4.4 Iron Surfaces: In addition to general preparation all slag burrs, mill scale and other objectionable surface irregularities shall be removed by wire-brushing, chipping or sand blasting before cleaning.

443.4.5 Wood Surfaces: Wood surfaces shall be prepared for painting by removing all cracked or peeled paint, loose chalky paint, dirt, and other foreign matter by wire brushing, scraping, sanding, or other approved means immediately prior to painting. All surfaces shall be wiped or dry brushed to remove any dust or chalky residue that may result from cleaning operations. All wood designated to be painted shall be thoroughly dry before paint is applied.

443.4.6 Concrete And Masonry Surfaces: All required repair of concrete shall be performed, all protruding surface irregularities shall be removed, and joints where mortar is loose or missing shall be repointed with a 1:1 cement-sand grout. Sand used in the grout shall all pass a No. 50 screen. New concrete and masonry and freshly sack-rubbed surfaces shall be aged at least 3 weeks before application of any paint system.

Surfaces to be treated shall be cleaned until they are free of dirt, excess mortar, loose particles, and any other foreign material. Hosing with clean water may be employed to remove dirt. Grease and oil stains shall be removed by solvent washing, followed by caustic or detergent cleaning and thorough rinsing with clear water. Wax-base curing compound shall be removed by sandblasting. Glaze, laitance, or efflorescence shall be removed and the surface etched by the application of a 10 percent water solution of muriatic acid to the affected area. The acid-etching solution shall remain on the surface for at least 5 minutes or until the bubbling stops after which the treated surface shall be washed with fresh water and scrubbed briskly with stiff bristle brush during the wash. Rinse thoroughly with clear water after scrubbing and allow to dry before painting. In the event that one application of acid does not thoroughly clean the surface, the process shall be repeated until the surfaces is properly etched. A properly etched surface will be slightly granular and free from any glaze. Unless otherwise specified, the surfaces shall be allowed to dry thoroughly before application of the paint. The surfaces shall be damp (saturated surface dry) for the first coats of all latex materials.

443.4.7 Repainting Surfaces: When repainting existing surfaces, the method of cleaning will be steam cleaning. Areas not designated for repainting which are damaged as a result of the contractor's operations shall be repaired by the contractor, at his expense, and as approved by the Engineer.

All dirt, grease, loose chalky paint or other foreign material which has accumulated on previously painted surfaces shall be removed with a steam cleaning apparatus prior to all other phases of cleaning. It is not intended that sound paint be removed by this process. After steam cleaning, any paint which has become loose, curled, lifted or loses its bond to the preceding coat or coats shall be removed to sound paint or metal surface by the contractor at his expense.

A detergent shall be added to the feed water of the steam generator or applied to the surface to be cleaned. The detergent shall be of such composition and shall be added in such quantity that the specified cleaning is accomplished.

Any residue, detergent or other foreign material which may accumulate on cleaned surfaces shall be removed by flushing with fresh water.

Steam cleaning shall not be performed more than two weeks prior to starting painting operations or other phases of cleaning.

Subsequent painting shall not be performed until the cleaned surfaces are thoroughly dry and in no case in less than 24 hours after cleaning.

443.5 APPLICATION METHODS:

Painting shall be done in a neat and workmanlike manner. Unless otherwise specified paint shall be applied either by brush, roller, or spray methods.

If brushes are used, they shall have sufficient body and length of bristle to spread the paint in a uniform coat. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes. Paint shall be evenly spread and thoroughly brushed out. If a considerable amount of brush marks appear, it will be considered that the paint has been improperly applied. If rollers are used they shall be of a type that do not leave a stippled texture in the paint film.

On all surfaces which are inaccessible for brushing, the paint shall be applied by spray or by sheepskin daubers especially constructed for the purpose, or by other means approved by the Engineer.

If spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory and the Contractor may be required to apply the remainder of the paint by brush.

A water trap acceptable to the Engineer shall be furnished and installed on all equipment used in spray painting.

Mechanical mixers shall be used to mix the paint. The paint shall be mixed a sufficient length of time, prior to use. To thoroughly mix the pigment and vehicle together paint shall be kept thoroughly mixed while being applied.

443.6 PROTECTION AGAINST DAMAGE:

The contractor shall provide protective devices as necessary to prevent damage to the work and to other property or persons from all cleaning and painting operations.

Paint or paint stains which result in an unsightly appearance on surfaces not designated to be painted shall be removed or obliterated as approved by the Engineer.

All painted surfaces that are marred or damaged as a result of the contractor's operations shall be repaired with materials and to a condition equal to that of the paint coating specified herein.

Upon completion of all painting operations and of any other work the painted surfaces shall be thoroughly cleaned.

443.7 SAFETY PRECAUTIONS:

The following safety precautions shall be observed in addition to those prescribed by law in Section 107.

The applicable sections of NACE, a manual for painter safety.

443.8 APPLICATION:

443.8.1 General: No painting shall be done immediately after a rain or during rainy weather, over dew, or when the temperature is below 50 degrees Fahrenheit. No painting shall be done under dusty conditions. If fresh paint is damaged by the elements it shall be redone by the Contractor at his expense.

Where one coat of the same colored paint is to be applied over another, the first coat shall be tinted slightly different so that coat can readily be distinguished from the next coat. Where bituminous or coal tar coatings are applied, the first coat of two-coat work, or the middle coat of three-coat work, shall be distinguished by adding sufficient aluminum powder to show a difference.

New metal shall be painted a minimum of one shop coat (prime coat) and two field coats, unless otherwise specified. Suction spots between coats shall be touched up, and additional coats shall be provided as required to produce a finished surface of solid, even color, free from defects. Damaged paint or scratched painted surfaces shall be sanded smooth before repainting. Sanding and repainting shall be done to such a degree and in such a manner that all evidence of the scratches or damages are obscured.

Where rates of application are give herein, 1 gallon of unthinned paint as originally furnished by the manufacturer shall cover the same square feet of area specified by the manufacturer whether applied by spray gun, roller, brush or other means.

Where paint film thicknesses are specified herein, they shall govern over rates application per square feet of area. Additional coats of paint shall be added if necessary to bring the total thickness up to not less than that specified. No holidays shall be left. Particular care shall be used to assure that the specified coverage is secured on the edges and corners of all surfaces. Additional brush coats shall be applied if necessary to cover the edges and corners. The Contractor shall control and check the dry film thickness of the coatings on metal surfaces with a correctly calibrated thickness meter and shall check for holidays with a low-voltage holiday detector. The Engineer may use the Contractor's meter and detector for additional checking.

Additional coats of paint shall not be applied until the paints underneath are thoroughly dry. Drying time for any paint shall be at least as long as recommended by the manufacturer in his published literature. Unless otherwise specified, all paint shall be allowed to dry at least 24 hours before application of another coat. Twenty-four hours drying time between coats of paint does not mean putting one coat on in the afternoon and starting the next coat the following morning. Excessive time or exposure between coats shall not occur in cases where excessive time or exposure between coats will impair the bond between coats.

Skips, holidays, and thin areas or other deficiencies in any 1 coat of paint shall be corrected to the satisfaction of the Engineer before the succeeding coat is applied.

The surface of the paint coat being covered shall be free of any deleterious material before any additional paint is applied.

Drop cloths and other covering shall be placed at all times to protect concrete, slabs, floors and other surfaces from paint spatter and droppings. Articles which are not to be painted shall be masked off or removed completely. All work shall be done in a workmanlike manner, leaving the finished surfaces free from drops, ridges, waves, holidays, laps and brush marks.

After a facility is complete that has exposed metal, all parts and components shall be painted and match each other with the same color and tint.

It is the intent of this specification that the following list of items shall not be painted. Each of these items shall be masked or protected from paint or damage resulting from painter's work.

Aluminum surfaces including handrails, stairs and grating.
Encased piping or conduit.
Buried pipe, unless otherwise specified.
Electrical cable in trays.
Galvanized cable trays.
Anodized surfaces.
Brass, bronze, stainless steel, rubber, or chrome items.
Grease fittings.
Names plates and serial number plates.
Concrete floors, slabs, or walkways.
Concrete pump bases.
Concrete pipe supports.
Fencing.
Roofing.
Glass.
Metal letter.
Stainless steel.

The following list of equipment shall receive its final finish coats at the factory, unless specified otherwise, and shall be protected against damage during transit, storage and erection. These shall be finished as shown on the construction drawings or as specified in the section covering the particular equipment. Damaged areas must be refinished as the original.

Motor control center.
Electrical panels and fixtures.
Control panels.
Gauges.

Upon completion of the painting, the Contractor shall remove all masking, all surplus materials, rubbish and completely remove spattered paint from hardware, concrete surfaces, piping and equipment. Any damaged places in painted surfaces shall be touched up to the satisfaction of the Engineer.

443.9 PAINT MIXING:

Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating. No thinning will be allowed unless approved by the Engineer.

443.10 SHOP PROTECTIVE COATING:

Shop protecting coating shall be performed to the extent and as required under these Specifications. If not there particularized, it is intended generally that all manufactured parts and fabricated metal surfaces shall be given a minimum of one protective coat of paint, varnish or rust preventive material which shall be compatible with and is acceptable to the approved manufacturer of the herein specified field paint. Where equipment is finish-painted before delivery, in a manner satisfactory to the Engineer, field painting may be omitted at the express permission of the Engineer.

443.11 BURIED METALS:

Non-exposed metals, which shall be painted as follows, shall include pipe, fittings, valves, and similar items not otherwise covered. Metals encased in concrete need not to be painted.

Thoroughly clean of all rust, grease, dirt, moisture, and other deleterious substances in accordance with the section entitled "preparation of surfaces".

443.11.1 All interior and exterior steel or cast iron surfaces of all valves and all waterworks specialities and assemblies shall be shop coated prior to delivery to the job site.

443.11.2 All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C550-81, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

443.11.3 All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

443.11.4 All buried steel and iron shall be shop coated with one of the following systems:

(A). Wrap with cold-applied coal-tar tape conforming to AWWA C209. Minimum thickness of tape shall be 50 mils. Apply tape with manufacturer's recommended prime coat. Tape shall be Tapecoat 20, Protecto-Wrap 110, or equal.

(B). Wrap with hot-applied coal-tar tape conforming to AWWA C203, Section 3. Minimum thickness of tape shall be 50 mils. Apply tape with manufacturer's recommended prime coat. Tape shall be Tapecoat 20, Protecto-Wrap 110, pr equal.

(C). Coat with coal-tar epoxy having a minimum volume solids of 68% (ASTM-D2697) Clean surface and apply a prime coat of Ameron 78HB< 16 mils; Tnemec 46H-413, 16 mils; Porter 7080, 16 mils; or equal. Apply a top coat 16 mils thick of same material.

443.11.5 Before backfilling, all couplings, steel flanges, bolts nuts, anchor bolts and rods, bolting of all flanged valves, and all exposed steel and iron shall receive one (1) field brush coat of Tnemec 46H-413 Hi-Build Tneme-Tar coal tar epoxy applied at a rate that will provide a minimum dry film thickness of not less than 20 mils. The coating shall be without flaw when covered with earth backfill.

443.11.6 All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coating shall be not less than 0.030 inches in thickness at any point.

Extruded coatings shall be of polyethylene or polyvinyl chloride, coat tar or asphalt tape. Protecto Wrap No. 200 Safe-t-Clad FOS No. 655, Tapecoat, Trantex asphalt tape. Protecto Wrap No.900, Scotchrap No. 50 or approved equal Tape shall be edge lapped no less than 1/4 inch.

443.11.7 Aluminum surfaces in contact with concrete shall receive one brush coat of Tnemec 46H413, Hi-Build Tnemec-Tar applied at a rate that will provide a minimum dry film thickness of not less than 16 mils.

443.11.8 Cement Mortar Exterior Coating: When specified on the plans or in the specifications, steel pipe including flanged and welded joints that are to be buried, are to receive a cement-mortar coating on the exterior of the pipe, and fittings in accordance with AWWA Standard C205. Pipe is to receive a shop coating of cement coating and all joints are to receive a field coating of cement mortar in accordance with appendix A3 of AWWA Standard C205 except that the joint coating shall be reinforced with wire fabric furred from the metal surface. The cement shall be Type V portland cement rather than type I and II as specified in AWWA C205. All cement shall meet the applicable requirements of ANSI/ASTM C150.

443.11.9 Polyethylene Corrosion Protection: Domestic water line construction that uses buried steel or iron pipe with valves and water work specialities, shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to polywrap. The polywrap shall be in accordance with standard specification 610.5.

443.12 EXPOSED METALS:

Exposed metals, other than structural steel and machinery shall be painted as follows, includes pipe, fittings, valves, gratings, brackets, strap anchors, support angles, valve and pipe supports, boxes and similar items not otherwise covered.

Thoroughly clean of all rust, grease, dirt, moisture, and any other deleterious substances in accordance with section entitled "Preparation of Surfaces".

443.12.1 The interior and exterior steel or cast iron surfaces of all valves and all water work specialities and assemblies shall be shop coated prior to delivery to the job site.

443.12.2 All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of the Food and Drug Administration Protection Agency.

443.12.3 All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

443.12.4 Bare ferrous metal surfaces shall receive one coat of Tnemec 20-1255 Pota-Pox Primer (Sand Beige) applied at a rate that will provide a minimum dry film thickness of 4 to 6 mils.

443.12.5 Cast iron or ductile iron surfaces which have been coated with a shop coat of epoxy coal-tar or varnish shall be given one coat of Tnemec 20-1255 Pota-Pox Primer (Sand Beige) applied at a rate that will provide a minimum dry film thickness of 4 to 6 mils.

443.12.6 Galvanized, sherardized, or copper surface shall be solvent washed followed by one coat of Tnemec 20-1255 Pota-Pox Primer (Sand Beige) applied at a rate that will provide a minimum dry film thickness of 4 to 6 mils.

443.12.7 After the surfaces have been prepared as in any of cases 443.12.4, 443.12.5 or 443.12.6 above, the final finish shall be tow coats of Tnemec Series 71 Endura-Shield applied at a rate that will provide a minimum dry film thickness of 1.5 to 2.5 mils per coat. Brush, roller or spray application will be acceptable.

Loose handles, wrenches, operating keys. etc., for valves shall be painted along with the valves.

Unless shown or specified otherwise color for all exposed metal surfaces shall be a warm beige Color 2001 as shown on Tnemec Master Color Card. Generally, piping less than 1/2 inch in size shall be painted the same as the surface or piece of equipment to which it is attached.

443.12.8 Exposed plastic pipe shall be sanded or roughened and primed with one (1) coat of Tnemec Series 77W Chem-Prime. Final finish shall two (2) coats of Tnemec, Series 2, Tnemec-Gloss.

443.12.9 Fencing, Corrugated Metal Pipe and wire that is galvanized, shall be left unpainted. Areas of galvanized coating damaged due to welding after fabrication or handling shall be prepared as specified in there specifications and then painted with 2 coats of No. 11 paint.

443.12.10 Metal Guard Rail when specified is to be painted with 2 coats of No. 11 paint.

443.13 STRUCTURAL STEEL:

443.13.1 Paint: Unless otherwise required on the plans or in the special provisions, the paints to be applied to structural steel surfaces shall consist of a shop prime coat, as specified in Section 515, a second coat, and a finish coat. The total dry film thickness of the prime and second coat shall be not less than 3 mils. The dry thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge.

Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

Unless specified otherwise on the plans or in the special provisions, the paint coat shall be as specified for general use on structural steel in Section 790. Succeeding coats of paint, not otherwise materially different in color, shall have carbon black mixed into the paint in accordance with Section 790 to produce a perceptible color difference between the paint coat being applied and the preceding coat.

443.13.2 Cleaning: After erection and riveting or welding, all surfaces of structural steel which will be exposed to air in the completed structure and the repainting of existing steel structures where partial cleaning is required, the method of cleaning will be as directed by the Engineer or as specified in the special provisions.

Any damage to should paint on areas not designated for treatment, resulting from the Contractor's operations, shall be repaired as directed by the Engineer.

443.13.3 Application of Paint: Painting of structural steel, except for shop applied prime coats and sections which will be inaccessible after erection as described below, shall be done after erection unless otherwise specified in the special provisions. Requests to do any additional painting prior to erection shall be submitted by the Contractor and approved by the Engineer in writing before such work is started. Painting prior to erection will be limited to a prime coat of paint, except that surfaces exposed to the atmosphere which would be inaccessible for painting after erection shall be painted the full number of coats prior to erection. Any deficiencies in the prime coat of paint, or any second coat shall be corrected to the satisfaction of the Engineer prior to the application of the finish coat of paint.

The surface of the paint coat being covered shall be free from moisture, dust, grease, or any other deleterious material which would prevent the bond of the succeeding coat. In spot painting, any old paint which lifts after application of the touch-up coat, shall be removed by scraping and the area repainted before application of the next coat.

The finish coat shall not be applied until the required total film thickness of the undercoats of paint, as described above is obtained.

Open seams at contact surfaces of built-up members which would retain moisture shall be caulked with red lead paste before applying the second coat of paint.

Except for another bolt assemblies, steel embedded in concrete need not to be painted. Anchor bolt assemblies shall be painted or dipped with 1 coat of paint prior to installation.

With the exception of abutting chord and column splices and column and truss shoe bases, machines finished surfaces shall be coated with a rust inhibitor which can be easily removed. Surfaces of iron and steel castings which have been machine finished shall be painted with a coat of shop paint.

443.14 MACHINERY:

Prior to installation, all surfaces of machinery exposed to the atmosphere which are subject to corrosion and are normally painted, shall be painted with 2 coats of paint. Unless otherwise specified, after installation of the machinery, such surfaces shall be painted with a finish coat. All coats shall be as specified for structural steel.

443.15 SUBMERGED METAL:

Submerged metal includes those metal which will be submerged in water similar to piping in a pump station. After the surface is cleaned a shop coat is to be put on all pipe, fittings and water work specialities similar to what is required of exposed metals. After all bolts, flanges, coupling and other fasteners have been tightened, a two coat minimum system of Kopper's Bitumastic 300-W, Ameron 78HB, Tnemec 46H-413, Porter target 7080, or approved equal coating system be place on the parts to a minimum thickness of 16 mils.

443.16 EXPOSED WOOD SURFACES:

The surface shall be prepared as specified herein and painted with Paint No. 6 or 7. The number of coats of paint will be specified in the special provisions.

When permitted in writing by the Engineer, the prime coat of paint may be applied prior to erection. After the prime coat has dried and the timber is in place, all cracks, checks, nail holes, etc., shall be puttied flush with the surface and allowed to dry before the second coat is applied.

443.17 TESTING:

Paint and paint materials may be sampled and tested prior to use. Tests shall be conducted in accordance with methods specified by ASTM or by methods set forth in Federal Standard 141. In the absence of any such methods, other suitable methods may be designed and utilized by the Engineer. Lots or batches of paint of proprietary brand, as defined in Section 790, which have been previously sampled and tested by the Contracting Agency, and approved, may be used without further testing, if permitted by the Engineer.

Measure coating thickness specified for metal surfaces with a magnetic-type dry film thickness gage. Provide dry-film thickness gage as manufactured by Mikrotest or Elcometer. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

443.18 MEASUREMENT & PAYMENT:

Unless provided for in the special conditions, no separate pay item will be included in the proposal, nor direct payment made for painting and protective coating. The cost of these features of work shall be included in the unit or pay item painting and protective coating and appurtenant and incidental there to.

SECTION 445

DISINFECTING WATER MAINS

445.1 CLEANING AND TREATING PIPE:

The interior of all pipe and fittings shall be kept as free as possible of all dirt and foreign material at all times, until the pipe is placed in the new line.

If in the opinion of the Engineer, the pipe contains dirt that will not be removed during the flushing operation, the interior of the pipe shall be cleaned and swabbed, as necessary, with a .005 to .010 percent chlorine solution.

445.2 LAYING PIPE:

If the Contractor or pipe-laying crew cannot install the pipe in the trench without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size be placed over each end of the pipe and left there until the connection is to be made to the adjacent pipe.

At the close of each day's work, the end of the last laid section of pipe shall be plugged, capped, or otherwise tightly closed to prevent the entry of foreign material of any nature.

445.3 PREVENTING TRENCH WATER FROM ENTERING PIPE:

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. Joints of all pipe in the trench shall be completed before the work is stopped. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

445.4 PACKING MATERIAL FOR CAST IRON PIPE:

Only such packing materials as are included in the list of acceptable materials in AWWA C-600 for installation of cast iron water main, shall be used. The packing materials shall be handled in such a manner as to avoid contamination, and shall be dry when placed in the joints. All such materials shall be free of oil, tar, or greasy substances, except that treated paper packing material, jute, cement, or sulphur compound caulking will not be permitted.

445.5 FLUSHING COMPLETED PIPELINES:

(A) Preliminary Flushing: All mains 12 inches and smaller shall be flushed, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. It is difficult to flush mains over 12 inches in diameter, so in such instances the requirements above, must be rigidly adhered to.

Heavy duty, factory bushed, tapped couplings, with corporation stops shall be located at all high points in the lines to allow the air to be removed prior to testing the waterlines and at disinfection points as may be required. Field taps will not be permitted.

The couplings, at high points and disinfection points, shall be left exposed during backfilling until the testing is complete. Couplings and corporation stops shall be left on the mains upon completion of water mains.

(B) Valve Damage by Foreign Material: Unless proper care and thorough inspection are practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid or repaired. If it is believed that such foreign material(s) may be in the main, all hydrants on the line shall be thoroughly flushed and carefully inspected after flushing to see that the entire valve operating mechanism of each hydrant is in good condition.

445.6 CHLORINE RESIDUAL:

Before being placed in service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe.

445.7 METHODS OF APPLYING CHLORINE:

Any of the following methods of application of chlorine (arranged in order of preference) may be used, subject to the approval of the Engineer:

Liquid chlorine gas-water mixture.

Direct chlorine feed.

Calcium or sodium hypochlorite and water mixture.

445.8 APPLICATION OF LIQUID CHLORINE:

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

445.9 CHLORINE-BEARING COMPOUNDS IN WATER:

On approval of the Engineer, a mixture of water and a chlorine-bearing compound of known chlorine content may be substituted for liquid chlorine.

(A) Compounds to be Used: The chlorine-bearing compounds that may be used are: Calcium hypochlorite*, and sodium hypochlorite**.

(B) Preparation of Mixture: High-test calcium hypochlorite must be prepared as a water mixture for introduction into the water mains. The powder should first be made into a paste and then thinned to approximately a 1 percent chlorine solution (10,000 ppm). The preparation of a 1 percent chlorine solution requires the following proportions of powder to water:

Product	Amount of Compound	Quantity of Water (Gallons)
High-test calcium hypochlorite (65-70% CI)	1 lb.	7.50
Liquid laundry bleach (5.25% CI)	1-2 pts.	12.6

445.10 POINT OF APPLICATION:

The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension or any valved section of it and through a corporation stop inserted in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension.

445.11 RATE OF APPLICATION:

Water from the existing distribution system or other source of supply shall be controlled so the rate of flow shall not exceed 500 gpm, unless approved by the Superintendent of Water Distribution, through a suitable measuring device into the newly laid pipeline during the application of chlorine. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering

the newly laid pipe shall produce at least 10 ppm of residual chlorine after 24 hours standing in the pipe. This may be expected with an application of 50 ppm, although some conditions may require more.

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*Comparable to commercial products known as HTH, Perchloron, and Pittchlor.

**Known commercially as liquid laundry bleach.

On lines 12 inches in diameter or less, determination of the rate of flow of water into the line to be treated may be made by starting with the line full of water and measuring the rate of discharge at a hydrant located at the end of the pipe farthest away from the point of chlorine application.

For lines larger than 12 inches in diameter, the disinfection operation is generally started with the line empty.

Measurement of the flow of water into and out of all lines shall be made by means of a pitot gage, current type meter, or other approved device.

445.12 PREVENTING REVERSE FLOW:

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves shall be used to accomplish this.

445.13 RETENTION PERIOD:

Treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. This period should be at least 24 hours and should produce no less than 10 ppm residual chlorine at the extreme end of the line at the end of the retention period.

NOTE: If the circumstances are such that less than a 24 hour retention period must be used, the chlorine concentration shall be increased to 100 ppm. Under these conditions, special care should be taken to avoid attack on pipes, valves, hydrants and other appurtenances.

445.14 CHLORINATING VALVES AND HYDRANTS:

In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

445.15 FINAL FLUSHING, SAMPLING AND TESTING:

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities until the replacement water throughout its length shall, upon testing, be proved comparable in quality to the water served to the public from the existing water system. This satisfactory quality of water delivered by the new main shall continue for a period of at least 2 full days as demonstrated by laboratory examination of samples taken from a tap located and installed in such a way as to prevent outside contamination. Such samples for laboratory examination shall not be taken until flushing of the pipe shall have reduced the residual chlorine to 0.6 ppm or less throughout its length. Samples shall never be taken from an unsterilized hose or fire hydrant, because such samples will seldom meet bacteriological standards.

Yuma County Health Department will perform sampling for tests of new water mains. It shall be the contractor's responsibility to coordinate with the Health Department for these tests.

Waterlines up to but less than 150 feet in length require one sampling riser installed near the end; lines 150 feet to 300 feet in length, two sampling risers, one near each end of the line; lines 300 to 3,000 feet in length, a minimum of three sampling risers.

Two samples shall be taken on separate days at each sampling location.

Results of all tests shall be sent by the laboratory to the Water and Sewers Department. Results of laboratory analysis will be interpreted by the Water and Sewers Department, and reported to the Engineer. Under no circumstance shall the Contractor or Engineering Division personnel contact the laboratory. If there is need for test results before written reports are submitted, such information shall be obtained only from the Water and Sewers Department.

445.16 REPETITION OF CHLORINATION PROCEDURE:

Should the initial treatment fail to result in the conditions specified above, the original chlorination procedure shall be repeated until satisfactory results are obtained.

445.17 MEASUREMENT AND PAYMENT:

No separate pay item shall be contained in the proposal for disinfecting water mains. This operation shall be included in the price bid for the water mains, installed complete in place, as specified in the proposal.

SECTION 447

DEWATERING

447.1 DESCRIPTION:

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work, whether the water be surface water or ground water. Water shall be disposed of in such a manner as will not cause damage to public or private property or constitute a nuisance or menace to the public.

447.2 EQUIPMENT:

The Contractor shall furnish, install and operate pumps, points, pipes, appliances and equipment of sufficient capacity and quantity and so located as to keep all excavations and accesses free from water while work is in progress, and during weekends and holidays when required, and until construction has been inspected and Engineer, consents to shut down. The Contractor shall provide all means or facilities necessary to conduct water to the pumps.

447.3 CONSTRUCTION METHODS:

Before a contractor installs dewatering equipment along any section of pipe construction or for a structure construction, he shall obtain approval from the engineer that dewatering is necessary. The Contractor shall provide pot holes or other means for the Engineer to make the determination.

Dewatering shall be installed and operated prior to any excavation activity and shall continue throughout the time of work in that area until all construction has been installed, inspected, completed and approved by the Engineer. Interruption, equipment failure or any other malfunction of the dewatering process that causes the uncompleted construction to be flooded, shall be reason to reject that work entirely. Dewatering equipment shall be manned and operated in a safe and protected condition at all times.

No construction of any type shall be placed upon or against saturated material and backfill over new construction shall be clean, dry and in suitable condition to obtain proper compaction. Any extra excavation required is to be included and a part of the this item. No concrete or masonry footings, foundations, or floors shall be laid in water, nor shall water be allowed to rise over them until the concrete or mortar has set at least 24 hours. Water shall not be allowed to rise unequally against walls for period of 14 days.

Written permission shall be secured from the Engineer before locating any wells, well points, or drain lines for the purposes of dewatering within the limits of a structure foundation. The Engineer shall have the right to require that any dewatering well, line or trench drain left in place within the structure foundation limits be filled with Class C concrete or grout at no cost to the Owner.

Water disposal sites shall not interfere with surrounding property, traffic flow, farming or other neighboring public or private use. The disposal site shall be returned to its original or improved condition after use.

447.4 PERMISSIONS:

Before a dewatering discharge pipeline plan is submitted, the Contractor shall provide the Engineer a letter of approval from the entity or person where water is to be disposed. Discharge sites are to be returned to original improved conditions.

447.5 DEWATERING DISCHARGE PIPELINE PLAN:

The Contractor shall submit to the Engineer for approval prior to execution, a dewatering discharge pipeline plan showing pipeline routes and discharge area.

447.6 CLEANUP:

All areas used for dewatering operation including disposal sites & pipelines shall be returned to or be in better condition than before it was used.

447.7 MEASUREMENT:

Dewatering for structure construction will be measured as a lump sum unit.

Dewatering for pipeline construction will be measured by the linear foot.

447.8 PAYMENT:

Payment for dewatering will be made at the contract unit price for dewatering for a structure and dewatering pipeline construction which price shall be full compensation for all labor, materials, equipment and incidentals necessary to complete the work in accordance with the plans and as specified herein.

PART 500

STRUCTURES AND MASONRY

SECTION	TITLE
502	Structural Excavation and Backfill.....
505	Concrete Structures.....
507	Concrete Joints and Water Stops.....
510	Concrete Block Masonry.....
511	Brick Masonry.....
518	Steel Reinforcement.....
525	Pneumatically Placed Mortar.....
532	Concrete Catch Basins.....
545	Pump Station.....

SECTION 502

STRUCTURE EXCAVATION AND BACKFILL

502.1 DESCRIPTION:

Structure excavation shall consist of excavation and removal of all material necessary for the construction of foundations for bridges, retaining walls, box culverts, large head walls, vaults, pump stations, inlet, outlet and other structures and other excavation designated on the plans or in these specifications.

Structure backfill shall consist of furnishing material, if necessary, placing and compacting backfill material around structures to the lines designated on the plans or specified or directed by the Engineer.

Structure excavation and structure backfill shall include the furnishing of all materials, equipment and providing of other facilities which may be necessary to perform the excavations, place and compact the backfill.

502.2 LINE AND GRADE:

Structure excavation shall be constructed to line and grade stakes. Adequate staking shall be accurately located to allow the Contractor to perform the work as per the plans. Maintenance of the survey points and stakes shall be the sole responsibility of the Contractor until completion of the work.

502.3 SHORING:

Where necessary, excavations shall be properly sheeted and braced, to furnish acceptable working conditions. The bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength. Any damage to structures occurring through settlements, water or earth pressures, slides, caves or other causes, due to failure or lack of sheeting or bracing or improper bracing or through negligence or fault of the Contractor in any other manner shall be repaired by the Contractor at his own expense.

502.4 EXCAVATION:

The Contractor shall notify the Engineer sufficiently in advance of the beginning of excavation to allow measurements to be taken of the undisturbed ground. The required excavation shall then be performed in reasonably close conformity to the lines, grades and cross sections as shown on the plans.

The sides of excavations may be sloped as required by soil conditions to stabilize the sides for safe working conditions. Such excavation shall be limited to the amount considered necessary for safety, in accordance with State of Arizona OSHA Safety and Health Standards for the Construction Industry (Latest Edition).

When structure footing, concrete box culverts or other structures are to rest on a excavated surface other than rock and no piles are used, care shall be taken to protect the surface from water and not disturb the bottom of the excavation. If suitable material in the bottom of the excavation is disturbed or is removed for the Contractor's convenience, the foundation shall be restored by the Contractor, at his expense, to a condition at least equal to the undisturbed foundation as determined by the Engineer.

When undisturbed original material at the planned grade of the excavation is deter-mined by the Engineer to be unsuitable material, such material shall be removed to the limits directed by the Engineer and the resulting excavation backfilled with structure backfill material.

When structures are to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled or cut to steps and shall be roughened. Seams in the rock shall be grouted under pressure or treated as directed by the Engineer and the cost thereof will be paid for as extra work.

Where rock, in either ledge or boulder formation or other unyielding material is encountered in one portion of structural excavation for a box culvert and a yielding material shall be removed for a minimum depth of two feet below grade and replaced with structure backfill.

When structures are to be supported on piles, excavations shall be completed to the bottom of the footings before any piles are drilled of driven therein. When swell or subsidence results from driving piles, the Contractor shall, at his expense, excavate or backfill with suitable material the footing area to the grade of the bottom of the footings as shown on the project plans.

When during the course of the structural excavation, material is removed in excess of what is required, the Contractor shall backfill said excavated areas in accordance with the requirements for structure backfill as specified herein and no compensation will be made for the additional material or work required.

Excavated material which is not suitable for or not used as structure backfill shall be utilized either for the construction of embankment or disposed of, off the site.

Suitable materials from structure excavation shall be used in the construction of the embankment or other purposes shown on the project plans or specified in the special provisions, unless otherwise designated for disposal.

502.5 TESTING AND INSPECTION BEFORE PLACEMENT OF CONCRETE:

Prior to placing concrete or masonry and after all excavation is completed, the area shall be inspected and approved by the Engineer. After it has been compacted to a uniform density of 95% or more of maximum density as determined by ASTM D-2922 and D-3017 using standard Figure A for rock correction. One test minimum shall be performed for each structure.

Structural backfill shall not be placed until the structure footing or other portion of the structure or facility have been inspected by the Engineer and approved for backfilling.

502.6 REMOVAL OF WATER:

The Contractor shall at all times during construction provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the excavations or other part of the work. Dewatering shall be accom-plished in accordance with Section 447 and as specified.

502.7 BLASTING:

All blasting operations shall be in accordance with Section 204.

502.8 STRUCTURE BACKFILL:

Structure backfill material if present shall be selected from site excavations or be provided by the Contractor. It shall not contain frozen lumps, stones larger than three inches in diameter, chunks of clay or other objectionable material. Backfill material to be used for metal piles or similar items of metal shall have a value of resistivity not less than 3000 ohm-cm or the value shown on the project plans, whichever is less. Backfill material shall have a pH value between 6.0 and 9.0, inclusive, for all installations. Test for pH, percent passing or resistivity shall be performed at the direction of the Engineer before backfilling operation starts.

Structure backfill material shall conform to the following gradation:

Sieve Size	Percent Passing
3 inch	100
3/4 inch	60-100
No. 8	35- 80
No. 200	0-12

The plasticity index shall not exceed 12 when tested in accordance with the require-ments of AASHTO T-90.

502.9 USE OF SLURRY:

As an alternate to the material requirements of Structural Backfill, the Engineer may allow material conforming to the following requirements to be used in a slurry mixture in situations where the slurry will be confined by free-draining soils:

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	90-100
No. 8	35- 80
No. 200	0- 12

The plasticity index shall not exceed 8 when tested in accordance with the requirements of AASHTO T-90.

502.10 PLACEMENT OF BACKFILL:

All earth material which has loosened or collapsed into the excavation from the adjacent ground and all trash, forms and loose large rock shall be removed from the excavation before backfill is placed.

Backfill material shall not be placed against the back of concrete abutments, concrete retaining walls or cast-in-place concrete structures until the concrete has developed its full design strength.

Backfill material shall not be placed against concrete structures not designed to retain earth loads until the concrete has attained a minimum compressive strength of 2,000 psi and in no case less than 72 hours.

Unless otherwise shown on the plans or designated in the special provisions, minor structures such as catch basins or other structures which are furnished as precast structures shall be placed on a layer of structure backfill at least six inches in depth. The layer shall have been shaped to fit the bottom surface of the precast unit and compacted to a density of not less than 100 percent of the maximum density. At the time the unit is placed the moisture content of the layer shall be at or near the optimum moisture. After the unit has been initially set in place and checked for line and grade, it shall be removed and any defects in its bearing area shall be corrected by trimming and by placing and compacting similarly moistened structure backfill. The process of removal, correction and replacement shall continue until the imprint of the unit on the bearing area indicates essentially uniform contact and the unit is in reasonable conformity with the lines and grades shown on the project plans.

Where a structure is located within a paved area, all backfill material above finished subgrade elevation shall conform to the requirements of the typical pavement section of the same elevations.

Backfill compacted by pneumatic or mechanical tamping devices, shall be placed in layers not more than eight inches in depth before compaction. Backfill placed as a slurry shall be placed in uniform horizontal layers not exceeding four feet in depth. The maximum water content of the slurry mixture shall be 35 gallons of water per ton of backfill material. Aggregate slurry shall be thoroughly mixed in a mixer approved by the Engineer. Unless otherwise approved by the Engineer, the slurry shall be compacted with internal vibrators.

502.11 COMPACTION OF BACKFILL:

All structural backfill in any existing or proposed street or where any portion of the backfill is within 2 feet of the above shall be compacted to the minimum density specified in Table 601-2, for Type I.

All other structural backfill shall be compacted to the minimum density of 95%. One test minimum per each four foot of backfill on each structure.

502.12 MEASUREMENT AND PAYMENT:

Unless otherwise provided in the special provisions or proposal, no payment will be made for structure excavation and backfill as such; the cost thereof shall be included in the price bid for the construction or installation of the items to which such excavation and backfill are incidental or appurtenant.

SECTION 505

CONCRETE STRUCTURES

505.1 DESCRIPTION:

The work shall consist of furnishing all materials, labor, equipment, supplies and perform all work necessary to construct concrete bridges, culverts, catch basins, retaining walls, abutments, piers, footings, foundations, vaults, pump stations and similar structures in accordance with the plans and specifications.

505.2 MATERIALS & RELATED WORK:

Concrete shall conform to the requirements of Section 725. Reinforcing steel shall conform to the requirements of Sections 518 and 727. Mortar shall conform to the requirements of Section 776. Expansion joint filler shall conform to Section 729. Concrete curing materials shall conform to Section 726. Concrete joints and water stops shall conform to Section 507. Dampproofing and waterproofing concrete surfaces shall conform to Section 442.

505.3 SUBMITTALS:

Prior to the start of forming, the Contractor shall submit three (3) sets of shop drawings of the reinforcing steel and the attachment of any equipment to the concrete structures direct to the Engineer and obtain approval.

505.4 EXCAVATION AND BACKFILL:

All excavation and backfill work shall be in accordance with Section 502.

505.5 SUBGRADE FOR CONCRETE STRUCTURES:

Each subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept several inches below subgrade until the concrete has set. When the subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed.

When the design details for the project provide for the construction of filter or drain material consisting of gravel or combination of gravel and sand, which material becomes subgrade for concrete, the placing of steel reinforcement and pouring of concrete shall follow the placing of the filter or drain material as closely as practical. The filter or drain material shall be kept dewatered to the extent necessary to prevent any portion of concrete materials being carried away before the concrete has attained its final set. No payment will be made for the work required to keep such materials dewatered, other than such costs as may be included in the prices bid for various items of work or amount bid for dewatering when the schedule provides an item for same.

When concrete is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the Engineer and the base for structures shall be slush grouted or otherwise treated as the Engineer may direct.

505.6 SHORING:

Shoring shall be accordance with Section 502.

505.7 DEWATERING:

Dewatering shall be in accordance with Section 447.

505.8 LINE AND GRADE:

Structures shall be constructed to line and grade stakes. Adequate staking shall be accurately located to allow the Contractor to perform the work as per the plans. Maintenance of the survey points and stakes shall be the sole responsibility of the Contractor until completion of the work.

505.9 FORMS:

Forms shall be of suitable material and of type, size, shape, quality and strength to enable construction as designed. The forms shall be true to line and grade, mortar tight and sufficiently rigid to resist any appreciable amount of springing out of shape during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails and other foreign matter shall be completely removed from forms before any concrete is deposited. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes that would appreciably deface the finished surface. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused, and the reuse of forms shall be subject to the approval of the Engineer. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber or material which will provide a surface at least equally satisfactory. Any lumber or material which becomes badly checked or warped prior to placing concrete may be rejected.

Forms for all exposed surfaces of bridges, viaducts, over crossings and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall be exterior type, of the grade Concrete-Form Exterior, conforming to the specifications of the NBS, Commercial Standards, latest edition. Plywood shall be furnished and placed in 48 inch widths and in uniform lengths of not less than 96 inches, except where the dimension of the member formed is less than the specified panel dimension. Plywood shall be placed with the grain of the outer plies in the direction of the span. Where plywood is attached directly to the studding or joints, the panels shall be not less than 5/8 inch thick and the studdings or joints shall be spaced not more than 12 inches, center to center. Plywood less than 5/8 inch thick, otherwise conforming to the requirements specified, may be used with a continuous backing of 3/4 inch sheathing. All form panels shall be placed in a neat, symmetrical pattern with the horizontal joints level and continuous.

Wood forms for copings and curbs shall have a thickness of not less than 1-5/8 inches and a width of not less than the full depth of coping or curb.

Unless otherwise shown on the plans, all sharp edges shall be chamfered with 3/4 inch triangular fillets. Forms for curved surfaces shall be so constructed and placed that the finished surface will not deviate appreciably from the arc of the curve.

Forms shall be so constructed that portions, where finishing is required, may be removed without disturbing portion of forms to remain.

Forms for girders and slabs shall be cambered as may be required by the Engineer.

Forms shall, as far as practicable, be so constructed that the form marks will conform to the general lines of the structure.

Form clamps or bolts, approved by the Engineer, shall be used to fasten forms. The use of twisted wire loop ties to hold forms in position will not be permitted, nor shall wooden spreaders be used unless authorized by the Engineer. Clamps or bolts shall be of sufficient strength and number to prevent spreading of the forms. They shall be of such type that they can be entirely removed or cut back 1 inch below the finished surface of the concrete. Forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten such wales, all based on the rate of concrete pour.

The Contractor may at his own option, pour such portions of the concrete for the structure directly against the side of the excavation or sheathing without the use of outside forms, provided that the following conditions are met.

(A) If concrete is poured directly against the sides of the excavation, the faces of the excavation must be firm and compact and be able to stand without sloughing off and be at all points outside the concrete lines shown on the plans.

(B) If concrete is poured against sheathing, such sheathing shall be closely fitted and shall be outside of the concrete lines shown on the plans. Those surfaces against which the concrete is to be poured shall be faced with building paper. Except as otherwise specified all sheathing shall be removed, but not until either at least 7 days after placing concrete or until the concrete has attained a strength in compression of not less than 2,000 psi. Care should be used in pulling sheathing so as to avoid damaging the concrete. Voids left by the removal of sheathing, piles and/or similar sheathing supports shall be backfilled with material having a sand equivalent of not less than 30 and consolidated by jetting as directed by the Engineer. When, in the opinion of the Engineer, field conditions or the type of sheathing or methods of construction used by the Contractor are such as to make the removal of sheathing impracticable, that portion of the sheathing against which concrete has been poured may be left in place.

Regardless of the method used in pouring concrete without outside forms the fol-lowing stipulations shall hold:

(A) The reinforcing steel shall be accurately set and held firmly in place, to the satisfaction of the Engineer.

(B) No direct payment will be made for building paper, sheeting, gunite or concrete placed outside of concrete lines shown on the plans. The cost thereof shall absorbed in the prices bid for the various items of work.

(C) The Contractor shall assume all risks of damage to the work or to existing improvements due to any reason whatsoever that may be attributable to the method of construction outlined above.

505.10 FALSEWORK:

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were poured at one time.

All falsework, staging, walkways, forms, ladders, cofferdams and similar accessories shall equal or exceed the minimum applicable safety requirements of Section 107. Compliance with such requirements shall not relieve the Contractor from full responsibility for the adequacy and safety of said items.

Falsework shall be founded upon a solid footing safe against undermining and protected from softening. When the falsework is supported on timber piles, the piles shall be driven to a bearing value as determined by the formula specified in Section 501, equal to the total calculated pile loading. The maximum calculated pile loading shall not exceed 20 tons.

Falsework and forms shall be so constructed as to produce in the finished structure the lines and grades indicated on the plans. Suitable jacks or wedges shall be used in connection with the falsework to set the forms to grade or camber shown on the plans or to take up any settlement in the form work either before or during the placement of concrete. Single wedges for this purpose will not be permitted; it being required that all such wedges be in pairs to insure uniform bearing. Dead load deflection in stringers and joints will be compensated for by varying the depths of the joists or by using varying depth nailing strips.

Arch centering shall be removed uniformly and gradually, beginning at the crown and working toward the springing, to permit the arch to take its load slowly and evenly. Centering for adjacent arch spans shall be struck simultaneously.

Falsework under any continuous unit or rigid frame shall be struck simultaneously; the supporting supports being released gradually and uniformly, starting at the center and working both ways towards the supports.

505.10.1 Falsework Design: Falsework shall be designed by the Contractor to carry all loads and pressures which may be applied to it. The construction loads to be applied are as follows:

Tunnel centering -- 100 percent of the concrete load where concrete is placed by pumping. Forms shall be so constructed to provide adequate relief for excessive pump pressure.

All other structures -- a live load of 30 pounds per square foot of horizontal area.

Transverse and longitudinal bracing -- a horizontal force equal to 2 percent of the vertical load.

The unit stresses for wood falsework shall be those recommended in the West Coast Lumbermen's Association's standard grading and dressing rules increased 25 percent for short time loading.

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

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

Unit stresses for steel falsework shall be in accordance with the requirements of the specifications for design, fabrication and erection of structural steel for buildings of the AISC.

505.11 PLACING REINFORCEMENT:

Reinforcing bars shall be accurately placed as shown on the plans and in accordance with Section 727 and shall be firmly and securely held in position by wiring at all intersections with wire not smaller than No. 16 gage and by using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Wooden supports shall not be used.

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

Bundle bars shall be tied together at not more than 6 foot centers.

505.11.1 Splicing: Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced they shall be lapped at least 30 diameters, unless otherwise shown on the plans.

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

505.11.2 Bending Reinforcement: Bends and hooks in bars shall be made in the manner prescribed in the ACI, Manual of Standard Practice.

Bars shall not be bent nor straightened in a manner that will injure the material. Bars with kinks or unspecified bends shall not be used.

505.11.3 Welded Wire Fabric: Welded wire fabric shall he held firmly in place and spliced not less than 2 meshes.

505.12 INSPECTION:

During forming and reinforcing bar installation safe and suitable ladders and scaffolds shall be provided to permit access to all portions of the work for inspection. Before placing any concrete for the structure, the Contractor shall notify the Engineer that he is ready to pour concrete and obtain approval from the Engineer.

Concrete sampling and testing shall conform to Section 725.

505.13 PLACING CONCRETE:

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

The placing of concrete for a given pour shall start at the low point and shall proceed upgrade, unless otherwise permitted by the Engineer.

With the exception of concrete placed in slope paving, aprons and concrete placed under water, all concrete shall be compacted by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The number of vibrators employed shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least 2 vibrators shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The locations, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Fresh concrete shall be spread in horizontal layers insofar as practicable and the thickness of the layers shall not be greater than can be satisfactorily consolidated with the vibrators. If additional concrete is to be placed, care shall be taken to remove all laitance and to roughen the surfaces of the concrete to insure that fresh concrete is deposited upon sound concrete surfaces. Layers of concrete shall not be tapered off in wedge-shaped slopes, but shall be built with square ends and level tops.

Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

Fresh concrete shall not be permitted to fall from a height greater than 6 feet without the use of adjustable length pipes or elephant trunks.

The use of approved external vibrators for compacting concrete will be permitted when the concrete is inaccessible for adequate compaction provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

During the placing of concrete, care shall be taken that methods of compaction used will result in a surface of even texture free from voids, water or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface. Spades or broad-tined forks shall be provided and used to produce the desired results if required by the Engineer.

The use of chutes in conveying or depositing concrete will be allowed only at the discretion of the Engineer and wherever they are used they shall be laid at such inclination as will permit the flow of concrete of such consistency as is required. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed. Where necessary in order to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

Columns shall be poured preferably through pipes of adjustable length and not less than 6 inches in diameter.

Horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections has been consolidated and a minimum 2 hour period has elapsed to permit shrinkage to occur.

Walkways shall be provided along each side and for the full length of bridge structures outside the deck area. These walkways shall be of sufficient width, and so constructed as to provide for the support of the bridges from which the longi-tudinal floats specified are to be operated. Inspection walkways and access thereto shall be provided under the deck forms between each pair of girders and outside of each outside girder for the full length of the bridge structure. The walkways shall be not more than 8 feet below the concrete to be inspected.

505.13.1 JOINTS AND WATERSTOPS: Joints and waterstops shall be constructed at the locations specified on the project plans unless specifically permitted otherwise by the Engineer and in accordance with Section 507.

505.13.2 ADVERSE WEATHER CONCRETING:

(A) Hot Weather Concreting: Hot weather is defined as any combination of high ambient temperature, low relative humidity and wind velocity which would tend to impair the quality of fresh concrete. These effects become more pronounced as wind velocity increases. Since last minute improvisations are rarely successful, preplanning and coordination of all phases of the work are required to minimize these adverse effects.

As an absolute minimum, the Contractor shall insure that the following measures are taken:

1. An ample supply of water, hoses and fog nozzles are available at the site.

2. Spare vibrators are on hand in the ratio of one spare vibrator for each three in use.

3. Preplanning has been accomplished to insure prompt placement, consolidation, finishing and curing of the concrete.

4. Concrete temperature on arrival should be approximately 60°F and in any event shall not exceed 90°F. The use of cold water and ice is recommended.

5. The subgrade is moist, but free of standing water.

6. Fog spray is utilized to cool the forms and steel.

Under extreme conditions of high ambient temperature, exposure to the direct rays of the sun, low relative humidity and wind, even strict adherence to these measures may not produce the quality desired and it may be necessary to restrict concrete placement to early morning only. If this decision is made, then particular attention must be directed to the curing process since the concrete will be exposed to severe thermal stresses due to temperature variation; heat of hydration plus midday sun radiation versus nighttime cooling.

(B) Cold Weather Concreting: Concrete shall not be placed on frozen ground, nor shall it be placed when the ambient temperature is below 40°F, unless adequate means are used to heat the aggregate and/or water and satisfactory means have been taken for protecting and heating the concrete during the curing period.

(C) Wet Weather Concreting: Placing of concrete shall be discontinued when the quantity of rainfall is such as to cause a flow or wash to the surface. Any concrete already placed and partially cured shall be covered to prevent dimpling. A construction joint will be installed prior to shut down.

(D) Replacement of Damaged or Defective Concrete: Upon written notice from the Engineer, all concrete which has been damaged or is defective, shall be replaced by the Contractor at no cost to the Contracting Agency.

(E) Recommended Reference:
1. ACI-305 Hot Weather Concreting
2. ACI-306 Cold Weather Concreting
3. ACI-308 Recommended Practices for Curing Concrete

505.14 CONCRETE DEPOSITED UNDER WATER:

When conditions render it impossible or inadvisable in the opinion of the Engineer to dewater excavation before placing concrete, the Contractor shall deposit under water, by means of a tremie or underwater bottom dump bucket, a layer of concrete of sufficient thickness to thoroughly seal the cofferdam. To prevent segregation the concrete shall be carefully placed in a compact mass and shall not be disturbed after being deposited. Water shall be maintained in a still condition at the point of deposit.

A tremie shall consist of a water tight tube having a diameter of not less than 10 inches with a hopper at the top. The tube shall be equipped with a device that will close the discharge end and prevent water from entering the tube while charging the tube with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water entering the tube and shall be entirely sealed at all times, except when concrete is being placed. The tremie tube shall be kept full of concrete. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous.

The underwater bucket shall have an open top and the bottom doors shall open freely and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid backwash and shall not be dumped until it rests on the surface upon which the concrete is to be deposited. After discharge, the bucket shall be raised slowly until well above the concrete.

Concrete deposited in water shall have 10 percent extra cement added.

505.15 CURING:

As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall either be sprinkled with water, covered with earth, sand or burlap; sprayed with a curing compound or sealed with a material conforming with Section 726. All concrete for bridge structures shall be water cured unless otherwise permitted by the Engineer.

Concrete that is water cured must be kept continuously wet for at least 10 days after being placed; preferably being covered, if possible, with at least 2 layers of not lighter than 7 ounce burlap, except that handrail, base rail, railing posts, tops of walls and similar parts of the structure, if water cured, must be covered with burlap as above prescribed, immediately following the finishing treatment specified therefor and such covering shall not be removed in less than 4 days. Roadway areas, floors, slabs, curbs, walks and the like, that are water cured may be covered with sand to a depth of at least 2 inches, in lieu of the burlap as specified above, as soon as the condition of the concrete will properly permit, and such covering must remain wet and in place until the concrete so covered is at least 10 days old unless otherwise directed by the Engineer or provided by special provisions.

When a sprayed impervious membrane is used it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely cover and seal all exposed surfaces of the concrete with a uniform film. To insure complete coverage, membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. The membrane, however, shall not be applied to any surface until all of the finishing operations have been completed; such surfaces being kept damp, until the membrane is applied. All surfaces on which a bond is required, such as construction joints, shear planes, reinforcing steel and the like, shall be adequately covered and protected before starting the application of the sealing medium in order to prevent any of the membrane from being deposited thereon; and any such surface with which the seal may have come in contact shall immediately thereafter be cleaned. Care shall be exercised to avoid and prevent any damage to the membrane seal during the curing period. Should the seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional impervious membrane over the damaged area.

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

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

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

Since hot weather leads to more rapid drying of concrete, protection and curing are far more critical than in cool weather. Water curing should be used wherever it is practical and should be continuous to avoid volume changes due to alternation of wetting and drying. The need for adequate continuous curing is greatest during the first few hours after placement of concrete in hot weather.

505.16 FINISHING CONCRETE:

Immediately after the removal of forms as provided above, all concrete surfaces shall be finished in accordance with the requirements specified below.

All surfaces scheduled to be covered with backfill shall be finished so as to be free of open and rough spaces.

All surfaces that will remain exposed in the completed work shall be finished so as to be free of open and rough spaces, depressions or projections. All angles and fillets shall be sharp and true and the finished surface shall present a pleasing appearance of uniform color.

All top surfaces of walls, abutments, piers, etc., shall be finished to a smooth surface and shall be cured by an approved method.

If rock pockets or honeycomb are of such an extent and character as to affect materially the strength of the structure and to endanger the steel reinforcement the Engineer may declare the concrete defective and require the removal and replacement of that portion of the structure affected by the Contractor at no additional cost to the Contracting Agency.

If finishing operations are not carried out as set forth below, all placing of concrete shall stop until satisfactory arrangements are made by the Contractor to promptly correct defective finishing work and to carry out finishing operations as specified.

One of the classes of finish as specified shall be applied to the various surfaces as set forth under applicability of finishes.

No finishing or patching shall be permitted until the surface has been inspected by the Engineer.

505.16.1 Finishing Fresh Concrete in Bridge Decks: Upon placing the deck to a uniform and true surface, screed supports shall promptly be removed from the surface and any necessary hand finishing shall be promptly accomplished in the areas where the screed supports have been removed.

After the floating, as specified above, is completed; the concrete surface shall be textured with a burlap drag or a drag boom, as required by the Contracting Agency.

The finished surface will be tested with a 10 foot straightedge furnished by the Contractor. The testing will be accomplished by holding the straightedge in contact with the deck surface and parallel to the centerline. The surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Areas showing high spots of more than 1/8 inch shall be corrected by cutting or planing. The cutting or planing machine shall be a rotary type, equipped with an adjustable cutter and having a minimum wheel base of 10 feet. Areas showing low spots of more than 1/8 inch shall be filled with an approved mixture of sand, cement and epoxy. The mixture shall firmly adhere to the surface and shall match the surrounding concrete. All areas corrected shall not show deviations in excess of 1/8 inch when tested with a 10 foot straightedge.

505.16.2 Finishing Fresh Concrete in Sidewalks and Bridge Sidewalks: After the concrete has been placed and spread between the forms, it shall be thoroughly worked until all the coarse aggregate is below the surface and the mortar comes to the top. Concrete may be consolidated by means of mechanical vibrators approved by the Engineer.

The surface shall then be struck off and worked to grade and cross section with a wood float.

A mechanical finishing machine that will consolidate the concrete and strike off and finish the surface may be used if permitted by the Engineer, provided that the machine produces a sidewalk equal to or better in all respects than that produced by the methods specified herein.

The surface shall be sweat finished by means of a steel trowel or light broom finished.

The sidewalks shall be marked and edged with the proper tools to form the joints, marking and edges shown on the plans.

505.16.3 Finishing Green Concrete:

(A) Class I Finish -- All bolts, wires and rods shall be clipped and recessed. All holes, honeycomb, rock pockets and other surface imperfections shall be cleaned out, thoroughly moistened and carefully patched with mortar. Mortar shall be composed of 1 part of cement and 2 parts of fine sand. A portion of the required cement for mortar shall be white as required to match the color of the surrounding concrete.

(B) Class II Finish -- The surface shall be patched and pointed as specified above for Class I Finish and then promptly covered with polyethylene film, wet burlap or wet cotton mats. If polyethylene film is used, the film shall be held securely to the surface by means of weights, adhesive or other suitable means. Only white poly-ethylene film for covering will be acceptable.

When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on surfaces sufficiently green to work up such lather, otherwise a carborundum stone shall be used. During the rubbing process, a thin grout composed of 1 part cement and 1 part of fine sand may be used to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be left on the finished surface. A portion of the required cement for grout shall be white as required to match the color of the surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform texture.

(C) Class III Finish -- The surface shall be treated as specified above under Class II Finish except that after brushing, the surface shall again be securely covered with polyethylene film, wet burlap or wet cotton mats. In not less than 1 day nor more than 4 days, the surface shall be uncovered and rubbed with a carborundum stone. This rubbing shall continue until the entire surface is of a smooth texture and uniform color. During the process, the use of a thin mixture of equal parts of sand and cement with water will be permitted. At the time a light dust appears, the surface shall be brushed or sacked, care being taken to carry this brushing in one direction so as to produce a uniform texture.

505.16.4 Finishing Hardened Concrete: If for reasons either beyond the control of the Contractor or with the approval of the Engineer, more than 6 days have elapsed between the time of placing concrete and the time of the removal of forms, the concrete shall be considered as hardened. Prior to finishing hardened concrete, the surface shall be covered with burlap or cotton mats and kept thoroughly wet for a period of at least 1 hour. Finishing shall be identical to the respective requirements for Class I, Class II and Class III Finish for green concrete, except that the use of a mechanically operated carborundum stone will be required for Class II and Class III Finishes.

505.16.5 Applicability of Finishes:

(A) Surfaces requiring Class I Finish -- All formed structures that are to be covered by backfill and those surfaces that are normally not in view of either vehicular or pedestrian traffic such as the surfaces on the inside of barrels of culverts, the under surfaces of decks, surfaces of concrete girders, piers and abutment walls.

(B) Surfaces requiring Class II Finish -- All exposed surfaces of headwalls, wing walls, deck edges on culverts, end of piers on bridges and culverts, vaults, pump stations, retaining walls and those vertical surfaces under highway grade separation structures that are exposed to view of the travelling public, including piers and pier caps, the outside face of outside girders and other similar surfaces.

When surfaces of uniform texture and pleasing appearance are obtained through the use of first class metal forms, paper tubing or the use of special form coatings and the use of special care, such surfaces may, upon approval of the Engineer, be excluded from the surfaces requiring Class II Finish.

(C) Surfaces requiring Class III Finish for bridge structures --
All formed or finished surfaces above the surface of the deck on the roadway side of the handrail and the outside vertical surfaces from the top of handrail and dado to the lower edge of the chamfer at the bottom of the deck.

505.17 REMOVAL OF FORMS:

The falsework supporting any span of a continuous or rigid frame structure subject to bending stress shall not be released until after the last concrete placed in the span and in the adjoining spans, excluding concrete above the deck slab, has attained a compressive strength of not less than twice the design unit stress, or 21 days after the concrete is placed, whichever occurs first.

Stairway riser forms shall be removed and the finish of the steps completed on the day the concrete is placed. Metal stairway treads, if required by the plans, shall be installed immediately after the steps have been placed.

Side forms for beams, girders, columns, railings or other members wherein the forms do not resist dead load bending shall be removed not more than 24 hours after placing concrete, where finishing is required, unless otherwise directed by the Engineer, provided that satisfactory arrangements are made to cure and protect the concrete thus exposed.

Side forms for arch rings, columns and piers shall be removed before the members of the structure which they support are poured or placed so that the quality of the concrete may be inspected. Such forms shall be so constructed that they may be removed without disturbing other forms which resist direct load or bending stress.

Forms and shoring for box and arch sections of sewers and storm drains may be removed as follows:

(A) Forms for open channel walls -- 16 hours.

(B) Outside forms of box sections and inside wall forms of box sections which do not support the slab forms -- 16 hours.

(C) Arch sections in open cut -- 12 hours.

(D) Slab forms for box sections:

(1) Type II Cement -- 48 hours or 6 hours per foot of span between supports, whichever is greater.

(2) Type III Cement -- 24 hours or 3 hours per foot of span between supports, whichever is greater.

(3) Type V Cement -- 56 hours or 7 hours per foot of span between supports, whichever is greater.

The periods of time at which the Contractor may remove forms, as set forth above, are permissive only and subject to the Contractor's assuming all risks that may be involved in such removals. At his option, except for surfaces to be finished, the Contractor may leave the forms in place for such longer periods as are, in his opinion, required.

505.18 DAMPPROOFING AND WATERPROOFING:

Dampproofing and waterproofing shall be in accordance with the plans and Section 442 of these specifications.

505.19 EQUIPMENT AND MATERIAL:

All equipment and materials furnished for the structure shall conform to the requirements on the plans or the special conditions.

505.20 MEASUREMENT AND PAYMENT:

Payment for portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete, furnishing and placement of steel, curing, waterstops, waterproofing and doing all work required to construct the structures in conformity with the plans and specifications.

Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans and on the basis of the concrete having the speci-fied lengths, breadths and thicknesses. However, all concrete shall be placed to line and grade within such tolerances as, in the opinion of the Engineer, are reasonable and acceptable for the type of work involved. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts or openings 5 square feet or less in area. The cost of cement used in mortar for covering construction joints, patching or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the item of work of which said mortar is a part.

The quantity of reinforcing steel, when scheduled as a separate item, will be calculated for payment on the basis of the number of each type bar actually placed in accordance with the plans or with the instructions of the Engineer. The weight will be calculated using the theoretical lengths of bars placed and the unit weight per linear foot specified in ASTM A-305.

SECTION 507

CONCRETE JOINTS AND WATERSTOPS

507.1 DESCRIPTION:

The work shall consist of furnishing all materials labor, equipment, supplies and perform all work necessary to install and construct construction and expansion joints, PVC water stops, premolded joint filler, joint sealant, bond breaker tape, preformed control joints, backing rod, steel expansion joint dowels and joint sealants in accordance with the plans, stand details and as directed by the Engineer.

507.2 RELATED WORK:

Mortar shall conform to the requirements of Section 776. Expansion joint filler shall conform to Section 729.

507.3 SUBMITTALS:

Submit manufacturer's literature, catalog data and statement of compliance with referenced standards and specifications for materials specified herein.

Submit material samples of waterstops and premolded filler.

Provide technical data sheets for the Contractor's personnel and the owner covering joint preparation, priming and sealant materials application.

507.4 MATERIALS:

507.4.1 PVC Waterstop:

A. Waterstops shall be extruded from a PVC compound and shall be lock-rib, center-bulb or flat-strip type as manufactured by B.F. Goodrich Company, Kirkhill Rubber Company, Green Streak Plastic Products Company or equal.

B. Waterstops shall be of the dimensions and profile shown on the drawings.

C. The basic resin of the material shall be a PVC resin plastic, containing nonmigrating-type plasticizers, and shall not be appreciably affected by alkali, acids, or saltwater. All material shall be virgin material; do not use reworked PVC or other substitute.

507.4.2 Joint Sealant for Concrete Structures: The joint sealant shall be a two-part, gray, nonstaining, nonsagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall be PRC 270, Multi-Chem MC287, Sikaflex 2C or equal.

TECHNICAL REQUIREMENTS

Consistency	Gun grade
Tack Free Time	24 hours at 75^0 and 50% R.H.
Pot Life	1 to 3 Hours
Hardness	30 Shore A, + /-5
Elongation	650%
Tensile Strength, ASTM D 142	200 psi
Peel Strength on Concrete	No loss of bond after 24 hours at 150% elongation
Temperature Service Range	-40^0F to $+175^0$F
Immersion in water	Continuous

507.4.4 Premolded Joint Filler: Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D 1752, Type I, as manu-factured by W. R. Grace Company of Cambridge, Massachusetts; W. R. Meadows, Inc., Elgin, Illinois; or an approved equal.

507.5 CONSTRUCTION METHODS:

Except as otherwise specified herein or specifically permitted otherwise by the Engineer, concrete joints and water stops shall be constructed at the locations and in accordance with the project plans.

507.5.1 Construction Joints: Construction joints - Except under emergency condi-tions, construction joints shall be planned and located in advance of placing concrete. All construction joints shall be perpendicular to the principal lines of stress and in general located at points of minimum shear and movement.

Construction joints shall be keyed, unless otherwise detailed. Form keyways by beveled strips or boards placed at right angles to the direction of shear. Except where otherwise shown on the drawings or specified, keyways shall be at least 1-1/2 inches in depth over at least 25% of the area of the section.

When it is necessary as determined by the Engineer to make a joint because of an emergency (an interval of 45 minutes between two consecutive batches of concrete shall constitute cause for an emergency construction joints), reinforcing dowels shall be furnished and placed across the joint. Dowels are to be embedded 48 bar dia-meters each side of the joint. Size and number of dowels shall match reinforcing in the structure. Furnishing and placing such reinforcing steel shall be at the Contractor's expense.

After placing of concrete has been completed to the construction joint and before placing fresh concrete, the exposed reinforcing steel and the entire surface of the construction joint shall be thoroughly cleaned of surface laitance, curing compound and other materials foreign to the concrete and clean, coarse aggregate exposed. Surfaces of concrete that have been in place for eight hours or more shall be cleaned by abrasive blast methods. Surfaces of concrete that have been in place for less than eight hours may be cleaned with air and water jets provided that surfaced laitance and curing compound is removed.

After the concrete surfaces have been treated as specified, they shall be cleaned of all dust and abrasive material.

All horizontal construction joints or those on slight slopes, shall be covered with Class D mortar as specified in Section 776. The mortar shall be spread uniformly and worked thoroughly into all irregularities of the surface. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed, and the consistency of the mortar shall be suitable for placing and working.

507.5.2 Expansion and Contraction Joints: Expansion and contraction joints in the concrete structures shall be formed where shown on the plans and as directed. In general, such joints shall have smooth abutting surfaces. Painted or separated and sealed as detailed on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans. Concrete or mortar shall not be permitted to lap these joints in such a manner as to effect a tie or bond that would later promote spalling.

Provide expansion joints with continuous edge reservoirs, which shall be filled with a joint sealant. Leave the material used for forming the reservoirs in place until immediately before the grooves are cleaned and filled with joint sealant. After removing edge forms from the reservoir, remove grout, loose concrete and fines; then sandblast the slots. Allow the reservoirs to become thoroughly dry, then blow out the reservoirs and immediately prime and fill with the expansion joint sealant and backup materials. The primer used shall be supplied by the same manufacturer supplying the joint sealant.

Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.

Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant spillage.

Where premolded filler is specified, install in joints as shown on the plans. Attach to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility. Expansion joint guards shall be in accordance with plans.

Plates, angles or other structural shapes provided as expansion guards for open joints shall be fabricated at the shop to conform to the section of the concrete slabs.

These guards shall comply with the details shown on the project plans.

507.5.3 Water Stops: Water stops of rubber or plastic, shall be placed in accordance with the details shown on the project plans. Where movement at the joint is provided for, the water stops shall be of a type permitting such movement without injury. They shall be spliced, welded or soldered to form continuous watertight joints.

Construct forms for construction joints in such a manner as to prevent injury to waterstops. Hold waterstops securely in position in the construction joints by wire ties, continuous construction and expansion joints in hydraulic structures or where shown on the drawings.

Make field splices with a thermostatically controlled heating iron in conformance with the manufacturer's current recommendations. Allow at least 10 minutes before pulling or straining the new splice in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80% of the unspliced materials.

507.6 MEASUREMENT & PAYMENT:

Unless otherwise provided in the special provisions or proposals, no payment will be made for concrete joints and waterstops as such; the cost thereof shall be included in the price bid for the construction or installation of the items to which such work is incidental or appurtenant.

SECTION 510

CONCRETE BLOCK MASONRY

510.1 DESCRIPTION:

The work consists of furnishing all materials labor, equipment, supplies and tools to perform all work necessary to construct concrete block masonry walls and units including excavation, placing footings, placing reinforcing grouting, back filling and all associated work in accordance with plans and County Construction Stan-dards.

510.2 MATERIALS:

All materials for concrete block masonry shall conform to the requirements of Sections 775 and 776.

510.3 EXCAVATION AND COMPACTION:

All excavation for footings or related work shall be in accordance with Section 601.

510.4 CONSTRUCTION:

Proper masonry units shall be used to provide for all windows, doors, bond beams, lintels, pilasters, etc. with a minimum of unit cutting. Where masonry unit cutting is necessary, all cuts shall be neat and regular and edges exposed in the finished work shall be cut with a power driven abrasive saw.

Where no bond pattern is shown, the wall shall be laid up in straight uniform course with regular running bond with alternate header joints in vertical alignment.

Intersecting masonry walls and partitions shall be bonded by staggering the joints to form a masonry bond and the use of 1/4 inch minimum diameter ties at 24 inches o.c. maximum.

Where stack bond is indicated on the plans, approved metal ties shall be provided horizontally at 24 inches o.c. maximum.

Where masonry facing is a part of wall construction metal ties shall be furnished and installed as directed by the Engineer.

Mortar joints shall be straight, clean and uniform in thickness. Unless otherwise specified or detailed on the plans, horizontal and vertical joints shall be approxi-mately 3/8 inch thick with full mortar coverage on the face shells, shall have vertical joints buttered well for a thickness equal to the face shell of the block and these joints shall be shoved tightly, so that the mortar bonds to both blocks. No slushing or grouting of a joint will be permitted, nor shall a joint be made by working in mortar after the units have been laid.

Exposed walls shall have joints tooled with a round bar or V-shaped bar to produce a dense, slightly concave surface well bonded to the block at the edges. Tooling shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.

If it is necessary to move a block so as to open a joint the block shall be removed from the wall, cleaned and set in fresh mortar.

510.5 PLACING REINFORCING STEEL:

Reinforcing steel shall be placed as indicated on the plans. Splices shall be lapped a minimum of 40 diameters, except that dowels other than column dowels need to be lapped only 30 diameters. Column dowels shall lap 50 diameters.Outside horizontal steel shall lap around corners 40 diameters, and be carried through columns unless otherwise shown on the plans. Inside horizontal steel shall extend as far as possible and bend into corner core. A dowel shall be provided in the foundation for each vertical bar. Bending of dowels to fit openings will not be permitted and, where required, new dowels shall be installed by drilling and grouting. All lap joints shall be wired.

Vertical cores containing steel shall be filled solid with grout, and thoroughly rodded.

Where knockout blocks are used, steel shall be erected and wired in place before 3 courses have been laid. Vertical cores at steel locations shall be filled as construction progresses.

Where knockout blocks are not used, vertical cores at steel locations shall be filled in lifts of not more than 4 feet. The maximum height of pour shall be 8 feet. Cores shall be cleaned of debris and mortar and shall have reinforcing steel held straight in place. If ordered by the Engineer, inspection and clean out holes shall be provided at the bottom of each core to be filled.

Reinforcing steel shall be inspected prior to placing grout.

510.6 BLOCK WALLS:

Non-retaining concrete block walls shall be constructed in accordance with Yuma County Construction Standard 3-310.

510.7 CURING:

Newly constructed masonry shall be kept damp for at least 5 days with a nozzle regulated fog spray sufficient only to moisten faces of the masonry but not of such quantity as to cause water to flow down over the masonry.

510.8 MORTAR AND GROUT:

Mortar and grout used for concrete block masonry shall conform to Section 776.

510.9 MEASUREMENT & PAYMENT:

Measurement and payment for concrete block masonry will be by the linear foot for walls or be by lump sum price for the structure of which the masonry is a part, unless another basis for payment is included in the proposal.

SECTION 511

BRICK MASONRY

511.1 MATERIALS:

Unless otherwise specified, brick masonry shall be constructed of brick conforming to Section 775 and cement mortar as described in Section 776.

511.2 BRICKLAYING:

The amount of wetting will depend on the rate of absorption of the brick at the time of laying. When being laid, the brick shall have suction sufficient to hold the mortar and to delete the excess water from grout, and shall be sufficiently damp so that the mortar will remain plastic enough to permit the brick to be leveled and plumbed after being laid without breaking the mortar bond.

Brick work shall be plumb, level, straight and true to dimensions shown on the plans. Such work shall start, where feasible, at a least important corner of wall and the masonry contractor shall request an early inspection of the work by the Engineer. All pattern work, bonds or special details indicated on the plans shall be accurately and uniformly executed. Face bonding shall be as shown on the plans, but if not shown, shall be running bond for standard size brick and approximately 1/3 bond for oversize brick and approximately 1/4 bond for modular brick unless otherwise designated by the Engineer. All bed and head joints shall be solidly filled with mortar at the time of laying.

Unless otherwise shown or detailed on the plans the thickness of mortar joints shall be uniformly 1/2 inch.

Face bricks shown to be laid in stack bond shall have the center lines of vertical joints plumb and the brick laid equidistant from the center line with not more than 1/8 inch variation in the width of these joints. The brick in each separate stack shall not vary more than 1/8 inch in length, but the separate stacks may vary in width of stacks.

When mortar has slightly stiffened, solidly fill with mortar all interstices between bricks and between bricks and other materials and also fill all line pin holes. Jointing and tooling shall be done before mortar has stiffened.

Masonry to be plastered shall have all mortar joints trowel cut flush.

Masonry to be painted and not shown to be tooled or raked, shall have all joints carefully and evenly struck with a trowel.

Masonry to be left exposed without paint or plaster, shall have all mortar joints carefully and evenly tooled with a metal jointing tool of a type as approved by the Engineer. Masonry shown or indicated to have raked joints shall have the joints raked out 3/8 inch deep, then tooled with a flat jointing tool, then brushed with a stiff non-metallic brush. Sack-rubbing or wiping finished masonry with rags will not be permitted.

511.3 PROTECTION:

Protect all sills, ledges, offsets, other materials, etc., from droppings of mortar during construction. Protect the tops of all unfinished masonry from rain by using water-repellent covering such as roofing felt or tar paper.

Protect the surfaces of wall, piers, etc., from mortar droppings or splashes at scaffold heights.

511.4 CURING:

Finished masonry shall not be wetted, except when exposed to extreme hot weather or hot wind and then only by using a nozzle regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

511.5 REINFORCED GROUTED BRICK MASONRY:

Mortar in all bed joints shall be held back 1/4 inch from edges of brick adjacent to grout space or shall be beveled back and upward from grout space. The thickness of head and bed joints shall be as herein before specified or shown. Head joints specified or shown to be less than 5/8 inch thick shall be solidly filled with mortar as brick are laid. Head joints 5/8 inch or more in thickness may have mortar sufficient only to form dams to retain the grout. Bed joints shall not be deeply furrowed with the trowel. All brick shall be shoved at least 1/2 inch into place. One outer tier shall be not more than 12 inches before grouting, but the other tier shall be not more than 4 inches high before placing the grout. Grout shall be thoroughly agitated and mixed to eliminate segregation before being placed. All interior grout spaces shall be filled with grout and immediately puddled or swished with a stick or rod (not a trowel) sufficiently to cause the grout to flow into all interstices between the bricks and to fully encase the reinforcing steel. Wherever possible, grouting shall be done from the inside face of exterior masonry. If any grout contacts the finished masonry, it shall be immediately removed and the surface cleaned.

In masonry which is more than 2 tiers in thickness, including pilasters and column, the interior shall be of whole or half bricks placed into grout with not less than 3/4 inch of grout surrounding each brick or half brick. Except at the finish course, all grout shall be stopped 1-1/2 inches below the top of both outer tiers. Where necessary to stop off a longitudinal run of masonry, it shall be done only by racking back 1/2 brick length in each course and stopping grout 2 inches back of the rack. Toothing will not be permitted unless special approval is given by the Engineer.

Reinforcing steel shall be accurately placed in strict accordance with the plans and notes thereon. Vertical steel shall be held firmly in proper position. Where necessary this shall be done by means of frames or other suitable devices. Horizontal steel may be placed as the work progresses.

511.6 MEASUREMENT AND PAYMENT:

Payment for brick masonry will be included in the lump sum price for the structure of which the masonry is a part unless another basis for payment is included in the proposal.

SECTION 518

STEEL REINFORCEMENT

518.1 DESCRIPTIONS:

The work under this section shall consist of fabricating, furnishing and placing steel reinforcement of the quality, coating, type, size, shape and quantity designated, all in accordance with the details shown on the project plans and the requirements of these specifications.

518.2 MATERIAL:

Steel reinforcing bars, wire and welded wire fabric shall conform to the requirements of Section 727.

518.3 SUBMITTAL:

Prior to the placement of steel reinforcement, the Contractor shall submit 3 copies of shop drawings to the Engineer and obtain approval. When the project plans show a bar list and bending diagram, the Contractor shall carefully check the schedule against the details in advance of ordering materials. The shop drawings are to show all lap splices and bends.

When bar bending diagrams are not shown on the project plans, shop drawings and lists showing the bending of reinforcement bars shall be included in the submittal by the Contractor to the Engineer. Approval shall not relieve the Contractor of responsibility for the correctness of such drawings and lists.

Any discrepancy or error found by the Contractor in checking a bar list or bending diagram shown on the project plans or in preparing shop drawings or list shall be reported immediately to the Engineer and the discrepancy or error shall be corrected in advance of fabrication and delivery of materials.

518.4 CONSTRUCTION METHODS:

Steel reinforcement shall be protected at all times from damage. When placed in the work, all reinforcement shall be free of dirt, oil, paint and grease. Rust, surface irregularities or mill scale shall not be cause for rejection, provided the weight, dimensions, cross-sectional area and tensile properties of a manually wire brushed test specimen are not less than the requirements of these specifications.

When bending is required, it shall be done without the use of heat and bars having cracks or splits at the bends will be rejected. Grade 40 bars which are No. 8 and larger and all sizes of Grade 60 bars shall not be rebent at the same location. Grade 40 which are size No. 7 and smaller may be rebent once at the same location.

Reinforcement shall be accurately fabricated and placed as shown on the plans and shall be firmly held in place by wire ties at all intersections and splices with 16 gauge or heavier tie wires and with precast mortar blocks of ferrous metal chairs, spacers, metal hangers, supporting wires or other approved supports at the spacing neces-sary to maintain the specified clearance of the reinforcing steel. The use of pebbles, broken stone, concrete masonry blocks, brick, metal pipe or wood blocks will not be permitted for the purpose of spacing or support. Where reinforcement spacing is less than 12 inches in each direction alternate intersections may be tied. Tack welding of reinforcement will not be permitted unless approved in writing by the Engineer. If tack welding of reinforcement is approved the reinforcement shall be deformed and shall conform to the requirements of ASTM A-706.

The following tolerances will be allowed when placing, tying and supporting reinforcing steel:

In slabs and beams, horizontal bars shall be within 1/4 inch, measured vertically, of the position indicated on the plans.

In slabs or walls, long runs of bars may vary up two inches in spacing, however, the specified number of bars shall be placed.

No concrete shall be placed until reinforcement in the member has been inspected and approved by the Engineer. Reinforcement which does not conform to the above tolerances shall be adjusted or repaired prior to concrete placement.

When required by the project plans, all reinforcement to be encased in the concrete of a bridge shall be epoxy coated. Reinforcement that is to be partially within the bridge deck concrete, but extends into other structural elements, will not require coating on that part which is to be outside the bridge deck concrete.

518.5 SPLICING AND LAPPING:

All reinforcement shall be furnished in the full lengths indicated on the project plans. Splicing of bars, except as shown on the plans, will not be permitted without the Engineer's approval. Splices shall be staggered as far as possible. The type and method of splices or connections shall be approved by the Engineer.

The Contractor may use either lap splices, full welded splices or mechanical connections for reinforcement bars up to and including bar size No. 11. Where the bar size exceeds No. 11, full welded splices or mechanical connections shall be used. Welded splices shall not be used on epoxy-coated bars to cause any heating of the coating. All exterior surfaces of positive connectors for epoxy-coated bars shall have the same coating as the bar.

In lapped splices, the bars shall be placed in contact with one another and wired together in such a manner as to maintain a clearance of not less that the minimum clear distance to other bars and the minimum distance to the surface of the concrete. Lap lengths shall be as shown on the plans or a minimum of 40 bar diameters.

A full welded splice is one in which the bars are butted and welded to develop, in tension, at least 125 percent of the specified yield strength of the bar. Test requirements shall be as specified in AWS D 12.1. Welding shall be performed in accordance with the requirements the American Welding Society (AWS) structural welding code AWS D1.1-80.

A mechanical connection is one in which the bars are connected to develop, in tension or compression as required, as least 125 percent of the specified yield strength of the bar.

Except as otherwise specified, mechanical splices shall be made in accordance with the manufacturer's recommendations as approved by the Engineer. As a condition of approval, the Contractor shall make three test splices in the presence of the Engineer of each size he intends to splice. Two of the test splices shall be tension tested to 125 percent of the specified yield strength of the bar and one splice shall be tested to destruction by an approved laboratory and certified reports of the test shall be submitted to the Engineer for approval. Field splices shall be subject to visual inspection and splices chosen at random by the Engineer shall be removed and tested to 125 percent of specified yield strength by the Engineer. Samples shall be at least 42 inches long with the splice at mid-length.

Sheets of welded wire fabric or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh width.

518.6 EPOXY-COATED REINFORCEMENT:

518.6.1 General: The requirements of this subsection for epoxy-coated rein-forcement are in addition to the previous requirements which apply to uncoated reinforcement.

518.6.2 Field Operations - Epoxy Coated Bar Reinforcement: All handling systems for coated bars shall have padded contact areas for the bars, wherever possible. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports or a platform bridge so as to prevent bar to bar abrasion from sags in the bar bundle. The bars or bundles shall not be dropped or dragged.

Chairs, tie wires, and other devices used to support, position, or fasten the reinforcement shall be made of or coated with a dielectric material. The specific hardware that the Contractor proposes to use shall be approved by the Engineer.

The Contractor shall be required to field repair damaged areas of the coating, and to replace items exhibiting severely damaged coatings. The material used for field repair shall be that supplied by the coating applicator.

Field repair shall be required wherever the area of coating damage exceeds two percent of the surface area of the bar in a one foot length and the damaged spot is larger than 1/4 inch by 1/4 inch. Field repair will not be allowed on bars which have severely damaged coatings. A severely damaged coating is defined as a coating which has a total damaged area greater than five percent of the surface area reinforcing bar. The Engineer shall be the sole determiner of the severity of damaged area for purposes of repair or replacement. A reinforcing bar having a coating determined by the Engineer to be severely damaged shall not be incorporated in the work and it shall be removed from the work site. All such bars shall be replaced in kind by the Contractor at no additional cost to the County.

518.7 DOWEL PLACEMENT:

Dowel placement shall consist of drilling or coring dowel holes, furnishing and placing setting materials and placing steel metal dowels in accordance with the details shown on the plans and the requirements of the specifications.

The diameter of dowel holes shall be 1/4 inch larger than the diameter of the dowels to be placed and the depth of the holes shall be as shown on the plans.

Setting materials shall be an approved epoxy adhesive unless otherwise specified on the plans.

The minimum tensile pull out strength of the dowel anchorage shall be as specified on the plans.

If required by the Engineer, the Contractor shall submit details of the anchorage system to the Engineer prior to dowel placement.

518.8 METHOD OF MEASUREMENT:

518.8.1 General: No measurement for payment will be made for steel reinforce-ment, whether coated or uncoated as required, which is included in precast or concrete item which is listed in the bidding schedule as a unit to be paid for at a lump sum price.

Steel reinforcement that is required on the plans to be epoxy-coated for use in bridge concrete and that is partially within the deck yet projects into other structural elements shall be included in the measurement and payment for Rein-forcing Steel (Epoxy-Coated). The Contractor is required to coat only that part of the reinforcement that is contained in a deck.

In those cases where steel reinforcing is a separate pay item it will be measured as a lump sum item or by the pound, as listed in the bidding schedule. Epoxy-coated reinforcement will be measured separate from uncoated reinforcement.

Dowel placement will not be measured.

518.8.2 Lump Sum Basis: The project plans will show an estimated net weight of reinforcing steel required for the work. This quantity shall be considered as approximate only. It shall be the responsibility of the bidder to determine the exact quantities of all reinforcing steel required, by computations based upon the details and notes shown on the project plans. It is understood that the quantities of all reinforcing steel required for the work shall be furnished by the Contractor, including samples for testing. Measurement of the quantity furnished will be made either when an alteration in the work is ordered or when evidence shows or there is good reason to believe that the actual quantity of reinforcing steel varies from the total quantity shown on project plans by three percent or more. When an alteration in the work is ordered or when the quantity varies as herein specified, the actual quantity of reinforcing steel will be computed by the Engineer and the amount of the increase or decrease will be measured by the pound.

518.8.3 Pound Basis: Reinforcing Steel will be measured in pounds based on the total computed weight for the size and lengths of bars, wire or welded wire fabric as shown on the plans or authorized.

The weight of bars will be calculated from weights shown in Table 518-1.

TABLE 518-1

Deformed Bar Designation Number	Weight - Pounds Per linear Foot	Nominal Diameter, Inches
3	0.376	0.375
4	0.668	0.500
5	1.043	0.625
6	1.052	0.750
7	2.044	0.875
8	2.670	1.000
9	3.400	1.128
10	4.303	1.270
11	5.313	1.410
14	7.650	1.693
18	13.600	2.257

Note: The nominal diameter of a deformed bar is equivalent to the diameter of a plain round bar having the same weight per foot as the deformed bar. Bar numbers are based on the number of eighths of an inch included in the nominal diameter of the bars.

The weight of welded wire fabric will be computed from the theoretical weight of plain wire of the corresponding gauge. If the weight per square foot is shown on the plans, that weight will be used.

In measurement of the weight of epoxy-coated steel reinforcement, no addition to or deduction from the weights shown on Table 518-1 will be made because of additional requirements for blast cleaning and epoxy coating.

When laps are made for splices other than those shown on the plans for the convenience of the Contractor, the extra steel will not be included in the measurement for payment.

The measurement of samples for testing will be the weight in pounds of the samples selected by the Engineer or the weight in pounds of the full length of reinforcing steel bars supplied for sampling purposes when sampling is done at the construction site.

518.9 BASIS OF PAYMENT:

Only when a bid item is provided for in the proposal the accepted quantities of reinforcing steel of the type shown in the bidding schedule, measured as provided above, will be paid for at the contract lump sum price or the contract unit price per pound, complete in place.

The lump sum price or unit price per pound shall also include the cost of chairs, supports, fasteners, connections, tie wire and any splices not specifically shown on the plans. If the Engineer permits the substitution of larger bars than those specified or splices not shown on the plans payment will be made only for the amount of steel which would have been required if the specified size and length has been used.

No measurement or direct payment will be made for furnishing and placing dowels which are required to replace existing reinforcing steel that is damaged as result of the Contractor's operations.

SECTION 525

PNEUMATICALLY PLACED MORTAR

525.1 DESCRIPTION:

The work under this section shall consist of furnishing all material and pneumatically placing by means of suitable equipment and competent operators, either premixed portland cement and fine aggregate (dry mix process) or premixed concrete (wet mix process).

525.2 DRY MIX PROCESS:

The dry mix process shall consist of thoroughly mixing a proportional combination of fine aggregate and portland cement and conveying this mixture through a delivery hose to a special nozzle where water is added and combined with the dry ingredients prior to discharge. The nozzle water ring shall be cleaned daily.

The fine aggregate shall be material sand conforming to ASTM C-33, with Gradation No. 1 as shown in Table 525.1 and with not less than 3 percent or more than 7 percent moisture by weight.

Portland cement and mixing water shall conform to the requirements of Section 725.

The dry mix shall consist of 1 part portland cement and 4.5 parts of fine aggregate by weight. Machine mixing will be required. This operation of proportioning and mixing shall be subject to the approval of the Engineer.

525.3 WET PROCESS:

The wet process shall consist of premixing by mechanical methods a proportional combination of portland cement aggregate and water required to produce mortar or concrete and conveying this mortar or concrete through the delivery hose to the special nozzle where additional compressed air is added prior to discharge. The air ports in the nozzle shall be cleaned daily.

The portland cement concrete used for the Wet Mix Process shall conform to Section 725 and shall be Class A (3,000 psi) unless otherwise specified. In no event shall a slump greater than 4 inches be used. As the work approaches the vertical, the maximum slump shall not exceed 1 inch.

The fine and coarse aggregate shall conform to ASTM C-33 using one of the three graduations shown in Table 525.1. Unless otherwise specified, Gradation No. 1 will be used.

TABLE 525.1
(A.C.I. TABLE 2.2.1)

Percent by Weight Passing Individual Sieves

Sieve Size	Gradation No. 1	Gradation No. 2	Gradation No. 3
3/4 in.	--	--	100
1/2 in.	--	100	80-95
3/8 in.	100	90-100	70-95
No. 4	95-100	70-85	50-70
No. 8	80-100	50-70	35-55
No. 16	50-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

* Batch fine and coarse aggregates separately to avoid segregation.

525.4 REINFORCING STEEL:

Reinforcing steel bars or welded-wire fabric shall conform to Section 727 and shall be 6 x 6 - W 1.4 x 1.4 welded wire fabric unless otherwise specified. Reinforcement shall be placed as closely as possible to the center of the mortar.

525.5 EQUIPMENT:

Prior to the start of construction, the Contractor shall demonstrate that his equipment, materials and operators are capable of providing a finished structure in accordance with the specifications. For this demonstration, the Contractor shall provide test panels, 30 inches by 30 inches, with a depth the same as the structure, but not less than 4 inches. A separate panel shall be provided for each shooting position to be used (overhead, slope and/or slab) and one half of each panel shall contain reinforcement as used in the structure. Cores will be taken for visual inspection and compressive strength tests. The Engineer has the authority to accept or reject equipment materials and/or operators based on his evaluation and his decision will be final.

If the Contractor can present valid factual documentation to the satisfaction of the Engineer that his equipment materials and operators have produced satisfactory results on similar work within the past six months, the Engineer may eliminate the test panel procedure.

525.6 SURFACE PREPARATION:

The surface on which the mortar is to be placed shall be compacted and true to line and grade as required by the plans and specifications. The surface shall be uni-formly moistened so that water will not be drawn from the freshly-placed mortar. Placement of the mix shall not start until the temperature is 35°F and rising and shall stop when the temperature is 40°F and falling.

525.7 FORMS AND GROUND WIRES:

Forms shall be plywood or some other suitable material, true to line and grade, sufficiently rigid to resist deflection during mortar placement.

Ground or gauging wires shall be installed where necessary to establish the thickness and finish lines of the structure.

525.8 JOINTS:

Construction joints shall be tapered to a shallow edge not more than one inch thick over a width of approximately one foot except where the joint will be subjected to compressive stress. In this case, square joints shall be constructed. Joints shall be thoroughly cleaned and wetted prior to any additional application.

Install control joints in accordance with the plans. Reinforcement will not extend across control joints.

525.9 FINISHING:

Unless otherwise specified, the natural gun finish will be provided.

525.10 CURING

Curing shall be accomplished using Type 2 compound as specified in Section 726. Application rate shall be not less than one tenth of a gallon per square yard. Section 505.13.2, "Adverse Weather Concreting" is applicable.

525.11 TESTING:

Tests to determine the quality of the mortar will be performed by the Engineer periodically during the course of work. Test panels shall be prepared by the Contractor.

Test panels shall be at least 12 inches square and as deep as the structure, but not less than 4 inches. Cores shall be taken from the panel for visual and compressive strength tests. The minimum compressive strength at the end of 28 days shall be 3,000 psi.

The Engineer may allow the use of 6 inch by 12 inch hardware cloth cylinders for testing in lieu of the test panels.

All rebound pockets and any mortar, defective in the compressive strength test, shall be cut out and replaced.

525.12 MEASUREMENT AND PAYMENT:

Payment for pneumatically-placed mortar will be made at the unit price per square yard or the lump sum price as set forth in the proposal. Such payment shall be full compensation for furnishing all labor, tools, equipment and accomplishing all work in conformance with the plans and specifications.

SECTION 532

CONCRETE CATCH BASINS

532.1 DESCRIPTION:

The work includes furnishing all materials, labor and equipment and perform all work necessary to construct cast in place reinforced concrete catch basins together with curb inlets, access openings, grate and grate frame complete as shown on the plans and in accordance with County construction standards, including all excavation irrespective of the nature of the material encountered or any necessary changes in depth due to unforeseen underground obstruction. Also, included shall be all compacted backfill and other necessary operations to complete the work to the lines and grades indicated on the drawings and as specified herein.

532.2 MATERIALS:

Portland cement concrete shall be Class "A" and shall conform with the requirements of Section 725.

Reinforcing steel shall conform with the requirements of Sections 518 and 727.

All structural steel shall be ASTM A36.

All welding shall conform to the standard specifications for welded highway and railway bridges of the American Welding Society.

532.3 SUBMITTALS:

Prior to forming, the Contractor shall prepare shop drawings and submit them for approval. The drawings shall show complete fabrication, reinforcing steel layout and how attachments are anchored.

The Contractor shall submit three (3) sets of prints of the completed and checked drawings and obtain approval. The fabrication of any material prior to approval of the drawings shall be at the Contractor's risk.

The approval of the drawings will be general and such approval will not relieve the Contractor of any responsibility for the correctness of the drawings or for errors in fabrication or field correctness.

532.4 LINES AND GRADE:

The catch basin shall conform to the lines and grades shown on the plans and meet adjacent sidewalk, road, finished grades, curb and gutter surfaces with no offset greater than 1/8 inch. The inlet gutter grades and pipe grades shall be as shown on the plans or as established by the Engineer.

532.5 CONSTRUCTION METHODS:

532.5.1 Basin Standards: As specified on the plans, catch basins shall be constructed in accordance with Yuma County Construction Standards 5-225 through 5-290.

532.5.2 Excavation and Backfillings: Excavation and backfilling work shall be performed in accordance with Section 601. Excavation for the structure shall be made to the lines and elevations shown on the plans. After forms are removed and only after the Engineer has inspected the outside of the structure, backfilling around the structure can proceed.

532.5.3 Concrete Work: Concrete work construction on catch basins are to be in accordance with Section 505. All material under the structure shall be firm and solid. The walls of catch basins may be poured directly against the earth, provided a satisfactory excavation is made true to the lines as shown on the drawings. In any event, the back form shall be carried to a depth of at least 1 foot below the finished ground line.

It is preferred that the structure be monolithic, without cold joints, however if the Contractor elects pour in two sections, the joint shall be made at the top the footing, and the footing poured to full depth and size before the wall forms are placed. The bond at the cold joint shall be in accordance with Section 507.

The top of all walls around the inlets shall receive a smooth trowel finish and the edges be neatly rounded.

Catch basins are to have troweled inverts to eliminate water from standing in bottom.

Concrete curing shall be in accordance with Section 726.

The catch basin seats and frames shall be constructed and set true to line and grade.

When specified on the project plans, aprons shall be constructed in accordance with the details shown on the plans. Aprons shall be constructed from portland cement concrete or from asphaltic concrete as shown.

Performed bituminous joint fill shall be installed where the catch basin concrete will meet new or existing concrete curb or pavement.

532.5.4 Frame, Grates & Covers: Grates, frames, access openings and curb openings shall be constructed in accordance with the plans, Yuma County Construction Standard 5-300 and Type II grate.

The access covers and catch basin grates and frames shall be fabricated and installed so that the bearing surfaces of the grates and access covers shall rest securely on the bearing surfaces of the frames.

532.5.5 Metal Furnishing: All structural members and assemblies shall receive one shop coat of prime paint and one field coat of a paint in accordance with Section 790.

532.6 MEASUREMENT AND PAYMENT:

532.6.1 Measurement: This item will be measured as a unit for each catch basin completed in place including frame, grates and access covers.

532.6.2 Payment: The amount of completed and accepted work, measured as provided above, will be paid for at the contract unit price each, which price shall be full compensation for all labor, materials and incidentals necessary to complete the work as shown on the drawings and as specified herein.

SECTION 545

PUMP STATION

545.1 DESCRIPTION:

The work includes furnishing all materials, labor, equipment, supplies and tools to perform all work necessary to construct a storm water pump station with a precast concrete pipe wet well. The work includes excavation, backfilling, site grading, surfacing, concrete slabs, inlet pipe connection, wet well barrel, top slab with access covers, liquid level sensors, discharge pipe, couplings, values, painting, other appurtenances and incidentals as detailed on the plans to provide a complete and operational pump station.

545.2 SUBMITTAL:

Submit three (3) copies of manufacturer's literature, catalog date and statement of compliance with referenced standards and specifications for materials specified herein to the Engineer for approval before use.

545.3 MATERIALS:

The wet well barrel shall be precast reinforced concrete pipe meeting the requirements of ASTM C-76 and ASTM C-655. Wet well pipe shall be cast in one length, if possible. Openings in the wet well for piping shall be cut in the field and sealed in accordance with the plans.

Pipe and fittings are to be either steel in accordance with Section 748 or be ductile iron in accordance with Section 750 for fittings to be manufactured of Class 125 ductile iron, cement lined. All fittings shall be flange type. All steel pipe below ground shall have a exterior mortar coating.

Gate valves, check valves, air and vacuum valves shall be in accordance with Section 767 and the project plans.

Discharge flow from the system shall be measured with a flow meter, Macrometer or equal. Flow rate indicator shall be in gallons per minute and register shall be in acre feet.

545.4 CONSTRUCTION METHODS:

545.4.1 Site Work: Excavation and backfill for the pump station wet well shall be in accordance with Section 502, Site grading shall be in accordance with Section 218, Aggregate base material is to be placed over the site and to the thickness in accordance with the plans and Section 310. The site shall be enclosed with chain link fencing and masonry block wall in accordance with the plans and standard specifications.

545.4.2 Wet Well: The wet well base shall be constructed of cast-in-place reinforced concrete and in accordance with the plans. Anchor bolts shall be accurately set for pump discharge base.

The Contractor shall furnish and install 316 stainless steel anchor bolts for each of the submersible pumps. The anchor bolts shall be furnished with 316 stainless steel washers and nuts. The anchor bolts shall be heavy duty as manufactured by Flygt or an approved equal. Bolts shall be installed with adequate projection.

The barrel shall be set plumb and sealed tight with grout so as to be water tight. Holes for piping shall be cut after the barrel has been set permanently in place. The holes shall be slightly larger than the pipe diameter to allow for grout seal. All openings shall be grout sealed after pipe installation.

The wet well top slab shall be precast concrete or cast-in-place concrete with specified access frame and cover and other openings. The exterior of the wet well shall be waterproofed before backfilling in accordance with Section 442.

In accordance with the plans, the Contractor shall furnish and install designated Flygt pumps or approved equal, access frames and covers, each complete with upper guide pipe holder and safety hooks. Each cover shall be provided with a recessed tilt-up access handle, padlock hasp and padlock. The padlock shall be Master Lock No. 21 with repeatable cylinder keyed to the County system.

Frames shall be securely placed and mounted above each pump as shown on the contract drawings. Frames shall be provided with sliding nut rails to attached the accessories required. Lower guide pipe holders shall be integral with the discharge connection. Guide pipes shall be 3 inches nominal diameter Schedule 40 galvanized steel pipe. The guide pipes shall not support any portion of the weight of the pump. Steps or a ladder shall be provided inside the wet well in accordance with the plans.

545.4.3 Pumps: Pumps complete with electrical motors and accessories shall be furnished and installed by the Contractor in the manner shown on the project drawings and in accordance with the specifications.

All pumps shall be set at the proper elevations, location, alignment and leveled. Pumps and motors shall be carefully mounted on prepared concrete bases where required. All piping shall be brought to the pump connections in such a manner as to prevent the possibility of any loads or stresses being applied to pump connections. Pumps shall never be forced on their foundation to accommodate piping.

545.4.4 Piping and Fittings: Piping and fittings includes the inlet pipe connection to the wet well and the pump discharge lines from the pump to a point where it connects onto existing pipe or to the point where the metal discharge pipe connects to other pipe after any manifold.

Pipe shall be installed at the locations indicated on the contract drawings. Where not detailed, exposed pipe shall be installed in straight, horizontal and vertical runs, parallel to the axis of the structure.

Discharge pipe shall be of the size and type shown and specified and shall be in accordance with Section 640.

545.4.5 Valves: The installation of valves shall conform to the details shown on the contract drawings and as specified in Section 645.

545.4.6 Painting: All exposed metals above ground and on the inside of the wet pit pump structure, including pumps and motors, shall be painted in accordance with Section 443.

545.4.7 Trash Racks: Trash rack grating shall be built and installed in accordance with the plans and conform to Section 770.

545.5 TESTING:

545.5.1 Discharge Piping: The discharge piping shall be tested for leaks in the following manner:

1. Supply enough water to wet well to allow pump to be run.
2. Close gate valve in discharge line approximately half way.
3. Start pump and gradually close gate valve while observing system for leaks. Gate valve shall be closed to approximately 3/4 shut to complete test.
4. Should leaks be observed, they will be corrected and the test repeated until no leaks occur.

545.5.2 Wet Well: After installation of wet well and all piping connections, it shall be tested with water for leaks. Plug all openings and fill to top with water furnished by Contractor. Allow to soak for four hours before beginning test. Begin test at that time with water level at the top and run the test for four hours. No leakage shall be evident at the end of the test with allowance made for evaporation. Any leakage indicated shall be corrected, followed by another test until no leakage is indicated.

If dewatering is required to construct the station, when the dewatering equipment has been shutdown and before the dewatering equipment has been removed, the wet well shall be observed for 48 hours for infiltration leaks. Should any leakage be observed the site shall be dewatered again, the leaks repaired and the wet well once again monitored for 48 hours for leaks. This procedure shall be repeated until there is no leakage observed.

545.5.3 Field Testing Pumps: After the pumps have been installed, the pumping equipment shall be lined up, tested and adjusted by a qualified representative of the pump manufacturer under the entire range of operating conditions as set forth in these specifications and shall be left in first-class condition, ready for continuous and satisfactory operation. The Contractor shall furnish all supplies for the field testing, including water, a portable electric generator, bulk heads, if necessary to operate and test the pumps and the services of the manufacturer's representative. The manufacturer shall provide a formal test procedure and forms for recording voltage, current and other significant parameters.

545.5.4 Electrical: All electrical work shall be installed in accordance with all applicable electrical codes, specifications herein and the details shown on the contract drawings.

The Contractor shall furnish and install a packaged pump control system to automatically operate the pumps with variations of water levels in the wet well. A high water level alarm light shall also be provided. The control system shall be in accordance with the specifications contained herein.

545.6 MEASUREMENT AND PAYMENT:

The pumping station shall be measured as a lump sum, including wet well inlet pipe connection, wet well with top slab and access doors, pump discharge piping, connection to PVC pipe, check and gate valves, flex couplings, pipe supports and brackets, liquid level sensors, excavation, pipe work, concrete work, site work, painting, other appurtenances and incidentals necessary to make a complete job. The amount of completed and accepted work, measured as a unit will be paid for at the contract unit price for "Pumping Station" which price shall be full compensation for all labor, materials, equipment and incidentals necessary to complete the work in accordance with the plans, specifications and provide for a completed station ready to use.

PART 600

PIPEWORK

SECTION	TITLE
601	Trench Excavation, Backfilling and Compaction.....
602	Boring and Casing.....
605	Subdrainage .....
610	Water Line Construction.....
612	Force Main Pipeline Construction.....
615	Sewer Line Construction.....
618	Reinforced Concrete Pipeline Construction.....
621	Corrugated Metal Pipe and Arches .....
625	Manhole Construction and Drop Sewer Connections.....
630	Tapping Sleeve and Valve .....
631	Water Service Taps and Meter Connections.....
640	Piping.....
645	Valves and Water Work Specialties.....
650	Water Main Lowering.....

SECTION 601

TRENCH EXCAVATION, BACKFILLING AND COMPACTION

601.1 DESCRIPTION:

The work under this section consists of furnishing all labor, equipment, materials and performing all operations in connection with the excavation and backfilling of trenches in accordance with the plans and the requirements of these Construction Standards.

Excavation for appurtenance structures, such as manholes, small headwalls, cutoff walls, small vaults, valve boxes, catch basins, wall footings, etc., shall be deemed to be in the category of trench excavation.

601.2 EXCAVATION:

601.2.1 General: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the plans and including excavation ordered by the Engineer of compacted backfill for the purpose of making density tests on the lower portion of the lift.

All excavation shall be open cut unless otherwise shown on the plans or approved by the Engineer.

601.2.2 Trench Widths: Trenches for other than cast-in-place concrete pipe shall conform to the following dimensions, unless otherwise specified in the special provisions, indicated on the plans and/or approved by the Engineer.

TABLE 601-1

Size Of Pipe (I.D.)	Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel	Minimum Width At Springline Each Side of Pipe
Less than 18"	16"	6"
18" to 24" inclusive	19"	7-1/2"
27" to 39" inclusive	22"	9"
42" to 60" inclusive	1/2 O.D.	12"
Over 60"	36"	12"

The width of the trench shall not be greater than the maximum indicated above, at and below the level of the top of the pipe. The width of the trench above that level is to be made as wide as necessary for sheeting and bracing and for proper installation of the work.

If the maximum trench width as specified above is exceeded at the top of the pipe the Contractor shall provide, at no additional cost to the Contracting Agency, the necessary additional load bearing capacity by means of bedding, having a higher bedding factor than that specified, higher strength pipe, a concrete cradle, cap or encasement or by other means approved in writing by the Engineer.

601.2.3 Trench Grade: Alignment and elevation stakes shall be furnished to the Contractor at set intervals and agreed upon offsets. On water main projects, elevation stakes will be furnished only when deemed necessary by the Engineer. In all cases where elevation stakes are furnished, the Engineer will also furnish the Contractor with cut sheets.

For all pipe 12 inches or greater in diameter, the Contractor shall excavate for and provide an initial granular bedding at least 4 inches or 1/12 the O.D. of the pipe whichever is greater. This bedding material shall be placed at a uniform density with minimum compaction and fine graded as specified below.

Bell or coupling holes shall be dug after the trench bottom has been graded. Such holes shall be of sufficient width to provide ample room for caulking, banding or bolting. Holes shall be excavated only as necessary to permit accurate work in the making of the joints and to insure that the pipe will rest upon the prepared bottom of the trench and not be supported by any portion of the joint.

Depression for joints, other than bell-and-spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

601.2.4 Fine Grading: Unless otherwise specified in the plans and/or special provisions, the bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells and for proper sealing of pipe joints.

601.2.5 Over Excavation: Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the depth indicated.

Unauthorized excavation below the specified grade line shall be refilled at the Contractor's expense with ABC material compacted to a uniform density of not less than 95 percent of the maximum density as determined by ASTM D-2922 and D-3017. See Section 211 of the Standard Specifications for rock correction.

Whenever rock is encountered in the trench bottom, it shall be over excavated to a minimum depth of six inches below the O.D. of the pipe. This over excavation shall be filled with granular material placed with the minimum possible compaction.

Whenever unsuitable soil incapable of supporting the pipe is encountered, the Contractor will notify the Engineer and a field determination will be made as to the depth of over excavation and the granular fill required.

601.2.6 Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories: The Contractor may excavate to place the concrete structure directly against the excavated surface, provided that the faces of the excavation are firm and unyielding and are at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall over excavate to place the structure and this over excavation shall be backfilled with the same material required for the adjoining pipe line trench and compacted per Table 601.2.

Any excavation below the elevation indicated for the foundation of any structure shall be filled with ABC and compacted to at least 95% at the expense of the Contractor.

601.2.7 Pavement and Concrete Cutting and Removal: Where trenches lie within the portland cement concrete section of streets, alleys, driveways, sidewalks, etc., such concrete shall be saw cut to neat vertical, true lines in such a manner that the adjoining surface will not be damaged. The minimum depth of cut shall be 1-1/2 inches or 1/4 of the thickness, whichever is greater.

Asphalt pavement shall be clean-cut, with approved equipment and by approved methods in accordance with the requirements of Section 336.

No ripping or rooting will be permitted outside limits of cuts. Surfacing materials removed shall be hauled from the job site immediately and will not be permitted in the backfill.

601.2.8 Grading and Stockpiling: All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

During excavation, material suitable for backfilling shall be piled in an orderly manner, a sufficient distance back from the edges of trenches, to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling or excess material, shall be hauled from the job site and disposed of by the Contractor.

The Contractor shall, prior to final acceptance of the work, submit a letter to the Contracting Agency stating the location of each disposal site for all excess or unsuitable material and certify that he has obtained the property owner's permission for the disposal of all such materials.

Where the plans and/or special provisions provide for segregation of topsoil from underlying material for purposes of backfill, the material shall not be mixed.

601.2.9 Shoring and Sheeting: The Contractor shall do such trench bracing, sheathing or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. The bracing, sheathing or shoring shall not be removed in one operation but shall be done in successive stages as determined by the Engineer to prevent overloading of the pipe during backfilling operations. The cost of the bracing, sheathing, shoring, and the removal of same, and excavation of slopes if necessary shall be included in the unit price bid per foot for the pipe.

All shoring and sheeting deemed necessary to protect the excavation and to safe-guard employees, shall be installed. See Section 107.

601.2.10 Open Trench: Except where otherwise noted in the special provisions, or approved in writing by the Engineer, the maximum length of open trench, where the construction is in any stage of completion (excavation, pipe laying or backfilling), shall not exceed 600 feet in the aggregate at any one location.

Any excavated area shall be considered open trench until all ABC for pavement replacement has been placed and compacted. With the approval of the Engineer, pipe laying may be carried on at more than one separate location, the restrictions on open trench applying to each location.

Trenches across streets shall be completely backfilled as soon as possible after pipe laying.

Substantial steel plates with adequate trench bracing shall be used to bridge across trenches at street crossings where trench backfill and temporary patches have not been completed during regular work hours. Safe and convenient passage for pedes-trians shall be provided. The Engineer may designate a passage to be provided at any point he deems necessary. Access to hospitals, fire stations and fire hydrants must be maintained at all times.

601.3 PROTECTION OF EXISTING UTILITIES:

601.3.1 Utilities: Unless otherwise shown on the plans or stated in the speci-fications, all utilities, both underground or overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

If the Contractor desires to simplify his operation by temporarily or permanently relocating or shutting down any utility or appurtenance, he shall make the necessary arrangements and agreements with the owner and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. All property shall be reconstructed in its original or new location as soon as possible and to a condition at least as good as its previous condition. This cycle of relocation or shutdown and reconstruction shall be subject to inspection and approval by both the Engineer and the owner of the utility.

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are shown on the plans (Sections 105 and 107 of these specifications apply). This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not shown on the plans is discovered, the Contracting Agency will either negotiate with the owner for relocation, relocate the utility, change the alignment and grade of the trench or as a last resort, declare the conflict as "extra work" to be accomplished by the Contractor in accordance with Section 104.

601.3.2 Irrigation Ditches, Pipes and Structures: The Contractor shall contact the owners of all irrigation facilities and make arrangements for necessary construction clearances and/or dry-up periods.

All irrigation ditches, dikes, headgates, pipe, valves, checks, etc., damaged or removed by the Contractor, shall be restored to their original condition or better, by the Contractor at no additional cost to the Contracting Agency.

601.3.3 Building, Foundations and Structures: Where trenches are located adjacent to building, foundations and structures, the Contractor shall take all necessary precaution against damage to them. The Contractor shall be liable for any damage caused by the construction.

Except where authorized in the special provisions or in writing by the Engineer, water settling of backfill material in trenches adjacent to structures will not be permitted.

601.3.4 Permanent Pipe Supports: Permanent pipe supports for the various types and sizes of sewer, water and utility lines shall conform to the Standard Details or the details shown on the plans. Such pipe supports shall be erected at the locations shown on the plans and/or at any other locations as necessary as determined by the Engineer.

601.3.5 Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: These underground facilities shall be adequately supported by the Contractor. Support for plastic pipes shall be continuous along the bottom of the pipe. Support for metal pipe and electrical conduit may be continuous or nylon webbing may be used for suspension at no greater than ten-foot intervals.

The Contractor shall avoid damaging the plastic pipe, pipeways or conduits during trench backfilling and during foundation and bedding placement.

There will be no measurement or payment for this work. The Contractor will include all associated costs in the unit bid price for the conduit installation.

601.4 FOUNDATION, BEDDING, BACKFILLING AND COMPACTION:

601.4.1 Foundation: The material upon which the conduit or structure is to be placed shall be accurately finished to the grade or dimensions shown on the plans or as directed by the Engineer. The bottom portion of the trench shall be brought to grade so that the conduit or structure will be continuously in contact with the material on which it is being placed. If rocky or unsuitable soil is encountered, Subsection 601.2.5 applies.

601.4.2 Bedding: Bedding shall consist of select material-type B, Aggregate Base, or granular material containing no pieces larger than 1-1/2 inches and free of broken concrete, broken pavement, wood or other deleterious material. Open graded rock will not be used without the written approval of the Engineer.

Bedding for P.V.C. or other plastic type piping shall be sand. The bedding material shall be placed between the trench bottom and to a point 12 inches above the top of pipe.

When water consolidation is approved by the Engineer and used, bedding for conduits, 24 inches or less in I.D., may be placed in one lift. For larger conduits the first lift shall not exceed the springline of the pipe.

Where mechanical compaction is used, the moisture content shall be such that the specified compaction can be obtained. The first lift shall be 8 inches or 2/3 of the distance to the springline whichever is greater. Succeeding lifts shall not exceed 2 feet loose and extreme care will be taken to prevent damage to or movement of the conduit by the compaction equipment.

601.4.3 Backfill: Backfill shall be sound earthen material free from broken concrete, broken pavement, wood or other deleterious material. Unless otherwise specified, this may be native material with no piece larger than 8 inches, select material or aggregate base course. Under pavement, parking lots, sidewalks, etc., pieces larger than 3 inches will not be used in the final 12 inches below the pavement subgrade.

Where water consolidation is approved and used, backfill will be placed in lifts as required in the following table prior to settlement.

Trench Width	Backfill Lifts
18" to 24"	Not to exceed 4'
25" to 36"	Not to exceed 6'
Over 36"	Not to exceed 8'

The above backfill lift limitations are not applicable when water saturation is done by the jetting method.

Where mechanical compaction is used, backfill shall be placed in lifts the height of which shall not exceed that which can be effectively compacted depending on the type of material, type of equipment and methods used and under no circumstances shall exceed 4 feet.

Backfill around utilities that are exposed during trench excavation, shall be placed in accordance with the bedding methods.

601.4.4 Compaction Densities: Unless otherwise provided in the plans and/or special provisions, the trench backfill shall be thoroughly compacted to not less than the densities per Table 601-2 when tested and determined by ASTM D-2922 and D-3017. Percentage of density to be adjusted in accordance with rock correction procedure on Figure 601.1.

The density required will depend on the type shown on the plans and/or called for in the special provisions. Density required for each type is as follows: Compaction tests shall be taken for each four foot of trench depth with one test per pavement cut and 300 feet in Type I and II locations and one test per structure in Type III locations.

TABLE 601-2

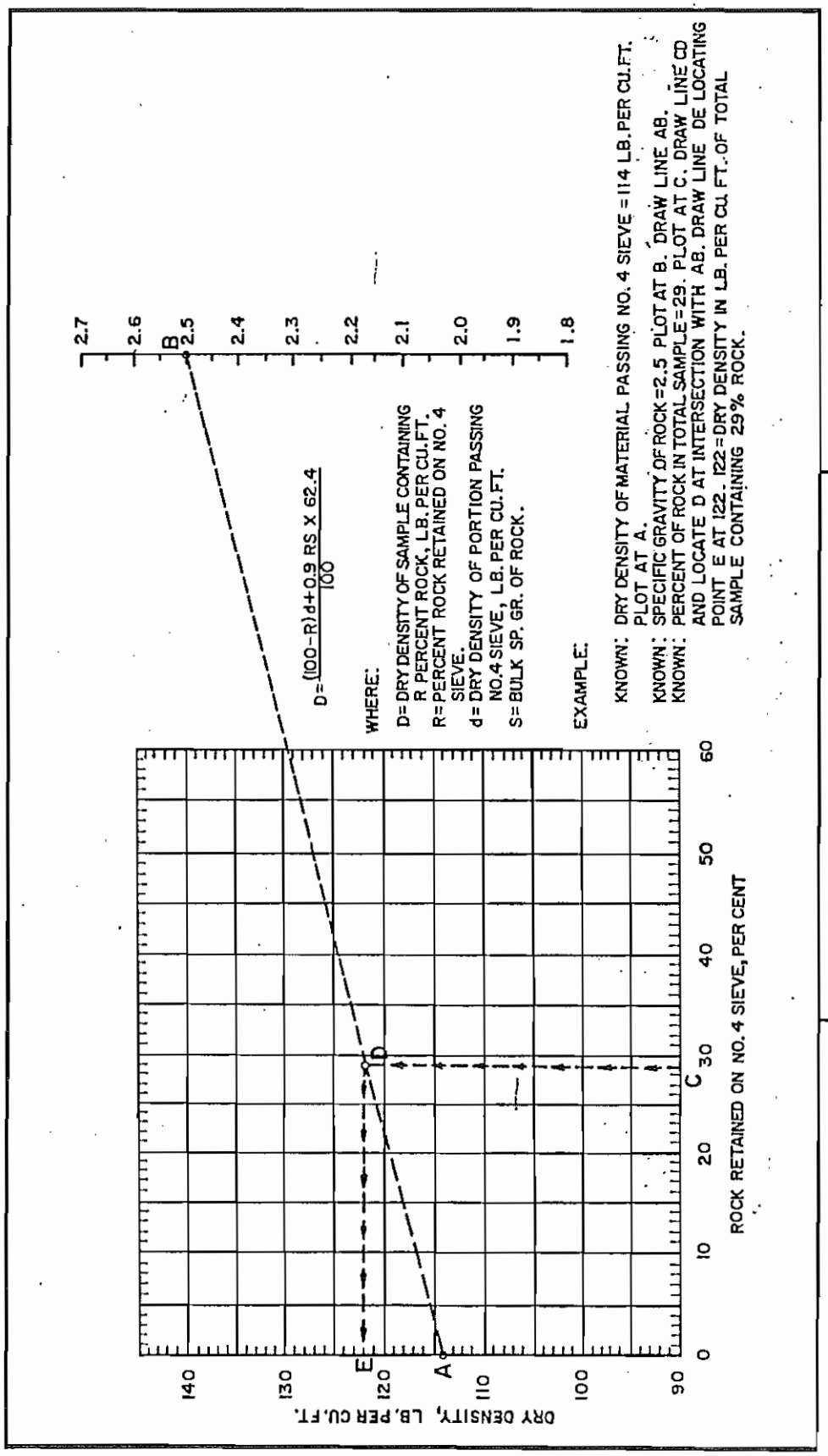
MINIMUM DENSITY REQUIRED

Backfill Type	Location	From Surface To 2' Below Surface	From 2' Below Surface To 1' Above Top of Pipe	From 1' Above Top of Pipe to Bottom of Trench
I	Under any existing or proposed pavement, curb, gutter,sidewalk or such construction included in the contract, or when any part of the trench excavation is within 2' of the above.	100% for granular 95% for non-granular	95%	95%
II	On any utility easement street, road or alley right-of-way outside limits of (1).	85%	85%	95%
III	Around any structures or exposed utilities	95%	in all cases	

Note: The type required will generally be shown on the plans and the plans will govern. Where no type is shown on the plans the type shall comply with the above.

A consideration in determining the backfill types as shown on the plans, is based on the trench widths as shown in the Contract Documents. If these trench widths increase beyond those widths referred to above and fall within the 2-foot limit of paved surfaces and other improvements due to construction exigencies, the backfill designation for that portion within the 2-foot limit of such improvements shall be Type I even though Type II backfill is shown on the plans.

Figure 601-1



ROCK CORRECTION PROCEDURE
FOR MAXIMUM DENSITY DETERMINATION

601.4.5 Compaction Methods: Water consolidation by jetting shall be accomplished with a 1-1/2" pipe of sufficient length to reach the bottom of the lift being settled with adequate hose attached and a water pressure of not less than 30 psi. All jetting shall be accomplished transversely across the trench at intervals of not more than 6 feet with the jetting locations on one side of the trench offset to the jetting locations on the other side of the trench. The entire lift shall be leveled and completely saturated working from the top to the bottom.

When jetting is used as the consolidation method on conduit bedding, the Contractor shall be entirely responsible for establishing each lift depth so as to avoid floating the conduit being placed and shall make any repair or replacement at no cost to the Contracting Agency. However, for conduit larger than 24 inches I.D., the first lift shall not exceed the springline of the conduit.

Flooding is not acceptable as a water consolidation method unless authorized in the specification or by a written change order. It will consist of the inundation of the entire lift with water and then puddled with poles or bars to insure saturation of the entire lift.

Where jetting or flooding is utilized and the surrounding material is such that it does not permit proper drainage, the Contractor shall provide at his expense, a sump and a pump at the downstream end to remove the accumulated water.

The use of water consolidation does not relieve the Contractor from the responsibility to make his own determination that such methods will not result in damage to existing improvements. The Contractor shall be responsible for any damage incurred.

Where water consolidation is not permitted or does not result in adequate compaction, the backfill material shall be compacted with hand and/or mechanical work methods using equipment such as rollers, pneumatic tamps, hydro-hammers or other ap-proved devices which secure uniform and required density without injury to the pipe or related structures.

Where Type I backfill is required, water consolidation will not be permitted for non-granular material.

601.4.6 Specifications for Granular Material: For purposes of this specification, granular material shall mean material for which the sum of the plasticity index and the percent of the material passing a No. 200 sieve shall not exceed 23. The plasticity index shall be tested in accordance with AASHTO T-90.

601.4.7 Rights-Of-Way Belonging to Others: Backfill and compaction for irrigation lines of the Water Users' Association and Irrigation Districts and for trenches in State of Arizona and Yuma County rights-of-way outside the limits of the Contracting Agency shall be accomplished in accordance with their permit and/or specifications.

601.4.8 Test Holes: Boring logs when available are noted but do not constitute a part of the contract and are included for the Contractor's convenience only. It is not intended to imply that the character of the material is the same as that shown on the logs at any point other than that where the boring was made. The Contractor shall satisfy himself regarding the character and amount of rock, gravel, sand, silt, clay and water to be encountered in the work to be performed.

601.4.9 Foundation and Bedding for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: Foundation and bedding for these underground facilities shall be native material or sand which conforms to the grading requirement of ASTM C-33 for fine aggregate. When backfill material consists of aggregate base course, crushed stone or other material containing stones, only sand will be used for foundation and bedding. The foundation depth shall be six inches and bedding depth shall be one foot above the top of the facility. Compaction will be in accordance with Section 601.4.4.

601.5 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:

601.5.1 Grading: The Contractor shall do such grading in the area adjacent to backfilled trenches and structures as may be necessary to leave the area in a neat and satisfactory condition approved by the Engineer.

601.5.2 Restoring Surface: All streets, alleys, driveways, sidewalks, curbs or other surfaces, in which the surface is broken into or damaged by the installation of the new work, shall be resurfaced in kind or as specified to the satisfaction of the Engineer in accordance with Section 336.

601.5.3 Cleanup: The job site shall be left in a neat and acceptable condition. Excess soil, concrete, etc., shall be removed from the premises.

601.5.4 Temporary Pavement: The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement in accordance with Section 336 immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided in Section 336, this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required backfill compaction is obtained and final pavement replacement is ordered by the Engineer. Temporary paving removed shall be hauled from the job site and disposed of by the Contractor at no additional cost to the Contracting Agency.

601.6 MEASUREMENT AND PAYMENT:

No pay item will be included in the proposal, nor direct payment made for trench excavation, backfilling, compaction or placement of temporary pavement. The cost of these features of the work shall be included in the unit price bid per linear foot for furnishing and laying pipe.

SECTION 602

BORING AND CASING

602.1 DESCRIPTION:

The work under this section includes furnishing all labor, material and equipment as required to perform a separate boring and casing operation in accordance with the plans and specifications.

In the performance of the work, the Contractor shall comply with the lawful requirements of the affected Contracting Agencies, owners of public utilities and any other facilities which might be endangered by boring and casing operations.

602.2 MATERIAL:

Unless otherwise provided for by the contracting or permitting agency, the Contractor shall be responsible for determining the required thickness of the steel liner plate or steel casting in accordance with the manufacturer's recommendations. Minimum thickness will generally be given on the plans.

The inside diameter of the steel liner plate or steel casing shall be a minimum of 12 inches larger than the largest outside diameter of the carrier pipe or the size indicated on the plans, whichever is greater. No part of the plates or flanges shall be allowed to extend inside this net diameter. It shall be the responsibility of the Contractor to increase such dimension where necessary to provide placement room for pipe bells or to provide adequate space for grout placement.

602.3 SUBMITTALS:

Before starting operations, the Contractor shall submit 3 copies to the Engineer for approval, detailed shop drawing of the jacking pit bracing, the casing, the jacking head, the carrier pipe installation method and the bracing to prevent carrier pipe flotation and shifting.

602.4 ALIGNMENT & GRADE:

The tolerances allowed for the alignment and grade of carrier pipe shall be the same as if it was being installed in a trench in accordance Section 610, 612, 615 and 618.

Final grade of the carrier pipe shall be that which is shown on the plans.

602.5 CONSTRUCTION METHODS:

602.5.1 Jacking Operation: Approach trench for boring and casing operations shall be shored as required to safeguard existing substructure and surface improvements and to protect against ground movement in the vicinity of the jack supports.

The casing shall consist of welded steel pipe (ASTM A-283 Grade C). Shop and field joints shall be butt weld. Fabrication and welding shall be in accordance with AWWA C-200. Weld or hydrostatic testing is not required.

The leading edge of the casing shall be equipped with a steel jacking head, securely anchored to prevent any wobble or alignment variation during the jacking operation.

Excavation shall not be made in advance of the jacking head and every effort shall be made to avoid any loss of earth outside of the jacking head. Excavated material shall be removed from the casing as excavation progresses and accumulation of material within the casing shall not be permitted.

Once the jacking operation has started, it shall be continued around the clock until the specified limits have been reached.

On steel casing 36 inches or larger (I.D.), grout connections shall be provided at a maximum spacing of 10 feet. Upon completion of the jacking operation, all voids around the outside face of the steel casing shall be filled by grouting. Grouting equipment and material shall be on the job site before the jacking operations are completed so that grouting may be started immediately. Grout shall be placed by means of pumps capable of pressures up to 100 psi unless otherwise approved by the Engineer. Grouting pressure shall be controlled to approximately 10 psi so as to avoid movement of the ground around the steel casing. After grouting has been completed, the grouting connections will be closed with threaded steel plugs.

Steel casing smaller than 36 inches (I.D.) will not require outside grouting unless caving or earth movement occurs.

602.6 DEWATERING:

Dewatering shall be accomplished in accordance with Section 447 of these Specifications and all water encountered during the jacking operation shall be disposed of by the Contractor in such a manner as will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes and equipment for dewatering will be considered incidental to the work and no additional payment will be made.

602.7 CARRIER PIPE PLACEMENT:

Carrier pipe, larger than 24 inches (I.D.), shall be placed using pipes or rails for alignment and grade. Carrier pipe, 24 inches I.D. or less, may be placed using pipes, rails or wooden skids, at the Contractor's option. In either case, it shall be the Contractor's responsibility to obtain the required alignment and grade for the carrier pipe and to ensure that the carrier pipe does not draw or rest on the casing or liner plate.

After the carrier pipe has been placed and securely blocked to prevent shifting or flotation, the entire remaining annular space shall be completely filled with grout. After grouting has been completed each end of the casing shall be sealed with an 8" wide brick and mortar plug.

If the Contractor is not ready to place the carrier pipe immediately following completion of the jacking or tunneling operation, the ends shall be protected with temporary bulkheads. The approach trench shall be backfilled in accordance with Section 601 and 336.

After completion of the grouting operation, the Contractor shall remove all loose and disturbed material in the approach trench and backfill the trench in accordance with Section 601 and 336.

602.8 MEASUREMENT AND PAYMENT:

602.8.1 Measurement: This item shall be measured by the linear foot for the various sizes of steel casing involved.

602.8.2 Payment: The amount of completed and accepted work, measured as provided above, will be paid for at the Contractor unit price per linear foot which shall be full compensation for all labor, material and incidentals necessary to complete the work as shown on the drawings and as specified herein.

For this work shall be at the ground surface and shall be the number of horizontal linear feet of ground surface undisturbed by the cut and cover construction on the ends of the steel casing or tunnel liner operation. Payment shall be made at the unit bid price per linear foot. The payment shall be full compensation for furnishing all labor, material, tools and equipment required for the successful completion of the jacking or tunneling operation, including carrier pipe placement, in accordance with this Section.No pay item will be included in the proposal, nor direct payment made for trench excavation, backfilling, compaction or placement of temporary pavement. The cost of these features of the work shall be included in the unit price bid per linear foot for furnishing and laying pipe.

SECTION 605

SUBDRAINAGE

605.1 DESCRIPTION:

The subdrainage system shall be constructed in accordance with the notes and details shown on the plans and the applicable provisions of these specifications except as modified in the special provisions.

605.2 CONCRETE:

All concrete placed in drainage structures, sub-drain outlets, pipe collars, and similar features of the subdrainage system shall conform to the applicable provisions of Section 725.

605.3 SUBDRAINAGE PIPE:

Subdrainage pipe, both perforated and non-perforated, shall be either bell and spigot concrete, bell and spigot vitrified clay, corrugated metal pipe or P.V.C. pipe as shown on the plans or specified in the special provisions. However, if the particular kind of pipe is not shown on the plans nor specified in the special provisions, subdrainage pipe shall be concrete pipe of at least standard strength quality and shall conform to the requirements of Section 736. Vitrified clay pipe shall conform to the requirements of Section 743. P.V.C. pipe shall conform to the requirements of Section 745. Corrugated metal pipe shall conform to the require-ments of Section 760.

605.3.1 Pipe Joints: Unless the pipe joints are of a self-aligning type, have the bottom half of the bell joint filled with mortar to securely hold the pipe in alignment and to bring the inner surface of abutting pipes flush and even. Where a tight joint for non-perforated pipe is required, the bell joint shall be completely filled with mortar.

605.4 SUBDRAINAGE MANHOLES:

Subdrainage manholes, including inlets, outlets, flap gates, gate boxes and drop steps, shall comply with the requirements of the plans and the special provisions.

605.5 FILTER MATERIALS:

The filter materials shall be placed within the limits shown on the plans. The compositions of the filter materials shall each conform to one of the following grading requirements; the particular requirement to be used will be specified in the special provision.

The materials used shall conform to requirements for concrete aggregates in Section 701; however, the requirements for grading and reactivity, as stated therein, shall not apply. The minimum bulk specific gravity shall be 2.50, by ASTM C-127.

TABLE 605-1

Filter Material Grading - % Passing

Screen or Sieve Size	TYPE F1	F2	F3
3/4"		100	100
3/8"	100	80 - 100	70 - 100
No. 4	90 - 100	60 - 85	45 - 75
No. 8	75 - 90	45 - 70	30 - 60
No. 16	55 - 80	30 - 55	20 - 45
No. 30	30 - 60	15 - 40	10 - 30
No. 50	10 - 40	5 - 20	0 - 15
No. 100	0 - 15	0 - 10	0 - 5
No. 200	0 - 5	0 - 5	

605.6 PLACEMENT:

605.6.1 General: The excavated subgrade shall be kept free of surface water. Mud holes, ruts or soft spots due to the Contractor's operations shall be repaired at no additional cost to the Contracting Agency, as ordered by the Engineer.

Filter and drain material shall be placed around drainage pipe so as to provide even support throughout the entire length of the pipe and to permit the installed pipe to lie upon true alignment and grade. The minimum thickness of filter material surrounding the pipe shall be 6 inches.

Filter material shall be spread to such depth as to obtain the required thickness after compaction and shall be uniform and true to the line and grades indicated on the plans.

The surface under sloped bank lining or invert shall not show any variation or departure greater than 1/2 inch from the testing edge of a 10 foot straightedge. Ridges and humps shall be regraded, depressions filled, compacted and tested for straightness until grading is accomplished within the tolerance specified. No relative density will be required.

Pipe damaged during placement or compaction shall be replaced by the Contractor at no additional cost to the Contracting Agency. The Contractor shall exercise due care to prevent water from surface drainage or other sources, mud, muck or debris, from running into the filter material both during and after its placement, until the lining, backfill or structure placed thereon is completed or set. The Contractor shall provide and operate drainage sumps and pumps or equivalent means satis-factory to the Engineer, to prevent any such saturations of the filter materials.

605.6.2 Under Sloped Bank Lining: Those portions of filter materials which become subgrade for sloped bank lining shall be compacted by 4 passes of a small roller weighing not less than 600 pounds and 20 pounds per inch of roller width or by other means approved by the Engineer.

605.6.3 Under Invert: Those portions of filter materials which become subgrade for channel invert linings shall be compacted by 2 passes of a smooth-wheeled roller lapping 1 foot each pass or by use of manually-operated hand tampers or by other means as approved by the Engineer. The weight of the roller or the size of the tamper shall be as approved by the Engineer.

605.6.4 In Trenches and Along Heels of Walls or Sides of Structures: The filter materials shall be placed in 1 foot lifts and compacted by hand-held tamping or vibrating equipment to the satisfaction of the Engineer.

605.7 TESTS OF THE SUBDRAINAGE SYSTEM:

Two separate tests shall be made on each sub-drain line by the Contractor to assure the proper functioning of the sub-drainage system.

Each test shall be conducted in the presence of the Engineer and shall consist of the flushing of the sub-drain line with sufficient water to develop a flow of 5 cubic feet per minute out of the end of the line being tested, as measured by approved measuring equipment furnished by the Contractor.

When a channel invert slab is required, the first test of each completed section of the sub-drain system shall be performed immediately prior to the placement of reinforcing steel for the channel invert slab and the second test shall be performed after completion of the channel invert work. Manholes shall be cleared of all debris prior to beginning the second test.

Final acceptance of the subdrainage system will be made only if the discharge is of uniform flow and of adequate quantity. Any necessary clearing of drain lines to meet the above requirements shall be performed by the Contractor at no additional cost to the Contracting Agency.

All costs involved in the performance of the tests, including the furnishing of all labor, equipment and material required therefore, shall be included in the prices bid for the items under which the sub-drainage system is to be constructed.

605.8 PAYMENT:

Payment for the work included in this specification will be made on the basis of the lump sum or unit prices stipulated in the proposal, unless the payment for sub-drainage work is included in the cost for other improvements. Such payment shall include full compensation for furnishing all labor, tools, equipment and incidentals for doing the work involved.

SECTION 610

WATER LINE CONSTRUCTION

610.1 DESCRIPTION:

The work under this section shall consist of providing all labor, equipment, tools, parts, waterline materials and all other materials required to complete all operations in connection with waterline construction including excavation, trenching, hauling, installation of waterline, providing all fittings, bolts, connector, couplings, valves, protective wrap, thrust blocks, vaults, blow-off valves, locator wire, furnishing, placing and compacting backfill, testing and disinfecting waterline and appur-tenances in accordance with the project plans and these specifications. The construction of all water lines shall conform to applicable County Construction Standards and details, except as otherwise required on the plans or as modified in the special provisions.

610.2 MATERIALS:

All pipe for water lines shall be of the classes shown on the plans or as specified below.

(A) Four inch through 16 inch pipe shall be P.V.C., ductile iron or cast iron, except where a particular material is specified. All pipe shall be Class 150 unless otherwise specified.

(B) Pipe larger than 16 inches may be either ductile iron or reinforced concrete water pipe, steel cylinder pretensioned type, unless an additional option is provided in the special provisions.

Cast iron water pipe and fittings shall conform to Section 750 of these specifications. Ductile iron water pipe and fittings shall conform to Section 750. P.V.C. water pipe and fittings shall conform to Section 746. Reinforced water pipe, steel cylinder type and fittings shall conform to AWWA C303.

All gate and butterfly valves shall be in accordance with Section 759.

Polyethylene protective wrap shall be in accordance with Section 791.

All fire hydrants are to conform to Section 756.

Couplings used to join the pipe to flange valve adapters shall be Dresser Style 38, Smith Blair 411 or an approved equal.

Joints and fitting shall conform to Sections 745, 746, 748, 750 and 754.

610.3 SUBMITTALS:

The Contractor shall submit 3 copies to the Engineer for and obtain approval before installation of all product data, including manufacturer's catalog data and details, material lists, detail construction sheets showing all valve and water work compon-ents with dimensions, description of materials and applicable specifications.

610.4 CONSTRUCTION METHODS:

610.4.1 Pipe Work: Except as otherwise required in this specification, the special provisions or by the Engineer, trench excavation, backfilling and compaction shall be in accordance with the requirements of Section 601. Backfilling may be accom-plished as soon as the pipeline has been installed to the satisfaction of the Engineer, subject to the requirements for testing, as contained below. A maximum of 1,000 feet of trench is to be left open at any one time. All pipe shall be delivered, handled and installed in accordance with the manufacturer's recommendations and/or applicable provisions of AWWA standards for installation of the various types of water mains specified, insofar as such recommendations and provisions are not in variance with the standard specifications and details.

Where waterlines are to be constructed in new subdivisions or in conjunction with street repaving projects, the streets shall be pre-graded to within 6 inches of the new street subgrade prior to trenching or cut stakes shall be set for trenching.

SECTION 610

All waterlines are to be located in accordance with County Construction Standards 5-160 through 5-190. All water mains in major streets shall have a minimum cover of 42 inches over the top of the pipe. Water mains in other locations shall have a minimum cover over the top of the pipe as follows:

(A) 36 inches for mains smaller than 12 inches.

(B) 42 inches for mains 12 inches and larger.

Cover for water mains will be measured from existing or proposed finished grade of pavement or from natural ground, whichever is deeper.

Pipe shall be laid up-grade with the socket or bell ends of the pipe up-grade unless otherwise authorized by the Engineer. Pipe shall be laid to the plans line and grade, with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the socket or bell end of the pipe, which shall not bear upon the subgrade or bedding. The spigot end shall be inserted to the proper depth of the socket as indicated by the home mark. Pipe shall be laid to line and grade as shown on the plans. Any pipe which is not in true alignment or grade or shows nay undue settlement after laying shall be taken up and relaid at the Contractor's expense.

No water main shall be deflected, either vertically or horizontally, in excess of that recommended by the manufacturer of the pipe or coupling, without the appropriate use of bends or offsets.

If adjustments of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. At all times when pipe laying is not in progress, the open ends of the pipe line shall be closed by a watertight plug or other means approved by the Engineer.

All corporation stops used for testing and chlorination shall be left in the pipe line with the stop closed and all connecting pipe removed.

P.V.C. pipe shall be installed in accordance with AWWA C-900, except pipe and fittings shall be in accordance with Section 746.

Cast iron pipe shall be installed in accordance with AWWA C-600, except pipe and fittings shall be in accordance with Section 750.

Ductile iron pipe shall be installed in accordance with this specification and pipe and fittings shall be in accordance with Section 750.

610.4.2 Polyethylene Corrosion Protection:

(1) General: Where called for in the plans and all cast and ductile iron, pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure, the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

(2) Installation: The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. With the pipe suspended from the center, the tube shall be slipped over the spigot end and bunched up between the point of support and the spigot end. After the pipe is installed into the bell of the adjacent pipe the pipe shall be lowered to the trench bottom and the supporting sling removed from the center of the pipe. The pipe shall then be raised at the bell end enough to allow the tube to be slipped along the full length of the barrel with enough left at each end to overlap the adjoining pipe about 1 foot. A shallow bell hole must be made at each joint to facilitate installation of the polywrap.

Pull the bunched-up polywrap from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. Then slip the end of the polywrap from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Tape it in place.

The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

Repair any rips, punctures or other damage to the tube with the adhesive tape or pieces of tube material secured with tape.

Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the adhesive tape.

610.4.3 Valves and Valve Boxes: Valves shall be installed in accordance with AWWA C-600 or AWWA C-603 modified as follows:

Just before installation in the trench, valves shall be fully opened and closed to check the action and a record made of the number of turns required to fully open or close the valve. For valves 16 inches and larger, a member of the water utility shall be present to check the action and record the number of turns. The inside of all valves shall then be thoroughly cleaned and the valve installed.

Valves three inches and larger in size shall be supported by concrete anchor blocks, in accordance with the County Construction Standard 5-110. Valves larger that eight inches shall be anchored to the block with tie rods. Valves 16 inches and larger in size along with their bypass valves, shall be supported on concrete slabs and/or concrete piers, as indicated on the plans.

Concrete supports shall be provided under valves in vaults and shall be constructed an inch low, then grouted with non-shrink grout. Adjustable pipe supports shall be as indicated on the plans.

Valve box cover and frames shall be installed over all buried valves in accordance with County Construction Standards 5-210 and 5-220.

Standard couplings or matching joints shall be used when more than one length of riser pipe is required or when two or more pieces are joined, to form the valve box riser. The valve box riser shall be plumb, centered over valve operating nut and be free of dirt and debris. Install operation nut extension on all valves where the operating nut is 18 inches or more below grade.

610.4.4 Vaults: Construction shall consist of furnishing all materials and constructing vaults complete in place, as detailed on the plans and as shown in County Construction Standards, including foundation, walls, cast iron steps, frames, covers and any incidentals thereto, as shown on the plans.

Vaults shall be constructed of reinforced concrete conforming to Section 505 and masonry construction in accordance with Section 510. Vaults shall be kept moist for 7 days before backfilling.

610.4.5 Fire Hydrants: Fire hydrants are to be installed so as to provide proper height and setback at locations shown on the plans and in accordance with the County Construction Standard 5-120.

All hydrants shall be installed on a gravel pit drain and shall stand plumb, with the 4-1/2" pumper nozzle facing the curb. Hydrants shall be installed with all of break-off spool exposed above established or proposed finished grade. Hollow end of bolts to point down.

Fire hydrant head and all exposed portion of spool shall be repainted with high gloss heavy duty enamel prior to acceptance.

If paint is chipped, scuffed, or otherwise damaged during handling and installation, the Contractor shall touch up such spots as may be designated by the Engineer.

Where there is no curb, the fire hydrant is to be protected with guard posts in accordance with County Construction Standard 5-103.

All hydrants must be flushed and left in good working condition with the control valve open.

610.4.6 Separation of Water and Sewer: When a sewer crosses 2 feet or more below a waterline, no extra protection is required. When a sewer crosses less than 2 feet below a waterline, the sewer shall be constructed of ductile iron pipe with leaded or mechanical joints or other approved pipe, for at least 6 feet in both directions from the crossing, or the sewer shall be encased in concrete of 6 inch minimum thickness for the same distance. When a waterline must cross under a sewer, a vertical separation of at least 18 inches between the bottom of the sewer and the top of the waterline shall be maintained with support provided for the sewer to prevent settling. The sewer shall be constructed of cast iron pipe with leaded or mechanical joints or other approved pipe, for at least 6 feet in both directions from the crossing or the sewer shall be encased in concrete of 6 inch minimum thickness for the same distance.

610.4.7 Blow-Off Valve: Blow-off valves are to be installed where indicated on the plans and in accordance with County Construction Standard 5-140.

610.4.8 Locator Wires: A number 12 gauge, plastic coated, soft copper wire shall be placed directly on the top of the main line pipe for its entire length. The wire shall be placed near but not in contact with metal fittings or valves in the line.

610.4.9 Connection To Existing Mains: Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade or fittings, if necessary.

All connections to existing mains shall be constructed according to the plans.

Valves connecting new work to the existing system shall be kept closed at all times.

If it is necessary to obtain water from a utility system, clearance must be obtained from the water company. Valves shall not be operated until such clearance is obtained.

After disinfected samples have been taken and the new work passes the bacterio-logical tests, the new line shall then be turned over to the water company with all branch lines and tie-in valves closed.

When shutdown of an existing water main is necessary in order to connect to the new lines, the Contractor shall make application and pay the required charges to the water company. A conference between the Contractor's representative, engineering inspector and water company personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary to minimize inconvenience to customers, shutdowns may be scheduled during other than normal working hours. The water supply to some customers, such as hospitals, cannot be shut off at any time.

Provisions to furnish a continuous supply of water to such establishments will be required. After the procedures and time for a shutdown are agreed upon, it shall be the Contractor's responsibility to notify all customers in advance that the water will be turned off. When possible, customers shall be notified 24 hours in advance and in no case, except in emergency, shall notification be less than 30 minutes. Notification shall be in writing, giving the reason for the shutdown and the time and duration the water service will be shut off.

Unless otherwise directed, the Water Company will close existing valves, but will not guarantee a bone-dry shutdown.

610.4.10 Water Service and Meter Connections: Water service and meter connections are to be constructed at the locations as shown on the plans and in accordance with Section 631.

610.4.11 Tapping Sleeves and Valves: Tapping sleeves and valves are to be constructed at the locations as shown on the plans and in accordance with Section 630.

610.4.12 Fire Line Service Connections: Fire line service connections shall be installed in accordance with the project plans and in accordance with these speci-fications.

610.4.13 Couplings, Joints, Gaskets and Flanges:

(1) Couplings: The couplings used to join the pipe to flanged valve adapters shall be Dresser Style 38, Smith-Blair 411 or an approved equal.

(2) Joints: The joints and fitting shall conform to Sections 745, 748, 750 and 754.

(3) Bolts and Nuts:

(a) For pipe 12 inches and smaller: Bolts and nuts for use in field connections or for connecting fittings shall be carbon steel equivalent to ASTM A-307. Grade B, with cadmium plating in accordance with ASTM A-165 except that the minimum thick-ness of the plating shall be .00020 inches. Cadmium plated bolts shall have Class 2A threads and the nuts used with them shall have Class 2B threads. All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameter. High strength, heat treated cast iron tee-head bolts with hexagon nuts, all in accordance with the strength requirements of AWWA C-111, may be used in lieu of the cadmium plated bolts and nuts for jointing mechanical joint cast iron or ductile iron pipe and fittings only.

(b) For pipe 16 inches and larger: All bolts and nuts on flanges for valves and flexible couplings shall be carbon steel equivalent to ASTM A-307, Grade B. Bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameters.

(c) These bolted joints shall be protected as follows: Following installation and before backfilling, all couplings, steel flanges, bolts, nuts, anchor bolts, rods, bolting of all flanged valves and all exposed steel shall be protected from corrosion by either of the two methods outlined below at the Contractor's option.

Method 1: Below ground installations shall be coated with NO-OX-ID "A" with a film of not less than 1/32 inch thick and then coated with cement mortar not less than 1 inch thickness before backfilling cement mortar shall be composed of 1 part cement, ASTM C-150, Type II, low alkali, to 3 parts sand. Before application of the cement mortar coating the area to be protected shall be covered with a layer of 2 x 2 inch No. 14 gauge welded wire fabric, firmly wired in place or,

Method 2: Below ground installations shall be protected by the application of hot coal-tar enamel. The coal-tar enamel shall be in accordance with AWWA C-203 and shall be applied to the top part of the pipe or fittings by daubers for at least 2 coats for a total minimum thickness of 1/16 inch. The coal-tar for under side of the pipe flanges or fittings shall be applied by the pan or cocoon method as described below and in AWWA Manual M-11, Steel Pipe.

Pan Method: The coating pan is securely anchored in place on the underside of the pipe and straddling the connection to be coated. The pan shall be wide enough so that the entire connection will be coated.

Hot coal-tar enamel is poured into the pan, from one side only, until the pan is completely filled. The drain plug or valve, is then opened and the excess coal-tar drained out. The pan can then be removed. Details of the coating pan and corres-ponding dimensions are given in AWWA Manual M-11.

The upper portion of the connection and all remaining exposed steel pipe, will then be coated by the use of a dauber. The coal-tar coating shall be applied in at least 2 coats for a minimum thickness of 1/16 inch. The daubers and method of application conform to AWWA C-203. No thinning will be allowed.

Cocoon Method: The cocoon is formed by placing glass fiber cloth or roofing paper of the proper width around the underside of the connection and adjacent exposed steel pipe. The edges of the cocoon shall be securely fastened to the pipe. Backfill is lightly placed to the springline and the top of the cocoon is opened and laid back on the filled area and hot coal-tar enamel poured, from one side only, until the cocoon is completely filled. The loose backfill prevents rupture of the cocoon. The upper portion of the connection and remaining exposed steel pipe shall be coated as above.

(4) Gaskets: Except as otherwise provided, all gaskets for pipe lines shall be one piece full faced gaskets from one-ply cloth inserted SBR rubber material. Gaskets for flanges 20 inch and smaller shall be from 1/16 inch thick material. Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be M-109 as manufactured by Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM D-2000, Class 4AA805A13.

(5) Flanges: Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type and shall conform to AWWA C-207, Class D. All flanges shall be drilled and have flange diameters and bolt circles conforming to AWWA C-110, except bolt holes will be 1/8 inch larger than the bolts given for the various sizes. All bolts shall be as specified above and all flanges shall have a flat facing.

610.4.14 Blocking and Thrust Blocks: All pipe lines, valves and fittings 16 inches and smaller in diameter shall be blocked with concrete thrust blocks in accordance with County Construction Standards. Thrust block areas for pipe, valves and fittings larger than 16 inches in diameter shall be calculated for each size pipe, valve and fitting to be installed and shown on the plans.

Thrust block areas shall be calculated on the basis of Class 150 pipe tested at 188 psi bearing against undisturbed 3,000 psf soil.

If soil or pressure conditions other than those stated above are encountered, the thrust block areas shall be calculated and submitted for approval. The areas stipulated in the standard details are minimum and shall not be decreased.

610.5 TESTING:

All pipelines shall be tested for watertightness by subjecting each section to hydrostatic tests in accordance with applicable provisions of AWWA C-600, except as modified below and shall consist of pressure test and leakage tests. The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, including measuring device and all other equipment necessary for making the tests and shall pay for water used in the tests.

610.5.1 Pressure Tests: All pipe lines shall be tested for watertightness by subjecting each section to a pressure test, measured at the lowest end of the section under test. The test pressure shall be at least 125 percent of class rating of pipe under test. The duration of each pressure test shall be at least 2 hours. Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C-600 and/or as modified in these specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than 1/2 mile in total pipe length shall be tested without special written permission of the Engineer.

The test may be made before or after backfilling. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C-600, the test shall not be made until the backfilling is completed and compacted. All connections, blowoffs and hydrants and valves shall be tested with the main as far as is practicable.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as determined by the Superintendent of Water Distribution, with at least 24 hour notice required before tests are scheduled. While the test section is under test pressure, a visual inspection for leaks may be made along the pipe line and all visible leaks repaired. The pressure test shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption.

610.5.2 Leakage Tests: Leakage tests shall be made after pressure test has been satisfactorily completed and all backfilling and compaction is completed to top of trench. The Contractor shall furnish the necessary apparatus and assistance to conduct the test.

The duration of each leakage test shall be at least 2 hours. To pass the leakage test, the leakage from the pipe line shall not exceed the leakage allowed by the following formula:

$$L = \frac{ND(P)^{1/2}}{4500}$$

L = allowable leakage in gallon per hour.

N = number of joints in the pipe line being tested, the "N" being the standard length of pipe furnished divided into the length being tested, with no allowance for joints at branches, blowoff, fittings, etc.

D = nominal diameter of pipe in inches.

P = average observed test pressure of the pipe being tested, equal to at least 100 percent of the class rating of pipe being tested, in psi gauge, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gauge.

Should the test on any section of the pipe line show leakage greater than specified above, the Contractor shall locate and repair the defective pipe, fittings or joint until the leakage is within the specified allowance of 2 hour duration.

Leakage is defined as the quantity of water necessary to be supplied into the pipe line section under test to maintain the specified leakage test pressure after the pipe line has been filled with water and all air expelled. All repairs and retests, if required, shall be made at the Contractor's expense.

Connections to the existing pipelines or existing valves shall not be made until after that section of new construction has satisfactorily passed the hydrostatic tests.

Cast iron and Ductile pipe used in conjunction with other types of pipe will be tested to the other type of pipe's standards, unless otherwise directed by the Engineer. High pressure systems of all cast iron or Ductile iron will be tested in accordance with AWWA C-600, Section 4.1.

610.5.3 Deflection: Installed pipe shall be tested to ensure that vertical deflections for plastic pipe does not exceed the maximum allowable deflection. Maximum allowable deflections shall be governed by the requirements stated herein and shall nominally be:

1) 3 percent of the maximum average ID for ABS or PVC Composite Pipe.

2) For all plastic pipe other than ABS or PVC Composite Pipe, the percentage listed of the maximum average ID.

Nominal Pipe Size	**Percentage**
Up to and including 12"	5.0
Over 12" and including 30"	4.0
Over 30"	3.0

The maximum average ID shall be equal to the average OD per applicable ASTM standard minus two minimum wall thicknesses per applicable ASTM standards. Manufacturing and other tolerances shall not be considered for determining maximum allowable deflections.

Deflection tests are to be performed not sooner than 30 days after completion of placement and densification of backfill. The pipe shall be cleaned and inspected for offsets and obstructions prior to testing.

610.6 DISINFECTING WATER LINES:

After pressure testing and before placing in service, all water lines shall be disinfected. Disinfection shall be accomplished in accordance with Section 445. All valves in the lines being disinfected shall be opened and closed several times during the 24 hour period of disinfection.

610.7 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be in accordance with the requirements of Section 336.

610.8 CLEANUP:

When testing, chlorination, compaction and cleanup do not follow pipe laying in an orderly manner, the Engineer reserves the right to close down trenching and pipe laying until these operations are adequately advanced.

610.9 MEASUREMENT AND PAYMENT:

610.9.1 Pipe: (1) Measurement of all pipe shall be of the linear feet of pipe installed, measured along the centerline of the pipe, through all valves and fittings, from the centerline of the fittings or centerline of valves on ends of pipe to the centerline of fittings, centerline of valves on ends of pipe or to the end of pipe, as the case may be, for all through runs of pipe. Measurement shall be to the nearest foot.

Measurement of branch line pipe shall start at the centerline of valve at connection to the main. Branches of tees that are valved and capped will not be measured.

(2) Payment will be at the unit price bid per linear foot of each type and size of pipe called for in the proposal. Such payment shall be compensation in full for furnishing and installing the pipe and all fittings, specials, adapters, bolts, connectors, etc., complete in place, as called for on the plans and/or on the standard details and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, installation of locator wire, installation of polyethylene protection, testing, disinfecting, connections to existing lines or works and all work not specifically covered in other pay items.

610.9.2 Water Service Taps and Meter Connections: Measurement and payment for this item will be provided for in accordance with Section 631.

610.9.3 Concrete Thrust Blocks: Concrete thrust blocks and anchors for all pipe 16 inch and larger shall be measured by the cubic yard(s) of concrete placed, as required on the plans and/or as directed by the Engineer. Payment will be made at the unit price bid per cubic yard and shall be compensation in full for excavation, form work, placing and finishing concrete, reinforcing, backfilling and compaction, pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section 336. All thrust blocks and anchors for 6 inch and smaller pipe shall be included in the linear foot cost of the pipe.

610.9.4 Valve and valve boxes: Measurement will be by each valve and its valve box installed of the various size valves. Payment will be made by the unit price bid for each size of valve in accordance with the bid schedule and shall be full compensation for each unit complete in place including all labor, materials, equipment and all incidentals necessary to complete the work.

610.9.5 Fire Hydrants, Blow Off Valve and Vaults: Measurement shall be for each unit installed. Payment will be at the unit price bid for the installation of each item complete in place and in operating condition. The 6 inch pipe and fittings, required for making the connection from the main line to a hydrant, shall be paid for as pipe length.

610.9.6 Pavement and/or Surfacing Replacement: Measurement and payment for pavement and/or surfacing replacement will be in accordance with Section 336, except as otherwise established in this specification.

SECTION 612

FORCE MAIN PIPELINE CONSTRUCTION

612.1 DESCRIPTION:

The work under this section shall consist of providing all labor, equipment, tools, parts, materials and all other work and materials required to complete all operations in connection with force main pipeline construction including excavation, trenching, hauling, installing force main pipeline, providing and installing all fittings, bolts, connectors, couplings, valves, protective wrap, thrust blocks, vaults, air release/vacuum valves and locator wire, furnishing, placing and compacting backfill, testing and appurtenances in accordance with the project plans and these specifications.

612.2 MATERIALS:

All pipe for force main pipeline shall be of the class and type shown on the plans.

Except as otherwise provided, 4" through 20" diameter pipe shall be P.V.C. and in accordance with Section 746. All pipe shall be Class 150, unless otherwise provided.

Steel cylinder pipe and fittings shall conform to AWWA C303. Fittings for P.V.C. pipe shall be in accordance with Section 750.

Gate valves shall conform to Section 759. Air/Vacuum valve shall conform to Section 767. Couplings shall conform to Dresser Style 38, Smith-Blair 411 or approved equal.

612.3 CONSTRUCTION METHODS:

612.3.1 Delivery and Temporary Storage of Pipe: Ship, store and place pipe at the installation site, supporting the pipe uniformly. Avoid scratching the pipe surface. Do not stack higher than 4 feet nor stack with weight on bells. Cover to protect from sunlight.

612.3.2 Pipe Layout for Curved Alignment: Pipe lengths may be bent for curved alignment but to no smaller radius curve than the following:

Pipe Diameter	Minimum Curve Radius
4 inch	400 feet
6 inch	600 feet
8 inch	800 feet
10 inch	1000 feet
12 inch	1,200 feet

612.3.3 Handling Pipe: Hoist pipe with mechanical equipment using a cloth belt sling or a continuous fiber rope which avoids scratching the pipe. Do not use a chain. Pipes up to 12 inches in diameter may be lowered by rolling on two ropes controlled by snubbing. Pipes up to 8 inches in diameter can be lifted by hand.

612.3.4 Excavation and Backfilling: Trench excavation, backfilling and trench compaction shall be in accordance with Section 601 and the following:

(A) Backfill materials in the zone between the trench bottom and to a point 12 inches above the top of the pipe shall be sand. Compact by means of vibratory equipment, by flooding or by hand tamping. Apply backfill in layers having a maximum thickness of 8 inches. Do not add successive layers unless the previous layer is compacted to 95% relative compaction per ASTM D-1557.

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

(C) Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction, water jetting or hand tamping. Do not float pipe. Do not use high-impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

612.3.5 Pipe Installation: All force mains shall have a minimum cover of 42 inches.

Pipe shall be laid to plan lines and grade with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the socket or bell end of the pipe.

The spigot and bell or bell coupling shall be dirt free and slide together without displacing the rubber ring. Lay the pipe section with the bell coupling facing the direction of laying.

Insert the rubber ring into the groove in the bell in the trench just before joining the pipes. First clean the groove. Observe the correct direction of the shaped ring. Feel that the ring is completely seated.

Lubricate the spigot over the taper and up to the full insertion mark with the lubricant supplied by the pipe manufacturer. If the lubricated pipe end touches dirt, clean the pipe end and reapply lubricant.

Insert the spigot into the bell and force it slowly into position.

Check that the rubber ring has not left the groove during assembly by passing a feeler gauge around the completed joint.

Any pipe which is not in true alignment or shows any undue settlement after laying shall be taken up and relaid at the Contractor's expense.

All pipe shall be protected during handling against impact shocks and free falls. No damaged or defective pipe or fittings shall be installed in the work. Pipe shall be kept clean at all times and as the work progresses, the interior of the pipe shall be cleared of all dirt and superfluous materials of every description.

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no water, earth or other substance will enter the pipe or fittings.

Pipe shall be cut by the Contractor for making closures, connections to fittings and to structures. The cost of this work shall be included in the price bid per linear foot of pipe. Field closures shall be made in accordance with the pipe manufacturer's recommendations.

612.3.6 Polyethylene Wrapping: Iron pipe and fittings installed underground shall be protected from corrosion by encasement in a polyethylene protective wrapping as per Section 791. The wrapping shall provide a continuous barrier between the pipe, fittings and the surrounding bedding and backfill.

612.3.7 Blocking: All force main fittings shall be blocked with concrete thrust blocks in accordance with details shown on the plans and in accordance with Yuma County Construction Standard 5-100.

612.4 VALVES AND VALVE BOXES:

Valves shall be installed in accordance with AWWA C-600 or AWWA C-603 modified as follows:

Just before installation in the trench, valves shall be fully opened and closed to check the action and a record made of the number of turns required to fully open or close the valve. For valves 16 inches and larger, the inspector shall be present to check the action and record the number of turns. The inside of all valves shall then be thoroughly cleaned and the valve installed.

Valves 3 inches and larger in size shall be supported by concrete anchor blocks, in accordance with Yuma County Construction Standard 5-110. Valves larger than 8 inches shall be anchored to the block with tie rods.

Valves 16 inches and larger in size, shall be supported on concrete slabs and/or concrete piers, as indicated on the plans. Concrete supports shall be provided under valves in vaults and shall be constructed an inch low, then grouted with non-shrink grout. Adjustable pipe supports shall be as indicated on the plans.

Valve box cover and frame shall be installed over all buried valves in accordance with Yuma County Construction Standards 5-210 and 5-220.

Standard couplings or matching joints shall be used when more than one length of riser pipe is required or when two or more pieces are joined, to form the valve box riser. The valve box riser shall be plumb and centered over valve operating nut and be free of dirt and debris. Install operation nut extension on all valves where the operating nut is 18 inches or more below grade.

612.5 DRAIN LINE AND VALVE:

Drain line and valves are to be installed where indicated and in accordance with the details on the plans.

612.6 CONNECTION TO EXISTING FACILITIES:

Existing facilities to which connection are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade or fittings, if necessary. All connections to existing facilities shall be constructed according to the plans.

612.7 AIR RELEASE/VACUUM VALVES:

Air vacuum/release valves are to be installed where indicated and in accordance with details on the plans. The equipment is to conform to Section 767.

612.8 LOCATOR WIRE:

A number 12 gauge, plastic coated, soft copper wire shall be placed directly on the top of the force main pipe for its entire length. The wire shall be placed near but not in contact with metal fittings or valves on the line.

612.9 COUPLINGS, JOINTS, GASKETS AND FLANGES:

612.9.1 Couplings: The couplings used to join the pipe to flanged valve adapters shall be Dresser Style 38, Smith-Blair 411 or an approved equal.

612.9.2 Joints: The joints and fittings shall conform the Sections 746 and 750.

612.9.3 Bolts and Nuts:

(A) For pipe 12 inches and smaller: bolts and nuts for use in field connections or for connecting fittings shall be carbon steel equivalent to ASTM A-307. Grade B, with cadmium plating in accordance with ASTM A-165 except that the minimum thickness of the plating shall be .00020 inches. Cadmium plated bolts shall have Class 2A threads and the nuts used with them shall have Class 2B threads. All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameter. High strength, heat treated cast iron tee-head bolts with hexagon nuts, all in accordance with the strength requirements of AWWA C-111, may be used in lieu of the cadmium plated bolts and nuts for jointing mechanical joint cast iron or ductile iron pipe and fittings only.

(B) For pipe 16 inches and larger: all bolts and nuts on flanges for valves and flexible couplings shall be carbon steel equivalent to ASTM A-307, Grade B. Bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameters.

(C) These bolted joints shall be protected as follows: following installation and before backfilling, all couplings, steel flanges, bolts, nuts, anchor bolts and rods, bolting of all flanged valves and all exposed steel shall be protected from corrosion by either of the two methods outlined below at the Contractor's option.

Method 1: Below ground installations shall be coated with NO-OX-ID "A" with a film of not less than 1/32 inch thick and then coated with cement mortar not less than 1 inch thickness before backfilling cement mortar shall be composed of 1 part cement, ASTM C-150, Type II, low alkali, to 3 parts sand. Before application of the cement mortar coating the area to be protected shall be covered with a layer of 2 X 2 inch No. 14 gauge welded wire fabric, firmly wired in place.

Method 2: Below ground installations shall be protected by the application of hot coal-tar enamel. The coal-tar enamel shall be in accordance with AWWA C-203 and shall be applied to the top part of the pipe or fittings by daubers for at least 2 coats for a total minimum thickness of 1/16 inch. The coal-tar for the undersides of the pipe flanges or fittings shall be applied by the pan or cocoon method as described below and in AWWA Manual M-11, Steel Pipe.

Pan Method: The coating pan is securely anchored in place on the underside of the pipe and straddling the connection to be coated. The pan shall be wide enough so that the entire connection will be coated.

Hot coal-tar enamel is poured into the pan, from one side only, until the pan is completely filled. The drain plug or valve, is then opened and the excess coal-tar drained out. The pan can then be removed. Details of the coating pan and corresponding dimensions are given in AWWA Manual M-11.

The upper portion of the connection and all remaining exposed steel pipe, will then be coated by the use of a dauber. The coal-tar coating shall be applied in at least 2 coats for a minimum thickness of 1/16 inch. The daubers and method of application conform to AWWA C-203. No thinning will be allowed.

Cocoon Method: The cocoon is formed by placing glass fiber cloth or roofing paper, of the proper width, around the underside of the connection and adjacent exposed steel pipe. The edges of the cocoon shall be securely fastened to the pipe. Backfill is lightly placed to the spring line and the top of the cocoon is opened and laid back on the filled area and hot coal-tar enamel poured, from one side only, until the cocoon is completely filled. The loose backfill prevents rupture of the cocoon. The upper portion of the connection and remaining exposed steel pipe shall be coated as above.

612.9.4 Gaskets: Except as otherwise provided, all gaskets for pipelines shall be one piece, full-faced gaskets from one-ply cloth inserted SBR rubber material. Gaskets for flanges 20 inches and smaller shall be from 1/16 inch thick material. Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be M 109 as manufactured by Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM D-2000, Class 4AA805A13.

612.9.5 Flanges: Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type and shall conform to AWWA C-207, Class D. All flanges shall be drilled and have flange diameters and bolt circles conforming to AWWA C-110, except bolt holes will be 1/8 inch larger than the bolts given for the various sizes. All bolts shall be as specified above and all flanges shall have a flat facing.

612.10 TESTING:

All pipelines shall be tested for watertightness by subjecting each section to hydrostatic tests in accordance with applicable provisions of AWWA C-600, except as modified below and shall consist of pressure, leakage tests and deflection testing. The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, including measuring device and all other equipment necessary for making the tests and shall pay for the water used in the tests.

612.10.1 Pressure Tests: All pipelines shall be tested for watertightness by subjecting each section to a pressure test, measured at the lowest end of the section under test. The test pressure shall be at least 125 percent of class rating of pipe under test. The duration of each pressure test shall be at least 2 hours. Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C-600 and/or as modified in these specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than 1/2 mile in total pipe length shall be tested without special written permission of the Engineer.

The test may be made before or after backfilling. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C-600, the test shall not be made until the backfilling is completed and compacted. All connections, blowoffs and hydrants and valves shall be tested with the main as far as is practicable.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as determined by the Superintendent of Water Distribution, with at least 24 hour notice required before tests are scheduled. While the test section is under test pressure, a visual inspection for leaks may be made along the pipe line and all visible leaks repaired. The pressure test shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption.

612.10.2 Leakage Tests: Leakage tests shall be made after pressure test has been satisfactorily completed and all backfilling and compaction is completed to top of trench. The Contractor shall furnish the necessary apparatus and assistance to conduct the test.

The duration of each leakage test shall be at least 2 hours. To pass the leakage test, the leakage from the pipe line shall not exceed the leakage allowed by the following formula:

$$L = \frac{ND(P)^{1/2}}{4500}$$

L = allowable leakage in gallon per hour.

N = number of joints in the pipe line being tested, the "N" being the standard length of pipe furnished divided into the length being tested, with no allowance for joints at branches, blowoff, fittings, etc.

D = nominal diameter of pipe in inches.

P = average observed test pressure of the pipe being tested, equal to at least 100 percent of the class rating of pipe being tested, in psi gauge, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gauge.

Should the test on any section of the pipe line show leakage greater than specified above, the Contractor shall locate and repair the defective pipe, fittings or joint until the leakage is within the specified allowance of 2 hour duration.

Leakage is defined as the quantity of water necessary to be supplied into the pipe line section under test to maintain the specified leakage test pressure after the pipe line has been filled with water and all air expelled. All repairs and retests, if required, shall be made at the Contractor's expense.

Connections to the existing pipelines or existing valves shall not be made until after that section of new construction has satisfactorily passed the hydrostatic tests.

Cast iron and Ductile pipe used in conjunction with other types of pipe will be tested to the other type of pipe's standards, unless otherwise directed by the Engineer. High pressure systems of all cast iron or Ductile iron will be tested in accordance with AWWA C-600, Section 4.1.

612.10.3 Deflection Test For PVC Pipe: the contracter shall perform a deflection test on the system as directed by the engineer. Any part of the installation which shows deflection in excess of 5% of the average inside diameter, per ASTM D-3034 for PVC pipe, shall be corrected. For all plastic pipe, other than PVC composite pipe, the maximum allowable deflection is listed as a percentage of the maximum average I.D. as follows:

Nominal Pipe Size	Percentage
Up to and including 12"	5.0
Over 12" and including 30"	4.0
Over 30"	3.0

The maximum average ID shall be equal to the average OD per applicable ASTM standard minus two minimum wall thicknesses per applicable ASTM standards. Manufacturing and other tolerances shall not be considered for determining maximum allowable deflections.

Deflection tests are to be performed not sooner than 30 days after completion of placement and densification of backfill. The pipe shall be cleaned and inspected for offsets and obstructions prior to testing.

> After acceptance, but prior to the terminations of the warranty period, the contracting agency determines that the deflection has exceeded 71/2% of the average inside diameter, that portion of the installation shall be corrected by the contractor at no cost to the contracting agency.

612.11 CLEANING:

Force main shall be swabbed, flushed with water or subjected to a combination of these or other methods in order to leave the pipeline clean and free from debris, garbage, rubbish, stones, deposits and like foreign materials.

612.12 MEASUREMENT AND PAYMENT:

612.12.1 Pipe:

(1) Measurement of all pipe shall be by the linear foot of pipe installed, measured along the centerline of the pipe, from the centerline of valves or fittings to the ends of pipe. Measurement shall be to the nearest foot.

(2) Payment will be at the unit price bid per linear foot of each type and size of pipe called for in the proposal. Such payment shall be compensation in full for furnishing and installing the pipe and all fittings, specials, adapters, bolts, connectors, etc., for the pipeline complete in place, as called for on the plans and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, installation of locator wire, installation of polyethylene protection, testing, connections to existing lines or structures and all work not specifically covered in other pay items.

612.12.2 Thrust Blocks: All measurement and payment for thrust blocks and anchors for 16 inches and smaller pipe shall be included in the linear foot cost of the pipe.

612.12.3 Valves, Valve Boxes and Air Vacuum/Release Valves:

(1) Measurement will be by the various sizes of each valve and its valve box installed.

(2) Payment will be made by the unit price bid for each size of valve in accordance with the bid schedule and shall be full compensation for each unit complete in place including all labor, materials, equipment and all incidentals necessary to complete the work.

612.12.4 Drain Line and Valve:

(1) Measurement will be by each complete unit in place including pipe, connection to mainline, valve and valve box.

(2) Payment will be made by unit price bid in accordance with the bid schedule and shall be full compensation for the complete unit in place.

612.12.5 Pavement and/or Surface Replacement: Measurement and pavement for pavement and/or surface replacement will be in accordance with Section 336 except as otherwise noted.

612.12.6 Connection to Existing Facilities: All measurement and payment for connection to existing facilities shall be included in the linear foot cost of the pipe.

SECTION 615

SEWER LINE CONSTRUCTION

615.1 DESCRIPTION:

The construction or extension of sanitary sewer lines shall conform to the applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

615.2 MATERIAL:

Concrete pipe shall conform to Section 734 or 735 as specified. Vitrified clay pipe shall conform to Section 743. PVC pipe and fittings shall conform to Section 745.

615.3 CONSTRUCTION INSTALLATION:

615.3.1 Excavation: Excavation of trenches shall be accomplished in accordance with Section 601.

The Contractor shall furnish the Engineer alignment and elevation stakes at agreed upon intervals and offsets together with cut sheets showing the difference in elevation from the top of the stakes to the flowline of the pipe.

The trench shall be dry when the fine grading of the bottom of the trench is accomplished. Before placement of pipe the fine grade shall be carefully checked by use of a string line, laser beam or other means so that when in final position the pipe will be true to line and grade, ±0.05 feet for 8 inches through 12 inches, ±0.10 feet for 15 inches and larger.

For PVC pipe installation the width of trench as listed in Table 601-1 or as given in the contract documents may be increased to provide sufficient space for the instal-lation of fittings or for compaction of the bedding. The adjusted maximum width at the top of the pipe must be approved by the Engineer. Any adjustment of the trench width to accomplish the above shall be done at no additional cost to the Contracting Agency.

615.3.2 Laying Pipe: Pipe shall be of the type, class and size called for on the plans. All pipe shall be protected during handling against impact shocks and free falls. No damaged or defective pipe shall be installed in the work. Pipe shall be kept clean at all times and as the work progresses, the interior of the pipe shall be cleaned of all dirt and superfluous materials of every description.

The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

The alignment and grade of each length of pipe shall be checked after setting by measurement from the stringline, laser beam target or other means approved by the Engineer.

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no water, earth or other substance will enter the pipe or fittings.

PVC pipe and fittings shall be installed in accordance with ASTM 2321. The bedding shall be placed in two lifts. The first lift will be from the bottom of the trench to the spring line of the pipe. The second lift will be from the spring line to one foot above the top of pipe. Separate inspections will be required on each lift. The Contractor shall place the first lift in a manner that will insure uniform support under the haunches and proper alignment of the pipe. When called for on the plans, sanitary sewers shall be concrete encased. When sewer lines infringe upon the area of a waterline, extra protection shall be provided in accordance with County Construc-tion Standard 5-060.

615.3.3 Fittings: All fittings shall conform to the requirements of the pipe specifications and shall be located as shown on the plans or as directed by the Engineer, in accordance with the details.

615.3.4 Jointing: Prior to making pipe joints, all surfaces of the portions of the pipes to be joined shall be cleaned, dried and prepared in accordance with the manufacturer's recommendations. The joints shall then be carefully centered and completed.

Trenches shall be kept water-free during the installation of joints and couplings.

The joint and coupling materials will be as specified in the appropriate pipe sections and shall be installed in accordance with the manufacturer's recommendations. Cement mortar joints will NOT be permitted in sanitary sewer construction.

615.4 SANITARY SEWER HOUSE CONNECTION:

When the construction of sanitary sewer connection taps are called for in the plans, they shall be constructed in accordance with County Construction Standard 5-020 and the project plans.

The location of the service tap for each property shall be in the downstream 1/3 of the lot or as requested by the property owner. Sewer service taps shall not be covered until they have been plugged and marked in accordance with standard details and their location has been recorded by the Engineer.

615.5 SANITARY SEWER CLEANOUTS:

The cleanouts shall be constructed at locations shown on the plans, in accordance with Yuma County Construction Standard 5-010.

615.6 MANHOLES:

Manholes shall be constructed to conform with the requirements of the plans, Section 625 of these specifications and Yuma County construction standards.

615.7 BACKFILLING:

Backfilling and compaction shall be done in accordance with Section 601 and county construction standards.

615.8 TESTING:

As the pipe laying progresses and after partial backfilling, the interior of the sewer or pipeline shall be visually inspected for alignment and grade, by means of artificial or reflected light. Necessary corrections shall be made by the Contractor at his expense.

Storm sewer pipelines shall be subject to test for leakage after the lines have been partially backfilled, in accordance with the following:

Approximately 20 percent of the length of lines will be tested as specified below. If test made indicate that the work is being done satisfactorily and the lines are tight, the Engineer may waive tests on the other parts of the lines or call for spot tests, to ensure proper construction. The maximum length of pipe allowed to be tested at one time shall be 500 feet.

The Engineer reserves the right to require testing of the entire installation. The cost of testing shall be borne by the Contractor and sections showing excess leakage shall be repaired by the Contractor at his expense. All visual leaks shall be repaired by the Contractor at his expense.

615.8.1 Low Pressure Air Test:

Testing will be accomplished by the means of "Low Pressure Air Testing". Tests may be conducted by the Contractor or an independent testing firm. However, accept-ance tests shall be made only in the presence of the Engineer.

Test Procedure:

1. Before testing, the pipe shall be thoroughly cleaned.

2. The Contractor shall seal off the section of pipe to be tested at each manhole connection. Test plugs must be securely braced within the manholes.

3. A minimum of two connecting hoses to link the air inlet test plug with an above ground test monitoring panel must be provided.

a. One hose is to induce air thru the test plug and into the test chamber.

b. The second hose is for the purpose of monitoring the test pressure from within the enclosed pipe.

4. UNDER NO CIRCUMSTANCES ARE WORKERS TO BE ALLOWED IN THE CONNECTING MANHOLES WHILE A PRESSURE TEST IS BEING CONDUCTED.

5. Add air slowly into the test section. After an internal pressure of 4.0 PSI is obtained, allow internal air temperature to stabilize.

6. After stabilization period, adjust the internal air pressure to 3.5 PSI, disconnect the air supply and begin timing the test.

7. Refer to the air test table to determine the length of time (minutes) the section under test must sustain while not losing in excess of 1 PSI as monitored by the test gauge.

8. Sections so determined to have lost 1 PSI or less during the test period will have passed the leakage test. Those sections losing in excess of 1 PSI during the test period will have failed the leakage test.

9. Appropriate repairs must then be completed and the line retested for acceptance.

TABLE 615

AIR TEST

Minimum Test Time for Various Pipe Sizes

Nominal Pipe size, in.	T(time) min/100 ft.	Nominal Pipe size, in.	T(time) Min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

(a) Table shows the required test time, T, in minutes/100 ft. of pipe for each nominal pipe size. Test times are for an 1.0-psi (7-kPa) pressure drop from 3.5 to 2.5 psi (24 to 17 kPa). Table has been established using the formulas contained in the appendix.

(b) If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.

(c) It is not necessary to hold the test for the whole period when it is clearly evident that the rate of air loss is less than the allowable.

615.8.2 Hydrostatic Test: Exfiltration Testing (water):

Sanitary sewer testing by means of exfiltration should only be considered when low pressure air testing cannot be used and only with the approval of the Engineer.

Testing Procedure:

1. The Contractor shall furnish all equipment for testing.

2. Seal off the downstream end of the line and fill with water to a minimum head of 4' in a stand pipe at the high end.

3. A period of at least one hour will be allowed for absorption time before making the test.

4. A suitable meter or method of measuring the quantity of water used is necessary.

5. The allowable water loss for sanitary sewers shall not exceed 0.5 gallons per hour per 100 feet of pipe per inch of diameter of pipe under a minimum test head of 4 feet above the top of the pipe at the upper end.

615.8.3 Deflection Test for PVC Pipe: In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the average inside diameter as per ASTM 3034 shall be corrected.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long term deflection of the sewer. If the Con-tracting Agency determines that the deflection has exceeded 7-1/2% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

615.9 PAVEMENT AND SURFACING REPLACEMENT:

Pavement and surfacing replacement shall be done in accordance with Section 336.

615.10 CLEANUP:

The Engineer has the right to close down forward trenching and pipe laying where testing, backfill, compaction and cleanup does not follow in an orderly manner.

615.11 MEASUREMENT AND PAYMENT:

615.11.1 Sewer Pipe and Fittings: (Vitrified clay, cast iron, P.V.C. and other approved types of pipe.)

(A) Measurement will be made horizontally thru manholes and fittings and from centerline to centerline of structures, for the various types and sizes of pipe called for on the plans and in the proposal.

(B) Payment for the various sizes and types of pipe will be made in accordance with the bid schedule at the unit price bid per linear foot and shall be compensation in full for furnishing and installing the pipe and fittings complete in place, as specified, including excavation, removal of obstructions, backfilling, water settling, compaction, sheeting and bracing, testing, and all incidental work not specifically covered in other pay items.

615.11.2 Sanitary Sewer Service Taps:

(A) Measurement will be the number of taps installed.

(B) Payment will be made at the unit price bid and shall be compensation in full for furnishing and installing pipe and fittings complete in place, as specified and called for on the plans and standard details, including all costs of excavation, removal of obstructions, shoring and bracing, backfilling, compaction, testing and all work incidental thereto.

615.11.3 Sanitary Sewer Cleanouts:

(A) Measurement will be the number of cleanouts installed.

(B) Payment will be made at the unit price bid and shall be compensation in full for furnishing and installing pipe, fittings and frame and cover as called for on the plans and in accordance with the standard details.

615.11.4 Sanitary Sewer Encasement or Infringement Protection:

(A) Measurement will be by the linear foot complete in place.

(B) Payment will be made by the contract unit price bid and shall be full compensation for furnishing and installing all pipe, fittings, concrete, steel and pavement replacement as called for in the plans and in accordance with the County Construction Standards.

615.11.5 Manholes: Measurement and payment shall be in accordance with Section 625.

SECTION 618

CONCRETE PIPELINE CONSTRUCTION

618.1 DESCRIPTION:

The work under this section shall consist of all labor, equipment, furnishing pipe and all other materials required to complete all operation in connection with the installation of concrete pipe primarily for stormsewer purposes including excavation, trenching, hauling, installation of pipe, furnishing, placing and compacting backfill materials and appurtenances, all in accordance with the plans and specification.

618.2 MATERIALS:

618.2.1 Pipe: Pipe shall be of the type, class and size shown on the plans or in the special provisions.

Gravity storm sewer pipe shall be reinforced concrete pipe conforming to Section 735. Pipe for low head storm sewer construction, shall be reinforced concrete pipe, in accordance with Section 734. The minimum cover from the top of the pipe to the finished grade shall be 2 feet. Class of pipe is to be determined from job require-ments.

The concrete pipe, specials, joints, gaskets, and testing shall be as indicated on the plans except as specified below or as modified by special provisions.

618.2.2 Specials: A special is defined as a piece of pipe other than a normal full length straight section, and includes but is not limited to sections with outlets, closure pieces, wyes, tees, bends, adapter sections, manhole shafts and shall be provided as indicated on the plans. Such specials shall be made equal in strength, diameter and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing or steel items. Drawings of specials shall be submitted to the Engineer for approval before their fabrication. Specials shall be used on all outlets, branches, connections, manholes, etc. when using pressurized pipe.

618.2.3 Rubber Gasket Joints: When rubber gasket pipe is used, the joint shall be sealed with a continuous ring gasket made of a special composition rubber of such size and cross section as to fill completely the recess provided for it. The gasket shall be the sole element depended upon to make the joint watertight, and shall have smooth surfaces, free from pits, blisters, porosity, and other imperfections and conform to Section 765.

618.2.4 Tongue and Groove Joints: Mortar or grout shall consist of 1 part portland cement and 2 parts sand, by volume. The quantity of water in the mixture shall be sufficient to produce a soft workable mortar, but in no cases exceed a water cement weight ratio of 0.53. Where outside joints are made by the diaper method, the grout shall be composed of 1 part cement to 3 parts sand and shall be mixed to the consistency of thick cream. The sand shall conform to the section entitled "Rock Gravel and Sand" and the cement shall conform to the section entitled "Portland Cement Concrete".

618.2.5 Care of Pipe And Materials: All pipe and materials shall be manufactured, handled, loaded, shipped unloaded, and laid in such manner as to be undamaged an in sound condition in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer, otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in acceptable condition. At all times rubber gaskets shall be stored in a cool, dark place until ready for use. The gaskets shall not be exposed to direct sunlight for a time greater than needful for normal installation.

618.3 SUBMITTALS:

Prior to fabricating, the Contractor shall submit for approval three (3) sets of the following information. Approval shall be obtained before construction and manufacturing.

(A) Shop drawings, in accordance with the General Conditions.

(B) Submit manufacturer's affidavit of compliance with the cited standards, e.g., ASTM C-361 for low head pressure pipe.

(C) Submit tabulated layout schedule including:

(1) Order of installation and closures.

(2) Pipe invert station and elevation at each change of grade and alignment.

(3) Elements of curves and bends, both in horizontal and vertical alignment including elements of the resultant true angular deflections in cases of combined curvature.

(4) Pipe internal diameter, wall thickness and design internal head.

(5) Locations of bulkheads for field hydrostatic testing of pipeline.

(6) Locations of closures for length adjustment and for construction convenience.

(7) Locations of manholes and other points of access for placement of mortar lining at field joints and removal of test bulkheads.

(8) Locations of valves and other mechanical equipment.

(D) Details of specials.

(E) Joint details.

(F) Test reports on shop testing performed as per the applicable ASTM standards.

(G) Details of bulkheads and of their method of attachment to pipeline.

(H) Certificate that cement complies with the applicable ASTM standard and designating type.

(I) Mill test reports on each heat from which the steel is rolled.

(J) Test reports on physical properties of rubber used in gaskets.

(K) A shoring plan for excavations deeper than 6 feet.

618.4 CONSTRUCTION METHODS:

618.4.1 Excavation: Excavation, bedding, backfilling, compaction or consolidation of backfill and bedding of trenches shall be accomplished in accordance with Section 601, except as specified below or as modified by special provisions.

The Contractor shall over-excavate the trench and fill with select material as required and as shown on the project plans.

618.4.2 Trench Width: Where the cover over the top of the pipe is less than 10 feet, the maximum trench width is unrestricted. The pay width, however, for pavement replacement shall remain in accordance with Section 336. For pipe, with 10 feet or more cover, the maximum trench width shall be as required by Section 601.

618.4.3 Pipe Laying: The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

Variation from prescribed alignment and grade shall not exceed 0.10 foot and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipeline unless otherwise approved by the Engineer. For closures and deflection angles greater than 10 degrees, joints shall be made by use of a concrete collar, per standard details.

Pipe shall be kept clean at all times as work progresses. The interior of the pipe shall be cleaned of all dirt and superfluous materials of every description. The type of pipe joint shall be as specified on the plans.

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed with caps or plugs to the satisfaction of the Engineer, so that no water, earth or other substance will enter the pipe or fittings.

Whenever the end of a pipeline remains unjoined to an existing pipe or structure, it shall be closed by a stopper of concrete and brick tightly sealed in place.

Mortar for connection pipe joints shall be as herein defined.

618.4.4 Concrete Cradle Bedding: Where concrete bedding is shown on the plans or called for in the Special Conditions, the lower exterior part of the pipe shall be bedded in a continuous cradle constructed of Class "C" concrete (2,000 psi) having a minimum thickness under the pipe of 1/4 the inside diameter and extending up the sides of the pipe for a height equal to 1/4 the outside diameter. If the excavation is in reasonable sound rock, the minimum thickness under the pipe may be reduced from 1/4 the inside diameter to 6 inches. The cradle shall have a width at least equal to the outside diameter plus 8 inches and shall be constructed monolithically without horizontal construction joints.

618.4.5 Openings In Non-Pressurized Pipeline: All connections to the concrete pipe that require openings be cut into the pipe for outlets and branch connections, shall be full size, within 1 inch of the outside diameter of the connecting pipe or fitting. Such openings shall be cut in the pipes either before or after the pipes are laid at the Contractor's option. After the pipes are laid, the cuts shall not be made until the joint mortar is thoroughly cured.

All connections shall be cut to fit closely and shall be strongly cemented to the line with bonding mortar. Where possible, both the inside and outside of the joint shall be brushed smooth.

618.4.6 Openings in Pressurized Pipeline: All connections, outlets, manhole, branches, etc. required on new construction of pressurized pipe shall be a special.
When specified on the plans, jointing of a fitting or connection to an existing pipe shall consist of a welded splice of the wire cage of the jointing pipes and the construction of a mortar collar 2-1/2 inches thicker than the pipe wall and overlapping each pipe wall at least 4 inches. The collar shall be reinforced with 2 x 2 inch 12 gauge welded wire fabric, top and bottom, continuous around the joint. Both pipes at the connection shall be free from cracks and the interior of both pipes at the joint shall be smooth.

618.4.7 Delivery: Place the pipe in the order in which it is to be installed and secure it from rolling.

618.4.8 Long Radius Curves and Vertical Curves:

(1) For curved alignment, use straight or beveled pipe of normal or 1/2 normal lengths pulled partially open on one side of the joint or use pipes with a bend of up to 5 degrees next to the joint ring. Design pipes with a bend in excess of 5 degrees as specials.

(2) Do not pull a joint more than 1/2 of the watertight extensibility provided by the bell and spigot design.

618.4.9 Installing Buried Piping:

(1) Inspect each pipe and special before the buried pipe or fitting is lowered into the trench. Inspect the interior and exterior protective coating and patch damaged areas in the field with material recommended by the pipe manufacturer. Clean the ends of the pipe thoroughly. Remove foreign matter and dirt from inside of the pipe and keep clean during and after laying.

(2) Handle pipe in such manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches.

(3) The laying of the pipe shall commence at the lowest points with the spigot end pointing in the direction of the flow.

(4) When installing piping in trenches, do not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.

(5) Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Before laying each section of pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

(6) At the location of each joint, dig bell holes in the bottom of the trench and at the slides to permit visual inspection of the entire joint.

(7) Provide and maintain means and devices at all times to remove and dispose of all water entering the trench during the process of pipe laying. Keep the trench dry until the pipe laying and jointing are completed.

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

(9) Where the shaped foundation is made in compacted fill, provide a minimum of 6 inches of compacted fill beneath the pipe. Tamp compacted fill material in 6 inch layers around the pipe for the remainder of the lower 37% of the outside diameter of the pipe. Compact fill material to at least 95% relative compaction. Then place fill material to the top of the pipe on each side in layers not exceeding 6 inches in thickness.

(10) Backfilling of pipe shall follow closely behind the pipe laying, such that all installed pipe is immediately backfilled to a point which is at least 1 foot above the top of the pipe.

(11) It is the Contractor's responsibility to protect the pipe from flotation and from other shifts in alignment and grade throughout the project construction process. Any pipe which is displaced or shifted from its intended location or grade shall be removed and relaid by the Contractor at no additional cost to the District.

618.5 MANHOLES:

When specified on the plans, manholes are to be constructed in accordance with Section 625 and in accordance with Yuma County Construction Standards 5-030, 5-035, 5-040, 5-045 and, when specified on the project plans and bid schedule, in accordance with Yuma County Construction Standard 5-046.

618.6 JUNCTION STRUCTURES:

Special pipeline junction structures shall be constructed as shown on the plans and in accordance with Section 505, "Concrete Structures".

618.7 JACKING PIPE:

At locations where jacking is required, the storm drain line shall be installed by jacking to the lengths indicated on the plans, in accordance with the following. The methods and equipment used in jacking reinforced concrete pipe conduit shall be optional with the Contractor, provided that the proposed method is first approved in writing by the Engineer. Such approval, however, shall in no way relieve the Contractor of the responsibility for damages of any nature which might occur as a result of the methods used.

Only workers experienced in the operation of jacking concrete conduit shall be used.

The driving ends of the conduit shall be properly protected and the conduit shall be driven true to alignment and grade. The deviation from true line and grade at any single point within the jacked portion shall be limited to 0.5 feet horizontal deviation from line and ±0.2 feet vertical deviation from grade.

Any section of conduit which may show signs of failure shall be removed and replaced with a new section of precast conduit or with a cast-in-place section, which in the opinion of the Engineer is adequate to carry the loads imposed upon it. In this respect it shall be understood that where pipe is specified on the drawings to be jacked into place the jacked pipe shall be reinforced concrete of the strength specified in these specifications and the design of such pipe is based upon super-imposed loads and not upon loads which may be placed upon the pipe as a result of jacking operation. Any increase in pipe strength required in order to withstand jacking loads shall be the responsibility of the Contractor. The reinforcing shall be circular and of either single or double cage design.

Spacer blocks shall be placed in the inside circular space which will allow sufficient width for point mortaring when jacking is completed and to equalize pressures during jacking. Three grout holes per 8-foot section of pipe shall be made during manu-facturing.

Double rubber gaskets and band type joints shall be provided for 36 inch diameter and larger pipe.

One hole shall be made on the top midway between the ends. Two additional holes, each approximately 1.5 feet from each end and approximately midway between the springline and top on opposite sides shall be made.

Where the nature of the soil or the structure under which the conduit is being jacked is such that, there is increased danger of a cave-in or damage to said structure, the method of jacking the conduit shall be as specified below.

The leading section of conduit shall be equipped with a jacking head securely anchored thereto to prevent any wobble or alignment variation during jacking operations. The length and details of the jacking head shall be subject to the written approval of the Engineer. Excavation shall be carried out entirely within the jacking head and no excavation in advance thereof will be permitted. Every effort shall be made to avoid any loss of earth outside of the jacking head. Excavated material shall be removed from the conduit as excavation progresses, and no accumulation of such material within the conduit will be permitted. Upon completion of the jacking operations, all voids around the outside face of the conduit shall be filled by grouting through each of the previously constructed grout holes to the satisfaction of the Engineer. The grout shall be a mixture of one part cement to three parts sand and a mixture by volume.

618.8 TESTING OF PIPE:

618.8.1 Exfiltration Test: Unless excessive ground water is encountered, each section of sewer, between the two successive structures, shall be tested by closing the lower end of the sewer to be tested and the inlet sewer into the upper structure with stoppers and filling the pipe and structures with water to a point 4 feet above the invert of the sewer in the upper structure. Allowable leakage will be computed by the formula:

The leakage per 100 feet of length, as determined by an hour test, must not exceed 0.35 gallon per hour per inch of inner diameter of the pipe.

In making this hydrostatic test, the water in the pipe and standpipe shall be maintained at the 4.0 level as noted above for a period of at least 2 hours. Any individual leaks showing up during this 2 hour period shall be repaired.

If the leakage, as shown by the test, is greater than allowed by the formula, the pipe shall be overhauled and, if necessary, relaid until the joints shall hold satisfactorily under the test. If the leakage is less than allowed, the Contractor shall stop any individual leaks that may be observed.

618.8.2 Infiltration Test: If, in the construction of a section of the sewer between structures, excessive ground water is encountered, the test for leakage described above shall not be used, but instead the end of the sewer at the upper structure shall be closed sufficiently to prevent the entrance of water and pumping of ground water shall be discontinued for at least 3 days, after which the section shall be tested for infiltration. The infiltration shall not exceed 0.35 gallon per hour per inch of diameter per 100 feet of main sewer being tested. The length of connections entering the section shall not be included. Where any infiltration in excess of this amount of infiltration reduced to a quantity within the specified amount before the sewer is accepted. Should, however, the infiltration be less than the specified amount, the Contractor shall stop any individual leaks that may be observed.

All tests shall be completed before street or trench is resurfaced.

The above hydrostatic tests do not apply to the catch basin leads.

All labor, tools, material, appliances and bulkheads required for making the test shall be supplied by the Contractor.

618.9 MEASUREMENT:

618.9.1: Pipe will be measured by the linear foot parallel to the central axis of the pipeline and shall include the length of fittings.

618.9.2: Tees, wyes other branches and specials will be measured as pipe along the central axis of the pipes to the point of intersection of said central axes. Pipe reducers will be measured as pipe of the larger diameter along the central axis.

618.9.3: Pipe stubs and their plug will be measured as each unit complete in place.

618.9.4: Jacked pipe shall be measured at the ground surface and shall be the number of linear feet of ground surface undisturbed by the cut and cover construction on either end of the jacked section. Measurement shall include the actual linear feet of pipe jacked.

618.10 PAYMENT:

Payment will be made at the contract unit price as established in the proposal for each item and shall be compensation in full for the complete installation in place including all labor, materials, equipment and all incidentals necessary to complete the installation.

SECTION 621

CORRUGATED METAL PIPE AND ARCHES

621.1 DESCRIPTION:

These specifications cover plain galvanized, bituminous coated and bituminous coated and paved galvanized corrugated metal pipe for use in storm sewers. The pipe shall be of the types, constructed as specified, and shall be manufactured in accordance with the requirements of the stated specifications. Except as otherwise required, corrugated metal pipe shall conform to AASHTO M-36 and M-190.

621.2 MATERIALS:

The types of pipe and fabrication shall be in accordance with Section 760.

All helically-wound corrugated metal pipe shall have a marking system which shall provide a quick external visual check of diameter variations during and after the manufacturing process.

621.3 INSTALLATION:

621.3.1 Excavation: Excavation, bedding and backfill shall be in accordance with Section 601, except as modified by details.

621.3.2 Pipe Laying: No pipe shall be laid except in the presence of an inspector. Each pipe shall be carefully inspected immediately before it is laid and defective pipe will be rejected. Pipe lines shall be laid to the grades and alignment indicated on the drawings. Variation from prescribed grade and alignment shall not exceed 0.10 foot, and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet, unless otherwise approved by the Engineer. Proper facilities shall be provided for lowering sections of pipe into trenches. All pipes, elliptical or round, as well as pipe arches requiring bituminous coating and/or pavement shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

All field repairs to the bituminous coating or paving shall be made with asbestos reinforced bituminous mastic: Flintkote C-13-C4, Inertol Hotmastic (black), Pioneer Kooler Seal or an approved equal.

Corrugated metal pipe and/or pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed 1/2 inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. Any metal in the joints which is not thoroughly protected shall be coated with bituminous mastic. During the installation, the pipe shall be handled with care so as not to damage the bituminous coating. Coupling band bolts and damaged areas of the coupling bands and pipe shall be given a coating of bituminous mastic as specified above prior to placing the backfill. Pipe on which the bituminous coating or paving has been damaged to such extent that satisfactory field repairs cannot be made, as determined by the Engineer, shall be removed and replaced at no additional cost to the Contracting Agency.

621.3.3 Joints: Before the connecting band is placed around the pipe, the ends of the pipe that will be beneath the band, shall be coated with bituminous mastic or, if of suitable design, fitted with circular rubber gaskets to provide a watertight joint. The band shall be tightened evenly, keeping equal tension on the bolts. If mastic is used, tension shall be maintained over an interval of time until the flow of mastic terminates. The joint shall remain uncovered over a period designated by the Engineer and before covering the joint the nuts shall be tested for tightness. If the nut has a tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained. Prior to backfilling around the joint, bolts, lugs and nuts shall be given a coating of bituminous mastic. The annular space between abutting pipe sections shall be filled with bituminous mastic after jointing.

621.3.4 Pipe Elongation: Except as otherwise specified, the standard details shall control as to conditions under which pipe must be elongated. Pipe shall be elongated 5 + 1/2 percent of the nominal diameter to take advantage of the build-up of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical diameter of the pipe at any point along the pipe section, after backfill and compaction is completed, be less than the nominal diameter of the pipe or more than 5 percent greater than the nominal diameter of the pipe as shown on the plans or specified elsewhere in this specification. Any damage done as a result of strutting shall be repaired as directed by the Engineer at no additional cost to the Contracting Agency. Strutting of pipe shall be approved by the Engineer.

621.3.5 Cutting: The Contractor will be prohibited from using conventional welding torches in cutting full lined CMP due to fire hazard. Pipe will either be sawcut or cut with special cutting tools which will not expose the pipe to the fire hazard of a normal acetylene torch. Whenever possible, connections shall be shop fabricated to prevent any exposure to fire hazard.

621.3.6 Repair of Damage to Coatings: Corrugated metal pipe shall be carefully handled at all times to prevent damage to the asphalt or spelter coating or asphalt paving. Each length of pipe shall be carefully inspected immediately prior to placing in the trench to ascertain that no damage has been done to the exterior coating that will be concealed when the pipe is placed. Any damage to the spelter coating shall be repaired to the satisfaction of the Engineer in accordance with Section 771. Any damage to the asphalt coating or asphalt paving shall be repaired to the satisfaction of the Engineer with bituminous mastic as specified above.

621.4 TEST SPECIMENS:

All tests on the bituminous coating shall be made on samples secured from pipe delivered to or about to be delivered to the Contractor or from the coating and lining facility of the pipe fabricator at the time the pipe is being coated.

Compliance with these specifications as set forth, shall be the responsibility of the Contractor. Three certified copies of test results indicating compliance shall be furnished for each lot or shipment prior to delivery of the material to the Contractor.

621.5 MEASUREMENT:

Measurement of corrugated metal pipe will be the number of linear feet of pipe, measured horizontally, from end to end of pipe through manholes and specials. At changes in diameter the measurement will be to center of manhole or special.

621.6 PAYMENT:

Payment will be made at the contract unit price bid per linear foot, to the nearest foot, for each size and type of pipe and shall be compensation in full for furnishing and installing the corrugated metal pipe as specified, including removal of obstructions, excavation, backfilling, compacting, testing and all incidental costs not specifically covered in other items in the proposal.

MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

625.1 DESCRIPTION:

625.1.1 Sewer Manholes: Construction shall consist of furnishing all materials and constructing manholes complete in place in conformance with Yuma County Construction Standards and as detailed, including manhole base, walls, steps, manhole frames and covers and any incidentals thereto, at locations shown on the plans.

625.1.2 Drop Sewer Connections: Construction shall consist of furnishing all materials and constructing drop sewer connections complete in place in conformance with Yuma County Construction Standards and as detailed, including foundations, encasements, pipe and any incidentals thereto, at locations shown on the plans.

625.2 MATERIALS:

Unless otherwise shown on the plans or specified in the special provisions, materials to be used shall conform with the following:

Bricks for manholes shall conform to the requirements of Section 775.

Cement mortar for manholes shall conform to the requirements of Class D, Section 776.

Concrete for manholes shall conform to requirements of Class A and for drop sewer connection shall conform to the requirements of Class C, Section 725.

Precast manhole sections shall conform to the requirements of Section 747 and the requirements of the Yuma County Construction Standards.

Pipe used in manholes or drop sewer connection shall conform to the applicable pipe specifications of the job.

Manhole frame and cover shall conform to the requirements of Section 787 and cast in accordance with the construction standards.

Manhole steps shall conform to the Yuma County Construction Standards with plastic manhole steps, conforming to OSHA and ASTM C-487 requirements and steel manhole steps, being completely encapsulated in corrosion resistant rubber and conform to OSHA and ASTM C-478 requirements. The manufacturer shall furnish the Engineer a certification indicating conformance.

625.3 CONSTRUCTION METHODS:

625.3.1 General: Manholes shall be constructed of brick, of precast concrete sections or of cast in place concrete with manhole steps, cast iron frames and covers, in accordance with Yuma County Construction Standards and as specified in the project plans. The invert channels shall be smooth and semicircular in shape, conforming to the inside of the adjacent sewer sections. Changes in direction of flow shall be made with a smooth curve, having a radius as large as the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

625.3.2 Manhole Bases: The excavation shall be made cylindrical to a diameter sufficient in size to permit sheeting if necessary and leave room that the bricks may be laid in a workmanlike manner and the outside plaster coat properly applied or the precast concrete sections or forms may be properly assembled.

Manhole bases shall be constructed of Class A concrete to the dimensions indicated on the drawings and details. Projecting ends of the sewer and pipe stubs shall be adequately supported to prevent displacement from line or grade during the construction of the base. All manholes shall have the invert shaped as indicated on the plans and details to provide an adequate channel between the inlet and outlet pipes. The entire surface of the manhole invert including channels and shelves shall be steel troweled to a smooth, dense surface.

625.3.3 Inverts: It is intended that all inverts of junction manholes be shaped while the manholes are under construction. The Contractor shall have the choice of continuing the pipe through the manhole, building the invert and later remove the pipe above the midpoint of the pipe, in which case he will be required to patch and smooth up with cement mortar the broken edges of the pipe; or he may stop the shape and sizes of pipe as detailed. All inverts shall follow the grades of pipe entering the manholes. The entire surface of the manhole invert including channels and shelves shall be steel troweled to a smooth dense surface.

Where laterals enter manholes located over a large trunk or main sewer at an elevation above the main invert shelf, an invert shall be shaped above the main invert shelf to the flow line of the lateral. This requirement applies to cases where the elevation of the lateral invert is above, at or below the crown of the main sewer.

All grades through manholes shall conform to the grade of the pipe entering and leaving the manhole.

625.3.4 Manhole Shafts: Precast manhole sections shall be set in a bed of mortar to make a watertight joint and shall be neatly pointed on the inside and shall be set perfectly plumb. Sections of various heights shall be used in order to bring the top of the manhole ring and cover to the elevation established by the Engineers. The precast concrete manhole rings shall be joined with a minimum thickness of 1/2 inch of mortar.

Precast manhole sections or brickwork shall not be laid upon a concrete base less than 24 hours after such foundation has been poured. No brick work shall be laid in water, nor except as prescribed for curing, shall water be allowed to stand or run on any brick work until the mortar has thoroughly set. Where new work is joined to existing unfinished work, the contact surfaces of the latter shall be thoroughly cleaned and moistened.

Bricks shall be thoroughly moistened prior to placing and shall be laid in full cement mortar beds. Every course may be a header course, but at least every fourth course shall be a header course. The horizontal cross section of the manhole shall be circular unless otherwise called for on the plans or standard details. An oval or egg-shaped section will not be permitted. A double row-lock course of brick in the manhole wall shall be arched over the top half of the circumference of all inlet and outlet pipes. The brick manholes shall be plastered outside with 1/2 inch of cement mortar as shown on the standard details. Inside of brick wall shall be neatly pointed. The plaster coat shall be cured with a liquid membrane-forming compound conforming with Section 726 immediately after plaster has been placed and finished.

625.3.5 Frame and Covers: The frame and cover shall be set to within 1/4" below finished roadway surface and firmly anchored to the manhole rings with cement mortar. Class B Portland Cement Concrete to a depth of 6 inches and to a width as shown in the details shall be applied around the frame with the surface receiving a broom finish. No traffic shall be permitted to travel over concrete for 2 days.

Adjusting rings shall be joined with a minimum thickness of 1/2" of Portland Cement Mortar as defined in the Section "Manhole Shafts".

All machined surfaces on the frame and cover shall be such that the cover will lie flat in any position in the frame and have a uniform bearing through its entire circumference. Any frame and cover which creates any noise when passed over by automobiles shall be replaced.

Where frames and covers for new manholes are to be set in new bituminous mix or asphaltic concrete surfaces, they shall not be set until the roadway has been surfaced. Where a bituminous seal coat or asphaltic concrete finishing course is to be placed on the new surfacing, the frames and covers shall be set after the surface course has been completed and prior to the placement of the seal coat or the finishing course.

Steel plates of a size approved by the Engineer shall be placed over the manhole prior to surfacing operations. After surfacing operations are completed, the steel plates shall be removed and the frames and covers set in concrete at the proper elevation so that the cover will be flush with the adjacent finished surface. Care shall be taken that the base and surfacing materials are not disturbed beyond the edges of the plate. Concrete and reinforcing steel shall be placed around the frame as detailed on the plans. The concrete shall be protected during the curing period.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section 601.

625.3.6 Drop Sewer Connections: Drop sewer connections shall be constructed in conformance with Yuma County Construction Standards and the project plans.

Backfilling shall be done in accordance with the requirements for trench backfilling, as stated in Section 601.

625.4 TESTING:

Where groundwater is high, infiltration into the manhole will be observed. Each manhole shall be tested for exfiltration by filling to the top. The maximum rate of infiltration and exfiltration is 0.1 gal. per hour per vert. foot. Manholes showing leakage greater than that allowed shall be repaired by the Contractor at his expense.

625.5 MEASUREMENT:

Measurement of manholes will be by type (brick or precast) and per each manhole installed, complete in place, regardless of depth.

Measurement will be per each drop sewer connection installed.

625.6 PAYMENT:

Payment will be made at the unit price bid for each type of manhole and shall be compensation in full for furnishing and installing manhole, complete, with formed invert, concrete bases, ladder rungs, cast iron frame and cover, excavation and backfill, paving cut replacement in excess of the applicable pay widths authorized in Section 336 and any incidentals thereto, in conformance with the plans and specifications.

Payment will be made at the unit price bid each and shall be compensation in full for furnishing and installing sewer drop connections, concrete encasement, excavation, backfilling, water settling, compaction, sheeting and bracing, removal of obstruc-tions, paving cut replacement, in excess of the applicable pay widths authorized in Section 336, testing and all work incidental thereto in conformance with the plans and specifications.

SECTION 630

TAPPING SLEEVE AND VALVE

630.1 DESCRIPTION:

This item consists of furnishing all materials and performing all work necessary to install tapping sleeves and valve on pipelines at the locations as shown on the plans and in conformance with the specifications and details. The work includes excavation, backfilling, compaction, field connections of tapping sleeve and valve, protective wrap, thrust blocks and appurtenances.

630.2 MATERIAL:

Tapping sleeve shall conform to Section 758.

Gate valves are conform to Section 759.

Bolts and nuts are to confirm to the requirements of Section 610.

Polyethylene wrap is to conform to Section 791.

Valve box and cover shall be in accordance with Yuma County Construction Standards 5-210 and 5-220.

630.3 SUBMITTALS:

The Contractor shall submit 3 copies to the Engineer for and obtain approval before installation of all product data, including manufacturer's catalog data and details, material lists, detail construction sheets showing all valve and water work components with dimensions, description of materials and applicable specifications.

630.4 CONSTRUCTION METHODS:

Trenching, excavation, backfilling and compaction shall be in accordance with Section 601.

Tapping sleeves shall be placed a minimum of 36 inches from a pipe joint.

Before assembly, pipe barrel shall be cleaned thoroughly to provide a smooth, hard surface for the sleeve. Tapping sleeves and valve shall be well supported independently of the pipe before tap is made. The sleeve shall be supported from behind and under with concrete thrust blocks in accordance with Yuma County Construction Standards. Blocking is to extend to undisturbed ground. The valve is to be firmly attached to the sleeve with all bolts securely tightened. Tap is to be made after 24 hours of construction of thrust blocks.

Tapping sleeves in which the water is confined to the immediate area of the tap opening shall be Kennedy Square Seal, Rich-Corey improved or approved equal.

The outlet half of each sleeve shall be fitted with a continuous gasket of approximately circular cross section permanently cemented into a groove surrounding the outlet opening. The back half of each sleeve shall be fitted with elastomeric pads, a metal shoe or other device for developing adequate pressure on the afore mentioned gasket to prevent leakage at any pressure within the design capacity of the pipe.

If required by the water utility, the actual wet taps shall be made by the utility using their tapping machine, after the Contractor has installed the tapping sleeve and valve. The Contractor must make the excavation of sufficient size to allow the field crews room to perform the necessary work. The Contractor shall pay the utility the established fees for these services.

The Contractor shall pay the established shutdown charge to the water utility any time it is necessary to shut off valves and take a section of a water main out of service. No valve in the existing system shall be operated by the Contractor.

A valve box and cover shall be installed in accordance with Yuma County Construction Standards 5-210 and 5-220.

630.5 TESTING:

The tapping sleeve and valve are to be tested with the attached pipe.

630.6 MEASUREMENT AND PAYMENT:

630.6.1 Measurement: Measurement will be by the unit each of the various sizes of tapping sleeve and valve, including valve boxes and covers.

630.6.2 Payment: Payment will be made at the unit price bid each and shall be compensation in full for the complete installation in place including all labor, materials, equipment and all incidentals necessary to complete the installation. The compensation will also include the cost of necessary pavement replacement in excess of the pay widths allowed in Section 336 for pavement replacement over pipe trenches.

SECTION 631

WATER SERVICE TAPS AND METER CONNECTIONS

631.1 DESCRIPTION:

This specification consists of furnishing all material and performing all work to install water services at the locations shown on the plans and in conformance with these specifications and details. The work includes excavation, backfilling, compaction, connection of service to main waterline, installation of pipeline, valves, meter box and appurtenances.

631.2 MATERIALS:

All water service connections shall be constructed of Type K copper tubing or Polyvinyl Chloride Pipe.

Copper pipe, tubing and fittings shall conform with Section 754. PVC pipe shall conform with Section 746.

All fittings and service clamps shall be in accordance with Yuma County Construction Standard Detail 5-150.

Meter boxes shall conform the Yuma County Construction Standard Details 5-151 through 5-154.

631.3 CONSTRUCTION:

631.3.1

(A) General: The water service connection shall include the tap on the main, the corporation stop, the saddle if applicable, service pipe, appurtenant fittings, the curb stop, meter box and meter box cover, in accordance with standard details. Water meter boxes shall be installed in accordance with standard details as to line and grade. Upon acceptance, the Owner shall be responsible for damage to water meter boxes and covers until such time as the meters are installed by the utility company.

After the installation and acceptance of the water main, meter service and pipe connections, the water meter will be installed by the utility company upon proper application and payment of prevailing fees.

(B) Standards: Except as otherwise specified all work shall be done in accordance with Sections 601 and 610 and Yuma County Construction Standard 5-150.

(C) Excavation and Backfill: The backfilling and compaction may be done as soon as the service line is installed, except backfilling and compaction shall not be completed around the corporation stop at the main water line until after inspection and recording of all tap locations. Trench bottom must be smooth and free of sharp objects. The minimum width of trench for water service pipe shall be 3 inches. The minimum depth of service pipe shall be 30 inches below the finished paving grade.

(D) Service Taps: 1-1/2 inch and smaller service taps to new mains may be made with a saddle, tapped coupling or direct tap in accordance with the following provisions: The Contractor may use heavy tapped couplings for meter service connections on all sizes of pipe including the 3 inch in cul-de-sac streets. Bronze corporation stops must be installed in the tapped couplings prior to pressure testing or disinfection of the water main. Normally in subdivisions no saddles are required for 6 inch pipe and larger. At the Contractor's option, saddles may be used on all 6 inch pipe and larger. All service connections on major and collector streets shall be made with saddles or heavy duty tapped couplings regardless of the water main size or service pipe size. All taps on pipe smaller than 6 inches must be made by either a saddle or heavy tapped coupling with bronze insert. Direct taps must be made by the use of a corporation stop with tapered AWWA machine thread. All wet taps must be made by the Mueller Type B-100 tapping machine or approved equal. A sharp tapping bit must be used in order to obtain clean sharp threads. In general, each tapping tool should be resharpened or discarded after making 6 taps. All copper service pipe which is attached to metallic water mains shall be insulated at the corporation stop with a dielectric insulator. The minimum distance between taps, saddles and tapped coupling shall be 3 feet.

(E) Pavement replacement shall be in accordance with Section 336.

631.3.2 Connect existing meter to new waterline: When plans call for connections from a new water main to an existing water meter, the work shall include new copper pipe or polyethylene pipe and fittings except as follows:

(A) Wrapped galvanized pipe shall be used to connect or extend existing galvanized service pipe. Type K soft copper pipe or tubing shall be used to connect or extend existing copper service pipe except when otherwise called for in the plans.

(B) When the existing main is not abandoned and the existing meter is to be connected to the new line, the corporation stop at the old main shall be closed and the abandoned service line cut 6 inches from the old main.

(C) Taps and service connections to the new main shall not be made until after testing and disinfection is completed

(D) Meter service piping may be installed by drilling in place of open cut construction when approved by the Engineer.

631.9.3 Relocation of Water Meter and Box: When called for on the plans, the meter and box shall be relocated by the Contractor as directed by the Engineer. Existing meters which are shown on the plans to be relocated shall be located and installed in accordance with the standard details.

Water meter boxes which are broken during construction shall be replaced by the Contractor at no additional cost to the Contracting Agency. Existing meter boxes which are already broken prior to the start of construction shall be replaced by the Contractor with boxes furnished by the Contracting Agency after written authorization. The written authorization shall include the street address of each broken meter box and the size of meter box required. All water meter boxes shall conform to the standard details.

631.4 TESTING:

Before the service taps are made, the water mains shall be pressure and leakage tested and disinfected in accordance with Sections 610 and 445. After service taps are made and service lines installed, corporation stops shall be left open. The service pipe shall be tested by being subjected to normal main line pressure. Both ends of the service pipe shall be left exposed until after inspection and recording of all tap locations.

631.5 CLEANUP AND COMPLETION:

Upon completion and acceptance of all phases of the water main and meter service lines the Contractor shall release the new subdivision water system to the utility company for final operation and maintenance with all interior valves and corporation stops in open position and with all meter curb stops and valves at the connections to existing mains closed.

631.6 INSPECTION:

The Contractor shall make an as-built plan and make a record of the locations of all water service connections prior to the connections being covered up. This as-built plan shall give the stationing of each service tap. The stationing is to be continuous for each street and shall begin at the street intersection or property line at the end of the block.

631.7 SERVICE OVER 2 INCHES:

On water lines that are in service, all service taps larger than 2 inches shall be made by the utility company after an application and payment of prevailing fees, unless otherwise required by the Contracting Agency.

631.8 SERVICE ON EXISTING MAINS:

Where a parcel is served by existing water mains, only authorized personnel of the utility company shall install the service connections upon proper application and payment of prevailing fees.

631.9 MEASUREMENT:

Measurement will be by the unit complete in place as follows:

631.9.1 Water Service Tap and Meter Connection: This includes a complete service, 1-1/2 inch or smaller, service saddle corporation stop, the service pipe, angle stop and meter box and cover complete in place.

631.9.2 Connection of Existing Meter and Service to New Waterline: This includes a new connection to the new water main, necessary fittings and service pipe to accomplish the new connection measured as one unit, complete.

631.10 PAYMENT:

Payment will be made at the unit price bid each and shall be full compensation for the complete installation in place including all labor, materials, equipment and all incidentals necessary to complete the installation. The compensation will also include the cost of necessary pavement replacement in excess of the pay widths allowed in Section 336 for pavement replacement over pipe trenches.

SECTION 640

PIPING

640.1 DESCRIPTION:

The Contractor shall furnish all the materials, labor and equipment for and shall properly connect in place, all piping, fittings, specials, sleeves, etc. which are necessary for the proper completion of the work in accordance with the project plans but not included in other pipeline construction.

640.2 MATERIAL:

640.2.1 Welded Steel Pipe: Steel pipe and any flexible couplings for steel pipe shall be in accordance with Section 748.

640.2.2 Iron Pipe and Any Fittings: Iron pipe and any fittings shall conform to the requirements on Section 750.

640.2.3 Galvanized Pipe and Any Fittings: Galvanized pipe and any fittings shall be in accordance with Section 753.

640.2.4 Copper Pipe, Tubing and Any Fittings: Copper pipe, tubing and any fittings shall be in accordance with Section 754.

640.3 SUBMITTALS:

The Contractor shall submit to the Engineer (3) three sets of completely detailed and dimensioned drawings drawn to scale of all piping and fittings he proposes to furnish and no pipe or fittings shall be delivered to the site of the work prior to the approval of such drawings. The Contractor also shall submit material lists and when using manufactured items, shall submit the literature for approval before delivery.

640.4 CONSTRUCTION METHODS:

640.4.1 General: Where not detailed, exposed pipe shall be installed in straight, horizontal and vertical runs, parallel to the axes of the structures, unless a drainage slope is called for or specified. No exposed piping shall be erected until all equipment to which the pipe is to be attached has been installed and it can be determined where piping and fittings shall be located to make a neat, efficient arrangement. Pipes run in groups shall be neatly spaced and kept parallel throughout the length of run.

The drawings shall be taken, in a sense, as diagrammatic for piping that is not shown in detail. Sizes, type and class of piping and locations are indicated and shown on the plans but is not intended to show every offset and fitting nor every structural difficulty that will be encountered during the installation of the work. The alignment of pipes shall be varied from that indicated on the drawings without extra expense to the Owner, where necessary to avoid structural or mechanical difficulties or to avoid the work of any other trades. The Contractor shall furnish such parts and pieces as may be necessary to complete the fixtures and apparatus in accordance with the best practice of the trade and to the satisfaction of the Engineer.

If the Contractor desires to change any of the piping layouts shown on the detail drawings, he shall submit to the Engineer for approval, his reasons for the change and detailed proposed layouts.

Pipe work shall be suspended and/or supported in such manner as to prevent sagging or overstressing of the pipe or its connections and to prevent the transfer of loads and strains to any equipment. The drawings show the location of some of the hangers and supports, but do not locate all that may be necessary. All pipe work shall be supported or suspended as necessary to meet the requirements above and as further specified.

SECTION 640

Pipe supports shall be fabricated and located under the discharge pipes as shown on the drawings and as required. The vertical pipe support shall be provided with a screw-type threaded adjustment or post jack by which the support can be snugged up so that it fully supports the discharge pipe. The metal work making up the support yoke shall be painted the same as the rest of the discharge pipe assembly. The base shall be constructed of 2,500 psi concrete.

All pipes which are not able to resist axial tension shall be properly blocked wherever the pipelines changes direction, changes size or terminates. Exposed pipe shall be blocked or tied. Buried pipe shall have concrete kick blocks cast against undisturbed vertical earth banks of the size shown on the drawings or if not indicated, shall be sized so as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line test pressure. All blocking and ties shown on the drawings shall be installed without exception; others may be necessary.

Pipes through floors or foundation pads shall be installed in sleeves or thimbles built into the concrete or masonry as indicated on the drawings. Ends of sleeves shall be flush with surfaces of concrete or masonry unless shown otherwise. Install when placing concrete.

Provide seepage ring on wall pipes and sleeves passing through concrete walls which are to be watertight. Wall thickness shall be the same as the pipe wall thickness when connecting to steel pipe.

Wall flanges shall be in the form of a steel wall collar welded to the steel sleeve or penetration. Cut welded wall collars from 1/4 inch steel ring. Attach the collar to a steel wall pipe or sleeve with full circle, 3/16 inch fillet welds. Welding procedures shall be in accordance with ANSI B31.3, Chapter V.

All pipes shall be protected during handling against impact shocks and free falls. No damaged or defective pipe or fittings shall be installed in the work. Pipe shall be kept clean at all times and as the work progresses, the interior of the pipe shall be cleaned of all dirt and superfluous materials of every description.

At all times when work is not in progress, open ends of the pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no water, earth or other substances can enter the pipe or fittings.

Fitting and joint type size and class shall be as shown on the drawings or as specified in the special conditions.

Any excavation or trenching shall be accomplished in accordance with Section 601.

Unless otherwise shown on the drawings or specified, where pipe of any type is to be encased in concrete, the encasement shall provide a minimum of six inches of concrete coverage completely around the pipe. The concrete shall fill the bottom of the trench from bank to bank when encasement is not formed and it shall be rein-forced with four continuous longitudinal No. 5 deformed bars, one in each corner of the encasement, in any case. The length of encasement shown on the drawings or specified shall be considered the minimum length and the encasement shall terminate at either end within 18 inches of a joint in the pipe.

When pipe is being buried, grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

Keep the trench in dewatered condition during pipe laying. Removal of water shall comply with these specifications.

When pipe laying is not in progress, including the noon hour, close the open ends of pipe. Do not permit trench water, animals or any other foreign material to enter the pipe.

640.4.2 Iron Pipe And Fittings: Installation of pipe shall be in accordance with Section 610.4 of these specifications.

All cast iron and ductile iron pipe shall be carefully handled during loading, unloading and installation. No pipe shall be dropped from cars or trucks to the ground. All pipe shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or cement lining. Any broken or chipped lining shall be carefully patched to the satisfaction of the Engineer. Where it is impossible to repair broken or damaged lining in pipe because of its size, the pipe shall be rejected as unfit for use unless facilities are provided for relining pipe in accordance with these speci-fications. Pipe shall not be dropped nor pounded to fit grade.

Iron pipe and fittings installed underground shall be protected from corrosion by encasement in a polyethylene protective wrapping in accordance with Section 610.5 of these specifications. The wrapping shall provide a continuous barrier between the pipe, fittings and the surrounding bedding and backfill.

Where so indicated or specified, joints shall be made with flexible couplings, flanged coupling adapters, uni-flange adapters, flanges joints or with mechanical joints. Mechanical joint pipelines shall have flanges where necessary for valve and other connections.

After being drawn up, all buried bolts and nuts shall receive one (1) brush coat of Tnemec 46H-413 Hi-Build Tneme-Tar coal tar epoxy applied at a rate that will provide a minimum dry film thickness of not less than twenty (20) mils. The coating shall be without flaw when covered with earth backfill.

All flange bolts shall be cut and finished to project not more than 1/4 inch beyond outside face of nut after joint is assembled. Gaskets for flanged joints shall be full faced gaskets in accordance with Section 610.12 (D).

640.4.3 Galvanized Pipe And Fittings: Installation of pipe shall be in accordance with standard practices of the industry. All fittings shall be screwed and be 150 psi banded, galvanized malleable iron. Unions are to be galvanized malleable iron with brass or ground seat and be located on each side of a valve or other fixture and at locations as necessary in order to repair or replace sections of the pipe system. All pipe cuts shall be squared and threads shall not be wiry, rough or chewed. Pipe dope shall be applied to the male threads before joining. All fittings shall be screwed into pipe a minimum of 3/4 of the thread depth of the fitting and until tight.

Pipe shall be installed in neat, straight rows, supported at close enough intervals to support weight and avoid sagging. Use clevis or roll hangers on pipe larger than 1 inch diameter and anchor as required.

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coating shall be not less than 0.030 inches in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extrucoat or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, coat tar or asphalt tape. Protecto Wrap No. 200 Safe-t-Clad FOS No.655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchwrap No. 50 or approved equal. Tape shall be edge lapped no less than 1/4 inch.

640.4.4 Steel Pipe And Fittings: The welded steel pipe, fittings flanges and equipment shall be assembled and erected as shown on the drawings. For above ground installations the Contractor shall furnish and install such temporary supports and bracing as may be required to support the discharge piping in place during installation. Sleeve-type couplings shall be installed in accordance with the coupling manufacturer's instructions. Pipe shall be installed without springing, forcing or stressing the pipe or any adjacent connecting valves or equipment.

Flanged piping shall come together at the proper orientation without distortion. Springing of the pipe to fit, heating the pipe for elongation, expansion or bending, tensioning flange bolts more than others, force-fitting with hammers, and like practices shall be prohibited. Flange bolts shall slip freely into place by hand. If the proper fit is not obtained, the piping shall be altered by methods approved for standard shop practice. Machined flanges shall be used where necessary for changes in pipeline grade. Lubricate bolts with graphite and oil prior to installation.

Assembly and erection of welded pipe and fittings shall conform to the following:

A. Field welding shall in accordance with AWWA-C206.

B. Beveled ends for butt-welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag and other material detrimental to welding.

C. The minimum number of passes for welded joints shall as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

Welds shall be full circumferential.

D. Use the shielded metal arc welding (SMAW) process for welding.

E. Welding preparation shall comply with ANSI B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3, Tables 341.3.2A and 341.3.2B, and Paragraph 341.4 for visual examination.

F. Identify welds in accordance with ANSI B31.3, Paragraph 328.5.

G. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.

H. Welding electrodes shall comply with AWS A5.1 or A5.5.

I. Any pipe welds that require ultrasonic testing shall be in accordance with ANSI/AWS D1.1 latest revisions.

Flexible couplings shall be of gasketed, sleeve-type with a diameter to properly fit the pipe. They shall be steel, Dresser Style 38, Rockwell Type 411, Baker Series 200 or equal. Each coupling shall consist of a steel gaskets and sufficient steel bolts to properly compress the gaskets. The middle ring wall thickness shall be equal to the wall thickness of the pipe and shall be not less than 10 inches long. The welded seam at the end of each coupled steel pipe shall be ground smooth for approximately 12 inches. Couplings shall be entered on pipe ends. Pipe stops shall be omitted. Couplings shall be provided with lug harnesses.

Coat all buried steel piping with one of the following systems:

1. Wrap with cold-applied coal-tar tape conforming to AWWA C209. Minimum thickness of tape shall be 35 mils. Apply tape with manufacturer's prime coat. Tape shall be Tapecoat CT, Protecto-Wrap 200 or equal.

2. Wrap with hot-applied coal-tar tape conforming to AWWA C203, Section 3. Minimum thickness of tape shall be 50 mils. Apply tape with manufacturer's recommended prime coat. Tape shall be Tapecoat 20, Protecto-Wrap 110, or equal.

3. Coat with coal-tar epoxy having a minimum volume solids of 68% (ASTM-D2697) Clean surface and apply a prime coat of Ameron 78HB <16mils; Tnemec 46H-413, 16 mils; Porter 7080, 16 mils; or equal. Apply a top coat 16 mils thick of same material.

640,4,5 Copper Pipe, Tubing And Fittings: Copper pipe and tubing shall be installed in neat, straight runs, supported at close enough intervals to avoid sagging. All details shown on the drawings shall be followed. Cuts shall be made with a tubing cutter, or with a 32-tooth hacksaw and shall be square. The inside of the pipe or tubing shall be reamed and burrs removed from the outside, holding the end of the pipe or tubing downward during these operations so chips or filings cannot fall inside. If necessary, a sizing tool shall be used to correct any distortion.

All fittings except as indicated otherwise shall be solder type forged or wrought copper. The outside surface of the end of the pipe and the inside surface of solder fittings shall be cleaned with steel wool until the metal is bright. Soldering flux shall be applied to the cleaned surfaces of pipe and fittings in a thin, uniform and complete coating. After the pipe has been inserted in the fitting as far as it will go, the fitting shall be twisted on the pipe to help spread the flux uniformly. The fitting shall be heated until it reaches the correct temperature to melt the solder. The flame shall then be removed and the solder applied to the edge of the fitting or to the solder hole in the fitting, if there is one and the joint completely filled with solder. When the solder has congealed to a plastic state, the excess metal shall be removed with a cloth or brush. Joints shall not be quenched after soldering.

Flaring shall be done with a flare block and yoke type screw feed flaring tool. After removing the tubing from the block, both surfaces of the flare shall be inspected for splits, cracks or other imperfections and if there are any imperfections, the imperfect flare shall not be used. In assembling the fittings, all contacting surfaces shall be thoroughly cleaned. Tubing shall not be sprung into place and connections shall seat freely before sleeve nuts are tightened.

Copper pipe connected to ferrous pipe or valves or other noncopper items shall be connected by means of dielectric, insulating unions or fittings as manufactured by Mueller Company or equal. When making connections to meters or other devices having iron pipe size threaded fittings, special thread to tube adapters shall be used. Such adapters shall be Crawford Fitting Company "Swagelok", Hoke "Gyrolok" or equal.

640.5 TESTING:

After piping has been placed, each run shall be tested to the design pressure of the pipe by the Contractor and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer. Leaks shall be made tight before final acceptance of the work by tightening, renewing packing or replacing materials. Caulking will not be permitted. The Contractor shall furnish all necessary meters, gauges, water, bulkheads, other materials and appliances necessary to conduct the tests as herein required.

Pipe to be encased in concrete shall be tested before the concrete is cured around the pipe. Pipe to be buried shall be tested before the joints are covered, unless otherwise directed by the Engineer.

After the test on any section has been completed, the Contractor shall carefully drain the line of all water to prevent freezing of same. The Contractor shall also demonstrate to the satisfaction of the Engineer that all piping is absolutely clean and clear of any dirt, all chips, shavings or other foreign material.

640.6 PAINTING & PROTECTIVE COATING:

As specified on the project plans, field and shop painting work of unprotected fittings and accessories shall in accordance with Section 472.

640.7 MEASUREMENT AND PAYMENT:

A. Measurement - Items specified in this section shall be an integral part of the unit they are a part of and are to be incorporated therein.

B. Payment - No separate payment shall be made for items specified in this section. Payment shall be included in units as shown in the Contract Bid Schedule.

SECTION 645

VALVES AND WATERWORKS SPECIALTIES

645.1 DESCRIPTION:

The Contractor shall furnish and install all valves and waterworks specialties in accordance with the project plans and these specifications and such incidental materials and equipment as are required to make the items complete and ready for use.

645.2 MATERIALS:

645.2.1 Gate and butterfly valves shall be in accordance with the requirements of the project plans, Yuma County Construction Standards and Section 759.

645.2.2 Check and Air relief valves shall be in accordance with the requirements of the project plans and Section 759.

645.2.3 Sluice gates shall in accordance with the requirements of the project plans and construction specifications.

645.2.4 Flow meters shall be in accordance with the requirements of the project plans and construction specifications.

645.2.5 Cock valves, pressure gauges and other water work items shall be in accordance with the project plans and construction specifications.

645.2.6 Couplings shall be in accordance with the requirements of the project plans and construction specifications.

645.3 SUBMITTALS:

The Contractor shall submit to the Engineer for approval before installation 3 copies of shop drawings, manufacturer's catalog data and detail construction sheets showing all valve parts, description of materials and specifications (such as AWWA or ASTM) showing valve dimensions including laying length.

645.4 CONSTRUCTION METHOD:

645.4.1 General: The size, type and other pertinent information of valves and water work specialties are either identified in the County Construction Standards or on the project plans. The valve or specialty item is to be placed in the location as shown on the plans.

645.4.2 Bolting And Gaskets: Nuts and bolts for above ground installations of flanged units shall be standard hexagonal head machine bolts and hexagonal nuts conforming to ASTM Designation A307, Grade B. Bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameters.

Nuts and bolts for buried installations of flanged units shall be standard hexagonal head machine bolts and hexagonal nuts conforming to ASTM Designation A307, Grade B with cadmium plating in accordance with ASTM Designation A165, except that the minimum thickness of the plating shall be 0.00020 inches. Cadmium plated bolts shall have Class 2A threads and the nuts used with them shall have Class 2B threads. All bolt diameters shall normally be 1/8 inch smaller than the bolt hole diameters.

Except as otherwise provided, all gaskets for pipe lines shall be one piece full faced gaskets from one-ply cloth inserted SBR rubber material. Gaskets for flanges 20 inches and smaller shall be from 1/16 inch thick material. Gaskets for flanges 24 inches and larger shall be from 1/8 inch thick material. Gasket material shall be J-M 109 as manufactured by Johns-Manville Corporation or an approved equal. Physical characteristics of the rubber compound shall meet ASTM D-2000, Class 4AA805A13.

645.4.3 Installation: Installation of waterwork components shall be in accordance with project plans with proper alignment, grade and support. All bolts are to be tightened and all components firmly secured. Installation shall conform to the requirements of Section 640.4.1 of these specifications. Operating hand wheels or levers, operating nuts and wrenches are to be provided for all valves.

On sluice gates, the gate shall operate when erected without vibration, binding or other problems. Adequate anchor bolts in the concrete shall be placed and adequate support of the rails shall be provided.

645.4.4 Testing: Test valves and components at the same time that the connecting pipe lines are tested. Repair or replace any leakage problem and retest. On sluice gates, they shall be water tight when closed.

645.4.5 Protective Coatings: All buried valves and water work specialties shall be protected as specified in Section 640. As specified on the plans, valves and waterwork specialties unprotected shall be painted in accordance with Section 443.

645.4.6 Measurement: Measurement shall be in accordance with the terms of the contract and shall be based as set forth in the proposal.

645.4.7 Payment: Payment for valves and waterworks specialties will be made in conformity with the contract and will be based on the unit prices and/or lump sums as set forth in the proposal. Such payment shall be full compensation for furnishing all labor, materials, tools, equipment and doing all work required to install PVC pipe in conformity with the plans and specifications.

SECTION 650

WATER MAIN LOWERING

650.1 DESCRIPTION:

The Contractor shall furnish all labor, materials, tools, equipment and perform all work necessary to lower or raise water mains in accordance with the plans and the specifications and as required by field conditions and approved by the Engineer.

650.2 MATERIALS:

All materials shall conform to Section 746, 748 or 750 as indicated on the plans. Concrete shall conform to Section 725.

650.3 CONSTRUCTION METHODS:

Trenching and related work shall conform to Specification 601.

Water line construction shall conform to Specification 610.

All work on water lines shall be coordinated with the utility company who owns the water line.

650.4 MEASUREMENT:

This item will be measured by the linear foot along the center of the pipeline from beginning to end of relocated section.

650.5 PAYMENT:

Payment for this item sahll be at the contract unit price for various sizes and types of water main lowerings included on the proposal, the price shall be full compensation for excavation, backfilling compaction, dewatering, for water, for shoring and for all labor, materials, equipment and incidentals necessary to complete the work as shown on the plans and specified herein.

PART 700

MATERIAL SPECIFICATIONS

SECTION	TITLE
701	Rock, Gravel and Sand.....
702	Base Materials.....
705	Portland Cement Treated Base.....
710	Asphaltic Concrete.....
711	Paving Asphalt.....
712	Liquid Asphalt.....
713	Emulsified Asphalts.....
716	Cover Material "Chips".....
718	Preservative Seal .....
725	Portland Cement Concrete.....
726	Concrete Curing Materials.....
727	Steel Reinforcement.....
729	Expansion joint Filler.....
734	Reinforced Concrete Low Head Pressure Pipe.....
735	Reinforced Concrete Pipe.....
736	Non-Reinforced Concrete Pipe.....
743	Vitrified Clay Pipe.....
744	ABS Truss Pipe and Fittings.....
745	PVC Sewer Pipe and Fittings.....
746	PVC Pressure Pipe and Fittings.....
747	Precast Concrete Manholes.....
748	Steel Pipe and Fittings.....
749	Tapping Sleeve.....
750	Iron Water Pipe and Fittings.....
751	Water Service Fittings.....
753	Galvanized Pipe and Fittings.....
754	Copper Pipe, Tubing and Fittings.....
756	Fire Hydrants.....
757	Sprinkler Irrigation System .....
759	Valves for Water Lines - Gate and Butterfly.....
760	Coating Corrugated Metal Pipe and Arches.....
761	Structural Plate Pipe, Arches, and Pipe Arches.....
765	Rubber Gaskets for Concrete Pipe.....

767 Valves for Pump Stations.....
770 Structural and Rivet Steel, Rivets, Bolts, Pins and Anchor Bolts.....
771 Galvanizing.....
772 Chain Link.....
775 Brick and Concrete Block.....
776 Masonry Mortar and Grout.....
778 Lumber.....
779 Wood Preservatives.....
785 Steel Castings .....
786 Bronze Castings .....
787 Gray Iron Castings.....
790 Paint.....
791 Polyethylene Protective Wrap.....
792 Dust Palliative.....
795 Landscape Material.....

MATERIALS

SECTION 701

ROCK, GRAVEL, AND SAND

701.1 GENERAL:

The following specifications set forth the requirements for crushed rock, gravel, sand and quarry stone. Sampling and sieve analysis shall be performed in accord-ance with ASTM D-75 and ASTM C-136. Sand equivalents shall be determined in accordance with AASHTO T-176. The liquid limit and plasticity index shall be deter-mined in accordance with applicable ASTM specifications.

701.2 CRUSHED ROCK AND GRAVEL:

Rock and gravel shall be clean, hard, sound, durable, uniform in quality and free of any detrimental quantity of soft, friable, thin, elongated or laminated pieces, disintegrated material, organic matter, oil, alkali or other deleterious substance.

The loss by abrasion in the Los Angeles abrasion machine, determined as prescribed in ASTM C-131, Grading A, shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

701.2.1 Crushed Rock: Crushed rock shall consist of the product obtained by crushing rock, stone or gravel so that at least 50 percent by weight of aggregate retained on the No. 4 sieve for 3/4 inch or larger maximum sizes and 50 percent retained on the No. 8 sieve for maximum sizes less than 3/4 inch shall consist of particles which have at least one rough, angular surface produced by crushing. All material that will pass a grizzly with bars spaced 15 inches apart, clear opening, shall be crushed when producing from the Contracting Agency's source.

The gradation of crushed rock shall comply with ASTM D-448.

701.2.2 Gravel: Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water-worn. Crushed rock obtained by crushing rock which exceeds ASTM D-448 maximum gradation sizes may be combined provided it is uniformly distributed throughout and blended with the gravel. The quality and gradation requirements shall be as stated in this specification.

701.3 SAND:

Sand shall be fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay and other deleterious substances to be thoroughly suitable for the purpose for which it is intended.

701.3.1 Sand for Asphaltic Concrete Pavement: Sand for asphaltic concrete pavement shall comply with AASHTO M-29 except that grading requirements shall be deleted and have a minimum sand equivalent of not less than 50 and shall be non-plastic when tested in accordance with AASHTO T-89 and T-90.

701.3.2 Sand for Portland Cement Concrete, Mortar and Plaster: It shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances.

The average value of sand equivalent determined on 3 successive samples shall not be less than 70. No individual sample shall have a sand equivalent less than 65.

The size and grading of sand to be used in cement concrete, mortar and plaster shall be such as to conform with the requirements specified as follows:

Concrete:	ASTM C-33
Mortar:	ASTM C-144
Plaster:	ASTM C-35

701.3.3 Coarse Aggregate for Portland Cement Concrete: Coarse aggregate shall conform to ASTM C-33 grading size No. 467, 57, 67, and 7.

701.3.4 Aggregate for Masonry Grout: The size and grading of the fine or coarse aggregate to be used in masonry grout shall conform with ASTM C-404.

701.4 QUARRY STONE:

701.4.1 General: Quarry stone shall be angular, sound, durable, hard, resistant to abrasion, free from laminations, weak cleavages, undesirable weathering, leaching, exfoliation tendencies and slaking and of such character that it will not disintegrate from the action of air, water or the conditions to be met in handling and placing. Stone shall be clean and free from deleterious impurities, including alkali, earth, clay, refuse and adherent coatings. Suitable tests and/or service records will be used to determine the acceptability of the stone. Tests to which the material may be subjected include petrographic analysis, X-ray diffraction, specific gravity, absorption, abrasion, rock drop, soundness, wetting and drying and such other tests as may be considered necessary to demonstrate to the Engineer that the materials are acceptable for use in the work. In connection therewith, the Con-tractor shall notify the Engineer in writing at least 60 days prior to use of the intended sources of quarry stone.

701.4.2 Test Requirements: Quarry stone shall meet the following requirements except as may be otherwise provided on the plans and in the special provisions:

(A) Apparent specific gravity: 2.65 minimum.

(B) Breakdown:

Rock drop breakdown:	5 percent maximum.
Abrasion breakdown at 1000 revolutions:	40 percent maximum.
Breakdown after 10 cycles of wetting and drying:	5 percent maximum.
Solubility in water, breakdown, or softening:	None.

701.4.3 Test Methods: Unless otherwise specified in the special provisions or indicated on the plans, test methods for quarry stone shall be as follows:

(A) Apparent specific gravity per ASTM C-127.

(B) Abrasion characteristics to be determined by either Rock Drop Test or Los Angeles Rattler, ASTM C-131, as required on the plans or the special provisions.

(1) Standard Rock Drop Test. Tests shall be made on groups of 5 accurately weighed sizes of rocks; No. 1, ranging from 75 to 100 lbs.; No. 2, 100 to 125 lbs.; No. 3, 125 to 150 lbs.; No. 4, 150 to 175 lbs.; No. 5, 175 to 225 lbs.

Each rock of the 5 sizes shall be dropped 3 times on the group of the other 4, in an enclosure, from successive heights of 10, 15 and 18 feet. The enclosure shall have a flexible medium weight galvanized iron floor or equivalent, set on a solid foundation. Order of dropping shall be Nos. 3, 2, 4, 1, 5. All rock passing a 3 inch square mesh screen after test shall be weighed and recorded as a percentage of the total initial weight of the 5 rocks.

(2) Los Angeles abrasion machine, per ASTM C-131, Grading B.

(C) Wetting and drying. The stone shall be crushed, screened and 1,000 or 1,500 grams of the 3/4 inch to 3/8 inch fraction taken for the test.

The crushed and graded stone shall be submerged in water for 18 hours at room temperature, after which the sample shall be drained and oven-dried at 140°F. When dry, the sample shall be cooled to room temperature. This would complete one cycle.

The percent loss shall be determined by screening the tested sample on a No. 4 sieve and shall be computed as follows:

$$\frac{100 \times \text{Weight of Material Passing No. 4 Sieve}}{\text{Total Weight of Sample}} = \%\ \text{Loss}$$

(D) Accelerated water breakdown and solubility test. Air-dry samples of representative stone weighing approximately 1 lb. each shall be immersed for 8 hours at 140°F., in distilled water, local tap water or 3.5 percent sodium chloride solution.

SECTION 702

BASE MATERIALS

702.1 GENERAL:

Materials for use as aggregate base shall be classified in the order of preference as follows:

(A) Crushed aggregate.

(B) Processed natural material.

(C) Processed steel slag.

(D) Decomposed granite.

When base material without further qualification is specified, the Contractor shall supply crushed aggregate. When a particular classification of base material is specified, the Contractor may substitute any higher classification of base material for the specified classification.

Except where materials are being obtained from a previously approved source, the Contractor shall give the Engineer 10 days advanced notice, in writing, of the source of the base material he intends to use in order to allow sufficient time to perform the necessary tests.

702.2 CRUSHED AGGREGATE:

Crushed aggregate shall consist of crushed rock, crushed gravel or a combination thereof as defined in Section 701.

702.2.1 Soundness: The percentage of wear of crushed aggregate to be used as base will be determined as in Section 701, except that Grading B of ASTM C-131 shall be used. The percentage of wear of the material shall not exceed 40 after 500 revolutions.

702.2.2 Grading: The aggregate shall be well graded when tested in accordance with ASTM C-136 and C-117. The percentage composition by weight shall be within the following limits:

TABLE 702

Percentage by Weight Passing Sieve

Sieve Sizes (Square Openings)	Type A	Type B	Aggregate Base
3"	100		
1-½"		100	
1-⅛"			100
No. 4	30-75	30-70	38-65
No. 8	20-60	20-60	25-60
No. 30	10-40	10-40	10-40
No. 200	0-12	0-12	*3-12
P.I. MAX	5	5	*5

* Except as required in Section 312.5 for inverted section and does not apply to Processed Steel Slag.

702.3 PROCESSED NATURAL MATERIAL:

702.3.1 General: Processed natural material shall consist of hard, durable fragments of stone or gravel and a filler of sand or other finely divided mineral matter. It shall be free from an excess of soft or disintegrated pieces, alkali, adobe, vegetable matter, loam or other deleterious substances.

702.3.2 Physical Requirements: When sampled and tested in accordance with standard test methods, the aggregate shall meet the following requirements:

(A) Percentage of Wear: When tested in accordance with ASTM C-131, the percentage of wear shall not exceed 40 percent after 500 revolutions.

(B) Plasticity Index: When tested in accordance with AASHTO T-90, the plasticity index shall no be more than 5.

(C) Liquid Limit: When tested in accordance with AASHTO T-89, the liquid limit shall not be more than 25 percent.

702.3.3 Crushed Material: Crushed material is not required, but may be incorp-orated in the finished product.

702.3.4 Grading: The aggregate shall conform to the sieve analysis in this specification except that the least dimension of the maximum particle size shall not exceed 2/3 of the compacted thickness of the specified lift being placed.

702.4 DECOMPOSED GRANITE:

Decomposed granite shall be any granitoid igneous rock which has been weathered in place and which has as principal constituents granular fragments of quartz and feldspar. It may also contain fragments of granitic rock not yet broken down into the component minerals. This material shall remain stable when saturated with water. Particles larger than 3 inches, which will not be broken in the process of rolling and tamping during construction, shall not be used.

Decomposed granite shall conform to the following requirements;

(A) When tested in accordance with this specification, not more than 20 percent shall pass the No. 200 mesh sieve.

(B) The P.I. of material passing the No. 200 sieve prior to testing shall not be less than 3 nor greater than 10.

702.4.1 Preparation of Test Specimens: A quantity of sufficient size to have a dry weight of 15 pounds shall be selected and dried to constant weight at a temperature between 215°F and 230°F. Fifteen pounds of this material shall then be subjected to 500 revolutions in a Los Angeles abrasion machine, as described in Section 701, except that nothing shall be placed in the drum other than the material to be tested.

The material that has been subjected to the breakdown shall be tested in accordance with ASTM C-117 to determine the percentage of material finer than a No. 200 mesh sieve by washing.

SECTION 705

PORTLAND CEMENT TREATED BASE

705.1 GENERAL:

The cement treated base shall consist of furnishing all materials in accordance with these specifications. The estimated cement requirement is 5 percent by weight of the dry aggregate. The cement shall be Type II, low alkali.

705.2 AGGREGATE FOR CEMENT TREATED BASE:

The aggregate for cement treated base shall conform to the requirements of Section 701 except the plasticity of the material passing the No. 40 sieve shall not exceed 5 and the grading shall be as follows:

TABLE 705

Sieve Size	Percentage By Weight Passing Screen
1-1/2"	100
No. 4	40-70
No. 40	30 Max.
No. 200	0-15

705.3 PORTLAND CEMENT AND WATER:

Portland cement and water shall conform to the requirements of Section 725.

705.4 COMPRESSIVE STRENGTH OF CEMENT TREATED BASE:

The minimum compressive strength at 7 days shall not be less than 500 psi when tested in accordance with ASTM D-1633.

705.5 BITUMINOUS MATERIAL FOR CURING SEAL:

Bituminous material for curing seal shall conform to the requirements of Section 712 or 713 for the type specified.

SECTION 710

ASPHALTIC CONCRETE

710.1 GENERAL:

Asphaltic concrete shall consist of a mixture of paving asphalt and mineral aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed at a central mixing plant in the proportions hereinafter specified to provide a homogeneous and workable mixture.

Asphaltic concrete is designated as **Type A** 1-1/2 Base Course; **Type B** Single or Base Course; **Type C** 3/4 Single Course; **Type D** 1/2 Single or Surface Course; **Type E** 3/8 Surface Course of Dense Graded Mixes; **Type F** 1-1/2 Base Course and **Type G** 3/8 Surface Course of Open Graded Mixes.

710.2 MATERIAL:

710.2.1 Asphalt: The asphalt to be mixed with mineral aggregate shall be paving grade asphalt conforming to Section 711 and shall be AC-10 to AC-40 as directed by the Engineer, unless otherwise specified in the special provisions.

710.2.2 Aggregate: Coarse and fine aggregates shall conform to the applicable requirements of Section 701 except as modified herein.

Coarse aggregate is material retained on the No. 4 sieve and fine aggregate is material passing the No. 4 sieve.

Blending sand shall be clean, hard and sound material, either naturally occurring sand or crushed fines which will readily accept asphalt coating. The exact grading requirements shall be such that, when it is mixed with the mineral aggregate, the combined product shall meet the requirements of the designated mix as specified elsewhere in this specification.

710.2.3 Mineral Filler and Anti-Stripping Agent:

(A) Mineral filler shall conform to the requirements of AASHTO M-17. The mineral filler shall be dry hydrated lime conforming to the requirements of ASTM C-207 Type N or portland cement conforming to Section 725 or other approved mineral filler shall be added to the aggregate in accordance with the requirements contained herein. The amount of mineral filler to be used shall be approved by the Engineer in the mix design and be approximately 1.5 percent by weigh of the mineral aggregate. The method of adding the mineral filler shall be such that the aggregate is uniformly coated and the mineral filler is uniformly distributed without loss or waste within the material prior to adding the asphalt to the mixture.

(B) When aggregate is subject to stripping, as determined by one of the two procedures below, dry hydrated lime conforming to the requirements of ASTM C-207 Type N, portland cement conforming to Section 725 or other approved anti-strip agent shall be added. Hydrated lime and portland cement shall be added in accordance with Section 710.2.3. Other approved no strip agents shall be added in accordance with the manufacturer's recommendations and approved by the Engineer.

(1) Prepare a test sample of the paving mixture. Spread it out in a loose thin layer and allow to air-season for 24 hours before testing. A suitable size sample (approximately 1/2 contents of a one quart container) shall be tested by placing it in a glass jar with a tight screw cap. The sample shall be completely covered with distilled water at room temperature. The jar and contents shall be allowed to stand for a period of 24 hours.

Then the sample shall be vigorously shaken for a period of 15 minutes. The sample of mixture shall be examined for stripping.

(2) ASTM D-1075 with a minimum dry strength of 250 psi and a 70 percent retained wet strength.

710.2.4 Combined Aggregates: The combined aggregates sampled after all processing, except the adding of asphalt and mineral filler, shall conform to the following quality requirements.

The ratio of the percentage of aggregate by weight passing the No. 30 sieve, to that passing No. 8 sieve, shall not exceed 65 percent in all dense graded asphalt concrete mixes.

The ratio of the percentage of aggregate by weight passing the No. 30 sieve, to that passing No. 8 sieve, shall not exceed 65 percent in all dense graded asphalt concrete mixes.

At least 75 percent by weight of the aggregate retained on the No. 8 sieve shall consist of particles which have at least one rough, angular surface produced by crushing.

710.2.5 Job-Mix Formula: Unless otherwise authorized by the Engineer, no work shall be started on the project nor any mixture accepted therefore, until the Contractor or his supplier has submitted samples of the materials intended for use and the Contractor has submitted a satisfactory job-mix formula based upon tests of the materials furnished. The mix design shall be prepared under the direct supervision of a professional engineer experienced in the development of mix designs and mix design testing. The formula shall indicate the definite percentage for each sieve fraction of aggregate and for bituminous cement; also the intended temperature of completed mixture at the time it is discharged from the mixer. The material furnished shall conform to the approved job-mix formula within the tolerances specified herein.

Job-Mix Tolerances

Aggregate passing sieve No. 4 and larger .....± 6 percent
Aggregate passing sieves No. 8 and 30. .....∓ 6 percent
Aggregate passing sieve No. 200.....∓ 2 percent
Temperature of mixing and placing.....∓ 25°F

The tolerances used in conjunction with the job-mix formula shall be such that the resulting gradation shall be within the specification limits. The amount of liquid asphalt by weight to be added to the different gradations of the mineral aggregate shall be as specified and determined by the job-mix formula. The amount specified shall be within the following range of the percentages of the total mixed material:

Mix Description	Percentage of Asphalt Range
A 1-1/2"	4.0 to 5.0
B 1" C 3/4"	5.0 to 6.0
D 1/2" E 3/8"	5.5 to 6.5
F 1-1/2"	4.5 to 6.0
G 3/8"	6.0 to 7.0

The allowable tolerance in percentage of asphalt cement content from that percentage specified by the Engineer, when sampled and tested in accordance with AASHTO T-164 and T-168 as modified by Contracting Agency shall be plus or minus 0.4 percent.

After the job-mix formula has been approved and the mixing plant selected, the Contractor and/or his supplier shall not change either of the above or utilize additional mixing plants without prior approval of the Engineer.

710.2.6 Testing: A stripping test for aggregate and a gradation analysis of the combined aggregate for each coarse is to be performed before paving work is begun. Any corrections necessary as indicated from the test results are to be made before pavement production is begun. If stripping occurs, the aggregate shall be rejected or an anti-stripping agent is to be added as noted in Section 710.2.3B. The stripping test shall be performed in accordance with Section 710.2.3. Gradation analysis shall be performed in accordance with ASTM C136 and C117.

710.3 COMPOSITION AND GRADING:

The grading of the combined aggregates shall be such as to conform to the requirements indicated in the following tabulations in which the percentages shown are based on the weight of dry aggregate only.

SECTION 710

TABLE 710-1

MINERAL AGGREGATE - PERCENTAGE BY WEIGHT PASSING

	TYPE DENSE GRADED MIXES					TYPE OPEN GRADED MIXES	
SIEVE SIZE	BASE COURSE	SINGLE COURSE OR BASE COURSE	SINGLE COURSE	SINGLE OR SURFACE COURSE	SURFAC E COURSE	BASE COURSE	SURFACE COURSE
	A 1-1/2	B 1	C 3/4	D 1/2	E 3/8	F 1-1/2	G 3/8
1-1/2"	100	100				100	
1"	80-100	100	100	100		50-90	
3/4"	70-95	80-100	90-100	97-100		50-90	
1/2"	--	65-85	75-100	85-100			
3/8"	50-65	55-75	65-90	70-90	100		100
No. 4	35-50	40-60	45-70	50-75	65-85	0-20	25-70
No. 8	25-40	25-45	30-55	35-65	45-70		0-10
No. 30	10-25	10-30	15-35	20-40	20-40		
No. 100	--				5-15		
No. 200	2-8	2-8	2-8	2-8	3-8	0-5	0-4

710.4 STORING, DRYING AND SCREENING AGGREGATES:

710.4.1 Stockpiling (Cold Feed Separation): Aggregate for dense graded mixes shall be separated and stockpiled into 2 or more sizes of aggregate. If the mineral aggregate is separated into 2 sizes, one stockpile or bunker shall contain material of which a minimum of 80 percent will pass a No. 4 sieve and the other stockpile or bunker shall contain material of which a minimum of 80 percent will be retained on the No. 4 sieve. If the mineral aggregate is separated into more than 2 sizes, at least 2 of the stockpiles or bunkers shall comply with the above and the sizes and toler-ances shall be as approved by the Engineer.

The grading of the cold feed stockpiles or bunkers, for the duration of any one project shall not deviate from the grading as determined at the beginning of the project by more than the following tolerances:

Stockpile Tolerances

Aggregate passing 3/4", 3/8", No. 4, No. 8 & No. 30.....± 10 Percent

Aggregate passing No. 200.....± 4 Percent

Any material added to the stockpiles or bunkers during the progress of the project shall comply with the above requirement, however, the resulting gradation shall be within the specification limits.

In placing materials in storage or moving them from storage to the drier, any method which may cause the segregation, degradation, contamination or the combining of materials of different gradings which will result in any stockpile or bunker failing to meet the requirements shall be discontinued and the material shall be reprocessed or wasted.

710.4.2 Drying and Heating: The mixing plant shall be provided with accurate mechanical means for feeding the aggregates from the stockpiles or bunkers into the drier at such a rate that a uniform production and temperature of dried aggregates will be obtained.

The feeders may be of the apron belt, reciprocating plate, vibrating type or tip gate and shall have accurate and separate adjustments. These adjustments shall be cap-able of being locked in any position and the feeders shall be capable of delivering the required aggregate in the proper proportions.

Drying shall continue until the moisture content is not greater than 0.75 percent. In special cases when the aggregate is unusually porous, a moisture content in excess of 0.75 percent may be permitted at the discretion of the Engineer. In no event shall the aggregate be heated beyond the lowest temperature necessary for proper drying, mixing, spreading and compacting.

The drier shall be provided with a heat indicating device in order that the temperature of the aggregate leaving the drier may be determined. The heat indi-cating device shall be accurate to the nearest 10°F and shall be installed in such a manner that a fluctuation of 10°F in the aggregate temperature will be shown by the heat indicating device within one minute.

The drier shall be equipped with an approved type of dust collector system capable of removing objectionable or excess dust from the aggregate and either wasting the material so collected or returning all or any portion of it uniformly to the mixer, as the Engineer may direct. Dust collector shall comply with the Maricopa County Bureau of Air Pollution Control Rules and Regulations as adopted by the County Board of Supervisors and applicable State laws or local ordinances.

710.5 BIN SEPARATION:

After being dried and in advance of mixing with asphalt, the mineral aggregate shall be separated into 3 or more sizes and stored in separate bins.

All mineral aggregate for mixes **A** 1-1/2, **B** 1 and **C** 3/4, Dense Graded, shall be separated into 3 or more bins as follows:

(A) Bin No. 1:

Not less than 80 percent of the material in Bin No. 1 shall pass a No. 8 sieve.

(B) Bin No. 2:

The sum of the percent of the material retained on a 3/8 inch sieve and the percent of the material passing a No. 8 sieve shall not exceed 25 percent.

(C) Bin No. 3:

Not more than 20 percent of the material in Bin No. 3 shall pass a 3/8 inch sieve.

Mineral aggregate for mixes **D** 1/2 and **E** 3/8, Dense Graded, shall be separated into 2 or more separate bins as follows:

(A) Bin No. 1:

Not less than 80 percent of the material in Bin No. 1 shall pass a No. 8 sieve.

(B) Bin No. 2:

Not more than 20 percent of the material in Bin No. 2 shall pass a No. 8 sieve.

Mineral aggregate for mixes **F** 1-1/2 and **G** 3/8, Open Graded shall be separated into 2 or more separate bins as follows:

(A) Bin No. 1:

Not less than 85 percent of the material in Bin No. 1 shall pass a No. 8 sieve.

(B) Bin No. 2:

Not more than 15 percent of the material in Bin No. 2 shall pass a No. 8 sieve.

Failure to comply with the requirements shall be corrected by drawing the bin and rescreening the material. If there is evidence of fine material hanging on the sides of the fine bin, the fine bin shall be equipped with a vibrating unit which will effectively vibrate the side walls of the bin and prevent any hang-up of segregated sizes while the plant is operating. A positive signal system shall be provide to indicate the low level of material in each bin. Each bin shall be provided with an overflow chute to prevent spilling into adjacent bins and to waste excess material from the bin. The inter-mingling of material between bins by the removal of patch-plates or by other openings between bins, will not be permitted. The composite analysis of the bins as proportioned, shall comply with the grading limits required for the size mineral aggregate designated.

710.6 GENERAL MIXING:

The mineral aggregate and asphalt shall be mixed at a central mixing plant of the batch type mixes, continuous type mixes or drum type mixer, as the Contractor may elect.

The right is reserved to order the use of any drying, proportioning and mixing equipment discontinued which, in the opinion of the Engineer, fails to produce a satisfactory mixture.

Filler material, if required, shall be added separately and in a thoroughly dry condition. Heating of filler material will not be required.

The amount of filler material to be used will be specified by the Engineer and shall be accurately proportioned by weight or by volumetric methods.

The amount of asphalt to be added to the mineral aggregate shall be as specified in this specification.

The temperature of the mineral aggregate shall not be higher than necessary for spreading and finishing at the time of adding the paving asphalt and in no case shall the temperature for the Dense Graded Mixes exceed 325°F, nor shall it exceed 250°F for Open Graded Mixes.

Asphalt shall be added to the mineral aggregate at a temperature conforming to the range of temperature specified in Section 711.

Thermometric equipment shall be provided to indicate the temperature of the asphalt near the charging valve at the mixer.

All scales shall be certified as to accuracy and sealed at least annually by the Sealer of Weights and Measures and rechecked as ordered by the Engineer. Each scale installation shall be provided with certified weights as follows:

The Contractor shall provide not less than 20 certified weights, each weighing 50 pounds, to be used by the Engineer in checking scales used on the project. Each weight shall be numbered and show the corresponding certified weight. The scales and weights shall remain the property of the Contractor and no payment will be made for their use.

The asphalt concrete manufacturer shall make whatever alternations are necessary to his equipment to enable the Sealer of Weights and Measures to conveniently check, calibrate and seal the aggregate and asphalt scales used in production of asphalt concrete.

Scales shall be so located that the mixer operator and the plant inspector have an unobstructed close-up-view of the indicating or registering devices. They shall indicate the true net weight without the application of any factor. The dial for dial type scales shall not be less than 12 inches in diameter and the figures thereon shall be clearly legible.

710.7 BATCH MIXING:

710.7.1 General Requirements: The mixer shall be of the twin-shaft pug mill type and shall be operated at the speed recommended by the manufacturer. It shall be equipped with paddles of sufficient size and number to deliver a thorough and uniform mixture. Should the paddles or other parts of the pug mill become worn to such extent as to adversely affect the quality of the mixing or allow leakage from the discharge gate, they shall be promptly replaced.

The amount of material that may be mixed per batch shall not exceed the rated capacity of the plant or that which will permit complete mixing of all the material.

Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected either by a reduction in the volume of materials or by other adjustments.

All boxes, hoppers, buckets or similar receptacles used for weighing mineral aggregate, filler material and asphalt, as well as all scales used in batching materials shall be insulated against the vibration or movement of the rest of the plant, so that the error in weighing, with the entire plant operating, will not exceed 2 percent for any setting nor 1-1/2 percent for any batch.

Dial heads or readout devices shall be mounted separate from batch plant or tower supports. This will nullify most vibrations from readout.

710,7.2 Aggregate: The aggregate scales shall be either multiple beam or spring-less dial type having a capacity exceeding 1-1/2 times the total amount of materials to be weighed in one operation. Each scale graduation shall be approximately 1/1000 of the total capacity of the scale.

710.7.3 Asphalt: For mixers with a manufacturer's rated capacity of 4,000 pounds or less, the asphalt shall be measured by weight in a heated insulated bucket sus-pended from a springless dial scale system having a capacity of not more than 500 pounds with one pound gradations. For mixers with a manufacturer's rated capacity of more than 4,000 pounds, the scale system shall have a capacity of not more than 1,000 pounds with one pound gradations.

Asphalt shall be introduced into the mixer by means of a distributing pan fixed to the side of the mixer, by gravity distribution along the center of the mixer parallel to the mixer shafts or by pressure spraying. The pan shall be equipped with movable vanes in order that the flow of asphalt may be directed across the width of the pan as desired. The vanes shall be equipped with a means of quick adjustment and a positive lock to prevent shifting.

710.7.4 Filler Material: Filler material shall be introduced into the mixer through the weight box or introduced into the center of the mixer.

710.7.5 Mixing: The entire batch shall be continuously mixed until all the materials are thoroughly blended into on homogeneous mass. The maximum mixing time for any one batch shall be as hereinafter specified for that particular type mix. The time of mixing a batch shall begin on the charging stroke of the weigh hopper dumping mechanism and shall end when discharge from the mixer has started. The mixer shall be equipped with a time lock mechanism which locks the mixer discharge gate for the mixing period and activates an indicator light or bell, which shall be used in signaling the end of the mixing time. The time lock and indicator light or lights, shall be actuated by the charging stroke of the weigh hopper charging mechanism. There shall also be provided an interlock and indicator light to provide for the dry mixing time for the introduction of filler which shall be a minimum of 4 seconds and not more than 15 seconds as required by the Engineer. The device shall be accurate to within 2 seconds. The time of mixing shall be not less than 30 or more than 45 seconds or as otherwise directed by the Engineer. If for any reason the mix cannot be discharged when the mixing cycle is completed, power to the mill shall be cut off or the mix shall be wasted. The mixing shall begin with the introduction of the asphalt into the mixer and shall end when the mixer gate is opened. When asphalt is introduced by spraying, the spraying time shall not exceed 15 seconds. In any event, mixing shall continue until uniform coating of the aggregate is obtained.

The mixer platform shall be of ample size to provide safe and convenient access to the mixer and other equipment. Mixer and weigh-box housing shall be provided with hinged gates of ample size to permit ready sampling of the discharge of aggregates from each of the plant bins.

Means shall also be provided for convenient and accurate sampling of the mixture.

710.8 CONTINUOUS MIXING:

710.8.1 General Requirements: In addition to the general requirements above specified, continuous mixing of the materials shall conform to the following:

(A) No asphalt concrete shall be produced until the plant has been calibrated to the satisfaction of the Engineer. When there is a change in the weight per cubic foot of the aggregate, the Engineer may require that the plant be recalibrated.

(B) The maximum rate of production at which the plant will be permitted to operate shall not exceed the manufacturer's recommendations.

710.8.2 Storage Bins: Storage bins shall be equipped with overflow chutes for each compartment. If there is evidence of fine material hanging on the sides of the fine bin, the fine bin shall be equipped with a vibrating unit which will effectively vibrate the side walls of the bin and prevent any hang-up of segregated sizes while the plant is operating. A positive signal system shall be provided to indicate the low level of material in each bin and as the level of material in any one bin approaches the strike off capacity of the feed gate, the device will automatically close down the feed of all materials to the mixer instantly. Unless this automatic signal system is in good working condition, the plant will not be permitted to operate. Openings in the partitions between the bins will not be permitted.

710.8.3 Feeder: The correct proportions of each aggregate size and filler material introduced into the mixer shall be drawn from the storage bins by an approved type of continuous feeder, which shall supply the correct amount of aggregate and filler material in proportion to the asphalt, and be so arranged that the proportion of each size can be separately adjusted. The continuous feeder for the aggregate may be mechanically or electrically actuated.

Aggregate feeders that are mechanically driven shall be directly connected with the drive on the asphalt pump.

Aggregate feeders that are electrically driven shall be actuated from the same circuit that serves the motor driving the asphalt pump. Current for operation of plants equipped with electrically driven feeders shall be actuated from the same circuit that serves the motor driving the asphalt pump. Current for operation of plants equipped with electrically actuated aggregate feeders shall not vary in frequency in excess of one cycle nor in voltage in excess of 10 percent. The drive shaft on the feeder shall be equipped with a revolution counter reading to one-hundredth of a revolution.

710.8.4 Asphalt Pump: The asphalt pump shall be a positive displacement type pump. The use of a pressure relief valve will not be permitted. The plant shall be equipped with an indicating meter between the pump and spray, and the meter shall be in good working condition and accurately record the gallons of material pumped. All pipe, bins, fittings, and meter shall be steam jacketed or otherwise properly insulated.

The asphalt storage system shall be equipped with a device for automatic plant cut-off when the intake of the positive displacement pump is not working under positive pressure.

A suitable by-pass shall be installed between the pump and the spray bar to divert the flow of asphalt into an auxiliary container of not less than 25 gallon capacity in order that the Engineer may check the rate of delivery of the pump.

710.8.5 Discharge Hopper: The material from the mixer shall be discharged into a hopper in order that segregation of the mixture will be at a minimum. The hopper shall be approved by the Engineer.

710.8.6 Facilities for Sampling: Continuous mixing plants shall be equipped with 3 or more sampling hoppers. These shall be so placed that the discharge from each aggregate feeder may be diverted into each hopper while the feeders are in full operation. The weight of the hoppers shall be determined by means of a springless dial or a beam type scale.

The area around the hoppers shall be kept free of all aggregate and debris and the contractor shall furnish all labor required in handling the hoppers and weighing the materials and in disposing of all excess materials.

Means shall be provided for convenient and accurate sampling of the mixture as it leaves the mixer.

If the results obtained indicate that uniform proportioning of the aggregate from the bins or uniform and correct amounts of asphalt are not being delivered, the Engineer shall order that operations cease until proper corrections have been made.

710.9 DRUM MIXING:

710.9.1 General Requirements: The drum mix plant shall be capable of producing a thorough and uniform mixture. The production of the drum mix plant shall be governed by the rate required to obtain a through and uniform mixture.

No asphaltic concrete shall be accepted until the plant has been calibrated to the satisfaction of the Engineer. When tests indicate material produced is not in conformance with the approved job-mix design, no asphalt concrete will be allowed to be used on the job until the plant has been recalibrated to the satisfaction of the Engineer.

710.9.2 Aggregate Delivery System: An automatic plant shut-off shall be provided to operate when any aggregate bin becomes empty. Provisions shall be provided for conveniently sampling the full flow of materials from the total cold feed. Total cold feed shall be weighed continuously. The weighing system shall have an accuracy of 0.5 percent when tested for accuracy. The plant shall provide weight control of the cold aggregate feed by use of a belt scale, or other appropriate device, which will automatically regulate the feed gate and permit instant correction of variations in load. The cold feed flow shall be automatically coupled with the asphalt flow to maintain the required proportions of each material. Provisions shall be made for introducing the moisture content of the cold feed aggregates into the belt weighing signal and correcting wet aggregate weight to dry aggregate weight. Screens or other suitable devices which will reject oversize particles or lumps of aggregate that have been cemented together shall be installed in the feeder mechanism between the bins and the dryer drum.

Dry weight of the aggregate flow shall be displayed digitally in appropriate units of weight and time and totalized.

710.9.3 Additive Delivery Systems: Satisfactory means of metering shall be provided to introduce the proper amount of additives into the mix. Delivery systems shall prove accurate to plus or minus one percent where tested for accuracy. The additive flow shall be displayed digitally in appropriate units of (weight) and time shall be totalized.

710.9.4 Thermometric Equipment: A recording thermometer of adequate range shall be located to indicate the temperature of the bituminous material in storage. The plant shall also be equipped with approved recording thermometers, pyrometers, or other approved recording thermometric instruments at the discharge chute of the drum mixer.

710.9.5 Asphalt Delivery System: The drum mixer plant shall be equipped with a positive displacement type asphalt pump and an indicating meter between the pump and and spray to monitor the proper amount of asphalt being introduced into the mixwhen displaced digitally in appropriate units of volume or weight. The asphalt delivery shall be interlocked with the aggregate weight and accurate to plus or minus one percent when tested for accuracy.

The asphalt delivery system shall be equipped with a device for automatic plant cut-off when the intake of the positive displacement pump is not working under positive pressure.

A suitable by-pass shall be installed between the pump and the spray bar to divert the flow of asphalt in order that the Engineer may check the rate of delivery of the pump.

710.9.6 Temporary Storage of Bituminous Mixture: Use of surge bins or storage bins for temporary storage of hot bituminous mixtures will be permitted as follows:

The bituminous mixture may be stored in insulated and heated storage bins for a period of time not to exceed 12 hours, provided an inert gas atmosphere is maintained in the bin during the storage period.

If the Engineer determines that there is an excessive amount of heat loss, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bin will be discontinued.

710.10 GENERAL REQUIREMENTS:

A temperature indicating device reading to 500 degrees F. and accurate to 5 degrees F. shall be fixed in the asphalt line or storage tank at a suitable location.

The temperature of the mixture discharged into the hauling vehicles shall not vary more than 30 degrees F. for successive batches. The discharge end of the asphalt binder circulating pipe shall be maintained below the surface of the asphalt binder in the storage tank to prevent discharging hot bituminous binder into open air. The contractor shall provide a suitable sampling outlet in the asphalt feed lines connecting the plant storage tanks to the asphalt weighing system or spray bar. The sampling device shall consist of a 1/2 inch or 3/4 inch valve constructed in such a manner that a one gallon sample may be withdrawn slowly at any time during plant operations. The valve shall be maintained in good condition and if it fails to function properly, it shall be replaced. The sampling device shall be placed in a location that is readily accessible and in an area free of dangerous obstructions. A drainage receptacle shall be provided for flushing the devices prior to sampling.

The beds of trucks used to haul asphalt concrete mixtures shall be coated with a light film of distillate or light oil before loading. If, in the opinion of the plant inspector, there is an excessive amount of oil on the beds, the truck driver shall be required to raise the bed of the truck and drain off the excessive amount of oil.

Mixtures shall be delivered to the site of the work without segregation of the ingredients and within the temperature range specified in Section 321.

SECTION 711

PAVING ASPHALT

711.1 GENERAL:

The asphalt shall be produced from crude asphalt petroleum or a mixture of refined liquid asphalt and refined solid asphalt. It shall be free from ad-mixture with any residues obtained by the artificial distillation of coal, coal tar, or paraffin oil and shall be homogeneous and free from water.

Asphalt shall not be heated during the process of its manufacture, storage, or during construction so as to cause injury as evidence by the formation of carbonized particles.

711.2 TESTING REQUIREMENTS:

Paving asphalt shall be classified by viscosity and shall conform to the requirements set forth in table 711.1.

TABLE 711-1
ASTM D-3381

TABLE I Requirements for Asphalt Cement, Viscosity Graded at 140°F (60°C)
NOTE 1 - Grading based on original asphalt
NOTE 2 - If ductility is less than 100, material will be accepted if ductility at 60°F (15.5°C) is minimum at a pull rate of c cm min.

Test	Viscosity Grade					
	AC-2.5	AC-5	AC-10	AC-20	AC-30**	AC-40
Viscosity, 140°F (60°C) P	250±50	500±100	1000±200	2000±400	3000±600	4000±800
Viscosity, 275°F (135°C), min. cSt	80	110	150	210	250	300
Penetration, 77°F (25°C), 100 g. 5 s. min.	200	120	70	40	30	20
Flash point, Cleveland open cup, min. Degrees F (Degrees C)	325 (163)	350 (177)	425 (219)	450 (232)	450 (232)	450 (232)
Solubility in trichloroethylene, min. %	99.0	99.0	99.0	99.0	99.0	99.0
Test on residue from thin-film oven test; Viscosity, 140°F (60°C), Max. P	1250	2500	5000	10,000	15,000	20,000
Ductility, 77°F (25°C), 5 cm/min. min. cm	100	100	100	75	60	45

** ASTM D-3381 Table 11

711.3 TEST REPORT AND CERTIFICATION:

At the time of delivery of each shipment of asphalt, the supplier supplying the material shall deliver to the purchaser 3 certified copies of the test report which shall indicate the name of the refinery and supplier, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and results of the above specified tests. The test report shall be signed by an authorized representative of the supplier certifying that the product delivered conforms to the specifications for the type and grade indicated.

Until the certified test reports and samples of the material have been checked by the Engineer, that material will be only tentatively accepted by the Contracting Agency. Final acceptance will be dependent upon the determination of the Engineer that the material involved fulfills the requirements prescribed. The certified test reports and the testing required in connection with the reports shall be at no additional cost to the Contracting Agency.

711.4 TEMPERATURES:

Unless otherwise specified in these specifications or in the special provisions, the various grades of paving asphalt shall be applied within the temperature range indicated in Table 711-2. The exact temperature shall be determined by the Engineer.

At no time, after loading into a tank car or truck for transportation from the refinery to the purchaser, shall the temperature of the paving asphalt be raised above 400 degrees F.

TABLE 711-2
Application Temperature of Paving Asphalts

	Pug Mill Mixing Asphalt Temperature °F		Distributor Application Temperature °F	
Grade of Material	**Minimum**	**Maximum**	**Minimum**	**Maximum**
AC-40	275	325	300	390
AC-30	275	325	300	370
AC-20	275	325	295	360
AC-10	275	325	250	345

Paving asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the paving asphalt during heating.

711.5 DISTRIBUTING EQUIPMENT:

Distributing Equipment shall meet the requirements of Section 330.

711.6 CONVERSION OF QUANTITIES:

When pay quantities of paving asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D-1250. In converting volume to weight, the computations shall be based on the following data:

TABLE 711-3

Grade of Material	Gallons Per Ton at 60°F	Lbs. Per Gallon at 60°F
AC-40	233	8.6
AC-30	234	8.6
AC-20	235	8.5
AC-10	235	8.5
AC-5	235	8.5

SECTION 712

LIQUID ASPHALT

712.1 GENERAL:

Liquid asphalt shall consist essentially of either natural crude or refined asphalt petroleum, or a residual product thereof.

The liquid asphalt shall be medium curing product designed by the letters MC, and shall consist of a paving asphalt conforming to the provisions in Section 711, fluxed or blended with a kerosene type solvent.

The asphalt shall not be heated during the process of its manufacture or during construction so as to cause injury as evidence by the formation of carbonized particles.

712.2 TEST REQUIREMENTS:

The liquid asphalt shall consist of materials specified above and shall conform to the requirements set forth in Table 712-1.

712.3 TEST REPORTS AND CERTIFICATIONS:

Test reports and certifications will be furnished in accordance with Section 711.

712.4 CONVERSION OF QUANTITIES:

When pay quantities of liquid asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D-1250. In convening volume to weight the computations shall be based on the data contained in Table 712-2.

SECTION 712

TABLE 712-1

AASHTO M-82 TABLE 1

	MC-30		MC-70		MC-250		MC-800		MC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Kinematic Viscosity at 60°C (140°F) centistokes	30	60	70	140	250	500	800	1600	3000	6000
Flash point (Tab. open-cup), degrees C° (F)	38 (100)	. . .	38 (100)	. . .	66 (150)	. . .	66 (150)	. . .	66 (150)	. . .
Water percent	. . .	0.2	. . .	0.2	. . .	0.2	. . .	0.2	. . .	0.2
Distillation test: Distillate percentage by volume of total distillate to 360°C (680°F)	. . .	25	0	20	0	10	. . .	. . .	. . .	. . .
to 225°C (437°F)	40	70	20	60	15	55	0	35	0	15
to 260°C (500°F)	75	93	65	90	60	87	45	80	15	75
to 315°C (600°F)										
Residue from distillation to 360°C (680°F) Volume percentage of sample by difference	50	. . .	55	. . .	67	. . .	75	. . .	80	. . .
Tests on residue from distillation: Absolute viscosity at 60°C (140°F) poises	300	1200	300	1200	300	1200	300	1200	300	1200
Ductility, 5 cm/cm, cm.	100	. . .	100	. . .	100	. . .	100	. . .	100	. . .
Solubility in Trichloroethylene, percent	99.0	. . .	99.0	. . .	99.0	. . .	99.0	. . .	99.0	. . .

TABLE 712-1A

ASTM D-2026

Requirements for Cutback Asphalt (Slow-Curing Type)

NOTE — If the ductility at 77°F (25°C) is less than 100, the material will be acceptable if its ductility at 60°F (15.5°C) is more than 100.

Designation	SC-70		SC-250		SC-800		SC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Kinematic viscosity at 140°F (60°C), Cst	70	140	250	500	800	1600	3000	6000
Flash point (Cleveland open cup), °F (°C)	150 (66)	. . .	175 (79)	. . .	200 (93)	. . .	225 (107)	. . .
Distillation lost: Total distillate to 680°F (360°C), volume %	10	30	4	20	2	12	. . .	5
Solubility in trichloroethylene, %	99.0	. . .	99.0	. . .	99.0	. . .	99.0	. . .
Kinematic viscosity on distillation residue at 140°F (60°C), St	4	70	8	100	20	160	40	350
Asphalt residue: Residue of 100 penetration, %	50	. . .	60	. . .	70	. . .	80	. . .
Ductility of 100 penetration residue at 77°F (25°C), cm	100	. . .	100	. . .	100	. . .	100	. . .
Water, %	. . .	0.5	. . .	0.5	. . .	0.5	. . .	0.5

TABLE 712-2

Grade of Materials	Gals. Per Ton at 60 Degrees F.	Lbs. Per Gals. at 60 Degrees F.
70	253	7.90
250	249	8.03
800	245	8.16
2000	241	8.30

SECTION 713

EMULSIFIED ASPHALTS

713.1 GENERAL:

Emulsified asphalts shall be composed of a paving asphalt base uniformly emulsified with water and an emulsifying or stabilizing agent. It shall be homogeneous throughout and if stored shall show no separation of ingredients within 30 days after delivery. Emulsified asphalt shall be classified as quick setting, rapid setting, medium setting or slow setting type in either anionic or cationic emulsions.

Emulsified asphalt shall be specified as follows:

a) Penetration type and high viscosity type emulsion shall be designated by the letters RS-Rapid Setting.

b) Mixing type emulsion shall be designated by the letters SS-Slow Setting, MS-Medium Setting and QS-Quick Setting.

713.2 TESTING REQUIREMENTS:

The emulsified asphalt shall conform to the requirements set forth in Table 713-1 and the latest amendments specified by AASHTO.

713.3 TESTS REPORT AND CERTIFICATION:

Test reports and certifications shall be made in accordance with Section 711.

TABLE 713-1
(Specification Designation)

TABLE 1
REQUIREMENTS FOR ANIONIC EMULSIFIED ASPHALT

Type	Rapid-Setting				Medium-Setting						Slow-Setting			
Grade	RS-1		RS-2h		MS-1		MS-2		MS-2h		SS-1		SS-1h	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Tests on emulsions Viscosity, Saybolt Furol at 77°F (25°C)s	20	100			20	100	100		100		20	100	20	100
Viscosity, Saybolt Furol at 122°F (50°C)s			75	400										
Settlement, 24 hour day, percent		1		1		1		1		1		1		1
Demulsibility, 35 ml. 0.02 N. $CaCl_2$, percent	60		60											
Coating ability and water resistance..... Coating, dry and aggregate....					good		good		good					
Coating, after spraying.....					fair		fair		fair					
Coating, wet aggregate.....					fair		fair		fair					
Coating, after spraying.....					fair		fair		fair					
Cement mixing test, percent..												2.0		2.0
Sieve test, percent.....		01.0		0.10		0.10		0.10		0.10		0.10		01.0
Residue by distillation, percent.....	55		63		55		65		65		57		57	
Tests on Residue from Distillation Test: Penetration 77°F (25°C), 100g, 5 s.....	100	200	40	90	100	200	100	200	40	90	100	200	40	90
Ductility, 77°F (25°C), 5 cm/min. cm.....	40		40		40		40		40		40		40	
Solubility in trichloroethylene, %.....	97.5		97.5		97.5		97.5		97.5		97.5		97.5	

TABLE 713-1 (continued)
(Specification Designation)

TABLE I
REQUIREMENTS FOR ANIONIC/CATIONIC EMULSIFIED ASPHALT

Type	Quick Setting				Rapid Setting				Medium Setting				Slow Setting			
Grade	QSH		CQSH		CRS-1		CRS-2h		CMS-2		CMS-2h		CSS-1		CSS-1h	
Tests on emulsions: Visc., Saybolt Furol at 77°F., sec.	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	20	100											20	100	20	100
Visc., Saybolt Furol at 122°F., sec					20	100	100	400	50	450	50	450				
Settlement, 24 hour day, percent						1		1		1		1		1		1
Demulsibility, 35 ml 0.8% sodium dioctyl sulfosucinate, %					40		40									
Coating ability and water resistance: Dry aggregate									Good		Good					
after spraying									Fair		Fair					
wet aggregate									Fair		Fair					
after spraying									Fair		Fair					
Particle charge test	Negative		Positive		Positive		Positive		Positive		Positive		Positive		Positive	
Sieve Test, %	0.10		0.10		0.10		0.10		0.10		0.10		0.10		0.10	
Cement Mixing test, %														2.0		2.0
Distillation: Oil distillate, by volume of emulsion, %						3		3		12		12				
Residue, %	57		57		60		65		65		65		57		57	
Test on Residue from distillation test: Penetration, 25°C (77°F), 100 g, 5 sec.	40	110	40	110	100	250	40	90	100	250	40	90	100	250	40	90
Ductility, 25°C (77°F.) 5 cm per min, cm.	40		40		40		40		40		40		40		40	
Solubility in trichloroethylene, %	97.5		97.5		97.5		97.5		97.5		97.5		97.5		97.5	
Storage Stability Test, 1 day, %	1		1													

*If the Particle Charge Test result is inconclusive for CSS-1 and CSS-1h, material having a maximum pil value of 6.7 will be accepted.

713.4 TEMPERATURES

Unless otherwise specified, the various grades of emulsified asphalt shall be applied at temperatures within the limits specified below, the exact temperature to be determined by the Engineer. Emulisfied asphalt shall be reheated if necessary. But at no time, after loading into a tank car or truck for transportation to the work site, shall the temperature of the emulsion be reaised above the maiximum temperature shown in Table 713-2. During all reheating operations, the emulsified asphalt shall be agitated to prevent localized overheating. Emulsified asphalt shall not be permitted to cool to a temperature of less than 40 °F.

TABLE 713-2

Application Temperature of Emulsified Asphalt

Grade of Emulsified Asphalt	Minimum °F.	Maximum °F.
RS-1, MS-1, SS-1, SS-1h, CSS-1, CSS-1h	70 F.	140 F.
RS-2, MS-2, MS-2h, CRS-1, CRS-1h, CRS-2, CRS-2h, CMS-2, CMS-2h, QSH, CQSH	125 F.	185 F.

Emulsified asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the emulsified asphalt during heating.

713.5 CONVERSION OF QUANTITIES:

When pay quantities of emulsified asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 degrees F. in accordance with ASTM D-1250. In converting volume to weight, the computations shall be based on the following data:

TABLE 713-3

Grade of Material	Gals. Per Ton at 60^0 F.	Lbs. Per Gal. at 60^0 F.
All grades	240	8.33

SECTION 716

COVER MATERIAL

716.1 GENERAL:

Cover material "chips" shall consist of precoated or uncoated aggregate spread in conjunction with a bituminous or asphalt-rubber seal coat.

716.2 STONE CHIPS:

716.2.1 General: The stone chips shall be crushed rock as per MAG Section 701 except as modified below.

716.2.2 Tests: The chips' weight loss shall not exceed 40 percent at 500 revolutions where tested in accordance with ASTM C-131.

The chips shall not show a loss in excess of 12 percent when tested in accordance with AASHTO T-104 (Sodium Sulfate Soundness).

A minimum of 75 percent of the material, by weight, retained on the No. 8 sieve, shall have at least one fractured face produced by the crushing operation.

716.2.3 Gradation: When tested in accordance ASTM C-136 and C-117, gradation shall comply with table shown below.

TABLE 716-1

For Low Volume Traffic Only

Sieve Size	Percent Passing
1/2"	100
3/8"	97/100
1/4"	70/100
#8	0-5
#200	0-2

TABLE 716-2

For High Volume Traffic

Sieve Size	Percent Passing
3/4"	100
1/2"	97/100
3/8"	70/100
1/4"	0-10
#8	0-5
#200	0-2

716.3 PRECOATED CHIPS:

When specified, the aggregate shall be heated and precoated with asphalt cement as specified in Section 711. The quantity of bituminous material used shall not be more than 0.50 percent of the combined weight of the bituminous material and the aggregate.

The final percentage of asphalt used for coating shall be as directed by the engineer. The precoating shall be done in a pug mill mixing facility for a minimum of 30 seconds or until the asphalt is present on the aggregate, which ever is greater. With approval of the Engineer, a drum mix plant may be used, however, the end result shall produce a uniform, dust free product.

716.4 UNCOATED CHIPS:

When liquid or paving grade asphalt is used as the bituminous binder, the uncoated chips shall not contain moisture in excess of a saturated surface dry condition.

When emulsified asphalt is used as the bituminous binder, the uncoated chips shall be surface wet but free from running water.

SECTION 718

PRESERVATIVE SEAL

718.1 GENERAL:

Asphalt concrete preservative seal shall be one of the following types or equal, with typical application rates.

Type A - Petroleum resin-oil base emulsion. Applied at 0.005 to 0.10 gallons per square yard, diluted.

Type B - Petroleum hydrocarbon emulsion. Applied at 0.05 to 0.20 gallons per square yard, diluted.

Type C - Gilsonite and tall oil pitch emulsion. Applied at 0.10 to 0.15 gallons per square yard, diluted.

Type D - Polymer Modified B or C. Applied at 0.10 to .20 gallons per square yard or as specified by the manufacturer.

718.2 TEST METHODS AND REQUIREMENTS:

Preservative seal shall meet Type A, B or C on Table 718 by certification from the manufacturer. Type D will be certified by methods established in special provisions.

TABLE 718

Property and Test Method		Specification		
		Type A	Type B	Type C
Viscosity @ 77 F SFS Residue	ASTM D244 ASTM D244	15-40 60-45	25-150 62 Min	10-100 30 Min
Sieve Test Particle Test	ASTM D244 ASTM D244	0.01 Max Positive	0.01 Max Positive	0.01 Max Positive
Cement Mixing 5 Day Settlement	ASTM D244 ASTM D244		2.0 Max 2.0 Max	 5.0 Max
Tests on Residue From ASTM D-244				
Viscosity c.st @ 140°F c.st @ 140°F	ASTM D445 ASTM D2170	100-200	 1,000-9,500	
Flash Point Solubility in Trichlorethyone	ASTM D-92 ASTM D2042			450°F 97.5 Min
RTFO Weight Change Specific Gravity	ASTM D2872 ASTM D-70			2.5 Max 0.98 Min
n-Pentane Insolubles Polar Compounds	ASTM D2007 ASTM D2007			15 Min 25 Min
Aromatic Saturates	ASTM D2007 ASTM D2007			15 Min 10 Max
Asphaltenes Maltenes Ratio PC/S Ratio	ASTM D2006(74) ASTM D2006(74) ASTM D2006(74)	0.75 Max 0.3 - 0.5	11.0 Max 0.7 - 1.4	
Type A Maltenes Dist Ratio	$\frac{N + A1}{P + A2}$	ASTM D2006 (74)		
Type B Maltenes Dist Ratio	$\frac{PC + A1}{S + A2}$	ASTM D2006 (74)		

SECTION 725

PORTLAND CEMENT CONCRETE

725.1 GENERAL:

Portland cement concrete shall be composed of Portland cement or Portland Pozzolan cement, Pozzolonic Materials, fine and coarse aggregates, water, and if provided for or allowed, certain admixtures.

All of the materials used for concrete shall be in accordance with these specifications and requirements for the particular material as provided herein.

Weighing and metering devices used for the purpose of proportioning materials shall fulfill requirements as to accuracy and tolerance prescribed by the Weights and Measures Division of the State of Arizona and shall be sealed and certified in accordance with the procedures established by this agency. This certification shall not be over 12 months old and shall be renewed whenever required by the Engineer. When portable plants are set up at a new or temporary location, the scales and scale assembly shall be inspected and certificate issued regardless of the date when the scales were last tested. The Engineer may require the Contractor to run a quick scale check at any time with certified weights furnished by the Contractor and order the scale recertified if necessary.

725.1.1 Classes of Concrete:

TABLE 725

Classes and Master Limits of Concrete

Class of Concrete	Min. Cement Content Lbs. Per Cu. Yd.	Min. Compressive Strength (1) At 14 Days P.S.I.	At 28 Days P.S.I
AA	600	3,200	4,000
A	520	2,400	3,000
B	470	2,000	2,500
C	420	1,600	2,000

(1) As tested in accordance with ASTM C-39. Maximum slump 5 inches when tested in accordance with ASTM C-143.

Class AA concrete shall be used as specified.

Class A concrete shall be used for concrete structures, either reinforced or non-reinforced, and for concrete pavements.

Class B concrete may be used for curbs, gutters and sidewalks.

Class C concrete may be used for thrust blocks, encasements, fill or overexcavation, etc.

725.2 PORTLAND CEMENT:

Cement to be used or furnished under this specification shall be Portland cement, conforming with the requirements of ASTM C-150. Type II, low alkali, or Portland Pozzolan Cement, conforming with the requirements of ASTM C-595, Type IP (MS), low alkali, except when another type including high early strength is specified in the special provisions or shown on the plans. Type V cement (ASTM C-150) shall be specified in the special provisions for use in concrete which will be exposed to contact with soil or water containing water soluble sulfates (as S04) in concentration greater than 0.20% by weight of soil or 1500 PPM in solutions. Pozzolonic materials shall not be used as a directly added ingredient in concrete in combination with Portland Pozzolan Cement.

Cement shall be sampled and tested as prescribed in applicable ASTM specifications. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the cement manufacturer, identifying the cement and stating that the cement delivered to the batching site complies with those specifications. When requested by the Engineer, the Contractor shall furnish him with 3 copies of said certification. The cost of furnishing tested cement shall be considered as included in the contract bid price and no additional allowance will be made therefore.

When suitable facilities, as recommended by the Concrete Plant Manufacturer's Bureau, and approved by the Engineer, are available for handling and weighing bulk cement, such facilities shall be used. Otherwise the cement shall be delivered in original unopened sacks that have been filled at the mill and bear the name or brand of the manufacturer. The type of cement, and the weight of cement contained in each sack shall be plainly marked thereon.

Cement shall be stored in such manner as to permit ready access for the purpose of inspection and identification, and so as to be suitably protected against damage by contamination or moisture. Should any lot of bulk cement be delivered to the site show evidence of contamination, the Engineer may require that such lot be removed from the site.

A cement shall not be mixed with any other brand or type unless written permission has first been obtained from the Engineer.

All cement used in the manufacture of concrete for any individual structure shall be of the same brand unless otherwise approved by the Engineer.

725.2.1 Pozzolonic Materials: Pozzolonic materials to be used in concrete or furnished under this specification shall conform to the requirements of ASTM C-618 for Class N or Class F.

If an approved pozzolonic material is used, 15 percent by weight of the Table 725 minimum Portland cement requirement shall be replaced. The replacement ratio shall be 1.2 pounds of pozzolan per pound of replaced Portland cement.

Pozzolans shall be sampled and tested as prescribed in ASTM C-618 and ASTM C-311. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the Pozzolan supplier identifying the Pozzolan and stating the Pozzolan delivered to the batching site complies with applicable specifications. The cost of furnishing tested Pozzolan shall be considered as included in the contract bid price and no additional allowance will be made therefore.

Pozzolan material shall be handled and stored in the same manner as Portland cement. When facilities for handling bulk Pozzolan are not available, the Pozzolan shall be delivered in original unopened sacks bearing the name and brand of the supplier, the type and source of the Pozzolan, and the weight contained in each sack plainly marked thereon.

A Pozzolan shall not be mixed with any other brand or type unless written permission has first been obtained from the Engineer. All Pozzolan used in the manufacture of concrete for any individual structure shall be of the same type, and from the same source unless otherwise approved by the Engineer.

725.3 AGGREGATES:

Aggregates shall be crushed rock or gravel or a combination thereof and sand conforming to the requirements prescribed in Section 701. Prior to the delivery of the aggregates, the Contractor will be required to furnish samples for testing, and shall notify the Engineer as to when and where they will be available. Thereafter, additional required samples shall be furnished at the expense of the Contractor, but the cost of testing and making the grading analysis will be borne by the Contracting Agency. Samples shall be taken by the Engineer or in the presence of the Engineer.

No method which may cause the segregation, degradation or the combining of materials of different grading shall be used.

725.4 AGGREGATE GRADING:

Aggregates for each batch of concrete to be prepared shall be combined from materials separately stored in the various sizes and gradations as prescribed in Section 701. The relative proportions of each aggregate used will be as required to meet the provisions of this specification and will be the responsibility of the Contractor.

Except where the amount of concrete for any one job is 10 cubic yards or less, various sizes of both coarse and fine aggregate shall be proportioned by weight unless permission to do otherwise has first been obtained from the Engineer. Aggregates that are proportioned by volume shall be measured in containers of known capacity. Regardless of the method employed, either by weight or volume, each individually stored size of aggregate shall be proportioned separately, but not necessarily weighed individually.

The maximum size of the aggregate shall not be larger than one-fifth of the narrowest dimension between forms of the members for which the concrete is to be used, or larger than 3/4 of the minimum clear spacing between reinforcing bars.

725.5 WATER:

The amount of water shall be varied in accordance with the percentage of free moisture in the material and the requirements of the workability of the aggregate.

The equipment for measuring and supplying the water in the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured, in gallons or by weight, positively and that the predetermined quantity of water required can be discharged rapidly in one operation into the mixing drum without dribbling. Tanks or other equipment for measuring and discharging water into the mixer shall be sufficiently accurate that the amount of water delivered to the mixer for any batch shall not vary more than 1 percent from the required quantity. Adequate means for determining and checking the accuracy of the equipment shall be provided and made available to the Engineer at all times.

The water used for mixing with concrete shall be potable and free from oil, vegetable matter and other deleterious substances, and shall conform to the following requirements:

Water for prestressed concrete shall not contain chlorides calculated as sodium chloride in excess of 1,000 parts per million nor sulfates calculated as sodium sulfate in excess of 1,000 Parts per million nor any sulfates calculated as sulfate in excess of 1,000 parts per million. Water shall not contain an amount of impurities that will cause a change in the time of setting of Portland cement of more than 25 percent nor a reduction in the compressive strength of Portland cement mortar of more than 5 percent compared to results obtained with distilled water.

725.6 ADMIXTURES:

Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer.

If an air-entraining agent is authorized, the amount used will be limited to the extent that the amount of entrained air by volume shall not be more than 6 percent. Air-entraining agents complying with AASHTO M-154 or ASTM C-260 will be permitted as long as strength requirements are met. Any admixture shall be measured accurately by mechanical means into each batch by equipment and in a method approved by the Engineer. Any admixtures used shall be included in the bid price for that item.

725.7 PROPORTIONING:

All proportioning equipment shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association. The proportioning shall consist of combining the specified sizes of aggregates, each stored in a separate bin with cement, Pozzolonic Materials, and water as herein provided. Weigh hoppers shall be charged from bins located directly over the weigh hoppers or from conveyor belts. When conveyor belts are used, there shall be a separate belt for each size of aggregate.

Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the batch ingredients are released for discharge. The cement hopper shall be attached to a separate scale for individual weighing.

All Pozzolan that is to be incorporated into the concrete as a separate ingredient shall be weighed. When the cement scales are used for weighing both cement and Pozzolan, the cement shall be weighed first. If separate scales are provided, they shall be accurate to $\pm$ 0.3 percent of the scale capacity.

Scales utilized in the proportioning device may be of the springless dial-type or of the multiple-beam type.

If the dial-type, the dial shall be of such size and so arranged that it may be read easily from the operating platform.

If the multiple beam-type, the scales shall be provided with an indicator operated by the main beam which will give positive visible evidence of over or under weight. The indicator shall be so designed that it will operate during the addition of the last 400 pounds of any weighing. The over travel of the indicator hand shall be at least 1/3 of the loading travel. Indicators shall be enclosed against moisture and dust.

Weighing equipment shall be as recommended by the Concrete Plant Manufacturer's Bureau and be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cutoff shall not vary from the weight designated by the Engineer more than 1 percent for cement, Pozzolan or Cement Pozzolan, 1-1/2 percent for any size of aggregate, nor 1 percent for the total aggregate in any batch.

When proportioned at a central mixing plant there shall be an approved moisture meter, accurate within 1/2 percent, installed to indicate the moisture in the fine aggregate.

725.8 MIX DESIGN SUBMITTAL:

A Concrete Mix Design for each type of concrete used shall have been submitted by the Contractor 15 days before and approval obtained before any concrete work. If an approved mix design is on file from the designated concrete supplier, a letter from the Contractor shall be submitted to the Engineer requesting use of the approved design and approval obtained before any concrete work.

725.9 MIXING:

Machine mixing will be required in all cases other than those in which it would obviously prove to be impractical; in which latter event hand mixing will be permitted, only to the extent necessary. Regardless of the method employed, mixing shall be commenced as soon as possible after the cement is placed in contact with the aggregates.

The temperature of materials as charged in the mixer shall be such that the temperature of the mixed concrete at the time it is placed in final position does not exceed 90°F. When the atmospheric temperature at the time of placing concrete is less than 40°F, the temperature of the concrete, as placed, shall not be less than 60°F.

All concrete mixers shall be of such design and construction, and so operated, as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed.

725.9.1 Paving and Stationary Mixers: Paving and stationary mixers shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association. They shall be equipped with an accurate automatic timing device so designed and constructed as to lock the discharge lever before aggregate, cement and Pozzolan enter the drum, and release such lever only after the specified mixing time has elapsed. The regulation of the setting of said device shall be under the supervision of the Engineer. Water control equipment as described in this specification shall also be provided with each concrete mixer.

Mixers shall be maintained in proper and serviceable working condition, and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced.

The proper proportions of aggregate, cement, Pozzolan and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than 50 seconds after all such materials are in the drum.

The rotating speed at which the mixer shall be operated shall conform to that recom-mended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

725.9.2 Transit Mixers: Transit mixers shall be high quality equipment and meet the requirements of the Truck Mixer Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association. Ready mix concrete shall comply with ASTM C-94 except as herein specified.

The total elapsed time between the addition of water at the batch plant and depositing the completed mix shall not exceed 90 minutes. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates, installed by the manufacturer, on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.

Each mixer shall have an identification number painted on the truck in such a location that it can be easily read from the batching platform.

The total volume of materials introduced into the mixer for mixing purposes shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete so mixed does not meet the uniformity requirements of this section, the amount of materials charged into the mixer shall be reduced.

The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

Each batch of concrete placed in the mixer shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades, at the speed designated by the manufacturer of the equipment as mixing speed. Additional mixing shall be at the agitating speed designated by the manufacturer of the equipment. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum. Before any portion of the materials for any batch of concrete is placed therein, the drum of the mixer shall be completely emptied of the previously mixed batch.

At the time of delivery to the job site, the Engineer shall be provided with a legible weighmaster's certificate (delivery ticket) which shall contain the following information:

Date and Truck Number.

Name of the Supplier.

Name of the Contractor.

Specific designation of job (name and location).

Number of cubic yards in the batch.

Type of cement.

Type of Pozzolan, if any.

Time the transit mixer is loaded.

Amount of water added at the jobsite at request of receiver, and his signature or initials.

Suppliers' mix design code number.

Type and amount of admixture, if any.

Serial number of the ticket.

The type, capacity and manner of operation of the mixing and transporting equip-ment for ready-mix concrete shall conform to the current Standards for Operation of Truck Mixers and Agitators of the National Ready-Mixed Concrete Association and the Truck Mixer and Agitators Standards of the Truck Mixer Manufacturer's Bureau. Water shall not be added to the batch during transit. Additional water may be added at the point of discharge to adjust slump providing the slump after such water addition does not exceed the maximum allowed by these specifications and that water so added is mixed into the batch for a minimum of 30 additional revolutions at mixing speed. Loss of cement mortar during discharge which in the opinion of the Engineer would be of sufficient amount to affect the homogeneity of the concrete will be cause for rejection of the load. The Contractor shall be responsible for all concrete to which water is added at the jobsite.

725.9.3 Hand Mixed Concrete: Hand mixed concrete shall be prepared on a water-tight level platform in batches of not to exceed 1/3 cubic yard each. The required amount of coarse aggregate shall first be spread on the platform in an even and uni-form layer, over which the proper proportion of fine aggregate shall then be likewise spread. The combined depth of both such layers shall not be greater than one foot. The required quantity of cement shall then be evenly distributed over the fine aggregate; following which the entire batch shall be turned with shovels at least twice before the water is added. The proper amount of water shall then be uniformly sprinkled or sprayed over the batch, which shall thereafter be returned with shovels not less than 3 times before being removed from the platform.

725.9.4 Drybatched Unmixed Concrete: Should the Contractor elect to use dry-batched unmixed concrete, an accurate automatic batch weight recorder shall be provided to record the quantities of cement, aggregate and water batched into the containers; the weight of cement shall be recorded on either a separate chart from the aggregate or on the same chart using a separate needle. The recorder shall produce an autographic readable record on a visible chad of the weights of each of the materials batched. After batching, the needle on the chart shall return to zero. The chart scale along the ordinate shall be such that the major portion of the chart is used to record the total weights of the aggregates and water, and the cement. The date of batching, the container number and the batching certificate number shall be recorded on the recorder chart at the time of batching. The recorder charts, or copies thereof, shall become the property of the Contracting Agency and shall be submitted upon request.

All dry batched unmixed concrete delivered to the job site shall be stored in containers so constructed that the cement cannot co-mingle with the water and aggregate within the container. Any admixture added in powder form shall be added to the cement; added in liquid form, it shall be added to the water.

The contents of the container shall be discharged into a mixer at the job site. Following discharge of the first container into the mixer, the mixer shall be operated at mixing speeds during the discharge of the remaining containers. After the contents of the last container have been discharged into the mixer, the concrete shall be mixed as specified in this specification for transit mixer, and drum or turbine type mixers.

Any spillage of cement, aggregate, water or admixture during the filling, trans-porting, or the discharging of the container, shall be cause for rejection of the container or the contents of the mixer if any portion of the rejected container is dis-charged into the mixer.

725.10 LOADING AND TRANSPORTATION OF MATERIALS AND MIXED CONCRETE:

The compartments of trucks or other equipment used for the purpose of transporting proportioned aggregates, bulk cement or mixed concrete, shall be sufficiently high and tight, and otherwise suitably constructed and adequately protected, to prevent loss or leakage of the contents thereof during transit or charging.

725.11 TESTS:

Concrete specimens for compression tests will be taken in the field by a representa-tive of the Engineer in accordance with ASTM C-172 and C-31 or AASHTO T-23, except as noted hereinafter.

Concrete samples shall be taken from the approximate middle 50 percent of the batch in a uninterrupted stream from the chute directly into the wheelbarrow or similar equipment. Where excessive slump is suspected, a controlling slump test may be made from any portion of the batch, except for the approximate 5 percent on each end of the discharge. If excessive slump is verified, a set of cylinder for compressive strength shall be taken from the batch. The rate of discharge of the batch shall be regulated by the rate of revolutions of the drum and not by the size of the gate opening. Specimens for compression tests shall be stored in the field in accordance with methods approved by the Contracting Agency and protected from vibration and other disturbances, for a minimum of 18 hours and maximum of 76 hours. A maximum storage period would be involved only where weekends or holi-days are involved. Cylinders stored in the field for the maximum period shall have the same validity as cylinders that have been stored overnight and brought in the following day.

Not less than 4 cylinder specimens are to be made for each 30 cubic yards of each grade of concrete with a minimum of 4 specimens for each grade placed and not less than 4 specimens for each concrete structure and each half-day's pour. Specimens will be tested in a laboratory designated by the Engineer in accordance with ASTM C-39 at the expense of the Contracting Agency. Two cylinders shall be tested at 14 days. If their strength meets or exceeds the minimum 14-day requirements, the Contracting Agency will accept the concrete. The Engineer may test the other two cylinders at 28 days or discard at 60 days.

If this strength does not meet the 14-day requirement, the Contractor shall schedule and pay for two cores to be taken on the 28th day, from the area of concrete repre-sented by the cylinders. The Engineer shall be present when the coring is accom-plished or additional cores will be required.

The Engineer will test the remaining two cylinders on the 28th day. If this test meets or exceeds the 28-day minimum compressive strength requirement, the Con-tracting Agency will accept the concrete and the Contractor may cancel the scheduled coring.

If the 28-day cylinder test does not meet the minimum 28-day compressive strength requirement, the cores will be tested in accordance with ASTM C-42 in a laboratory designated by the Contracting Agency. If the cores meet or exceed the minimum 28-day strength, the concrete will be accepted by the Contracting Agency and the Contractor will be reimbursed for the cost of coring.

If the strength of the 28-day cylinders and the strength of the cores as calculated in accordance with ASTM C-42 are deficient, the Contractor shall remove all of the concrete represented by the failing test specimens with the exception that if the Contractor believes that the deficient concrete was confined to a single batch, he may immediately cut a minimum of 4 additional cores, two on either side of the affected batch. The cores would be compared with the minimum specified compres-sive strength, for the purpose of defining the confines of the deficient concrete. All coring done to establish this premise would be at the expense of the Contractor. Evaluation of the cores shall be by the Engineer, or by a substitute agent designated by the Contracting Agency, and his decision shall be final.

725.12 ACCEPTANCE:

Concrete represented by a strength test of at least 95% of the required 28-day com-pressive strength will be acceptable. All concrete falling to meet this requirement as evidenced by tests of either standard cylinder or drilled core specimens shall be rejected, removed and replaced by the Contractor at the Contractor's expense.

When concrete is accepted on the basis of strength tests of less than 100% of the required minimum 28-day compressive strength, an adjustment in the contract unit price will be made for the quantity of concrete represented by such strength tests in accordance with the following schedule:

Adjustment in Contract Unit Price for Strength Deficiency

Percent Of Specified Minimum 28-Day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed
100% or greater	100
98-99	90
96-97	85
95	80

SECTION 726

CONCRETE CURING MATERIALS

726.1 GENERAL:

Curing materials shall consist of waterproof paper, polyethylene film or liquid membrane-forming compounds which, when applied to fresh concrete, will inhibit moisture loss and reduce temperature rise during the curing period. All curing materials and methods shall be approved by the Engineer prior to use. Wet cover-ings such as burlap, cotton mats, or other moisture-retaining fabrics also may be used, or may be required by special provisions.

726.2 MATERIALS:

(A) Waterproof paper, or polyethylene film, shall conform with AASHTO M-171.

(B) Liquid membrane-forming compounds shall conform with AASHTO M-148. Type I compound with either a Class A or Class B vehicle shall be used for concrete structures, except bridge decks. Type 2 compound, with either a Class A or Class B vehicle shall be used for Portland cement concrete pavement, bridge decks and approach slabs.

(C) Burlap cloth made from jute or kenaf shall conform to AASHTO M-182. Cotton mats shall conform to AASHTO M-73 "Specification for Cotton Mats for Curing Concrete."

SECTION 727

STEEL REINFORCEMENT

727.1 GENERAL:

The following specifications set forth the requirements for bar reinforcement, wire reinforcement and wire mesh reinforcement. The reinforcement shall conform accu-rately to the dimensions and details indicated on the plans or otherwise prescribed and before being placed in any concrete work, shall be thoroughly cleaned of all loose rust, mill scale, mortar, oil, dirt, or coating of any character, which would be likely to destroy, reduce, or impair its proper binding with the concrete.

No reinforcing steel will be accepted under this specification until it has been approved by the Engineer. When required by the Engineer, the Contractor or sup-plier shall furnish a spot sample taken on the project and notify the Engineer as to when and where they will be available. Such samples shall be furnished at the expense of the Contractor or supplier, but the cost of any testing that may be required will be borne by the Contracting Agency. Samples shall only be taken in the presence of the Engineer. The Contractor shall furnish 3 certified mill test reports or certificates of compliance for each heat or size of steel which can be clearly identified with the lot. When such information has been furnished, placing of the steel will not be held up until results of spot samples have been received. Unless otherwise specified, all reinforcing steel bars shall be deformed intermediate grade 40 billet steel conforming with ASTM A-615 and the shapes shall conform with ASTM A-670. In testing bar reinforcement, only the theoretical cross-sectional area will be used in all computations.

Bending of steel shall conform to the requirements of ACI-318.

The various grades of steel shall not be used interchangeably in structures.

727.2 WIRE REINFORCEMENT:

Wire reinforcement shall in all respects fulfill requirements prescribed in ASTM A-82.

727.3 WIRE MESH REINFORCEMENT:

Mesh reinforcements shall conform to ASTM A-185. The gage of the wire and the dimension of the mesh will be specified in the special provisions or shown on the plans. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during necessary handling. The effective cross-sectional area of the metal shall be equal to that specified or indicated on the plans.

727.4 WIRE TIES:

Wire for ties shall be black, annealed, not lighter than 16 gauge.

SECTION 729

EXPANSION JOINT FILLER

729.1 PREMOLDED JOINT FILLER:

Expansion joint filler material shall consist of premolded strips of a durable resilient compound and comply with ASTM D-1751, D-1752 or D-2628, as specified by the Contracting Agency.

729.2 POUR TYPE JOINT FILLERS:

Pour type joint fillers shall comply with ASTM D-1850, D-1190, D-1854, or with the following formulation, as specified by the Contracting Agency.

Asphalt latex joint filler shall consist of asphalt latex emulsion and sodium fluosilicate furnished in separate containers and mixed on the site. The emulsion shall consist by volume of 60 parts AR-1000 asphalt conforming to the requirements of Section 711, 40 parts of synthetic latex, GRS-Type 4, and 5 to 10 parts of sodium fluosilicate, half strength. The emulsion and sodium fluosilicate shall not be mixed until the joint is ready to be filled. The amount of sodium fluosilicate to be mixed with the emulsion shall be approximately 3 to 5 percent by weight of the emulsion. The joint to be filled shall be thoroughly cleaned and surface dry.

The sealing compound shall consist of paving asphalt, Grade AR-1000 conforming to the provisions of Section 711, emulsified with rubber latex in the presence of a suitable emulsifying agent. Rubber latex designated as GRS-Type 4, or any other approved type, containing approximately 40 percent solids.

The resulting emulsion shall consist of a minimum of 55 percent of paving asphalt and a minimum of 36 percent of rubber latex and shall conform to the requirements set forth in the following table.

TABLE 729

ASPHALT-LATEX EMULSION JOINT SEALING COMPOUND

SPECIFICATION DESIGNATION	TEST METHOD	LIMITS	REMARKS
Furol Viscosity at 77°F.	AASHTO T-72	50-250 seconds	Before adding gelling agent.
Sieve Test	AASHTO T-59	1% Max.	Before adding gelling agent.
Penetration at 77°F.	ASTM D-217	50-250	The penetration test is made on a specimen prepared by stirring 5% of sodium fluosilicate into the asphalt latex emulsion in a 6 ounce deep ointment can. The specimen is then allowed to stand in the air at a temperature of 77°F. ± 2° for a period of 30 minutes and is then penetrated with a grease cone under a total load of 150 grams.
Elasticity		70% Min.	After addition of 5% of sodium fluosilicate and curing for 24 hours at 100°F. ± 2°, the specimen shall have an elastic recovery of not less than 70%.
Dehydration		Loss 30% maximum	Twenty-five grams of emulsion, prior to adding the gelling agent, is placed in an 8 ounce flat ointment can and dehydrated in a suitable oven maintained at a temperature of 200°F. ± 2° for a period of 24 hours.
Time of Set		15-60 minutes	After mixing the emulsion with 1% to 4% by weight of powdered sodium fluosilicate the emulsion shall harden or develop a set in from 16 to 60 minutes, under field conditions.

729.3 TEST REPORT AND SHIPMENT CERTIFICATE:

Each shipment shall be accompanied by a certificate in triplicate from the supplier that the material will comply with the above specifications and such certificate shall be delivered to the Engineer. The certificate shall show the shipment number for the entire lot of material contained in the shipment and shall also show a list which will enable the Engineer to identify each individual container by the supplier's batch number, with which each container shall be plainly marked.

729.4 APPLICATION:

At no time shall emulsion types be subjected to a temperature below 40°F. Prior to application, the material may be warmed, if necessary, to permit proper pouring of the joints. The method of heating shall be carefully controlled to avoid overheating of any part of the container or mixture and under no circumstances shall emulsions be heated to a temperature greater than 130°F.
Joints and cracks shall be thoroughly cleaned by hand or mechanical means immediately in advance of pouring the filler material. When new pavement has been cured by the Pigmented Sealing Compound Method, the joints and cracks shall be thoroughly scrubbed by means of a wire brush or a cloth mop saturated with gasoline or by other approved means.

All joints and cracks shall be surface dry before application of the joint sealer. No sealer shall by placed during unsuitable weather or when the atmospheric temperature is below 50°F., or when weather conditions indicate that the temperature may fall to 32°F. within 24 hours.

The joints and cracks shall be filled in a neat and workmanlike manner by means of a cornucopia pot or other approved method.

SECTION 734

REINFORCED CONCRETE LOW HEAD PRESSURE PIPE

734.1 GENERAL:

These specifications cover reinforced concrete pipe and asssociated specials intended to be used for conveyance of groundwater and stormwater under pressure. A special is defined as any piece of pipe other than a normal full length of straight section. This includes, but is not limited to, elbows, manhole sections, short pieces, reducers, adapter sections with special ends, sections with outlets, etc.

734.2 PIPE SPECIFICATION:

Reinforced concrete pipe and specials shall be manufactured and tested in conformance with the requirements of ASTM C-361, except as modified herein.

734.3 SUBMITTAL:

The Contractor shall submit to the Engineer 3 copies of a tabulated layout schedule when required and product data including joint and pipe details with sizes and dimensions.

The Contractor shall submit for approval details of the shape and size of the gaskets he proposes to furnish. The Supplier shall also submit certified test results in triplicate showing the physical properties of the materials used in the manufacture of gaskets. The pipe manufacturer shall supply a cement mill certificate in triplicate for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the cement used meets this specification. The pipe manufacturer shall also certify in writing that the cement content of the concrete complies with the specification as to yield per cubic yard of concrete poured.

Certification by the manufacturer that the pipe meets the specification herein defined and of the specification referenced is required. All test are required by the applicable specification and standard. The compression and hydrostatic test results are required. Certification shall state that the pipe meets the minimum internal pressures as specified in the bid schedule. Three certified copies shall be submitted to the Engineer, for approval before delivery.

734.4 MATERIALS:

Except when otherwise permitted by the Engineer, no materials shall be used in the manufacturing of the pipe or special other than water, portland cement, mineral aggregate and steel used in manufacturing pipe conforming to ASTM C-361, with the following exceptions:

734.4.1 Cement shall comply with ASTM C-150, Type V. The pipe manufacturer shall supply a cement mill certificate in triplicate for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of cement used meets this specification. The pipe manufacturer shall also certify in writing that the cement content of the concrete complies with the specifications as to yield per cubic yard of concrete poured.

Satisfactory facilities shall be provided for identifying, inspecting, and sampling cement at the mill, the warehouse, and the point of delivery. The Contracting Agency shall have the right to inspect the cement and obtain samples for testing at any of these points.

Cement shall be stored in weathertight, dry, well-ventilated structures approved by the Engineer.

If the temperature of the cement exceeds 150 F., it shall be stored until cooled to that temperature.

734.4.2 Water Cement Ratio Concrete shall have a water cement ratio no higher than 0.5 percent by weight.

734.4.3 Concrete Admixtures The pipe manufacturer shall certify in writing that no calcium chloride or admixture containing calcium chloride has been used in the manufacture of the pipe. Other admixtures may be used if approved by the Engineer. The pipe manufacturer shall certify to the brand and chemical content of such admixtures used.

734.4.4 Steel Reinforcement The pipe manufacturer shall supply three copies of mill certificates showing heat numbers, chemical analysis, and physical tests on reinforcing steel. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of steel used meets this specification. The number of steel wraps shall not be less than 5 percent below that shown on the shop drawing for any one pipe.

734.4.5 Joints The joints of concrete pipe shall be O-ring rubber gasket joints conforming to ASTM C-361 except the composition and properties of the rubber gaskets shall be as follows:

All rubber gaskets shall be extruded or molded and cured in such a manner as to be dense, homogeneous, and free from porosity and other imperfections. The tolerance for any diameter measured at any cross section shall be ± 1/32 inch. All gaskets shall be manufactured from a synthetic rubber compound. Said compound shall contain not less than 60 percent by volume of first grade synthetic rubber, shall contain no deleterious substances, and shall conform to the following requirements.

RUBBER GASKETS

Physical Properties	Value
Tensile strength, Min. psi	2300
Elongation at break, Min %	425
Shore durometer hardness, Type A. (1)	40-60
Compression set Max% of original Deflection (2)	20
Accelerated aging maximum % of original decrease in tensile strength - decrease in elongation	15 20
Liquid immersion, maximum % weight increase	5
Ozone Resistance	No visible cracking in accordance with Method D 1149

1. Pipe manufacturer shall select value suitable to type of joint.

2. Use Method B, except disc shall be 1/2 " long section of rubber gasket stock.

It is the intent of these specifications that the gasket container shall be performed rectangular groove so constructed that when two pipes are joined together the rubber gasket shall be compressed and for all practical purposes substantially fill and be largely confined within the rectangular groove.

3. Pipe sections shall be supplied with an adequate number of ring gaskets and lubricant.

734.5 MANUFACTURER'S QUALIFICATIONS AND EQUIPMENT REQUIREMENTS:

The manufacturer shall be competent to manufacture the type, size and quality of pipe; in addition, he shall have satisfactory curing and storage facilities, and satisfactory financial resources.

Calibration of Cement and Aggregate Scales: The pipe manufacturer shall make whatever alterations are necessary to his equipment to enable the Contracting Agency's Sealer or State Inspector of Weights and Measures to check, calibrate and seal the aggregate and cement scales used in pipe production.

734.6 CURING OF PIPE:

734.6.1 Steam Curing The manufacturer shall provide adequate steam plant, piping, enclosures, and other facilities for curing the pipe. The enclosures shall be such that the temperature is maintained continuously between 110 and 150 F.

734.6.2 Curing of the pipe and specials shall not commence until the concrete has attained its initial set, but in any event not sooner than 1 hour nor later than 8 hours after placing of the concrete. Rate of rise of temperature shall not exceed 30 per hour.

734.6.3 Water Curing The pipe shall be kept moist during daylight hours. The pipe, including the ends, shall be covered with burlap for the first 3 days, except that, if the pipe is kept constantly and completely wet with fog sprays during the daylight hours, the burlap covering may be omitted. If the manufacturer fails to proceed immediately with the required water curing he shall seal the surfaces of the concrete, except joint surfaces that are to be grouted, with an approved, white pigmented sealing compound in accordance with AASHTO M-148, Type 2.

734.6.4 Membrane Curing Membrane curing shall not be used as a method in the curing of pipe.

734.7 TEST AND ACCEPTANCE:

734.7.1 Basis of Acceptance The basis of acceptance for the reinforced concrete shall be in accordance with ASTM C-361 by the method stated in the special provision and as amended herein. However, the purchaser may at his option, make concrete cylinder tests for the purpose of determining release dates for shipment of the pipe and for his information in regard to general quality of the concrete.

734.7.2 Segregation of Material The slump of the concrete mix shall not exceed 4 inches so as to preclude excessive segregation of the materials used and shall be proportioned so that the result shall be a homogeneous concrete mixture of such quality that the pipe will conform to the tests and design requirements of these specifications.

734.7.3 Honeycomb, Cracks and Blisters Porous or honeycomb concrete areas 6 inches or lesser diameter may be removed and repaired. Pipe having defects or repairs greater than 6 inches in diameter will not be accepted.

Any crack exceeding 1 foot in length that goes completely through the pipe, is not considered acceptable whether repaired or not, except that a singe end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

Any crack that is .01 inch in width for 1/16 inch in depth or deeper, for a length of 1 foot or more and continues as a hairline crack down to the reinforcing steel for over 1/2 the length of the pipe is not considered acceptable whether repaired or not.

A single continuous hairline crack which does not extend to the reinforcing steel and not excess of .01 inch in width for a distance of 1 foot is acceptable without repair. This type of crack, longer than 1 foot shall be repaired.

Repairs shall be made by filling the defect with epoxy under pressure or by chipping out a V-section to the full depth of the defect and repairing with an approved patching compound. The composition of the patching compound shall be furnished to the Engineer for approval.

All pipe joints having blisters involving less than 1/4 the interior surface area shall be repaired by removing all loose material and exposing all hollow area and replacing with fresh concrete properly bonded, with and acceptable bonding agent, and curing the repair with membrane coating. Blisters with larger areas are not considered to be repairable or acceptable.

Painting of pipe, or portion of pipe, with grout to cover defects, minor or major, will not be permitted until approved by the Engineer.

734.7.4 Testing During the fabrication of the pipe, concrete cylinders shall be made from a representative sample of the concrete. Concrete cylinders and slump tests shall be made by the Engineer or under his direct supervision. A set of cylinders shall consist of three. A minimum on one set shall be made for each day's production. In vibrated and spun pipe, where the slump of the concrete approaches O, the cylinders shall be made as follows:

Fill the cylinder can in three equal layers. Each layer shall be vibrated and assisted by rodding or other mechanical contrivance simultaneously until the moisture comes to the surface. Care shall be taken that the material is not over-vibrated which will cause segregation. When the moisture rises to the surface of the third layer, it is struck off and leveled. The cap is put on the cylinder and it is marked for identification. It shall then be steam cured in the same manner as the pipe, at the conclusion of which, the cylinders shall be brought into the laboratory for standard moist curing until the prescribed time for the compressive test.

The cylinders shall be made according to ASTM C-31 where pipe is manufactured with concrete that has enough slump for the material to be hand rodded.

All shipments of reinforced concrete pressure pipe manufactured within or outside of the continental limits of the United States of America shall be tested within the United States at the manufacturer's plant or at an approved testing laboratory.

734.8 MARK: The trade name, specification designation, nominal size and class, designated pressures or head shall be stamped and plainly marked on each length and each special. In addition, each length of pipe and special shall be marked with the hydrostatic test pressure and date of manufacture.

SECTION 735

REINFORCED CONCRETE PIPE

735.1 GENERAL:

These specifications cover reinforced concrete pipe and related structures intended to be used for conveyance of sewage, industrial waste, storm and irrigation water.

The size, type, and D-load of the concrete pipe to be finished shall be as shown on the plans, or as specified under the item of work for the project of which the pipe is a part and shall be for pipe installed by the open-cut method of construction.

When specified in the special provisions, three sets of pipe line layout drawings shall be furnished to the Engineer prior to the manufacture of the concrete pipe. Catch basin connector pipe need not be included in the pipe line layout; however, pipe stubs shall be included. In lieu of including catch basin connector pipe in the pipe layout, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall contain the following information:

(A) Size and D-load of pipe.

(B) Station at which pipe joins main line.

(C) Number of section of pipe, length of section, type of sections (straight, horizontal bevel, vertical bevel, etc.).

The pipe layouts will be used by the Contracting Agency for reference only, but their use shall in no way relieve the Contractor of the responsibility for the correctness of the layout.

(D) All pipe installed in tunnels shall be ASTM C-76, Class III. Pipe stronger than that specified may be furnished at the Contractor's option, and at no additional cost to the Contracting Agency, provided such pipe conforms in all other respects to the applicable provisions of these specifications.

Whatever struts or other protective methods proved necessary to furnish and install the pipe to meet the limitation of cracks as specified herein, shall be provided and maintained throughout pipe handling and transportation.

735.2 QUALITY:

Reinforced concrete pipe shall be manufactured and tested in conformance with the requirements of ASTM C-76, except as modified herein. All reinforced concrete pipe less than 36-inch inside diameter shall include an area of reinforcing steel in the bell not less than the area required for the circumferential reinforcement in the wall of the pipe.

735.3 CURVES, BENDS AND CLOSURES:

Horizontal and vertical long-radius curves shall be formed by bevel adapters or by beveling the straight pipe joint. The bevel of the pipe shall not exceed 5 degrees and the total angular deflection, for beveled pipe, shall not exceed 10 degrees. Small angular changes may be made with straight pipe provided that the joint opening does not exceed 3/4 inch. Short radius curves and closures shall be formed with fabricated specials; however, the angular deflection of any segment of the fabricated section shall not exceed 10 degrees.

735.4 MATERIALS:

Except when otherwise permitted by the Engineer, no materials shall be used in the manufacturing of the pipe other than water, portland cement, mineral aggregates and steel used in manufacturing pipe conforming to ASTM C-76, with the following exception:

A) Cement shall comply with ASTM C-150, Type II, low alkali. The pipe manufacturer shall supply a cement mill certificate in triplicate for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of cement used meets this specification. The pipe manufacturer shall also certify in writing that the cement content of the concrete complies with the specifications as to yield per cubic yard of concrete poured.

Satisfactory facilities shall be provided for identifying, inspecting, and sampling cement at the mill, the warehouse, and the job site of the work. The Contracting Agency shall have the right to inspect the cement and obtain samples for testing at any of these points.

Cement shall be stored in weathertight, dry, well-ventilated structures approved by the Engineer.

Cement containing lumps will be rejected and shall immediately be removed from the site of work.

If the temperature of the cement exceeds 150°F., it shall be stored until cooled to that temperature.

(B) Mixture: The proportion of portland cement in the mixture shall be not less than 564 lbs. per cubic yard of concrete.

(C) Concrete Admixtures: The pipe manufacturer shall certify in writing that no calcium chloride or admixture containing calcium chloride has been used in the manufacture of the pipe. Other admixtures may be used if approved by the Engineer. The pipe manufacturer shall certify to the brand and chemical content of such admixtures used.

(D) Steel Reinforcement: The pipe manufacturer shall supply 3 copies of mill certificates showing heat numbers, chemical analysis, and physical tests on reinforcing steel. In lieu of the above, on stockpiled pipe the manufacturer shall certify that the type of steel used meets this specification. The area of steel used shall be the same as that shown on the shop drawing for that pipe.

(E) Rubber Gaskets shall comply with Section 765.

735.5 MANUFACTURER'S QUALIFICATIONS AND EQUIPMENT REQUIREMENTS:

The manufacturer shall be competent to manufacture the type, size and quality of pipe; in addition, he shall have satisfactory curing and storage facilities, and satisfactory financial resources.

Calibration of Cement and Aggregate Scales: The pipe manufacturer shall make whatever alterations are necessary to his equipment to enable the Contracting Agency's Sealer or State Inspector of Weights and Measures to check, calibrate, and seal the aggregate and cement scales used in pipe production.

735.6 CURING OF PIPE:

(A) Steam Curing: The manufacturer shall provide adequate steam plant, piping, enclosures, and other facilities for curing the pipe. The enclosures shall be such that the temperature is maintained continuously between 110 and 150°F.

(B) Curing of the pipe shall not commence until the concrete has attained its initial set, but in any event not sooner than 1 hour nor later than 8 hours after placing of the concrete. Rate of rise of temperature shall not exceed 30° per hour.

(C) Water Curing: The pipe shall be kept moist during daylight hours. The pipe, including the ends, shall be covered with burlap for the first 3 days, except that, if the pipe is kept constantly and completely wet with fog sprays during the daylight hours, the burlap covering may be omitted. If the manufacturer fails to proceed immediately with the required water curing he shall seal the surfaces of the concrete, except joint surfaces that are to be grouted, with an approved, white pigmented sealing compound in accordance with Section 726.

735.7 TESTS AND ACCEPTANCE:

(A) Basis of Acceptance: The basis of acceptance for the reinforced concrete pipe shall be in accordance with ASTM C-76 by the method stated in the special provision and as amended herein. However, the purchaser may, at his option, make concrete cylinder tests for the purpose of determining release dates for shipment of the pipe and for his information in regard to general quality of the concrete.

(B) Segregation of Material: The slump of the concrete mix shall not exceed 4 inches so as to preclude excessive segregation of the materials used and shall be proportioned so that the result shall be a homogeneous concrete mixture of such quality that the pipe will conform to the tests and design requirements of these specifications.

(C) A pipe has failed the D-load test when the opening crack exceeds .01 inch for a distance of 1 foot when measured at close intervals. These measurements are taken within the 1 foot measured span only where the crack line is more or less parallel to the axis of the pipe, as it is obvious that where the crack deviates substantially from parallel, and approaches a direction normal to the axis, that the edges of the crack tend to slip past each other, instead of opening up under load. The intent of the test is to measure the crack opening under stress.

(D) Porous or honeycomb concrete areas 6 inches or less in diameter may be removed and repaired. Pipe having defects or repairs greater than 6 inches in diameter will not be accepted.

(E) Any crack exceeding 1 foot in length that goes completely through the pipe, is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

(F) Any crack that is .01 inch in width for one-sixteenth inch in depth or deeper, for a length of 1 foot or more and continues as a hairline crack down to the reinforcing steel for over 1/2 the length of the pipe is not considered acceptable whether repaired or not.

(G) A single continuous hairline crack which does not extend to the reinforcing steel and not in excess of .01 inch in width for a distance of 1 foot is acceptable without repair. This type of crack, longer than 1 foot shall be repaired.

(H) Repairs shall be made by filling the defect with epoxy under pressure or by chipping out a V-section to the full depth of the defect and repairing with an approved patching compound. The composition of the patching compound shall be furnished to the Engineer for approval.

(I) The words regarding acceptability and repairability in the above paragraphs shall also apply when the crack occurs after loading of the pipe in the trench with backfill. Cracks wider than .01 inch shall be assumed to indicate overstress of the steel. In such case, the defective portion of the installation shall be replaced or repaired in a manner acceptable to the Engineer. After structural repairs are completed, the remaining cracks shall be filled as required above. All corrective measures shall be at the expense of the Contractor.

(J) Blisters: All pipe joints having blisters involving less than 1/4 the interior surface area shall be repaired by removing all loose material and exposing all hollow area and replacing with fresh concrete properly bonded, with an acceptable bonding agent, and curing the repair with membrane coating. Blisters with larger areas are not considered to be repairable or acceptable.

(K) Painting of pipe, or portion of pipe, with grout to cover defects, minor or major, will not be permitted until approved by the Engineer.

(L) Where the modified or special design method, under ASTM C-76 is elected, acceptance on the basis of material tests and inspection of manufactured pipe for defects and imperfections shall be as stated in ASTM C-76, and as amended herein. However, one joint of each size and D-load shall be selected by the Engineer for test purposes, and shall be tested for strength by the 3 edge bearing method, ASTM C-497, with the results being used for confirmation of the submitted design for this D-load. If the pipe section tested fails in compression or shear before reaching the D-load specified, the test shall be considered a failure. Additional sections of the same diameter size and class shall be tested as specified above until the load requirements are met for the D-load strength. This test procedure shall be accomplished only once per manufacture regardless of the number of contractors he supplies. Placing of reinforcing steel in the test section of pipe to control shear cracks will not be permitted.

Requirements regarding defects shall be the same as stated above for standard pipe.

Concrete test requirements specified under compression tests of ASTM C-76 shall be amended in part to read as follows: "The average of any 5 consecutive strength tests of the laboratory-cured specimens shall be equal to or greater than the specified strength set forth in Tables III, IV, or V, and not more than 20 percent of the strength tests shall have values less than the specified strength. If more than 20 percent have values less than the specified strength, the lot represented shall be considered to be defective and not acceptable. In no case shall any cylinder tested fall below 80 percent of the specified design strength. If any one cylinder falls below 80 percent of the specified design strength, then the entire production represented by that cylinder will not be accepted for purchase by the Contracting Agency unless the Contractor can

demonstrate by coring to the satisfaction of the Engineer, that the cylinder in question is not representative of the entire production, or is representative of only a portion of the entire production."

During the fabrication of the pipe, concrete cylinders shall be made from a representative sample of the concrete. Concrete cylinders and slump tests shall be made by the Engineer or under his direct supervision. A set of cylinders shall consist of three. A minimum of one set shall be made for each day's production.

In vibrated and spun pipe, where the slump of the concrete approaches 0, the cylinders shall be made as follows:

Fill the cylinder can in 3 equal layers. Each layer shall be vibrated and assisted by rodding or other mechanical contrivance simultaneously until the moisture comes to the surface. Care shall be taken that the material is not over-vibrated which will cause segregation. When the moisture rises to the surface of the third layer, it is struck off and leveled. The cap is put on the cylinder and it is marked for identification. It shall then be steam cured in the same manner as the pipe, at the conclusion of which, the cylinders shall be brought into the laboratory for standard moist curing until the prescribed time for the compressive test.

The cylinders shall be made according to ASTM C-31 where the pipe is manufactured with concrete that has enough slump for the material to be hand rodded.

735.8 DOWNGRADING OF PIPE:

For the purpose of these specifications, downgrade pipe shall be defined as pipe which is to be used under loads less than that for which they have been designed.

735.9 SANITARY SEWER PIPE:

In addition to the above, sewer pipe shall meet the requirements of ASTM C-76, reinforced concrete pipe having O-ring Rubber Gasket Joints with an interior lining of plastic liner plate in accordance with Section 741.

(A) Pipe Design: The wall thickness and the amount of circumferential reinforcement shall not be less than that required for the D-load indicated on the plans and required by the specifications. The calculations for wall thickness and amount of steel area per foot of pipe, having concrete lining, shall be for a pipe 2 inches larger in internal diameter than that specified on the plans. The additional concrete lining shall not be considered in the calculation for the area of steel required, nor in any of the load calculations.

D-load class of pipe and the date poured shall be plainly marked inside each pipe section. Specific approval must be obtained, prior to submitting a bid, to decrease the cover over the reinforcing steel at the joint should the steel interfere with the rubber gasket in the groove at the spigot end.

(B) Pipe Construction: Tamped or packed head pipe will not be allowed. Pipe having concrete lining shall have the internal diameters indicated on the plans, measured to the inside of the additional 1 inch of covering. The various sizes of pipe shall be centrifugally spun. Pipe having plastic liner plate shall be vibrocast to 1/2 inch tolerance to match the unlined pipe of the D-load indicated on the plans.

(C) Test and Acceptance: In addition to the statements above, any crack that goes completely through the pipe, regardless of length of crack is not considered acceptable whether repaired or not, except that a single end crack that does not exceed the depth of the joint as measured from the end to the inside shoulder is acceptable.

735.10 ACCEPTANCE MARK:

The Engineer may, at the place of manufacture, indicate his acceptance of the pipe for delivery to the job by marking the pipe with the Contracting Agency's mark. Such acceptance, however, shall not be considered a final acceptance.

If the pipe is subsequently rejected, the mark placed thereon by the Engineer shall be defaced.

SECTION 736

NON-REINFORCED CONCRETE PIPE

736.1 GENERAL:

The size and classes of the non-reinforced concrete pipe to be furnished shall be as shown on the plans, or as specified under the item of work for the project of which the concrete pipe is a part.

Strength classes of non-reinforced concrete shall be as identified in ASTM C-14, Class 1 non-reinforced concrete pipe. Class 2 non-reinforced concrete pipe, or Class 3 non-reinforced concrete pipe.

Unless otherwise specified, Class 3 non-reinforced concrete pipe will be used.

736.2 MATERIALS:

Materials used in manufacturing the pipe shall be as specified in ASTM C-14, with the following exception:

Cement shall conform to ASTM C-150, Type II, low alkali. Samples and testing shall conform to the methods designated therein. The pipe manufacturer shall supply a cement mill certificate, in triplicate, for each load of cement delivered, showing the specification, type, chemical analysis, and quantity. On stockpiled pipe in lieu of the above, the manufacturer shall certify that the type of cement used meets this specification. Satisfactory facilities shall be provided for identifying, inspecting, and sampling cement at the mill, the warehouse, and the site of the work. The Contracting Agency shall have the right to inspect the cement and obtain samples for testing at any of these points. The cement shall be stored in a weathertight, dry, well ventilated structure approved by the Engineer. Cement salvaged by cleaning cement sacks, mechanically or otherwise, shall not be used in the work. Cement containing lumps will be rejected and shall immediately be removed from the site of the work. If the temperature of the cement exceeds 150°F., it shall be stored until cooled to that temperature.

736.3 PIPE JOINTS:

The joints may be either tongue and groove mortared joints or O-ring rubber gaskets joints or as detailed on the plans. Tongue and groove, non-centering joints, shall be mortared inside and grouted outside. Grouting of the outside joints shall be by the diapering method. Mortaring and grouting of joints will be required on O-ring rubber gasket joints. Self-centering joints shall be mortared in accordance with Subsection 736.3.1.

736.3.1 Cement Mortar Joints: (A) The mortar or grout shall consist of 1 part portland cement and 2 parts sand, by volume. The quantity of water in the mixture shall be sufficient to produce a soft workable mortar, but shall in no case exceed a water-cement weight ratio of 0.53. Where outside joints are made by the diaper method, the grout shall be composed of 1 part cement to 3 parts sand, and shall be mixed to the consistency of thick cream. The sand shall conform to Section 701, and the cement shall conform to Section 725.

(B) The pipe ends shall be thoroughly cleaned and wetted with water before the mortar or grout is placed. No backfilling around the joints shall be done until the joints have been fully inspected and approved.

(C) Mortar joints shall be cured by keeping them wet for 3 days or by using a curing compound.

736.3.2 Rubber Gasket Joints: Rubber gaskets shall comply with Section 765.

736.4 CURVES, BENDS AND CLOSURES:

Horizontal and vertical long-radius curves shall be formed by slight deflection at the joints, provided that the maximum joint opening caused by such deflection shall not exceed 3/4 inch. Short radius curves shall be formed by straight pipe in which the joints are beveled. The bevel of the pipe shall not exceed 5 degrees, and the total angular deflection for beveled pipe shall not exceed 10 degrees at any joint.

736.5 CARE OF PIPE AND MATERIALS:

All pipe and materials shall be manufactured, handled, loaded, shipped and unloaded in such manner as to be undamaged and in sound condition, in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer, otherwise they shall not be used in the work and shall be replaced with an equal pipe or special in an acceptable condition. At all times rubber gaskets shall be stored in a cool, dark place until ready for use.

736.6. TESTS:

Before pipe is delivered to the job site for use in any work under the contract, test pipes shall meet the requirements of the hydrostatic pressure test and the loading test described in ASTM C-14. The test shall be made at the point of manufacture and shall be made under the presence of the Engineer.

SECTION 743

VITRIFIED CLAY PIPE

743.1 GENERAL

Vitrified clay pipe, 30 inch diameter or less, shall be extra strength in accordance with the requirements set forth in ASTM C-700, except as modified herein. Pipe larger than 30 inches shall be of the type specified in the Special Provisions.

743.2 MANUFACTURING REQUIREMENTS:

743.2.1 Shape: Pipe ends shall be square with the longitudinal axis, and sockets shall be true, circular, and concentric with the barrel of the pipe.

The ends of the pipe shall be so formed that when the pipes are laid together and the joints made, they shall constitute a continuous and uniform line of pipe and shall have a smooth and regular interior surface.

743.2.2 Stoppers, Branches, Ends: Stoppers shall be used with all branch pipes that are to be left unconnected. Stoppers for branch pipes having flexible compression joints may be either clay discs with flexible compression joints, factory applied, that will mate with the branch joint; or, a resilient material of controlled design and dimensions for mating with the branch pipe to which it is to be applied; or, of other material approved by the Engineer. Wooden stoppers will not be accepted.

Branches shall be furnished with connections of the sizes specified, securely and completely fastened to the barrel of the pipe in the process of manufacture.

"T" branches shall have their axis perpendicular to the longitudinal axis of the pipe. "Y" branches shall have their axis 45 degrees (unless otherwise specified) from the longitudinal axis of the pipe, measured from the socket end.

All branches shall terminate in sockets. Barrel of the branch shall be of sufficient length to permit making proper joint when the connecting pipe is inserted in the branch socket.

743.2.3 Imperfections: The following additional imperfections in a pipe or fittings will be considered injurious and cause for rejection:

(A) Any surface fire crack in the ends of the spigot or bell which exceeds 1 inch in length.

(B) Any piece broken from the bell end of the pipe or fittings when it adversely affects the performance of the joint or connection.

743.2.4 Certification: A certificate from the manufacturer shall be furnished attesting that the pipe meets the requirements of this specification, including test reports for the hydrostatic pressure test and the loading test herein specified.

743.3 TESTS:

In addition to the required tests at the manufacturer's plant, the Engineer's representative may select specimens at random at the point of delivery or at the job site. Tests on these specimens shall be performed at a local testing facility under the supervision of the Engineer's representative. The cost of such supervision will be borne by the Contracting Agency and all other costs shall be borne by the Contractor.

When the pipe is subjected to an internal hydrostatic pressure of 10 psi for the time shown in the following table, the accumulated moisture on the exterior surface shall not run down the sides in such quantity that will exceed 10 milliliters.

TABLE 743-1
TABLE OF TESTING TIME FOR PIPES

Thickness of Wall	Test Time Minutes
Up to and including 1	7
Over 1 and including 1½	9
Over 1½ and including 2	12
Over 2 and including 2½	15
Over 2½ and including 3	18
Over 3	21

The loading test shall conform in manner to that specified in ASTM C-301 for 3-edge bearing and shll be applied to all speciments selected for testing.

743.4 IDENTIFICATION MARKS:

Pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, a code number identifying production control and plant location and extra strength designation.

743.5 JOINTS:

Acceptable joints shall be flexible compression type for bell and spigot pipe or flexible compression couplings for plain-end pipe.

Compression joints and couplings shall conform to the requiarements of ASTM C-425.

SECTION 744

ABS TRUSS PIPE AND FITTINGS

744.1 GENERAL

Truss pipe is defined as an internally-braced double-walled ABS composite pipe conforming to ASTM D-2680. When noted on the plans or in the special provisions, gravity sanitary sewer system may be constructed using truss pipe for diameters not exceeding 15 inches.

Truss pipe shall have both ends of each pipe length sealed at the factory such that the inert filler material between the two concentric thermoplastic tubes is impervious. All field cuts shall be sealed according to the manufacturer's recommendations.

744.2 COUPLINGS AND FITTINGS:

Fittings for truss pipe may include couplings, wyes, tees, elbows, caps, plugs adapters, manhole water stops and clamps. All couplings and fittings shall be assembled by a chemically welded method. Solvent shall be of the type recommended by the pipe manufacturer. Each solvent weld type coupling or fitting shall be accurately formed and entirely compatible in joining the pipe to assure a leak-proof joint. Couplings and fittings shall be manufactured from the same material as the pipe except that caps, plugs and adapters may be fabricated or molded from rubber, polyurethane or other suitable compounds. The couplings and fittings shall have chemical and physical properties equal or superior to the pipe itself.

744.3 SOLID WALL PIPE AND FITTINGS:

744.3.1 General: When noted on the plans or in the special provisions, Sewer and Drain Solid Wall Pipe and Fittings may be used for 4-inch and 6-inch service lines, risers and fittings.

744.3.2 Material: Sewer and Drain Solid Wall Pipe shall be manufactured of virgin ABS compound as specified in ASTM D-1788, Types I and IV, excepting that the minimum heat deflection temperature (ASTM D-648) shall be 180°F.

744.3.3 Strength: Test samples of pipe, 6 inches long, shall be cut from full length sections and tested by the method outlined in ASTM D-2412. The pipe shall be deflected at least 35 percent without failure and the stiffness at 5 percent deflection shall equal or exceed the value listed in Table I below after the test samples have been immersed in a 5 percent solution by weight of sulfuric acid and n-Heptain for a period of 24 hours prior to testing. Failure is defined as rupture of the pipe wall.

Stiffness factor may be computed by the method outlined in ASTM D-2412 or by dividing the load in lbs/linear inch by the deflection in inches and 5 percent deflection (F/<delta>Y in Table 1).

TABLE 1

Minimum Stiffness Requirements

Nominal Size	F/<delta>Y 2.5% min.
4"	55 lb./in.^{2}
6"	55 lb./in.^{2}

744.3,4 Couplings and Fittings: All couplings and fittings shall be assembled by a chemically welded method. Each solvent weld type coupling or fitting shall be accurately formed and entirely compatible with the Sewer and Drain Solid Wall Pipe to assure a leak proof joint. Couplings and fittings shall be manufactured from the same material as the pipe except that caps, plugs and adapters may be fabricated or molded from rubber, polyurethane or other suitable compounds. The couplings and fittings shall have chemical and physical properties equal or superior to the pipe itself.

744.4 MANHOLE CONNECTIONS:

A clamp gasket or approved equivalent method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket.

744.5 CERTIFICATION:

A certificate from the manufacturer shall be furnished attesting that the pipe meets the requirements of ASTM D-2680.

744.6 IMPERFECTIONS:

Any imperfections which in the opinion of the Engineer may adversely affect the performance of the pipe or joints shall be cause for rejection.

744.7 INSTALLATION AND TESTING:

Truss pipe shall be installed in accordance with applicable provisions of Section 615. In addition to the tests prescribed in Section 615, the Engineer may, at his option, require a deflection test on all or any part of the line. Any pipe which shows deflection in excess of 5% shall be removed and replaced at no cost to the Contracting Agency.

SECTION 745

PVC SEWER PIPE AND FITTINGS

745.1 GENERAL:

This specification covers the requirements of polyvinyl chloride (PVC) plastic sewer pipe and fittings for gravity flow sewers and building connections. Fittings, couplings and joints for said pipe are included as part of these specifications.

745.2 MATERIALS:

745.2.1 Pipe and Fittings: Pipe from nominal diameter of 4" inch through 15" inch shall conform to the requirements of ASTM D 3034-SDR 35. Pipe with diameters from 18" inch through 24" inch shall conform to ASTM F679.

745.2.2 Caps and Plugs: Caps and plugs for building connections may be molded or fabricated from rubber, polyurethane or other suitable compound.

745.2.3 Gaskets: Rubber gaskets shall be manufactured from a synthetic elastomer and shall comply in all respects with the physical requirements specified in ASTM D3212.

745.2.4 Lubricant: The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe.

745.2.5 Solvent Cement Joints: The assembly of joints shall be accordance with ASTMD-2855.

745.3 Submittals:

1. Submit information in accordance with the General Conditions.
2. Provide affidavit of compliance with ASTM D3034 or ASTM F679.
3. Submit fully dimensioned cross section of the bell and barrel of the pipe. Show the bell maximum outside diameter and its minimum wall thickness at the same location.
4. Submit copies of the following manufacturer-required tests conduced on project pipe:
   a. Stiffness of pipe.
   b. Flattening resistance of pipe.
   c. Drop impact test.
   d. Record of additional tests after test sample failure

745.4 JOINING SYSTEMS:

Joints for the piping system and fittings shall consist of an integral bell gasketed joint designed so that when assembled, the elastomeric gasket located within the bell is compressed radially on the pipe or fitting spigot to form a positive seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service.

All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

Joints shall provide a permanent seal against exfiltration and infiltration, All surfaces of the joint upon which the gasket may bear shall be smooth and free of any imperfections which could adversely affect sealability.

The assembly of the joints shall be in accordance with the pipe manufacturer's recommendations.

745.5 FITTINGS:

Fittings for PVC pipe may include elbows, wyes, tee wyes, double bell couplings, plugs, caps adapters, increasers and others.

745.5.1 Manhole Connections: A manhole adapter gasket or approved equivalent method shall be provided at manhole entry or connection to prevent infiltration and exfiltration. Where precast manholes are used, entrance holes shall be large enough to allow for proper grouting around the manhole ring.

745.6 IMPERFECTIONS:

Any imperfections which in the opinion of the Engineer may adversely affect the performance of the pipe or joints shall be cause for rejection.

745.7 MARKING:

Legibly mark pipe and fittings at 5' foot intervals to identify manufacturer's name or trademark and code, nominal pipe size, the PVC cell classification and ASTM specification.

SECTION 746

PVC PRESSURE PIPE AND FITTINGS

746.1 GENERAL:

This specification covers the requirements of polyvinyl chloride (PVC) plastic pressure pipe utilized to construct water lines and force main pipelines under pressure. Fittings, couplings and joints for said pipe are included as part of these specifications.

746. 2 Material:

746.2.1 Pipe: Pipe from nominal diameter of 4" thru 12" shall conform to the requirements of AWWA C900, material compound meets ASTM D1784, cell class 12454B, Class 150 meeting requirements of DR18.

A. Elastomeric Seal: The pipe is to be integral bell gasketed provided with gaskets meeting requirements of ASTM F477.

B. Gasket Joint Assembly: The gasket joint assembly shall meet the requirements of ASTM D3139.

746.2.2 Pipe: Pipe from nominal diameter of 14" through 36" shall conform to AWWA C905, material compound meets ASTM D1784, cell class 12434B, with an established hydrostatic design basis of 4000 psi.

A. Elastomeric Seal: The pipe is to be integral bell gasketed provided with gaskets meeting requirements of ASTM F477.

B. Gasket Joint Assembly: The gasket joint assembly shall have an integrally thickened bell meeting ASTM D3139 as measured in accordance with ASTM D2122.

746.2.2 Fittings: Fittings shall conform to AWWA C110 with a minimum pressure rating of 250 psi. Size bells specifically for OD of cast iron equivalent PVC pipe including rubber-ring retaining groove.

746.2.4 Flanges: Flanges on outlets of fittings shall be Class 125 per ANSI B16.1.

746.2.5 Lining and Coating for Fittings:

1. Provide cement-mortar lined fittings per AWWA Cl04. Lining thickness shall conform to ASTM C 150, Type V.
2. Coat fittings per Section 472.11.

746.3 SUBMITTALS:

1. Submit information in accordance with the General Conditions.
2. Provide affidavit of compliance with AWWA C900 or C905.
3. Submit fully dimensioned cross section of the bell and barrel of the pipe. Show the bell maximum outside diameter in the pressurized area and its minimum wall thickness.
4. Submit copies of the following manufacturer required tests conduced on project pipe:
   A. Quick-burst strength of pipe and couplings.
   B. Flattening resistance of pipe.
   C. Record of additional tests after test sample failure.
5. Submit manufacturer's literature of gray iron and ductile-iron fittings including dimensions, thickness, weight, coating, lining and a statement of inspection and compliance with the acceptance tests of AWWA C110.

746.4 PRODUCT MARK:

Legibly mark pipe at 5-foot intervals and each coupling to identify the nominal diameter, the OD base, that is, cast-iron or steel pipe (IPS), the material code for pipe and couplings, the dimension ratio number, AWWA C900, C905 and suitability of the material for potable water service (NSF in the United States.)

SECTION 747

PRECAST CONCRETE MANHOLES

747.1 GENERAL:

Precast concrete manholes sections shall be constructed as defined herein and in accordance with Construction Standard 5-030 or as noted on the plans. The manholes sections shall be constructed of precast eccentric or concentric concrete manhole units as required for the project. Manholes shall be built with steps, unless noted on the plans.

747.2 MATERIALS:

Concrete shall be Class A (Type II - low alkali) and conform to the requirements of Standard Specification No. 725. Steel reinforcement for the precast units shall be in accordance with ASTM C-478. Steps shall be polypropylene and in accordance with Construction Standard No. 5-045.

747.3 PRECAST MANHOLES SECTIONS:

Precast concrete manhole sections shall be manufactured in a plant especially designed for the purpose. Concrete will be compacted by vibration in steel forms. All units shall conform to the size, shape, form and details as required by these specifications and as necessary to complete the project work. In the walls of the reinforced precast manholes, steel reinforcement shall be in accordance with ASTM C-478 latest revision. Steps shall extend 5" horizontally from inside wall surface, and spaced vertically on 16" centers except in the top and bottom sections of the assembled manhole. The lowest step in the assembled manhole will not exceed 18" above the shelf and the top step in the cone will not exceed 30" below the top of the C.I. Cover.

747.4 CERTIFICATION:

The supplier shall provide the Engineer a letter of certification before final payment attesting that the materials meet the requirements of these specifications. Test reports are to be provided when required.

SECTION 748

STEEL PIPE AND FITTINGS:

748.1 GENERAL:

This specification is intended to described 4 inch and larger steel pipe and fittings used in conjunction with pump station or other installations that require bends and connections for distribution systems that carry water under pressure.

748.2 PIPE:

Steel pipe shall be black carbon steel and conforming to the requirement of ASTM A-53 Type E or S, Grade A or B, or ASTM A135. Pipe shall be standard weight per ANSI B36.10 and a minimum 0.375 inches wall thickness for 12" inch pipe and above or as specified on the plans.

748.3 JOINTS:

Joints for buried pipe shall be butt-welded.

Joints for above ground or exposed pipe larger than 4" shall be flanged or butt-welded as shown on the plans.

748.4 FITTINGS:

Unless otherwise specified in the plans, fittings for buried pipe shall be flanged or butt-welded and fittings for above ground or exposed pipe shall be flanged.
Welding fittings for steel pipe 6-inches and smaller in size shall be butt-welded fittings of seamless carbon steel conforming to ASTM A-234, Grade A or B as to material and conforming to ANSI B-16.9 as to dimensions where established. Standard weight fittings shall be used with standard weight pipe. Welding fittings for pipe larger than 6-inches shall be butt-welded fittings in accordance with ANSI B-16.9, except that they may be light wall, light weight or light gauge provided the wall thickness is at least the same wall thickness as the pipe with which used. Welding fittings may be made up of sections of pipe welded together. Fittings made up of sections of pipe welded together shall be made of pipe of at least the same wall thickness as the pipe with which used; and bends shall be miter bends with radius the same as corresponding butt-welding fittings. Forty-five degree bends shall be 4-piece construction. Welding of these made-up fittings shall be in accordance with AWWA Standard C206.

Flanged fittings of cast iron for steel pipelines shall be governed by ANSI B16.1, Class 125. Flanged fittings of steel shall be made up from sections of steel pipe, as used on either side of the fittings, with attached steel flanges, all in accordance with AWWA Standard C208 or as detailed on the drawings. Drawing details govern over corresponding details in referenced specifications.

748.5 FLANGES:

Unless otherwise noted, flanges shall be in complete accordance with the minimum requirements of ANSI B16.5 and ASTM A181, I or II, forged carbon steel flanges, 150 pound.

Bolting, facing, threading, and dimensions shall be as given in the respective specifications listed. Slip-on flanges shall be attached to the pipe by back and face welds as shown in AWWA Standard C107. Welding neck flanges shall be single welded from the outside. Field welding shall be in accordance with AWWA Standard C206. Flanges shall be attached before any required linings or coatings are applied. Where cap screws or stud bolts are required, flanges shall be provided with threaded holes to receive such screws and bolts.

Full face or flat ring gaskets of 1/16-inch thick Granite, or equal shall be used.

748.6 BOLTS AND NUTS:

Bolts and nuts for buried flanges, flanges located outdoors above ground, flanges located in open vaults and structures, and submerged flanges shall be Type 304 stainless steel conforming to ASTM A N193, Grade B8, for bolts and ASTM A 194, Grade 8, for nuts. Bolts and nuts larger than 1-1/8 inches shall be steel, ASTM A 307, Grade B, with cadmium plating, ASTM A 165, Type NS>.

Provide washers for each nut. Washers shall be of the same material as the nuts.

748.7 GASKETS:

A. Gaskets shall be fullface, 1/16 inch thick, and shall be one of the following nonasbestos materials:

1. Cloth-inserted rubber. Products: Manville No. 109, John Crane Co. Style 777, or equal. Gaskets shall be suitable for a pressure of 350 psi at a temperature of 180 degrees F.

2. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400 degrees F.

748.8 FABRICATION:

A. Beveled ends for butt-welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding.

B. Fabrication shall comply with ANSI B31.3, Chapter V.

C. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

Welds shall be full circumferential.

D. Use the shielded metal arc welding (SMAW) process for welding.

E. Welding preparation shall comply with ANSI B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3, tables 341.3.2A and 341.3.2B, and paragraph 341.4 for visual examination.

F. Identify welds in accordance with ANSI B31.3, paragraph 328.5.

G. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.

H. Welding electrodes shall comply with AWS A5.1 or A5.5.

748.9 FLEXIBLE COUPLINGS:

Flexible pipe couplings for steel pipe shall be steel, Dresser Style 38, Rockwell Type 411, Baker Series 200, or equal.

748.10 LININGS AND COATINGS:

All steel pipe and fittings shall be cement-mortar lined and unless otherwise specified all steel pipe and fittings that are to be installed underground shall be coated on the outside in accordance with the requirement of Standard Specification No. 640.

The cement mortar lining and if specified cement mortar coating on the outside of the buried pipe shall be in accordance with AWWA - C205.

All exposed piping, joints and fittings shall receive one shop coat of protective paint of Tnemec 20-1255 Pota-Pox Primer (sand beige) applied at a rate that will provide a minimum dry film thickness of 4 to 6 mils.

SECTION 749

TAPPING SLEEVE

749.1 GENERAL:

The following specification sets forth the requirements for materials to perform a tapped connection under pressure including the valve on an existing water pipe line for a new connecting water pipe line.

749.2 MATERIAL:

749.2.1 Tapping Sleeve: Tapping Sleeves shall be of extra heavy construction to provide resistance to line pressures. They shall be built in two halves for assembly around the main to be tapped. Walls of castings shall be extra heavy and reinforced for extra strength.

The branch outlet shall have a flanged face for bolting to the tapping valve.

The inside diameter of the outlet branch shall be sufficiently larger than the nominal size cutters of the tapping machine.

Tapping sleeves may be of either the type in which water is allowed to circulate between the sleeve and the outside surface of the pipe, or of the type in which water is confined to the area immediately surrounding the tap opening. Sleeves shall be used only on the type and size of pipe for which they are designed and dimensioned.

For sleeves of the first type, gaskets of lead or of other suitable material shall be provided to form water tight joints along the entire length of the sleeve. The circumferential joints at the ends of the run of these sleeves shall be sealed by lead caulked joints or mechanical joints. These joints all conform to the requirements set forth in AWWA C-111 as to dimensions, clearances, materials, etc., except that gaskets and glands for mechanical joints shall be in two pieces.

The longitudinal gaskets shall be totally confined or compressed between ridges and/or grooves extending continuously for the full length of both halves of the sleeve casting. Bolts shall be located close to the outside of the gaskets and closely spaced so as to exert sufficient pressure to form a water tight joint and to amply take care of any design stresses. For sleeves with lead gasketed longitudinal joints and lead caulked end joints, the minimum bolting shall be as follows, or have bolts having an equivalent cross sectional area.

LINE SIZE (inches)	BRANCH SIZE	MINIMUM NO. BOLTS Lead Gaskets	MINIMUM SIZE BOLTS
3,4	3,4	6	3/4"
6 thru 16	3,4,6	10	3/4"
8 thru 12	8,10,12	12	3/4"
14, 16	8, 10, 12	12	7/8"
14, 16	14, 16	16	7/8"
18, 20, 24	3, 4, 6, 8	10	1"
18, 20, 24	10, 12, 14, 16	14	1"
18, 20, 24	18, 20, 24	18	1"

Tapping sleeves in which the water is confined to the immediate area of the tap opening shall be Kennedy Square Seal, Rich-Corey improved or approved equal.

The outlet half of each sleeve shall be fitted with a continuous gasket of approximately circular cross section permanently cemented into a groove surrounding the outlet opening. The back half of each sleeve shall be fitted with elastomeric pads, a metal shoe or other device for developing adequate pressure on the before mentioned gasket to prevent leakage at any pressure within the design capacity of the pipe.

749.2.2: Tapping Valves: Tapping valves shall be identical in construction with the specifications for gate valves. Tapping sleeves are considered an integral part of a tapping sleeve and valve assembly with openings the same as the valve. Tapping valves shall have ends and seat rings of sufficient size to permit the use of full size cutters of either the Mueller or Smith type tapping machines. The inlet end of the tapping valve shall be flanged for bolting to the tapping sleeve. The face of the flanged end shall have a raised lip to fit the recessed grooved surface of the tapping sleeve. This flanged end shall be in accordance with MSS SP-60, latest revision.

The tapping valve shall have the discs and seat ring so constructed that the inside diameter of the rings shall be at least 3/16" larger than the nominal size of the valve and the discs shall be proportionately larger to match.

SECTION 750

IRON WATER PIPE AND FITTINGS

750.1 GENERAL:

All cast iron and ductile iron water pipe shall be cement mortar lined and coal tar coated in accordance with AWWA C-104.

750.2 CAST IRON WATER PIPE:

All cast iron water pipe shall be designed in accordance with AWWA C-101.

Cast iron water pipe may be designed for either 18/40 or 21/45 physicals and shall conform to AWWA C-106 or AWWA C-108.

Except as otherwise provided cast iron or water pipe shall be designed to meet internal pressure of 150 psi, external cover of 5 feet, and Standard Laying Condition B.

Cast iron pipe shall be nominal 18 foot lengths.

750.3 DUCTILE IRON WATER PIPE:

All ductile iron water pipe shall be designed in accordance with AWWA C-150 and shall be manufactured in accordance with AWWA C-151 and be cement mortar lined. The class shall be as desig-nated in the plans or special provisions. Ductile Iron water pipe below 12" shall have a minimum wall thickness of Class 50 and pipe 12" and above shall have a minimum wall thickness of Class 52.

750.4 JOINT REQUIREMENTS:

Push-on joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include synthetic rubber gaskets and lubricant.

Mechanical joints for cast iron or ductile iron water pipe shall conform to AWWA C-111 and shall include cast iron glands, synthetic rubber gaskets, and T-head bolts and nuts.

Flanged joints for cast iron or ductile iron water pipe shall be class 125 and as detailed on the plans or as designated in the special provisions.

750.5 FITTINGS:

Iron fittings shall be either Gray-Iron or Ductile-Iron conforming to AWWA C-110 or AWWA C-153 with a minimum pressure rating of 250 psi. Flanged ends shall conform to AWWA C-110. Push-on and mechanical joints ends shall conform to AWWA C-111.

Fittings shall be cement mortar lined and coal-tar coated in accordance with AWWA C-104.

SECTION 751

WATER SERVICE FITTING

751.1 GENERAL:

All water service fittings shall conform to the Public Works Construction Standard 5-150 and these specifications.

751.2 MATERIAL:

All water service fittings including stops shall be cast of high grade bronze conforming to the requirements of ASTM Standard Specification B-62.

Corporation stops and curb stops shall have a full bore waterway of full diameter of the designated size. All nuts, washers and contact surfaces shall be faced to a true fit. All tapers shall be carefully ground and show no leakage under hydrostatic test. All stops shall have finished in a neat and workmanlike manner and the thickness of metal shall be equal around the axis of the circular way. All burrs on the inside of stops shall be carefully removed, leaving a clean smooth waterway. The following fittings have been approved for use in Yuma County.

Approvals are not necessarily exclusive, if approval of a similar device believed to be comparable and equal is desired, a request supported by appropriate information and data should be submitted to the Development Services

Corporation Stops

Manufacturer	Plastic Services	Copper Services
Jones	J-3402	J-1500
Ford	F-1001	F-600

Angle Stops

Jones	J-4202	J-4201
Ford	KUP-3W	KUT-3W

Service Saddles

Jones	J-979
Baker	KUP-3W
Ford	

Curb Stop

Jones	3/4" J-182
	1" J-206

SECTION 753

GALVANIZED PIPE AND FITTINGS

753.1 GENERAL:

All galvanized pipe shall be new galvanized welded or seamless steel pipe, conforming to the requirements of ASTM A-120 standard weight, schedule 40.

753.2 CORROSION PROTECTION:

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coating shall be not less than 0.030 inches in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extrucoat or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, coal tar or asphalt tape. Protecto Wrap No. 200, Safe-t-Clad FOS No. 655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchrap No. 50 or approved equal tape shall be edge lapped no less than 1/4 inch.

753.3 FITTINGS:

All fittings for screwed galvanized pipes shall be 150 psi, banded, galvanized malleable iron screwed fittings.

753.4 VALVES:

Valves on galvanized pipelines shall be all bronze, double disc, nonrising stem with wheel handle on top, such as Jones, J37-3 or equal, with bodies, bonnets, yokes and wedges made of material conforming to ASTM B-62.

SECTION 754

COPPER PIPE, TUBING AND FITTINGS

754.1 PIPE AND TUBING:

All copper pipe and tubing shall be new seamless copper pipes and tubes, designed for underground water services, plumbing purposes, etc. They shall conform to all the requirements of ASTM B-88, Type K.

All pipe or tubing shall be made of copper free from cuprous oxide, as determined by microscopic examination at a magnification of 75 diameters.

Type K tubing, when furnished in coils, shall be annealed after coiling.

754.2 FITTINGS:

All fittings used in connection with copper pipe or tubing, shall be copper or bronze fittings as manufactured by Jones, Mueller, or approved equal, as shown on standard details.

SECTION 756

FIRE HYDRANTS

756.1 GENERAL:

Fire hydrants furnished by the Contractor shall comply with AWWA C-502, supplemented as follows:

756.2 SUBMITTALS AND GUARANTEES:

Prior to delivery of hydrants, the Contractor shall deliver to the Engineer, the following information:

1. Catalog cut and materials list for approval showing construction and dimensions of hydrants to be provided.
2. Written guarantee from the manufacturer that the hydrant meets the friction loss requirements of AWWA Specification C-502, except that guarantee for delivery through steamer nozzle shall be for 2 1/2 psi maximum pressure drop when delivering 600 gpm.
3. Written guarantee from the manufacturer that the hydrant is so constructed that the valve stem will not be bent when the hydrant is broken off at the breaking flange.

756.3 HYDRANTS:

Fire hydrants shall be dry barrel similar or equal to the Corey or Mueller Improved Type. The inside diameter of the barrel shall be a minimum of 7 inches and the diameter of the main valve seat opening shall be not less than 5 inches. The entire valve assembly shall be effectively sealed against moisture. The net watering area of the barrel and shoe at the smallest part, exclusive of the inlet connection and the main valve opening, shall not be less than 190 percent of the net opening of the main valve operating nut shall turn left to open. All interior ferrous surfaces of the shoe exposed to fluid flow shall be epoxy coated to a minimum dry thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

Style of inlet connections shall be bell or mechanical joint with accessories, gland, bolts, gaskets and having a 6 inch diameter inlet connection. Facing of the main valve against seats shall be synthetic rubber or balata. The top of the stem or bonnet shall be equipped with the O-ring seal. Hydrants shall be constructed so that extension sections in multiples of 6 inches, with rod and coupling, can be added to increase barrel length. The hose and steamer nozzle connections shall match the standard size and threads per inch of the Contracting Agency. Operating and outlet nozzle cap nuts shall be of solid pentagonal shape. Each nozzle cap shall be fitted with chain and gasket. The pentagon shall measure fifteen-sixteenths to thirty-one thirty-seconds inch on side, 1-1/2 inch from point to flat. All barrels above ground shall have a prime coat and painted with two coats of fire hydrant yellow paint. Hydrants shall be constructed so that the standpipe can be rotated to at least 8 different positions and the center of the lowest nozzle shall have a ground clearance of not less than 15 inches.

756.4 MANUFACTURER:

The hydrant shall be dry barrel, waterous, Pacer WB-67, American Darling Improved Mueller Type or approved equal conforming to these specifications. The manufacturer shall guarantee that the hydrant is so constructed that the valve stem will not be bent when hydrant is damaged or broken at or near the grade level. A safety breaking flange or thimble, shall be provided. The friction loss must be guaranteed, by the manufacturer, to satisfy Table 756-1.

TABLE 756-1
MAXIMUM PERMISSIBLE LOSS OF HEAD FOR HYDRANTS

Number of Outlet Nozzles	Nominal Diameter of Outlet	Total Flow From Outlet Nozzles	Maximum Permissible Head Loss - PSI
2	2 1/2"	500	2.0
1	4"	600	2.5

SECTION 757

SPRINKLER IRRIGATION SYSTEM

757.1 GENERAL:

All materials and fittings shall be new, of the manufacturer's most current design, and shall bear the appropriate National Association seal of approval for example, NSF, UL, etc. Similar units shall be procured from the same manufacturer and internal parts shall be common and interchangeable. Parts listing and source of supply for replacement parts will be furnished to the Engineer.

757.2 PIPE AND FITTINGS:

The type of pipe material and fittings shall be as designated on the plans or in the special provisions. The type utilized shall comply with one of the following:

757.2.1 Steel Pipe: All steel pipe shall be newly galvanized, standard weight, Schedule 40 conforming with Section 753.

757.2.2 Plastic Pipe: Plastic pipe shall be rigid, unplasticized polyvinyl chloride, PVC 1120 or 1220, with an SDR of 26 or less, complying with ASTM D-1785. Schedule 40 pipe shall be used for the continuously pressurized run on the supply side of Control Valves when the pipe size is 3 inches or less. Use Class 315 for sizes larger then 3 inches or the supply side of the control valve. PVC 1120 to 1220, SDR 26, pressure rated at not less than 125 psi shall be used on the discharge side of all control valves.

757.2.3 Pipe Fittings and Couplings: (A) Steel Pipe Fittings and Couplings -- Steel pipe fittings and couplings shall be galvanized, malleable iron, screwed fittings or couplings, conforming with Section 753.

(B) Plastic Pipe Fittings and Couplings -- Plastic pipe fittings and couplings shall be either threaded type or Slip fitting tapered socket solvent weld type. Schedule 80 pipe only will be used for threaded joints. Tapered solvent weld fittings may be either Schedule 80 or Schedule 40, but in any case, will be equal to or greater than the Schedule and Pressure Rating of the plastic pipe being joined. Tapered fittings shall be sized so that a dry, unsoftened taper cannot be inserted more than halfway into the socket. Plastic saddles and flange fittings are not permitted.

(C) Copper Pipe Fittings and Couplings -- Copper pipe fittings and couplings shall conform with Section 754.

757.2.4 Solvent Cement: The solvent cement shall be a solution of Type 1, Grade 1, unplasticized, polyvinyl chloride molding or extrusion compound as specified in ASTM D-1784, or an equivalent PVC resin. The cement shall be free flowing and shall not contain lumps, microscopic undissolved particles or any foreign matter that will adversely affect the ultimate joint strength. It shall show no stratification or separation that cannot be removed by stirring. Container labeling shall be in accordance with ASTM D-2564.

757.3 VALVES AND VALVE BOXES:

757.3.1 General: Valves shall be of the size, type, and capacity designated on the plans or in the special provisions and shall comply with the requirements specified herein.

All valves except garden valves shall be capable of satisfactory performance at a working pressure of 200 psi. Valves shall be designed to permit disassembly to replace sealing components without removal of the valve body from the pipeline.

757.3.2 Gate Valves: Gate valves in size two inches and smaller shall be all bronze double disc wedge type with integral taper seats and non-rising stem. Sizes two and one-half inches and larger shall be iron body, brass trimmed, with the other features the same as for the two inch. Section 753 applies.

757.3.3 Manual Control Valves: Manual control valves shall be brass or bronze, and shall be straight or angle pattern glove valves, full opening, key operated with replaceable compression disc and ground joint union on the discharge end.

757.3.4 Electrical Remote Control Valves: Remote control valves shall be electrically operated, designed for a 24 volt, 60 cycle system. They shall be brass or bronze with accurately machined valve seat surfaces, equipped for flow control adjustment, and with the capability for manual operation. They shall be readily disassembled for repair and the internal parts shall be easily accessible for service even when installed in the line.

The internal valve shall be a normally closed, diaphragm type with slow opening and closing action as protection against surge pressures. Actuation shall be by an encapsulated type solenoid with the solenoid shunt band, tube, and plunger of stainless steel for corrosion protection A removable and cleanable strainer shall be provided at the control chamber inlet to prevent debris from entering the solenoid operating section.

757.3.5 Garden Valves: Garden valves shall be brass or bronze except for the handle. They shall have a replaceable compression disc, and shall be 3/4 inch straight-nosed, key operated and pressure rated for operation at 150 psi.

757.3.6 Quick-Coupling Valves and Assemblies: Quick-coupling valves shall be brass or bronze with built-in flow control and self-closing valve and supplied in 3/4-inch size unless otherwise required. When a quick-coupler assembly is specified, it shall consist of the valve, quick-coupler connection and hose swivel. Keys and hose swivel ells shall be furnished as specified on the plans.

757.3.7 Valve Boxes: Valve boxes shall have bolted locking covers shall be molded, noncorrosive plastic. Applicable ASTM references: D-638, D-356.

757.4 BACKFLOW PREVENTER ASSEMBLY:

The backflow preventer assembly shall consist of pressure type or reduced pressure type backflow preventer unit and associated components conforming to the governing code requirements and as shown on the plans. It shall be equal in quality and performance to a "Surgical Mechanical Research, Inc. P-711" type. Atmosphere backflow preventer shall be champion 362 or equal. Pressure backflow preventer shall be SMR P-711 or equal.

757.5 SPRINKLER EQUIPMENT:

Sprinkler heads, bubbler heads and spray nozzles shall be of the types and sizes as shown on the plans. All major components shall be brass, bronze, stainless steel, or high impact plastic.

Equipment of one type with similar flow characteristics shall be from the same manufacturer and shall bear the manufacturer's name and identification code in a position where they can be identified after installation.

Fixed head sprinklers shall have a one-piece housing with provisions for interior parts replacement. Pop-up sprinklers shall be designed to rise at least 2 inches during operation. Full or part circle sprinklers shall be interchangeable in the same housing.

Bubbler heads shall be of corrosion-resistant, durable bodies, injection molded out of cycolac, and tapped for 1/2" I.P.S. threads. The bubbler shall be fully adjustable from 0 to 5 gallons per minute and shall have a minimum discharge of 1.7 gallons per minute under pressure of 15 pounds per square inch and a minimum discharge of 2.4 gallons per minute under pressure of 30 pounds per square inch supplied at the head. The bubbler heads shall require a tool, such as a screwdriver, to make flow adjustments.

757.6 ELECTRICAL MATERIAL:

All equipment and material shall comply with the requirements of the governing code and shall be listed by Underwriters' Laboratories, Inc.

757.6.1 Conduit: Conduit shall be galvanized steel conforming to Section 753.

757.6.2 Conductors: Service line conductors shall be supplied in the size shown on the plans and shall be THW 600 volts insulation rating conforming to ASTM D-734. Low voltage control conductors shall be Type UF No. 14 AWG copper unless otherwise shown on the plan and shall be UL approved for direct burial installation.

757.6.3 Electro-Mechanical Controller: The control unit shall be fully automatic, with provisions for manual operation, sized to accommodate the number of stations or control valves included in the system and designated on the plans or in the Special Provisions. Outdoor models shall be housed in a vandal-resistant, weatherproof enclosure which has a locking cover.

The unit shall require a standard 117 volt, 60 cycle input and provide a 26.5 volt, 60 cycle output and shall incorporate a 14-day programming capability. The unit shall have a "Master On-Off" switch which will deactivate the controller but allow the day and hour clocks to continue operation.

In addition, it shall include a resettable circuit breaker for unit protection.

Each station timing dial shall have an "Omit" or "Off' position and incremental dial settings for timing controls up to 30 minutes.

SECTION 759

VALVES FOR WATERLINE AND PIPELINES

759.1 GENERAL:

The following specification set forth the requirements for gate and butterfly valves; check valves and air release and vacuum valves for installations on pipeline construction.

759.2 SUBMITTALS:

For valves 12 inches and smaller, the Contractor shall furnish the manufacturer's standard data and catalogues for the items being furnished:

For valves larger than 12 inches, the Contractor shall furnish shop drawings and technical data required for evaluating and approval of each type of valve, tapping sleeve and valve and butterfly valve. This information shall include complete details, dimensions, weights, diameter of stems, alloy for all valve pans and any information that may be required to assemble, install, operate and maintain the valve.

When it is doubtful that a manufacturer's product conforms to specifications, the Contracting Agency reserves the right to require submittal of more complete information before approving the above items.

The name of the manufacturer, the year of manufacture, the size of the valve, model number and rated working pressure, shall be cast on the body of each valve.

The Contracting Agency may test 10 percent of each type and size of valve furnished. Failure of any of the valves tested to meet these specifications, shall be deemed sufficient cause to reject the entire lot delivered.

759.3 MATERIALS, GENERAL:

All interior ferrous valve surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C550-81 and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous valve surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specification TT-V-51 c or shall be epoxy coated as required above for interior surfaces.

Bronze for all interior valve parts shall contain not more than 6% zinc.

759.3 GATE VALVES 3" thru 12":

All valves shall conform to the latest revisions of AWWA C-500 or C-509, supplemented as follows:

Valves shall be iron body resilient seated solid wedge gate valves with a cast iron wedge, designed to work equally well with pressure on either side of the gate. Valves shall be of the non-rising stem type and shall be left hand opening, counter-clockwise.

Bronze for all interior pads of valves shall contain not more than 6 percent zinc if made from cast bronze, or must conform to Copper Development Association #67600 if made from bar stock material.

Valves on water mains shall be hub-end or have Ring-Tite or Fluid-Tite bells for Class 150 LPVC pipe or mechanical joints conforming to AWWA C-111 or Titon joints for cast iron pipe.

Valves attached to side outlets shall be flanged and unless otherwise noted have 2 inch square operating nuts.

By-pass valves shall be flanged.

Valves in blow-off lines shall be flanged.

Valves in fire hydrant lines shall have hub-ends or mechanical joint ends.

Valves in air release and vacuum relief lines shall be flanged or screwed as shown on the plans.

Valves 12 inches and smaller, shall be equipped with O-ring packing.

Valves, 2 inches and smaller, shall be Jones, Ford, Hayes, Mueller or an approved equal, and shall be threaded. All bronze, standard, double-disc, non-rising stem valves with wheel handles.

759.3.2: Gate Valves: Valves 16-inches and larger shall be double disc gate valves, in accordance with AWWA C-500 except as hereinafter modified. When called for on the plans, there shall be by-passes for valves 16-inches and larger.

Valves shall have bevel gears with 2 inch square operating nuts. The gears and stuffing box shall be enclosed in a watertight cast iron case, for operation in a buried location. Bolts, nuts, studs, etc., used with the gear case, shall conform to the requirements for Bonnet Bolting in AWWA C-500. The case shall be filled with grease at the factory.

Valves shall be for operation in a horizontal position. The valve ends shall be flanged.

Valves shall be equipped with bronze tracks, rollers and scrapers, for operation in a horizontal position.

By-pass valves shall be furnished with each valve, mounted in position A as indicated in AWWA C-500. By-pass valve sizes shall be as follows:

TABLE 759-1

Gate Valve Diameter in Inches	By-Pass Valve Diameter in Inches
16 to 20	3
24 to 30	4
36 to 42	6
48	8

759.3.3 Tapping Sleeve Valves: Tapping valves shall be identical in construction with the above specifications for gate valves. Tapping sleeves are considered an integral part of a tapping sleeve and valve assembly, with openings the same as the valve. Tapping valves shall have ends and seat rings of sufficient size to permit the use of full size cutters of either the Mueller or Smith type tapping machines. Tapping sleeve valves shall be flanged on one end to fit the tapping sleeve and the other end shall be hub-end or mechanical joint.

The tapping valve shall have the discs and seat ring so constructed that the inside diameter of the rings shall be at least 3/16 inch larger than the nominal size of the valve. The seat rings shall be bronze and shall have a minimum seating surface area equal to that of a standard gate valve and the discs shall be proportionately larger to match.

759.3.4 Butterfly Valves 3" inches through 12": This specification generally describes valves and operator assemblies designed for underground service, as manufactured by Dresser Industries, B-I-F Industries Incorporated, Henry Pratt Company, Allis Chalmers Manufacturing Company or approved equal.

SECTION 759

Where material or equipment is designated on the plans or in this specification by trade or manufacturer's name, it is so designated primarily to establish standards of quality, finish , appearance and performance.

All specific requirements of this specification must be adhered to and all necessary modifications shall be made in the article specified by the trade name, type or model of manufacturer's equipment to make it conform to all specific requirements of this specification.

The valves shall be in accordance with AWWA C-504, Class 150-B except as modified herein:

1. Valve ends may be the thin type or wafer type to be installed between flanges drilled in conformance with ASA B 16.1-125 or may be flanged both ends or the valves may have bell ends with rubber gaskets for cast iron pipe or asbestos cement pipe conforming to the kind of pipe being used.

2. Valves shall be designed for buried service with the valve shaft in a horizontal position and the operating shaft vertical.

3. Valves shall be left-hand-opening, counter-clockwise unless shown otherwise on the plans.

4. Discs shall be Ni-Resist, ASTM A-436, Type I or cast iron, ASTM A-48, Class 40, in accordance with the following variations:

   A. Cast iron disc may be used providing the rubber seat ring is contained on the bronze ring contained in the body of the valve.

   B. Ni-Resist disc may be used where rubber seat is contained in the valve body.

   C. Valves with rubber seats in the valve body may have cast iron discs with a Type 304 stainless steel or bronze edge seating surface retained on the edge of the disc.

   Shafts and disc shaft fasteners shall be constructed of Type 304, stainless steel, completely sealed from the line fluid. Valve shafts completely sealed from the line fluid may be of high strength steel with all other meatal parts in contact with the line fluid to by Type 304 stainless steel.

   Valves with rubber seat mounted in the body shall have the rubber either bonded or mechanically retained in it's final position. Rubber sets which are on the disc edge shall be retained by a clamping ring and screws. Clamping ring and screws shall be made of 18-8 stainless steel, Type 304 or bronze conforming to ASTM B-61 or ASTM B-143.

   Manual operators shall have AWWA 2 inch square operating nuts and shall require at least 2 turns per inch diameter to rotate the disc 90 degrees. Operators must accept a minimum of 300 ft. lbs. input torque on stops at ends of travel without damage to valve or operator. The operator torque rating shall equal, or exceed, the valves shown in Table I of AWWA C-504 for valve class specified above.

   All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils.

   The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements AWWA C550-81 and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

   All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with 2 coats of asphaltic varnish conforming to Federal Specification TT-V-51 c, or shall be epoxy coated as required above for interior surfaces.

759.3.5 Butterfly Valves 16" inches and larger: Valves shall be in accordance with AWWA C-504 latest revision as modified herein:

1. Valve body shall be of cast iron or ductile iron with connecting ends one or a combination of : Flanged (Short Body), mechanical joint or ACP Hub End.
2. Valves shall be Class 150-B unless otherwise specified.
3. When requested, the manufacturer shall furnish records of tests specified in AWWA C-504.
4. Shaft seal may be O-ring seal, V-type packing or pull down packing.
5. The valve disc may be either cast iron or ductile iron.
6. Valves and operators shall be for direct burial installation.
7. Valves to be furnished with manual operators and 2" square operating nut. Operator torque rating shall be calculated in accordance with AWWA C-504.
8. Valves shall open when turning the operating nut counter-clockwise.
9. Valves shall be installed with valve shaft in a horizontal position and the operating shaft vertical.
10. All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550 and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.
11. All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with tow coats of asphaltic varnish conforming to Federal Specification TT-V-51C or shall be epoxy coated as required above for interior surfaces.

759.3.6 Check Valves: The check valve shall be a rubber flapper swing check valve and have a heavily constructed cast iron body and cover. The body shall be long pattern design with integrally cast-on end flanges. The flapper shall be Buna-N-having a "O" ring seating edge and be internally reinforced with steel.

Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve. Flapper shall be easily removed without need to remove valve from line. Check valves to have full pipe size flow area. Seating surface to be on 45 degree angle requiring the flapper to travel only 35 degrees from closed to full open position.

Buna-N flapper shall be hi-strength coated fabric-coated both sides with 70 duro and moded internally.

Materials of construction shall be certified in writing to conform to ASTM specifications as follows:

1. Body & cover: Cast iron
2. Flapper: Buna-N

Valve to be APCO series 100 rubber flapper swing check valve as manufactured by Valve and Primer Corp., Schaumburg, Illinois or equal.

759.3.7 Combined Air Relief/Vacuum Valve: A Combination Air Valve shall be equivalent to the single body, double orifice Model No. 147C combination air valve as manufactured by APCO Valve and Primer Corp., Schaumburg, Illinois. Valve shall allow large volumes of air to escape out the large orifice when filling a pipeline

and closes when liquid enters the valve. During a large orifice closure, the small air release orifice will open to allow small pockets of air to escape automatically and independently from the large orifice. The large orifice shall also allow large volumes of air to enter during pipeline drainage to break the vacuum. The body inlet must be baffled to protect the lower float from direct forces of rushing air and water to prevent premature valve shut off. The top large orifice plug or float must be protected in similar manner for the same purpose.

The Buna-N seat must be fastened to the valve cover, without distortion, for drop tight shut off. The floats shall be heavy stainless steel, hermetically sealed; designed to withstand 1000 psi. The top plug or float shall be center guided through hex bushings for positive shut off.

Valve shall have cast iron body and cover with Buna-N seat. Float and all other internal parts shall be stainless steel. Valve exterior to be painted with Red Oxide Phenolic Primer paint. Inlet and outlet shall be N.P.T. threaded per ANSI B2.1 pipe threads.

SECTION 760

COATING CORRUGATED METAL PIPE AND ARCHES

760.1 GENERAL:

Corrugated metal pipe, pipe arches, and connectors to be used or furnished under this specification shall be manufactured and inspected in conformance with the requirements of AASHTO M-36, and as hereinafter specified. The size, type, and gage of the pipe to be furnished shall be as shown on the plans or standard details.

760.2 MATERIALS:

Corrugated metal products covered by this specification shall be plain galvanized conforming to the requirements of AASHTO M-36 as modified herein.

The types of bituminous coated pipe shall be as specified by the standard details or special provisions. In addition to the types listed in AASHTO M-190 there will be a Type D.

Type D: Coated and Smooth Lined Pipe -- The pipe shall be uniformly coated on the outside as required for Type A pipe. In addition, the pipe shall be paved on the inside for the entire periphery with bituminous material as specified above. The bituminous paving material shall be applied in such a manner that a smooth interior will be formed throughout with all corrugations filled. The pavement shall have a minimum thickness of 1/8 inch above the crest of the corrugations.

760.3 BASE METAL, SPELTER AND FABRICATION:

The nominal pipe diameter shall meet the tolerances of this specification. Elliptical Pipe, when specified, shall be shaped after fabrication and coating have been completed.

In lieu of corrugations as specified in AASHTO M-36 corrugations may be 3 inches from center to center, with a depth of not less than 1 inch.

Helically Corrugated Metal Pipe: The pipe shall be fabricated from flat sheets in coils. The base metal, spelter coating, method of sampling, accepted brands of metal, sheet manufacturer's certified analysis and guarantee, workmanship, marking, inspection and rejection, shall meet the requirements of AASHTO M-36. Structures furnished shall be either full circle, or pipe-arch in accordance with Table 4 of AASHTO M-36, or other shape as shown on the plans. The pipe dimensions shall conform to AASHTO M-36 in all respects, except that the corrugations shall be helical instead of annular. The thickness of the galvanized metal shall be in accordance with standard details or as otherwise specified. Pipe with helical corrugations shall have a continuous lock or welded seam extending from end to end of each length of pipe. The seams shall be fabricated in such a manner that they will not affect the shape or nominal diameter of the pipe and so that they will not create an element of weakness in the pipe.

760.4 COUPLING BANDS:

Watertight joints shall be fabricated for corrugated metal pipe by the use of galvanized couplers or connecting bands, bituminous coated, with each band overlapping by at least 2 inches. Corrugated coupling bands shall be constructed and connected as specified in AASHTO M-36, except as otherwise required herein. Dimple type coupling bands shall be manufactured by Garland Steel Company, American Bridge Company, Republic Steel Company, or shall be of an approved equivalent design and quality conforming to the above requirements. The couplers or bands shall be manufactured of material 2 gages lighter than the gage specified for the pipe material, shall have corrugations or dimples to match the pipe corrugations or may be flat, and shall be fastened with bolts. Dimpled coupling bands shall be 10-1/2 inches wide for diameters 12 through 60 inches, and 17 inches wide for diameters above 60 through 96 inches. The 10-1/2 inch wide bands shall have 2 rows of dimples of not less than 7 dimples per row, and the 17 inch wide bands shall have 4 rows of dimples of not less than 7 dimples per row. The dimple arrangement shall be such that a maximum spread can be attained. The shape of the dimple shall be such that it shall, in general, conform to the standard pipe corrugation. The connecting angles for dimpled coupling bands may be riveted as for standard corrugated coupling bands, or may have slotted angles. The bands shall be attached by means of 1/2 inch nominal diameter carriage bolts. Two bolts are required for

pipes up to 36 inches in diameter, 3 bolts for 36 through 60 inch diameters and 5 bolts for pipes above 60 inches in diameter. Plain flat coupling bands shall have the same width and number of bolts as specified above. Flat coupling bands having a single circumferential corrugation rolled in each edge to match a similar corrugation in the end of each pipe may be 10-1/2 inches wide regardless of pipe diameter and shall be fastened with 2 bolts.

760.5 PERMISSIBLE VARIATIONS IN DIMENSION:

Plain galvanized and Type A pipes: The internal diameter of 12 through 24 inch pipe shall not vary more than +1.5 percent from the design diameter. The internal diameter of 27 through 108 inch shall not vary more than ±1 percent or 3/8 inch, whichever is greater from the design diameter.

Type D pipe: The design diameter of the metal pipe before paving shall be the diameter shown on the plans plus 1/4 inch. The design diameter may vary as above.

SECTION 761

STRUCTURAL PLATE PIPE, ARCHES, AND PIPE ARCHES

761.1 GENERAL:

Structural plate pipe, arches, and pipe arches shall be of the sizes, gages, and dimensions designated on the plans or in the special provision and as specified herein.

761.2 MATERIALS:

Plates, nuts and bolts shall conform to the specifications of AASHTO M-167.

Galvanized surfaces which are damaged shall be repaired in accordance with the provisions in Section 771.

Bituminous coating shall conform to the provisions of AASHTO M-190.

Damaged bituminous coatings shall be repaired by the Contractor at his expense by applying bituminous material conforming to AASHTO M-190.

761.3 IDENTIFICATION:

The gages of structural plates will be identified on the plans in accordance with the following:

Each installation will be designated not only by size, but also by symbol indicating the number and gage of plates required. Thus, (412-18) will be used to designate an installation for 1 plate length composed of 4, 12 gage plates and 1, 8 gage plate, the heaviest to be placed in the invert.

761.4 DISTORTION:

In advance of placing backfill material around circular structural plate pipes, the pipe shall be distorted.

Distortion may be performed either at the fabricating shop or in the field.

If the plates are distorted in the fabricating shop, the plates shall be distorted to provide an increase in the vertical diameter of the pipe, after assembly, of approximately 5 percent for the full length. Plates shall be marked in order to assure that they will be placed in proper position.

If the pipes are distorted in the field the method of distortion shall conform to the details shown on the plans. The vertical diameter shall be increased the approximate percentages listed in the following table, throughout that portion of the pipe between shoulder lines.

Pipes using 1 or 3 gage top and side plates -- 1 percent

Pipes using 5 or 7 gage top and side plates -- 2 percent

Pipes using 8, 10, or 12 gage top and side plates -- 3 percent

Between the shoulder lines and the outer ends of the pipe the distortion may decrease uniformly to zero.

SECTION 765

RUBBER GASKETS FOR CONCRETE PIPE

765.1 GASKETS FOR LOW HEAD PRESSURE CONCRETE PIPE:

Gaskets for low head pressure concrete pipe shall be in accordance with Specification 734.4

765.2 GASKETS FOR GRAVITY SANITARY SEWER PIPE:

The joints of sanitary sewer concrete pipe shall be O-ring rubber gasket joints conforming to ASTM C-361 except the composition and properties of the rubber gaskets shall be as follows:

All rubber gaskets shall be extruded or molded and cured in such a manner as to be dense, homogeneous, and free from porosity and other imperfections. The tolerance for any diameter measured at any cross section shall be ± one-thirty-second inch. All gaskets shall be manufactured from a synthetic rubber compound in which the elastomer is chloroprene (ASTM-SAE Designation TYPE SC) exclusively. Said compound shall contain not less than 50 percent by volume of neoprene, shall contain no deleterious substances, and shall conform to the following requirements:

TABLE 765

RUBBER GASKETS

Physical Properties	Value	Method of Test
Tensile strength, Min. psi	1500	ASTM D-412
Elongation at break, Min.%	425	ASTM D-412
Shore durometer hardness, Type A, (1)	40-60	ASTM D-2240
Compression set, Max.% of original deflection, (2)	20	ASTM D-395
Accelerated aging, tensile strength, %, (3)	80	ASTM D-572
Max. increase over original shore duromerter value after accelerated	8	ASTM D-2240
Specific gravity	0.95-1.45 ± 0.05	ASTM D-297

(1) Pipe manufacturer shall select value suitable to type of joint.

(2) Use Method B, except disc shall be 1/2 inch long section of rubber gasket stock.

(3) Percent of tensile strength, after aging by the oxygen-pressure chamber (96 hours, 158 ±1.8°F, 300 ±15 psi), of the tensile strength before aging.

It is the intent of these specifications that the gasket container shall be a preformed rectangular groove so constructed that when 2 pipes are joined together the rubber gasket shall be compressed and for all practical purposes substantially fill and be largely confined within the rectangular groove.

765.3 GASKETS FOR GRAVITY STORMSEWER IRRIGATION AND DRAINAGE PIPE:

The gasket shall be the sole element depended upon to make the joint watertight, and shall have smooth surfaces, free from pits, blisters porosity, and other imperfections. The rubber compound shall contain not less than 60% by volume of first grade synthetic rubber. The remainder of the compound shall consist of pulverized fillers free from rubber substitutes, reclaimed rubber and deleterious substances. The compound shall meet following physical requirements when tested in accordance with appropriate ASTM Specifications:

(1) Tensile strength of the compound shall be at least 2,100 psi ASTM D-412.

(2) Elongation at Rupture shall be at least 400%, ASTM D-412.

(3) Shore Durometer Hardness, Type A. Value *40-60, ASTM D-2240.

(4) Cold Flow: The percentage shall not exceed 20. The determination shall be made in accordance with Method B ASTM D-395, with the following exception. The disc shall be 1/2" thick and the diameter shall be that of the rubber gasket. The gaskets shall not be exposed to direct sunlight for a time greater than needed to accomplish normal installation.

(5) Specific gravity shall be consistent within +0.05 and shall be between 0.95 and 1.45, ASTM D-297.

765.4 SUBMITTALS:

The Contractor shall submit certified test results in triplicate showing the physical properties of the materials used in the manufacture of all gaskets.

SECTION 767

VALVES FOR PUMP STATIONS

GENERAL:

This specification specifies materials for those valves used in stormwater pump station applications where installations are above ground or in vaults or structures.

767.2 MANUAL GATE VALVES:

Manual gate valves shall comply with the requirements of AWWA- C500 supplemented as follows:

Valves shall be iron bodied, solid bronze internal working parts, parallel faced, bottom wedging double-discs and O -ring seals. The minimum designated water working pressure shall be 200 psi. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall be ASTM B 62 (85-5-5-5) bronze, except that stem bronze shall have a minimum stencil strength of 60,000 psi, a minimum yield strength of 30,000 psi and a minimum of 10% elongation in 2 inches. Body bolts shall be Type 304 or Type 316 stainless steel , ASTM A 276. Valves shall be left hand opening, counter-clockwise with arrow indicator. Valve shall be of the non-rising stem type with hand wheel operator, flanged joint ends conforming to ANSI Specification B16.1, Class 125. Valve shall have a stuffing box of an "O-ring" type.

Unless otherwise stated in the detailed valve specifications, packing, O-rings and gaskets shall be one of the following non-asbestos materials:

A. Teflon

B. Kevlar aramid fiber.

C. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard", "Klinger", "Klingersil C4400," or equal.

D. Buna-N (nitrile.)

Valves shall have the year cast, the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate. Valves shall be Clow AWWA gate valve, MUELLER Series A2380 or equal.

Valves, 2 inches and smaller, shall be Jones, Ford, Hayes, Mueller or an approved equal and shall be threaded. All bronze, standard, double-disc, non rising stem valves with wheel handles.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or therosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% of AWWA C550-81 and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specification TT-V-51 C or shall be epoxy coated as required above for interior surfaces. Apply a finish coat of paint to match adjacent piping in accordance with protective coating spec.

Bolts, nuts and gaskets for flanged valves shall be in accordance with Section 645.

Unless otherwise indicated on the drawings, install valves in horizontal runs of pipe having centerline elevations 4'-6" or less above the floor with their operating stems horizontal.

767.3 CHECK VALVES:

Check valves shall be of swing type and shall meet the material requirements of AWAA specification C508. The valve shall be iron body, bronze mounted, single gate for non-shock working pressure 175 psi 2"-12", 150 psi 14"-24" and hydrostatically tested at double the working pressure. Ends shall be flanged. All working parts are to be bronze to bronze or bronze to stainless steel. When there is no flow through the line the gate shall hang lightly against the seat. It shall have a bronze face gate.

The valve shall be so constructed that by simply unbolting and lifting off the cover, the internal working parts may easily be removed and replaced without removing the valve from the line. The valve shall be furnished with outside lever and adjustable spring. Check valves shall be suitable for mounting in horizontal lines or vertical lines when water flow is up. Check valves shall have stainless steel hinge pin. Hinge pin shall operate in bronze support bearings (2"-12") or babbitt support bearings (14"-24".)

Exterior painting of ferrous surfaces shall conform to paragraph 1510.2 of these specifications.

Bolts, nuts and gaskets for flanged valves shall be in accordance with specification No. 645. Check valves shall be Clow List 115 or equal.

767.4 AIR/VACUUM VALVE

Valves shall release air and release vacuum automatically. Air release on the discharge side of the submersible pumps shall be controlled by the use of air release valve assemblies installed with gate valves and miscellaneous blow-off piping as shown on the contract drawings and at a minimum, piping to discharge releases on the ground.

Each air release valve shall be constructed with a cast iron body and cover, an inlet connection an outlet connection. The float shall be stainless steel with a Buna-N rubber seat. Valves shall be constructed for a maximum working pressure of 150 psi. The largest air release orifice shall be provided that will perform satisfactorily at the actual working pressures in the pipelines. Valve may be either flanged or screwed.

Air release on water mains shall be controlled by the use of an air release valve assemble, of size and type as shown on the plans. Air release valves shall be of the flanged or screwed type as shown and shall be similar and equal; to Apco, Crispin or Simplex.

Vacuum and Air Relief when called for on the plans shall be controlled by a vacuum relief valve on the air release valve noted above and the valve shall be of the same manufacture or may be a combination air and vacuum valve assembly similar and equal to Apco, Crispin or Simplex.

Valve shall be painted in accordance with these specifications.

SECTION 770

STRUCTURAL AND RIVET STEEL, RIVETS, BOLTS, PINS, AND ANCHOR BOLTS

770.1 GENERAL:

All steel, unless otherwise designated on the plans or in the special provisions, shall conform to the requirements of ASTM A-36.

Report of Tests: Before fabrication, the Contractor shall furnish to the Engineer a certified mill report in triplicate, for each identifiable melt of steel or iron from which the material is to be fabricated. The report shall include the chemical and physical tests required by the ASTM specifications.

Additional Tests: The Contracting Agency reserves the right to require and to make additional mill and laboratory tests. The number of such additional tests will be limited as follows, except that in the case of failure of the material to comply with the ASTM requirements, more tests will be made:

Structural steel, 1 complete test for each heat or each 10 tons of identifiable stock. Rivets, 1 complete test for each size. Bolts, 1 complete test for each lot.

Identifiable stock is material for which authentic records of the chemical and physical properties are available.

Test specimens shall be furnished, cut, and machined in accordance with the ASTM specifications, for the material to be tested, as referred to herein. Test specimens shall be furnished and machined by the Contractor at no additional cost to the Contracting Agency.

Mill Tolerances: Rolling and cutting tolerances, permissible variations in weight and dimensions, defects and imperfections shall not exceed the limits for structural steel contained in ASTM A-6.

Stock Material: When the Contractor proposes to use material already in stock, he shall notify the Engineer of such intention at least 10 days in advance of beginning fabrication, to permit sampling and testing.

770.2 STRUCTURAL STEEL:

Stock Materials: The Contractor shall select the material he wishes to use from stock. The Contractor shall furnish 3 certified mill reports for each of the heat numbers. Two samples shall be taken by a representative of the Engineer from each heat number, one for the tension test and one for the coldbend test. If the heat numbers cannot be identified, the representative of the Engineer shall select random test specimens from the unidentifiable heats. The number of such test specimens shall be at the discretion of the Engineer. The cost of all tests on stock material shall be borne by the Contractor.

High Strength Low-Alloy Structural Steel: The material shall conform to the requirements of ASTM A-242, A-440, A-441, A-374, A-375 or A-446 Grades C, D, or E as specified in the special provisions.

Copper Bearing Structural Steel: Copper bearing structural steel shall conform to the requirements of ASTM A-36, A-245, A-570, A-440, or A-446 as specified in the special provisions.

770.3 RIVETS:

Stock Material: Rivets taken from identifiable stock shall be accepted by the Engineer in accordance with this specification.

Rivets from unidentifiable stock, for which authentic records of the chemical and physical properties are not available, shall not be used except where shown on the plans or when approved by the Engineer.

High-Strength Structural Rivet Steel: The material shall conform to the requirements of ASTM A-502.

Structural Rivet Steel: The material shall conform to the requirements of ASTM A-502, except that the test specimen shall be bent upon itself when performing the bend test.

770.4 BOLTS:

Unfinished Bolts: The bolts shall have square heads and square nuts unless otherwise specified. The bolts shall be long enough to extend entirely through the nut but not more than 1/4 inch beyond. Washers shall not be furnished unless specified.

Steel bolts shall conform to the requirements of ASTM A-307, except that steel manufactured by the acid Bessemer process shall not be used.

High Strength Bolts: High strength bolts shall conform to the provisions of the specification for the design, fabrication and erection of structural steel for buildings of the AISC.

770.5 ANCHOR BOLTS:

Anchor bolts shall be manufactured from steel conforming to ASTM A-36 or A-307.

770.6 MILD-STEEL FORGINGS FOR STRUCTURAL PURPOSES:

Steel forgings shall be made from steel of forging quality and shall conform to the requirements of ASTM A-235. They shall be Class C forgings with a maximum carbon content of 0.35 percent and shall be given a thorough annealing. The metal shall have a minimum Brinnel hardness number of 130, and a maximum of 190, when tested in accordance with ASTM E-10.

SECTION 771

GALVANIZING

771.1 GENERAL:

Materials shall be hot-dip galvanized and the weight and uniformity of coating determined in accordance with the standard specifications given in the following table:

TABLE 771

GALVANIZING SPECIFICATIONS

	ASTM	Wt. of Coating Oz./Sq. Ft. (Min.) Spec.
Corrugated Metal Pipe	A-444	1.80
Flat Steel or Iron Sheets	A-525	1.25
Iron or Steel Wire	A-116	.80
Chain Link Fabric	A-392	1.20
Barbed Wire	A-121	.50
Steel Pipe Rails	A-53	1.80
Structural Shapes, Tie Rods, Ornamental Iron Railings, Handrails, Manhole and Catch Basin Steps and Curb Armor	A-123	2.00
Bolts, Nuts, Washers, Anchor Bolts, Packing Spools, Gray Iron and Malleable Iron Castings and Steel Castings	A-153	1.25

771.2 WORKMANSHIP:

The galvanizing shall be applied in such a manner that the spelter will not peel off. The finished product shall be free from blisters and excess spelter, and the coating shall be even, smooth, and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting and other fabricating shall all be done as far as is practicable before the galvanizing. No member shall be galvanized which is out of alignment. All members (nuts, bolts, washers, etc.) shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings due to poor workmanship, rough handling, or any other reason shall be cause for rejection.

771.3 TEST COUPONS:

Test coupons for determining the quality of the galvanizing shall be wired to the materials to be galvanized before immersion in such a manner as to represent the amount of coating deposited on the materials.

771.4 REPAIR OF GALVANIZED SURFACES:

Unless otherwise specified, where galvanized surfaces are field or shop cut, broken, burned or abraded, thus breaking the galvanizing, the locations thus damaged shall be repaired to the satisfaction of the Engineer with zinc dust-zinc oxide coating conforming to AASHTO M-36.

SECTION 772

CHAIN LINK FENCING

772.1 GENERAL:

All material shall be new and the Contractor, upon request, shall furnish to the Contracting Agency, a certificate of inspection stating that the posts, rails and braces have been manufactured, sampled, tested and inspected so as to meet the requirements for its type as specified below.

772.2 POSTS, RAILS AND BRACES:

Posts, rails and braces shall be constructed of pipe in conformance with types A,B or C below. Unless specifically designated by type in the plans or specifications, the Contractor may utilize any of the three types. The posts and rails in this section will cover fencing up to 12 feet in height with post spacing not to exceed 10 feet. The nominal outside dimensions and minimum weights shall be in accordance with Table 772. The manufacturer or his representative shall legibly mark each length of pipe by rolling, stamping or stenciling to identify the product by product name, ASTM standard, etc. and the county of manufacture.

Type A: Pipe shall be black steel, welded or seamless hot-dipped zinc coated, manufactured in conformance to ASTM F-1083, plain end, standard weight (schedule 40). The hot-dipped zinc coating (galvanized)shall be applied both inside and outside with not less than 1.8 oz.s. per square foot ± 0.1 ozs.

Type B: Steel used in the manufacturing of the pipe shall be hot-rolled strip steel in compliance with ASTM F-569 having a minimum yield strength of 50,000 psi. The pipe will be manufactured by electric welded cold-formed process per ASTM A-669. The exterior surface will be triple coated and the interior surface single coated per ASTM F-1234. The triple coated external surface shall be hot-dipped zinc coated (galvanized) having a weight of not less than 1.0 ozs. per square foot ±0.1 ozs., followed by a chromate conversion coating, having a weight not less than 1.05 micro ounces per square foot ± 0.353 micro ounces (30 micrograms per square inch ± 15 micrograms) and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches. The internal surface shall be coated with a zinc base paint having a 90% zinc powder loading and having a minimum thickness of 0.0005 inches.

Type C: Steel used in the manufacturing of the pipe shall be strip steel in compliance with ASTM A-446 Grade D having a minimum yield strength of 50,000 pse. Both sides of the strip shall be hot-dipped zinc coated (galvanized) per ASTM A-525 having the weight of not less than 1.0 oz. per square foot ± 0.1 oz. The zinc coating will form the first coat of a triple coated external surface and the final coat of the interior surface. The pipe will be manufactured by electric welded cold formed process per ASTM A-669. After manufacturing, the final two external coatings shall be a chromate conversion having a weight of not less than 1.05 micro ounces per square inch ± 0.353 micro ounces (30 micrograms pe square inch ± 15 micrograms) and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches.

TABLE 772

USE	FENCE HEIGHT (Feet)	AISC/NPS DESIGNATION NOMINAL DIAMETER (Inches)	OUTSIDE DIAMETER (Inches)	WEIGHT (Lb/Lf Minimum)	
				TYPE A Schedule 40	TYPE B and C
FENCE POSTS					
End, corner, slope, pull and strain posts	Less than 6	2	2.375	3.65	3.12
	6 and over but less than 9	2½	2.875	5.79	4.64
	9 and over but not over 12	3½	4.000	9.11	6.56
Line posts	less than 6	1½	1.900	2.72	2.28
	6 and over but less than 9	2	2.375	3.65	3.12
	9 and over but not over 12	2½	2.875	5.79	4.64
GATE POSTS					
Single swing gates 6 feet or less in width or double swing gates 12 feet or less	less than 6	2	2.375	3.65	3.12
	6 and over but not over 12	3½	4.000	9.11	6.56
Single swing gates over 6 feet but not over 13 feet in width or double swing gates over 12 feet but not over 26 feet in width	—	3½	4.000	9.11	6.56
Single swing gates over 13 feet but not over 18 feet in width of double swing gates over 26 feet but not over 36 feet in width	—	6	6.625	18.97	—
Single swing gates over 18 feet in width or double swing gates over 36 feet in width	—	8	8.625	28.55	—
OTHER MEMBERS					
Top rail and braces	—	1¼	1.666	2.27	1.84
Frame for gates	—	1½	1.900	2.72	2.28
Stiffners for gates	—	1¼	1.666	2.27	1.84

All unit weights shall be subject to the standard mill tolerance of ±5 percent.

Posts shall be fitted with tops designed so as to fit securely over the posts and carry a top rail where specified. They shall have a total length of not less than the depth of the concrete footings, as specified, plus the length required above ground. Where no top rail is required, pipe posts shall be fitted with suitable caps. H-Section posts will require no caps.

Top rail shall be furnished in random lengths of approximately 20 feet where required.

772.3 CHAIN LINK FABRIC:

Chain link fabric shall conform to the requirements of ASTM A-392 (Zinc-Coated) or ASTM A-191 (Aluminum-Coated.) The coating process must leave the fabric completely free of barbs, icicles or other projections which might be hazardous. The wire used in the manufacture of the fabric shall be 11 gage for all fence 60 inches or less in height and shall be 9 gage for all fence over 60 inches in height unless otherwise specified.

All chain link fabric shall be woven into approximately 2 inch mesh. Fabric 60 inches or greater in width shall have twisted and barbed finish on both edges. Barbing shall be done by cutting the wire on the bias.

772.4 TENSION WIRES AND FABRIC TIES:

Tension wires shall be at least 7 gage galvanized coil spring steel wire per ASTM A-824. Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 11 gage galvanized steel, 6 gage aluminum wire, or approved non-corrosive metal bands.

Tension bars used in fastening fabric to end and corner posts and gate frames shall be galvanized high carbon steel bars not smaller than three-sixteenths inch x 3/4 inch.

772.5 TRUSS OR TENSION RODS:

Truss or tension rods used in trussing gate frames and line posts adjacent to end, corner, slope or gate posts shall be adjustable 3/8 inch diameter galvanized steel rod. When used in trussing line posts, adjustment shall be provided by means of galvanized, turnbuckle or other suitable tightening devices.

772.6 FITTINGS:

Fittings shall conform to ASTM F-626. Fittings, hardware, nuts and belts shall be galvanized.

Couplings to connect the individual lengths of top rail shall be of the outside sleeve type at least 7 inches long. The bore of the sleeves shall be sufficiently true to maintain adjacent lengths of rail in alignment.

Extension arms for barbed wire on pipe posts shall be of 13 gage steel or heavier, single piece construction and a type that can be attached to the tops of the posts. Extension arms for barbed wire on H-Section posts shall be of the bent post type. Extension arms shall carry 3 wires at approximately 5-1/2 inch centers in a plane approximately 45 degrees from the vertical, inclined as shown on the plans or as directed by the Engineer.

772.7 BARBED WIRE:

Barbed wire shall be 4 point pattern, composed of 2 strands of 12-1/2 gage galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM A-121.

SECTION 775

BRICK AND CONCRETE BLOCK

775.1 BRICK:

Brick shall be whole, sound, and hard burned and shall give a clear ringing sound when struck together. They shall be uniform in quality and shall be culled or sorted before delivery to the work.

775.2 MANHOLE BRICK:

Sewer and water manhole brick shall conform, except for dimensional tolerances, to the requirements of ASTM C-32, Grade MM.

Manhole brick shall conform to the following dimensions:

TABLE 775

Brick	Inches Depth	Inches Width	Inches Length
Standard Size	2 1/4	3 1/2	7 1/2
Allowable Variations	±1/8	±1/8	±1/4

The following paragraphs shall be added to the section on visual inspection:

No individual brick shall be rejected unless it shows visual evidence of major cracking. A major crack is defined as one that has at least one complete separation, for a distance of 1-3/4 inches, through the brick in any direction, including any cored area. Such a crack shall be regarded as affecting the serviceability of the brick and shall be rejected and not used in the structure.

Fifty bricks may be sampled at random intervals from any cube for visual inspection. Of the 50 sampled, 45 must pass visual inspection for major cracks. Should less than 45 pass, the cube of brick shall be rejected and the brick must not be used in the structure.

775.3 BUILDING BRICK:

Building brick shall conform to the requirements of ASTM C-62, Grade MW.

775.4 FACING BRICK:

Facing brick shall conform to the requirements of ASTM C-216, Grade MW, Type FBS. The size, color, and texture shall be as specified on the plans or as approved by the Engineer.

775.5 MORTAR, GROUT AND PLASTER:

The class shall be specified in the special provisions and conform to Section 776.

775.6 CONCRETE BLOCK:

Masonry units shall conform to ASTM C-90 for Grade N-1 (1000 psi) units with the following modifications:

Units shall be fully cured and shall have been made not less than 28 days prior to delivery.

Moisture content at time of delivery shall not exceed 30 percent of the minimum absorption value of the units, and Contractor shall provide any protection he deems necessary to maintain units in this condition until time of use.

The linear change from saturated to cool oven dry shall not exceed .0072 inches per linear foot or .06 of 1 percent.

SECTION 775

Except as otherwise called for on the plans or specified, masonry units shall be made with sand-gravel aggregate or lightweight aggregate at the Contractor's option, but all units used in the work shall be of one type. Lightweight aggregates for use in concrete masonry units shall be restricted to expanded clay, expanded shale, scoria, volcanic cinders, pumice or a combination thereof and shall conform to ASTM C-331.

Size of units shall be as indicated on the plans.

Submit for approval of the Engineer at the site not less than 5 samples of units to show the full variance of texture and full range of color. Units used in the work shall match the approved samples. These samples will be tested for strength.

775.6.1 Mortar and Grout: Mortar and grout used for concrete block construction shall conform to Section 776.

SECTION 776

MASONRY MORTAR AND GROUT

776.1 GENERAL:

Masonry mortar and grout shall consist of a mixture of cementious material and aggregate to which sufficient water has been added to bring the resulting mixture to the desired consistency.

Table 776-1 and 776-2 indicates the average compressive strength obtained when the cementious material, aggregate, and water (the required amount to provide a flow of 110 ±5 percent) are combined in the proportion shown in Table 776-3 and 776-4.

The mortar or grout to be used will be designated by class in the special provisions and the correct proportions of cementious materials and aggregate will be combined with the minimum amount of water to provide a workable mixture.

Retempering of the mortar or grout will not be a standard practice and the Engineer's approval will be required for any exception.

TABLES 776-1 & 776-2

MASONRY MORTAR AND GROUT COMPRESSIVE STRENGTH

Table 776-1
Masonry Mortar

Type	Compressive Strength 28 Days (psi)
A	5500
B	5000
C	4000
D	3000
M	2500
S	1800

Table 776-2
Grout

Type	Compressive Strength 28 Days (psi)
Fine Grout	2500
Course Grout	2500

TABLE 776-3

MASONRY MORTAR PROPORTIONS BY VOLUME

Type	Portland Cement	Hydrated Lime	Aggregate ASTM C-144
A	1	0	1
B	1	0	1-1/2
C	1	0	2
D	1	0	1-1/2
M	1	1/4	1-1/4 to 3
*S	1	1/2	2-1/4 to 3

*Masonry Cement Type S may be substituted for the cementious material. Prior approval of the Engineer is required.

TABLE 776-4
GROUT FOR REINFORCED MASONRY PROPORTIONS BY VOLUME FOR FIELD BATCHING

Type	Portland Cement	Fine Aggregate (ASTM C-404)	Coarse Aggregate (ASTM C-404)
Fine Grout	1	2 1/4 to 3	0
Coarse Grout	1	2 1/2	1 to 2

776.2 PORTLAND CEMENT:

The cement used shall conform with Section 725. For volumetric proportioning an unopened sack of cement weighing 94 pounds shall be considered as having a 1 cubic foot volume.

In proportioning the cement, it shall be measured loose, without shaking or compacting, in measuring devices of known capacity.

776.3 AGGREGATE:

The aggregate used shall conform with Section 701. It shall be approved by the Engineer prior to being utilized on the job. Any change of source will require additional approval or this neglect will be considered as sufficient cause for rejection of work.

In proportioning the aggregate, it shall be measured damp, loose without shaking or compacting, in measuring devices of known capacity.

776.4 MASONRY CEMENT:

Masonry cement used shall conform to ASTM C-91 with the exception that the average compressive strength shall not be less than 2500 psi at 28 days.

776.5 HYDRATED LIME:

Hydrated lime used shall conform to ASTM C-207, Type S.

776.6 WATER:

The water used shall conform to Section 725.

776.7 ADMIXTURES:

Admixtures, unless prescribed in the special provisions, will not be used without prior approval of the Engineer.

776.8 TESTS:

776.8.1 Mortar: If in the opinion of the Engineer there is sufficient cause to question the quality of the mortar being utilized, random field test in accordance with ASTM C-780 Annex A-1 and A-6 will be performed. For this area, the penetration of the cone penetrometer correlating to a flow of 110 $\pm$5 percent is 40 $\pm$3 mm.

776.8.2 Grout: If required, tests shall be performed in accordance with Uniform Building Code Standard No. 24-23 Section 24.2301.

SECTION 778

LUMBER

778.1 GENERAL:

Unless otherwise specified or shown on the plans, all lumber shall be Douglas Fir or graded pine and shall be selected as to grade and shall conform in all particulars to the standard grading and dressing rules of the West Coast Lumber Inspection Bureau.

Plywood shall be not less than 3 ply, manufactured and graded in accordance with the standard grading rules of the APA.

Lumber for uses listed shall not be lower than the following grades:

(A) Permanent Construction, such as bridges and culverts	Select Structural, for beams and stringers; Construction, for balance of structure.
(B) Minor permanent construction, such as fences, guard rails and posts, pavement headers, bulkheads, retaining structures, etc.	Construction.
(C) Falsework and studs, and wales for formwork.	Construction, for framing, beams or timbers
(D) Form sheeting for nonshowing surfaces of concrete.	Standard, for boards; shiplap; or any grade of plywood.
(E) Form sheeting for showing surfaces of ornamental concrete.	C and Better Industrial clear; concrete form grad of plywood; or overlay plywood.
(F) Form sheeting for curved soffits of bridge & tunnel arches, plastered or unplastered.	Select Merchantable, board; concrete form grade of plywood; or overlay plywood.
(G) Soffits of beams and girders and slabs between beams and girders; for beam and girder sides, except ornamental concrete; and for headwalls or endwalls of culverts or covered conduits.	Concrete form grade of plywood or overlay plywood.
(H) Form sheeting for showing surfaces of channel walls or interior surfaces, except floors; for covered conduit and all other showing surfaces not specified above.	Tongue and groove flooring equal to C and Better flat grain; concrete form grade of plywood; or overlay plywood.
(I) All other lumber.	Construction.

778-2 REDWOOD:

Redwood lumber shall be selected as to grade and shall conform in all particulars to the standard specifications for grades of California Redwood of the California Redwood Association.

Redwood lumber for the uses listed shall not be lower than the following grades:

Uses	Grade
(A) Bridges, culverts, and guardrail posts.	Dense Structural
(B) All other Redwood Lumber.	Foundation.

778.3 GRADE MARKING:

Lumber. Each piece of lumber shall bear an official grade mark which, unless authorized otherwise, shall be the grade mark adopted by one of the following associations:

(A) For Douglas Fir and Pine -- The West Coast Lumber Inspection Bureau or other agency approved by the Engineer.

(B) For Redwood -- The California Redwood Association.

Plywood: Each sheet of plywood shall bear the official stamp of the APA stating the grading of the sheet.

SECTION 779

WOOD PRESERVATIVES

779.1 GENERAL:

This work shall consist of treating lumber, timber, and piling. Lumber, timber, and piling to be treated shall conform to the requirements of the specification of the AWPA and as specified herein.

Where practical, lumber to be treated shall be cut to size and framed, prior to treatment. Proper allowance for shrinkage in the sizes of lumber shall be made by the Contractor where it is necessary to meet definite dimensions shown on the plans.

779.2 OIL TYPE PRESERVATIVE TREATMENT:

Preservatives under this specification shall be creosote, creosote-coal tar solutions, creosote petroleum solutions, or pentachlorophenol in petroleum oils, conforming to AWPA specifications and as specified by the Engineer.

Treatment: The beating operations shall conform to the applicable requirements of the AWPA specifications.

Unless indicated otherwise on the plans or in the special provisions, the amount of preservative to be retained and the treating process to be used for the various types of service shall conform to the appropriate AWPA specification.

Incising: Unless otherwise specified, timber to be treated under this specification that is 3 inches or more in nominal thickness and 4 inches or more in nominal width, shall be incised before treatment as a means of securing penetration of the preservative. If such thickness is less than 4 inches, the material may be incised on the wide faces only; otherwise, all 4 faces shall be incised.

779.3 WATER BORNE SALT PRESERVATIVES TREATMENT:

Preservatives under this specification shall conform to the requirements of AWPA specifications unless otherwise approved in writing by the Engineer, but restricted to the following preservatives:

Chromated Zinc Chloride (CZC)

Tanalith (Wolman Salts)

Ammoniacal Copper Arsenite (Chemonite)

Chromated Zinc Arsenate (Boliden Salt)

Chromated Copper Arsenate (Erdalith)

779.4 FIELD TREATMENT OF CUT SURFACES:

When sawing or drilling is necessary after plant treatment, the cut surfaces shall be thoroughly brushed with 2 coats of the same kind of preservative in conformance with AWPA specification. The maximum protection requirement specified therein shall be met in all instances.

SECTION 785

STEEL CASTINGS

785.1 GENERAL:

The castings shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or defects that would affect the service value of the casting.

Blowholes shall not have a depth sufficient to affect injuriously the strength of the castings. Minor defects which do not impair the strength of a casting may, with the approval of the Engineer, be welded by an approved satisfactory means and after welding, the castings shall be annealed, if so required by the Engineer. Castings which have been welded without the permission of the Engineer shall be rejected.

785.2 FINISH:

The dimensions of the finished castings shall be not less than the specified dimensions. Castings shall not be more than 7-1/2 percent overweight.

The bearing surfaces of rockers and rocker plates shall be machined accurately to the dimensions shown on the plans. The final surface shall be produced by a finishing cut. They shall be straight, smooth, and free from flaws.

Chemical analysis shall be performed in accordance with ASTM E-30.

785.3 TEST SPECIMENS:

Test coupons from which tension test pieces are prepared shall be attached to the castings where practicable. If, in the opinion of the manufacturer, the design of the casting is such that test coupons should not be attached thereon, the test coupons shall be cast attached to separate cast blocks. Sufficient coupons shall be cast to represent each lot with additional specimens for use in case retests should be required. A lot shall be considered as all castings in a melt which have constituted part or all of a heat-treatment charge.

Coupons shall remain attached until after the annealing process has been completed. Coupons may be identified by a representative of the Engineer. Where test coupons are cast separately from the castings, a representative of the Engineer may be present at the time of pouring to identify both coupons and castings. Coupons cast separately from the castings shall not be detached from the block to which they are fastened until identified.

The test coupons shall be of such size that test specimens can be machined to dimensions as specified in the ASTM procedure referred to herein. Where a specimen on machining, appears faulty and a true sample of the lot of castings to which it belongs, the representative of the Engineer may substitute another coupon of the lot in question. Test specimens shall be furnished and machined by the Contractor at no additional cost to the Contracting Agency.

785.4 RETESTS:

If the results of the physical test for any lot do not conform to the requirements specified, the manufacturer may reheat-treat such lot. Representative coupons shall be reheat-treated with the lot to serve as retest specimens.

785.5 HIGH-STRENGTH STEEL CASTINGS FOR STRUCTURAL PURPOSES:

Castings shall conform to ASTM A-148, Grade 80-50 except that the steel shall contain not less than 0.60 percent of manganese and not less than 0.20 percent of silicon.

785.6 MILD-TO-MEDIUM STRENGTH CARBON-STEEL CASTINGS FOR GENERAL APPLICATION:

Castings shall conform to ASTM A-27, Grade 65-35. The metal shall have a minimum Brinell hardness number of 130, when tested in accordance with ASTM E-10.

785.7 CASTINGS FOR HIGHWAY BRIDGES:

Steel castings for highway bridges shall conform to ASTM A-486 or AASHTO M-192.

SECTION 786

BRONZE CASTINGS

786.1 GENERAL:

The castings shall be true to pattern in form and dimensions and free from defects that would affect the service value of the casting. Minor defects may be repaired with the approval of the Engineer. Chemical analysis shall be made in accordance with ASTM E-54.

786.2 PHYSICAL PROPERTIES:

Expansion and bearing plates shall conform to the physical properties as required in ASTM B-22, for alloy C castings.

The physical test shall be performed on coupons cast integrally with the casting, as described in ASTM B-208, double keel block test bar. The coupons shall remain attached during all heating and cooling cycles to which the casting is subjected. In cases where castings are of such a size or design that it is difficult to cast attached coupons, permission may be granted by the Engineer to cast test coupons independently of the castings.

786.3 WORKMANSHIP:

Castings shall be sound, clean, and free from blowholes, porous places, cracks, and other defects.

Castings that show injurious defects revealed by machine operations or by X-ray, Subsequent to delivery may be rejected and, if rejected, shall be replaced by the Contractor without charge.

No welding or patching of defects in castings will be permitted unless authorized by the Engineer. Any such welding or patching done without authorization shall be cause fair rejection.

786.4 ORNAMENTAL TABLETS:

The letters shall be heavily raised and spaced carefully to secure a uniform and balanced effect over the entire area of the panel. The background of the letter panel shall have a finely-pebbled surface. The model of the tablet shall be submitted to the Engineer for approval before castings are made.

Castings shall be boldly filleted at angles, and the arrises shall be sharp and perfect. Castings shall be true to pattern in form and dimension and shall be free from inclusion of foreign material, casting faults, injurious blowholes, or other defects rendering them unsuitable for the service intended.

The faces and edges of lettering and ornaments shall be carefully hand-tooled sharp and clean. Beveled edges shall be band-tooled sharp, clean, smooth, and true. Outside borders shall be straight and true and shall be thoroughly polished. Filing and other tool marks shall be removed.

The lettering, the ornaments, and the beveled edges shall be given a fine satin hand finish; the lettering, bevels, and rosettes shall be highlighted; the leaves and scrolls slightly highlighted, but well polished. The pebble background shall be finished in dark statuary bronze, polished as the Engineer may direct.

786.5 EXPANSION AND BEARING PLATES:

The sliding contact faces shall be machined smooth to true planes. If practicable, one plate shall be machined at right angles to the other plate in the set.

SECTION 787

GRAY IRON CASTINGS

787.1 GENERAL:

The castings shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Castings shall be filleted boldly at angles, and the arrises shall be sharp and true.

Before the castings are removed from the foundry, they shall be thoroughly cleaned and the parting lines, gates, and risers ground flush.

787.2 TEST SPECIMENS:

Test coupons shall be cast separately of the castings, using a mold as described in ASTM A-48. A representative of the Engineer may be present at the time a melt is poured to identify both coupons and castings.

Two test coupons are required for each melt poured. Additional coupons shall be cast for use as replacements or in case a retest is required.

A representative of the Engineer may discard and replace specimens which show obvious lack of continuity of metal or if the machining is defective.

The manufacturer shall machine the tension specimens to the dimension specified for specime n B of ASTM A-48, at no additional cost to the Contracting Agency.

When approved by the Engineer transverse tests may be made in lieu of tensile tests, in which case the castings shall meet the requirements of ASTM A-48.

787.3 MANHOLE FRAME AND COVER SETS:

Castings shall conform to ASTM A-48, Class 30. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly onto the frame without rocking. Also the frames and covers shall be coated as specified below.

Covers shall be the types and shall be imprinted as shown on the plans or standard details.

787.4 RAILINGS, RAILING POSTS, AND WHEEL GUARDS:

Castings shall conform to ASTM A-48, Class 40.

787.5 ROCKERS, ROCKER PLATE BEARINGS, AND BEARING PLATES FOR BRIDGES:

Castings shall conform to ASTM A-48, Class 50.

Castings shall be machined and finished as specified on the plans provided that tool marks on sliding contact surfaces shall run in the direction of plate movement, or in the case of rocker plate bearings, perpendicular to the rocker movement. Tool marks shall be not more than 1/32 inch apart.

787.6 UNCLASSIFIED CASTINGS:

All castings not specifically classified, shall conform to the requirements of ASTM A-48, Class 30.

787.7 ASPHALTUM COATING:

Unless otherwise specified, castings shall be painted or dipped in commercial-quality asphaltu m paint.

SECTION 790

PAINT

790.1 GENERAL:

Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the intended use. Finished paint shall be well-ground and the pigment shall be properly dispersed in the vehicle according to the requirements of the paint; and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened air-tight containers, appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, specifications paint number, and lot or batch number. The container shall have a formula label.

No paint shall be used until at least 7 days have elapsed from the date of manufacture.

790.2 PROPRIETARY BRANDS:

For the purpose of this specification, proprietary brands of paint and paint materials shall be construed to mean paint or paint materials conforming to the requirements of this specification and produced for distribution and consumption through regular wholesale and retail outlets. Whenever paint or paint materials are designated on the plans or special provision by a manufacturer's name or catalog reference, any proprietary brand of equal quality will be permitted, subject to the approval of the Engineer. Information required by the Engineer as proof of the comparative quality shall be furnished by the Contractor.

790.3 PAINT COATS:

The first coat of paint applied to an unpainted surface shall be called the prime coat. The paint applied to field connections, welds, rivets, and all damaged or defectively painted or rusty areas on a prime coated surface shall be called a touch-up coat. The paint applied over the prime coat and touch-up coat shall be called the second coat. The final coat of paint shall be called the finish coat.

790.4 MATERIALS:

Materials shall conform in all respects to the requirements of reference specifications indicated for such material.

Upon request of the Engineer, the Contractor shall furnish a certification from the manufacturer that the material conforms with this

(A) Vehicles:	Specifications:
Raw Linseed Oil	ASTM D-234
Boiled Linseed Oil	ASTM D-260
Water-Resistant Spar Varnish	Navy Department Specification 52V20
Alkyd Resin	TT-R-266C
Driers	ASTM D-600, Class A or Class B as applicable
Xylene	TT-X-916B, Grade A
Turpentine (shall be used in paints for timber)	ASTM D-13, Gum Spirits
Petroleum Spirits (Mineral Spirits)	ASTM D-235

(B) Pigments:	Specifications:
Carbonblack	TT-P-343 Form 1, Class B
Lampblack	ASTM D-209
Red Lead	ASTM D-83
Titanium Dioxide, Non-extended	ASTM D-476, Type II, Class II
Titanium Dioxide, Extended (Titanium Calcium, Rutile)	ASTM D-476
Titanium Dioxide	TT-P422, Type III, C
White Lead Basic Carbonate	ASTM D-81
Zinc Yellow (Zinc Chromate)	ASTM D-478, Type II
Zinc Oxide	ASTM D-79
Iron Blue	TT-P-385
Iron Oxide Yellow	TT-P-458-A
Iron Oxide Orange	ASTM D-84
Hansa Orange	MIL-H-10330
Organic Green Gold	DuPont YT 562-D or equal, specific gravity 161 ± 0.05
Chromium Oxide, Green Graphite	TT-P-347

Graphite shall be natural amorphous material (American product) which shall contain not less than 35 percent nor more than 45 percent graphite carbon. The remainder shall be insoluble siliceous material containing a total of not more than 5 percent calcium and magnesium carbonate and sulfate. The pigment shall be ground to such a fineness that not less than 97 percent shall pass a No. 325 sieve. The graphite paste shall be made by grinding the pigment in pure raw linseed oil in the following proportions:

Amorphous Graphite.....68.0 percent
Linseed Oil.....32.0 percent

(C) Inert Materials:	Specifications:
Diatomaceous Silica	ASTM D-604, Type A
Magnesium Silicate	ASTM D-605

790.5 MIXED PAINTS:

All mixed paints shall, in general, be machine-mixed and shall consist of the pigment of the required fineness and composition, ground to the desired paste consistency in pure raw or boiled linseed oil, to which shall be added the remainder of the vehicle to make paint conforming to the required formula as herein specified.

Paint which has hardened and thickened in the container such that it cannot be readily broken up to a smooth uniform paint of good brushing consistency shall not be used.

SECTION 790

All materials used in mixed paints shall conform to the requirements as herein specified. The paint shall be made to satisfactory workable consistency conforming to one of the following formulas for paint as required on the plans or in the special provisions. All percentages shown are by weight.

Any of the following paints which are too thick to have a satisfactory workable consistency shall be thinned with a suitable thinner from the group of thinners herein specified. In no case shall gasoline be used as a thinner.

Fineness of grind for enamel shall conform to Hegman 7 minimum.

The following paints shall conform to the latest ADOT Standard Specifications for Road and Bridge Construction. All paints, except Paint No. 10 (Aluminum), shall be shipped ready for use.

When Paint No. 1 is specified, it may be Paint No. 1-A or Paint No. 1-B. Paint No. 1-D shall be used only when specifically designated.

Paint Number	Type
1-A	(Red Lead -- Linseed Oil)
1-B	(Red Lead -- Alkyd Resin)
1-D	(Zinc Chromate)
4	(Dull Black)
5	(Jet Black)
6	(Black -- For Timber Primer Only)
7	(White -- For Timber Primer Only)
8	(White)
9	(Light Grey)
10	(Aluminum)
11	(White Enamel
15	(Zinc)

SECTION 791

POLYETHYLENE PROTECTIVE WRAPPING

791.1 General: All cast and ductile iron , pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafer as polywrap. Although not intended to be a completely air and water tight enclosure, the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

791.2 Materials: The polywrap shall be of virgin polyethylene, not less that 8 mils in thickness, formed into tubes or sheets as may be required. Naturally pigmented material may be used where exposure to ulta violet light will be less than 48 hours. Otherwise, the material shall be pigmented with 2 to 2 1/2 percent of well dispersed carbon black with stabilizers.

The polywrap shall be secured as specified below with 2 inch wide pressure sensitive plastic tape not less than 10 mils thick. Tape shall be Scotchrap No. 50, Polyken No. 900, Tapecoat CT, Johns-Manville No. V-10 Trantex or approved equal.

The minimum tube size for each pipe diameter shall be as listed below:

TABLE 791-1
Polywrap Flat Tube Width (Inches)

Nominal Pipe Diameter (inches)	Case Iron or Ductile Iron With Pus-on Joints	Cast Iron or Ductile Iron With Mechanical Joints
4	14	16
6	17	20
8	21	24
10	25	27
12	29	30
14	33	34
16	37	37
18	41	41
20	45	45
24	53	53

SECTION 792

DUST PALLIATIVE

792.1 GENERAL:

Since the establishment of grades will not normally be required prior to the application of this palliative, and since there is always the possibility that the Contracting Agency will grade in this area, the Contracting Agency will not assume any responsibility for the maintenance of this work. The Contractor will, however, be responsible for obtaining satisfactory results within the limits of the materials and the requirements of these specifications.

Sufficient grading shall be done prior to treatment to provide reasonable drainage.

Except as stated in the special provisions, the material to be used shall be the type designated by the Engineer.

792.2 TYPE AND APPLICATION OF MATERIALS:

(A) Petroleum Resinous Type:

The material shall be a light yellow emulsion. Coherex or approved equal, suitable for use as an agglomerant for soil particles. The emulsion shall contain 60 +3 percent of a thermoplastic resinous petroleum fraction characterized by the following properties:

ASTM

Specification Designation	ASTM Test Method	Requirements
Viscosity, SUS at 100^0 F. Sec	D-88	6,000 min.
Residue, %	D-95	60 + 3
Flash Point, CO, ^{0}F.	D-92	400 min.
Specific Gravity	D-1298	1.00 min.

The emulsion shall be stable, i.e., should not break when stored in clean closed containers at ordinary temperatures, excluding freezing or boiling, for a minimum of 3 months. It shall be miscible with water in all proportions, including a ratio of 1 part emulsion to 5 parts water. The sequestering agents shall make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion shall be non-corrosive to metal containers. The materials shall penetrate into the soil surface and not form a skin at the surface or a crusted surface.

Immediately after compacting, the 1 to 5 diluted emulsion shall be applied in 1 to 3 applications, as required, at a rate of approximately 0.17 gallons per square yard per application. The material shall be applied by means of a thoroughly cleaned bituminous distributor or other approved means.

(B) Lignin Based Types:

Lignin sulfonates, a residual co-product of wood pulping by the sulfite process in the manufacture of cellulose products. This material may be supplied in either the granulated solid or liquid form, liquid form to contain 50 + percent lignin solids by weight. The application rate shall be such that the residual lignin solids constitute approximately 1 percent by weight of the soil being treated. One gallon of 50 +2 percent solids lignin sulfonate concentrate* will usually result in the required residual content for a soil volume of 1 square yard 6 inches deep.

*Lignin sulfonates are usually diluted to 10 to 25 percent solids before application. The rate of dilution is variable and shall be determined by the Engineer.

Application of this material may be made by either a pressure type water sprinkling truck or an asphalt distributor; however, the same precautions to prevent contamination of adjacent objects will be required as in the case of the asphalt base products. For other than skin treatments, multiple applications and some scarifying and blading may be necessary.

SECTION 795

LANDSCAPE MATERIAL

795.1 GENERAL:

Material used for landscaping purposes shall be in conformance with this Section.

The common and scientific names of plants shall conform to the approved names in Standard Plants Names (SPN) or its successor, American Association of Nurserymen (ASN). For identification and inspection, durable, legible labels, bearing the plant's name in water-resistant ink, shall be attached to all nursery stock or container of stock delivered to the project site.

795.2 TOPSOIL:

Topsoil shall be a fertile, friable soil, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, noxious weeds or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the Contractor shall furnish the Engineer at no additional cost, with a soil sample from each source for analysis and tests.

To be acceptable the PH factor shall not exceed 8.0 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 15 inclusive, and it shall contain approximately 1-1/2%, by dry weight, of organic matter either natural or added. Gradation shall be in accordance with the table shown below:

Sieve Size	Percent Passing
1"	100
1/2"	95-100
No. 4	90-100
No. 10	70-100
No. 200	15-70

795.3 SOIL FERTILIZING MATERIAL:

Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. All fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's guarantee analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals or plants. It shall be delivered in unopened containers and shall have the chemical analysis as specified in the plans or specifications. Material which has become caked or otherwise damaged shall not be used.

Slow release fertilizer pills for ground cover beds shall be Agriform 18-6-12 (+ iron, or equal).

795.4 ORGANIC SOIL CONDITIONERS:

In general, soil conditioners shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a PH not exceeding 7.5, and organic matter not less than 85%. Its gradation shall be such that at least 85% passes the 1/4-inch screen. In addition, it shall be treated with a non-toxic agent so as to be hygroscopic.

When manure is used as a soil conditioner, it shall be the product of yard fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be of a consistency that will readily spread with a mechanical spreader.

795.5 CHEMICAL SOIL CONDITIONER:

Chemical soil conditioners such as soil sulfur, gypsum or iron additive shall be commercially approved brands designated for agricultural use. Material which has become caked or otherwise damaged shall not be used.

795.6 SEEDS:

Seeds shall be fresh, clean seeds, premixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer's guaranteed analysis and germination percentage. They shall have a certificate or a stamp or a release accomplished by an agricultural commission.

795.7 PLANTS, TREES, AND SHRUBS:

795.7.1 General: All landscape stock shall be grown in nurseries approved by the State Department of Agriculture. They shall have a growth habit normal to the specie. Stock shall be sound, healthy, and vigorous; free from insect pests, sun scald, excessive bark abrasions and other objectionable disfigurements. They shall have normal, well-developed branch systems and vigorous, fibrous root systems which are neither root nor pot-bound and are free of kinked or girdling roots.

All stock shall have been grown in pots, cans, tubs, or boxes for a minimum of three months and a maximum of one year. They shall have sufficient roots to hold earth together after removal from the containers. This earth shall be free from noxious weeds including bermuda grass.

Stock shall be inspected and approved by the Engineer at the Contractor storage site prior to delivery to the project.

795.7.2 Flatted Plants: Flatted plants shall be grown and remain in the flats until transported to the project site. The soil and spacing of the plants in the flats shall insure the minimum disturbance of the root system at transplanting.

795.7.3 Trees: Trees shall be of the specified height, spread and caliper and shall stand erect without support. The height shall be measured from the root crown to the last division of the terminal leader with the branches in a normal position and the caliper shall be measured 12 inches above the crown roots. For palm trees only, the height shall be measured from the ground line to the base of the growing bud.

795.7.4 Shrubs: Shrubs shall be of the specified type, height and spread. They shall be selected from high quality, well-shaped nursery stock.

795.8 MISCELLANEOUS MATERIAL:

795.8.1 Headers and Stakes: Lumber for landscaping shall be construction heart, rough-sawn redwood in the sizes specified; splicing will not be permitted. Stake used with header boards shall be 2 x 4 inches, pointed and at least 18 inches long.

795.8.2 Tree Stakes: Unless otherwise specified, tree stakes shall be 2 x 2 inch redwood posts, free of knots and reasonably straight, and of sufficient length to properly support the tree.

795.8.3 Tie Wires: Tie wire shall be No. 12 AWG zinc coated wire and the cover for this wire shall be 1/2 inch garden hose.

795.8.4 Decomposed Granite: Decomposed granite shall be as per Section 702.4 with the following additions: It shall be "Desert Gold" in color. A thirty pound sample shall be submitted to the Engineer for approval prior to use. The decomposed granite shall not contain lumps or balls of clay, caliche,

organic matter or calcareous coating. The contractor shall insure that sufficient quantity is available from a single source to complete the contract. Gradation for Type A and Type B will be as shown in the table below:

TYPE A		TYPE B	
3/4" Minus Sieve Size Passing	Granite Percent Passing	3/4" Sized Granite Sieve Size	Percent
1"	100	1"	100
3/4"	95-100	3/4"	90-100
1/2	85-100	3/8"	0-20
No. 4	60-80		
No. 40	10-20		
No. 200	0-5		

Note: Type A is used for landscaping and Type B for Shrub/Tree Pits.

795.9 Submittal: The contractor shall submit to the Engineer three copies of written certifications that plants are the species and varieties and size specified.