Special Provisions

SR 51-Squaw Peak Highway

Contract No. 95-01
TRACS No. 051 MA 009 H 2059 01 C
RAM 600-2-514
Shea Boulevard to Thunderbird Road

February 5, 1996
95% Submittal

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

Prepared For

ARIZONA DEPARTMENT OF TRANSPORTATION

Prepared By

BRW

BRW, INC.
T.Y. International
Harding Lawson Associates
Aztec Engineering
Bolduc Smiley & Associates
AGRA Earth & Environmental

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SPECIAL PROVISIONS

ARIZONA PROJECT RAM 600-2-514
51 MA 009 H 2059 01C
SQUAW PEAK HIGHWAY (SR 51)
SHEA BOULEVARD TO THUNDERBIRD ROAD

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SPECIAL PROVISIONS

ARIZONA PROJECT RAM 600-2-514
TRACS NO. 51 MA 009 H 2059 01C

PHOENIX URBANIZED AREA
SQUAW PEAK HIGHWAY (SR 51)
SHEA BOULEVARD TO THUNDERBIRD ROAD

GRADING, PAVING, DRAINAGE, AND BRIDGE CONSTRUCTION

PROPOSED WORK:

The proposed work is located in Maricopa County on the Squaw Peak Highway in the City of Phoenix, beginning one thousand feet south of Shea Boulevard (MP 9.18) and extending northerly for a distance of 2.21 miles across Thunderbird Road.

The proposed work consists of grading, drainage channels, roadway excavation, portland cement concrete paving, asphaltic concrete paving, barriers, storm drains; removal and relocation of water and sewer lines; curbing, signing, pavement marking, signalization, lighting, retaining walls, sound walls; construction of new bridges and a pump house, and other incidental work.

(SPC90ST, 02/15/94)

SPECIFICATIONS:

The work embraced herein shall be performed in accordance with the requirements of the following separate documents:

Arizona Department of Transportation, Highways Division, Standard Specifications for Road and Bridge Construction, Edition of 1990,

Arizona Department of Transportation, Highways Division, Standard Drawings, listed in the project plans and defined hereinafter,

Arizona Department of Transportation, Traffic Control Manual for Highway Construction and Maintenance, January, 1989,

Manual on Uniform Traffic Control Devices for Streets and Highways, 1988, and Amendments, and

The Proposal Pamphlet and Non-bid Pamphlet which include the following documents:

These Special Provisions,

Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246), July 1, 1978, Revised November 3, 1980 and Revised April 15, 1981,

Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246), July 1, 1978, Revised November 3, 1980 and Revised April 15, 1981,

Executive Order 75-5, April 28, 1975, Revised November 25, 1980,

Compliance Reports, Non-Federal Aid Projects, July 1, 1975, Revised May 20, 1981,

Bidding Schedule,

Included in the Proposal Pamphlet only:

Proposal,

Surety (Bid) Bond, 12-1303,

Certification With Regard to the Performance of Previous Contracts or Subcontracts, Subject to the Equal Opportunity Clause of Executive Order No. 75-5 and the Filing of Required Reports, Non-Federal Aid Projects, July 1, 1975,

Certification With Respect to the Receipt of Addenda,

Affidavit by contractor certifying that there was no collusion in bidding for contract,

BID SUBMISSION:

In submitting a bid, the holder of the Proposal Pamphlet shall completely execute the following documents:

Proposal,

Bidding Schedule,

Surety (Bid) Bond, 12-1303,

Certification With Regard to the Performance of Previous Contracts or Subcontractors, Subject to the Equal Opportunity Clause of Executive Order No. 75-5 and the Filing of Required Reports, Non-Federal Aid Projects, July 1, 1975,

Certification With Respect to the Receipt of Addenda, and

Affidavit by contractor certifying that there was no collusion in bidding for contract.

PROPOSAL GUARANTY:

Each bidder is advised to satisfy himself as to the character and the amount of the proposal guaranty required in the Advertisement for Bids.

CONTRACT DOCUMENTS:

The bidder to whom an award is made will be required to execute a Performance Bond and a Payment Bond, each in 100 percent of the amount of his bid, an Insurance Certificate and the Contract Agreement.

A copy of these documents is not included in the Proposal Pamphlet which is furnished to prospective bidders; however, each bidder shall satisfy himself as to the requirements of each document.

The documents, approved by the Department of Transportation, Highways Division, are identified as follows:

Statutory Performance Bond, 12-1301, September, 1992
Statutory Payment Bond, 12-1302, September, 1992
Contract Agreement, 12-0912, August, 1988
Certificate of Insurance, 12-0100, May, 1989

A copy of each document may be obtained by making a request to Contracts and Specifications Services.

COPIES OF PROJECT DOCUMENTS:

Distribution of a limited number of plans and Special Provisions will be made to the successful low bidder, at no charge, following confirmation of bid prices and DBE submittal, if applicable. The distribution will be made on the following basis:

CONTRACT SIZE (DOLLARS)	FULL SIZE PLANS	1/2 SIZE PLANS	BOUND BID BOOKS	UNBOUND BID BOOKS
$0 - $10,000,000	2	25	5	25
over $10,000,000	5	50	5	50

These plans and Special Provisions will be set aside and designated for use by the low bidder along with an equal number held in reserve for the responsible District Office. In the event that excess documents remain following bid opening, the additional documents will be evenly split between the low bidder and the A.D.O.T. District Office.

Any additional plans or Special Provisions that the low bidder may require beyond the above distribution will be available at the invoice cost of printing by ordering thru the Engineer.

MATERIAL AND SITE INFORMATION:

The following site investigation reports are available for viewing and/or purchase at:

Reprographics Systems
909 East Camelback Road
Phoenix, Arizona 85014-3686
(602) 266-6544

FINAL GEOTECHNICAL INVESTIGATION REPORT - BRIDGE STRUCTURE LOCATIONS, REPORT NO. 1, REVISION NO. 2, JULY 31, 1995 ($X.XX)

FINAL GEOTECHNICAL INVESTIGATION REPORT - BRIDGE STRUCTURE LOCATIONS, REPORT NO. 1, REVISION NO. 2, ADDENDUM NO. 1, SEPTEMBER 12, 1995 ($x.xx)

GEOTECHNICAL INVESTIGATION REPORT - SHEA BOULEVARD TO THUNDERBIRD ROAD, REPORT NO. 2, REVISION NO. 1, JULY 31, 1995 ($x.xx)

GEOTECHNICAL INVESTIGATION REPORT - SHEA BOULEVARD TO THUNDERBIRD ROAD, REPORT NO. 2, REVISION NO. 1, ADDENDUM NO. 1, OCTOBER 23, 1995 ($x.xx)

GEOTECHNICAL INVESTIGATION REPORT - INDIAN BEND WASH, REPORT NO. 3, JULY 31, 1995 ($X.XX)

GEOTECHNICAL INVESTIGATION REPORT - INDIAN BEND WASH, REPORT NO. 3, ADDENDUM NO. 1, SEPTEMBER 11, 1995 ($X.XX)

Questions regrading the site investigations are to be directed to Nick LaFronz at:

AGRA Earth & Environmental, Inc.
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502
(602) 272-6848
FAX (602) 272-7239

ADOT has undertaken some preblast/pre excavation surveys related to potential ground settlement areas. The contractor shall familiarize himself with this information to deter additional or supplemental surveys.

(NOGOAL, 07/31/90)

DISADVANTAGED BUSINESS ENTERPRISES:

Policy:

It is the policy of the Arizona Department of Transportation (Department) that Socially and Economically Disadvantaged Business Enterprises (DBE's) shall have maximum opportunity to participate as contractors, subcontractors, suppliers, or vendors in the performance of contracts.

MARICOPA ASSOCIATION OF GOVERNMENTS AND CITY OF PHOENIX STANDARDS:

The project plans and these special provisions reference certain standard specifications and standard details promulgated by the Maricopa Association of Governments, commonly known as MAG, and certain supplements to these MAG Standards promulgated by the City of Phoenix.

When MAG standard specifications and standard details are specified for certain items of work, the description, materials, construction requirements, methods of measurement, and basis of payment for those items shall conform to the requirements of the special MAG Standards in Parts 200 through and including 700, except as may be superseded or supplemented by the City of Phoenix standards, and as may be additionally superseded or supplemented by these special provisions. Part 100 and the fifteen pages of forms in the MAG Standard Specifications are not applicable.

MAG Standards are available from:

Maricopa Association of Governments
1820 West Washington Street
Phoenix, Arizona 85007

City of Phoenix Standards are available from:

Engineering Department
City of Phoenix
125 East Washington Street
Phoenix, Arizona 85004

References to Sections of MAG and City of Phoenix Standard Specifications in these special provisions will be so designated. All other sections and subsections of specifications referenced shall be construed to be ADOT Standard Specifications.

GENERAL REQUIREMENTS:

The average elevation of the project is 1,400 feet.

SAWCUTTING:

Sawcuts at the points of abutting existing pavements will be required. Sawcuts shall be made to a minimum depth of 3 inches and in all cases deep enough to insure a near vertical joint. Payment for all sawcuts shall be included in other contract items.

There will be no measurement or direct payment for saw cutting and/or wheel cutting, the cost being considered included in the contract items.

CONTINUOUS WATER AND SANITARY SERVICE:

The contractor shall be responsible for maintenance of water service and sanitary disposal of wastes during the construction period. Suitable pumps, temporary pipe lines, and/or hauling equipment shall be provided to prevent backing up of flow in underground systems upstream from the construction site.

No separate payment will be made for pumping and/or disposal of water or sewage; all costs in connection therewith shall be included in the unit price bid per linear foot of new pipe or related items.

DETOURS:

Detours shall be constructed at the locations and in accordance with the details shown on the project plans. Payment for constructing detours will be made under the respective contract items. The contractor will be responsible for maintaining the detours in a manner approved by the Engineer.

At the time specified by the Engineer, the bituminous surfacing shall be broken up and stockpiled at sites designated by the Engineer. The remaining detour roadways shall be removed, and the natural subgrade shall be restored as nearly as practicable to the condition existing prior to the construction of the detour.

The contractor shall assume responsibility for the design, construction, maintenance and cost of temporary drainage facilities for contractor proposed detour changes or construction phasing changes which impact temporary drainage facility requirements.

No measurement or direct payment will be made for the work of maintaining the detour, removing the detour, stockpiling the material or excavating temporary ditches.

SALVAGE ITEMS:

The fire hydrants identified for Removal and Salvage shall be delivered to the City of Phoenix Maintenance Yard at XXXX, Phoenix, Arizona. The contractor shall contact Mr. XXXX at XXXX to schedule the deliveries.

After removal, the temporary guard rail along the Thunderbird Road detour shall be delivered to _____. The contractor shall contact _____ at _____ to schedule the deliveries.

SECTION 601 - CONCRETE STRUCTURES:

CONCRETE PAINT:

(1) Description: of these Special Provisions is revised to read:

FINISHES:

An acrylic emulsion paint shall be applied to the following exposed concrete surfaces:

The sides and bottoms of cast-in-place concrete box girder bridges, the outer face and bottom of the eastern-most girder of the northbound Sweetwater Avenue Overpass the outer face and bottom of the western-most girder of the southbound Sweetwater Avenue Overpass, the deck edge and bottom of the deck overhang on the east side of the northbound Sweetwater Avenue Overpass, the deck edge and bottom of the deck overhang on the west side of the southbound Sweetwater Avenue Overpass;

All surfaces of bridge piers, piles, columns, parapet walls and abutments, concrete retaining walls, concrete box culvert wingwalls and noise barrier walls, to at least one foot below finished grade;

The exposed side of the permanent roadway and retaining wall barriers not adjacent to the traveled way and the surfaces of bridge barriers not adjacent to the traveled way except for the concealed side of the lower of the two bridge barriers forming the SR 51median.

Top side of decks, sidewalks, inside of curbs barriers, and downdrains shall be excluded from painting. Other areas to be excluded will be so specified on the project plans.

RIGHT-OF-WAY MARKERS AND FENCE:

Right-of-Way Markers, Right-of-Way fencing, and noise walls shall be installed at the first opportunity as determined by the Engineer.

MATERIAL SOURCE:

No department designated material source has been established for this project. Materials sources shall be as specified in Section 1001 of the Standard Specifications.

WORKING HOURS:

Work on this project shall not begin before 6:00 a.m. and shall conclude prior to 7:00 p.m. each day unless otherwise approved by the Engineer. Work at times other than those specified will be considered by the Engineer subject to the duration and type of activity proposed and the resulting impact on adjacent residential areas. Hours for hauling operations may be subject to approval by City of Phoenix authorities, in accordance with local ordinances. Except as specified herein, weekend work will be only as approved by the Engineer.

Should the contractor be permitted to work between the hours of 7:00 p.m. and 6:00 a.m., the Engineer will determine what measures the contractor will be required to take to inform the affected public.

EMBANKMENT CONSTRUCTION IN PIMA FREEWAY CORRIDOR:

All surplus excavated materials suitable for embankment construction shall be loaded and hauled to the Pima Freeway Corridor (SR 101L) and placed in the area from the west side of Cave Creek Road to the east side of 32nd Street as shown on the project plans. The plans for embankment placement on SR 101L are shown in metric dimensions.

The contractor of the Pima Freeway project shall be responsible for the surveying and overexcavation of the embankment placement area.

Construction of the westbound portion of the embankment prism between approximate Stations 47+450 to 47+940 and 48+120 to 48+220 shall be given first priority in the placement order of material. The material shall be placed in the embankment area and compacted in accordance with the requirements for roadway embankments as specified in Section 203 of the Standard Specifications.

The contractor will be responsible for all dust control, compaction and other operations necessary for construction of the embankments. There will be no measurement or payment for this work, it being considered as included in the cost for excavation items.

ALTERNATE BIDS:

This project includes two bridge abutment alternates for the Cactus Road Traffic Interchange Underpass (Structure Number 2455), a cast-in-place reinforced concrete full height cantilever abutment and a stub abutment on drilled shafts with a soil nail wall consisting of shotcrete and a cast-in-place facing. Proposals are to be prepared based on only one of the two alternates.

DEWATERING TRENCHES:

This work covers the entire project except as specified elsewhere in these specifications.

Any water encountered during the installation of underground facilities shall be disposed of by the contractor in such a manner as will not cause damage to public or private property or constitute a nuisance or menace to the public. The contractor shall furnish, install, and operate pumps, pipes, appliances, and equipment of sufficient capacity and located as required to keep all excavations free from water while work is in progress, including weekends and holidays. The contractor shall provide all means and facilities necessary to conduct water to the pumps. No separate payment will be made for dewatering trenches.

RETAINING AND NOISE BARRIER WALLS:

Proprietary alternatives to ADOT standard retaining and noise barrier walls will be allowed as indicated on the plans and in these Special Provisions. Where alternative wall types are allowed, the contractor may either construct a cast-in-place concrete wall per ADOT standards or use any of the alternative systems listed as acceptable.

EXISTING CONDITIONS:

The contractor is advised that the existing retention basin north of Shea Boulevard is to be left in place until the linear detention basin is completed to Indian Bend Wash and Indian Bend Wash is graded to 40th Street.

The Geotechical Investigation Report indicates that bedrock was encountered at two general locations within the alignment, including the northern portion of the Shea Boulevard traffic interchange at approximate stations 216± to 220± and the pump house site.

As part of the construction of the Shea Boulevard Underpass, the bedrock was preshot to a depth below the subbase for both the northbound and southbound lanes for a distance of approximately 50 feet to the north of the bridge. This contract includes removal of the fractured material.

CONSTRUCTION SEQUENCE:

The allowed time to construct the 24" waterline at Thunderbird Road is from October 15, 1996, to April 15, 1997.

MITIGATION FOR CULTURAL RESOURCES:

In order to prevent accidental damage to sensitive areas outside but adjacent to the construction zone in Indian Bend Wash, the contractor shall provide flagging around the site. ADOT Environmental Planning Section shall be notified at least five working days in advance of the time to arrange a meeting to identify the sensitive areas that need to be protected. This meeting can occur with ADOT District representatives and/or a lead person from the construction contractor. Contact Ed Green at 255-7767 or Bettina Rosenberg at 255-8641 of the Environmental Planning Section to schedule the meeting.

The flagging must be in place prior to beginning construction in Indian Bend Wash. All vehicle and personnel access will be restricted from the flagged area. The contractor is responsible for ensuring that the flagging is in place for the duration of the construction project.

FENCE CONSTRUCTION:

The contractor shall construct sound wall no. R3 and the permanent fencing which does not interfere with other activities within the first 90 days of Contract Time. At those locations where the permanent fencing conflicts with construction of other facilities, the contractor shall erect temporary chain link fence to completely close off access to the construction site from pedestrians. Sound walls and permanent right-of-way fences are to be erected upon completion of the conflicting construction items at the wall or fence site. The maintenance and care of the fence and walls shall be the full and complete responsibility of the contractor until project acceptance.

INSPECTION:

The City of Phoenix and its representatives shall have access to the work whenever it is in preparation or progress, and the contractor shall provide proper facilities for access and for inspection during the manufacturing process.

Inspection by the City or its representatives, or failure by the City or its representatives to provide inspection, shall not relieve the contractor of his responsibility to furnish materials and to perform work in accordance with this specification.

Material, fabricated parts, and pipe which are discovered to be defective or which do not conform to the requirements of these specifications, will be subject to rejection at any time prior to final acceptance. Rejected material and pipe shall promptly be removed from the site of the work.

TRANSPORTATION SYSTEM MANAGEMENT (TSM) PROGRAM:

As a part of this project the Department is implementing a Transportation System Management (TSM) Program. The purpose of this program is to keep the motoring public, adjacent homeowners, City of Phoenix transportation officials and other interested parties informed of the status of construction, changes in traffic-handling and routing, and other aspects of construction which affect nearby residents and commuters. TSM efforts are described in a TSM Manual, and will be directed by a Steering Committee including Department officials and representatives of the City of Phoenix, the design consultant, traffic design consultants and others. The contractor shall participate in TSM activities as follows:

- The contractor's project manager shall serve on the TSM Steering Committee,
- Participate in the preparation of graphics for use in communicating construction progress, traffic handling schemes, and other aspects of the project of interest to the public, and
- Provide information regarding the status of construction and planned activities which will affect the public, for use and distribution by the TSM Steering Committee.

There will be no special payment for the contractor's participation in TSM activities.

WORK BY CITY OF PHOENIX FORCES:

The City of Phoenix forces will make all shutdowns of City water mains and all service taps to existing lines.

When the contractor requires the shutdowns of a City water main and/or a service tap, he shall make application to the Water and Wastewater Department and pay the established charges for shutting down the water main and the cost of making a service tap to the City in advance of the work being performed.

When a shutdown is allowed, the contractor will be required to notify the public when the shutdown will cause any water customer to be without water.

Where cut and plugs are required on the project plans, City valve crews will restore and flush the water mains and inspect the cut and the plug assembly for leakage.

No direct payment will be made to the contractor for the work performed by the City.

REMOVAL OF EXISTING IMPROVEMENTS:

Existing improvements removed by the contractor for the convenience of the contractor during utility work shall be done as described under Section 202. All items removed or disturbed shall be replaced in a condition equal to or better than that prior to construction of the utility. No payment will be made for this work.

(ERRATA, 04/01/94)

ADDITIONS AND REVISIONS TO THE STANDARD SPECIFICATIONS:

STANDARD SPECIFICATIONS ERRATA:

The following changes shall be made to cover errors in the text of the Standard Specifications:

Page 91:

109.04 (A) (3) **Equipment:** the phone number in the fourth sentence of the first paragraph is revised to read (800) 669-3282.

Page 94:

109.06 **Partial Payments:** the last sentence of the first paragraph of the Standard Specifications is hereby deleted:

Page 99:

201-3.01 **Clearing and Grubbing:** the fourth paragraph of the Standard Specifications is revised to read:

In embankment areas, where the subgrade is five or more feet above the natural ground line, all trees, stumps and roots shall be cut off not more than one foot above the natural ground or shall be completely removed where a structure is to be constructed, piles are to be placed or driven or where unsuitable material is to be removed.

Page 108:

203-3.03 (A) **General:** the second sentence of the first paragraph of the Standard Specifications is revised to read:

When Portland Cement Concrete Pavement or Asphaltic Concrete Pavement are to be placed directly on the subgrade, the finished surface shall not vary by more than 0.02 foot above or 0.04 foot below the established grade.

Page 119:

203-5.04 (A) **Structural Excavation:** the last paragraph of the Standard Specifications is revised to read:

No measurement for payment will be made for structural excavation when structures are to be supported on piles or drilled shafts in new embankment sections.

Page 122:

203-10.03 (A) **Placement:** the second sentence of the first paragraph of the Standard Specifications is revised to read:

When Portland Cement Concrete Pavement or Asphaltic Concrete Pavement are to be placed directly on the subgrade, the finished surface shall not vary by more than 0.02 foot above or 0.04 foot below the established grade.

Page 127:

205-3.04 **Compacting and Finishing:** the second sentence of the second paragraph of the Standard Specifications is revised to read:

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 Pavement are to be placed directly on the subgrade, the finished surface shall not vary by more than 0.02 foot above or 0.04 foot below the established grade.

Page 197:

404-1 **Description:** the second paragraph of the Standard Specifications is revised to read:

The kind of bituminous treatment may consist of one or a combination of the following:

Prime Coat
Tack Coat
Fog Coat
Chip Seal Coat

Page 224:

406-10.03 **Proportioning:** the fourth sentence of the third paragraph of the Standard Specifications is revised to read:

The mixing device shall be designed such that the mixture of aggregate and admixture is moved in a near horizontal direction by the mixing paddles without the aid of conveyor belts for a distance of at least three feet.

Page 242:

SECTION 407 - ASPHALTIC CONCRETE FRICTION COURSE: the number for Subsection 407-1 Construction Requirements of the Standard Specifications is revised to read:

407-10 **Construction Requirements:**

Page 256:

408-7.03 **Proportioning:** the fourth sentence of the third paragraph of the Standard Specifications is revised to read:

The mixing device shall be designed such that the mixture of aggregate and admixture is moved in a near horizontal direction by the mixing paddles without the aid of conveyor belts for a distance of at least three feet.

Page 326:

503-2.01 **Concrete:** of the Standard Specifications is revised to read:

Portland cement concrete shall conform to the requirements of Section 1006 for Class B concrete.

Page 340:

601-3.02 (D) **Removal of Falsework and Forms:** the first sentence of the seventh paragraph of the Standard Specifications is revised to read:

Placement of backfill material shall be in accordance with Subsection 203-5.03 (B).

Page 472:

730-6 **Locations of Utilities:** the second and third paragraphs of the Standard Specifications are revised to read:

In addition to the requirements of Subsection 107.20, the contractor's attention is directed to the requirements of A.R.S. 40-360.21 through .29 requiring all parties excavating in public streets, alleys or utility easements to first secure the locations of all underground facilities in the vicinity of the excavation.

The contractor shall contact the Blue Stake Center at least two working days prior to commencing excavation, for information relative to the location of buried utilities within the project limits.

Page 626:

902-2.05 **Tension Wire and Fabric Fasteners:** the last paragraph of the Standard Specifications is revised to read:

The minimum weight of zinc-coating shall conform to the requirements of ASTM A641, Class 3. The minimum weight of aluminum coating shall be 0.40 ounces per square foot of wire surface area.

Page 672:

SECTION 914 - SOUND BARRIER WALLS: the title for Section 914 of the Standard Specifications is revised to read:

WALLS AND MISCELLANEOUS STRUCTURES:

SECTION 914-1 Description: of the Standard Specifications is revised to read:

The work under this section consists of furnishing all materials and constructing walls and miscellaneous structures at the locations and in accordance with the details shown on the project plans.

SECTION 914 - SOUND BARRIER WALLS: the number of Subsection 915-5 Basis of Payment of the Standard Specifications is revised to read:

914-5 Basis of Payment:

Page 757:

1012-3 Miscellaneous Materials: the first sentence of the fourth paragraph of the Standard Specifications is revised to read:

The metal used to manufacture reflector tabs shall be either 3003-H14 aluminum strip 0.063" ± .004 inch thick or steel strip 0.078" ± .008 inch thick with a G-90 galvanized coating.

(101PLANS, 07/31/92)

SECTION 101 - DEFINITIONS AND TERMS:

101.35 (A) Standard Drawings: of the Standard Specifications is modified to add:

The cost of each set of Standard Drawings is $5.00. Single copies of each drawing are also available at $0.15 each. The above costs include postage. The minimum mail order is $1.00.

101.35 (C) Working Drawings and Supplemental Drawings: of the Standard Specifications is revised to read:

Supplemental designs sheets, shop drawings, or similar data which the contractor is required to submit to the Engineer such as stress sheets, erection plans, falsework plans, forming plans for cast-in-place bridge girders, framework plans, cofferdam plans, bending diagrams for reinforcing steel, computations, or any other supplementary data required of the contractor.

(102FALSE, 05/15/92)

SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS: of the Standard Specifications is revised as follows:

102.03 Suspension from Bidding: is revised to read:

The Department may suspend any person and any subsidiary or affiliate of any person from further bidding to the Department and from being a subcontractor to a contractor with the Department or a supplier to the Department if that person or any officer, director, employee or agent of that person is convicted, in this State, of any of the following charges, or of similar charges in any Federal court, or a court in any State:

(1) Entering into any contract, combination, conspiracy or other unlawful act in restraint of trade or commerce,

(2) Knowingly and willfully falsifying, concealing, or covering up a material fact by trick, scheme, or device,

(3) Making false, fictitious, or fraudulent statements or representations,

(4) Making or using a false writing or document knowing it to contain a false, fictitious, or fraudulent statement or entry.

Under this Subsection, a person means any individual, partnership, corporation, association or other entity formed for the purpose of doing business as a contractor, subcontractor or supplier.

(102BIDS, 10/01/92)

SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS: of the Standard Specifications is revised as follows:

102.12 Proposal Guaranty: is revised to read:

A proposal guaranty in the form of either a certified or a cashier's check made payable to the Arizona Department of Transportation for ten percent of the amount of the bid or in the form of a surety (bid) bond for ten percent of the amount of the bid shall accompany the proposal.

The Surety (bid) bond will be accepted only on the form provided by the Department. The surety (bid) bond shall be executed solely by a surety company or companies holding a certificate of authority to transact surety business in this State issued by the Director of the Department of Insurance. The surety bid bond shall not be executed by an individual surety or sureties.

Surety (bid) bonds shall be signed by the bidder and by the surety company with the current power of attorney attached.

(103BONDS, 08/15/92)

SECTION 103 - AWARD AND EXECUTION OF CONTRACT: of the Standard Specifications is revised as follows:

103.05 Requirement of Contract Bonds: is revised to read:

The successful bidder shall furnish the Department the following bonds with surety, which shall become binding upon the execution of the contract:

1. A performance bond in the amount of 100 percent of the total contract amount conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions thereof. Such bond shall be solely for the protection of the Department.

2. A payment bond in the amount of 100 percent of the total contract amount solely for the protection of claimants supplying labor or materials to the contractor or its subcontractors in the prosecution of the work, and the payment of all workman's compensation, occupational disease and unemployment compensation premiums.

The bonds shall be written or countersigned by an authorized representative of the surety. The authorized representative must be either a resident of the state of Arizona or must maintain its principal office in this State, as by law required. The bonds shall have attached thereto power of attorney of the signing official.

The forms of the bonds will be provided by the Department. Each bond shall be executed solely by a surety company or companies holding a certificate of authority to transact surety business in this State issued by the Director of the Department of Insurance. The bonds shall not be executed by an individual surety or sureties.

(104PARTR, 05/01/92)

SECTION 104 - SCOPE OF WORK:

104.01 **Intent of Contract:** of the Standard Specifications is modified to add:

(A) COVENANT OF GOOD FAITH AND FAIR DEALING:

This contract imposes an obligation of good faith and fair dealing in its performance and enforcement.

The contractor and the Department, with a positive commitment to honesty and integrity, agree to the following mutual duties:

(1) Each will function within the laws and statutes applicable to their duties and responsibilities.

(2) Each will assist in the other's performance.

(3) Each will avoid hindering the other's performance.

(4) Each will proceed to fulfill its obligations diligently.

(5) Each will cooperate in the common endeavor of the contract.

(B) Voluntary Partnering:

The Arizona Department of Transportation intends to encourage the foundation of a cohesive partnership with the contractor and its principal subcontractors and suppliers. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objectives are effective and efficient contract performance and completion within budget, on schedule, and in accordance with plans and Specifications.

This partnership will be bilateral in makeup, and participation will be totally voluntary. Any cost associated with effectuating this partnering will be agreed to by both parties and will be shared equally.

To implement this partner initiative prior to starting of work in accordance with the requirements of Subsection 108.02 and prior to the preconstruction conference, the contractor's management personnel and ADOT's District Engineer will initiate a partnering development seminar/team building workshop. Project personnel working with the assistance of Construction Operation Services will make arrangements to determine attendees at the workshop, agenda of the workshop, duration, and location. Persons required to be in attendance will be the ADOT Construction Supervisor and key project personnel; the contractor's on-site project manager and key project supervision personnel of both the prime and principal subcontractors and suppliers. The project design engineers, FHWA and key local government personnel will also be invited to attend as necessary. The contractors and ADOT will also be required to have Regional/District and Corporate/State level managers on the project team.

Follow-up workshops may be held periodically throughout the duration of the contract as agreed by the contractor and Arizona Department of Transportation.

The establishment of a partnership charter on a project will not change the legal relationship of the parties to the contract nor relieve either party from any of the terms of the contract.

(104SCOOP, 12/03/91)

104.02 (B) **Alterations In Details of Construction:** of the Standard Specifications is modified to add:

When the Department makes alterations in the details of construction or Specifications, that are limited in scope, to the extent that the cost of the alterations will not exceed $5,000.00, the Engineer and the contractor may reach agreement upon the scope of work and a lump sum amount to cover the cost of the work to be performed. This agreement shall be reflected in a letter from the Engineer to the contractor, which, when executed by both parties, shall have the same force and effect as a supplemental agreement. Work shall not proceed until both parties have signed the agreement. This work will be paid for under ITEM 9240101 - Miscellaneous Work, at the lump sum amount agreed upon, which item will not be a part of the Bidding Schedule, but will be established by the Engineer through the initial letter agreement.

104.03 **Maintenance of Traffic:** of the Standard Specifications is modified to add:

(1) Work on connecting the tie-in of construction on Cactus Road and Thunderbird Road as well as other activities which cause traffic disruption on these streets shall be limited to non-peak traffic hours as defined below:

(2) Peak traffic hours:

5:30 A.M. to 9:00 A.M., 4:00 P.M. to 6:00 P.M. Except Sundays and Holidays.

All other time shall be considered non-peak hours.

(3) Complete closure of 36th Street and Sweetwater Avenue will be allowed only once for each of the culvert locations. Two way traffic is be restored by 5:00 A.M. Monday following the weekend closure.

(4) For every 15 minute period or portion thereof that traveled lanes remain closed beyond these periods, the contractor will be assessed a penalty of $1,500.00.

(5) The contractor shall submit to the Engineer, for his approval, a plan showing temporary traffic control during installation of the traffic control shown. This plan shall be submitted at least two weeks in advance of installation.

(6) All traffic closures are subject to the approval of the Engineer. Closure times may be adjusted at the discretion of the Engineer.

(104VEJP, 06/30/92)

104.06 **Cost Reduction Incentive:** the Title and Subsection of the Standard Specifications are revised to read:

104.06 **Value Engineering Joint Proposal:**

Proposals may be submitted to the Engineer for modifying the plans, specifications, or other requirements of the contract for the sole purpose of reducing the total cost of construction without impairing in any manner the essential functions or characteristics of the project, including but not limited to service life, economy of operations, ease of maintenance, desired appearance, or design and safety standards.

After execution of the contract, an initiative may be recommended by the contractor or, if applicable, sponsoring governmental agency. The initiative must be identified as a value engineering initiative, and may include modifications to the plans or specifications, construction phasing or procedures, or other contract requirements.

Once a value engineering initiative is recommended, a team will be assembled consisting of the Engineer, contractor, sponsoring governmental agency, and other parties as deemed appropriate by the Engineer. The team will review the initiative and determine whether to proceed with a value engineering joint proposal.

The Engineer reserves the right to make alterations to the contract, in accordance with Subsection 104.02. The Engineer will notify the contractor in writing of any alterations to the contract. Such alterations shall not be eligible for inclusion in any value engineering initiatives or joint proposals.

It shall not be inferred from this subsection that the Engineer is required to consider any initiative submitted.

Submissions that propose changes in the basic design of a bridge, or changes in type of pavement will not be considered. Changes in the pavement structural section, or in structure design details may be considered with prior approval by the Material or Structures Engineer. Changes to contingency items such as traffic control and dust palliative will not be considered if they are part of pre-determined lump sum contract amounts. Contingency items such as traffic control and dust palliative may be considered when they are reduced as part of a value engineering initiative to change scope, method or procedure, provided they are specified as individual contract bid items.

A savings resulting solely from the elimination or reduction in quantity of a bid item will not be considered as a value engineering initiative, in accordance with this subsection. A savings resulting from the elimination or reduction in quantity of a bid item specified as part of a value engineering initiative will be considered.

The Engineer and the contractor must jointly agree to the merit of any value engineering initiative prior to preparation of the value engineering joint proposal. The Department will not be liable for failure to accept any value engineering initiative.

If the Engineer and the contractor jointly agree to the initiative, the contractor shall prepare the value engineering joint proposal. The contractor shall identify the proposal as such, and it shall contain, at a minimum, the following:

(A) A description of both the existing contract requirements for performing the work and the proposed changes.

(B) All engineering drawings and computations necessary for a thorough and expeditious evaluation.

(C) An itemization of the existing contract requirements that must be changed if the proposal is adopted, and a recommendation as to the manner in which the change should be made.

(D) A detailed estimate of the cost of performing the work under the existing contract and under the proposed changes, including the cost of implementing the changes.

(E) The contract items affected by the proposed changes and any variations in quantities resulting from the changes. Any new items not listed in the bid schedule.

(F) An objective estimate of any effects the proposal will have on collateral costs to the Department, costs of related items, and costs of maintenance and operation.

(G) A statement as to the effect that the proposal will have on the time for the completion of the project.

(H) A statement in which the Engineer and contractor jointly establish an acceptable period of time for evaluation of the proposal, and execution of a supplemental agreement. Any delays or extensions must be jointly approved by the Engineer and contractor, or such proposal shall be considered rejected.

(I) A statement as to any contract time extension or time related costs which will be requested by the contractor as a condition for implementing the proposed changes.

(J) A detailed statement indicating the costs for developing the changes, along with the costs for preparing the value engineering joint proposal.

If, after formal review, the value engineering joint proposal is rejected, the Department will share equally in the contractor's costs for developing and presenting the proposal, and the contractor will share equally in the cost to the Department for investigating and evaluating the proposal. A supplemental agreement will be executed to adjust the contract for the net increase or decrease in monies resulting from the contractor's development costs as listed above in paragraph (J), and the Department's evaluation costs. The supplemental agreement will terminate the Department's review of the value engineering joint proposal. The Department will not be liable for any delay in executing the supplemental agreement, nor for any failure to accept the value engineering joint proposal.

The contractor will be notified in writing by the Engineer as to whether the proposal has been accepted. The decision by the Department is final and shall not be subject to the provisions of Subsection 105.17.

If the value engineering joint proposal is accepted in whole or in part, the necessary contract modifications and contract price adjustments will be made by the execution of a supplemental agreement which will specifically state that it is executed pursuant to the provisions of this subsection. The Department will be the sole judge of the acceptability of a proposal, and of the estimated net savings in construction costs from the adoption of all or any part of the proposal.

The contractor shall continue to perform the work in accordance with the requirements of the contract until a supplemental agreement incorporating the proposal has been executed, or until the contractor has been given oral or written approval by the Engineer. If the supplemental agreement has not been executed, or the contractor has not been given oral or written approval on or before the date jointly determined above in paragraph (H), the proposal shall be deemed to be rejected.

The executed supplemental agreement shall incorporate the changes in the plans, specifications, or other requirements of the contract which are necessary to permit the proposal, or such part of it which has been accepted, to be put into effect, and shall include any conditions upon which the Department's approval thereof is based. The executed supplemental agreement shall also extend the time for the completion of the contract if, the extension was requested by the contractor as a condition for implementing the proposal, and such an extension has been deemed to be warranted by the Department.

The executed supplemental agreement shall also establish the estimated net savings in the cost of performing the work attributable to the value engineering joint proposal. In determining the net savings, the Engineer reserves the right to disregard the contract bid prices if, in the Engineer's judgement, such prices do not represent a fair measure of the value of the work to be performed or to be deleted. The net savings will be established by determining the contractor's cost of performing the work, taking into account the contractor's cost of developing the value engineering joint proposal and implementing the change, and reducing this amount by the Department's costs for investigating and evaluating the proposal, including any ascertainable collateral costs to the Department. Such collateral costs may include increased costs for maintenance or operation, or costs for related or additional work items or elements. The executed supplemental agreement shall provide that the contractor be paid 50 percent of the estimated net savings amount. Administrative or construction engineering costs by the Department will not be included in the determination of the estimated net savings. Changes in overhead costs by the contractor resulting from the proposal, including related time reductions or extensions, shall not be allowed.

The executed supplemental agreement shall also provide for the adjustment in contract prices. Contract prices shall be adjusted by subtracting the Department's share of the accrued net savings.

The amount specified to be paid to the contractor in the executed supplemental agreement shall constitute full compensation to the contractor for the value engineering joint proposal and the performance of the work thereof pursuant to the said supplemental agreement.

Upon acceptance of a value engineering joint proposal, any restrictions imposed by the contractor on its use or on disclosure of the information shall become void, and the Department thereafter shall have the right to use all or any part of the proposal without obligation or compensation of any kind to the contractor.

(105PRNTS, 03/31/93)

SECTION 105 - CONTROL OF WORK: of the Standard Specifications is revised as follows:

105.02 **Plans and Working Drawings:** the last sentence of the fifth paragraph is revised to read:

The contractor shall submit at least one exact copy of the material submitted to the Engineer directly to the appropriate departmental office in Phoenix so that the time necessary for the required approval may be shortened. The Engineer will specify which departmental office is to receive the copy.

105.02 **Plans and Working Drawings:** the third to the last paragraph is revised to read:

Five sets of prints or other acceptable type copies and one set of positive reproducibles, such as positive mylars or positive sepias, shall be submitted to the Engineer for review. The prints and the reproducibles shall be clear, precise and suitable for microfilm photography. Upon completion of the review, the Engineer will stamp the drawings in accordance with item one, two or three listed above and return one set of the prints to the contractor. Drawings requiring a resubmittal shall be revised in accordance with the Engineer's annotations, after being verified by the contractor, and resubmitted as described above, including the set of positive reproducibles. This resubmittal process shall continue until all corrections and revisions have been made and are acceptable to the Engineer.

105.16 (B) **Final Acceptance:** the second paragraph of the Standard Specifications is modified to add:

In addition, final acceptance will not be made until all completed plans and working drawings as required in Subsection 105.02 have been submitted and deemed acceptable by the Engineer.

105.07 Cooperation between Contractors: of the Standard Specifications is modified to add:

The contractor is advised there will be construction activity adjacent to the embankment placement project site. The contractor is to coordinate his work to accommodate the construction activities of the following project:

101 L MA 24 H 3565 01C Pima Freeway (SR 101L)
RAM 600-1-406 23rd Avenue to 56th Street

The Department anticipates this contract will be under construction by the beginning of 1997. The work consists of bridges, retaining walls, roadway, drainage, grading, box culvert and utility relocation construction. The overexcavation for the locations of embankment placement will be done by the Pima Freeway contract. The contractor is advised that he shall schedule and coordinate all work activities so as not to adversely conflict with this work.

(105CLAIM, 08/01/93)

SECTION 105 CONTROL OF WORK:

105.17 Claims: of the Standard Specifications is revised to read:

(A) Notice of Claim:

It is the purpose of this subsection that claims for additional compensation and any difference between the parties arising under and by virtue of the contract be brought to the attention of the Engineer at the earliest possible time and at the first responsible level to increase the possibility for such matters to be resolved or for appropriate action to be taken promptly. This section shall be construed to apply to all claims including, but not limited to, claims based on contract clauses as well as claims based on breach of contract or tort.

In the event any basis for additional compensation or time extension is perceived by the contractor to have occurred, the contractor shall give the Engineer immediate oral or written notice of such basis for additional compensation or time extension for the earliest possible decision, instruction, notice or action duly taken by the Engineer.

Should the contractor disagree with any decision, order, instruction, notice, act or omission of the Engineer, the contractor may submit a Notice of Claim to the Engineer. The Notice of Claim shall be submitted in writing within three working days after the contractor has learned of the Engineer's action regarding the occurrence or event and before the contractor begins the work on which he/she based the claim. For projects on

which the voluntary partnering process as specified in Subsection 104.01 is followed, and the contractor elects to file a claim, the Notice of claim shall be submitted within three working days after the completion of the issue resolution process.

The Notice of claim shall indicate, insofar as possible, the basis and the nature of the claim. If notification is not given, the contractor hereby agrees to waive any claim for additional compensation. Within a 10 day period from the submission of the Notice of Claim, the contractor shall submit in writing a projection of the contractor's additional costs resulting from the alleged incident. Such costs shall include both present and future costs resulting from the alleged incident.

At the time the contractor gives written notice of his/her claim, the contractor shall immediately begin to keep and maintain complete and specific records to the extent possible, including but not limited to, cost records concerning details of the perceived claim.

The contractor shall give the Engineer access to any such records and, when so requested, shall furnish the Engineer copies of claim documentation.

Unless otherwise agreed to in writing, the contractor shall continue with and carry on the work and progress during the pendency of any claim, dispute, decision or determination by the Engineer, and any mediation or arbitration proceedings, and the Department will continue to make progress payments to the contractor in accordance with the contract documents.

(B) Submission of Claims:

As promptly as possible following the submission of a Notice of Claim in accordance with Subsection (A) of this section but in no event later than 30 calendar days after all of the contractor's costs have been incurred, the contractor shall submit his/her claim to the Engineer concerning the matter so noticed.

The claim shall set forth clearly and in detail, for each item of additional compensation or extension of time requested, the reasons for the claim, references to applicable provisions of the specifications, the nature and the specific cost ascribed to each element of the claim or for each period of time involved, the basis used in ascribing each such element of cost or for each such period of time, and all other pertinent factual data.

The contractor shall, insofar as it is possible to do so, promptly furnish any clarification and additional information or data deemed necessary and requested in writing by the Engineer.

(C) Decision on Claims:

The Engineer will make a written decision in relation to any claim presented by the contractor within the following time frames:

(1) For an adjustment in compensation, or other contractual dispute between the parties where the amount in controversy is $200,000.00 or less, 30 calendar days from receipt of the contractor's claim;

(2) For an adjustment in compensation or other contractual dispute between the parties where the amount in controversy is more than $200,000.00, 60 calendar days from receipt of the contractor's claim.

Unless the contractor and the Engineer otherwise stipulate in writing to a later time, if the Engineer does not make a decision or determination within the time frames prescribed in this subsection, the claim shall be deemed denied and the contractor may proceed with the legal remedy prescribed herein.

The decision of the Engineer in relation to the contractor's claim shall be final unless the contractor commences arbitration or litigation as follows:

(1) Where the amount in controversy is $200,000.00 or less, the contractor's sole legal remedy shall be arbitration as prescribed in Section 105.18.

(2) Where the amount in controversy is more than $200,000.00, the contractor shall initiate litigation within twelve months after the cause of action accrues as prescribed in Section 12-821 of the Arizona Revised Statues.

(D) Mediation:

Notwithstanding Section 105.17 (C), if the contractor is not satisfied with the decision of the Engineer, and prior to filing for arbitration or litigation, the contractor may request a non-binding mediation by filing a request for mediation in writing with the Engineer. The Engineer will then arrange for a mutually agreeable mediator. Such request for mediation shall be made within 30 calendar days from actual receipt of the Engineer's decision as provided for in this section.

In connection with the mediation, each party shall bear its own costs, and any fees and expenses assessed by the mediator shall be borne equally by the parties.

105.18 **Arbitration of Claims and Disputes:** of the Standard Specifications is revised to read:

(A) If the contractor elects to invoke his/her right to arbitration, the contractor shall file a Demand for Arbitration in writing with the American Arbitration Association, United States Arbitration and Mediation of Arizona, or any equivalent arbitration service, and serve a copy thereof upon the State Engineer. Such Demand for Arbitration shall be made by claimant within 30 calendar days measured from actual receipt of the Engineer's decision as provided for in Section 105.17 above, unless a mediation process is already underway, in which case the Demand for Arbitration shall be made within 30 days of the termination of the mediation process. The scope of the arbitration proceeding shall be restricted and limited to the matters presented to the Engineer upon which the decision or determination was made and shall include no other matters. All arbitration of claims shall be conducted in Phoenix, Arizona in accordance with the rules of the arbitration service hearing the dispute.

(B) The decision or award of the arbitrator shall be supported by substantial evidence and, in writing, contain the basis for the decision or award and findings of fact. The decision or award by the arbitrator when made shall be final and nonappealable except as provided in Section 12-1512, Arizona Revised Statutes. Both the contractor and the Engineer shall be bound by the Arbitration Award for all purposes and judgment may be entered upon it in accordance with applicable law in the Superior Court of Arizona in and for the County of Maricopa.

(C) For the purposes of this section, a claim for adjustment in compensation shall mean an aggregate of operative facts which give rise to the rights which the contractor seeks to enforce. That is to say, a claim under this section is defined as the event, transaction or set of facts that give rise to a claim for compensation, costs or expenses or damages which do not exceed $200,000.00 in amount.

In making a determination whether the amount in controversy is $200,000.00 or less, the parties shall not consider, quantify or take into account any requested extensions of contract time, or the release or remission of liquidated damages previously assessed, under Section 108.08 and 108.09 of the Specifications.

(D) Any contractor having a claim, adjustment or dispute for an amount in excess of $200,000.00 may waive or abandon the dollar amount of any such claim in excess of $200,000.00 so as to bring the claim, adjustment or dispute within the scope and coverage of this section, provided that the amount allowed to any such contractor by the arbitration award shall not exceed $200,000.00. Various damages claimed by the contractor for a single claim may not be divided into separate proceedings to create claims within the $200,000.00 limit.

(E) The claim shall be submitted to a single arbitrator who shall be selected by the parties from a list of arbitrators furnished by the arbitration service. Each party shall alternately strike names from the list until only one name remains. The person whose name thus remains on the list of arbitrators is their first choice but if that person is not available to serve, the two persons whose names were last stricken are acceptable, with the one whose name was last stricken being the first alternate.

(F) Unless agreed to otherwise, the parties shall select the arbitrator within ten calendar days after each has received a copy of the list of arbitrators.

(G) Each party to the arbitration shall bear its own costs and any other cost and fees assessed shall be divided equally between the parties to the arbitration.

(106EFFL, 01/15/92)

SECTION 106 - CONTROL OF MATERIAL: of the Standard Specifications is revised as follows:

106.01 Source of Supply and Quality Requirements: is modified to add:

Whenever water is required on a project, as part of either a process or a product, it shall be free of contaminants which, in the judgement of the Engineer, constitute a health hazard to those individuals employed on the project and to the general public.

Untreated effluent shall not be utilized in any aspect of the work.

(106QCMAT, 10/30/94)

SECTION 106 - CONTROL OF MATERIAL:

106.04 **Tests and Acceptance of Material:** of the Standard Specifications is revised to read:

(A) Department Quality Acceptance:

All materials will be inspected, tested and approved by the Engineer prior to incorporation in the work. Any work in which materials not previously approved are used shall be performed at the contractor's risk and may be considered as unauthorized and unacceptable and not subject to the payment provisions of the contract.

Materials will be sampled and tested in accordance with the requirements of the Materials Testing Manual and the Materials Policy and Procedure Directives Manual and by a qualified representative of the Department unless otherwise specified in the contract documents. Copies of all test results will be furnished to the contractor's representative at the contractor's request.

Whenever a reference is made in the specifications to an Arizona Test Method, it shall mean the test method in effect on the bid opening date.

Whenever a reference is made in the specifications to a Federal Specification, or to a specification or test designation of the American Society for Testing and Materials, or any other recognized national organization, it shall mean the year of adoption or latest revision of the specification or test designation in effect on the bid opening date.

(B) Contractor Quality Control:

The contractor is responsible for quality control measures necessary to provide acceptable quality in the production, handling, and placement of all materials.

The specifications may require specific quality control measures for certain materials by referencing Subsection 106.04(C). When so specified, the contractor shall provide all the personnel, equipment, materials, supplies, and facilities necessary to obtain samples and perform the tests listed in the applicable section and as given herein in Subsection 106.04(C).

(C) Specific Contractor Quality Control Measures:

(1) General:

At the preconstruction conference, the contractor shall designate a qualified employee as Quality Control Manager to be responsible for implementing, monitoring and, as necessary, adjusting the processes to assure acceptable quality. The Quality Control Manager shall be a full time employee of the contractor, and shall be on the project site during all construction activities. Also at the preconstruction conference, the contractor shall be prepared to discuss his understanding of the quality control responsibilities for the specified materials.

When requested by the contractor, the Department will engage in testing of materials for the purpose of correlating the contractor's test results to those of the Department's acceptance laboratory.

(2) Quality Control Laboratory:

The laboratory or laboratories shall meet the requirements of the Department's "System for the Evaluation of Testing Laboratories." These requirements may be obtained from ADOT Materials Group, 1221 North 21st Avenue, Phoenix, Arizona 85009.

The Engineer shall promptly advise the contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures.

(3) Quality Testing Supervisor:

The contractor shall designate a Quality Testing Supervisor to be responsible for supervising sampling and testing in accordance with the test requirements specified for the applicable section. The Quality Testing Supervisor shall be an employee of the contractor or a consultant engaged by the contractor. The contractor's Quality Testing Supervisor may be responsible for sampling and testing for one or more projects if that person can be at the job site within 24 hours of being notified of a problem.

The Quality Testing Supervisor shall be an individual meeting one of the following requirements:

(a) Professional Engineer registered in Arizona with one year of highway experience acceptable to the Department.

(b) Engineer-In-Training certified by the State of Arizona with two years of highway experience acceptable to the Department.

(c) An individual with three years of highway experience acceptable to the Department, and with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology, or Construction.

(d) Construction Materials Technician certified at Level III by NICET.

(e) Highway Materials Technician certified at Level III by NICET.

(f) A NICET certified Engineering Technician in Civil Engineering Technology with five years of highway materials testing experience acceptable to the Department.

(g) An individual with eight years of highway materials testing and construction experience acceptable to the Department.

(4) Technician Qualification:

The Quality Testing Technician performing the actual sampling and testing shall meet one of the following criteria:

(a) Construction Materials Technician certified at Level II or higher by NICET in appropriate subfield.

(b) Those listed under (3)(a) through (3)(f) above, meeting the criteria for Quality Testing Supervisor,.if they have a demonstrated proficiency in performing the appropriate test(s).

(c) Construction Materials Technician trainee under direct observation of an individual listed in (4)(a) or (4)(b) above. The number of trainees shall not exceed one-third of the total number of Quality Control Technicians on the project.

(5) Records:

The contractor shall maintain complete testing records and make them available to the Department for review and copies as requested.

Linear control charts shall be maintained by the contractor. Control charts shall be posted in a location satisfactory to the Engineer and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the upper and/or lower specification limit applicable to each test parameter, and the contractor's test results. The contractor shall use the control charts as part of a process control system for identifying production and equipment problems and for identifying potential pay factor reductions before they occur.

(6) Weekly Quality Control Reports:

The Contractor shall submit Weekly Quality control Reports to the Engineer. The weekly reports shall state the type of work performed during the report period, and other process control measures taken to assure quality. Results of all tests, corrective action, retests, and linear control charts shall be attached to the weekly report. The report period shall end at midnight of each Friday, and the report shall be submitted to the Engineer no later than 5:00 p.m. of the following Wednesday.

(106CERT, 05/01/93)

SECTION 106 - CONTROL OF MATERIAL:

106.05 Certificates: of the Standard Specifications is revised to read:

(A) General:

The Contractor shall submit to the Engineer an original or copy of either a Certificate of Compliance or a Certificate of Analysis, as required, prior to the use of any materials or manufactured assemblies for which these specifications or the special provisions require that such a certificate be furnished.

The Engineer may permit the use of certain materials or manufactured assemblies prior to, or without, sampling and testing if accompanied by a Certificate of Compliance or Certificate of Analysis, as herein specified. Materials or manufactured assemblies for which a certificate is furnished 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.

Certificates shall comply with the requirements specified herein and of the Materials Testing Manual.

(B) Certificate of Compliance:

A Certificate of Compliance shall contain the following information:

(1) A description of the material supplied.

(2) Quantity if material represented by the certificate.

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

(4) Statement that the material complies in all respects with the requirements of the cited specifications. Certificates shall state compliance to the specific cited specification, such as AASHTO M-194, ASTM A-588; or specific table or section of the Arizona Department of Transportation Standard Specifications or Special Provisions. Certificates may cite both, if applicable.

(5) The name, title, and signature of a person having legal authority to bind the manufacturer or the supplier of the material. The date of the signature shall also be given. The name and address of the manufacturer or supplier of the material shall be shown on the certificate. A copy or facsimile reproduction (FAX) will be acceptable. However, the original certificate shall be made available upon request. 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 in writing by one of the three listed above. The manufacturer or supplier may submit a list of those who are authorized to sign certificates. This list shall be submitted under the name, title, and signature of one of the first three listed above. This list will be kept on file for subsequent certificates received on that project.

Each of the first four items specified above shall be completed prior to the signing as defined in item five. No certificate will be accepted that has been altered, added to, or changed in any way after the authorized signature has been affixed to the original certificate. However, notations of a clarifying nature, such as project number, contractor, or quantity shipped are acceptable, provided the basic requirements of the certificate are not affected.

(C) Certificate of Analysis:

A Certificate of Analysis shall include all the information required in a Certificate of Compliance and, in addition, shall include the results of all tests required by the specifications.

SECTION 107 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC:

107.02 Permits, Licenses and Taxes: of the Standard Specifications is modified to add:

Permits for hauling materials over City of Phoenix Streets in accordance with City Ordinance G-2817, City Code Section 36-88.07 will be required.

Permits may be obtained from Phoenix Development Services as 125 East Washington Street.

In applying for a Haul Permit, the contractor may be required to address the following issues in their Haul Plan:

1. A site plan showing the following information:
   - Vicinity map
   - Property lines
   - Adjacent streets, sidewalks and alleys
   - Limits of fill or excavation, including elevations
   - Amount of fill or excavation to be moved
   - Method of moving fill or excavation

2. A detailed traffic control plan showing:
   - Access to site
   - Hours of operation
   - Number of trucks to be used
   - Frequency of trucks entering and leaving site
   - Haul Route(s) to be used to and from origin or destination of haul
   - Traffic control methods including police officers, flagmen, signs and channelization to be provided for traffic control at the site and as needed on the haul route(s)

3. A written plan of action detailing methods that will be used to:
   - Prevent dust, spillage, tracking and blow-off
   - Provide continuous clean-up and final clean-up of all streets (including adjacent sidewalks) used for hauling
   - Inspect and repair street damage on the haul route(s) caused by trucks hauling to or from the permit site
   - Implement proposed method of minimizing public inconvenience or annoyances

This list is not to be considered as all-inclusive, but is intended to provide a summary of key points to be considered in a Haul Plan. The contractor shall familiarize himself with the requirements of City Ordinance G-2817 in preparing his bid and in submitting requests for Haul Permits.

Should the contractor have questions pertaining to hauling, he may contact the following:

<u>ADOT</u>

Evan Leander
Resident Engineer
(602) 255-8892

<u>City of Phoenix</u>

John Perez
Supervisor, Construction Traffic Control
(602) 262-6565

The contractor is advised that the City of Phoenix retains ultimate authority to approve or disapprove the Haul Plan, impose additional restrictions, curtail hauling for special events or during certain hours, and require the use of specific routes.

Applications for Haul Permits shall be made directly to the City of Phoenix, with a copy of the approved permit delivered to the Engineer prior to commencement of haul operations.

If the proposed work is to occur at night, the Engineer will have the final approval authority in accordance with Section 105 and these special provisions.

(107HAZMT, 01/15/93)

SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC: of the Standard Specifications is revised as follows:

107.07 Sanitary, Health, and Safety Provisions: is modified to add:

Prior to construction the Department will make a reasonable effort to locate, identify and remove potentially hazardous or contaminated materials, including underground storage tanks, within a project area. Despite these efforts, some of these materials may still be found during the construction of the project. Should material be encountered during construction operations which the contractor believes to be hazardous or contaminated, the contractor shall immediately do the following:

(1) Stop work and remove all workers within the contaminated area. For life threatening situations, follow the procedures in the Safety Plan, specified in Subsection 107.08.

(2) Barricade the area and provide traffic control, if necessary, to prohibit unauthorized entry.

(3) Notify the Engineer. If after work hours, and the Engineer cannot be reached, contact the Arizona Department of Transportation Safety Section at (602) 223-8323. If the Safety Section cannot be reached, contact the Department of Public Safety (DPS). The contractor shall not resume work in the area suspected to contain hazardous or contaminated materials unless approved by the Engineer.

The Department will determine the extent and nature of the hazardous or contaminated area and specify a clean-up plan, if necessary. Once the Department determines the limits of the area affected by the contaminated materials, work may then be resumed for the remaining areas of the project where contamination is determined to not present a significant hazard.

Substantial suspension of work as result of the discovery of contaminated or hazardous materials within the project limits shall be in accordance with the requirements of Subsection 104.02.

The Department will determine the contractor's qualifications to perform the work specified in the clean-up plan. If the contractor is not qualified to do the work specified in the clean-up plan, the Department will assist the contractor in locating other contractors who are qualified to perform the work. The Engineer will execute a supplemental agreement to cover the additional work, in accordance with Section 104.02 of the Standard Specifications.

(107SAFE, 05/01/93)

SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC: of the Standard Specifications is revised as follows:

107.07 **Sanitary, Health, and Safety Provisions:** the third paragraph is revised to read:

Occupational Safety and Health Standards shall apply at all times. The contractor shall have, in accordance with OSHA requirements, Material Safety Data Sheets (MSDS) available for all applicable materials stored or utilized on the project. Should the contractor fail to follow OSHA regulations, the Engineer may suspend the work by written notice until compliance has been achieved. Any such failure to comply with OSHA regulations shall constitute waiver of any right to claim for such suspended work. If regulations are in conflict, the more strict regulation will apply.

107.08 **Public Convenience and Safety**: the third paragraph is revised to read:

The Contractor shall abide by all OSHA 29 CFR Part 1926 and 29 CFR Part 1910 Regulations, as well as all applicable standards of the Environmental Protection Agency (EPA), the Arizona Department of Environmental Quality (ADEQ), and the Mine Safety and Health Administration (MSHA). The Contractor shall maintain a copy of the specified OSHA Standards on the construction site at all times.

The Contractor shall submit a Safety Plan at the preconstruction conference. The Safety Plan shall specify the procedures the Contractor will implement to satisfy OSHA and any state occupational safety guidelines related to the worker as well as the public in the construction of excavations, structures and confined air spaces along with all other activities involved in the project. The Engineer will review the Safety Plan within 10 working days and identify any additional elements of the project to be included. The Contractor shall then modify the Safety Plan, if necessary, for re-submittal to the Engineer within 5 working days. The Contractor shall not commence work until the Safety Plan has been approved, unless authorized by the Engineer.

The safety plan shall include a list of emergency procedures, phone numbers, and methods of communication for medical facilities, Police, Fire Department, and other emergency services which may become necessary. The Contractor shall be responsible for providing First Aid treatment and medical supplies on the project site, in accordance with OSHA 29 CFR Part 1910, and for producing and maintaining records of any injury-related incidents. The Safety Plan shall include the requirement that all workers must wear OSHA approved hard hats, reflective safety vests or other approved high visibility warning garments, work shoes, and, when appropriate, safety glasses while in construction areas. The Engineer and Project Superintendent shall each ensure that their visitors comply with the above requirements as appropriate.

The Contractor shall designate a competent person as Safety Supervisor to be responsible for implementation of the Safety Plan throughout the contract period. The competent person shall be capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and have authority to take prompt corrective measures to eliminate them. The Safety Supervisor shall also conduct safety meetings, oversee and maintain safe job-site conditions, and ensure that emergency procedures, phone numbers, and all applicable OSHA notification posters are conspicuously placed in all work areas.

The safety Supervisor shall maintain records demonstrating that all workers have sufficient experience to operate their equipment, and have been instructed in the proper operation of the equipment. The Safety Supervisor shall furnish evidence that crane operators have been instructed in accordance with the requirements of OSHA 29 CFR Part 1926.550 Subpart N, and 1926.955 Subpart V.

(107DUST, 4052/S 04/01/94)

SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC:

107.14 Prevention to Air and Noise Pollution: of the Standard Specifications is modified to add:

For work performed within Maricopa County, the contractor will be required to prepare a comprehensive fugitive dust control plan, in accordance with the guidelines established in Rule 310 of Maricopa County Regulation III - Control of Air Contaminants. The contractor may contact Maricopa County, Division of Air Pollution Control, to purchase a copy of the guidelines. The contractor shall complete and submit the control plan with the permit application, and obtain approval prior to construction or any other activities which may produce dust pollutants.

Some of the measures which the contractor may use to control or minimize fugitive dust include: increased use of water or chemical dust suppressants, cease work temporarily during high winds, reducing vehicle speeds and number of trips, maintaining freeboard of three inches or more in hauling, and covering or stabilizing stockpiles. The contractor shall be required to cover haul trucks with tarps or other suitable enclosures.

No separate payment will be made for preparation and implementation of the fugitive dust control plan, the costs being considered as included in the price of contract items.

107.14 Prevention of Air and Noise Pollution: of the Standard Specifications is modified to add:

Noise levels resulting from the contractor's construction activities shall not exceed 75 DBA Leq at any right-of-way line abutting a residential area between the hours of 10:00 p.m. and 5:00 a.m. The Engineer will measure noise levels.

Any night operations approved by the Engineer shall be staged to minimize noise and inconvenience to the abutting residential areas. Including but not limited to 1.) Staging night work away from residential areas. 2.) Haul routes to minimize use of back up alarms. 3.) Shielding of equipment with berms, temporary sound deflecting devices, permanent sound walls, etc. 4.) Directing lighting away from residential areas. 5.) Enhanced equipment mufflers, etc.

107.15 Prevention of Landscape Defacement; Protection of Streams, Lakes and Reservoirs: is revised to read:

(A) Description:

1) General

The contractor shall give special attention to the effect of the contractor's operations upon the landscape, and shall take special care to maintain natural surroundings undamaged.

The contractor shall implement the requirements of the National Pollutant Discharge Elimination System (NPDES) for erosion control due to storm water runoff during construction, as specified under the Environmental Protection Agency (EPA) General Permit for Arizona.

To comply with the General Permit the Contractor and the Engineer shall jointly review and agree on the Storm Water Pollution Prevention Plan (SWPPP) included in the project plans. If revisions are made by the Contractor, the Engineer shall agree to the changes.

The contractor shall then file a Notice of Intent (NOI), implement the SWPPP during construction and, upon completion of the construction, file a Notice of Termination (NOT), all as described in the following subsections. The work under this section also included the implementation of "good housekeeping" practices, inspections, and recordkeeping.

The contractor shall designate a competent employee as Environmental coordinator to be responsible for implementing the SWPPP. The person shall be capable of identifying existing and predictable effects of the contractor's operations upon the landscape, and shall have authority to take prompt corrective measures to minimize or eliminate them. The Environmental Coordinator shall be familiar with SWPPP procedures and practices and shall conduct pollution prevention meetings to ensure that emergency procedures, and the SWPPP are updated and available.

The contractor shall also be aware of the requirement to obtain a separate NPDES permit associated with industrial activity for any onsite or off-site and concrete plants which provide material for the project. The Department will not be responsible for the administration, coordination, or any costs associated with the contractor's permit responsibilities for these activities.

No condition of the Arizona General Permit or the SWPPP shall release the contractor from any responsibilities or requirements under other environmental statutes or regulations.

2) Storm Water Pollution Prevention Plan (SWPPP)

The project plans contain an Erosion Control Plan which shall become a part of the SWPPP unless an alternate plan, acceptable to the Engineer and is submitted by the contractor.

If the contractor desires to deviate from the Erosion Control Plan contained in the project plans, he shall submit two copies of proposed revisions to the engineer for approval. Revisions must meet the terms and conditions of the EPA permit and be compatible with any approved changes to construction sequencing and the maintenance of traffic plans made in accordance with Section 701-1 of these Special Provisions. Two weeks shall be allowed for review and approval of the proposal.

At the preconstruction conference the contractor will provide the engineer with the draft SWPPP for the project. the draft SWPPP shall include some of the following information and forms:

- Site description
- Expected sequencing of operations and construction schedule
- Weather monitoring procedure
- Descriptions and details of erosion controls, including dust control
- Erosion Control Plans
- Controls for other potential onsite stormwater pollutants
- This special provisions

- Maintenance and inspection procedures and forms
- Description of potential non-storm water discharges at the site
- Notice of Intent (NOI) form
- Notice of Termination (NOT) form
- Contractor and Subcontractor Certification forms
- Other recordkeeping forms and procedures
- "Good housekeeping" practices and requirements

The contractor shall supplement the information initially provided in the draft SWPPP to complete the outline shown above. The Engineer, and the contractor shall then jointly review the modified draft SWPPP and agree to any needed revisions. The Engineer and contractor shall then approve and sign the revised SWPPP. When the SWPPP (including the Erosion Control Plan) is approved, it will be the document in force on the project. The NOI shall not be submitted until an approved SWPPP is in place. Construction may not begin until an NOI is submitted.

The approved SWPPP will specify levels of pollution protection on a multi-tiered, most cost-effective approach, in accordance with good engineering practices and ADOT's "Erosion and Pollution Control Manual for Highway Design and Construction." In addition, the plan will describe and ensure the implementation of practices which will be used to reduce the pollutants in storm water discharges to assure compliance with the terms and conditions of the EPA permit.

The SWPPP shall be placed in a three-ring binder so that completed inspection forms and other records may be inserted. The contractor shall maintain a current copy of the SWPPP and all associated records and forms at the job site throughout the duration of the project. The SWPPP shall be available for public inspection and for the inspection and use of the Engineer.

The contractor shall implement the SWPPP as required throughout the construction period and shall maintain all related erosion control elements in proper working order. Unless approved in writing by the Engineer, the contractor shall perform no clearing and grubbing or earthwork until the SWPPP has been implemented.

Also prior to construction, the contractor and all subcontractors shall sign certifications (included in the draft SWPPP) that they understand the requirements of the NPDES permit. All subcontractors shall comply with the requirements of the NPDES under the supervision of the contractor.

The SWPPP (including inspection forms) and all data used to complete the NOI shall be provided to ADOT at the completion of the project. The contractor shall retain his own records for a period of at least three years from the date the site is finally stabilized.

No measurement or direct payment will be made for time spent in reviewing and revising the Storm Water Pollution Prevention Plan (SWPPP) and for providing other required documentation, the cost being considered as included in the price of contract terms.

3) Notice of Intent (NOI)

The Engineer and contractor will each complete separate Notice of Intent (NOI) forms for the project. The NOI's must be submitted to the EPA at the following address at least two days prior to the start of construction (including clearing and grubbing):

EPA Stormwater Notice of Intent
P.O. Box 1215
Newington, VA 22122

At that time, copies must also be submitted to:

Arizona Department of Environmental Quality
Stormwater Coordinator
P.O. Box 600
Phoenix, AZ 85001-0600; and

ADOT Environmental Planning Services
205 S. 17th Avenue, Mail Drop 619E
Phoenix, AZ 85007.

The NOI shall be posted at the construction site on the bulletin board throughout the duration of the project.

4) Erosion Controls

The work under this section shall include providing, installing, maintaining, removing and disposing of temporary erosion control measures such as gravel filter berms, dikes, catch basin inlet protection, end-of-pipe filtering devices, silt fences, check dams, sediment basins, netting, straw bale barriers, slope drains, and other erosion control devices or methods as specified in the SWPPP.

Temporary and permanent erosion controls shall be installed as soon after construction of cut and fill slopes or installation of drainage facilities as practical. Permanent erosion control features called for in the project plans, such as culvert outlet structures, channel riprap, ditch paving and slope seeding, shall be constructed as early as feasible during construction sequencing to minimize the nee d for temporary erosion control measures.

If construction of permanent controls is significantly delayed, temporary erosion controls shall be installed at the Engineer's direction. No payment will be made for temporary erosion controls installed where, in the opinion of the Engineer, permanent erosion control features could have reasonably been constructed instead. The Engineer's decision is final. To meet this requirement it will be necessary to mobilize seeding crews, riprap crews, etc. periodically throughout the duration of the contract.

Specific temporary erosion controls are detailed in the project plans and are described in more detail in Subsections B) Materials for Erosion Controls and C) Construction Requirements of this Special Provision.

Erosion control and pollution prevention work specified in the contract, which is to be accomplished under any of the various contract items, will be paid for as specified under those items.

5) Controls for Other Pollutants

The work under this section shall include implementing controls to eliminate the discharge of pollutants other than erodible soil (such as pollutants from materials stored onsite) into storm water. The work shall include the implementation of spill prevention and material management controls and practices to prevent the release of pollutants into stormwater. These controls and practices shall be specified in the SWPPP, and shall include storage procedures for chemicals and construction materials, disposal procedures, cleanup procedures, the contractor's plans for handling pollutants such as fuels, lubricants, bitumens, raw sewage, wash water, or other harmful materials and other pollution prevention measures.

Spill prevention, containment and counter-measures (SPCC) will be required if the volume of fuel in a single container exceeds 660 gallons, or if the total storage volume at any one site exceeds 1,320 gallons.

The contractor shall assist in any efforts to clean up hazardous material spills, as instructed by the engineer or other authorities. Soil contaminated with smaller spills shall be hauled away from the project site and disposed of according the applicable State and Federal regulations.

In the event of any spill of a hazardous material, the contractor shall immediately contact the engineer and the following agency:

Name:	24 Hour Emergency Response Hotline
Organization:	Arizona Department of Environmental Quality (ADEQ)
Phone Number:	(602) 257-2330

The United States Forest Service, Department of Public Safety, or the Arizona Department of Environmental Quality shall also be contacted, as appropriate.

6) "Good Housekeeping" Practices and Requirements:

The SWPPP will specify the contractor's "good housekeeping" practices and requirements, including vehicle wash-down areas, onsite and offsite tracking control, protection of equipment storage and maintenance areas, and sweeping of highways and roadways related to hauling activities.

The contractor shall take sufficient precautions, considering all conditions, to prevent pollution of streams, lakes, and reservoirs with fuels, oil bitumens, calcium chloride, fresh portland cement, fresh portland cement concrete, raw sewage, muddy water, chemicals or other harmful materials. None of these materials shall be discharged into any channels leading to such streams, lakes or reservoirs.

To reduce the possibility and minimize the impacts of accidental spills or discharge, machinery service and refueling areas shall be located away from streambeds or washes.

Waste materials from blasting, including explosives containers, shall be burned or disposed of off site in accordance with applicable federal regulations. Non-waste materials, such as used cans, oils, machine and equipment parts, paint, hazardous materials, plastic and rubber parts, discarded metals, and building materials, shall be removed from the construction site and disposed of at an approved landfill.

Where the contractor's working area encroached on a running or intermittent stream, barriers shall be constructed and maintained between the working areas and the stream bed adequate to prevent the discharge of any contaminants.

Frequent fording of running streams with construction equipment will not be permitted; therefore, temporary bridges or other structures shall be used whenever an appreciable number of crossings is necessary.

Unless approved in writing by the Engineer, mechanical equipment shall not be operated in running streams.

Streams, lakes and reservoirs shall be promptly cleared of all falsework, piling, debris or other obstructions inadvertently placed thereby or resulting from construction operations.

No measurement or direct payment will be made for the contractor's "good housekeeping" practices and requirements, the cost being considered as included in contract terms.

7) Inspections and Revisions to the SWPPP

For areas that receive less than 20 inches of annual rainfall, the Engineer and contractor shall perform a minimum of one inspection per month of the site (including disturbed areas that have not been finally stabilized, areas used for storage of materials, locations where vehicles enter or exit the site, and all of the erosion and sediment controls that are included in the SWPPP). Where mean annual rainfall equals 20 inches or more, inspections shall be performed at least every seven calendar days. In addition, an inspection must be performed within 24 hours after each rainfall of greater than or equal to 0.5 inches. The contractor shall monitor rainfall with a rain gauge accurate to the nearest 0.1 inch of rain.

The contractor shall document the inspections on forms provided in the draft SWPPP. The inspection forms shall be signed in accordance with the requirements of the SWPPP and the EPA permit. The inspection forms shall be retained onsite in the SWPPP notebook throughout the construction period.

It may be necessary to revise the SWPPP during the construction to make necessary improvements or revisions or to respond to unforeseen conditions noted during construction or site inspections. For that purpose, the SWPPP shall specify the mechanism whereby revisions may be proposed by the contractor or the Engineer and incorporated into the plan, including review and approval of minor changes by ADOT, and review and approval of major changes (as judged by the Engineer) by ADOT. The Engineer and contractor shall jointly approve and sign each revision to the SWPPP before implementation. Approved modifications shall be implemented within 7 calendar days following the date of the inspection when deficiencies or necessary corrections were first noted.

8) Notice of Termination (NOT)

Upon final acceptance by the Engineer, in accordance with Subsection 105.16, the Engineer and the contractor shall each complete and mail separate Notice of Termination (NOT) forms for the project to the following address:

Stormwater Notice of Termination
P.O. Box 1185
Newington, VA 22122

Copies of the NOT's shall also be sent to the Arizona Department of Environmental Quality and the ADOT Environmental Planning Services Department.

(B) Materials for Erosion Controls:

1. Straw Bales

Straw Bales shall be approximately 40" long by 24" wide by 14" high, 3-wire bales. Straw shall be well-compacted, with a low seed content. Baling shall be nylon string.

Stakes shall be wooden stakes, 2" x 2" x 4'.

2. Sandbags

Sandbag size shall be approximately 24" long 16" wide and 6" thick. Sandbag material shall be polypropylene, polyethylene or polyamide woven fabric, minimum unit weight four ounces per square yard. Mullen burst strength exceeding 300 psi and ultraviolet stability exceeding 70 percent. When sediment depth reaches 6", remove and properly dispose of accumulated material.

3. Endwall Treatment

The riprap for Endwall Treatment shall be 6" dumped riprap conforming to the requirements of Section 913 of the Standard Specifications. The gradation shall comply with Subsection 913-2.01(D) of these Special Provisions.

(C) Construction Requirements

The contractor shall implement the SWPPP throughout the construction period, including the following:

- Filing the NOI with all appropriate agencies, as previously discussed.
- Implementing the erosion controls shown or discussed in the SWPPP
- Implementing controls for other potential pollutants, as shown or discussed in the SWPPP
- Implementing good housekeeping procedures given in the SWPPP
- Performing inspections
- Maintaining records
- Filing the NOT with all appropriate agencies, as previously discussed.

The following table lists erosion control features and indicates which are to be removed and which are to remain in-place at the end of the project. The contractor shall remove the temporary erosion controls (those identified in the table as "Remove") when final stabilization of the area is achieved (such as by revegetation of the area). Permanent controls shall not be removed.

SUMMARY OF
EROSION CONTROL FEATURES

Erosion Control Feature	Permanent Status
Straw Bale Barrier	Remove
Sandbags	
Endwall Treatment	To Remain

2)b) Straw Bale Barriers:

Straw Bales shall be installed in accordance with the project plans and details or as directed by the Engineer. The bottom of bales shall be embedded a minimum distance of 4" and a maximum distance of 6" into the ground. Unless otherwise shown on the plans, there shall be a minimum distance of 6" between the straw bale barrier and the toe of the cut or fill slopes. In locations where rows of bales are installed, joints between bales in adjacent rows shall be staggered.

Straw Bales shall be staked as shown on the project plans and details. Stakes shall be driven flush with the top of the bale and battered in opposite directions to adjacent stakes and perpendicular to the direction of flow. In areas where straw bales may be allowed to remain in place, wood stakes must be used. In other areas, #4 steel bars may be used. A minimum of two stakes are required for each bale.

Straw Bales shall be installed tightly together to form a cohesive unit without gaps or voids. Joints between bales shall be hand filled with straw to maintain a uniform density throughout the unit and to eliminate voids.

The contractor shall maintain all straw bales in a functional condition. Accumulated sediment shall be removed and disposed of by the contractor when approximately 75% of the available capacity has been reached, or as directed by the Engineer.

Straw Bale Check Dams shall remain in service until disturbed areas have been stabilized, as directed by the Engineer.

When the use of a straw bale barrier is discontinued, all materials shall be removed and become the property of the contractor. During removal, all sediment shall be disposed of and the area restored to a finished condition as shown on the plans.

If directed by the Engineer, straw bale barriers shall be left in place at completion of the project and shall become the property of the Arizona Department of Transportation.

No separate measurement or payment will be made for removal, disposal or maintenance of straw bale barriers, the cost of this work being considered as included in the price of contract terms.

3) Endwall Treatment:

Endwall Treatment shall be installed in accordance with the project plans and details or as directed by the Engineer. Endwall Treatment shall cover the transition from the berm over the top of the culvert to the toe of the berm. The treatment shall be shaped into a configuration conducive to directing flow into the riprap.

Riprap shall be installed as shown on the project plans and details. Riprap shall conform to Arizona Department of Transportation Standard Specifications and the specifications contained herein. Riprap shall completely cover the transition and conform to that same shape. Riprap shall be embedded into the ground at the edge of the treatment area to allow flow to enter the area. Riprap shall be feathered at the toe of the slope and embedded into the ground.

Riprap shall be installed to form a cohesive unit with no loose pockets or rock. Gaps and voids shall be hand filled to obtain a uniform density throughout the unit.

The contractor shall maintain each Endwall Treatment in a functional condition. Accumulated debris shall be removed and disposed of by the contractor after each rain storm, or as directed by the Engineer.

Endwall Treatment is a permanent project feature and shall remain in continuous service after installation.

Endwall Treatment shall be left in place at completion of the project and shall become the property of the Arizona Department of Transportation.

No separate measurement or payment will be made for maintenance of Endwall Treatment, the cost of this work being considered as included in the price of contract terms.

(D) Method of Measurement

1) General:

The Department will reimburse the contractor for the work of implementing the requirements of the NPDES on the basis of unit bid prices for the various Elements of Work.

Elements of work shall be measured for payment for the various elements shown in the bidding schedule.

Elements by the linear foot will be measured along the centerline of the element installed in place, parallel to the ground surface. No allowance will be made for material in laps.

Elements by the square yard will be measured by the square yard in place. Measurement will be to the nearest square yard. No allowance will be made for material in laps.

Elements by the cubic yard will be measured by the cubic yard of protection constructed by computing the surface area measured parallel to the protection surface and the total thickness measured normal to the protection surface.

Elements by the each will be measured as an each unit provided as described in the bidding schedule.

Elements by the lump sum will be measured as a lump sum for the item as described in the bidding schedule.

There will be no additional measurement or payment for associated earthwork, ground preparation, stakes, silt removal, or maintenance. These shall be considered as included in the unit bid price.

Elements of Work specified under this Subsection which are lost, destroyed, or are deemed unacceptable by the Engineer, while in use on a project shall be replaced by the contractor at not additional cost to the Department.

No payment will be made for the contractor's "good housekeeping" practices and requirements, the cost being considered as included in contract items.

No measurement or direct payment will be made to the contractor for time spent in reviewing or revising the Storm Water Pollution Prevention Plan (SWPPP), or providing other required documentation, the cost being considered as included in contract items.

Any deficiencies in the erosion control elements or other elements of work listed herein will be brought to the attention of the contractor by the Engineer and all deficiencies shall be corrected before the close of that work shift, unless otherwise specified.

In cases of serious or willful disregard for the protection of the waters of the U.S. and/or natural surrounding by the contractor, the Engineer may place the erosion and/or other pollution control elements in proper condition and deduct the cost thereof from monies due or becoming due the contractor.

The Contractor shall be responsible for maintaining all silt fences, check dams, erosion control mattings, and other erosion and pollution control devices in proper functioning condition at all times.

In the event that the Engineer determines that the Contractor's construction operations are not resulting in the diligent prosecution of the work under contract, no payment will be made to the Contractor for the elements of work listed herein until suck time as the Engineer determines that the Contractor is devoting appropriate efforts toward completion of the work.

E) Basis of Payment:

The accepted quantities for the described elements, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the work, complete in place, including all excavation, preparation, furnishing and installing the element and final removal and disposal of the element, including returning the area to a natural condition as approved by the Engineer.

107.18 Contractor's Responsibility for Work: is revised to read:

The contractor shall implement the requirements of the National Pollutant Discharge Elimination System (NPDES) for erosion control due to storm water runoff during construction, as specified above in Subsection 107.15 Prevention of Landscape Defacement; Protection of Streams, Lakes and Reservoirs.

Until final written acceptance of the project by the Engineer, the contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof by the action of the elements, or from any other cause, whether arising from the execution or from the nonexecution of the work. The contractor shall rebuild, repair, restore and make good all injuries or damages to any portion of the work occasioned by any of the above caused before final acceptance. No reimbursement shall be made for work necessary due to the contractor's failure to comply with the requirements of the SWPPP.

Except as specifically provided under Subsection 104.04, in case of suspension or work from 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, provide for normal drainage and shall erect any necessary temporary structures, signs or other facilities. during such period of suspension of work, the contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings, furnished under his/her contract and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

107.18 **Contractor's Responsibility for Work:** of the Special Provisions is modified to add:

The contractor is advised that his work and activities are subject to flooding from weather conditions. The contractor shall keep abreast of potential flows in Indian Bend Wash.

(107STORM, 06/15/94)

SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC:

107.19 **Damage by Storm, Flood or Earthquake:** of the Standard Specifications is revised to read:

Damage by Storm, Flood, or Earthquake: Attention is directed to Section 107.18, "Contractor's responsibility for the Work". In the event damage to the work is caused by a storm, flood, or earthquake which constitutes an "Occurrence," as hereinafter defined, the provisions of this Section 107.19 shall be applicable and the contractor may apply in writing to the Engineer for the State to pay or participate in the cost of repairing damage to the work from such cause or, in lieu thereof, and at the sole discretion of the Department, terminate the contract and relieve the contractor of further obligation to perform the work, subject to the following:

(A) Occurrence:

"Occurrence" shall include tornadoes, earthquakes in excess of a magnitude of 3.5 on the Richter Scale and storms and floods for which the Governor has proclaimed a state of emergency, when the damaged work is located within the territorial limits to which such proclamation is applicable, or which were a catastrophic, unusual, sudden, and unforeseeable manifestation of the forces of nature, the effect of which could not have been prevented or minimized by reasonable human foresight and effort.

(B) Application by Contractor:

The contractor shall immediately begin performing emergency work necessary to provide for the safety and passage of public traffic, and such other emergency work necessary to mitigate damages to the facilities. The contractor's written request for the State to pay or to participate in the cost of rebuilding, repairing, restoring or otherwise remedying the damage to the work caused by the occurrence shall be submitted to the Engineer. The repair work may begin prior to authorization by the Engineer, but the contractor shall keep accurate costs of all such work performed.

(C) Repair Work:

Repair of damaged work under the provisions of this subsection shall be pursuant to a supplemental agreement issued hereunder and specifying the repair work to be performed on the damaged facility. Such repair work shall consist of restoring the in-place construction (for the purposes of this subsection erected falsework and formwork shall be considered in-place construction) to the same state of completion to which such work had advanced prior to the Occurrence. Emergency work which the Engineer determines would have been part of the repair work if it had not previously been performed, will be considered to be part of said repair work. The Department reserves the right to make changes in the plans and specifications applicable to the portions of the work to be repaired, and if such changes will increase the cost of repairing the damage over the Engineer's estimate of the cost of repair without the changes, the contractor will be paid for such increased costs in accordance with Subsection D.

Nothing in this section shall be construed to relieve the contractor of full responsibility for the risk or injury, loss or damage to materials not yet incorporated in the work and to materials, tools, and equipment (except erected falsework and formwork) used to perform the work, nor to relieve the contractor of his responsibility under Section 107.16, "Responsibility for Damage Claims". The Department will be responsible for any portion of the work accepted by the Engineer in accordance with Subsection 105.16.

(D) Determination of Costs:

Unless otherwise agreed between the Engineer and the contractor, the cost of the work performed pursuant to this Subsection will be determined in accordance with the provisions in Section 109.04, "Force Account Work". The cost of emergency work, which the Engineer determines would have been part of the repair work if it had not previously been performed will be determined in the same manner as the authorized repair work. The cost of superintendence and other documented direct project costs associated with recovering the site, including idled equipment, remobilization costs and project office overhead shall be included in the cost of emergency and repair work. No payment shall be made for home office overhead.

(E) Payment for Repair Work:

The State will pay the cost of the repair work as determined in Subsection D.

(F) Termination of Contract:

If the Department elects to terminate the contract, the termination and the determination of the total compensation payable to the contractor shall be governed by the provisions of Subsection 108.11 - Termination of Contract for Convenience.

(UTIL107, 4051/F, 12/30/91)

SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC:

107.20 **Contractor's Responsibility for Utility Property and Services:** of the Standard Specifications is modified to add:

The contractor shall be ADOT's Blue Stake field locator, and perform all requirements as prescribed in A.R.S. 40-360.21 through .29, for all underground facilities that have been installed by him on the current project, until the project is accepted by ADOT.

Al least two (2) working days prior to commencing excavation, the contractor shall call BLUE STAKE CENTER, between the hours of 7:00 a.m. and 4:30 p.m., Monday through Friday for information relative to the location of buried utilities. The number to be called is as follows:

Maricopa County 263-1100

Copies of existing ADOT permits, subject to availability, may be obtained from Dave Zimbro (ADOT Area Permit Supervisor) as listed below:

PHOENIX MAINTENANCE DISTRICT 255-7522 2410 W. Hilton Avenue
Phoenix, AZ 85009

The contractor's attention is directed to the following utility companies which have facilities in the area:

Arizona Public Service Company, Lois Winkler, 371-6837

2121 W. Cheryl Drive, Building F-2
P.O. Box 53933, Mail Station 3539
Phoenix, AZ 85072-3933

Arizona Public Service Company (APS) relocated an overhead facility along the south side of the Cholla Street Underpass prior to the start of this project. The contractor is to notify APS five (5) days in advance of work on the bridge to have the line de-energized. The contractor may work beside the line provided it is not touched. The contractor is to notify APS as soon as the bridge work is complete so that the line can be re-energized.

The contractor is to provide APS with six weeks advance notice so that the utility company can schedule and remove the overhead line before the start of construction of the Cactus Road Underpass. APS is to be given four weeks advance notice of the completion of the bridge so that the line can be installed and three weeks in which to complete the work.

Utilities in conflict include a temporary shoo-fly for a 69 Kv and 12Kv line along the north side of the Shea Boulevard bridge. The shoo-fly is to remain in place until October 29, 1996, at which time APS will relocate the line back into its permanent position and remove the poles. APS estimates that it will require three weeks to reposition the line and remove the poles.

Other APS facilities in the project area were relocated in advance of this project and no further conflicts with APS facilities are anticipated.

U S WEST Communications, Robert Arrieta - Ducts, 395-2316
Chuck Bernacchi - Cabling & Temporary Lines, 395-2404
2233 W. Dunlap, Room 232
Phoenix, AZ 85021

U S WEST has removed or relocated facilities within the area in advance of this project to avoid construction conflicts. Buried facilities within the area include:

- An east-west line on the south side of Desert Cove
- An east-west line along Sweetwater Avenue between 33rd and 34th Streets and on the south side between 35th and 36th Streets
- A north-south line along the east side of Indian Bend Wash from Emile Zola Avenue to south of Thunderbird Road
- An east-west line along the north side of Thunderbird Road which proceeds north on the east side of Indian Bend Wash

- A north-south line in the alley in back of the houses on the east side of 33rd Street, and a north south line on the east side of 36th Street from Sweetwater Avenue to the south

Facilities in conflict include temporary shoo-fly detours around the south side of Cholla Street and the north side of Cactus Road. These lines are to remain in service until the new lines through the bridges can be installed and activated.

The contractor's assistance and coordination will be required in the final installation of ducts, duct supports and associated items, coordination with and allowance of time windows for relocation and installation activities by US WEST COMMUNICATIONS, Inc. (US WEST) forces in the relocation of the temporary lines through the bridges at Cholla Street and Cactus Road. The contractor will coordinate his activities with US WEST for this work, and will install screed support inserts, conduit, and blockouts for use by US WEST in installing their facilities on the bridges. All materials required for the relocation of the US WEST cable to its permanent position shall be provided by US WEST unless otherwise indicated on the plans or in the Special Provisions. The contractor shall establish contact with US WEST at the time of mobilization and advise of the construction schedule so that US WEST has sufficient time to insure that the necessary US WEST supplied materials for this project are on hand.

The contractor shall notify the Engineer in writing, with a copy to US WEST, two (2) weeks in advance of the date upon which the site will be available for US WEST to relocate the cables in the conduit through the bridges. US West will require twenty-one (21) working days to complete the installation of the cable through the bridge and remove the temporary shoo-fly detour.

The contractor's attention is directed to the fact that up to the time US WEST relocates the temporary lines, the cable will be suspended over the construction site. Any damage to the cable by the contractor's forces or equipment will be the responsibility of the contractor. Should the contract be delayed by Acts of God, the elements, adverse weather or other reasons such that delays are not counted against the contractor's "construction days", the same extension of time shall be allowed to US WEST to complete their work.

The existing east-west lines along the south side of Sweetwater Avenue are currently in two conduits embedded in the sidewalk of the concrete box culvert crossing Indian Bend Wash. These cables are to remain in service. The contractor shall support the lines during construction of the two additional barrels, place conduit around the cables and embed the cables in the new sidewalks.

The contractor will be constructing facilities in the Cholla Street and Cactus Road Underpasses for use by US WEST. US WEST will not install cables in the new conduits until after the complete installation of the conduits, but will have inspectors on site during construction of the conduits and has requested three (3) weeks prior notification so that the inspectors can be scheduled.

Southwest Gas Corporation, Wade Patrick, 484-8649

9 So. 43rd Avenue
P.O. Box 52075
Phoenix, AZ 85072-2075

SW Gas has removed or relocated facilities within the area in advance of this project to avoid construction conflicts. Buried facilities within the area but not in conflict include:

- An east-west line through the construction site at approximate station 280+40
- An east-west line through the construction site at approximate station 322+00

Cox Communications, Carl McKay, 352-5860

115 N. 51st Avenue
Phoenix, AZ 85043

Cox Communications has buried lines in the same east west trench south of Desert Cove as U S WEST.

The contractor will be constructing facilities in the Cholla Street and Cactus Road Underpasses for use by Cox Communications. Cox Communications will not install lines in the new conduits until after the complete installation of the conduits, but will have inspectors on site during construction of the conduits and has requested three (3) weeks prior notification so that they inspectors can be scheduled.

No other conflicts with Cox Communications are anticipated.

City of Phoenix, Gerald Arakaki, 261-8229

Water/Wastewater
200 W. Washington Street, 8th Floor
Phoenix, AZ 85033-1611

Portions of the City of Phoenix utility systems within the project limits shall be relocated, constructed, plugged or removed under terms of this contract.

Water lines will be installed in the Cholla Street and Cactus Road Underpasses; plans covering this work are included in the project plans.

Another agency contact that may be helpful is:

Maricopa County Flood Control District, Donald Rerick, 506-1501
2801 W. Durango Street
Phoenix, AZ 85009

(107PHXUT, 10/01/90)

SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC:

107.20 **Contractor's Responsibility for Utility Property and Services:** of the Standard Specifications is modified to add:

Utilities falling within the Vertical Excavation Limits as defined under "Excavating and Backfilling for Pipe in Trenches" will be either braced, removed and replaced, or relocated by the respective utility.

Where utilities are located between the outer edge of the Vertical Excavation Limits and the slope limits prescribed by Subsection 203-5.03 (A) of the Specifications, the contractor, at his option and expense, may elect to either request the removal, relocation or reinstallation of the affected utilities, and pay the affected utility for expenses incurred, or install sheet piling or cribbing to protect the affected utility and provide safety for the workers.

At some locations it may be necessary to relocate or adjust existing water lines which fall within the outer perimeter of the new storm drain.

The City of Phoenix will adjust an obstructing water line ten inches or smaller in diameter where the obstructing line crosses the new line at an angle from normal to a 45 degree skew. The contractor shall perform the excavating and backfilling required in accordance with the requirements specified under Section 203 of the Specifications.

Where an obstructing line:

(1) Is larger than 10 inches in diameter, or

(2) Crosses the new line at a skew angle less than 45 degrees, or

(3) Approximately parallels the new line

The City of Phoenix will, at its option, make necessary adjustments to the obstructing line or will alter the location of the new pipe or will make arrangements with the contractor for the required relocating or adjusting.

Damaged water lines shall be replaced in kind to the requirements of the City of Phoenix Standard Specification No. 603.

Sewer lines falling within the Vertical Excavation Limits will either be braced, removed and replaced, or relocated by the City of Phoenix. When it is necessary to relocate or adjust sewer lines, the City of Phoenix will, at its option, make necessary adjustments to the obstructing line, or will make arrangements with the contractor for the required relocation or adjustment, or will alter the location of the new pipe or structure.

Pipe supports required and constructed at locations designated by the Engineer will be paid for under Item 8080681 when the major portion of the support is within the Vertical Excavation Limits. No payment will be made for pipe supports required or constructed outside the Vertical Excavation Limits for the convenience of the contractor.

(108CPM, 07/31/90)

SECTION 108 - PROSECUTION AND PROGRESS:

108.03 **PRECONSTRUCTION CONFERENCE:** of the Standard Specifications is modified to add:

The contractor shall be responsible for planning, scheduling and reporting the progress of the work to ensure timely completion of the contract.

The contractor shall submit a schedule in two parts, based upon the Sequence of Construction shown in the project plans or in these special provisions, in accordance with the following:

(A) Part I shall be a preliminary schedule and shall be submitted at the Preconstruction Conference for the Engineer's acceptance. It shall be a schematic (arrow) diagram or precedence diagram, showing the work stages and operations for all activities required by the contract. The diagram shall be in sufficient detail to allow day-to-day monitoring of the contractor's operations. Along with the preliminary schedule, the contractor shall include his calendar for the contract period which shall show work days, calendar days and dates. The diagram shall include four to ten milestone events as identified by the contractor and accepted by the Engineer.

(B) Part II shall be submitted for the Engineer's acceptance within fifteen (15) calendar days after Part I has been accepted by the Engineer. This second schedule shall include a complete critical path schedule to cover the contractor's anticipated time schedule. The schedule shall include a detailed network diagram acceptable to the Engineer with the following features:

(1) It shall be time-scaled in calendar days. All activities shall be plotted on their early start and finish dates. Unless approved by the Engineer, activities shall not exceed 15 working days in length. The plot shall have a size and scale acceptable to the Engineer.

(2) It shall show the order and interdependence of activities and the sequence of work as reflected in the Schedule Report specified in (B)(7) below. The critical activities shall be prominently distinguished on all reports by the use of color or other means acceptable to the Engineer.

(3) It shall include, in addition to all construction activities, such tasks as mobilization, demobilization, submittal and approval of samples of materials and shop drawings, procurement of significant materials and equipment, fabrication of special items, installation and testing and interfacing with other projects.

(4) The activities shall be sufficiently detailed so that a reviewer can follow the sequence. For example, the activities shall show forming, reinforcing, and placement of concrete on the calendar days they are scheduled to be performed.

(5) The diagram shall show for each activity the preceding and following event numbers or activity numbers, the activity description, the total float, and the duration of the activity in working days.

(6) The activities shall be organized and described so as to conform to the contract bid items. Activity descriptions shall be unique and specific with respect to the type of work and location.

(7) The diagram shall be accompanied by a Schedule Report of the network with a tabulation of the following data for each activity:

(a) Preceding and following event numbers or activity number
(b) Activity description
(c) Activity duration
(d) Earliest start date
(e) Earliest finish date
(f) Latest start date
(g) Latest finish date
(h) Total float times
(i) Responsibility for activity - e.g., contractor, subcontractor, supplier, etc.
(j) Resource loading for each activity listing personnel, equipment and anticipated revenue.

(C) The contractor shall make updated schedules and reports under the following circumstances or as requested:

(1) The contractor shall submit a monthly report of actual construction progress by the tenth working day of each calendar month by updating his schedule report to reflect all complete and in progress activities on the project. All negative float shall be explained in detail. If, in the opinion of the Engineer, the detailed network diagram requires revision, either wholly or in part, he shall so direct the contractor and the contractor shall submit such revision within ten (10) calendar days.

(2) The monthly report also shall show the activities or portion of activities completed during the one (1) month reporting period and the portion completed on the project to date, showing actual start and finish dates plus all future activities.

(3) The monthly report shall state the percentage of revenue actually earned as of the report date.

(4) The monthly report shall be accompanied by a narrative description of job progress, problem areas, current and anticipated delaying factors and their expected effect, and any corrective actions proposed or taken. The narrative description shall also clearly identify any departures from earlier schedules, including, but not limited to, changes in logical sequence or logical ties, constraints, changes in activity durations and changes, additions or deletions in event numbers, activity numbers and activity descriptions. The reasons for each departure shall be included in the narrative description. Any additions or deletions of milestone events must be approved by the Engineer.

(5) The monthly report shall include a summary of all activities sequenced by the total float from least to greatest float and ordered by early start.

(6) The required schedules and report shall be submitted to the Engineer as follows:

(a) Part I(Preliminary Schedule) - 7 originals
(b) Part II (Detail Network Diagram) - 7 originals
(c) Revisions to Part II - 7 originals
(d) Monthly Report - 3 originals plus 3 copies of the narrative.

(7) The monthly report shall include a detailed predecessor/successor analysis showing the predecessors, successors, logic ties, and constraints for each activity scheduled. These activities shall be ordered by event number or activity number from least to greatest.

(8) All Extra Work shall be shown on an updated Schedule.

The automated system software shall be Primavera or approved equal. If the contractor proposes and the Engineer approves an alternate software, the contractor shall furnish an unopened licensed disc package of the software to the Engineer for use during the duration of the project. The software shall be IBM PC compatible.

No measurement or direct payment will be made for contractor costs relating to preparation and submission of schedules and reports and revisions thereto, the cost being considered as included in the prices paid for contract items.

Float time is not for the exclusive use or benefit of either the Department or the contractor. Extension of time for performance may be granted to the extent that equitable time adjustment for the activity affected exceeds the total float or where otherwise justified, impact on the contract completion can be shown.

Acceptance of the contractor's schedules by the Engineer is not to be construed as relieving the contractor of his obligation to complete the work within the contract time; or as granting, rejecting, or in any other way acting on the contractor's requests for adjustments to the date for completing contract work, or claims for additional compensation. Such requests shall be processed in strict compliance with other relevant provisions of the contract.

The contractor shall participate in a review and evaluation of the proposed Part I, Preliminary Schedule and Part II Schedule and monthly updated schedule by the Engineer. Any revisions necessary as a result of their review shall be submitted for acceptance to the Engineer within 10 calendar days after the review. The accepted Part II Schedule shall then be used by the contractor for planning, organizing, executing, and directing the work and for reporting progress of work accomplished. The contractor shall furnish a copy of the Part II Schedule and monthly updated schedule on a 5 1/4 inch floppy disk to the Engineer for project use.

The Engineer shall complete review of Part I Preliminary and Part II Schedules within fifteen (15) calendar days of the receipt of each. No monthly progress payment will be made until Part I has been accepted. Within the next sixty (60) calendar days after acceptance of Part I, Part II will be submitted, reviewed, and accepted. If Part II has not been accepted within these sixty (60) calendar days, progress payment will be withheld until Part II has been accepted.

Failure of the contractor to comply with the monthly updated Schedule requirements specified herein, will be grounds for the Engineer to withhold an additional ten (10) percent of the monthly progress payments, in addition to the normal retention, until the contractor is in compliance. Additional money withheld will be paid upon compliance to the contractor in the next scheduled monthly estimate. If the monthly updated schedule is not received by the tenth working day of each month, but received prior to the 25th of the month, five (5) percent will be withheld until the following estimate.

(108SAFE, 01/15/93)

SECTION 108 - PROSECUTION AND PROGRESS: of the Standard Specifications is revised as follows:

108.03 Preconstruction Conference: The sixth paragraph is revised to read:

The Contractor shall submit a traffic control plan in accordance with Subsection 701-1. The Contractor shall designate an employee who is competent and experienced in traffic control to implement and monitor the traffic control plan. The qualifications of the designated employee must be satisfactory to the Engineer.

The Contractor shall submit a safety plan and designate an employee as Safety Supervisor, in accordance with Subsection 107.08.

Both plans must be satisfactory to the Engineer.

At this same time, the Engineer will designate a Department employee or employees who will be responsible to see that the plans and any alterations thereto, are implemented and monitored to the end that traffic is carried through the work in an effective manner and that the motorists, pedestrians, and workers are protected from hazards and accidents. If approved by the Engineer, the Contractor may designate one employee to be responsible for both plans. The Contractor shall not designate its superintendent as the responsible person for either plan, unless approved by the Engineer.

108.03 Preconstruction Conference: The ninth paragraph is revised to read:

If the Contractor fails to provide the required submissions, the Engineer may order the conference suspended until such time as they are furnished. Work shall not begin until the conference has been concluded and the safety plan has been approved, unless authorized by the Engineer. The Contractor shall not be entitled to additional compensation or an extension of contract time resulting from any delays due to any suspension.

(108QCMGR, 10/15/94)

SECTION 108 - PROSECUTION AND PROGRESS: of the Standard Specifications is modified as follows:

108.03 Preconstruction Conference: Is modified to add:

When the Specifications require specific quality control measures for certain materials by referencing Subsection 106.04(C), the contractor shall designate a qualified employee as Quality Control Manager. The Quality Control Manager shall be responsible for the implementing and monitoring of the quality control requirements described in Subsection 106.04 (C).

(108ACMIX, 07/31/90)

108.04 Prosecution and Progress: of the Standard Specifications is modified to add:

The contractor shall submit his Asphaltic Concrete Mix Design, in accordance with the applicable subsections of Section 406, 407 and 416, within 30 calendar days from the date of notice of award of contract, unless otherwise noted and/or approved in writing by the Engineer.

(108SCHED, 08/15/93)

SECTION 108 - PROSECUTION AND PROGRESS:

108.09 **Failure to Complete the Work on Time:** the Schedule of Liquidated Damages of the Standard Specifications is revised to read:

Schedule of Liquidated Damages

ORIGINAL CONTRACT AMOUNT		LIQUIDATED DAMAGES PER DAY	
From More Than	To and Including	Calendar Day or Fixed Date	Working Day
$ 0	$ 100,000	$ 350	$ 500
100,000	500,000	490	700
500,000	1,000,000	840	1,200
1,000,000	2,000,000	910	1,300
2,000,000	5,000,000	1,190	1,700
5,000,000	10,000,000	1,540	2,200
10,000,000	----------	2,380	3,400

(109FORCE, 12/15/94)

SECTION 109 - MEASUREMENT AND PAYMENT:

109.01 **Measurement of Quantities:** the thirteenth paragraph of the Standard Specifications is revised to read:

Scales of acceptable size shall be furnished by the contractor and shall be sealed by an inspector of the Department of Weights and Measures Division, State of Arizona, or a Licensed Service Agency approved by the State of Arizona Department of Weights and Measures. The Licensed Service Agency certifying the scales shall not be affiliated with the contractor or company supplying the materials for payment by weight.

109.04 (A)(3) Equipment: the third sentence of the first paragraph of the Standard Specifications is hereby deleted:

109.04 (A)(3) Equipment: of the Standard Specifications is modified to add:

Following is a rate adjustment factor table to be utilized with the Blue Book rates in adjusting rates, based on year of manufacture, for equipment used on force account work.

RATE ADJUSTMENT FACTOR TABLE

Year of Manufacture	Adjustment Factor
1994 and later	1.000
1993	0.988
1992	0.980
1991	0.971
1990	0.959
1989	0.946
1988	0.933
1987	0.926
1986	0.922
1985 and earlier	0.917

109.04(A)(3)(a) Rental Rates (Without Operators): the first paragraph on page 92 of the Standard Specifications is revised to read:

The Blue Book regional adjustment factor will be 0.95 for all types of equipment.

109.04(A)(3)(a) Rental Rates (Without Operators): of the Standard Specifications is modified to add:

Overhead and profit will be allowed in an amount equal to four percent of the total of the equipment costs, after application of the yearly and regional factors, and the operating costs.

109.06 Partial Payments: the second sentence of the first paragraph of the Standard Specifications is revised to read:

Except as herein provided, the Department will retain five percent of each monthly statement of amount earned until the final acceptance of the work.

109.07 **Partial Payments for Material on Hand:** the Partial Payment Factor for Precast Concrete Bridge Members (after curing period is completed) of the Standard Specifications is revised to read:

Precast Concrete Bridge Members (after curing period is completed)	0.80

(109LSUM, 02/15/92)

SECTION 109 - MEASUREMENT AND PAYMENT:

109.10 **Lump Sum Payment for Structures:** of the Standard Specifications is modified to add:

The Department will compensate the contractor for construction of each of the following structures or groups of structures on the basis of a lump sum amount:

(A) Cholla Street Underpass (Structure 2454)
(B) Cactus Road TI Underpass (Structure 2455)
(C) Sweetwater Avenue Overpass (Structure 2456)
(D) Thunderbird Road Overpass (Structure 2457)
(E) Reinforced Concrete Box Culvert (4-10'x8'x95') Cholla Street and Linear Detention Channel
(F) Reinforced Concrete Box Culvert (6-10'x8'x162') Cactus Road and Linear Detention Channel
(G) Reinforced Concrete Box Culvert (3-12'x9'x366') Sweetwater Avenue and Linear Detention Channel
(H) Reinforced Concrete Arch Culvert (2-28'x7'x126') Thunderbird Road and Indian Bend Wash
(I) Reinforced Concrete Box Culvert (3-12'x9'x158') Sweetwater Avenue
(J) Reinforced Concrete Box Culvert (6-12'x9'x69') 36th Street and Indian Bend Wash
(K) Reinforced Concrete Box Culvert (1-8'x5'x24') Sweetwater Avenue and Linear Ditch
(L) Reinforced Concrete Box Culvert (1-10'x6'x355') Emile Zola Avenue
(M) Reinforced Concrete Arch Culvert (1-28'x7'x318' & 1-16'x10'x318') SR 51 and Indian Bend Wash
(N) Reinforced Concrete Box Culvert (2-10'x8'x72.12') Sweetwater Avenue and Indian Bend Wash

Measurement and payment for the work will be made in accordance with the requirements of LUMP SUM PAYMENT FOR STRUCTURES under SECTION 109 - MEASUREMENT AND PAYMENT.

109.10 (B) **Adjustments Due to Quantity Variations:** is revised to read:

For all items of work, other than the Structural Concrete, Structural Steel, Reinforcing Steel, Structural Excavation, and Structure Backfill items, no adjustment to the Bidding Schedule's quantities, unit prices, extended amounts, and resulting lump sum amount will be made following the award of contract because of any errors or omissions made either by the Department in its calculations of quantities or by the contractor in his/her calculations.

Adjustments in the Bidding Schedule quantities for Structural Concrete, Structural Steel, Reinforcing Steel, Structural Excavation, and Structure Backfill may be initiated by the contractor or the Engineer if evidence indicates that the required quantity varies by an amount greater than five percent of the Bidding Schedule quantity. The contractor shall advise the Engineer in writing, submitting such evidence and requesting an adjustment of the quantities. The Engineer will determine the amount of adjustment, if any. The quantity upon which payment will be based will be the Bidding Schedule quantity plus or minus only that portion of the adjustment that exceeds five percent of the Bidding Schedule quantity. No adjustment to contract time will be allowed due to lump sum structure quantity variations.

109.10 (C) **Adjustments Due to Revisions Ordered By The Engineer:** the last paragraph of the Standard Specifications is revised to read:

If the revisions affect work for which no Bidding Schedule item has been established, payment for this work will be made in accordance with the requirements of Subsection 104.02.

109.10 (D) **Payment:** the second sentence of the third paragraph of the Standard Specifications is revised to read:

At least five days prior to the closing date scheduled for monthly progress payments, the contractor shall furnish the Engineer an estimate of the quantity of each item of work shown in the Bidding Schedule for which the contractor expects to be compensated.

SECTION 202 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS:

202-1 Description: of the Standard Specifications is modified to add:

In addition to the work described in the Standard Specifications under Section 202, the work under this item shall include the following:

(A) Removal of approximately 84,220 Square Yards of AC pavement at streets within the construction area

(B) Removal of approximately 47,210 Linear Feet of curb and gutter at streets within the construction area

(C) Removal of approximately 177,870 Square Feet of sidewalk or driveway within the construction area

(D) Removal of approximately 580 Linear Feet of ACP along the south side of Thunderbird Road

(202REMVL, 11/15/94)

202-3.01 General: the fifth paragraph of the Standard Specifications is revised to read:

Holes, cavities, trenches and depressions resulting from the removal of structures or obstructions, except in areas to be excavated, shall be backfilled with suitable material which shall be compacted to a density of not less than 95 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

202-5 Basis of Payment: of the Standard Specifications is revised to read:

Payment for the accepted quantities of removal of structures and obstructions will be made by lump sum or by specific removal items or by a combination of both. Payment for removal of structures and obstructions not listed in the bidding schedule but necessary to perform the construction operations designated on the project plans or specified in the special provisions shall be considered as included in the prices of contract items.

The prices shall include all excavation and subsequent backfill incidental to the removals; the furnishing and placing of asphaltic concrete to fill and repair voids resulting from the work under Subsection 202-3.07; compaction of base material resulting from the work under Subsection 202-3.03(C); and the salvaging, hauling, storing, and disposing of all materials as provided herein.

(203QCEW, 10/15/94)

SECTION 203 - EARTHWORK: of the Standard Specifications is modified to add:

203-2.02 Contractor Quality Control:

The contractor shall perform the quality control measures described in Subsection 106.04 (C). At the weekly meeting, the contractor shall be prepared to explain and discuss how the following processes will be employed:.

(a) Backfill production, including crusher methods, pit extraction, and washing.

(b) Stockpile management, including stacking methods, separation techniques, stockpile pad thickness, and segregation prevention.

(c) Transporting and placing, including transport technique, lift thickness, processing and mixing technique, and compaction methods.

(d) Excavation and transporting, including method of excavation and transporting methods.

(e) Embankment, including method of mixing, compaction methods, unsuitable material control, waste site, and lift thickness.

The contractor shall obtain samples and perform the tests specified in the following table:

CONTRACTOR QUALITY CONTROL TESTING REQUIREMENTS

TYPE OF TEST	TEST METHOD	SAMPLING POINT	MINIMUM TESTING FREQUENCY
Structural Backfill			
Gradation	ARIZ 201	Stockpile	1 per 500 CY per Source
PI	AASHTO T89, T90		
Proctor Density	ARIZ 225, ARIZ 226, ARIZ 245		1 per Source
Compaction	ARIZ 227, ARIZ 230, ARIZ 231, ARIZ 232, ARIZ 235, ARIZ 246	Roadway	1 per 200CY, minimum 1 Per lift
Subgrade			
Gradation	ARIZ 201	Roadway	1 per Soil Type
PI	AASHTO T89, T90		
Proctor Density	ARIZ 225, ARIZ 226, ARIZ 245		
Compaction	ARIZ 227, ARIZ 230, ARIZ 231, ARIZ 232, ARIZ 235, ARIZ 246	Roadway	1 per 1000 linear foot per lift

Natural Ground for Embankment less than 5 feet

Proctor Density	ARIZ 225, ARIZ 226, ARIZ 245	In-place	1 per Soil Type
Compaction	ARIZ 227, ARIZ 230, ARIZ 231, ARIZ 232, ARIZ 235, ARIZ 246	In-place	1 per 1000 linear foot per lift

Embankment

Proctor Density	ARIZ 225, ARIZ 226, ARIZ 245	In-place	1 per Soil Type
Compaction	ARIZ 227, ARIZ 230, ARIZ 231, ARIZ 232, ARIZ 235, ARIZ 246	In-place	1 per 1000 linear foot per lift

Borrow Within 3 ft. of Finished Subgrade Elevation

Gradation	Ariz 201	In-place	1 per 2000 CY
PI	AASHTO T89, T90		

203-3.03 (C) Blasting: of the Standard Specifications is modified to add:

(3) Control of Blasting and Construction Vibrations:

The contractor shall be sensitive to the potential impacts that vibration from his activities may have on the public. The strict adherence to rules of common courtesy may be of great importance in maintaining adequate pubic relations.

(4) Local Codes and Regulations:

The contractor shall be familiar with and meet applicable local codes and regulations, including City of Phoenix noise limits, Phoenix Fire Department blasting regulations and the Maricopa Association of Governments (MAG) Section 107.8 specifications pertaining to blasting.

(5) Vibration Monitoring:

A vibration monitoring plan shall be submitted to the Engineer for approval before initiating activities causing significant vibrations. Every blast performed on the project site shall be monitored with at least one blast monitoring seismograph. Blasts performed in the vicinity of residential or other non-project structures shall be monitored with additional seismographs as appropriate. In addition, occasional monitoring of other construction vibrations, such as ripping, may become necessary if complaints from nearby residents or others are made.

(6) Allowable Blasting Vibration Levels:

(a) Residential and Other Non-Project Structures:

Criteria established by the U.S. Department of the Interior Office of Surface Mine Regulation and Enforcement (OSMRE) shall be used to determine allowable vibration levels at residential and other non-project structures. These criteria permit the use of different levels of monitoring instruments and prescribe allowable vibration levels accordingly. A partial description of these criteria follow.

When using seismographs that record only ground motion velocity, maximum allowable velocities are 1.25, 1 and 0.75 inches per second (ips) for structures at distances of 0-300, 301-5,000, and greater than 5,000 feet, respectively. When using seismographs that record both velocity and frequency, maximum allowable velocities are 0.75 ips between 4-11 cycles per second (cps) for structures with drywall interiors, and 2.0 ips above 30 cps. These ground motions are measured at the nearest structures to blasting.

(b) Historic or Sensitive Older Structures:

Should any historic or sensitive structures be located near to blasting, a more restrictive criteria shall be used. The maximum allowable ground motions at such a structure shall be 0.25 ips for frequencies below 10 cps and 0.5 ips for frequencies above 40 cps.

(c) On-Site Structures:

Allowable ground motions at on-site structures shall be 2.0 ips, except that higher ground motions may be permitted in some instances subject to the review and approval of the Engineer.

(7) Airblast:

OSMRE criteria shall be used for the control of airblast. A maximum level of 133 decibels shall be allowed for a transducer with a 2 cps or lower flat response. A maximum level of 129 decibels shall be allowed for a transducer with a 6 cps or lower flat response. To minimize annoyance and complaints, airblast should be kept to 110 decibels or lower.

(8) Flyrock:

Blasting shall be conducted so that project personnel, the general public, and nearby houses, buildings, vehicles and other objects will be safe from rocks and other projectiles.

(9) Non-Blasting Vibrations:

The contractor shall make every effort to minimize the impact of vibration on nearby residents and others.

(10) Costs:

The costs incurred for Preblast Surveys, vibration monitoring and any other measures required to mitigate blasting impacts shall be included in the contract unit price paid for those items of work for which blasting is required.

ADOT has undertaken some preblast/pre excavation surveys related to potential ground settlement areas. The contractor shall familiarize himself with this information to deter additional or supplemental surveys.

203-5.04(B) **Structure Backfill:** of the Standard Specifications is modified to add:

No measurement for payment will be made for structure backfill placed adjacent to abutments or beneath approach and anchor slabs constructed in new embankments. Backfill in these areas shall conform to the requirements of Sections 203-10.01 through 203-10.03 of these Special Provisions.

203-10.01 **Description:** of the Standard Specifications is modified to add:

Additionally, embankment requirements shall apply to the construction of embankments adjacent to bridge abutments, retaining walls, wingwalls, pump house walls and beneath approach and anchor slabs.

The limits of the Material, Placement, and Compaction requirements for embankment material placed adjacent to abutments, retaining walls, wingwalls, pump house walls and beneath approach and anchor slabs shall be as specified herein or as determined by the Engineer.

203-10.02 **Embankment Materials (Metal Pile Locations):** of the Standard Specifications is modified to add:

(A) Drilled Shaft Locations:

Embankment material containing broken concrete, rock, or other solid materials which are larger than six inches in greatest dimension, shall not be placed within ten (10) feet or three shaft diameters, whichever is greater, horizontally of any proposed drilled shaft.

(B) Abutments, Retaining Walls, Wingwalls, Pump House Walls, Approach and Anchor Slab Locations:

Where embankment material is to be placed adjacent to abutments, retaining walls, wingwalls, pump house walls and beneath approach and anchor slabs, the embankment material shall not contain broken concrete, rock or other solid materials which are larger than six inches in greatest dimension or other unsuitable material as determined by the Engineer. Material which is determined by the Engineer to be incapable of being compacted to the specified density using ordinary methods or is otherwise unsuitable for the planned use shall not be placed in the embankment.

Embankment material shall conform to the following gradation (Arizona Test Method 201):

Sieve Size	Percent Passing
6 inch	100
3 inch	75 - 100
No. 4	25 - 60
No. 200	0 - 15

The plasticity index shall not exceed 12 when tested in accordance with the requirements of AASHTO T 90.

203-10.03 Embankment Construction Requirements:

(A) Placement: of the Standard Specifications is modified to add:

Embankment materials placed adjacent to abutments, retaining walls, wingwalls, pump house walls and beneath approach and anchor slabs shall be placed in eight (8) inch loose lifts.

The limits of the requirements for embankment material placed adjacent to abutments beneath approach and anchor slabs shall be the full width embankment and to a length from the abutment backwall of two hundred feet.

Embankment materials shall not be placed against the back of abutments until the concrete has developed its full design strength.

Each layer of embankment material placed adjacent to abutments, retaining walls, wingwalls, pump house walls and beneath approach and anchor slabs shall be uniform as to material, density, and moisture content before beginning compaction. At the time of placement and compaction, the embankment material shall possess a uniform moisture content such that the specified relative compaction will be obtained and the embankment material will be in a firm and stable condition.

Embankment placed within three (3) feet of finished subgrade shall meet the following requirements:

The Plasticity Index (PI) (AASHTO T90) and the percent passing the No. 200 sieve (minus 200) (Arizona Test Method 201) when used in the equation below, shall give a value of X that does not exceed 63.

$$X = (\text{minus } 200) + 2.83\ (PI)$$

(B) Compaction:

(1) Earth: of the Standard Specifications is modified to add:

Each layer of embankment material placed adjacent to abutments, retaining walls, wingwalls, pump house walls and beneath approach and anchor slabs shall be compacted to a density of not less than 100 percent of the maximum density. The contractor shall take density tests on each lift.

Prior to hauling and placing the embankment at SR 101, the contractor shall make provisions to satisfy the material requirements of SR 51. If, having failed to do so, the contractor shall replace any shortages as specified under Section 203-3.03(E).

(2) Rock: of the Standard Specifications is modified to add:

(a) Compaction of rocky material placed adjacent to abutments, retaining walls, wingwalls, pump house walls and beneath approach and anchor slabs shall be in accordance with the following:

Density requirements will not apply to those portions of embankment which contain sufficient amounts of rock such that the material cannot be tested for compliance with density requirements by approved methods. Each layer of embankment shall be compacted in accordance with the provisions below until there is no evidence of further compaction. Each layer of rocky embankment material shall be placed, spread and leveled in 8-inch thick layers over the full width of the embankment, with sufficient earth or other fine material so deposited to fill the interstices to produce a dense, compact embankment. The largest dimension of the largest rock shall not exceed 6 inches. Compaction of each layer of embankment fill shall be performed on a minimum rolling basis as follows:

1. A minimum of four passes of a self-propelled 50-ton compression-type roller or vibratory roller having a minimum frequency of vibration during operation of 1,000 cycles per minute, and minimum dynamic force at the operating frequency of 40,000 pounds; or

2. A minimum of eight passes of a self-propelled 10-ton compression-type roller or vibratory roller having a minimum frequency of vibration during operation of 1,000 cycles per minute, and minimum dynamic force at the operating frequency of 30,000 pounds.

The maximum roller speed during operation shall be no greater than 2.5 miles per hour.

(3) General: is hereby added to the Standard Specifications:

The contractor shall furnish the Engineer a Certificate of Compliance certifying that the embankment material placed adjacent to abutments and retaining walls and beneath approach and anchor slabs comply with the applicable contract specifications. A copy of all test results performed by the contractor necessary to assure contract compliance shall also be furnished to the Engineer. The Certificate of Compliance and all testing shall be in accordance with Section 106 and as outlined in the contractor's Quality Control Plan.

All embankment not in conformance with the stated requirements, as determined by the Engineer, shall be removed and replaced at the contractor's expense.

(203PHXEX, 04/15/91)

ITEM 2030051 - STRUCTURAL EXCAVATION (FOR WATER LINE ADJUSTMENT):

(1) Description:

The work under this item shall consist of furnishing all materials, personnel and equipment to perform all excavation and backfilling required so that the City of Phoenix can adjust an obstructing water line in accordance with the requirements of the Specifications.

(2) Method of Measurement:

Measurement of this work will be made by the cubic yard.

(3) Basis of Payment:

Payment for this work will be made at the contract unit price of $6.00 per cubic yard, as shown in the bidding schedule.

The amount of excavation necessary to effect the required adjustment may vary considerably from the quantity shown in the bidding schedule; however, no adjustment in the contract unit price will be made because of any increase or decrease in the estimated quantity.

SECTION 207 - DUST PALLIATIVE:

207-3 Construction Requirements: of the Standard Specifications is modified to add:

Material to be excavated between the existing ground surface and the finished subgrade shall be pre-wet prior to its removal. The contractor shall rip or scarify the upper 18 inches of soil in excavation areas concurrently with the applications of water. Dust shall be kept at a minimum. The contractor shall provide a monitoring system that is capable of checking the penetration of moisture for the full depth of excavation. The moisture content of the material shall be kept at optimum plus or minus two percent. Any required drying of pre-wetted materials shall be done at the contractor's expense.

207-5 Basis of Payment: of the Standard Specifications is modified to add:

The cost of the water, hoses, fittings, sprinklers and any other equipment necessary to perform the pre-wetting will be considered as included in the cost of dust palliative as provided herein.

For pre-wetting of material, the contractor will be reimbursed 50 percent of the quantity of water used for pre-wetting, provided the pre-wet is as approved by the Engineer. Payment for the adjusted water quantity for pre-wetting will be paid as dust palliative. There will be no payment of dust palliative for pre-wetting of materials not approved by the Engineer.

SECTION 303 - AGGREGATE SUBBASES AND AGGREGATE BASES:

303-2 Materials: of the Standard Specifications is modified to add:

The aggregate subbbase shall be Class 6. The grading shall be as follows:

Sieve Size	% Passing
3"	100
1/4"	45 - 75
#200	0 - 15

The plasticity index shall not exceed 5.

(303QCAB, 10/15/94)

SECTION 303 - AGGREGATE SUBBASES AND AGGREGATE BASES: of the Standard Specifications is modified to add:

303-3.04 Contractor Quality Control:

The contractor shall perform the quality control measures described in Subsection 106.04 (C). At the weekly meeting, the contractor shall be prepared to explain and discuss how the following processes will be employed:

(a) Aggregate production, including crusher methods, pit extraction, and washing.

(b) Stockpile management, including stacking methods, separation technique, stockpile pad thickness, and segregation prevention.

(c) Transporting and placing, including transport technique, lift thickness, processing and mixing technique, and compaction methods.

The contractor shall obtain samples and perform the tests specified in the following table:

CONTRACTOR QUALITY CONTROL TESTING REQUIREMENTS

TYPE OF TEST	TYPE OF TEST	SAMPLING POINT	MINIMUM TESTING FREQUENCY
Aggregate Base Class 1, 2, 3			
Fractured Faces	ARIZ 212	Crusher belt or Stockpile	1 per 1200 CY
Gradation	ARIZ 201		1 per 600 CY
PI	AASHTO T89, T90		
Proctor Density	ARIZ 225, ARIZ 226, ARIZ 245		1 per Source
Compaction	ARIZ 227, ARIZ 230, ARIZ 231, ARIZ 232, ARIZ 235, ARIZ 246	Roadway	1 per 600 CY
Aggregate Base Class 4, 5 6			
Fractured Faces (Class 4)	ARIZ 212	Crusher Belt or Stockpile	1 per 1200 CY
Gradation	ARIZ 201		1 per 600 CY
PI	AASHTO T89, T90		
Proctor Density	ARIZ 225, ARIZ 226, ARIZ 245		1 per Source
Compaction	ARIZ 227, ARIZ 230, ARIZ 231, ARIZ 232, ARIZ 235, ARIZ 246	Roadway	1 per 600 CY

SECTION 401 PORTLAND CEMENT CONCRETE PAVEMENT

401-3.05 (B) **Longitudinal Joints:** of the Standard Specifications is modified to add:

Smooth epoxy coated dowels of the size specified in the plans shall be used in lieu of tie bars in the longitudinal construction joints. Dowels shall be 24 inches long.

401-3.06(A) **Sawed Joints:** of the Standard Specifications is modified as follows:

Item 2 is revised to read:

The sealant used shall be silicone joint sealant either DOW 890-SL, CRAFCO Roadsaver 903-SL, or CSL Silicones CSL-315 self leveling and shall be applied in accordance to the manufacturer's recommendations except of the shape factor requirements and with the additional stipulation that hand tooling be required to ensure proper dimensions and placement within the joint. All recommended manufacturer's field testing shall be immediately repaired by the contractor; cost to be considered incidental to the pavement pay items. Any sealant spilled on the concrete pavement shall be removed.

Immediately prior to applying joint sealant, an expanded closed cell polyethylene foam backer rod, approved by the Engineer shall be inserted along the joint as shown on he plans. The backer rod shall be compatible with the joint sealant and shall be at least 25% larger than the nominal sawed joint width.

SECTION 404 - BITUMINOUS TREATMENTS:

404-3.13 **Fog Coat:** of the Standard Specifications is modified as follows:

Delete the first paragraph and replace with the following:

The bituminous material shall be ERA-25, diluted with 1 part water to 1 part ERA-25. The bituminous material shall be applied at the approximate rate of 0.08 gallon per square yard. When a fog coat is specified for new asphaltic concrete, it shall be applied as soon as practicable after placing the asphaltic concrete.

(404BIMAT, 12/01/91)

SECTION 404 - BITUMINOUS TREATMENTS:

404-5 Basis of Payment: of the Standard Specifications is modified to add:

The term "bituminous material" as used herein shall include asphalt cement, liquid asphalt and emulsified asphalt.

The contract unit price for each item of bituminous material will be considered to include all costs for furnishing, hauling, handling, spreading, and mixing of the material as required, including the "initial cost" of asphalt cement, but excluding any difference in the cost of asphalt cement that occurs between the date of bid opening and the date that the material is delivered or used.

The "initial cost" of asphalt cement, liquid asphalt and emulsified asphalt will be determined monthly by the Department based on the selling prices of asphalt cement published by the Asphalt Weekly Monitor, a publication of Poten & Partners, Inc.

The price will be made known by means of a memorandum issued on the last Wednesday of each month and mailed to those currently receiving copies of the Advertisements for Bids. This price will be the arithmetic average of the high and low selling prices for asphalt cement shown in the previous four reports for the Arizona/Utah and Southern California regions.

This price will be deemed to be the "initial cost" for bituminous material of all types, grades, etc. on projects on which bids are opened during the following month. This price may also be obtained from Contracts and Specifications Services, (602) 255-7221.

For each item of bituminous material for which there is a specific pay item, an adjustment in compensation will be made for either an increase or decrease in the price of asphalt cement as shown in the latest memorandum, current as of the date of use, as compared to the "initial cost".

The tons of emulsified products to which the adjustment will be applicable will be the tons of the emulsified bituminous asphalt prior to dilution.

Adjustments in compensation for emulsified asphalts will be made at 60 percent of either the increase or decrease.

The tons of bituminous materials which are paid for on an invoice basis to which the adjustment will be applicable are the tons which have been delivered to the project and subsequently incorporated into the work. The adjustment will be applicable on the date of use.

The tons of bituminous materials which are paid for on the basis of extraction tests to which the adjustment will be applicable are the tons which have been incorporated into the mixture.

No additional compensation will be made for any additional or increased charges, costs, expenses, taxes, etc., which the contractor may have incurred since the time of bidding and which may be the result of any increase in the "initial cost" of bituminous material.

Adjustment in unit prices of items governed by this provision will be made in the next regular monthly progress payment following actual use or application.

After the expiration of the specified completion time set forth in the contract or as may be extended in accordance with the provisions of Subsection 108.08 of the Specifications any adjustment in compensation made for bituminous material incorporated into the work will be on the basis of the price of paving asphalt shown in the latest memorandum on the date of the expiration of the specified completion time, as hereinbefore specified.

(406ASP, 10/30/94)

SECTION 406 - ASPHALTIC CONCRETE: of the Standard Specifications is revised as follows:

406-2 **Asphaltic Concrete Mix Design Criteria:** TABLE 406-1 is modified to add:

Criteria	Requirements 1/2" Mix	3/4" Mix	Base Mix	Arizona Test Method
Effective Voids, Percent, Range	5.5 ± 0.2	5.5 ± 0.2	4.0 ± 0.2	815
Index of Retained Strength, Percent, Min.	50	50	50	802

The minimum stability for the Base Mix shall be 2000 pounds.

406-3 **Materials:** is modified to add:

For comparative purposes, quantities shown in the bidding schedule have been calculated based on the following data:

	1/2" Mix	3/4" Mix	Base Mix
Unit Weight, Pounds per Cubic Foot	146	146	148
Percent, Asphalt Cement	5.0	5.0	4.5

406-3.02 **Mineral Aggregate:** Table 406-3 is modified to add:

The Combined Bulk Specific Gravity shall be 2.35 - 2.85.

The Combined Water Absorption shall be 0 - 2.5.

The requirement for crushed faces, determined in accordance with Arizona Test Method 212, shall be 50% minimum for the 1/2" mix and the 3/4" mix, and 30% minimum for the Base Mix asphaltic concrete.

406-3.03 **Mineral Admixture:** the first paragraph is modified to add:

A Certificate of Analysis conforming to the requirements of Subsection 106.05 of the Standard Specifications shall be submitted.

406-3.03 **Mineral Admixture:** the requirement for lime in Table 406-4 is revised to read ASTM C 1097.

406-3.04 **Bituminous Material:** is modified to add:

The grade of bituminous material to be used shall be AC-40 for Asphaltic Concrete (3/4") and (1/2") and AC-20 for Asphaltic Concrete (Base Mix).

406-4.01 **New Mix Designs:** the last sentence of the third paragraph is revised to read:

The requirements may be obtained from the Materials Group, 1221 North 21st Avenue, Phoenix, Arizona, 85009-3740.

406-6 **Verification Testing:** Table 406-6 is revised to read:

TABLE 406-6
VERIFICATION CRITERIA

	Property	Allowable Deviation From Proposal Targets	Limiting Values
1)	Sand Equivalent	-10 (Note 1)	45 Min.
2)	Crushed Faces, Percent		
	(a) 1/2" mix, 3/4" mix	----	50 Min.
	(b) Base Mix	----	30 Min.
3)	Abrasion 100 Revolutions	----	9 Max.
	500 Revolutions	----	40 Max.
4)	VMA, Percent		
	(a) 1/2" mix, 3/4" mix	1.5	14.5 Min
	(b) Base Mix	----	14.0 Min
			--
5)	Effective Voids, Percent	1.0	
6)	Stability, Pounds		
	(a) 1/2"mix, 3/4"mix	----	1,750 Min.
	(b) Base Mix	----	1,750 Min.
7)	Flow, 0.01 Inch	----	7-17
8)	Index of Retained Strength, Percent	----	(Note 2)
9)	Wet Strength, psi	----	140 Min.
10)	Absorbed Asphalt, Percent	----	1.0 Max.

(Note 1): In verifying previously used mix designs only.

(Note 2): The limiting value for Index of Retained Strength Shall be 5 less than the index of retained strength requirement from Table 406-1.

406-6 **Verification Testing:** the last paragraph is revised to read:

Results of testing will be verbally furnished to the contractor within ten working days following the date of receipt of both an acceptable mix design proposal and the samples in the Central laboratory. For any mix design that requires artificial gradation, an additional two working days will be required for verification testing. The contractor will be verbally notified of failing test results within one working day of failure.

406-10.03 **Proportioning:** the first paragraph is revised to read:

Mixing plants shall conform to the requirements of AASHTO M 156 except as modified herein. The contractor shall provide documentation by calibration charts or other approved means that the mineral aggregate, asphalt cement and/or mineral admixture is being proportioned in accordance with the approved mix design.

406-10.05 **Mixing:** the first paragraph is revised to read:

The production of the plant shall be governed by the rate required to obtain a thorough and uniform mixture of the materials.

406-10.07 **Joints:** is modified to add:

The contractor shall schedule his paving operations to minimize exposed longitudinal edges. Unless otherwise approved by the Engineer, the contractor shall limit the placement of asphaltic concrete courses, in advance of adjacent courses, to one shift of asphaltic concrete production. The contractor shall schedule his paving operations in such a manner to eliminate exposed longitudinal edges over weekends or holidays.

406-10.08 (B)(2) Compaction Acceptance Procedure: the last paragraph is revised to read:

In the event the contractor elects to question the core test results obtained for a particular lot, he may make a written request for additional testing of that lot. The core samples previously saved will be tested in accordance with the requirements of Arizona Test Method 415 in an independent testing laboratory designated by the Engineer. The testing of the samples will be performed by the independent testing laboratory without knowledge of the specific project conditions such as the identity of the contractor, the test results by the Department, or the density target. Using the referee test results, the Engineer will determine new PT's for the compaction characteristic. The result of this determination will be binding on both the contractor and the Engineer. The Engineer will pay for this testing: however, if the compaction pay factor of the lot does not improve, is reduced, or the lot remains in reject, payment to the contractor for asphaltic concrete shall be reduced by the amount of the cost of this testing.

406-11 **Method of Measurement:** the first paragraph is revised to read:

Asphaltic concrete will be measured by the ton for the asphaltic concrete actually used, which will include the weight of mineral aggregate, asphalt cement, and any necessary mineral admixture. Measurement will include any weight used in construction of intersections, turnouts, curbs, spillways and spillway inlets, ditches, catch basin entrances, median strips, sidewalks or other miscellaneous items or surfaces.

406-12 **Basis of Payment:** the fifth paragraph under **Compaction Pay Factor** which begins "Payment for asphalt cement..." is revised to read:

Payment for asphalt cement will be made by the ton. Adjustments in payment shall be made in accordance with the requirements of Subsection 1005-3.01.

406-13 **Definitions, Abbreviations and Formulas for Acceptance:** Table 406-7 is revised to read:

TABLE 406-7

Number of test "N" = 10

DETERMINATION OF PU or PL

QU or QL	PU or PL	QU or QL	PU or PL
2.176 or More	100	0.000 to -0.012	50
1.940 to 2.175	99	-0.013 to -0.038	49
1.798 to 1.939	98	-0.039 to -0.064	48
1.691 to 1.797	97	-0.065 to -0.090	47
1.603 to 1.690	96	-0.091 to -0.116	46
1.526 to 1.602	95	-0.117 to -0.142	45
1.458 to 1.525	94	-0.143 to -0.169	44
1.396 to 1.457	93	-0.170 to -0.195	43
1.339 to 1.395	92	-0.196 to -0.222	42
1.286 to 1.338	91	-0.223 to -0.248	41
1.236 to 1.285	90	-0.249 to -0.275	40
1.188 to 1.235	89	-0.276 to -0.302	39
1.143 to 1.187	88	-0.303 to -0.329	38
1.100 to 1.142	87	-0.330 to -0.356	37
1.058 to 1.099	86	-0.357 to -0.383	36
1.018 to 1.057	85	-0.384 to -0.411	35
0.980 to 1.017	84	-0.412 to -0.439	34
0.942 to 0.979	83	-0.440 to -0.467	33
0.906 to 0.941	82	-0.468 to -0.495	32
0.871 to 0.905	81	-0.496 to -0.524	31
0.836 to 0.870	80	-0.525 to -0.553	30
0.802 to 0.835	79	-0.554 to -0.582	29
0.769 to 0.801	78	-0.583 to -0.612	28
0.737 to 0.768	77	-0.613 to -0.642	27
0.705 to 0.736	76	-0.643 to -0.673	26

0.674 to 0.704	75	-0.674 to -0.704	25
0.643 to 0.673	74	-0.705 to -0.736	24
0.613 to 0.642	73	-0.737 to -0.768	23
0.583 to 0.612	72	-0.769 to -0.801	22
0.554 to 0.582	71	-0.802 to -0.835	21
0.525 to 0.553	70	-0.836 to -0.870	20
0.496 to 0.524	69	-0.871 to -0.905	19
0.468 to 0.495	68	-0.906 to -0.941	18
0.440 to 0.467	67	-0.942 to -0.979	17
0.412 to 0.439	66	-0.980 to -1.017	16
0.384 to 0.411	65	-1.018 to -1.057	15
0.357 to 0.383	64	-1.058 to -1.099	14
0.330 to 0.356	63	-1.100 to -1.142	13
0.303 to 0.329	62	-1.143 to -1.187	12
0.276 to 0.302	61	-1.188 to -1.235	11
0.249 to 0.275	60	-1.236 to -1.285	10
0.223 to 0.248	59	-1.286 to -1.338	9
0.196 to 0.222	58	-1.339 to -1.395	8
0.170 to 0.195	57	-1.396 to -1.457	7
0.143 to 0.169	56	-1.458 to -1.525	6
0.117 to 0.142	55	-1.526 to -1.602	5
0.091 to 0.116	54	-1.603 to -1.690	4
0.065 to 0.090	53	-1.691 to -1.797	3
0.039 to 0.064	52	-1.798 to -1.939	2
0.013 to 0.038	51	-1.940 to -2.175	1
0.000 to 0.012	50	-2.176 or Less	0

406-9.03 (A) **Mineral Aggregate Gradation:** of the Standard Specifications is modified as follows:

The first sentence is modified to read:

For each approximate 1000 tons of asphaltic concrete (Base Mix) at least one sample of mineral aggregate will be taken.

406-9.03 (B) **Asphalt Cement Content:** of the Standard Specifications is modified as follows:

The second sentence is revised to read:

The asphalt cement content shall be tested in accordance with the requirements of Interim Arizona Test Method 421 dated 8-25-95 using a nuclear asphalt cement content gauge. This interim test method is available from the ADOT materials Group, 1221 N. 21st Ave., Phoenix, Arizona, 85009-3740.

(501QCDRN, 10/15/94)

SECTION 501 PIPE CULVERT AND STORM DRAINS:

501 - 3 **Construction Requirements:** of the Standard Specifications is modified to add:

501 - 3.01 (A) Contractor Quality Control:

The contractor shall perform the quality control measures described in Subsection 106.04(C). At the weekly meeting, the contractor shall be prepared to explain and discuss how the following processes will be employed:

(a) Bedding and backfill production, including crusher methods, pit extraction, and washing.

(b) Stockpile management, including stacking methods, separation techniques, stockpile pad thickness, and segregation prevention.

(c) Transporting and placing, including transport technique, lift thickness, processing and mixing technique, and compaction methods.

The contractor shall obtain samples and perform the tests specified in the following Table:

CONTRACTOR QUALITY CONTROL TESTING REQUIREMENTS

TYPE OF TEST	TEST METHOD	SAMPLING POINT	MINIMUM TESTING FREQUENCY
Backfill and Bedding Material			
Gradation	ARIZ 201	Stockpile	1 per 500 CY per Source
PI	AASHTO T89, T90		
Proctor Density	ARIZ 225, ARIZ 226, ARIZ 245		1 per Source
Compaction	ARIZ 227, ARIZ 230, ARIZ 231, ARIZ 232, ARIZ 235, ARIZ 246	Roadway	1 per 200 CY, minimum 1 per lift

SECTION 501 **PIPE CULVERT AND STORM DRAINS:** the number and title of Subsection 501-3.01 of the Standard Specifications is revised to read:

501 - 3.01 (B) **Preparation of Foundations, Trenches, and Embankments:**

(501RESIS, 12/15/94)

SECTION 501 - PIPE CULVERT AND STORM DRAINS:

501-3.02(A)(1) **General:** The last paragraph of the Standard Specifications is revised to read:

Bedding material for all pipe shall have a value of resistivity not less than 2000 ohm-cm, unless otherwise specified or approved by the Engineer. Bedding material shall have a pH value between 6.0 and 10.0, inclusive, for all metal pipe installations, except aluminum. Bedding material for aluminum pipe installations shall have a pH value between 6.0 and 9.0, inclusive. Bedding material shall have a pH value between 6.0 and 12.0, inclusive, for all concrete or plastic pipe installations. Tests for pH and resistivity shall be conducted in accordance with the requirements of Arizona Test Method 236.

501-3.02(C)(2) Standard Aggregate Bedding Materials: the first paragraph of the Standard Specifications is revised to read:

Standard aggregate bedding material shall be compacted to at least 95 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

501-3.04(C) Compaction of Backfill Material: the first paragraph of the Standard Specifications is revised to read:

Backfill material shall be compacted to at least 95 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

501-3.07(B) Excavation: of the Standard Specifications is revised to read:

The trench shall be excavated to the lines and grades shown on the project plans. Laser guided alignment instruments shall be used to control the grade and alignment of the trench. Departure from and return to the established grade for the finished trench shall not exceed one inch per 10 linear feet. Departures from and return to specified alignment for the trench shall not exceed two inches per 10 linear feet, with a total departure not to exceed four inches. The bottom of the trench shall be shaped in accordance with the details shown on the plans and prepared to provide full, firm and uniform support over the bottom 180 degrees of the pipe to be constructed.

The length of trench permitted to remain open at any one time shall not exceed 1,600 linear feet, unless otherwise specified in the special provisions or as may be permitted by the Engineer.

The bottom of the trench must consist of either undisturbed native soil or compacted backfill. When soft, spongy or other unsuitable material is encountered in the bottom of the trench, such material shall be removed to the depth and width directed by the Engineer.

The resulting excavated area shall be backfilled with material conforming to the requirements herein before specified under pipe backfill. The backfill shall be compacted to not less than 95 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. This backfill shall then be excavated as specified above.

When boulders, bedrock, or rock ledges are encountered in the bottom or side walls of the trench, such material shall be removed to a distance of at least six inches from the nearest surface of the pipe, and the space then backfilled, compacted, and reshaped as required above for unsuitable material.

The trench walls, from a point one foot above the top of the pipe to the top of the trench, may be sloped as required by soil conditions to provide more stability in the trench and safer working conditions in accordance with the provisions of Subsection 107.07. The steepness of the side slopes shall be limited to the degree of stability considered necessary for safety, unless an approved shoring system is used.

501-3.07(C) **Concrete Placement:** of the Standard Specifications is revised to read:

At the time of concrete placement, all surfaces in the trench which will be in contact with the pipe shall be thoroughly moistened so that moisture will not be drawn from the freshly placed concrete; however, the trench shall be free of standing water, mud and debris.

When daytime ambient temperatures are expected to exceed 105 degrees F, and when directed by the Engineer, concrete shall be placed only between the hours of 8:00 pm and 8:00 am. Concrete shall not be placed when the temperature of the concrete exceeds 90 degrees F or is less than 50 degrees F. The soil adjacent to the trench shall be at a temperature above 32 degrees F.

The concrete shall be placed around the full circumference of the pipe in one operation. When metal forms are used, they shall be of sufficient strength to withstand vibrating and tamping the concrete.

The concrete shall be vibrated, rammed, tamped or worked with suitable devices until the concrete has been thoroughly consolidated and completely fills the formed space.

Laser guided alignment instruments shall be used to control the grade and alignment of the pipe. Departure from and return to the established grade for the invert of the installed pipe shall not exceed one inch per 10 linear feet. The surface of the invert shall not vary by more than 0.10 foot when tested with a 10-foot straight edge. Departures from and return to specified alignment for the pipe shall not exceed two inches per 10 linear feet, with a total departure not to exceed four inches.

When placing operations stop for such a time that initial set of the concrete is likely to occur before placement resumes, a construction joint shall be made by leaving the end of the pipe rough with a slope of approximately 45 degrees and inserting 24-inch No. 4 dowels one foot into the center of the pipe wall at approximately 18-inch intervals.

Collars may be used in lieu of doweled joints. An excavation shall be made along the sides and bottom of the construction joint to permit casting of a concrete collar around the outside of the joint. The collar shall have a minimum thickness 1.25 times the pipe wall thickness and shall lap the entire joint by at least two times the wall thickness.

Immediately before resuming concrete placement, the joint shall be cleaned of all laitance, loose or defective concrete, coatings and other deleterious materials, and thoroughly wetted.

Construction joints used for connections to another pipe or at junction structures shall be made by squaring off the end of the pipe. An excavation along the sides and bottom of the pipe to permit casting of the concrete collar shall be made as previously specified.

After the removal of forms, the inside of the pipe will be inspected for rock pockets, voids, cracks, form indentation, and excessive form lap. Any necessary repairs shall be made promptly and to the satisfaction of the Engineer.

501-3.07(G) Pipe Repair: of the Standard Specifications is revised to read:

Transverse cracks 0.05 inches or more in width that can be penetrated more than 1/4 inch with a standard machinist gauge leaf designated in AASHTO T 280 and are more than 12 inches in length shall be repaired by injection of an approved elastomeric compound or another method approved by the Engineer.

Longitudinal cracks 0.05 inches or more in width that can be penetrated more than 1/4 inch with a standard machinist gauge leaf designated in AASHTO T 280, are more than 12 inches in length, and within 45 degrees of either side of the crown or invert will be cause for rejection. At the sole discretion of the Engineer, these cracks may be structurally repaired by epoxy pressure grouting.

Longitudinal cracks 0.01 inches or more in width that can be penetrated more than 1/4 inch with a standard machinist gauge leaf designated in AASHTO T 280, are more than 12 inches in length, and within 45 degrees of either side of the spring line will be cause for rejection. At the sole discretion of the Engineer, these cracks may be structurally repaired by epoxy pressure grouting.

A longitudinal crack shall be defined as one which is generally oriented within 30 degrees of the alignment of the pipe.

Any section of pipe rejected by the Engineer shall be removed and replaced at no additional cost to the Department.

(501CHDP, 12/15/95)

SECTION 501 - PIPE CULVERT AND STORM DRAINS:

501-3.03(G) Corrugated Polyethylene Pipe: the title and text of the Standard Specifications are revised to read:

501-3.03(G) Corrugated High Density Polyethylene Plastic Pipe:

Corrugated high density polyethylene plastic pipe shall be assembled and installed in accordance with the manufacturer's instructions.

Watertight joints, unless otherwise specified, will not be required for storm drains, culverts or other drainage pipe. However, joints for these pipes shall be water resistant. Watertight joints shall be provided for siphon and irrigation pipe installations.

Watertight and water resistant joints shall conform to the requirements of Subsection 1010-8 of the Specifications.

A 6- by 18-inch strip of magnetic tape shall be placed in the trench at the crown of each length of installed pipe.

Special care shall be taken in the handling and installation of corrugated high density polyethylene plastic pipe and fittings to prevent damage and to assure that proper line and grade are maintained throughout the backfilling operation.

When end sections for corrugated high density polyethylene plastic pipe are called for on the plans, the contractor shall use flared metal end sections unless otherwise specified.

ITEM 5060100 - PUMP STATION:

506-1 GENERAL REQUIREMENTS:

506-1.01 DESCRIPTION:

The work under this section shall consist of the complete construction of a pump station, including, but not limited to, all excavation, shoring, and backfilling; masonry, concrete, reinforcement and structural steel; roof joists, metal roof decking, roofing; pumps and controls, diesel engine drives, emergency generator, pipes and valves; hatches; fuel storage; plumbing work; electrical work; painting, staining, site improvements and all appurtenances and other items of work as specified herein, and as indicated on the plans, including all items necessary to complete the pump station at the locations shown on the project plans.

506-1.02 LIST OF EQUIPMENT:

At the preconstruction conference the contractor shall submit in duplicate for the Engineer's approval a complete list of all equipment he proposes to furnish for the Pump Station(s). The equipment list shall include a complete description of all components with catalog cuts and drawings as necessary for in-depth evaluation of each unit and its interaction with the total system.

506-1.03 SHOP DRAWINGS:

Shop drawings shall be submitted in accordance with Subsection 105.02 of the Standard Specifications as the Engineer determines necessary to properly control all work under this Section.

506-1.04 AS-BUILT DRAWINGS:

The contractor shall maintain a set of record drawings for the Pump Station, upon which shall be clearly indicated (by shading, coloring, or some other acceptable method) the day-to-day extent of the work installed. All changes to the original design shall be clearly depicted.

At the completion of the construction phase, the contractor shall furnish to the Engineer all necessary drawings showing work which was not installed as shown in the contract drawings. All pertinent information, i.e., valve locations, pipe and duct routing (dimensionally located), etc. shall be indicated. All underground concealed or buried piping shall be located by two or more dimen\sions per run of pipe between each direction change. All elevations (invert or center line) shall be shown with the point of elevation change clearly located. All valves shall be numbered and lettered to correspond with the numbers and letters of the valve charts.

506-1.05 OPERATION AND MAINTENANCE INSTRUCTIONS:

Thirty calendar days prior to the completion of the installation and final inspection of the work, the contractor shall furnish to the Engineer for approval, eight copies of complete Instruction Manuals, bound in booklet form and indexed. All operating and maintenance manuals shall be sequentially numbered and identified to binder location in 3 ring binders labeled with the station name and contract number. Each binder shall contain an index and tabs to facilitate easy location of data. A master index shall be included in the first binder which shall identify the proper binder to proceed to. Drawings shall be placed in pockets.

Each manual shall contain the following items:

List of all equipment with manufacturer's name, model number and local representative, service facilities and normal channel of supply for each item.

Manufacturer's literature describing each item of equipment, along with detailed parts list. For fans and pumps, operation data including fan curves and pump curves shall be provided.

Detailed step by step instructions for starting, summer operation, winter operation, and shutdown of each system.

Detailed maintenance instructions for each system and piece of equipment.

Copy of Valve Chart.

Copy of each automatic control diagram with respective sequence of operation.

Individual equipment guarantees.

Certificates of Inspection.

Blueprints of "as-built construction" and related shop drawings.

All written material contained in the manual shall be typewritten.

506-2 PUMP STATION, WET WELL AND PUMP STATION SITE:

506-2.01 DESCRIPTION:

The work under this subsection shall include the furnishing of all labor, materials and equipment for the construction of the pump station, wet well and pump station site as indicated on the plans and in accordance with these specifications.

The work shall consist of excavation and backfill; concrete and reinforcing steel; inlet and outlet pipe sections; structural steel, roof joists, metal roof decking, and miscellaneous metal; masonry; built-up roofing; insulation with appurtenances; architectural metal work; painting and staining; paving; sidewalk; fencing; and all work included in the plans and specified herein.

506-2.02 MATERIALS:

(A) PORTLAND CEMENT CONCRETE:

All concrete to be used for the structure shall be Class S concrete, having a minimum compressive strength of 3500 psi at 28 days. Concrete shall comply with the requirements of Section 1006 except as follows:

(1) Slump range shall be 1 to 4.5 inches.

(2) Coarse aggregate shall meet the gradation requirements as stated in AASHTO M43 for size number 57.

(3) Water-cement ratio by weight shall not exceed 0.45.

(B) STEEL REINFORCEMENT:

All reinforcing steel shall be Grade 60 and comply with the requirements of Section 1003 of the Standard Specifications. All rebars shall be Grade 60.

(C) MASONRY:

Concrete masonry units shall be ASTM Grade N, Type I, moisture-controlled, load bearing units. Faces of all exposed concrete masonry units shall be of uniform medium texture, free of defects and of uniform dimensions. All special units shall be furnished as required. External corners shall be square.

All concrete masonry units shall be cured in a moisture controlled atmosphere at a minimum temperature of 180 degrees F. Moisture content in the units at time of delivery to job site shall not exceed 30 percent maximum absorption per unit.

Units shall be free of iron and other substances that will stain plaster or paint. Aggregate shall not contain more than 1.5 mg of ferric oxide per 200 grams when tested in accordance with ASTM C331.

The normal weight concrete masonry units shall comply with ASTM C90 for hollow blocks and ASTM C145 for solid blocks.

The pump service switch enclosure walls, and the exterior walls of the generator and control room shall be constructed of split face ribbed block laid in stack bond and the ribs exposed to exterior view. Ribbed blocks shall be "Sonora Block" as manufactured by Superlite Builders, Inc. or equivalent. Portions of wall not exposed to exterior view, corners of wall, and stepped portions of wall shall be constructed of blocks as specified and detailed on the plans.

The site perimeter wall shall be composed of split face ribbed block textured two sides ("Sonora Block"), and "Standard" smooth block. All masonry surfaces of the pump station buildings and fences shall be finished with an acrylic emulsion paint in accordance with Section 601 of the Standard Specifications.

(D) MORTAR AND GROUT:

The ingredients for mortar shall comply with the following:

(I)	Portland Cement	-	ASTM C150, Type I
(2)	Hydrated Lime	-	ASTM C207, Type S
(3)	Aggregate	-	ASTM CI44
(4)	Water	-	Potable
(5)	Admixtures	-	Use only as approved by the Engineer.

The mortar mix shall comply with ASTM C270, Type S, and the color shall be compatible with the masonry units as approved by the Engineer.

The grout for bond beams and reinforced concrete masonry shall be in compliance with ASTM C476, and grout for setting lintel beams and similar items shall be composed of one part Portland cement and two parts fine aggregate with sufficient lime putty added to form a quick set.

(E) MASONRY ACCESSORIES:

(1) Continuous Wall Reinforcement:

Continuous wall reinforcement shall be fabricated of deformed steel side rod and No. 9 gauge, or heavier, cross rods conforming to ASTM A82, cross ties shall be butt welded. Cross rods for cavity wall reinforcement shall have drip configuration. All reinforcing units for corners and butting and intersecting walls shall be factory fabricated. Reinforcing units shall be hot-dip galvanized after fabrication in accordance with ASTM A153, Class B2.

(2) Flexible Anchors:

Where masonry is to be anchored to structural framework with flexible anchors, two-piece anchors which will permit horizontal and vertical movement of masonry shall be provided. These flexible anchors will provide lateral restraint and shall be factory fabricated.

(3) Control Joint Filler:

Control joint filler shall be factory-extruded solid sections of rubber conforming to ASTM D2000 2AA-805 with durometer hardness of 80 when tested in conformance with ASTM D2240. The shear section shall not be less than 5/8 inch thick and the flanges, not less than 5/16 inch thick.

(4) Expansion Joint Filler:

Expansion joint filler shall be composed of cork granules in a resin binder conforming to ASTM D-1752.

(F) STRUCTURAL METALS:

Structural steel and miscellaneous metals shall comply with Section 1004 of the Standard Specifications and the American Institute of Steel Construction (AISC) "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings". All exposed steel shall be painted in accordance with Section 610.

The metal framing for the mansards shall be similar in appearance and equal to Versaroof framing system as manufactured by Decks International, Inc. of Northbrook, Illinois. All steel used for the framing system components shall meet minimum requirement of ASTM A-446, Grade A for 14, 18 and 20 gauge. The minimum hot-dipped galvanized coating weight shall be G-60 as defined in ASTM A-525. The Zee Purlins shall be 14 gauge galvanized steel spaced 4' - 0" maximum on center.

All framing components shall be fastened to each other using 12-14 3/4" box washer head, self-drilling fasteners.

(G) STEEL ROOF JOISTS:

Steel roof joists shall be Vulcraft Steel Joists as manufactured by Vulcraft, a division of Nucor Corp., Grapeland, TX or approved equal.

Joists shall be of the type and size indicated on the drawings. Design of steel joists to be supplied shall have been checked by the Steel Joist Institute and found to conform to the Steel Joist Institute Standard Specifications and Load Tables.

Bridging members shall be of the sizes and spacing shown on the drawings.

(H) METAL ROOF DECK:

Roof deck shall be USD Roof Deck, Type F, 20 gauge, as manufactured by United Steel Deck, Inc., South Plainfield, New Jersey; Vulcraft, a Division of Nucor Corporation, Charlotte, NC; Bowman Metal Deck, Pittsburgh, PA; or equal as follows:

Galvanized steel decking shall conform to ASTM A496, Minimum Fy = 33,000 psi; Galvanized coating shall conform to ASTM A-525.

Anchor clips, vent clips, flexible closure strips, welding washers, sump pans, plates, ridge and valley plates, hanger tools and other accessories shall be those types, sizes and configurations recommended by the roof decking manufacturer and shall be the same material and finish as the deck units.

The roof of the mansard shall be similar in appearance and equal to SN(SBS)-18/Structural Batten System as manufactured by AEP/SPAN Metal Corporation of Dallas, Texas. The batten system shall be fabricated from 24 gauge sheet metal and shall have a Kynar 500 finish with the color selected by the Engineer from a minimum of four color samples which shall be provided by the contractor. The system shall have a UL rating of 90.

The soffit shall be perma panels, 24 gauge HD6, G-90 as manufactured by AEP/SPAN Metal Corporation, or approved equal that is similar in appearance. Finish shall be Kynar 500 with color selected by the Engineer from a minimum of four color samples which shall be provided by the contractor.

All trim and flashings shall be of the same materials and finish as the batten roof systems and panels and custom formed to suit the project requirements.

(I) ROOF DRAINS AND ACCESSORIES:

(1) Roof drains shall be Zurn Crown Z-100 ERC or equal, 4", with cast-iron body and metal dome. These drains shall have a minimum 2" adjustable height and be provided with an underdeck clamp.

(2) Downspout nozzles shall be Zurn Z-I99, Smith 1770, or equal. All metal nozzle with wall flange, 4".

(3) Cast iron parapet scupper sleeves shall be Zurn Z-198 or equal. An aluminum bird screen shall be bolted in front of the flashing ring.

(J) WOOD:

Wood shall be Douglas Fir, White Fir, or Ponderosa Pine pressure treated in accordance with AWPA Standard C. All wood shall be construction grade or better if fir and No. 2 dense or better if pine.

(K) ROOF INSULATION:

The roof insulation shall be tapered Foamglass Board as manufactured by Pittsburgh Corning Corporation of Pittsburgh, Pennsylvania, or equal, secured with mechanical fasteners as approved by Factory Mutual and as follows:

(1) Thickness - 1 1/2", minimum.
(2) Thermal Conductivity - 0.32, ASTM C518.
(3) Compressive Strength - 100 psi, ASTM C165, C240.
(4) Water Absorption (Volume %) - 0.2, ASTM C240.
(5) Cant Strips: Foamglass as approved for roof insulation.

(L) BUILT-UP ROOFING:

(1) Built up roofing shall consist of four-ply felts, gravel surfaced, asphalt saturated roofing felt on tapered foamglass insulation and shall be UL Class A.

(2) The roofing membrane system manufacturer's recommendations for components of roofing materials, not listed in this Specification, shall be complied with.

(3) The roofing membrane system shall be Manville Roofing System Division Specification No. 4GIG; Celotex Roofing Products Division Specification No. AGS-P-4-F-G; Gafglas Built-Up Roofing Specifications No. NN-1-0-4-G; or approved equal, and meeting the following requirements:

(a) Flat Roofing Asphalt: ASTM D312, Type II.

(1) Softening point range in accordance with ASTM D36.

(2) Minimum flash point in accordance with ASTM D92.

(b) Tarred Felt: ASTM D226, Type I.

(c) Asphalt Glass Felt: ASTM D2178, Type IV.

(d) Steep Asphalt: ASTM D312, Type III.

(e) Surfacing Gravel: 1/4" to 3/4" crushed stone, ASTM D1863.

(f) Plastic Cement: FS SS C-153, Type I, PC88 adhesive.

(g) Flashing Material: To match roofing material as follows:

Manville Specification No. FE-I(LB)
Celotex Specification No. AB-20 PLUS
Gafglas Specification No. 1

(4) Counter Flashing: Type MA Springlok flashing as manufactured by Fry Reglet Corporation of Alhambra, California, or approved equal. AISI Stainless Steel Type 302.

(5) Traffic Pads: Size 12"x24"xl/2", preformed slab or plank consisting of asphalts, fibers and fillers as manufactured by Manville Corporation or approved equal.

(6) Roof Curb: Model CRC-5 as manufactured by Custom Curb Company of Chattanooga, Tennessee, or approved equal with similar appearance.

(M) WALL INSULATION:

Wall insulation shall be rigid board insulation as manufactured by Dow Chemical Co., Inc. or V.C. Industries, Inc. Insulation shall be formed, extruded polystyrene with a minimum compressive strength of 20 psi and a minimum density of 1.6 PCF. Thermal conductivity shall be 0.20 (K-value at 75F), vapor transmission shall be 0.75 perm-IN. maximum and water absorption shall be 0.3% maximum. Insulation shall have integral high density skin. Manufacturer's recommended standard sealant and mastic shall be used.

(N) DOORS AND FRAMES:

The hollow metal doors and frames shall conform to the U.S. Department of Commerce, Bureau of Standards simplified practice recommendations CS-242 for hollow metal single acting swing doors. Frame and trim shall be in accordance with the details shown on the project plans. The metal doors and frames shall be the product of one of the following manufacturers or approved equal.

- CECO Corporation, Oakbrook, Illinois 60521
- Pioneer Industries, Carlstadt, New Jersey 07072
- Curries, Mason City, Iowa 50401

Metal doors, frames and hardware shall be fabricated as follows:

(1) Frame:

(a) General:

Hot rolled, pickled and oiled carbon steel, conforming to ASTM A569, zinc-coated, not lighter than 16 gauge.

(b) Fire Rated:

(1) U.L. Labeled.
(2) Comply with NFPA 80.

(2) Anchors: Zinc-coated steel not lighter than 16 gauge for floor anchors and 18 gauge for all other anchors.

(3) Doors:

(a) General:

Cold rolled, low carbon, pickled and oiled and stretcher leveled sheet steel conforming to ASTM A366. Zinc-coated, not lighter than:

(1) Face Sheet: 18 gauge.
(2) Internal Stiffeners: 18 gauge.
(3) Sound deadening as recommended by door manufacturer.

(b) Fire Rated

(1) SDI Grade III, Model 3 or 4, Full Flush, Seamless.
(2) Galvanized Per ASTM A525, G 60
(3) U.L. Fire Labeled.
(4) U.L. Fire Labeled pairs without astragal.
(5) Clip, Bolts, Screws, Rivets: Stainless steel, sized as recommended by the manufacturer.
(6) Metallic Filler: FS TT-F-322.
(7) Zinc Coating: ASTM A525 Coating Designation G60.

(a) Wipe coat galvanized steel is not acceptable.

(8) Phosphate Treatments: FS TT-C-490.

(9) Primer: Per manufacturer's recommendation.

(10) Finish Coat: Shall be a baked-on urethane enamel; visual match to color chip number 26120 of Federal Standard No. 595-A.

(11) Hardware:

(a) Hinges: 4 1/2 x 4 1/2 standard weight, two ball bearing, solid stainless steel, US32D with non-removable pins, as manufactured by Stanley, Hager, Lawrence, or approved equivalent, except as noted.

(b) Locksets: Corrosion resistant mortise locks with 3/4 throw US32D, as manufactured by Sargent (8100 Series), Russwin (3000 Series), Yale (8000 Series), or approved equivalent, FSFF-H-06106 B Series.

(c) Cylinder: Removable core cylinder US32D. All cylinders shall be manufactured to fit a template key that will be provided by the Engineer.

(d) Closers: Primed, Sargent (154 Series), LCN (4010 Series) or approved equivalent.

(e) Automatic Door Bottom: CECO No. 370N or equal.

(f) Door Stops: Stainless steel and rubber tip type, as applicable.

(g) Astragali: CECO 4441 overlapping astragali attached to active leaf.

(h) Provide flush bolt at bottom to the inactive leaf of double door.

(O) ROLLING STEEL OVERHEAD DOORS:

The rolling steel overhead doors shall be the product of one of the following manufacturers or approved equal:

- Cookson Corporation
- North American Overhead Door
- Overhead Door Corporation

Rolling steel overhead doors and frames shall be fabricated as follows:

(1) Doors

(a) Doors shall be ASTM A526 with neoprene weatherproofing.

(b) Insulated Door Slats

(1) 2 5/8 IN high-flat profile with interlocked backing
(2) 22 GA exterior

(c) All exterior doors shall be insulated to a minimum value of 0.76.
(d) All exposed parts shall be factory prime painted.

(e) Electrical safety edge shall be furnished.

(f) Hood shall use air baffle weatherstripping.

(g) Guide sealing weatherstripping shall be provided at jambs.

(h) Weatherstripping shall be supplied in galvanized steel frame at Lintel.

(i) Maximum air infiltration shall not exceed 1CFM/FT of perimeter as measured by ASTM E283.

(2) Frames

(a) Frame shall be mounted to interior face of wall.

(b) Frame finish shall match door.

(P) STEEL GRATING:

Steel grating shall be Borden grating type W/B as manufactured by Borden Metal Products Co., Elizabeth, New Jersey or approved equal.

Grating shall be of the depths indicated on the drawings and fabricated in accordance with the National Association of Architectural Metal Manufacturers (NAAMM). Minimum bearing bar thickness shall be 3/16 inch.

The cross bars shall be welded or pressure locked to bearing bars. Top edges of bars shall be serrated to provide slip resistance.

Grating shall be galvanized with a minimum of 1.5 ounce per square foot zinc coating.

Ends and perimeter edging shall be banded. Openings through grating shall be located at joints between adjacent grating sections. Openings shall be reinforced to provide required load carrying capacity.

Clips and anchor bolts shall be galvanized.

(Q) LOUVERS:

Wall louvers shall be Model LE-49-1 Extended Sill Option, as manufactured by American Warming and Ventilating, Inc. of Maumee, Ohio, or approved equal meeting the following requirements:

(1) Frame: .081" extruded aluminum 6063-T5 alloy/per "Aluminum Association Standard and Data Book".

(2) Blades: .081" extruded aluminum 6063-T5 alloy/per "Aluminum Association Standard and Data Book".

(3) Finish: Shall be Amergard gloss enamel for exterior metal surfaces by American Warming and Ventilating Inc.; color shall be a visual match to color chip number 26120 of Federal Standard No. 595-A.

(4) Screen: 1/2 mesh .063" aluminum in an extruded aluminum frame secured to the interior face of louver with stainless steel screws. Screen shall be removable from louver for cleaning.

(R) ACCESS PANEL:

The access panel shall be Inryco/Milcor Style M-Standard, as manufactured by Inryco, Inc. of Deerfield, Illinois, or approved equal, similar in appearance and quality, meeting the following requirements:

(1) Frame: 16 gauge steel.

(2) Panel: 14 gauge steel.

(3) Hinges: Concealed spring type opening to 175.

(4) Lock: Key operated mortise cylinder with interior latch release mechanism as shown on the plans. All locks to be manufactured to fit a template key provided by the Engineer.

(5) Anchor: Factory attached masonry anchor.

(6) Finish: Prime coat shall be a baked on electrostatic powder. Finish coat shall be a baked on enamel and a visual match to color chip number 26120 of Federal Standard No. 595-A.

(S) SECURITY SCREEN, SECURITY GRILLE, AND SECURITY GATE:

The security screen, the security grille, and security gate indicated on the Plans shall be Orsogril Sterope type as manufactured by A&T Iron Works, Inc. of New Rochelle, New York, or approved equal, similar in appearance.

The security screen, grille, and gate shall be fabricated from ASTM A36 Steel and welded by means of electrofusion. The screen and grille components shall be as follows:

(1) Framing Bar: 31/32" x 5/32".

(2) Vertical Bars: 31/32" x 1/8" @ 2 7/16" O.C.

(3) Horizontal Tie: 3/16" @ 5 3/16" O.C.

(4) Coating: These materials shall be PVC coated accordance with Section 902 of these Special Provisions. The color shall be a visual match to match that of Paint No. 26120 of Federal Standard 595-A.

(5) Bolts and Nuts: Anti-thief, 3/8" diameter x 1", stainless steel.

(6) Padlock with two (2) keys shall be provided for the security gate.

(7) Bird Screen: 1/2" mesh, 0.063 aluminum in extrude aluminum frame secured to the Security Gate Grill with stainless steel nuts and bolts. Screen shall be removable for cleaning.

(T) METAL ENTRY GATE AND END CLOSURES:

The metal entry gate and end closure shall be manufactured from ASTM A36 steel with square pickets and a 10 gauge tubular frame. All joints and contact points shall be full welded except for brace bar contact with pickets which shall be tack welded only. Complete mounting hardware and anchors shall be provided. Fabricated gates and end closures shall be PVC coated in accordance with Section 902. The finish coat color shall be a visual match to color chip number 26120 of Federal Standard No. 595 - A.

(U) SAFETY LADDER AND REST PLATFORM:

Safety ladders shall be Climbers Buddy Fiberglass Climbing System as manufactured by Swager Communication, Inc., of Angola, Indiana, or approved equal, and shall comply with OSHA 1910.27, complete with all mounting hardware, clamps, plates, angles, etc., as shown on the plans and meeting the following requirements:

(1) Ladder: Fiberglass ANSI A-14.5

(2) Safety Sleeve: Alloy 6061-T6 cast aluminum, per "Aluminum Association Standard and Data Book" with stainless steel pins and rollers.

(3) Mounting Hardware: Standard ANSI Type 304 S.S.

(4) Safety Belts: Standard 2 D-ring safety belt and harness; four required. The belts shall be stored by attaching them to the ladder with snap hooks or other method as approved by the engineer.

The rest platform shall be fabricated in accordance with the details as shown on the plans, with the following materials:

(1) Support frame, MC 7 x 17.6, ASTM A36 steel, hot-dip galvanized.

(2) Gratings: Reliance Steel Product Company's Electro-Pressure Welded Construction, Type IR4, McNichols Co., or approved equal with 1" x 3/16" bearing bars spaced at 1 3/16" centers and 1/2" x 3/16" cross bars spaced at 4" centers. Wearing surfaces of bearing and cross bars shall be serrated. Grating shall be hot-dip galvanized after fabrication.

(3) Railing and Gates: 1-1/2" diameter galvanized steel pipe, ASTM A120, Schedule 40.

(4) Bolts and Nuts: ASTM A307, Grade A, galvanized unless otherwise specified.

(5) Miscellaneous Steel Plates: ASTM A123; galvanized.

(6) Galvanizing: ASTM A386.

(V) THERMAL AND MOISTURE PROTECTION, AND MISCELLANEOUS MATERIALS:

Thermal and moisture protection, and miscellaneous materials shall comply with the following requirements:

(1) Vapor Barrier: 6 mil. polyethylene, ASTM D4397.

(2) Damp-Proofing: Asphalt primer and asphalt mop coat, Section 907.

(3) Waterstop: P.V.C. Waterstop, Subsection 1011-2.

(4) Rungs: Gray casting, ASTM A48, Class 30B, Subsection 1004-6.

(5) Preformed Expansion Joint Filler: Subsection 1011-6.

(6) Caulking and Sealant: Polysulfide sealant, Fed. Spec. TT-S-00230C.

(7) Caulking Back-Up Material: Untarred oakum, polyurethane or polyethylene foam; color to match adjoining materials.

(8) Reinforced Concrete Pipe: Subsection 1010-6.

(9) Fire Extinguisher, Portable: shall be Halon 1211, UL listed and FM approved rated 3A80 BC, 17 pound content. Fire extinguisher shall be wall mounted with galvanized or painted brackets at the location shown on the plans.

(W) SHEET METAL:

(1) Generator exhaust plenums: 20 Ga reinforced galvanized sheet metal with access doors of equal gauge.

(2) Flexible plenum connections: Neoprene Coated flameproof fabric per UL 131.

(3) Ductwork: Galvanized ductwork, ducts with largest side to 30 IN shall be 0.05 IN thick; ducts with largest side greater than 30 IN shall be 0.08 IN thick. All ductwork shall meet or exceed SMACNA HVAC Duct Construction Standards for minimum of 2 IN water gauge L-1 type Pittsburgh lock. Contractor shall have two alternates for Transverse joints. Alternate A: SMACNA T-22 companion flange gasketed. Ducts with largest side or diameter to 30 IN: SMACNA Class D (1-1/2 x 1-1/2 x 1/8 IN angles). Ducts with largest side or diameter greater than 30 to 60 IN: SMACNA Class H (2-1/2 x 2-1/2 x 3/16 IN angles). Alternate B: Galvanized angels, corners, snaps and drives. Gaskets shall be closed cell neoprene and stainless steel

bolts. Sheet metal screws shall be self-drilling stainless steel with unthreaded section under head. Bolts shall be Rigidity Class 75 SMACNA Class H with 3/8 IN Dia. x 1 IN. There shall be a minimum of four bolts on each joint of 0.04 IN roll formed angles with integral seal and 0.10 IN on corners.

(X) ROOF HATCHES:

Roof hatches shall be aluminum,. factory fabricated Dur-Red products, Model EH, sized as indicated on plans with 12" high curb. Lids, curb and curb frame shall be aluminum, fully welded and ground smooth for absolute weather tightness; completely assembled with "heavy-duty" aluminum hinges, lid to have 1" fiberglass insulation, protected by a 20 Ga. lid liner, curb frame with rigid fiberglass typical four sides, fiberglass protected by metal corners; painted with two coats of zinc dust primer. Lid hardware shall have two point universals spring latch; inside, outside automatic hold-open and operating arms, with red vinyl handle grip; and bulb-neoprene seal.

Sump pump shall have hatch inside engine room in addition to hatch on roof. Engine room sump pump hatch shall be steel diamond pattern plate bolted to floor as shown on plans. Engine room sump pump hatch shall be gasketed to provide completely air tight seal between wet well and engine room.

(Y) FIBERGLASS GRATING (BAR SCREENS)

(1) REFERENCE STANDARDS

American Society for Testing & Materials (ASTM)

ASTM D 790	Flexural: Used to establish load and deflection data.
ASTM D 2583	Hardness (Barcol): Per resin manufacturer's specifications.
ASTM C 581	Chemical Resistance: Using Grating sample.
ASTM E 84	Surface Burning: To establish flame spread rating.

(2) SUBMITTALS

a. Product Data:

Submit manufacturer's published literature for specific products and accessories as applicable, including manufacturer's specifications, physical characteristics, performance data and installation recommendations.

b. Experience:

Proof that the grating manufacturer has produced this grating product for at least five years and has successfully used product for similar facilities in this industry (pump stations, municipal water/wastewater treatment plants, etc).

c. Product Sample:

The approved submittal sample shall become the standard for acceptable workmanship for the order.

d. Shop Drawings:

Shop drawings for the fabrication and installation of the grating.

e. Field Support:

Name, address and telephone number of manufacturer or manufacturer's representative who will provide field support.

(3) 3. MATERIALS

a. Grating shall be fiberglass roving reinforced thermoset plastic, constructed to provide thorough wetting of the glass by the polyester resin. The resin shall be CP-84, a chemical grade thermoset resin. The grating shall be made in a mold and of single piece construction so the reinforcing glass of the bearing bars are interwoven with the glass of the cross bars. Resin content will be 60% to 70% and fiberglass 30% to 40% by weight in the reinforced portion. The tops and bottoms of the bearing bars and cross bars shall be in the same plane. The grating shall be translucent to enable inspection for defects, air bubbles and thorough glass wetting, and the absence of fillers.

b. If reduced flame spread is required, the grating shall be molded from a premium grade halogenated resin producing a Class 1 flame spread below 25 and a fuel contribution of zero (0) when tested in accordance with ASTM-E-84. Filler content (any material which is not resin or fiberglass) shall be a maximum of 5% by weight of grating.

(4.) 4. DESIGN

a. The grating grid pattern shall be as indicated on the drawings with a minimum thickness of 1". Bearing bars (horizontal) shall be 1 1/2" on center. Cross bars shall be 6" on center. Grating shall be suitable for a uniform load of 50 pounds per square foot with a 1% deflection when supported a 4'-0" on center. Grating shall have a minimum open area of 65%.

b. Tolerances: The height shall be a minus zero and plus 0.060" of nominal bar height. Bearing and cross bar widths ± 0.010". Bars shall be ± 0.010" of nominal position relative to the neighboring bar and + 0.030" of true position: That is, build-up of tolerances shall not exceed 0.030". Mismatch between bottom surface of crossing bars not to exceed 0.020". Bottom and inside corners radius approximately 0.015". Surfaces shall be smooth.

c. Provide grating in 4'-0" x 4'-0" sections as shown on plans. Grating for end sections of bar screens shall be cut to shapes as required and edges finished smoothed.

(5.) 5. EXECUTION

a. INSPECTION:

Inspection of the grating is authorized and can be made at the manufacturer's plant, and/or the fabricator and/or the job site. Grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, de-lamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish with an average of not over four surface pits per square foot of surface area, with no pits exceeding 1/8" diameter, or a 1/32" depth.

b. PRODUCT HANDLING & STORAGE:

i. Store grating on pallets and cover. Do not top load. Separate each piece with a non-scratching spacer.

ii. Protect from damage. Avoid sharp or impinging loads such as chain slings. Do not drag panels across one another unless separated by a non-scratching spacer.

iii. Sand and re-surface coat any scratches, crushed or chipped edges or cuts required in the field.

c. INSTALLATION:

i. Perform all installation in accordance with the drawings and the approved submittals.

ii. Check supporting structurals for correct layout and alignment. Verify that support surfaces are free of debris. Check measurement of grating to determine fit.

iii. Tolerances of cuts and of fitting panels shall be ± 1/8".

iv. Field-cut or sanded surfaces shall be coated with resin furnished by manufacturer and applied in accordance with manufacturer's instructions.

v. If contractor performs additional tasks which may damage the installed grating, the contractor is responsible for covering the grating with plywood, or other suitable protective material.

506-2.03 CONSTRUCTION REQUIREMENTS:

(A) CONCRETE STRUCTURE:

All work to be performed under this subsection shall comply with the following Sections of the Standard Specifications:

(1) Earthwork: Section 203
(2) Concrete Work: Section 601
(3) Reinforcing Steel: Section 605
(4) Staining: Section 601

All interior concrete wall surfaces shall have smooth troweled surface finish. All honeycombs larger than 1/4 inch shall be filled with patching mortars.

(B) MASONRY:

General installation procedure shall be as follows:

(1) Dirt, debris, oil, grease and other foreign substances which would affect bond of mortar shall be cleaned from all surfaces to receive mortar.

(2) Wall shall be layed out to establish accurate spacing of bond pattern to ensure uniform joint widths and to locate openings, movement type joints, returns and offsets.

(3) Units shall be arranged in a manner which will result in as few unit cuts as possible.

(4) Masonry units shall be cut and fit in a manner which shall not damage the unit faces. All cuts shall be made with a masonry saw.

(5) Concrete masonry unit shall be layed dry. Blocks shall be layed to special pattern, where indicated, other blocks shall be layed using running bond.

(6) Continuous wall reinforcement shall be installed in accordance with the manufacturer's installation instructions and placed in alternate horizontal masonry joints as indicated. Reinforcement shall lap not less than six inches and, at corners and intersections, connect to prefabricated special shape reinforcement. Splices shall be made in a manner which will not carry reinforcement across control, isolation or expansion joints.

(7) Vertical reinforcement shall be installed where indicated and in poured grout studs which are formed by the vertically aligned cells of the unit masonry.

(8) Control joint filler shall be installed where indicated and in accordance with the manufacturer's installation instructions.

(9) Mortar and grout shall be placed within one hour after mixing. Mortar shall be placed on unit bearing surfaces in a manner such that the unit being installed is bonded to the bearing surface next below, and to the surface of the previously installed unit in the same course as the unit being installed; furrowing of mortar shall not be permitted. Mortar shall be packed under and around joint reinforcement before the unit is installed.

(10) Lintels shall be reinforced using special lintel blocks over head openings where indicated on the Plans. Fill lintel with concrete and reinforce with steel rods. Provide at least 7-5/8 inch bearing at ends.

(11) Joints shall be tooled concave and retooled after initial set. Concrete masonry units of uniform thickness shall be used. The joint between masonry and steel members shall be finished with sealant material and backing. Control joints shall be raked out 3/4 inch deep and finished with sealant material. Defective joints shall be raked out the full depth and patched with mortar to match adjacent joints.

(12) Masonry work shall be cleaned thoroughly. All installed unit masonry and mortar surfaces shall be left clean and free of mortar stain and other defacement.

(13) Concealed flashings shall be provided in masonry work as indicated on the plans. Wall flashing shall be placed as indicated on the plans. Wall flashing on bed of mortar and cover with mortar, penetrations in flashing shall be sealed with mastic before covering with mortar.

(C) STRUCTURAL STEEL:

Erection of structural steel shall be in accordance with Subsection 604-3 and the AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings.

Installation of the Versaroof framing system, mansard roof, and metal roof deck shall be in accordance with manufacturer's recommendation, and the applicable portion of Section 604 and the AISC Specifications.

(D) METAL ROOF DECK:

General installation procedure shall be as follows:

(1) Install roof deck in accordance with manufacturer's instructions and final approved shop drawings.

(2) Do not start placement of roof deck units until all supporting members are installed complete. Locate deck bundles to prevent overloading of structure.

(3) Place each deck unit on supporting structural members, adjust to final position, accurately align with ends bearing on supporting members.

   (a) Lap units at ends no less than 2 inches.
   (b) Do not stretch or contract side-lap interlocks.
   (c) Place units in accurate and close alignment for entire length of run.

(4) Secure deck units to supporting frame and at side laps as follows:

   (a) At end, intermediate and side perimeter supports: 5/8 inch diameter plug welds at 12 inch center to center.

   (b) At side laps provide 3/8 X 1-1/4 inch arc seam weld at 24 inches on center.

(5) Plug weld size is the effective fusion diameter of the weld. Weld metal shall penetrate all layers of deck material at end and side laps and have good fusion to supporting members.

(E) STEEL ROOF JOISTS:

General installation procedure shall be as follows:

(1) Install joists in accordance with manufacturer's instructions, the Steel Joist Institute Specifications, as herein specified, and as shown on the plans and on the approved Shop Drawings.

(2) Field weld joists to supporting steel framework in accordance with Steel Joist Institute Specifications for type of joists to be installed and as shown on the plans.

(3) Secure joists resting on masonry bearing surfaces by bedding in mortar and anchoring to masonry as specified in the Steel Joist Institute Specifications for type of joist to be installed and as shown on the plans. Masonry to support joists shall reach the required 28-day compressive strength prior to placing joists thereon.

(4) Place joists on supporting work, adjust and align in accurate location and spacing before permanently fastening in place. Provide end bearing and anchorages to secure joists to supporting members or walls in accordance with the Steel Joist Institute Specifications and as shown on the plans. When joists do not bear flush on supporting member or wall, take corrective measures to ensure full bearing. Provide steel shims as required for uniform flush bearing.

(5) Provide type, size, spacing and attachment of bridging in accordance with the Steel Joist Institute Specifications where not indicated otherwise on the plans. Completely install bridging immediately after joist erection before any loads are placed on the joists. Provide bridging connections at top and bottom chords of each joist capable of safely resisting the force specified in the Steel Joist Institute Standard Specifications for type of joist to be installed. Anchor ends of bridging lines to perimeter walls as indicated on the drawings.

(6) During construction, the contractor is responsible for any loads placed on joists. Contractor's attention is directed to the fact that joists may be unstable and cannot carry their design load until the steel deck and bridging are completely installed.

(F) ROOFING:

The built-up roofing shall be installed by an installer approved by the manufacturer of the roofing system and as specified below:

(1) Inspection: Do not proceed with the application of built-up roofing system until all defects have been corrected, which would prevent the execution and quality of application as specified.

(2) Preparation:

(a) Prepare deck and other surfaces to be smooth, dry, clean and free of projections that might damage the felts. Allow the deck to dry thoroughly before application of roofing.

(b) Give ample notice to other contractors whose work is related to the built-up roofing work so that they have ample opportunity to introduce, finish or locate embedded items before the built-up roofing work is placed.

(c) Install roof drains, scupper and prefabricated mechanical equipment roof curbs.

(3) Application:

(a) Insulation:

Install insulation in accordance with the manufacturer's installation instructions.

Install layers of insulation using approved mechanical fasteners, and mopping.

On metal decks, edges paralleling ribs shall bear on solid upper surface.

(b) Built-Up Roofing:

Install in accordance with manufacturers instructions and as specified below:

Provide thermostatic control and visible thermometer on kettle, and maintain in working order and keep calibrated.

Maximum Bitumen Temperature: 25 degrees below flash point of bitumen (by ASTM D-92).

Equivalent Temperature Range: The temperature at which a viscosity of 125 centistokes is attained, plus and minus 25 degrees F.

Minimum Rate of Application shall be:

- Over Insulation: Minimum uplift resistance of 40 pounds per square foot solidly mopped.
- Between Felt Layers:~ 20 pounds per 100 square feet.
- Top Pour Coat: Approximately 70 pounds per 100 square feet.

Solid mop bitumen under and between felts in a manner which shall prevent layers from touching layers and in a manner which shall create a continuous coating of bitumen. Lap base felts four inches at side and six inches at ends. The tarred felt plies shall be lapped 27 1/2 inches.

Lay felt parallel to the long dimensions, and either broom or press into the bitumen in a manner which will create tight and smooth laminations having no blisters, air pockets, wrinkles, buckles, kinks and other defects. Brooming distance behind felt laying shall not exceed six feet. Extend felts up face of cant and vertical surface a minimum of six inches.

(c) Aggregate Surfacing:

Install pour coat and aggregate surfacing in accordance with the manufacturer's recommended installation procedures.

Apply a uniform pour coat of hot bitumen over surface at not less than 70 pounds per 100 square feet.

Apply a uniform layer of aggregate surfacing to all areas except those to receive roof walkways at the rate of 400 pounds per 100 square feet.

Roll with a light roller, if necessary, to embed aggregate into hot pour.

(d) Roof Walkways, Preformed Planks:

Install preformed planks, Manville J-walk or equal,in accordance with manufacturer's recommendation and instructions.

(4) Certification:

After the roofing system has been installed, the Contractor shall require the roofing manufacturer to inspect and certify that the roofing system has been furnished and installed in accordance with the roofing manufacturer's materials and installation procedures, and approved modifications. A copy of the certificate shall be furnished and filed with the Engineer.

(G) WALL INSULATION:

Rigid Board Insulation with Stud Strips:

(1) Install rigid board insulation continuously on interior surfaces of exterior walls.

(2) Install one 1-1/2 IN thick course.

(3) Set in adhesive troweled over entire substrate.

(4) Make all joints tight. Stagger joints of second course.

(5) Neatly cut and fit insulation at corners, penetrations, connections, etc.

(6) Seal all joints with sealant applied continuously to edges of pieces before installation, or apply sealant bead continuously to joint after installation.

(7) Seal penetrations or connections which remain exposed after insulation is in place and cover with minimum 1 IN thick foamed-in-place silicone for a distance of 6 IN each side.

(8) Install stud strips vertically at 16 IN on center.

(9) Press back of channel flush with face of insulation.

(10) Fasten stud strips to substrate thru insulation with mechanical fasteners recommended by manufacturer. Space fasteners at maximum 12 IN on center.

(H) DOORS AND FRAMES:

(1) Fabrication: Doors and frames which are cut, reinforced, drilled and tapped at the factory to receive all template hardware, in accordance with ANSI Standard A-115 Series, as applicable shall be provided. The doors and frames shall receive surface applied hardware with reinforcing plates only by drilling and tapping mounting holes for surface applied hardware in the field. Reinforcing plates for hardware of not less than the gauges and sizes listed in commercial Standard CS242 shall be provided; welding hinges to door frames shall not be permitted. Rust inhibitive paint shall be provided for touch-up. Special construction to accommodate the mortisied door bottom shall be provided.

(2) Installation:

(a) Frames shall be set accurately in position plumb, aligned and braced securely until permanent anchors are set. The bottom of the frames will be anchored to floors with expansion bolts or with power fasteners if required. Build-in wall anchors shall be used to secure to adjoining construction as indicated. Backfill frames shall be built into masonry construction as wall construction proceeds.

(b) Doors shall be hung where indicated and in a manner which will ensure smooth and easy operations, and which will eliminate binds, warps and squeaks. Adjust and lubricate hardware to operate properly. Fully seat screws and fasteners.

(c) Hardware shall be installed in accordance with manufacturer's instructions.

(d) Prime and finish coat touch-up shall be applied immediately after installation: sanding, smoothing and touching up with same primer and finish as applied at the factory, all rust and all areas where finish coat has been damaged shall be carefully done. Touch up shall not be obvious.

(I) OVERHEAD ROLLING STEEL DOOR:

Overhead rolling steel door shall be installed in accordance with manufacturer's instructions.

(J) MISCELLANEOUS FABRICATED ITEMS:

Security gate and enclosures, screens, grille, hatches, safety ladders, gratings and platforms shall be fabricated and installed in accordance with the respective manufacturer's standards. Complete mounting hardware shall be provided in accordance with the manufacturer's recommendations when not shown on the plans.

(K) STEEL GRATING:

General installation procedure shall be as follows:

(1) Attach grating to end and intermediate supports with manufacturer's standard galvanized steel clips and bolts.

(2) Maximum connection spacing shall be 2 feet on center with a minimum of 2 connections per support.

(3) Attach individual units of grating together with clips or bolts at 2 feet on center with minimum of 2 connections per side.

(L) THERMAL AND MOISTURE PROTECTION:

The following materials shall be provided for thermal and moisture protection:

(1) Provide 6 mil polyethylene vapor barrier between the base and slab of the pump station where indicated on plans.

(2) Provide P.V.C. waterstop for all construction joints as indicated on the plans.

(3) All concrete walls and wall footings exterior, below final grade, shall receive one coat of asphalt primer and one coat of asphalt mop coat in accordance with Subsection 907-3 of the specifications.

(M) PAVEMENT, CURB AND GUTTER, SIDEWALKS, FENCE AND GATES:

All pavement, sidewalks, curb and gutter, fences and gates shall be constructed to the cross-section and details, and at the location shown on the plans in compliance with the following referenced sections of the Standard Specifications.

(1) Clearing and Grubbing: Section 201
(2) Earth Work: Section 203
(3) Subgrade: Section 301 or 302

(4) Aggregate Bases: Section 303
(5) Asphaltic Concrete: Section 406
(6) Asphaltic Concrete Friction Course: Section 407
(7) Security and Metal Entry Gates: Subsection 506
(8) Concrete Curbs, Gutters, Sidewalks: Section 908
(9) Masonry Block Fence : Subsection 506
(10) Pipe (RGRCP): Section 501

NOTES: a) The aggregate base shall be class 1.

b) All security gates will be lockable with a padlock in the closing mechanism. Padlocks and keys as approved by the Engineer shall be provided for each gate.

(N) PAINTING

This work shall conform to the applicable portions of Section 610 of the Standard Specifications, and shall comply with the requirements of the following table. Where the products of certain manufacturers are listed, equivalent products of other manufacturers will be accepted. The contractor shall submit paint specifications and color chips of the paints he proposes to use. The Engineer will accept or reject the material and will select the colors from those submitted from acceptable material. Colors will be selected to comply with OSHA, "Safety Color Code for Marking Physical Hazards."

Surface	Prime Coat	Finish Coat
Main pump columns and discharge pipes	Shop paint, see pump specs	Touch up damage areas with compatible coal-tar epoxy
Interior D.I. pipe and C.I. fittings	Tnemec 66-1211 Epoxoline primer 3 mils or Detroit Graphite 167 Poly/EP Primer 2 mils	Tnemec 66-color, Hi-build Expoxoline-2 coats, 4 mils each, or Detroit Graphite 9328 Rock/Tar Epoxy 2 coats, 5 mils each
Interior Galvanized pipe and fittings including railings and galvanized steel door and door frames	Tnemec 66-color Hi-Build Epoxoline 4 mils or Degraco Vinyl washcoat No. 91138	None or Detroit Graphite No. 37120 Hi-Build Vinyl 2 coats 4 mils

Surface	Prime Coat	Finish Coat
Exterior of buried concrete structures	Tnemec 461-1-413 Hi-Build Tnemec-Tar, 16 mils, or Detroit Graphite No. 9329 Moisture/Guard Bituminous Black 2 coats, 1.5 mils each	None
Interior masonry walls	Tnemec 54-660 Masonry filler, 100 sq. ft./gal. or Valspar 59402 sealer and Detroit Graphite 90046 Block Filler 1 coat, 8 mils	Tnemec 66-color Hi-Build Epoxoline 4 mils or Detroit Graphite 4100 series Metal/Crylic, 2 coats 2.5 mils each
Exterior Concrete	Standard Concrete Paint, Desert Sand 3318, or as approved by Engineer, in accordance with ADOT Stored Spec. Paint 601	Standard Concrete Desert Sand Paint, 3318
Exposed steel work, not galvanized, including doors	Shop paint, touch-up	Epoxy or Acrylic enamel compatible with shop paint 1 coat, 4 mils
Electrical cabinets and enclosures	Shop paint, touch-up	Tnemec 66-color, Hi-Build Epoxoline, 4 mils, or compatible substitute or Epoxy or Acrylic enamel, compatible with shop paint, 1 coat, 4 mils
Sump Pump	Shop paint, touch-up	Tnemec 66-color, Hi-Build Epoxoline, 4 mils, or compatible substitute or Epoxy or Acrylic enamel, compatible with shop paint, 1 coat, 4 mils

506-3 PUMP STATION EQUIPMENT AND CONTROLS:

506-3.01 DESCRIPTION:

The work under this subsection shall include the furnishing of all labor, materials and equipment for the installation of a complete coordinated pumping system and shall consist of but not be limited to the following:

(A) Pumps
(B) Drive Engines
(C) Control Equipment
(D) Motor Control Center
(E) Battery System
(F) Emergency Generator
(G) Fans
(H) Fuel Storage and Dispensing System
(I) Roof Hatches
(J) Foam Fire Protection Equipment

The total system shall be coordinated to provide matched pumps, pump shafts, right angle gear drives, drive shafts, drive engines, motor and controls. All disciplines including mechanical, electrical, and structural shall be coordinated to provide a complete system in accordance with the specifications.

The completed pump station shall be capable of pumping a minimum of 200 cfs of storm water at a TDH of (43') with the sump pump out-of-service.

It is the intent of this specification that the contractor shall furnish, install and place in successful operation a comprehensive automatic Pump Control and Protective System.

The systems shall be designed to operate under the following environmental conditions:

Altitude: 1200 feet above sea level
Room Temperature: 20 F. Minimum - 150 F. Maximum
Relative Humidity: 5% - 95%

The pumping station is designed to provide efficient pumping of storm water using constant-speed pumps. Particular care shall be taken to assure flexibility and allow alternate pump combinations and that each pump will be provided with its full complement of protective auxiliaries.

All of the motor control equipment and automatic control equipment shall be supplied by one manufacturer. It shall be factory assembled, wired, tested and covered by complete electrical drawings and operation and maintenance instructions.

Any system varying from these specifications as to results achieved will not be accepted.

The pump control operation shall be based on wet well level sensing utilizing two level sensing probes for each pump.

All necessary components and circuitry shall be provided to make the monitoring/protective/alarm sub-systems of each pump and associated equipment complete and operational. These shall include moisture-sensing and winding temperature-responsive systems as required where each condition shall be displayed and abnormal condition alarms or shut-down indicated by an appropriate light and remote alarm system actuation. All pump sensing-elements associated with such sub-systems shall be specifically approved by the pump manufacturer to make the equipment warranties fully effective. A separate contact for each pump, indicating pump on, pump called for and pump failure shall be provided as an input to the radio communications link.

A wet well level-responsive automatic pump control system shall be furnished and installed which optimizes available wet well storage capacity by using a multi-step pump operation. The pumps engines shall be operated on an additive and subtractive basis based on wet well level.

506-3.02 MATERIALS:

(A) MOTOR CONTROL CENTER:

The motor control center shall be manufactured, assembled, wired and tested at the factory in accordance with the latest issue of NEMA Publication ICS 2, Part ICS 2-322, for industrial Controls and Systems. The vertical sections and the individual units shall bear a UL label, where applicable, as evidence of compliance with UL standard 845.

The motor control center shall be suitable for operation on 480 volt, 3 phase, 3 or 4 wire, 60 hertz system having a short-circuit capacity as determined by utility company based on service size.

Wiring shall be NEMA Class II, Type B.

Enclosures shall be NEMA Type 1.

Vertical sections shall be constructed with steel divider side sheet assemblies formed or otherwise fabricated to eliminate open framework between adjacent sections or full-length bolted-on side sheet assemblies at ends of the motor control center.

The vertical sections shall be 90" high excluding mounting sills, 20" wide and 20" deep for front mounting of units. The motor control center shall be supplied, as standard, with 1-1/2" high x 3" wide channel sills which are continuous for the entire length of each shipping split. Mounting sills shall be constructed of 7 gauge steel suitable for welding to leveling plates or securing to the floor with four 1/2" anchor bolts at each vertical section.

The main horizontal bus shall be rated 600 amperes.

Vertical bus shall be rated 300 amperes.

All bus shall be copper, completely tin plated and with a conductivity rating of 100% International Annealed Copper Standard (IACS).

A copper ground bus shall be provided for the full length of the motor control center and a vertical ground bus which is solidly connected to the horizontal ground bus shall be provided in each vertical section. The vertical ground bus shall have provisions for connecting the equipment ground conductor at the associated unit location.

All painted parts shall undergo a phosphatizing prepaint treatment for rust resistance and a satisfactory paint bond. Vertical sections doors and cover plates shall be painted inside and out with one coat of light gray enamel, ANS 49 light gray. Bus support angles, control unit back plates, and top and bottom unit barrier plates shall be given one coat of white enamel. All paint shall be applied by the electro-static process and baked to a durable, hard-finish.

The motor control center(s) shall contain the following as a minimum:

1 - Combination reduced voltage solid-state starter with motor circuit protector for a 200 HP motor, UL listed.

The motor starter shall be solid-state containing three pairs of inverse parallel semi-conductor rectifiers (SCR's) with electronic control. The starter shall provide smooth and soft starting with an adjustable current limiting feedback control of the phase control SCR's. A solid state 3 phase overload relay to monitor all three phases of load current shall be provided. An overload condition shall automatically de-energize the starter and light a TRIP and a START INHIBIT LED indicator. On each starter an instantaneous magnetic trip only, motor circuit protector, (MCP) shall be furnished for each motor. The MCP shall be sized to allow continuous full load operation of the motors and shall be equipped with a shunt trip.

A shorting contractor shall be furnished to by-pass the solid state starter for across-the-line operation. The contractor shall be operated by a timer set to operate when motor obtains full load speed.

A shorted SCR device shall be incorporated into the controller to prevent and shutdown motor operation via the MCP shunt trip and at the same time cause a Light Emitting Diode (LED) indicator on the front of the controller to light.

Engraved laminated plastic nameplate having black letters on white backgrounds shall identify major components, vertical sections and breakers. Vertical sections shall have letters 3/8" high; other lettering shall be a minimum of 3/16" high. Nameplates shall be attached with screws.

The motor starter shall be furnished with the following components:

- Control power transformer with primary and secondary fuses
- Interlocking logic
- AC Ammeter, 2% accuracy
- Running time meter in hours with mechanical memory

The 480 volt power for the motor control center shall be from an electric utility company or from one (1) engine generator set described later in these specifications. The motor control center shall also contain other devices, as indicated on the drawings.

(B) PUMP CONTROL OPERATION:

Control operation of Storm water pumps P-1, P-2, P-3, P-4, and P-5 when the pumps are in automatic mode of operation, shall be accomplished at pump station main control panel. Transfer plugs shall be provided to allow for lag-lag combinations of pumps P-1, P-2, P-3 and P-4. Pump P-5 shall remain in the lead position. Level Controller shall start and stop lead, lag and lag-lag pumps. Refer to "Level Control Diagram" in drawings for additional information on start-stop operation of pumps.

In the case of a low water level, storm water pumps will shut down when level switch senses the wet well level has reached a prescribed level and shall shut pumps P-1 through P-4 off in a first-on/first-off sequence and lock them out to prevent rapid start/stop cycling in case of low water level at the pump suction.

In case of power failure the 24V battery system, then the stand-by generator shall insure that the control power is uninterrupted.

Hand-off automatic switch located at central control panel shall allow operator to manually start and stop engine drive for pumps P-1 through P-5. Selection of automatic position shall interlock pump and allow automatic operation of pump from level switches in pump station wet wall. Provide adjustable time delay relay for pump to prevent immediate restart after pump has shut off.

(C) INTERLOCKING LOGIC:

Interlocking logic for storm water pumps P-1 through P-4 shall be as follows when pumps are operated in automatic mode:

(1) Level Controller actuates lag pump start sequence for pumps P-1 through P-4.
(2) Engine warm-up cycle is started.
(3) Engage clutch to operate pump at engine low idle speed.
(4) Engine full-load cycle is started.
(5) Level Controller actuates pump stop sequence.
(6) Engine slows down disengaging clutch.
(7) Engine in cool down cycle (5 Min.) then shuts off.

Sequence of operation for storm water pumps will be as follows when pump is operated in manual mode:

(1) Hand-off-automatic switch is manually turned to hand position.

(2) Steps 2 through 4 are same for manual mode sequence of operation.

(3) Hand-off-automatic switch is manually turned to off position, disengaging pump from engine and placing engine in cool-down cycle.

(D) ELECTRODE TYPE LEVEL CONTROL:

The control relay shall be an intrinsically safe relay with high contact ratings, rated to operate at 24 volts DC. It shall be mounted on a high-strength, die cast baseplate. The coils shall be wound on nylon bobbins and shall be epoxy encapsulated. The contacts shall be fully enclosed, bridge double break type with 1/4-inch diameter silver cadmium oxide buttons. The contact combinations shall be as shown on the plans.

If more contacts are needed than are provided with the standard manufactured arrangement, an auxiliary relay with suitable contacts shall be provided.

The contact ratings shall be 16 amperes at 115 volts AC and 8 amperes at 230 volts AC; one horsepower at 115 and 230 volts AC.

The relay shall be for direct operation only with contacts assuming normal positions with open electrode circuit.

All structural parts shall be high mechanical and dielectric strength, dimensionally stable, arc resistant thermosetting phenolic plastic.

The primary winding shall be rated for the AC supply line shown on the plans, plus 10 percent minus 15 percent at a frequency of 50/60 hertz. It shall draw 4 watts and 15 volt-amperes maximum with short-circuited electrode circuit.

The secondary voltage for the electrode circuit shall be 220 to 300 volts AC nominal, with open-circuited electrode circuit; the circuit shall draw 6 volt-amperes with short-circuited electrode circuit. The sensitivity shall be 7,000 ohms-cm.

The spacings shall be for 600 volts minimum; they shall be 1/2-inch for creepage across surfaces and 1/4-inch through air.

The unit shall be capable of operating in ambient temperatures ranging from 0 degrees F to +150 degrees F. It shall be U.L. listed. It shall be housed in a NEMA 1 enclosure if it is to be installed in a heated and protected indoor location; it shall be housed in a NEMA 4 enclosure in other locations, unless specified otherwise on the Plans.
The terminals shall be numbered. They shall use Size 8 panhead screws with captivated wire clamping plate. They shall be located on the front of the unit. The relay shall be Series 7 as manufactured by Charles F. Warrick Company; or equal.

Electrodes shall be rigid 303 stainless steel rods, 1/4- inch diameter and length as shown on Plans. They shall be threaded at one end to fit the electrode holder threads and insulated with a 1/32-inch polyvinyl chloride sheath down to 1 inch from their other end.

They shall be Warrick Series 3R, or equal.

(E) FLOAT SWITCH:

A low level alarm float switch(s) shall be installed as shown on the plans. The float shall be AISI type 316 stainless steel, with a mercury switch inside and flexibly supported by a PVC jacketed heavy-duty cable. It shall be installed in accordance with the manufacturer's recommendations.

The float switch shall have a 20 amp. rating at 115 V AC. The float cable shall be submersible type with three #14 AWG fine-stranded copper conductors. The float shall be mounted as shown on the plans using AISI type 316 stainless steel hardware.

The float switch shall be furnished with its own intrinsically safe relay which shall be mounted in a NEMA 4 enclosure located as shown on the plans. The float switch shall be furnished with such accessories as are required to perform the specific control and alarm functions for this application.

The float switch shall have a three year factory warranty.

(F) PUMP STATION CONTROLLER CABINET:

The mounting and wiring of the control system shall be provided in a dustight, NEMA 12, painted steel enclosure.

(G) DESCRIPTION OF CONTROL AND MONITORING DISPLAY:

(1) General:

The system shall be provided with pilot lights to display the system status and push buttons to reset alarms.

(2) Wet Well Level:

The monitor lights shall include the various wet well levels as read by the wet well level probes.

(3) Pump Status:

Pump status lights shall show information relevant to each pump. The pump status shall show "Running", "Off", or "Failure". Lights shall show the pump selector switch position: "Hand", "Off", or "Auto" and shall indicate the pump's position in the alternator sequence when it is selected for automatic operation. When a pump is not in automatic, or when it has failed, it shall be removed from the alternator sequence, and the other pumps shall be resequenced to replace it.

(4) Pump Control:

During normal operation, pumps shall start and stop in response to the actual wet well level. When the wet well level falls below or is equal to the pump stop set-point level, the designated pump shall stop.

Pump designation is the operational order assigned to each pump. Pump designations are Lead, Lag 1, Lag 2, Lag 3, and Lag 4. For lag pumps the designations shall be manually assigned.

Pump No. 5 shall be designated permanently as the Lead Pump. Pump No. 1, Pump No. 2, Pump No. 3 and Pump No. 4 shall be capable of being assigned to operate in a sequence as manually selected.

Pumps selected "Off", running in "Hand", or failed pumps shall not be included in the pump sequence. The remaining pumps shall be controlled as described above.

Pumps shall be started and stopped after delays as programmed into the timers and as power is available to run the called for pump.

(5) Ventilation Control:

Wet well make-up air vent and exhaust fan No. 3 shall be energized by light switch when wet well is occupied. See DETECTION OF GAS IN WET WELL and SMOKE DETECTORS for further interlocks.

Exhaust fans EF-1 and EF-2 shall be staged to be energized depending on the temperature in the space. EF-1 is to be energized when temperature in the space reaches 90F (adjustable). EF-2 is to be energized at 95F (adjustable). The reverse shall happen when the temperature is declining.

See DETECTION OF GAS IN ENGINE ROOM and SMOKE DETECTORS for further interlocks.

Exhaust fan EF-4 and IH-1 motor operated damper shall be energized whenever the stairwell is occupied. See DETECTION OF GAS IN GENERATOR ROOM and SMOKE DETECTORS for further interlocks.

Supply fan SF-1, See SMOKE DETECTORS for control.

Terminal air conditioner TAC-1 shall have built-in controls for heating and cooling.

(H) PUMP CONTROL MODULES:

A pump control door module shall provide status/alarm indication and hand-off-auto selection for each pump. These modules shall include:

(1) One amber "call" lamp (LED)

(2) One green "pump running" lamp (LED)

(3) One red "pump failed" lamp (LED)

(4) One three-position, hand-off/reset-automatic selector switch that will call for the pump when it is in either the "hand" position or the "automatic" position and the automatic control system is calling for the operation of the equipment in the manner as herein described.

(5) One "High Temperature" lamp (LED)

(6) One "Seal Failure" lamp (LED)

Power for the LED lamps shall be obtained from the control power transformer.

Conditions that cause an alarm and actuate a remote outdoor red beacon are, but are not limited to:

	Description	Quantity
1.	Level	
a.	High level alarm	1
2.	Pump failure	
a.	Over temperature	5
b.	Seal failure	5
c.	Lack of flow	5
3.	Engine failure	
a.	Over Crank	4
b.	Over Speed	4
c.	Low Oil Pressure	4
d.	High Water Temperature	4
e.	Low Battery Voltage	4
f.	Fuel Level in Tank	2
g.	Battery Charger Failure	4
h.	Low Water Level in Radiator	4

4.	Standby Generator	
a.	Reverse Power	1
b.	Under Voltage/Frequency	1
c.	Failure to Synchronize	1
d.	Circuit Breaker Trip	1
5.	Combustible Gas	
a.	Wet Well Warning	1
b.	Engine Room Warning	1
6.	24V battery system	
a.	Battery charger Failure	1
b.	Low Battery Capacity	1
7.	Security System	
a.	East Doors	2
b.	West Doors	3
8.	Utility Power Failure	1
9.	Fire	1
10.	Wet Well High Temp	1

Conditions that actuate a remote outdoor flashing amber light are, but are not limited to:

1. Pumps operating

A door mounted pilot light shall be provided to indicate pump seal failure alarm condition of each pump. These lights shall be operated by a contact closure from each pump.

Signal conditioning, setpoint, control, alternation, logic function, transducer, alarm and all other control cards used in the control system shall be performed by solid-state modules which shall be standard catalog items of the system manufacturer, with proven field performance. At least one module of each type used in the system shall be stocked by the system supplier for replacement parts purposes. The modules shall be of compatible, integrated control family with a full range of control/protective/alternation/ telemetry capabilities and associated housings, enclosure system and appurtenances to perform a variety of functions as required by this project. It is the intent of this specification to disallow nonstandard equipment.

A normally "Open" contact which will "Close" upon pump failure, regardless of cause, shall be provided for each pump. Two normally open contacts (high level alarm, transducer and float switch) which close at high wet well levels shall be provided. These contacts shall be wired to a terminal strip in the pump control module and shall be connected to the interface terminal cabinet.

A pump exercise timer shall be provided in the pump control module. During exercise of the engine the pump shall be automatically operated for a period no greater than 30 seconds. Only one pump shall be operated at a time during the exercise period. An "Off-Auto" switch shall be provided for exercise cycle.

(I) ENGINE DRIVEN STANDBY GENERATOR SET:

(1) General:

The engine-generator shall be the product of an engine manufacturer, regularly engaged in the manufacture of generator plants. The set and all controls shall be built and tested by the engine manufacturer precluding divided responsibility. The plant shall be tested at the engine manufacturer's facilities. Certified test reports of the complete assembly shall be available from the engine manufacturer showing the plants power rating, voltage and frequency regulation, and other pertinent data.

(2) Generator:

Generator shall be direct connected, fan cooled, AC revolving field type, single bearing, with brushless exciter and damper windings. The Telephone Influence Factor and Deviation Factor shall be within NEMA MG-1.22. The generator rating shall be as shown on the project plans at ambient conditions stated, at 1800 rpm, 480/277 volts, 3 phase, 4 wire Wye, 60Hz. Insulation material shall be NEMA Class H. Temperature rise shall be within NEMA standards, (80 degrees C.) for continuous duty. Generator shall be rated at 0.8 power factor, and shall be mounted on the engine flywheel housing and shall have a multiple steel disc flexible coupling drive.

The generator shall be equipped with a 250/300 hz permanent magnet generator excitation system. Both the PMG and the rotating brushless exciter shall be mounted outboard of the bearing. The system shall supply a minimum short circuit support current of 300% of the standby rating for 10 seconds. The rotating exciter shall use a three phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multi-plate selenium surge protector.

(3) Generator Voltage Regulator:

The regulator shall be solid state with no voltage build up or other relays acceptable. The unit shall be encapsulated for humidity and abrasion protection. The regulator shall include true volts per hertz operation with adjustable cut in, loss of sensing shutdown, overexcitation shutdown with inverse time characteristic, three phase RMS sensing, and provisions for parallel operation.

The voltage regulation shall be + 1/2% from no-load to full load and 5% frequency variation. Regulator drift shall be less than 1% per 72 F(40 C) ambient temperature change. The voltage regulator shall be a static-type using nonaging silicon controlled rectifiers, with radio interference suppression to MIL-STD-461B, part 9.

Voltage dip shall not exceed 20% upon application of full continuous rated load at 0.8 PF with recovery to steady state band conditions within 1.5 seconds as measured on a light beam recorder.

The wave form harmonic distortion shall not exceed 5% total RMS measured line to line at full rated load. The Telephone Influence Factor (TIF) shall not exceed 50.

The contractor shall confirm the size of the generator and type of voltage regulator to function properly with the solid state reduced voltage starter and pump motors provided.

(4) Torsional Analysis:

It shall be certified that a mathematical torsional analysis has been made of a like combination of engine and alternator to insure that torsional stresses in the system at any speed below 1900 RPM shall not exceed 2500 PSI. The torsional analysis shall be confirmed by an electronic torsiograph test on a similar unit at the manufacturer's test facility.

(5) Factory Testing:

The assembled equipment shall be tested at the manufacturer's regular place of business to insure the proper operation of the individual components, subassemblies, and the complete assemblies, and to eliminate any electrical and mechanical defects. Tests shall be made at 150 F.

Test steps shall be performed while the set is delivering 50% and 100% of its specified KW rating at .8 power factor for two hours and shall include a test while the set is delivering 110% of its standby power rating for two hours.

The following engine parameters shall be read and recorded at 15-minute intervals throughout the test.

- Engine Oil Pressure
- Engine Oil Temperature
- Engine Exhaust Temperature at Exhaust Manifold
- Engine RPM - Maintain a constant 1800 RPM
- Jacket Water Temperature In and Out
- Fuel Consumption
- Ambient Air Temperature

The following checks shall be included:

Functioning of the high-temperature coolant circuit safety device by restricting cooling system capability.

Overspeed shutdown device. Record speed at which over-speed trip operates, must be set to operate at no more than a 10% overspeed condition.

A certified copy of the test data shall be provided to the Engineer prior to shipping.

(J) GENERATOR CONTROL PANEL

(1) Structure:

The enclosure shall be made from 14 gauge sheet steel. Construction shall be of the formed and welded design provided with barriers and stiffeners to form a solid unitized assembly. Suitable means of lifting shall be provided.

All equipment bases shall be fabricated with an adequate number of anchor bolt holes designed to put the base in direct contact with the concrete pad when bolted.

All doors shall be pan type, 12 gauge sheet steel, and be provided with sufficient concealed hinges and stiffeners to support the door and components for an absolute minimum deflection and wobbling when opening or closing. Doors must operate more than 90 degrees.

(2) Layout:

All equipment shall be arranged in a logical manner to facilitate ease of operation and maintenance of the equipment. No meters or switches shall be located above 6'-0" from the finished floor.

(3) Paint:

The complete assembly shall be thoroughly cleaned and treated prior to painting. The unit shall be painted ANSI-61, light gray with 2-part epoxy base paint suitable for indoor or outdoor locations.

(4) Wiring:

Control wiring shall be copper 600 volt, 90-C switchboard type SIS, minimum size No. 14. Solderless compression type connectors for terminating all wires shall be used. Current transformer circuit terminations shall be ring tongue type. Other circuits may be ring or spade type applied with the proper tool. Control wires shall be numbered on both ends with adhesive wire markers applied next to the terminals with the number visible. The low level signal circuits shall be separated and provided with shielded wire to minimize electromagnetic cross talk and interference. Shielded wires shall be grounded at the device only.

Grommetted holes shall be provided between each of the vertical sections to allow control wiring to pass through. Wiring shall not be spliced and shall be free of abrasions and tool marks. The wires shall be neatly laced up and harnessed, and shall be supported to prevent sagging or breakage from weight or vibration. Wiring bundles shall be contained in covered metal or plastic gutters.

All wiring to hinged doors shall be run through door terminal blocks. Terminal blocks shall be provided for all external connections and they shall be readily accessible in an area not exposed to hazardous bus or cables.

(5) Nameplates:

Engraved laminated plastic nameplates having black letters on white backgrounds shall identify major components, vertical sections and breakers. Vertical sections shall have letters 3/8" high; other lettering shall be a minimum of 3/16" high. Nameplates shall be attached with black anodized screws.

(6) Safety:

Components shall be enclosed within grounded metal enclosures.

Barriers shall be provided to isolate major components as provided by ANSI C37.20. All connections shall be terminated in accessible areas.

Warning labels shall be provided with "DANGER 480 VOLTS" for all access areas to power circuits.

(7) Locks:

Front doors shall be supplied with a lockable handle. All door locks shall be keyed alike to operate from a single key, and one key shall be supplied for each lock. Full height doors will utilize three point latches with roller cams to secure the door firmly when closing.

Keyed interlocks, when required, shall be supplied with one key in each required lock. One extra spare key of each type shall be supplied separately, tagged as: "Spare, store in a safe place to prevent bypassing interlocks."

(8) Generator Low Voltage System Circuit Breaker:

The low voltage 600V class switchgear with system circuit breaker shall be designed, built and tested in accordance with UL Standard 891.

(9) Generator Section:

Device numbers listed below are "American Standard Device Function Numbers".

Each unit shall contain the following devices:

1 Generator main circuit breaker of the molded case type, 200 amp frame, electrically operated, with auxiliary contacts (2a and 2b) and solid state overcurrent and short circuit trips. Trip units shall have adjustable long delay, short delay, ground fault and instantaneous trip settings.
2 Potential transformers, with primary and secondary fuses, 0.3% accuracy.
3 Current transformers, 0.3% accuracy rated at 600V.
1 Ammeter with 250 degree scale, 1% accuracy, 200 amp range.
1 Control power transformer with primary and secondary fuses, 0.3% accuracy.
1 Voltmeter with 250 degree scale, 1% accuracy, 600VAC range.
1 Frequency meter with a 250 degree scale of 55-65 hertz, 1% accuracy
1 Kilowatt meter with 250 degree scale, 1% accuracy.
1 Power factor meter with 250 degree scale of .5-1.0-.5 PF, 1% accuracy.
1 Circuit breaker control switch .
1 Ammeter phase selector switch.
1 Voltmeter phase selector switch.
1 Engine control switch.
1 Undervoltage relay, Device 27.

1 Frequency relay, Device 81.
1 Automatic engine cranking assembly with alarm and shut down modules.
1 Enable/Disable 12 V DC latching relay controlled by radio communication link (Motorola).

(10) Governor/Regulator and Accessories:

The following equipment shall be installed in the switchgear:

1 Voltage regulator
1 Voltage adjust device
1 Electric governor control module

(11) Annunciations and Shut Downs:

The following alarms shall be provided and displayed on the generator control panel and shall perform the listed functions:

SHUTDOWNS AND LIGHT INDICATIONS	LENS COLOR
Under Voltage/Frequency	Red
Circuit Breaker Trip	Red
Low Oil Pressure	Red
High Water Temperature	Red
Overspeed	Red
Overcrank	Red
Low Water Lever in Radiator	Red

LIGHT INDICATION ONLY	LENS COLOR
Battery Charger Failure	Amber
Not in Auto	Amber
Circuit Breaker Open	Green
Circuit Breaker Closed	Red

(12) Unit Sequence of Operation:

Upon receiving a remote signal, the controls shall cause the unit to start and come up to full speed and voltage. The unit shall assume load to the bus.

Upon receiving a stop signal, the unit will open its circuit breaker and run unloaded for an adjustable cool down period. The unit shall then stop and be ready for additional re-starts.

(13) Auxiliary Section:

The auxiliary section of the generator shall contain the following components:

(1) Automatic transfer switch rated at 480 volt, number of poles and size as shown on the plans. The transfer switch shall have the following features:

(a) The transfer switch shall be mechanically held and electrically operated by a single-solenoid mechanism.

(b) A minimum withstand current rating of 42,000 amperes at 480 volts.

(c) Close differential relaying protection on normal with pickup voltage adjustable from 85 percent to 100 percent of nominal and dropout voltage adjustable from 75 percent to 98 percent of the pickup value.

(d) Time delay to override momentary normal source outages, adjustable from 0.5 to 6 seconds.

(e) Time delay on retransfer to normal source, adjustable from 0 to 30 minutes.

(f) Time delay on transfer to emergency, adjustable from 0 to I minute.

(g) Two auxiliary contacts, one normal closed when transfer switch is connected to utility (normal) source and one normal closed when transfer switch is connected to generator bus. Contacts shall operate green and red signal lights on switchboard to indicate transfer switch position.

(14) Sequence of Operation/Automatic Transfer Switch:

If the voltage of any phase of the normal utility source falls below 85% and when the generator voltage reaches 90% and the frequency reaches 95% of their respective ratings, the load shall be transferred to the generator source after a preset time delay.

When the normal utility source has been restored to 90% of its normal voltage a time delay function shall be initiated on retransfer to the normal utility source. This is to insure that the normal source has become stabilized for an acceptable period of time before reassuming the load. If, during this timing period, the normal utility source voltage should fall below 85%, the time delay shall be reset to zero and start timing again from the beginning of the time delay period upon restoration of normal voltage to the pickup value.

If the generator source should fail during the retransfer timing period, the time delay shall be bypassed and the transfer switch shall immediately restore to the normal utility source.

(15) Testing:

The generator switchgear shall be factory tested to simulate a complete and integrated system. The circuit breaker supplied shall be installed in its actual position and electrically and mechanically tested. A narrative of the system operation shall be provided and shall be utilized when testing the equipment. Copies of the test reports shall be submitted to the Engineer.

The following separate tests shall be performed on the switchgear:

- Dielectric Test (Per ANSI C 37.20, 5.3.1)
- Mechanical Test (Per ANSI C 37.20, 5.3.2)
- Grounding of Instrument Transformer Case Test Per (ANSI C 37.20, 5.3.3)
- Electrical Operation and Control Wiring Test (Per ANSI C 37.20, 5.3.4.1)
- Control Wiring Insulation (Per ANSI C 37.20, 5.3.4.2)
- Polarity Test (Per ANSI C37.20, 5.3.4.3)
- Sequence Test (Per ANSI C37.20, 5.3.4.4)

All equipment shall be installed under the direct supervision of the manufacturer's representative.

(K) 24V BATTERY SYSTEM:

The 24V battery system shall be rated at 150F and shall consist of a battery charger, batteries, inverter, battery cables and accessories. Under normal power conditions, the battery charger shall be sized to provide power to the load and at the same time be able to completely recharge discharged batteries within 12 hours. Upon failure of the normal power source, the batteries shall continue to supply power to the system load for a minimum of 24 hours.

The system load is defined as the rated continuous load on the inverter at all times. Load calculations shall be submitted to the Engineer as part of the shop drawing submittal.

The battery charger shall be a completely automatic two-rate solid state, constant voltage type having ac voltage compensation, with dc voltage regulation, automatic surge suppressors, current limiting protection, and complete isolation of AC input from DC output.

Each battery shall be sized to compensate for an operating maximum ambient temperature of 150 degree F and normal power output depreciation over the life of the battery.

(L) MIXED FLOW PUMPS

The pump shall consist of a vertical shaft, single stage propeller type pump, directly connected to a right angle gear drive. Pumps shall be designed to operate safely in reverse direction of rotation, due to water returning through pump. The weight of revolving parts of pump, including unbalanced hydraulic thrust of propeller, shall be carried by a thrust bearing in driver. Pumps shall be supported from base plate by means of vertical column having a horizontal surface discharge located as shown on the plans.

Each pump shall have increasing head characteristics from first design condition to third design condition. Each pump curve shall extend across the entire range of system head curves. The combined pump curve with two pumps operating shall also extend across the entire range of system head curves. The curve shall be continually rising across the combined pump range.

Pumps shall be provided with net positive suction head requirements (NPSHR) less than the net positive suction head available (NPSHA) at all operating conditions, water elevations and piping arrangements shown on plans and specified.

Pumps shall be provided with operating speed such that no cavitation or appreciable vibration occurs throughout the entire operating range. Pumps shall operate at specific speeds which are within the limits prescribed by the Standards of the Hydraulics Institute for all conditions of head and submergence involved.

Pumps shall be designed to operate under the following performance and design requirements:

(1) Design condition: 50 cfs at 42.75' TDH with a minimum efficiency of 80%.

(2) Secondary condition: 48 cfs at between 43' c.d 46' TDM with minimum efficiency of 80%.

(3) Maximum pump speed: 880 RPM.

(4) Minimum solids passage: 4-1/2 inch.

System coordination. The pump manufacturer shall provide the following data which shall be used by the engine manufacturer to run a torsional analysis:

(1) Pump WR2.
(2) Pump impeller.
(3) Pumping unit (including gear) center of gravity.
(4) Pumping unit (including gear) natural frequency.

Reference standards:

(1) HI - Hydraulic Institute Standards for Centrifugal Rotary and Reciprocating pumps.

(2) ASTM - American Society for Testing and Materials.

(3) AISI - American Iron and Steel Institute

(4) ANSI - American National Standard Institute.

Testing.

(1) Tests shall be conducted in accordance with Hydraulic Institute Standards.

(2) All test results shall be certified by a registered professional Engineer or Officer of the Company.

A shop performance test shall be run on each pump at full speed. A performance curve showing head, capacity, efficiency and brake horsepower shall be prepared and forwarded to the Engineer. Each bowl assembly and discharge head shall be hydro-statically tested to a minimum of 45 PSI and maintained for a minimum of 30 minutes. A copy of the test report shall be signed by a registered professional Engineer or Officer of the Company and submitted for approval prior to shipment.

Discharge elbow shall be provided with plain round end with cross bolt lugs to accommodate connection to the discharge pipe with a restrained flexible compression coupling. Discharge elbow shall be long-sweep type consisting of at least four (4) mitered welded steel sections of forged cast iron. Adequate lifting lugs shall be provided on discharge elbow. Discharge elbow must be suitable for supporting angle gear drive.

Pumping unit shall be suspended from steel base plate of adequate thickness to support weight of complete unit including pump and right angle gear drive. The base plate shall be large enough to cover the opening in floor which shall be large enough to permit withdrawal of complete pumping unit. Base plate shall be gasketed to provide air tight seal between engine room and wet well.

Packing box shall be located on or above base plate. Base plate shall be integral part of discharge elbow or column pipe.
Suction bell and pump bowl shall be constructed for easy removal of propeller and bearings. Suction bell shall be furnished as flared inlet designed with vanes to support lower guide bearing. Minimum bowl wall thickness shall be equal to minimum column pipe wall thickness.

Propellers of the mixed-flow vane design, capable of passing a 4-1/2 IN. solid. Leading edges of vane shall be rounded to prevent accumulation of fibrous material. Propeller shall be statically and dynamically balanced to limit vibration and support propeller on both sides with bearings for stability.

Shaft of the pumping unit shall be of ample size to operate without objectionable distortion or vibration in both forward and reverse direction of rotation. Driver shaft shall be designed for adjusting propeller with reference to bowls.

Pump shall be designed with main bronze bowl bearing immediately above propeller, and a lower bronze bearing below propeller. Bearing of grease packed design shall be used below propeller .

Line shaft bearings shall be provided that are easily replaceable, and spaced to provide adequate support for shaft and prevent vibration. Lineshaft bearings of bronze construction shall be used and installed in bearing retainers. Bypass parts to drain excess oil from shaft enclosing tube shall be provided.

Enclosing tube shall be provided to protect lineshaft, support lineshaft bearings and contain oil lubricant required for lineshaft discharge bowl connector bearing. Interchangeable sections of uniform length not to exceed 6 FT shall be provided. Machine and thread ends internally to receive connector bearings. Bottom section of shaft enclosing tube shall be directly connected to discharge bowl connector bearing. Means in discharge head for tension loading at enclosing tube shall be provided.

Pump shaft shall be designed to transmit drive torque. Pump shaft shall be designed in accordance with ANSI-B58.1. Propeller shall be attached to pump shaft with longitudinal keyways and annular keyway with snap rings to prevent axial movement.

Oil lubrication system shall be provided for each pump, with solenoid operated lubricating system to supply lubricant to lineshaft bearings. Metal oil reservoir shall be provided for each pump with minimum capacity of two gallons. Suction bowl bearing with waterproof grease lubrication shall be provided.

Enclosing tube, shaft and column for propeller pumps shall be of same length. Material specifications shall be satisfied as follows:

Description	Material	Specification
Column pipe	Steel	ASTM A283-Grade D
Discharge head	Cast iron or steel	ASTM A48-Class 30 or ASTM A283 Grade D-A120
Bowls	Cast iron	ASTM A48-Class 30
Bowl bearings	Bronze	ASTM B505-(932)
Propeller	Bronze	ASTM B145-(836)
Lineshaft	Steel	AISI-1045
Lineshaft bearings	Bronze	ASTM B505
Enclosing tube	Steel	ASTM A120
Pump shaft	Stainless steel	ASTM 1582-Class 416
Suction bell	Cast iron	ASTM A48-Class 30
Diffuser cone	Cast iron	ASTM A48-Class 30

Provide head/gear adapter to locate right angle gear input shaft at elevation shown on drawings.

Provide a solid top shaft sized to transmit a minimum of 350 H.P. Provide couplings with solid bodies and flanged ends. Use keys and snap rings to transmit torque and connect top shaft to pump and gear shafts. Size shaft to operate at 75 percent of half critical speed. Provide intermediate stabilization if required.

The pumps shall be the standard manufactured items of the manufacturer who shall have similar type pumps installed and operating in the United States for a period of no less than 5-years.

The pump manufacturer shall warrant the units being supplied to the Department against defects in workmanship and material for a period of five (5) years or 10,000 hours under normal use, operation, and service. The warranty shall cover parts and labor and shall be in printed form and apply to all units.

(M) DRIVE ENGINES

Engines shall be provided complete with all ancillary equipment and including, but not limited to, engines, power takeoffs, clutches, pumps, starting systems, radiator cooling system and valves, exhaust piping and mufflers, air compressors, air separators, controls, switchgear and other necessary ancillary devices required for a complete and compatible automatic system.

Insure equipment service and replacement parts are available within a 50 mile radius of Phoenix. Engine manufacturer shall have had distributor in Phoenix area for a minimum of 5-years.

(1) Quality Assurance

The following Standards shall be referenced:

(1) National Fire Protection Association (NFPA) NFPA 37 - Stationary Combustion Engines and Gas Turbines

(2) National Electric Code (NEC)

(2) Submittals

Torsional analysis of engine and driven equipment shall be submitted to insure no critical or half critical frequencies are encountered.

Engine power output curve superimposed on driven equipment power curve shall be submitted to insure ample starting and operating power throughout the engine speed range.

Full details for performing engine tests shall be submitted. Upon completion of testing prepare and submit final results along with all data.

Full design of each system with full isometric drawings showing major elements, piping, supports, and auxiliary appurtenances shall be submitted. Complete 1/2 IN per FT scaled drawings, plan and sections, showing complete details of proposed piping, supports, valves, fitting and appurtenances shall be submitted. Specific access for portable hoist and equipment required for complete engine servicing and overhaul shall be shown.

A complete review of each cooling system including radiator, piping, flexible connection, supports, and anchors, heat rejection capacities and related items for cooling system shall be performed. A certified manufacturer's statement that the complete system has been reviewed, and is compatible with the engine supplied shall be submitted.

Copies of NFPA-37 - Stationary Combustion Engines and Gas Turbines shall be submitted.

Dimensions and coordination of units and support equipment shall be submitted.

(3) Operating and Performance Requirements

Engines, controls and accessories shall be provided rated for the following operating conditions:

Elevation	1200 FT above MSL
Diesel Engine Combustion Air Temperature	150 degF (max.) 20 degF (min.)
Relative Humidity	5% - 95%.
Fuel Supply	No. 2 Diesel fuel
Enclosures	NEMA 12

Diesel Engine combustion air temperature shall be defined as the temperature of the air inside the engine room as measured at the carburetor inlet to the engine.

Performance: Net output rating shall be established at end of driveshaft under specified operating conditions with necessary accessories operating. Engine shall be rated for diesel fuel as follows:

Maximum engine speed of engine shall be 1200 RPM.

Turbocharged engine of heavy-duty construction, water cooled, multi-cylinder, 4 cycle, designed for cold quick start, capable of delivering full load output to pump shaft, in 10 seconds shall be provided. Engine shall be provided with the following features:

Number of Cylinders	6, 8, or 12
Displacement (min.)	1,000 CU IN
Minimum Net Output Rating	Provide continuous rated engine sufficient to deliver required shaft horsepower to the pump under all specified head and flow conditions. The output rating shall be at least 12 percent higher than the maximum pump shaft horsepower (as specified in Section L) to consider losses through gear drive, and derating for altitude and ambient temperature conditions.
Configuration	In-line or "V"

The engine shall be designed, manufactured and rated for continuous duty operation at a continuous speed of 1,200 RPM without damage to engine components or additional operation of maintenance problems. The continuous duty rating of the engine as used herein shall be the continuous duty torque and horsepower delivery for the specified speed at the site elevation and temperatures and including all driven auxiliaries as specified herein.

The engine shall have replaceable cylinder liners of the wet sleeve type and replaceable valve seat inserts. Crankshaft and connecting rods shall be forged steel. Brake Mean Effective Pressure (BMEP) at rated load shall not exceed 200 PSI.

The engine starting shall be by means of a 24 volt starting motor. Nickel cadmium batteries of sufficient capacity for five, 10-second consecutive crank periods shall be furnished. The battery voltage shall be 24 volt DC. A battery rack and necessary cables and clamps shall be provided. An automatic, two rate battery charger with battery charger failure alarm controls shall be furnished. The battery charger shall be of the solid state design, current limiting, UL listed, complete with voltmeter and power on light. Engine manufacturer shall demonstrate previous experience with providing a 1200 rpm engine at a site with 150 degrees F. temperature conditions.

The diesel engine shall be provided with gear driven fuel transfer pump, day tank, fuel filters, electric solenoid fuel shut-off valve, fuel injection pump and a complete fuel distributing system.

Installation shall be in accordance with local, state and NFPA codes and standards.

The cooling system shall insure that the maximum cooling water temperature is safely within the normal working temperature range when the set is operating continuously at full load at maximum temperature when the diesel engine combustion air temperature is 150 degrees Fahrenheit. The jacket water temperature under such conditions shall not exceed 190 degrees Fahrenheit as measured at the radiator inlet.

An engine mounted, thermostatically controlled engine jacket water heater shall be provided to insure maintenance of block coolant temperature. The heater shall be 3000 watts at 120 VAC, single phase, and equipped with an automatic disconnect when engine is running.

Each water cooled engine shall be provided with a self-contained cooling system of ample capacity consisting of a heavy duty design radiator, a poly V-belt driven radiator blower fan and a centrifugal pump for water circulation, complete with 50% ethylene glycol solution. Radiator fan blades shall be of heavy gauge sheet metal protected against corrosion or of cast anti-corrosion metal. Provision shall be made for fan belt adjustment without interference with the cowl. The radiator assembly shall include a core guard and an air duct flange.

The engine shall be provided with a self contained water cooled exhaust manifold.

A pressure type lubricating system with positive displacement type oil pump, oil cooler and a full flow filter shall be fitted to the engine, complete with engine oil.

The lube oil filter elements shall be of the replaceable element type.

Air shall be induced to the engine manifold through an air cleaner with dry-type elements.

Each engine shall be equipped with a battery charging alternator with solid state voltage regulator.

The engine exhaust line shall be fitted with expansion bellows, a critical type silencer and schedule 40 black steel pipe insulated with 2" calcium silicate and strapped on fabricated aluminum jacket 0.02" thick. Bellows shall be AISI Type 304 stainless steel. A 3/4"-inch capped drip leg shall be provided to collect condensate.

Exhaust shall be in compliance with all city, state and federal requirements.

The actuator shall be of the PSG type.

The engine shall be equipped with automatic safety switches to stop the engine in the following cases:

(a) Water temperature exceeds a preset safe working limit.
(b) Lubricating oil pressure lower than a preset safe working limit.
(c) Speeds exceeding 110%.
(d) Overcrank
(e) Low water level

An engine mounted instrument control panel, NEMA I enclosure with hinged door, shall be equipped with gauges for water temperature, oil pressure, oil temperature, mechanical running time meter, and battery charge rate ammeter.

Relay contacts for remote indicating of the following alarms for each engine shall be provided:

(a) Overcrank
(b) Overspeed
(c) Low oil pressure
(d) High water temperature
(e) Low battery voltage
(f) Low water level

The engine unit shall be mounted on a full sub-base fabricated of structural steel. The engine base shall be mounted on floor mounted Elastomer Mounting System as manufactured by Korfund Dynamics Corporation to minimize vibration transmission to the building. Maximum vibration transmission shall not exceed 6%.

Piping and Valves: Provide piping and valves of minimum size shown on drawings. Include piping and valves on the following systems:

(1) Cooling system: Cooling system piping shall be provided complete with circulating lines, thermostat, expansion tank and radiator.

(2) Fuel system: Fuel system piping shall be provided complete from fuel storage to engine.

(3) Exhaust system: Complete exhaust system including mufflers and piping shall be provided.

(4) Drive Train System

Engines shall be provided with hydraulically engaged power take-off unit for direct connection through a floating drive shaft line coupling to the right angle gear drive on the pump. Clutch engager shall be designed to backoff the clutch after engaging and allow free travel of clutch and shall be as manufactured by Murphy Corporation or approved equal. Floating drive shaft line shall be provided as recommended by engine manufacturer. Basic requirements shall be provided for floating drive shaft on torsional analysis of entire system train to ensure that a critical speed does not exist within the operating ranges. Upon pump selection, engine manufacturer shall furnish a complete critical speed analysis (including both torsional and lateral) for the system train. Pump manufacturer shall furnish necessary data for analysis to engine manufacturer. It is responsibility of engine manufacturer to coordinate various components of power system train, including necessary modifications to drive system in order to provide a satisfactory critical speed analysis and operation. Provide metal guard for floating drive shaft line shall be provided in compliance with OSHA and as shown on plans. Necessary mounting brackets for guard shall be provided as shown on plans.

(5) Controls

Engine controls and electrical system shall be provided as specified and shown on drawings. Engine manufacturer shall be single point of responsibility for furnishing and installing engine control and electrical system located at the engine and engine control panel. Contacts, relays and similar components required to interlock engine controls and pump station controls shall be provided. Engine controls rated for 24 volt D.C. operating current shall be provided. Necessary power supplies and filters to convert 120 VAC, 1 phase incoming power to the engine control panels to the necessary engine control power rating shall be provided.

(6) Fuel Oil Day Tanks

Two (2) diesel fuel day tanks shall be provided and installed as indicated on the plans each having 150 GAL. capacity. Day tanks must be suitable for handling No. 2 diesel fuel. Piping and valving as indicated on plans shall be provided so both engines can be run off of either day tank with the second day tank out of service.

Fuel day tank factory shall be packaged in one self-contained unit, complete with the duplex electric pumps, duplex pump controller, fuel level gauge, overflow, valves, press to test switch, prepiped and prewired. Equipment including pump shall be mounted on top of tank. Tank shall be as manufactured by Tramout Corp, Pryco Corp. or approved equal.

Pumps operated from tank controls to transfer fuel oil from diesel fuel tank to day tank shall be provided and installed. Pump shall be 3 to 4 GPM each, U/L labeled, pressure relief valves 1/3 HP, 120 V, 1 phase motor.

Day tanks shall be coordinated with the following options: Auxiliary hand pump 0.2 GAL/per stroke and 18 feet of lift, duplex fuel strainer 6 IN SQ inspection port, pump check valves, separate float switch, solenoid pump valves, low fuel level alarm switch and two 2 IN OPW-113 vent caps and two 1-1/2 IN OPW-113 vent caps.

(7) Installation:

Rotation direction shall be coordinated with the right angle gear drive and propeller pump.

Complete access to equipment for service and major overhaul shall be insured. Contractor shall coordinate and provide valving, connectors, fittings, piping, supports, and auxiliary appurtenances to allow sectional removal of obstructions which hinder complete and simultaneous access to front, top and both sides of unit with portable floor supported, overhead hoist.

(8) Field Quality Control:

Contractor shall employ and pay for services of equipment manufacturer's field service representative to:

(1) Inspect equipment covered by these specifications.
(2) Perform all adjustments and installation checks.
(3) Run test, including conducting start-up and testing of equipment. For engines 100 hp or greater equivalent, a site run test shall be conducted for a period of not less than 8 hours at full load.

Upon satisfactory completion of start-up, a written statement from manufacturer that each engine is installed in accordance with manufacturer's recommendations, properly started up, tested and is ready for operation by the Owner's personnel shall be secured. Also, certification that required operation and maintenance training has been fully satisfied must be supplied.

(9) Special Requirements:

All uninsulated exhaust piping shall be painted. Flexible exhaust connectors shall not be painted.

(10) Maintenance Program:

A maintenance program shall be provided as specified herein for a period of one year after start-up. The work shall be performed in such a manner as to prevent unnecessary interruption or curtailment of Department's essential activities. Specific schedules shall be negotiated with the Department so as to perform all work during normal business hours (8 a.m. to 5 p.m.) where possible. In the event that a particular maintenance procedure by its nature dictates that it be performed during non-business hours, the supplier shall provide the service at no extra cost to the Department.

Six (6) copies of proposed maintenance program shall be submitted to be reviewed for compliance with specification and approved by the Engineer prior to testing. Detailed electronic diagrams and schematics shall be submitted with engine operations information.

The maintenance program shall consist of procedures as outlined below:

(1) Change engine lubricating oil and oil filters.
(2) Change engine fuel filter.
(3) Clean engine primary fuel filter if equipped.
(4) Change or clean air cleaner element.
(5) Take lube oil sample for analyzing by the atomic absorption spectrophotometry method.
(6) Start engine and check lube oil level and pressure, and coolant level and temperature.

(11) Expendables:

An initial charge of both lubricating oil and ethylene glycol shall be provided.

An ethylene glycol solution of 50 percent ethylene glycol and demineralized, buffered water, premixed by ethylene glycol manufacturer shall be provided.

Contractor shall fill diesel fuel storage tanks with No. 2 diesel fuel prior to testing of engines.

(12) Warranty:

The engines shall be the standard manufactured item of the manufacturer who shall have similar type diesel engines installed and operating in the United States for a period of no less than Five (5) years.

The engine manufacturer shall warranty the units being supplied to the Department against defects in workmanship and material for a period of Five (5) years or 10,000 hours under normal use, operation, and service. The warranty shall cover parts and labor and shall be in printed form and apply to all units.

N. RIGHT ANGLE GEAR DRIVE CONSTRUCTION

Right angle gear drives for engine driven storm water pumps shall be provided as shown on plans. Storm water pumps shall be connected to engine drives as specified elsewhere in these Specifications and shown on plans. Right angle gear drives of the bevel gear type with horizontal input shaft and vertical output shaft, designed and rated in accordance with the latest AGMA standards shall be provided. Drives rated for a minimum 350 horsepower at 1200 rpm and 1.25 service factor and output shaft speed as determined by pump manufacturer shall be provided. Vertical output shaft speed shall be as established by the pump manufacturer and coordinated with the engine.

Output shafts of the solid type, heat treated steel designed to furnish adequate gearing support and proper alignment with minimum deflection shall be provided. Nonreverse ratchets or self-release coupling on each unit shall be provided. Stresses for shafting shall be within limits set by AGMA standards for Shafting, Allowable Torsional and Bending Stresses. Shaft size information shall be supplied to engine manufacturer.

Gears rated according to AGMA 216.01A for durability and AGMA 223.41A for strength shall be provided. Bevel gear efficiency shall be a minimum of 98.5 percent mesh. Gears shall be designed in accordance with acceptable noise levels required in AGMA 295.02. Gears shall have adequate mechanical and thermal ratings to prevent overloading when operating under full load conditions. Gears and pinions shall be manufactured from alloy steel forgoings properly heat treated and/or case hardened. Gears which are finish lapped or ground in matched pairs shall be provided. Input pinion shall be integral with shaft. Larger gears shall be of webless ring type and shall be mounted on rigid cast hubs held by means of heat treated cap screws.

Anti-friction type bearings shall be designed for a minimum B10 life of 20,000 hours. Thrust bearing shall be capable of handling full pump thrust. Tilting pad type thrust bearings or Timken tapered roller type thrust bearings shall be used.

Easily removable shaft seals shall be provided which do not require dismantling shafts and couplings. Seals shall prevent loss of lubricating oil from gear housing and be constructed of material that will not cause excessive shaft wearing.

Positive lubricating system shall be provided to supply oil to mesh and bearings. Self-priming pump shall be provided, and shall be gear driven from lower end of shaft, to furnish positive pumping action at all times. Oil piping and passageways shall be cleaned of mill scale and foreign materials before closing system.

An air-cooled heat exchanger integral with gear for control of oil temperature rise shall be provided. A combination switch and gauge for the monitoring of oil temperatures shall be provided. A gauge with adjustable set point shall be provided for shut down on high oil temperature.

Gear drive shall be enclosed in heavy cast iron or fabricated steel housing. Housing shall be relieved of all internal stresses that would cause misalignment of the gears. Housing shall be designed to be sufficiently rigid to preclude distortion under operating loads and prevent excessive vibration. Gear housing with lifting lugs and inspection openings shall be provided.

Vertical elements shall be supported in common rigid frame, providing adequate support for bearings and enclosing piping as required.

(O) SUBMERSIBLE SUMP PUMP (PUMP #5):

(1) General:

Submersible storm water sump pump shall be furnished as shown on the Plans. The pump shall be fitted with a stainless steel lifting cable and sufficient power cable, seal chamber probe cable and thermal lead cables to permit raising and lowering the pump.

Pump shall be designed to operate under the following performance and design requirements:

(1) Design condition: 9,000 gpm at 49' TDH with a minimum efficiency of 82%.

(2) Secondary Condition: Pump shall be capable of operating at a head range of 35' to 53' with a minimum efficiency of 78%.

(3) Maximum Pump Speed: 600 RPM.

(4) Minimum Solids Passage: 5 inch.

(5) Column and Discharge Diameter: 20". Must adapt to existing elbow at Squaw Peak Highland Station and I-17, Bell Road Station.

(6) Minimum Horse Power: 120 hp.

(7) Maximum Horsepower: 150 hp.

The pump shall be capable of handling unscreened storm water. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected into place, and easily removed for inspection or service without need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be part of the pump unit. The entire weight of the pump unit shall be guided by two guide bars, and seal tightly against the discharge connection. The pump with its appurtenances and cables shall be capable of continuous submergence without loss of watertight integrity to a depth of 50 feet. The pump with its appurtenances shall be capable of running continuously without water damage to the pump or motor.

Guide bars shall be of the size recommended by the pump manufacturer and as approved by the Engineer. The guide bars shall not support any portion of the weight of the pump when it is in operating position.

The pumps shall be constructed of the following materials:

Pump Case	Cast Iron	- ASTM A48 Class 35B
Motor Housing	Cast Iron	- ASTM A48 Class 35B
Impeller	Cast Iron	- ASTM A48 Class 35B
Motor and Pump Shaft	Stainless Steel	- AISI Series 300 or 400
Wear Ring	Corrosion and Wear Resistant Materials	
O-rings	Buna-N or Nitrile Rubber Neoprene	
Bolts and nuts	Stainless Steel	

All metal-to-metal fits on the pump, where watertight sealing is required, shall be machined and fitted with 0-rings in slots or bevels for controlled compression. No sealing compound or gaskets shall be permitted.

Pump shafts shall be stainless steel AISI Type 304. Carbon steel (C1035) shall be permitted only if completely isolated from the pumped liquid.

Each pump shall be provided with a double mechanical rotating shaft seal system. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven tuntgsten carbide ring. The upper seal unit, between the pump and motor housing, shall contain one stationary carbon and one positively driven rotating ceramic ring. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaced. An electrode probe shall be provided to indicate water in unit.

The pump shaft shall rotate on two (2) totally sealed permanently lubricated bearings with B-10 life of 50,000 hours.

The impeller shall be dynamically balanced, non-clogging design with a solid-handling capability of 4" diameter.

The volute shall be of single piece design and shall have smooth fluid passages large enough at all points to pass any size solid which can pass through the impeller.

A wear ring system shall be installed to provide efficient sealing between the volute and impeller.

Exterior coating shall be manufacturer's standard system for specified application.

The pump motor cable shall be suitable for submersible pump application with P122-Mine Safety Health Act approval. This shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall comply with NEC Specification for pump motors. The pump cable shall be a single multi-conductor motor cable (3 phases and ground and thermisensor conductor) of sufficient length to connect to the building wire.

The pump and motor shall be designed for NEMA Class I, Division I, Group D service as rated by UL or FM. Motor insulation shall be Class F. The motor shall be designed for continuous duty at the "pump off" elevation with a minimum service factor of 1.15 at 40C. Motor and pump shall be designed to permit no less than 10 starts per hour without exceeding insulation class or affecting the service life of the unit. Maximum pump speed shall not exceed the speed indicated herein.

Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three thermal switches, one in each phase, embedded in the end coils of the stator winding. These shall be used in conjunction with and supplemental to external motor overload protection and wired to the control panel.

All pumps shall be inspected and tested as follows and written certification provided prior to shipment:

(1) Impeller, motor rating and electrical connections shall first be checked for compliance to the customer Purchase Order.

(2) A motor and cable insulation test for moisture content or insulation defects shall be made.

(3) Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

(4) The pump shall be run for 30 minutes submerged, a minimum of 6 feet under water.

(5) After operational test 4, the insulation test 2 is to be repeated.

(6) One pump shall be performance tested per Hydraulic Institute Standards.

The pumps shall be the standard manufactured items of the manufacturer who shall have similar type pumps installed and operating in the United States for a period of no less than 5 years. Pump manufacturer shall have local service personnel and parts suppliers within a 50 mile radius of the site.

(2) Pump Warranty:

The pump manufacturer shall warrant the units being supplied to the owner against defects in workmanship and material for a period of five (5) years or 10,000 hours under normal use, operation, and service. The warranty shall cover parts and labor and shall be in printed form and apply to all units.

(P) FANS:

Fans and their appurtenances, as specified herein and shown on the plans, shall be furnished and installed.

(1) A belt-driven centrifugal roof exhaust fan (EF-4), complete with disconnect switch, shall be furnished and installed as shown on the Plans. Top cap, wheel, inlet shroud, baffle and base shall be aluminum construction and shall be weatherproof. Fan shall be AMCA certified, non-overloading horsepower

capability with solid stainless steel drive shaft and statically and dynamically balanced wheel with backward inclined blades. The bearings shall be permanently sealed flange type ball bearing with 5-to-1 load capability to actual load ratio and 200,000 hr. average life.

Weatherproof compartment for motor and drives shall be separated from airstream. Variable pitch drives, V-belt and drives shall be sized for 150 percent motor capacity. Drive system shall have a vibration assembly. Accessories shall include aluminum roof curb with backdraft damper. Backdraft damper shall be 6063 T5 aluminum with extruded vinyl blade edge seals, .125 IN minimum frame thickness and 0.07 IN minimum blade thickness with 1/2 IN tie bars. Motor shall be TEFC. Size and capacity shall be as scheduled.

(2) Belt-driven propeller roof exhaust fans (EF-1, EF-2 and EF-3), complete with disconnect switch, shall be furnished and installed as shown on the Plans. Cast aluminum blades shall be mounted in a cast aluminum hub. Fans shall have a set of butterfly dampers to be forced open by the exhaust air and close by means of gravity. An integral electrical conduit shall be provided on all units and shall be weather-tight. Fan bearings shall be the greasable type with a minimum average life of 100,000 hours. The bearings shall be located out of the airstream along with the drive shaft belts and drives. A grease tube shall be run from the bearings to the outside of the unit for ease of maintenance. All drives and motors shall be designed for 150% of rated horsepower capabilities. Motor shall be TEFC with variable pitch drive and belts shall be oil resistant non-static. Accessories include aluminum roof curb and, for EF-1 and EF-2, a thermostat control as described in CONTROLS VENTILATION. Size and capacity shall be as scheduled.

(3) A belt driven centrifugal roof supply fan (SF-1), complete with disconnect switch, shall be furnished and installed as shown on the Plans. Airfoil blower and extruded tiers shall be aluminum construction. Fan shall be AMCA certified, non-overloading horsepower capability with solid stainless steel drive shaft. Wheel shall be statically and dynamically balanced with backward inclined blade. The bearings shall be permanently sealed flange type ball bearing with 200,000 hr. average life. Variable pitch drive, V-belt and drives sized for 150 percent motor capacity. Drive system shall have a vibration assembly. Accessories include galvanized roof curb with motor-operated damper. Damper body material to be 6063 T5 aluminum with extruded vinyl seal blade edge. Frame thickness on damper shall be 0.125 IN minimum with parallel opposed blades.

Air leakage on damper shall not to exceed on a 4 ft. sq damper at 4 IN WG pressure 6.2 cfm. Supply fan shall be equipped with 2-inch aluminum washable filters. Motor shall be TEFC.

(Q) MAKE-UP AIR UNIT:

(1) The make-up air unit (MU-1) shall be 16 GA aluminized steel cabinet with 12 GA aluminized steel on base channels. The blower shall be statically and dynamically balanced forwardly curved, double-width double-inlet and mounted on a solid turned ground shaft with keyway. Bearings shall be ball-bearings, self-aligning, permanently lubricated, pillow-block type. Blower scrolls, bearings and adjustable base shall be mounted on reinforced angle iron frame. Driver and driven sheaves are to be keyed hub type with drive sheaves fixed pitch diameter and driver sheave variable pitch. V-belt drives shall be sized for 150 percent of motor horsepower. Filter section shall be angle type with 2" disposable filters with access door for easy maintenance. Air intake hood with birdscreen and roof curb shall be supplied with the unit. The motor shall be TEFC with disconnect switch. The unit shall have one set of axillary contacts to indicate when the filter is dirty. The size and capacity shall be as shown on the plans.

(R) TERMINAL AIR CONDITIONER:

(1) The terminal air conditioner (TAC-1) shall be air cooled with electric heat and electric cooling. The unit chassis shall be slide-out design with wall sleeve. The unit shall be top discharge with built-in thermostat for cooling and heating. High, low and fan only modes with continuous/cycling fan selector switch shall be provided. TAC shall have 2-position control to introduce fresh air to space. The compressor shall be hermetically sealed and rubber shock or spring mounted. Evaporator and condenser coils shall be aluminum tubes and aluminum fins. Adjustable air discharger and components shall be UL rated. The filter shall be permanent (washable) and frame mounted. The architectural grill shall have light bronze finish. The size and capacity shall be as shown on plans.

(S) REGISTERS:

(1) Registers R-1 shall be extruded aluminum with sponge rubber gaskets and shall have two sets of individually adjustable louvers at 0 deflection. Dampers shall be key-operated opposed blade. Screws, duct collars, and transitions shall be furnished as required.

(T) INTAKE HOOD:

The intake hood IH-1 shall be tiered type extruded aluminum. The hood shall be equipped with bird screen, aluminum roof, curb and motor operated damper. Damper material shall be 6063T5 aluminum with extruded vinyl seal blade edge. The frame thickness of the damper 0.125 IN minimum with parallel opposed blades. Air leakage on damper not to exceed on 4 ft sq damper at 4-IN W.G. with pressure 6.2 CFM. Size and capacity shall be as shown on plans.

(U) FIRE DAMPERS:

The frame blades and enclosure shall be galvanized steel. The frame shall be 20GA, blades shall be 24 GA and enclosure shall be 20GA. Fusible link shall be at 211 DegF and UL listed. Fire rating shall be at 1-1/2 HR per UL 555. The blade package shall be out of air stream.

(V) DIESEL FUEL STORAGE:

Equipment, material and labor as shown on the Plans, as specified herein, and as required for a complete and satisfactory working fuel storage system shall be furnished and installed.

Each tank shall have a capacity of 1000 gallons and be configured as shown on the plans. The horizontal tank shall be welded carbon steel and shall be UL, FM, or CSA listed or approved Tanks shall be factory pressure tested with certification of the test results furnished to the Engineer before the tanks are shipped. Tanks shall be blast-cleaned to the "white metal," inside and out, and coated with an epoxy paint system compatible with No. 2 diesel fuel. The finish exterior coat shall be white.

The diesel fuel storage tank shall be complete with necessary tank openings and National Pipe Thread (NPT) threaded half-coupling or flanged fittings for piping connections. The contractor shall provide reducer bushings for piping sizes smaller than standard tank openings. Plugs shall be provided for tank openings not used.

The tank shall be supported on saddles inside the diesel storage area.

The tank shall be equipped, as shown on the plans with fuel gauge reading in gallons. The fuel tank level shall be signaled to the interface terminal cabinet for connection to the remote monitoring system.

Each tank shall be inspected and tested in the manufacturer's shop. Each tank shall be subjected to an internal air pressure test of .5 psig. The test pressure shall be maintained a sufficient length of time to determine if leakage is present by means of soaping the entire tank. Certified copies of the test report shall be furnished to the Engineer.

The equipment shall be installed as shown on the plans, in accordance with NFPA requirements, the manufacturer's instructions and all applicable rules and regulations. All pipe, fittings, valves, regulators, flexible connectors and appurtenances, shall be UL, FM or Canadian Standards Association listed or approved. All necessary shims, grout, anchor bolts, and other items required for installation and testing shall be furnished. All items of equipment shall be operated, adjusted, and tested for proper performance in accordance with the manufacturer's recommended test procedure.

(W) FOAM FIRE PROTECTION EQUIPMENT:

(1) General:

The fire extinguishing system shall be capable of having all components parts, other than those involved in the actual discharge of foam agent from the foam concentrate storage tank, tested without requiring any replacement of parts.

(a) Foam Concentrate Storage Tank:

The system shall be sized for a minimum of three 10 minute foam applications to the water surface of the sump as indicated on the plans. Water shall not continue to be applied between foam applications. The system shall be activated by thermostatic heat detectors and combustible gas detectors located in the protected area or by manual control from either local or remote control stations as shown on the plans. A pressure-operated switch shall be provided in the discharge line with normally open contacts which shall activate a red signal light in the manual control stations. The time delays shall be equipped with a manual by-pass. The system shall be capable of operating on city water with a minimum pressure of 40 psi. All equipment shall be of the explosion proof type.

One 500 gallon capacity horizontal diaphragm type proportioner foam concentrate storage tank complete with internal bladder type diaphragm, proportioning controller, and all necessary valving and fill, vent, and drain lines integrally piped assembled ready for installation, including a foam liquid control valve, shall be provided. The tank shall be designed for an operating pressure of 125 psi and shall be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Provisions shall be made for indicating amount of foam agent in tank.

(b) Foam Distribution Sprinklers:

Foam distribution sprinklers shall be of the foam-water aerated sprinkler head type. Each sprinkler shall be constructed of bronze and shall be provided with 1/2-inch male tapered iron pipe threaded inlet.

(c) Foam Agent:

500 gallons of 3% concentration, AFFF synthetic foam agent shall be provided. A minimum of 100 gallons of the foam agent shall be for testing the fire protection system after installation. If additional foam agent is required to perform the herein specified tests the Contractor shall also provide that amount. After testing 400 gallons of foam agent shall be provided for the initial charge.

(d) Deluge Valve:

One automatic valve of the deluge type shall be provided for the fire protection system. The automatic release shall be operated electrically and shall be suitable for operation at 120V AC. The valve shall also be arranged for manual operation and shall automatically close after completion of each foaming cycle. The valve shall have an auxiliary switch with contacts suitable for 120V AC. The auxiliary switch shall have 2 electrically independent contact circuits. The valve shall be equipped with a drain which shall be piped to drain to the floor. All electrical components shall be enclosed in explosion proof enclosures, approved for Class I, Division I, Group D hazardous areas.

(e) Piping:

All fire protection piping shall be provided as shown on the plans. Piping materials shall be in accordance with NFPA No. 11, "Standards for Foam Extinguishing Systems." Field connections shall be bolted or threaded as required. The structure as finally assembled shall be self-supporting. All pipe shall be thoroughly flushed and cleaned after installation. All hangers, supports with inserts, expansion anchors, and anchor bolts necessary for proper securing of the piping and equipment shall be provided by the Contractor.

(f) Manual Control Stations:

Two manual control stations shall be provided and shall be suitable for wall mounting. The stations shall be mounted at the locations indicated on the plans. Each station shall be furnished with a nameplate with the designation of the fire hazard area which it serves inscribed thereon. The control stations shall be complete with switch and red and green pilot lights. The green lamp shall indicate that the current supply is on. The red lamp shall light only when the pressure-operated switch closes to give positive indication that the foam has been released to the respective fire hazard area.

(g) Thermostatic Heat Detectors:

Industrial grade thermostatic heat detecting devices shall be provided. They shall be explosion proof for Class I, Division I, Group D hazardous areas and shall be single-pole, fixed-temperature type rated 70C. The temperature-sensing and contact actuating element shall be tubular, hermetically-sealed, with a corrosion-resistant metal shell. The contacts shall be normally open, designed to close on increase of temperature, and rated not less than 5.0 A at 120 V, ac and 0.5 A at 125 V, dc make and break for inductive circuits. The thermostats shall be suitable for mounting on the conduit outlet boxes.

(h) Pressure-Operated Switch:

A suitable pressure-operated switch shall be provided for installation in the discharge line. The switch shall be 2-pole type rated for 70c, and shall be operated by the pressure of the foam concentrate when it is released in the line. Adequate electrically independent contacts to perform the required functions hereinbefore described shall be provided. The switch shall be able to operate without damage to pressures up to 125 psi. The switch shall be explosion proof, for Class I, Division I, Group D hazardous areas.

(i) Control Cabinet:

A control cabinet surface mounted on a wall shall be furnished. All necessary circuit breakers, auxiliary relays, timing relays, and terminal blocks shall be mounted inside the cabinet. The control cabinet shall be provided with a timing device which shall limit the operational time of foam discharge to 10 minutes. After completion of a foam discharge interval, the complete control system shall automatically reset. All devices mounted inside the cabinet shall be accessible for inspection and maintenance, and the circuit breakers shall be operable when the cabinet door is open. Audible and visual alarm reset switch and one manual control station operable from cabinet front shall be included, installed and located as shown on the plans.

(j) Foam Liquid Control Valve:

The foam liquid control valve shall be electrically operated suitable for 120V AC, and shall energize to close. All electrical components shall be enclosed in a Class I, Division I, Group D explosion proof enclosure.

(2) Factory Tests and Inspection:

Each item of equipment shall be factory assembled and given the manufacturer's routine factory tests to verify that all parts function properly. Certified results of tests shall be submitted to the Engineer.

(a) General:

The equipment shall be installed as shown on the plans and in accordance with the manufacturer's instructions and recommended best practices. All necessary shims, grout, lubrication, anchor bolts, and other items required for installation and testing shall be furnished. All items of equipment shall be operated, adjusted, and tested for proper performance in accordance with the manufacturer's recommended test procedure and as specified herein. Before any final acceptance tests are made, the Engineer shall be notified so that such test may be witnessed.

(b) Installation:

The foam fire protection equipment shall be installed in accordance with NFPA Standard No. 11, "Standards for Foam Extinguishing System," as shown on the plans and as specified herein.
Installation of piping shall be in accordance with the requirements specified herein and the applicable NFPA requirements. All piping shall be clean inside and, where ending in open connections for other work, ends shall be capped for protection. Valves and other operating devices shall be easily accessible and gages and other indicating devices shall be located where they can be conveniently read from the floor or walkways.

Pipe routing and location of pipe supports shall be performed by the Contractor, unless otherwise shown on the plans.

(c) Testing

The foam fire protection system shall be tested as specified herein to determine whether or not the requirements of these specifications have been fulfilled. All expendable materials, including the foam concentrate, required for the tests specified herein shall be furnished by the contractor. Should it become necessary to repeat a test because of faulty operation of equipment furnished by the contractor, the contractor shall provide all expendable materials, including the foam concentrate, for the retest.

The contractor shall provide the services of a fully qualified factory trained service representative/test engineer who shall be responsible for supervision, inspection of installation, test procedure, and testing equipment for all field tests and check-out of the foam fire protection system and auxiliary equipment. The contractor shall furnish necessary equipment and personnel for performance of the tests as directed by the equipment manufacturers supervising test engineer.

(1) Preliminary Tests: All foam fire protection piping shall be blown out with compressed air and tested for leaks in accordance with the requirements specified elsewhere herein for testing pipe. All control wiring and equipment shall be given a direct-current energizing and operative test, including complete function of the system, except that no foam shall be discharged.

(2) Foam Test: After the preliminary tests have been made and the control system is found to function properly, a foam discharge test shall be made. Operation of the foam fire protection system shall be initiated by electrical release, or by other approved means, to verify that the foam fire protection system performs all of its specified functions, including discharge of foam concentrate from the system. The proper operation of all specified functions of the system shall be noted. The discharge tests conducted by the contractor shall correspond to not less than a single foam injection period of 10 minutes. The quantity of foam agent used for testing and for the initial charging of the system shall be furnished by the contractor, as specified hereinbefore. Upon charging the foam concentrate storage tank, proper care shall be taken by the contractor to avoid damaging the internal diaphragm. After all tests are completed and the system has been accepted by the Engineer, the contractor shall fully recharge the foam concentrate storage tank.

(d) Painting:

All equipment specified shall be shop-painted with the manufacturer's standard finish.

The contractor shall be responsible for coordination of the compatibility between the manufacturer's standard finish and the field-paint specified.

506-3.03 CONSTRUCTION REQUIREMENTS:

Installation of equipment shall be done in a neat and workman-like manner. Piping of equipment shall comply with applicable code requirements and details shown on the plans and manufacturer's shop drawings. Valves shall be provided at each pipe connection to equipment and where shown on the plans. Equipment shall comply with the sizes, capacities, types, etc., indicated on the plans and/or specified in these Specifications. Approved hangers and supports shall be provided for all suspended or wall-mounted equipment.

Equipment shall be set true and level with a maximum of 1/2 inch grout laid between the equipment basis and/or legs, and concrete bases or floor.

All rotating and reciprocating equipment resting on bases or supported, in any manner whatsoever, from walls or ceilings shall be provided with vibration isolation dampeners. Unless specifically called for on the plans or in the specifications, vibration isolation dampeners may be omitted for equipment driven by motors under one horsepower, and for factory assembled items if other approved vibration and noise isolation arrangements are provided integral with equipment.

The primary adjustments and servicing of all items of equipment shall be performed by the contractor to the complete satisfaction of the Engineer at the time of completion of the installation and prior to acceptance of the work. The supplier shall make adjustments and service the equipment furnished or installed by them for the full period of the guarantee, whenever called upon to do so by the Engineer.

The contractor shall arrange and pay for competent representative or representatives to thoroughly instruct four members of the Department's staff for a minimum of three, eight hour days in the efficient operation of all systems and items of equipment, such as all control and instrument components, engine generator sets, generator switchgear, pumps, fans, motor control center, starters, gas detectors, flap gates and switches, etc.

Field testing shall consist of operating all systems using contractor-furnished load bank connected to the pump motor starters located in the motor control center. All start/stop elevations shall be simulated, to turn pump load on and off, with the controller. Flap valve switch action shall be manually activated. All testing shall be performed in the presence of the Engineer and to his satisfaction. Should a malfunction occur repair or corrections shall be made and the test repeated. A written procedure for the tests shall be as approved by the Engineer prior to testing. The Engineer shall be notified five days prior to field testing.

506-4 PUMP STATION PIPING AND PIPING ACCESSORIES:

4.01 DESCRIPTION:

The work specified herein includes furnishing and installing all piping, and piping accessories as shown on the plans, as specified herein and as required for a complete and satisfactory working installation:

4.02 MATERIALS:

(A) PIPING:

Materials for the major piping services shall comply with the following:

Service	Pipe	Fittings
Pump discharge	Ductile iron, flanges	ANSI A21.51 ANSI A21.10 with ANSI B16.1, 125 lb.
Water supply above ground 4" and smaller.	Copper Type "L" hard drawn ASTM B88	Wrought copper solder type ANS B16.22 95/5 Tin Antimony, ASTM B32
Water supply below ground 4" and smaller	Copper Type "K" hard drawn ASTM B88 *Polybutyl or PVC C900, Class 150	Wrought copper solder type ANS B16.22 95/5 Tin Antimony, ASTM B32 *Polybutyl or PVC Pressure

Service	Pipe	Fittings
	Fittings, Socket Weld	
Spray water piping.	Schedule 80 PVC. PVC socket weld.	Schedule 80
Diesel Fuel	ASTM A53, Grade B blacksteel, Sch. 80 Underground piping shall be protected with factory applied single wrap of asbestos coal-tar epoxy saturated felt conforming to AWWA C203.	Forged steel ASTM A105, socket ends. 3,000 pounds.
Roof drains	Service weight cast iron soil pipe.	No-hub, MG coupling with approved gasket.

* When Approved by Local Codes

(B) VALVES AND ACCESSORIES:

(1) Flap Valves

Flap valves in pump lines indicated on the Plans shall be flange framed with resilient seat. The body shall be cast iron ASTM-A126B. Valves shall be especially designed for pump discharge service.

Bronze seat ASTM B584 Alloy 844 shall be pneumatically impacted into dove-tailed grooves machined in the cast iron cover and machined to a 63 micro-inch finish for maximum water tightness.

Resilient seat, neoprene or Buna-N, shall be bonded in a grove machined in the body to provide a wide seating surface for the seat machined in the cover.

The cover, shall be ductile iron, ASTM A126B, with spherically dished design to withstand maximum operating loads. The hinge arms shall be high-tensile bronze, ASTM B584-CA865. The hinge pins, designed in double shear, shall be Type 304 stainless steel. Each hinge arm shall have two pivot points, an adjustable lower pivot with limited rotation and a threaded upper hinge post to adjust flap valve sensitivity. A lubrication fitting shall be supplied for each pivot.

An anti-locking bar shall be provided between the hinge arms to prevent excessive rotation above the lower hinge pin.

A steel leaf spring attached to the body and extended over the cover shall be provided to limit the travel of the cover during pump discharge. A resilient pad shall be provided at the contact point.

A factory installed proximity switch shall be provided on flap valves. Refer to Section 506-5.03 (K).

(2) Sluice Gates

All sluice gates shall be the product of one of the following or approved equal:

- Rodney Hunt
- Waterman
- Hydro Gate

Sluice gate, stem lifts, and other appurtenances of site, type, material and construction shall be supplied as shown on the plans and specified. Gates shall meet requirements of AWWA specification C-501. Maximum clearance between seating surfaces with slide gate closed is 0.004 IN.

Sluice gate shall have manual handwheel operator with centerline of handwheel approximately 36 IN above operating floor unless otherwise shown. Lift shall be provided in accordance with AWWA C-501. All lifts shall be provided with clear butyrate plastic stem cover with mylar open-close indicator.

Service gate frame, glides, slide, pedestal, gear housing, thimble, and yoke shall be constructed of cast iron, ASTM A126 Class B, or seals for flush bottom gates of neoprene. Wedges shall be of bronze, ASTM B584, CA872. Stems and stem couplings shall be bronze ASTM B98.

(3) Hose Bibbs

Hose Bibbs shall be bronze, angle pattern with circular handles, 1-1/2inch diameter.

(4) Gate Valves

Gate valves 2 1/2 inches and smaller shall be Crane No. 428, Jenkins No. 47, Fairbanks No. 0252 or equal. Gate valves three inches and larger shall be Crane No. 465 1/2, Lunkenheimer 1430, Jenkins 651-A, or equal.

(5) Globe Valves

Globe valves 2 1/2 inches and smaller shall be Crane No. 7, Jenkins No. 106-A, Fairbanks 01, or equal; 3 inches and larger shall be Crane No. 359, Jenkins No. 142, Fairbanks 0102, or equal.

(C) SPECIALTIES:

The following specialty items shall be provided as described:

(1) Ball valve, diesel fuel, 125 psig working pressure, UL or FM listed.

(2) Angle valve shall be Rego Part No. 7550 or equal, suitable for operating pressure of 125 psig with a ductile iron body and stainless steel stem.

(D) WATER METER AND WATER SERVICE:

The contractor shall furnish and install an adequate water service to the pumping station, including a back flow preventor which shall be installed outside of the pump station building as shown on plans. The backflow preventor shall operate on the reduced pressure principle and contain at least two check valves, two gate valves, a pressure differential relief valve and four test cocks. The meter shall be a 4 inch turbo meter.

The service shall be coordinated with the local utility and be installed in accordance with all local regulations and codes.

506-4.03 CONSTRUCTION REQUIREMENTS:

(A) INSTALLATION:

The piping shall be installed as shown on the plans. Piping of 4" size and smaller is shown in general arrangement and routing only; the exact routing and pipe supports shall be determined by the contractor.

(B) WORKMANSHIP:

Workmanship shall conform to the applicable requirements, codes and standards listed herein and to the requirements specified herein. Pipe shall be cut accurately by the contractor to dimensions established at the site and shall be worked into place without springing or forcing. Where locations are not exactly shown by detailed dimensions, pipe shall be installed as closely as possible to walls or ceilings as shown or noted on the plans. All embedded piping shall be installed true to line and grade as shown on the plans. Proper allowance shall be made for expansion and contraction of pipe, whether or not such provision is shown on the plans.

(C) THREADED PIPE:

All threaded piping shall be threaded, fitted, and placed in a workmanlike manner. All pipe, after cutting and before threading, shall be reamed and all burrs removed. Pipe threads shall be full cut and free of torn or ragged surfaces, and not more than three threads on the pipe shall remain exposed after installation. Screwed joints shall be made with thread sealant applied to the male thread only.

(D) FLANGED AND WELDED PIPE:

Steel pipe shall, as far as practicable, be furnished cut to length with flanges fitted in place, or with the ends prepared for coupling or welding, but any required cutting, fitting or welding of such pipe shall be done by the contractor. Flanged cast-iron pipe shall be furnished to the required length, faced and drilled. Flanged joints shall be made up with undamaged gaskets and all bolts shall be drawn tight. Welded joints shall be fabricated in accordance with the applicable section of the ASME "Code for Pressure Piping".

Intersections and changes in direction shall be made with welded fittings. PVC piping shall be solvent welded in strict accordance with the manufacturer's instructions.

(E) IDENTIFICATION TAGS:

Identification tags shall be provided for all valves. The tags shall be 2 1/2" circular plates made of 16 gauge sheet brass with a punched hole and shall have stamped depressed letters which are easily legible. The tags shall be provided with an approved fastener and shall be placed on the valves as approved by the Engineer.

(F) PROTECTION OF PIPING:

Care shall be taken to keep all pipes and fittings clean during the progress of the work. Should any pipe become either partially or wholly clogged before final acceptance of the work, it shall be cleaned in a manner satisfactory to the Engineer or replaced by the contractor at his own expense. To prevent clogging of pipes during the construction work, open ends of pipe shall be fitted with plugs, or other suitable closures. Such closures shall be removed when additional piping is added to the system.

(G) PIPES THROUGH WALLS AND FLOORS:

All pipes passing through concrete slabs, walls or beams shall pass through galvanized steel pipe sleeves or cast iron wall sleeves. Sleeves through walls or beams shall be set flush with both sides of the wall or beam. Sleeves through floor slabs shall be set flush with the bottom of the slab and shall project one inch above the finished surface on the top side of the slab or as indicated on the plans. Synthetic rubber links with stainless steel bolts, nuts and pressure plates shall be used to seal area between pipe and sleeve.

(H) HANGERS AND SUPPORTS:

The type and spacing of hangers, pipe rollers and supports with inserts and expansion anchors and all anchor bolts necessary for properly securing all piping, machinery, and equipment shall be as shown on the plans or otherwise required for proper fastening. Vertical piping shall be supported at not more than every 15 feet for cast-iron pipe and screwed pipe smaller than l-inch-size, 20 feet for screwed pipe, one-inch-size and larger, and every 4 feet for copper tubing. No perforated band hangers will be permitted.

(I) UNIONS AND NIPPLES:

Except as otherwise shown, all piping shall be installed with unions located so that piping can be removed for repair or replacement without removing an excessive amount of pipe. Unions on screwed steel pipe shall be ground joint malleable iron. Unions in solder-joint copper tubing shall be of the ground joint type, commercial grade. Nipples shall be of the same material, type, and grade as the pipe in the system where used.

(J) UNDERGROUND PIPING

All underground piping shall be laid true to line and grade. Interior of pipe shall be cleared of dirt and superfluous material. All pipes shall be installed on undisturbed earth or a prepared compacted bedding, approved by the Engineer. No backfilling shall be permitted until pipe is tested and approved by the Engineer.

(K) WELDING:

All electric arc welding shall be performed under procedure control using automatic machines where practicable. All welds shall show good fusion with the base metal, particular care shall be taken in aligning and separating the edges of members jointed by butt welding so that complete penetration and fusion at the bottoms of the joint will be assured. All pinholes, cracks, and other defects in piping shall be repaired in accordance with the requirements of ANSI-B31.1, "Power Piping".

(L) WELDING PROCEDURE (ELECTRICAL):

The contractor shall have established and recorded a specification of the welding procedure that he follows and shall furnish the Engineer a copy of such procedure specification together with certified copies of reports of results of tests made in accordance therewith.

Piping welding procedure shall be in accordance with the applicable sections of ASME "Pressure Piping".

(M) QUALIFICATION OF WELDERS AND WELDING OPERATORS (ELECTRICAL):

All welding operators assigned to the work shall have Passed a qualification test conforming to ASME "Pressure Piping", for piping welders.

(N) TESTING:

All diesel fuel piping shall be pressure tested at 100 psig. Soap test shall be performed by the contractor and witnessed by the Engineer.

All water piping shall be tested in accordance with local codes.

(O) CLEANING:

All diesel fuel piping shall be cleaned of debris after testing and neutralized of moisture using 99.85% pure anhydrous methanol. Pipes shall be sealed to eliminate the entrance of air.

SECTION 506-5 PUMP STATION ELECTRICAL SYSTEM

506-5.01 DESCRIPTION:

The contractor, except as otherwise specified, shall furnish, fabricate, deliver erect, install and test electrical material, and equipment specified herein and as shown on the plans so as to constitute a complete and operating electrical system.

The contractor shall furnish and install the various systems of electrical work specified and indicated on the plans. The specifications and plans are not intended to cover every equipment detail. The contractor shall, however, furnish and install all devices and appurtenances which are necessary to fully complete the work even if said details are not shown or are not specified in detail.

The ventilation and pumping equipment, the 24V battery system, the solenoid operated valves, the tank level gauges, the pump control equipment and other equipment that shall be furnished and installed under other items of work, shall be connected as part of the work under this subsection, unless otherwise indicated.

Operating limits of electrical apparatus, whether furnished under this subsection or in other sections of the Specifications, shall be adjusted in the field to meet operating conditions. This shall include settings of all overcurrent and trip devices, load balancing on panel buses, transformer tap selection, timer and control device adjustments, etc.

The horsepower ratings shown on the plans are approximate. Actual motor horsepower and motor full load amperes shall be determined in the field from motor nameplate. Feeder sizes, and overload protection shall be selected and furnished in accordance with the requirements of the NEC, based on the actual nameplate data.

The contractor shall furnish, install and maintain all temporary power and lighting systems needed for construction in accordance with the requirements of the utility company involved. This temporary system shall include weatherproof panel(s) for the main breakers and distribution system. Ground fault interrupting equipment shall be installed. All connections shall be watertight with wiring installed using Type SO portable cable. After construction is completed, the contractor shall remove all temporary power equipment and devices.

The project plans indicate generally the location of outlets, fixtures, equipment, conduits, wiring, etc., and the general details necessary for the complete electrical installation. It shall be the contractor's responsibility to install all electrical work in a neat and workmanlike manner. The contractor shall cooperate with other trades to permit the installation of all the work without interferences.

If changes become necessary to avoid interference with other work being installed, the contractor shall submit to the Engineer for review the proposed changes and, upon review by the Engineer, proceed with the installation of such changes without additional cost to the Department.

The contractor shall not perform any electrical work until shop drawings for such work are completed, reviewed by the Engineer and returned to the contractor. Any such work installed by the contractor prior to this review will be the responsibility of the contractor and any modification of the electrical work necessary to meet the equipment requirements shall be made without additional compensation.

The contractor shall provide "As-built" plans prior to acceptance of the pump station.

506 - 5.02 ELECTRIC SERVICE AND METER INSTALLATION:

The contractor shall provide:

(A) A permanent underground service rated 277/480 volts, three phase, four wire, 60 Hz, to the pump station.

(B) A complete operating service and metered installation in full compliance with standards of the local electric utility.

Contractor shall furnish materials and equipment and labor not provided by the local electric utility, and shall pay all costs and fees in connection with the above, including, but not limited to, building service, outdoor meter socket, conduit, pullbox, pull rope, trenching and backfill.

The contractor shall obtain approval in writing from the local electric utility as to the entire service installation requirements up to and including metering before actual installation is made.

506-5.03 MATERIALS:

(A) NAMEPLATES:

The contractor shall furnish and install nameplates on all items of electrical equipment and appurtenances furnished and installed under this item. The nameplates shall be of laminated composition material, consisting of an inner black layer and outer white layer with polished surfaces on both sides so that the engraved inscription will be black on a white background. The nameplates shall be not less than 3/32 inch in thickness with a 1/32 inch bevel on the front edges. Unless otherwise specified elsewhere, the minimum size of each nameplate shall be 2 inches by 3/4 inch with 1/8 inch lettering.

Each nameplate shall be drilled and fastened by means of suitable mounting bolts or screws, finished to match the nameplate. Where adequate space is not available for mounting the nameplate on a particular item, the nameplate shall be mounted above or below the item.

(B) RACEWAY SYSTEM:

The contractor shall furnish and install all conduits, boxes and fittings required for the electrical power, control, instrumentation, communication, grounding, and lighting systems as shown on the plans or as directed. All necessary hardware such as screws, bolts, hangers, concrete inserts, clamps, locknuts, bushings, sealing bushings, couplings, identification tags, etc., shall be included. Unless otherwise shown or directed, the conduits shall be metallic. Properly sealed explosion-proof conduit seals and fittings for Class I, Division I, Group D hazardous areas shall be furnished and installed in conduits used for the installation of explosion-proof equipment. The wet well shall be by definition a Class I, Division I, Group D hazardous area and all work shall be installed in accordance with NEC Article 500.

(1) Conduits:

Rigid metal conduits shall be heavy-wall, hot-dip galvanized steel conforming to ANSI C80.1, "Specification for Rigid Steel Conduit, Zinc Coated."

Where indicated on the Plans, PVC conduit shall be Schedule 40 conforming to NEMA Standard TC 2.

(2) Fittings and Covers:

Metal conduit fittings and covers shall be hot-dipped galvanized with gaskets. They shall comply with NEMA Pub. No. FB-1 "Conduit Fittings, Cable Fittings, and Accessories," and ANSI C80.4, Specification for Fittings, for Rigid Metal Conduit, and Electrical Metallic Tubing." Composition or rubber gaskets shall be provided to prevent entrance of moisture.

(3) Expansion Joint Fittings:

Rigid metal conduit expansion joint fittings shall consist of standard manufactured products designed to prevent damage to the cables and equipped with approved means of providing the electrical continuity of the conduit run. Expansion joint fittings shall permit a small amount of transverse movement as well as longitudinal movement.

(4) Flexible Liquid-Tight Conduits:

Flexible liquid-tight conduit shall be "Sealtite Type UA," as manufactured by Anamet Inc., Liquidite Type "UA", as manufactured by Electri-Flex Company, or equal.

(5) Flexible Watertight Explosion-Proof Couplings:

Flexible, watertight explosion-proof couplings shall be as manufactured by Crouse-Hinds, OZ/Gedney, or equal.

(6) Conduit Installation:

Installation of all conduits, boxes, fittings, and accessories shall conform to the requirements of the "National Electrical Code." Any conduit which enters a slip hole in a sheet metal box or cabinet shall be secured with a locknut on each side of the sheet metal and terminated with an insulating type bushing. Exposed exterior conduits shall be terminated in watertight conduit hubs, Appleton, OZ/Gedney, or equal.

Conduit runs shall be straight and true; elbows, offsets and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends or with conduit body type fittings. Conduit body fittings shall be Crouse-Hinds, OZ/Gedney, or approved equal, with screw covers.

Conduit runs in buildings and structures shall be exposed unless otherwise shown on the plans.

Conduit runs shall not interfere with the proper and safe operation of equipment and shall not block or interfere with ingress or egress, including equipment removal hatches.

Exposed conduits shall be securely fastened with clamps or straps. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling.

No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit and equipment subjected to adjustment or vibration. The maximum length of flexible conduit shall be 30 inches. Where flexible conduit is used, it shall be weatherproof and watertight, or explosion-proof, as required.

All conduit shall be thoroughly reamed after the threads have been cut to remove burrs. Newly cut threads shall be re-galvanized using a zinc-rich paint, such paint shall be applied immediately after cutting and cleaning the threads. All joints shall be made with approved sealing compound and shall be watertight.

Bushings or conduit fittings shall be used at all conduit terminals. The total of all bends in any run between outlet and outlet, fitting and fitting or outlet and fitting shall not exceed the equivalent of four 90 degree bends (360 degrees total). Conduits brought into pull boxes, condulets, and other openings shall be capped until used to prevent the entrance of moisture. All spare conduits shall be capped.

Joints shall be made up tight. Hangers and fasteners shall be secure and of a type appropriate in design and dimensions for the particular application. Runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical.
Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction. Expansion fittings shall be as manufactured by OZ/Gedney.

Conduit installation in explosion-proof areas shall be done in conformance with all the requirements of the NEC for Class I, Division I, Group D hazardous areas.

Conduits buried underground shall be spaced 2 inches apart using nonmetallic spacers designed for the purpose and installed at intervals not greater than 10 feet. All conduits shall be buried a minimum of 24 inches with warning tapes buried 18 inches below grade. In multiple conduit runs, raceway coupling locations shall be staggered so that couplings in adjacent raceways are not in the same transverse line. For every one foot width of trench, one warning tape shall be buried. Where other utility piping systems are

encountered or being installed along a raceway route, a 12 inch minimum separation horizontally and 12 inch minimum separation vertically at crossings shall be maintained. Underground direct burial raceways shall not be backfilled until they have been inspected by the Engineer. Conduits shall slope uniformly 1/8" per foot minimum.

Conduits shall be inspected before conductors are installed and thoroughly cleaned of water and dirt with compressed air, swabs, or other approved methods. Conduits shall be checked for freedom from obstructions by pulling a wooden mandrel of the proper size through the conduit wherever required or directed.

(C) JUNCTION, OUTLET, DEVICE, TERMINAL AND PULL BOXES AND COVERS:

Junction, outlet, device, terminal and pull boxes and covers shall be made of cast steel and shall be hot-dip galvanized. Junction, outlet, terminal and pull boxes and covers shall conform to UL-514, "Outlet Boxes and Fittings," and to U.S. Fed. Spec. W-C 586a, "Conduit Outlets and Entrance Caps, Electrical Cast Metal - for Shore Use." Boxes 1 sq. ft. and larger shall be made of painted sheet steel, and shall have a hinged cover. All covers shall be fitted with gaskets, and shall be secured to boxes with stainless steel screws. Boxes to be used in hazardous areas shall be explosion-proof and suitable for installation in Class I, Division I, Group D areas.

(D) INSULATED WIRE AND CABLE:

The contractor shall furnish, install, connect, and test all insulated wire and cable required for component parts of electrical power, control, instrumentation, communication, grounding and lighting systems. The contractor shall furnish, install and connect all lugs and terminals, terminal blocks, cable joints, splice connectors, splice materials, cable clamps, cable supports, cable terminators, identification tags, and other miscellaneous equipment required to make a complete installation ready for operation.

(1) Standards:

Conductors shall be annealed copper wire and shall conform to the requirements of ICEA Standards and the "National Electrical Code."

Construction and testing of all wire and cable shall conform to the applicable requirements of the ICEA Standard S-66-524, NEMA Pub. No. WC-7, "Cross-Linked, Thermosetting, Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy;" ICEA Standard S-19081, NEMA Pub. No. WC-5, "Thermoplastic-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy."

Markers for cabling shall be B-292 vinyl as manufactured by Brady, Seaton, or equal.

(2) Power Cables:

600 Volt power cables shall be single conductor, suitable for 600 Volt service. Cable shall consist of copper conductor 90 C, with heat and moisture resistant insulation type THWN/THHN or XHHW. No wire smaller than No. 12 AWG shall be used. All conductors shall be Class B stranded. For sizes No. 6 and smaller, THWN/THHN shall be used; sizes No. 4 and larger shall be XHHW.

(3) Control Cables:

Control cables shall be single or multi-conductor suitable for 600 Volt service. Cable shall consist of Class B or C stranded conductors with insulation the same as that for 600 Volt power cable specified above. Individual conductors of the multi-conductor cable shall be color coded. The minimum wire size shall be No. 14 AWG.

(4) Interior Lighting Wire:

Lighting wire shall be single-conductor, 600 Volt, with insulation the same as that for the 600 Volt power cable. No wire smaller than No. 10 AWG shall be used for lighting circuits.

(5) Fixture Wire:

Fixture wire shall be No. 14 AWG with Class B stranding and with construction conforming to ANSI-CI, "National Electrical Code," type SF-2, consisting of a silicone rubber insulation with a protective woven fiber glass braid.

(6) Instrumentation and Signal Cable:

Instrumentation and signal cables for carrying digital, analog, or d-c pulsed signals shall be stranded tinned copper, 105- C PVC insulated for 600 Volt service, with overall shielding and PVC jacket. The conductors shall be 16 AWG minimum, Class C stranded. Individual conductors shall be color coded, number of conductors as required.

(7) Installation of Insulated Wire and Cable:

Cable runs shall be continuous from terminal to terminal to the extent permitted by available lengths. If splices are made in a run, they shall be made in terminal boxes provided for the purpose and in an approved manner.

Insulated wire and cable shall be handled with care to avoid kinking and damage to insulation and outer jackets. Cables shall not be bent around a radius less than that recommended by the manufacturer.

The contractor shall furnish all plugs, terminal blocks, and terminals required where not furnished with the equipment and shall make all connections required to provide a complete installation ready to operate. All wiring shall be identified as follows:

(a) Power and lighting branch circuits and feeders shall be identified at fixtures, outlets, motors, panel boards and motor control center with markers indicating wire origin and circuit number.

(b) Control and signal wiring shall be identified at cabinets, splicing, connection and termination points. Markings shall be in accordance with schedules prepared by the equipment manufacturer or by the contractor and approved by the Engineer.

Identification shall be done with self adhesive, wrap-around vinyl type markers. Cables entering free standing equipment compartments from below shall be supported near the floor with approved cable clamps and brackets.

After installation of all wire and cable but before connections are made to equipment terminals, the contractor shall check each wire or cable for continuity using an Ohmmeter or by ringing-out or talking-out methods. Each wire or cable shall be tested for insulation resistance between conductors, and between conductors and ground, using a 500 Volt DC direct reading Negger. Insulation resistance value in each case shall not be less than 1 megohm plus I,000 ohms per circuit volt.

(E) WIRING DEVICES AND PLATES:

(1) Receptacles:

Receptacles shall be of the corrosion resistant, duplex type as shown, 3-wire grounding, rated 20 A., 125V AC or DC, specification grade. Receptacles shall be as manufactured by Hubbell, Leviton or equal. Receptacles shall be mounted 18 inches above the finished floor. Receptacles located in wet well shall be rated for class I locations with previously mentioned ratings.

(2) Receptacle On Cord With Reel Assembly:

Receptacle on cord shall be single outlet type with 3 wire grounding rated for 20A at 120 V AC. The cord shall be wound on a wall mounted reel assembly. The receptacle assembly shall be labelled for use in Class I Division I locations and shall be manufactured by Appleton Electric Company, or equal.

(3) Switches:

Switches used for the control of lighting fixtures shall be of the corrosion resistant toggle type, specification grade, AC only, rated 20 A., 120-277V AC. Switches shall be single pole and three-way, as manufactured by Hubbell, Leviton or equal. Switches shall be mounted 48 inches above the finished floor. Switches located in wet well shall be rated for Class I, Division I locations with the previously mentioned ratings.

(4) Wallplates:

Switches and receptacles shall be covered with device plates suitable for the type. Device plates shall be galvanized cast steel with gasket and stainless steel screws.

(F) COMBINATION STARTERS:

Combination starters shall be manufactured in accordance with the latest published NEMA standards sizes and horsepower ratings. No fuse disconnect type combination starters shall be furnished. Motor circuit protector type circuit breakers shall be provided. The circuit breaker handle shall be clearly marked as to whether the disconnect device is "ON," "OFF," or tripped. The disconnect handle shall be pad lockable in the "OFF" position.

The starters shall be 3 pole, 600 VAC complete with three melting alloy type thermal overload relays sized for the nameplate amperage of the motor. Thermal units shall be of one-piece construction and interchangeable.

A "HAND-OFF-AUTO" selector switch in the cover of the combination starter, a fuse and fuse block for protection of the 120 volt control circuit wiring and all devices as indicated on the plans shall be furnished.

Combination starters shall be sized as indicated on the plans and shall be UL listed. Square D Co Class 8538, General Electric Co. CR207, or equal shall be provided.

(G) PANEL BOARDS:

Panel boards shall be dead-front safety type, conforming to NEMA standards NEC Article 384 and UL 67, and shall consist of circuit breakers, bus bars, lugs, and enclosure. Panel board interior shall be mounted on a reinforced steel backplate to facilitate support and alignment.

Circuit breakers shall be NEMA ABI, molded-case, bolt-on, quick-make/quick-break type with a mechanically trip-free switching mechanism, a thermal trip for inverse time delay overcurrent protection and a magnetic trip for instantaneous short-circuit protection. Circuit breakers shall be designed to carry continuous rating in ambient temperature of 150 F. Interrupting capacity shall be a minimum of 14,000 RMS amperes at 240 volts.

Bus bar shall be of copper having not less than 98 percent conductivity, shall have tin-plated contact surface, and shall conform to ASTM B187. Neutral bus shall have same rating as that of the phase bars.

Enclosures shall be of galvanized steel; surface- mounted type, and tamperproof; panel board shall have a ground bar, door, side and end wiring gutters, circuit identification, and directory holder; and shall conform to UL 50 and FS W-P-115a.

Ground bars shall be screwed to the enclosure.

Door shall have concealed hinges and trim clamps, combination catch, and flat-key lock; locks shall be furnished with two keys.

Top, bottom and side wiring gutters, for panel boards shall conform to N.E.C. Section 373-6.

The harness and support conductors in gutters, wiring spaces and compartments shall be neatly routed. The bending radii shall not be less than recommended by conductor manufacturer.

Enclosure shall be factory-cleaned, coated with one coat of zinc primer, and painted with one coat of manufacturer's standard gray enamel suitable for touch-up in the field.

A circuit directory shall be provided which is legible and which indicates panel board designation, source from which feed originates, and equipment controlled from each circuit breaker. The directory shall have a protective transparent cover, and shall be affixed to the panel board door.

Provisions for additional breakers (spaces) shall be such that no additional connectors or extension of bussing will be required to add breakers.

(H) TRANSIENT VOLTAGE SURGE SUPPRESSOR:

The surge suppressor shall be located in the service entrance section with the following ratings:

Maximum Operating Voltage: 320Vrms (452Vpk) (1-N); 640Vrms (905Vpk) (L-L)
Input Power Frequency: 0-4000 hz
Peak Surge Current: 480,000 Amps Total
Energy: 7360 Joules Total
Response Time: $\leq$ 1 nanosecond (1x10-9)
Altitude: Unlimited
Protection Mode: All modes: L-L, L-N (Normal Mode); N-G, L-G (Common Mode)
Physical Dimensions: 14 x 12 x 6 inches
Weight: 75 lbs. approx.
Let through Voltage Using ANSI/IEEE C62.41 1980 (Formerly IEEE 587)
Test Environment: Static Test, Positive Polarity
Circuit Design: Thermal stress reducing, parallel design
Listing: UL 1449, E75634

(I) VOLTAGE MONITOR (Phase Loss/Reversal):

The voltage monitor shall be of the solid state electronic type designed to meet NEMA ICS-1970 standards for a 480V, 60 HZ, three phase service. The monitor shall detect voltage below an adjustable predetermined value, single phasing, and phase reversal. The unit shall automatically trip the main disconnecting device when all three phases drop to an average value of 90% of rated voltage; when a phase is lost; or when phases are reversed. The unit shall have a normal trip delay time of three seconds and a reset time of three seconds.

The main disconnecting shall automatically reclose upon restoration of the line voltage for a period of time field adjustable up to 300 seconds. The function of the protection unit shall not be affected by running motors.

(J) CONTINUOUS LEVEL PROBES:

Continuous level probes shall be installed on the diesel storage tanks (#1 and #2). Probes shall produce a 4-20 MA DC signal proportional to the level of fuel in the tank. Level indicating system shall include level probe, transmitter, electronic indicator, and DC power supply. All components shall be manufactured by Drexelbrook Engineering Co. or equal.

(K) FLAP VALVE SWITCHES (PROXIMITY SWITCHES):

Proximity switches shall have positive make and break contacts through snap-action movement. Contact assembly shall be hermetically sealed in a hydrogen environment. Contacts shall be gold-flashed magnets and internal wiring shall be embedded in an epoxy compound. A terminal block for external connections shall be provided. Switch enclosure shall be brass with threaded conduit entry and shall have two through mounting holes. Proximity switches shall be submersible. Switches shall be certified not to leak under 20 psig external pressure and shall have an operating temperature range of -65 degrees to +250 degrees F. Proximity switch cable shall be three conductor, submersible type in sufficient length to be continuous without splice from the switch to the alarm control panel in the pumping station. Proximity switches shall be factory installed on the flap valves. Refer to Section 506-4.02 (B)(1) for flap valve specifications.

A suitable target shall be provided for each proximity switch. Mounting of the switch and/or positioning of the target shall be such that the switch is actuated by movement of the target away from the switch a distance of one-half inch or less.

(L) TEST:

All equipment components shall be tested by operating them a reasonable number of times to demonstrate their proper and safe installation and operation. To determine what constitutes a safe and proper operation, these specifications, manufacturer's recommendations, guidelines set by NEC, IEEE, ANS, OSHA shall be the norm.

Operational tests for all power, control and lighting equipment shall be performed to verify correctness of operation, connections, and interconnections with other equipment.

All motor operated equipment shall be tested by applying rated voltage and operating the controlling equipment (gas detector and manual switches,) to insure their proper interconnection and compliance with the requirements of the automatic operation of the equipment. After this has been verified, motor starters shall be operated manually to operate each motor at its connected load for a period of at least one-half hour.
Data to be taken for each motor shall be:

a - Proper direction of rotation
b - Full load amperes
c - Housing temperature (except pumps)

(M) GROUNDING SYSTEM:

The contractor shall furnish and install a complete grounding system which will permanently and effectively ground the neutral wire of the incoming electrical service, the frames of each piece of electrical and mechanical equipment, the entire conduit system, and all non-current carrying metal parts, as shown on the plans and as specified. The grounding system shall be in accordance with Article 250 of the N.E.C.

Ground conductors shall be bare, soft drawn, Class B stranded copper cables. Cable-to-cable, and cable to ground rod connections within the grounding system shall be welded by the "Cadweld" process as manufactured by Erico Products, Inc., "Thermoweld" process or equal. The cables shall be cleaned of dirt, grease, moisture, and oxidations before connections are made. Soldered connections will not be accepted. Driven ground rods shall be 5/8 inch in diameter and not less than 10 feet in length.

Connections to the equipment which may be removed for maintenance shall be made with approved bolted, clamp-type connectors, Brundy Eng. Co. or equal. All metal conduit shall be grounded either by being connected to equipment which is grounded, attached to grounded supports or by means of independent copper connections to the ground system. Grounding bushings shall be used to establish ground connections to the conduit.

The grounding system shall be tested by the contractor for continuity of all ground connections and for overall resistance to ground of the entire interconnected grounding system. Resistance to ground shall not exceed 5 ohms. Six certified copies of the field tests shall be furnished to the Engineer.

(N) LIGHTING EQUIPMENT:

The contractor shall furnish, install, and connect the indoor and outdoor lighting systems as shown on the plans and as specified herein. Electrical conduit, fittings, and grounding shall be furnished and installed as specified herein.

The plans show the approximate locations of lighting fixtures, switches, receptacles, and other equipment connected to the lighting panel board. They also show the circuit assigned to each device. Conduit and wiring connections shall be furnished by the contractor in accordance with the circuiting and control shown on the Plans.

(1) Fixtures:

Fixtures shall be installed where shown on the plans and as specified in the fixture schedule.

Ballasts for high pressure sodium fixtures shall be a minimum 90 percent power factor and shall have minimum line voltage limits of +5 percent.

Ballasts shall have a minimum 180-C class H insulation and shall operate in ambient temperatures of up to 50-C. Ballast shall be UL listed.

Lamps shall be as specified in the Fixture Schedule. The contractor shall furnish and install a complete set of new unused lamps just prior to the final acceptance tests on the lighting system.

(2) Time Clock:

The time clock shall be of the synchronous motor-driven type with an astronomic dial and a spring drive reserve feature sufficient to operate 16 hours after a power failure. Contacts shall be 40 amps per pole at 277 volt, DPST, motor voltage shall be 120 volts, 60 hertz. Time switch enclosure shall be a general purpose, NEMA 1, surface mounted type.

(3) Installation:

The contractor shall install all lighting fixture, lamps, associated supports, fittings, switches, control devices, conduit, boxes, wiring, and grounding conductors as called for in these specifications, as shown on the plans, as required and in accordance with the manufacturer's instructions and recommendations.

All fixtures shall be aligned and directed as shown or so as to illuminate the desired area properly. Fixtures shall be directly and rigidly mounted on their supporting structures.

All lighting fixtures shall be directly grounded to the equipment grounding system with a conductor of a size not less than that required by NEC. The ground conductor insulation shall be colored green.

(4) Testing:

After installation, the system shall be given adequate field tests to demonstrate that the requirements of the Specifications and Plans have been met and that the performance of the system is satisfactory. Three certified copies of the field tests shall be furnished to the Engineer.

(O) BUILDING, WET WELL SECURITY SYSTEM:

The contractor shall furnish and install a complete security system for the pumping station. The security system will be used to remotely alarm at the master station via the radio communication link any unauthorized entrance into the building and ancillary structures. The contractor's shop drawing submittal shall include control drawings and wiring diagrams for the security system and its control cabinet.

The pumping station security system shall consist of a control cabinet, mechanical door switches, proximity switches and shunt key switch.

Each door in the building shall be furnished with a mechanical switch which will close its contacts when the door is opened and will open its contacts when the door is closed. The switch shall be installed in the door frame, with provisions in the frame for access to switch wiring. Double doors shall have two switches, each switch operated by a door.

A round body type shunt key switch as approved by the Engineer, shall be furnished and installed outdoors, in the frame of the door designated by the Engineer as the main entrance door. The key switch shall be used to obtain entrance to the building by authorized personnel, without tripping the security system. The switch shall be single pole, double throw. Access to shunt switch wiring shall be provided on the indoor side of the door frame.

The security control cabinet shall be manufactured of 16-gauge steel, primed and finished painted on phosphatized metal surfaces. The cabinet shall be for wall mounting. The control panel, mounted inside the cabinet, shall be furnished and installed complete with 120/24V a.c. hard wired transformer, auxiliary control relays for interfacing alarm condition with the radio communications link, and other accessories as required to

perform the security control specified. The control cabinet shall be capable of providing, but not limited to, the following circuits and functions:

(a) Open and closed instant circuit.
(b) Open and closed delayed circuit (2-60 seconds)
(c) Open circuit switched zone.
(d) Arm and disarm switches and lights.

The contractor shall install the security system control cabinet on the wall in the electrical room, as shown on the plans. All power and interconnecting control wiring shall be furnished and installed, as required.

After installation, all power and interconnecting control wiring shall be checked for appropriate connection to terminal board. The contractor shall then perform operational tests to ascertain that the security system is operating as specified. Tests will be witnessed by the Engineer or his designated representative. The contractor shall notify the Engineer at least eight days prior to the test. Six copies of certified test data shall be furnished to the Engineer.

(P) INTERFACE TERMINAL CABINET:

The contractor shall furnish and install an interface terminal cabinet complete with terminal blocks for terminating all signals to be monitored by the Radio Communication Link. The cabinet shall be a NEMA 1 hinged door, surface mounted enclosure sized to handle terminal blocks in sufficient numbers for all items being monitored plus 25 percent spare capacity. The cabinet shall be minimum 6 inches in depth. Terminal blocks shall be 600 VAC, 20 amp UL listed, disconnect type Electrovert Inc. 9700 Series, Phoenix Terminal Block Inc. UK4 Series or equal. Interface terminal cabinet shall be Hoffman or equal.

(Q) COMBUSTIBLE GAS DETECTION AND ALARM SYSTEM:

(1) Obscuration sensitivity shall be 1.5 to 2.0% per foot.
(2) UL listed.
(3) 120 VAC operation.

The combustible gas detection and alarm equipment including appurtenances and accessories, shall be furnished, installed and tested as shown on the plans and as specified herein. All fittings, hangers and supports, anchors and guides where required, and special supports, not otherwise specifically provided for in these Specifications, but necessary to complete the various systems shall be included.

The gas detection and alarm equipment shall be as manufactured by Teledyne Analytical Instruments, Mine Safety Appliances Co., Delphian Corp., or approved equal and shall conform to the applicable provisions of the codes, standards and specifications and as specified herein.

The combustible gas detection system shall detect excessive accumulation of combustible gases in the pump station wet well and in the engine room.

The complete system shall be automatic with provisions for local alarm indication, and shall be arranged to initiate alarms and activate ventilation equipment.

(1) Detection of Gas in Wet Well:

When gas is detected in the wet well the following operations shall automatically be initiated:

(a) Alarm contacts close at warning level providing signal to the radio communication link via the interface terminal cabinet.

(b) Alarm contacts close at warning level providing signal to remote outdoor flashing red light.

(c) Wet well exhaust fan (EF-3) and wet well make-up air unit (MU-1) shall be activated at warning level.

(d) Exhaust fan designated EF-4 and motor operated damper in IH-1 for the stairwell shall be energized at warning level.

(e) Alarm contacts close at high level providing signal to radio communication link via the interface terminal cabinet.

(f) Alarm contacts close at high level activating wet well fire suppression system.

(g) Alarm contacts open at high level to shut down pump engines.

(2) Detection Of Gas In Engine Room:

When gas is detected in the engine room, the following operations shall automatically be initiated:

(a) Alarm contacts close at warning level providing signal to radio communication link via the interface terminal cabinet.

(b) Alarm contacts close at warning level providing signal to remote outdoor flashing red light.

(c) Ventilating fans designated Exhaust Fans EF-1 and EF-2 shall be activated at warning level.

When combustible gas concentration levels at all gas detector locations have fallen below the preset level, and after an adjustable time delay, the ventilation equipment shall shut down and alarm contacts return to normal.

(3) Control Settings:

The warning level alarm circuits for combustible gas detectors shall be initially set to close at 25 percent of the lower explosive limit (LEL) of combustible gas in the Engine Room and in the Wet Well. The high level alarm circuits for combustible gas detectors shall be initially set to close at 45 percent of the lower explosive limit (LEL) of combustible gas in the Engine Room and in the Wet Well.

(4) Equipment:

The system shall consist of two complete self-contained combustible gas monitors requiring only an external AC supply and two remote detectors arranged to detect a concentration of combustible gas in an area associated with the detectors, and upon detection, to alarm and initiate equipment start-up as specified herein.

The control unit shall be an assembly of drawout modules arranged in a NEMA 1 enclosure for wall mounting, and equipped with terminal blocks for connection of all external wiring.

Each module shall include but not necessarily be limited to the following:

Logic, regulation, alarm, and control circuits to operate from internal power supply with a single detector to close two independent contact circuits, one for alarm, and the second for control. Trip points shall be independently and continuously adjustable over the full range of lower explosive limit of the gas concentration. The alarm and control circuit shall be self reset.

Indicating meter, scaled 0 to 100% of lower explosive limit of combustible gas to indicate detector sampled gas concentration.

Adjusting switches to set trip points of alarm and control circuits.

Indicating lights for power-on, power-failure and to indicate operation of alarm and control circuits.

Alarm contact circuit for remote annunciation of control module trouble.

Independent alarm contact circuits shall be furnished for remote annunciation of alarm and control circuit operation.

Auxiliary relays, diodes, timers, and other devices to operate with other channel modules as necessary to accomplish the specified annunciation and shut down functions.

Combustible gas detectors as shown on the Plans, shall be of the diffusion type, explosion-proof, rated for Class I, Division 1, Group D areas, designed to utilize heat developed by combustion of a portion of the sampled air in contact with a heated element to activate an electric circuit.

(5) Accessories:

These shall include auxiliary relays and devices as appropriate to provide for the operation of a flashing red alarm light as indicated on the Plans.

(6) Spare Parts:

The following spare parts shall be furnished:

(a) Three detector head replacement active elements
(b) One relay of each type used
(c) Ten lamps of each type used
(d) One, calibration gas kit, of 2.0% Methane in air. Kit shall include regulators, adapters, adapter hoses, gas tank and portable carrying case.

(7) Factory Tests and Inspections:

Each item of equipment shall be factory assembled and given the manufacturer's routine factory tests to verify that all parts function properly. Six certified copies of test results shall be submitted to Engineer.

(8) Installation:

The equipment shall be installed as shown on the Plans and in accordance with the manufacturer's instructions. All items of equipment shall be operated, adjusted, and, tested for proper performance in accordance with the manufacturer's recommended test procedure and as specified herein.

Before any final acceptance tests are made, the Engineer shall be notified-8 days in advance so that such tests may be witnessed.

(9) Testing:

The combustible gas detection and alarm system shall be tested, as specified herein, to determine whether or not the requirements of these specifications have been fulfilled. All expendable materials, including the test gas, required for the tests specified herein shall be furnished by the contractor. Should it be necessary to repeat a test because of faulty operation of equipment furnished by the contractor, the contractor shall provide all expendable materials, including the test gas for the retest.

(a) Preliminary Test:

All control wiring and equipment shall be given an energizing and operative test, including complete function of the system.

(b) Detection Test:

After the preliminary tests have been performed and the control system is found to function properly, a gas concentration detection test shall be made. All required field testing calibration and measuring equipment including expendable materials such as gas, shall be furnished by the Contractor for all tests conducted. Operation of the combustible gas detection system shall be initiated by introducing a test gas of a known concentration level into the combustible gas detector, so as to verify that the system performs all of its specified functions. The proper operation of all specified functions of the system shall be noted.

(R) SMOKE DETECTORS:

The smoke detectors shall be of the photoelectric type suitable for industrial applications and shall have the following features and functions:

(1) LED monitor indicator.
(2) Manual testing capability.
(3) A solid state piezo alarm rated at 85 db at 10 feet.
(4) A form C SPDT relay contact for initiating remote annunciation. Contacts should be rated at 1.0 amperes minimum at 120 VAC.
(5) Obscuration sensitivity shall be 1.5 to 2.0% per foot.
(6) UL listed.
(7) 120 VAC operation.
(8) Functionality shall not be affected by collected dust or dirt in or on housing.

When smoke is detected, the following shall occur: EF-1, EF-2, EF-3, EF-4 and MU-1 shall be deenergized; the motorized damper in IH-1 shall close; SF-1 shall be energized with its motor operated damper opened to pressurize the stairwell; activate outdoor red beacon; and an alarm sent to the radio communication link via the interface terminal cabinet. Upon smoke detector reset, SF-1 shall be deenergized and its motor operated damper shall close. EF-1 through EF-4, MU-1, and IH-1 shall return to normal operation.

(S) ULTRASONIC OPEN CHANNEL FLOWMETER

The ultrasonic open channel flowmeter shall continuously measure the liquid level at the measuring point and convert the level to an output linear to flow rate. The flowmeter shall consist of an ultrasonic transducer with swivel mounting bracket or 2" pipe flange for mounting, interconnecting cable and microprocessor based flow transmitter, all furnished by the same manufacturer.

Accuracy shall be +/- 1.0%. The instrument system shall be automatically temperature compensated. Sonic beam angle shall be 6 degrees or less. Cable length shall be as required, but not to exceed 1,650 feet.

The transducer shall be accidental submergence proof and equipped with a swivel mounting bracket or 2" pipe flange for mounting. The instrument shall continuously scan within the frequency range from 40 to 60 KHz to detect and operate at maximum signal amplitude.

The transducer enclosure shall be of PVC and polycarbonate construction. Operating temperature shall be from 22 degrees to + 150 degrees F.

The transmitter shall contain in its permanent memory the flow equations for flumes and weirs (rectangular and triangular) which have the height over the measuring point, "h" to the 3/2 or 5/2 powers or combinations thereof. Field programmed data shall be protected in the event of power loss for a minimum of 6 months. The changing of field values shall require entry of a password to prevent unauthorized changes.

Zero and span, the value of each totalizer volume increment, volume between samples and high-low flow alarm set-point shall be field programmable.

The transmitter shall be field programmable to average the level measurements over any time interval from 1 to 99 seconds in order to smooth output oscillations caused by surface waves and ripples. The transmitter shall be programmable to hold last measurement upon loss of echo for from 1 to 99 seconds, then to continue to maintain last signal output, or default to zero of full scale flow output. The transmitter shall return to normal operation upon receipt of echo.

The transmitter enclosure shall be wall mounting NEMA-4X. The operating temperature range shall be from 14 degree to 150 degrees F. The transmitter flow signal output shall be 4-20 mA dc into a 750 ohm maximum load. Additionally, four 5A SPDT relay contacts shall be provided, one each to operate a remote flow totalizer, a sampler, a high low flow alarm and a lost echo alarm.

A 4-digit LCD flow rate indicator shall be provided. It shall be scaled in engineering units and visible without opening the enclosure.

One universal programmer or calibrator shall be furnished with integral 4-digit indicator. The programmer or calibrator shall be used to start-up the ultrasonic flow-meter.

The open channel ultrasonic flowmeter shall be Sparling Series 400 ECHOPAC Fischer and Porter 5OUs1000 or equal.

(T) RADIO COMMUNICATION LINK

This work consists of furnishing and installing the radio communication control, monitoring and reporting system at the pump station.

The control, monitoring and reporting system shall be INTRAK 2000, manufactured by Motorola.

The transmitter/receiver unit shall be factory installed in a NEMA 1 metal enclosure. Enclosure shall be manufacturer supplied to the contractor for installation at the location shown on the Plans. Installation method(s) shall be as required by the manufacturer and as approved by the Engineer.

A 120 volt, single phase, 60 Hz electric service to the system shall be provided from the Uninterruptible Power Supply.

Communication cable connections at the enclosure shall be performed by the manufacturer of the enclosure.

The contractor shall install wiring from the interface terminal cabinet to the transmitter/receiver units with wiring connections at the equipment controller performed by the manufacturer of the equipment.

Typical status and alarms of events to be monitored by the radio communications link via the interface terminal cabinet are:

Description

1. Pump Station Discharge (Proportional Signal)

2. Wet Well Level

   a. High level alarm

3. Pump Failure (Typical of Four)

   a. Over temperature
   b. Seal failure
   c. Lack of flow

4. Engine Failure (Typical for Four)

   a. Over crank
   b. Over speed
   c. Low oil pressure
   d. High water temperature
   e. Low battery voltage
   f. Battery charger failure
   g. Low water level in radiator

5. Pump Status (Typical of Four)

    a. Pump disable/enable status

6. Engine Status (Typical of Four)

    a. Engine on/off

7. Sump Pump

    a. Overload/Overtemperature
    b. On/off status
    c. Lack of Flow

8. Wet Well Exhaust Fan (EF-3)

    a. Overload
    b. On/off status

9. Stairwell Supply Fan (SF-1)

    a. Overload
    b. On/off status

10. Stairwell Exhaust Fan (EF-4)

    a. Overload
    b. On/off status

11. Make-up Air Unit (MU-1)

    a. Overload
    b. On/off status

12. Engine Room Exhaust Fans (EF-1, EF-2)

    a. Overload
    b. On/off status

13. Combustible Gas

    a. Wet Well

        1. Warning
        2. High/Foam Discharge

    b. Engine Room

        1. Warning

14. 24V battery system

    a. Battery charger failure
    b. Low battery capacity

15. Security Violated

16. Utility Power Failure

17. Standby Generator

    a. Malfunction
    b. On/off status

18. Alarm/Control Panel

    a. Power failure

19. Engine Room High Temperature

20. Wet well High Temperature

21. Fire/Foam Discharge

22. Diesel Storage Tanks

    a. Fuel level in Tank No. 1 (Proportional signal)
    b. Low level alarm in Tank No. 1
    c. Fuel level in Tank No 2 (Proportional signal)
    d. Low level alarm in Tank No. 2

Typical control functions to be executed by ADOT Central Control via the radio communications link are:

1. Disable each engine from starting, or stop each engine if already operating.

2. Enable (reset) each engine to start if local station control system calls for pumping action to start or resume.

3. Disable the submersible sump pump from starting, or stop it if already operating.

4. Enable (reset) the submersible sump pump to start if local station control system calls for pumping action to start or resume.

506-5.04 CONSTRUCTION REQUIREMENTS:

Installation of equipment shall be done in a neat and workmanlike manner. Equipment shall be installed with ample space allowed for removal, repair or changes to equipment.

Ready accessibility to removal of parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place. Approved hangers and supports shall be provided for all suspended or wall mounted equipment.

All electrical equipment shall be firmly secured to the surface on which it is mounted. When drilling and cutting through floors and walls, the contractor shall not disturb reinforcement steel without approval of the Engineer. Equipment shall be installed true and level, and in accordance with the manufacturer's recommendations. Lighting fixtures shall be rigidly supported from the building construction with approved supports, brackets, and hardware at locations and mounting heights indicated on the plans.

All motors and electrical equipment shall be grounded per NEC. Bonds and other connections in the grounding system shall be welded by the exothermic welding technique or by use of approved ground clamps. Bonding straps shall be accessible and shall not restrict normal functional movement of the members being bonded and other members nearby. Method of installation and point of attachment of bonding straps shall not weaken the members to which they are attached.

The primary adjustments and servicing of all items of equipment shall be performed by the contractor to the complete satisfaction of the Engineer at the time of completion of the installation and prior to acceptance of the work. The contractor shall make adjustments and service the equipment furnished or installed by him for the full period of the guarantee, whenever called upon to do so by the Owner or Engineer.

The contractor shall arrange and pay for competent representative or representatives to thoroughly instruct the Department's staff in the efficient operation of all systems and items of equipment, such as all control and instrument components, panel boards, gas detection equipment, lighting fixtures, etc.

The contractor shall provide a list of all equipment manufacturers and their addresses with the names, addresses, and telephone numbers of their local or closest representatives or service organizations.

506-6 CONTINUOUS PUMP TEST:

6.01 DESCRIPTION:

The work under this item consists of conducting a continuous four hour pump test. Included in this item are acquisition of test equipment, provision of test water, performance and documentation of the test and the removal of the testing equipment and restoration of the pump station. This work will be performed at the discretion of the Engineer.

6.02 TESTING:

The pump test consists of running at full head two pumps for a four hour time period. Flow capacity of each pump shall be monitored at approximately fifteen minute intervals for a two hour period. The pump test requires that provisions for recirculating water in the pump station be made by opening the sluice gate in the discharge box. On the day prior to the actual testing, water from the spray nozzles shall fill the wet well and reservoir to the third Pump - On elevation.

In the presence of the Engineer and with his approval, the control system will be turned on allowing one engine pump system to operate. The contractor shall supply personnel to monitor and record pump flow data, wet well water and discharge chamber water levels. Readings will be taken at 30 second intervals for the first fifteen minutes. Thereafter, fifteen minute intervals are required for the first two hours of the test. The pumps shall only be stopped to the second pump. The pump shall then be restarted and run for an additional two hours. Flow data shall be recorded at fifteen minute intervals.

At the discretion of the Engineer, additional tests may be required on the remaining pumps. The contractor shall make appropriate adjustments to repeat the testing procedure.

At the acceptable conclusion of this testing, the contractor shall drain the wet well and discharge chamber, replace the pumps, close the sluice gate and turn the station on-line.

506-7 METHOD OF MEASUREMENT:

Work under subsections Pump Station, Wet Well and Pump Station Site, Pump Station Equipment and Controls, Pump Station Piping and Piping Accessories, Pump Station Electrical System, and continuous pump test will be measured as a single lump sum unit under ITEM 5060100 - PUMP STATION.

The RGRC pipe shall be paid for in accordance with Section 501 of the Standard Specifications for Road and Bridge Construction (ADOT, 1990), Limits of payment for RGRC pipe on the pump station site shall be as shown on the plans.

506-8 BASIS OF PAYMENT:

ITEM 5060100 - PUMP STATION will be paid at the contract lump sum price, complete in place and shall be considered full compensation for all labor, materials, equipment, and all other items included and specified herein, and as indicated on the plans and as directed by the Engineer, and as required by the contractor for the complete construction and testing of the pump house and ancillary features.

(601PRCST, 06/15/92)

SECTION 601 - CONCRETE STRUCTURES:

601-1 **Description:** of the Standard Specifications is modified to add:

The following have been approved as alternates to cast-in-place minor structures:

Utility Vault Company Drawing HD-101A, dated 03-09-92, has been approved as an alternate to Standard Drawing C-11.10 for H-20 Loading. The use of this unit shall be limited to roadway locations with maximum longitudinal grades of six percent.

Utility Vault Company Drawing HD-101B, dated 03-09-92, has been approved as an alternate to Standard Drawing C-11.10 for H-10 Loading. The use of this unit shall be limited to a roadway locations with maximum longitudinal grades of six percent.

Pre-Cast Manufacturing Company Drawing CGF-C-11.10 Cattle Guard Foundation, as revised 01-25-88 has been approved as an alternate to Standard Drawing C-11.10.

Utility Vault Company Drawing HD-102, revised 03-09-92, has been approved as an alternate to Standard Drawing C-15.90.

Utility Vault Company Drawing HD-103, revised 03-09-92, has been approved as an alternate to Standard Drawing C-15.80.

Utility Vault Company Drawing HD-121, revised 03-09-92, has been approved as an alternate to Standard Drawing C-15.10 or C-15.30.

Pre-Cast Manufacturing Company Drawing CB-103, revised 05-27-86, has been approved as an alternate to Standard Drawing C-15.90.

Pre-Cast Manufacturing Company Drawings CB 15301, dated 04-19-87; CB 15302, dated 06-08-87; CB 15303, dated 06-09-87; and CB 15304, dated 06-04-87; have been approved as alternates to Standard Drawing C-15.30.

Pre-Cast Manufacturing Company Drawings CB 15801, dated 04-19-87; and CB 15802, dated 06-01-87; have been approved as an alternate to Standard Drawing C-15.80.

Pre-Cast Manufacturing Company Drawings CB 15101, dated 04-07-88; CB 15102, dated 01-21-88; and CB 15103, dated 01-23-88; have been approved as alternates to Standard Drawing C-15.10.

Hiway Hardware Inc. Drawing 92-100, dated 05-15-92, has been approved as an alternate to Standard Drawing C-11.11.

The "H" dimension for catch basins shall be determined in the field prior to casting. The contractor is advised to acquaint himself with conditions peculiar to the project which might limit the use of precast items.

To obtain approval of drawings for precast minor structures, the drawings must be submitted to the Engineer at least six weeks in advance of their need. Eight sets of clear, legible drawings, not exceeding 36 inches by 22 inches in size, must be submitted by the manufacturer. If corrections are required, one set of drawings will be returned with the required revisions noted thereon. After corrections have been made, two sets of corrected drawings must be re-submitted. Upon approval, the manufacturer will be notified in writing and the precast item will be listed as an approved alternate.

Drawings of proposed precast minor structures should be submitted to:

Arizona Department of Transportation
Assistant State Engineer, Construction
206 South 17th Avenue, Room 172A
Phoenix, Arizona 85007

(601CIPBG, 11/15/94)

601-3.01 **Foundations:** of the Standard Specifications is revised to read:

Foundations for structures shall be placed on suitable earth or rock bearing, on a concrete foundation seal, or on piling, as shown on the project plans. Excavation and backfill shall be in accordance with the requirements of Subsection 203-5. No concrete shall be placed under water or against water-bearing strata, except where a tremie concrete placement procedure is allowed by the Engineer.

601-3.02(A) **Design and Drawings:** the ninth paragraph of the Standard Specifications is modified to add:

No increase in allowable stresses for repetitive member uses will be allowed.

601-3.02(A) **Design and Drawings:** the twenty-first paragraph of the Standard Specifications is revised to read:

The drawings shall be complete and fully detailed working drawings showing the dimensions and material for all parts, arrangement, spacing, and connections, and all provisions for adjustment and for measuring displacement. The falsework foundations, any connections or contacts with previously built structures or other works, and the means of protecting such other works from damage shall be detailed. The above data may be presented as convenient either on the drawings or in the design summary, which shall also describe the assumptions and types of calculations used in the design and the stresses and deflections found for critical points. For any embankments used, the equivalent of the above drawings and data shall be submitted, and in addition the source, classification, and compaction requirements for the material and the results of any tests performed on the material. In no case shall the embankment be compacted to less than 90 percent compaction, and the top three feet shall be compacted to a minimum of 95 percent compaction when tested in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. The embankment shall be topped with a lean concrete waste slab screeded to the required grades.

601-3.02 (A) **Design and Drawings:** the twenty-fourth paragraph of the Standard Specifications is modified to add:

When modification of girders to support the deck falsework and forming has been approved by the Engineer, shop drawings for both the girders and the falsework and forming shall be submitted concurrently so that the review and approval of the drawings can be coordinated.

601-3.02 (A) **Design and Drawings:** of the Standard Specifications is modified to add:

The tops of the erected girders shall be surveyed by the contractor in the field prior to placement of the deck forming falsework. This survey shall be submitted to the Engineer for evaluation. If the top of erected girder elevations are higher than the screed elevations minus the combined deck slab and the buildup thicknesses, adjustments will have to be made in the roadway profile or in the girder bearing seat elevations. Encroachment into the deck slab of up to 1/2 inch will be allowed for random occurrences.

601-3.02 (C) (1) **General Requirements:** the first paragraph of the Standard Specification is modified to add:

Forming plans for cast-in-place bridge girders shall be prepared in accordance with the requirements of Subsection 105.02.

601-3.02(D) **Removal of Falsework and Forms:** of the Standard Specifications is revised to read:

No falsework or forms shall be relieved of load and no forms shall be removed without approval of the Engineer.

Falsework, excluding bridge deck cantilevered overhangs for cast-in-place prestressed structures, shall not be removed until after the prestressing steel has been tensioned and a minimum of 72 hours after the prestressing steel has been grouted. Falsework for the cantilevered bridge deck overhang shall be removed prior to prestressing but shall not be removed within seven days of concrete placement unless the concrete has attained a minimum compressive strength of 3,000 pounds per square inch. In no case shall falsework be removed within five days of concrete placement. On bridges with both transverse and longitudinal stressing, the deck or overhang falsework shall not be removed until after the transverse prestressing has been completed unless shown otherwise on the plans. The deck overhang falsework shall then be removed prior to performing the longitudinal prestressing.

Falsework for cast-in-place non-prestressed structures or composite superstructures, excluding concrete above the bridge deck, shall not be removed until either:

(1) At least ten days after the last concrete has been placed in each continuous span and until the compressive strength of all placed concrete has attained at least 70 percent of the required 28-day compressive strength.

(2) At least five days after the last concrete has been placed in each continuous span and until the concrete has attained the required 28-day compressive strength.

The sloped exterior girders of cast-in-place box girder bridges shall be laterally braced or supported until the top slab (deck) concrete has been placed and has attained at least 70 percent of the required 28 day compressive strength.

Side forms for footings, beams, girders, box culverts, columns, railings, curbs or other members wherein the forms do not resist dead load bending may be removed after the concrete has set and the contractor shall cure and protect the concrete thus exposed in accordance with the requirements of Section 1006. The contractor shall assume all risks and responsibility resulting from such removals. Forms for cast-in-place concrete, unless otherwise specified herein, shall not be removed until at least seven days after concrete has been placed in the forms, without the approval of the Engineer.

Placement of backfill material shall be in accordance with Subsection 203-5.03 (B). Where backfill is to be placed against both sides of a structural element, the backfill elevations on one side of the element shall not exceed the backfill elevations on the opposite side of the element by more than five feet.

Forms for precast concrete shall stay in place a minimum of eight hours.

The period of time between the placement of concrete in the top slab of a standard concrete box culvert (12 foot span or less) and the removal of the slab support forms may be reduced to 48 hours if the top slab remains supported along the center line of the culvert span by a continuous beam and line of posts erected as a part of the original slab form, and which will remain in place, undisturbed, a minimum of seven days.

If the Engineer allows the removal of forms before the specified curing period has elapsed, the contractor shall cure the concrete for the remaining required curing time by one of the methods specified in Section 1006.

Forms for cast-in-place concrete above the bridge decks that require a Class II finish may be removed after the concrete has set, providing the required surface finishing of the concrete is completed within four days. If finishing cannot be completed within four days, the forms shall remain in place for seven days.

All forms shall be removed, except forms used to support the deck of box girders when no permanent access to the cells is available.

Care shall be taken in removing falsework and forms so as not to deface or damage the structure. Methods of removal likely to damage or cause overstressing of the concrete shall not be used.

All falsework shall be removed from under bridge superstructures prior to opening the structure to traffic. Falsework shall be removed in such a manner that excessive stresses are not induced into the structure. Holes shall not be drilled into the structure to facilitate removal of the falsework. Round blockouts may be used for such purpose providing the contractor can submit evidence that the blockouts are not detrimental to the structure and the Engineer approves the use of the blockouts. The maximum blockout diameter shall not exceed six inches.

601-3.03(A) **General Requirements:** the twelfth paragraph of the Standard Specifications is modified to add:

This rate shall not apply to precast concrete members.

601-3.03(B) **Bridge Deck:** the eighth paragraph of the Standard Specification is revised to read:

Screed assemblies shall be equipped with vibrators. The screed assemblies shall be so designed that the vibrating units do not contact any reinforcing steel. Vibration shall be transmitted to the concrete in such a manner that when the motion of the machine is stopped, all vibration will cease.

601-3.03 **Placing Concrete:** of the Standard Specifications is modified to add:

(G) **Pedestrian Rail and Fence:**

This work shall consist of furnishing and constructing Traffic and Pedestrian Rail, Pedestrian Fence and Curb, Pedestrian Fence and Parapet, and Fence and Parapet, including all hardware and materials, in accordance with the requirements of the project plans.

(H) Bridge Barriers and Transitions:

This work shall consist of furnishing and constructing Bridge Concrete Barriers and Bridge Concrete Barrier Transitions, including all hardware and materials, in accordance with the requirements of the project plans.

(I) Approach and Anchor Slabs:

This work shall consist of furnishing and constructing reinforced concrete approach and anchor slabs for bridges, including all tools, equipment, labor, and materials. All work shall be in accordance with the details shown on the project plans and the requirements of the standard specifications.

601-3.04(B)(2) **Materials:** the second paragraph of the Standard Specifications is revised to read:

Steel shapes and plates shall conform to the requirements of ASTM A-36, or ASTM A-588.

601-3.04(B)(3)(f) **Galvanizing:** the first sentence of the first paragraph of the Standard Specifications is revised to read:

All metal parts of strip seal assemblies shall be galvanized after fabrication in accordance with the requirements of ASTM A123 and ASTM A153, unless ASTM A-588 steel is used.

601-3.09(B) **Materials:** the fourth paragraph of the Standard Specifications is revised to read:

A minimum of one test loop assembly per bridge or one test loop assembly for every 40 cable assemblies, which ever is greater, shall be furnished to the Engineer for testing. The test loop assembly shall be fabricated from the same lot of material, wire rope and fittings or clips as the cable assemblies. The test loop assembly shall be not less than 2'-3" or more than 2'-9" long when pulled taut.

601-4.02(A) **Cast-in-Place Concrete:** item (7) Girder Bearing Seats, of the Standard Specifications, is revised to read:

Deviation from plane surface (flatness): ±1/8 inch in ten feet.

Deviation from required elevation:

-1/4 inch
+1/8 inch

601-4.02(A) **Cast-in-Place Concrete:** item (8) Cast-in-Place concrete box girder superstructures, of the Standard Specifications, is modified to add:

Deviation of post-tensioning ducts:

±1/4 inch

601-4.02(B)(2) **Precast Concrete I-Beams:** of the Standard Specifications is revised to read:

The maximum allowable tolerances of deviations from dimensions and details shown on the project plans or the approved shop drawings shall be as follows:

(a) Length: ± 3/4 inch

(b) Width (flanges and fillets): +3/8 inch, -1/4 inch

(c) Depth (overall): +1/2 inch, -1/4 inch

(d) Width (web): +3/8 inch, -1/4 inch

(e) Depth (flanges and fillets): ± 1/4 inch

(f) Bearing plates (ctr. to ctr.):± 1/8 inch per 10 feet but not greater than ± 3/4 inch

(g) Horizontal alignment (deviation from straight line parallel to center line of member): 1/8 inch per every 10 feet in length

(h) Stirrup bars (deviation from top of beam): +1/4 inch, -3/4 inch

(i) Tendon position: ± 1/4 inch c.g. of strand group and individual strands

(j) Horizontal position of deflection points for deflected strands: ± 10 inches

(k) Position of handling devices: ± 6 inches

(l) Bearing plates (ctr. to end of beam): ± 1/4 inch

(m) Side inserts (ctr. to ctr. and ctr. to end):± 1/2 inch

(n) Exposed beam ends (deviation from square or designated skew):

Horizontal: ± 1/4 inch
Vertical: ± 1/8 inch per foot of beam depth

(o) Bearing area deviation from plane: ± 1/8 inch

(p) Stirrup bars (longitudinal spacing): ± 1 inch

(q) Position of post-tensioning duct: ± 1/4 inch

(r) Position of weld plates: ± 1 inch

601-4.02(B)(3) Precast Concrete Box Beams and Flat Slabs: of the Standard Specifications is revised to read:

The maximum allowable tolerances or deviations from dimensions and details shown on the project plans or the approved shop drawings shall be as follows:

(a) Length: ± 3/4 inch

(b) Width (over-all): ± 1/4 inch

(c) Depth (over-all): ± 1/4 inch

(d) Width (web): ± 3/8 inch

(e) Depth (top slab): ± 1/4 inch

(f) Depth (bottom slab) +1/4 inch, -1/8 inch

(g) Horizontal alignment (deviation from straight line parallel to center line of member): 1/8 inch per every 10 feet in length

(h) Camber differential between adjacent units: not greater than 3/4 inch

(i) Position of tendons: + 1/4 inch c.g. of strand group

(j) Longitudinal spacing of stirrup bars: ± 1 inch

(k) Position of handling devices: ± 6 inches

(l) Slab Void position: + 1/2 inch from end of void to center tie hole + 1 inch adjacent to end block

(m) Square ends (deviation from square): ± 1/2 inch

(n) Skew ends (deviation from designated skew): ± 1/2 inch

(o) Beam seat bearing area (variation from plane surface when tested with a straightedge through middle half of member): ± 1/8 inch

(p) Dowel tubes (spacing between the centers of tubes and from the centers of tubes to the ends and sides of members): ± 1/2 inch

(q) Tie rod tubes (spacing between the center of tubes and from the centers of tubes to the end of the member): ± 1/2 inch

(r) Tie rod tubes (spacing from centers of tubes to the bottom of the beams): ± 3/8 inch

(s) Total width of deck: theoretical width ± 1/2 inch per joint

(t) Position of side inserts: ± 1/2 inch

(u) Position of weld plates: ± 1 inch

601-4.04 **Opening to Traffic:** The first paragraph of the Standard Specifications is revised to read:

No vehicular traffic will be allowed on the structure until after the structure has been prestressed, tendons grouted, and all falsework removed from under the superstructure, for cast-in-place prestressed structures.

601-5 **Method of Measurement:** of the Standard Specifications is revised to read:

When concrete is to be paid for by the cubic yard, measurement will be made in accordance with the dimensions shown on the plans or such other dimensions as may be ordered in writing by the Engineer. No deduction will be made for the volume occupied by reinforcing steel, structural steel, prestressing materials, or pile ends embedded in the concrete.

The quantity of precast, prestressed structural members shall be measured to the nearest linear foot for each type and size of girder, box beam, or voided slab, as shown on the bidding schedule, installed in place, complete and accepted. Each member shall include the concrete, steel reinforcement and prestressing steel, enclosures for prestressing steel, anchorages, plates, nuts, elastomeric bearing pads, and such other materials contained within or attached to the unit.

Deck joint assemblies will be measured by the linear foot. Measurement will be made along the center line of the joint and at the surface of the roadway or sidewalk from face-of-curb or barrier to face-of-curb or barrier. Measurement will be to the nearest linear foot. No measurement will made for that portion of the deck joint assembly required by plan details to extend through the face-of-curb or barrier, such being considered as incidental to the sealing of the joint.

Measurement for vertical restrainers will be made for each restrainer acceptably installed in place for each bridge.

Traffic and Pedestrian Rail will be measured by the linear foot, determined from the outside dimensions of the rail. Pedestrian Fence and Curb, Pedestrian Fence and Parapet, and Fence and Parapet will be measured by the linear foot, from end post to end post. Measurements will be to the nearest linear foot.

Bridge Concrete Barrier, Type A, B, C, and 42" will be measured to the nearest linear foot. Bridge Concrete Barrier Transition will be measured as a unit for each constructed.

Reinforced Concrete Approach Slab will be measured to the nearest square foot.

Reinforced Concrete Anchor Slab will be measured to the nearest square foot. No measurement will be made for the reinforced concrete anchor lugs and "sleeper" slab.

601-6 **Basis of Payment:** of the Standard Specifications is modified to add:

The accepted quantities of Traffic and Pedestrian Rail, Pedestrian Fence and Curb, Pedestrian Fence and Parapet, and Fence and Parapet, measured as provided above, will be paid at the contract unit price, complete in place, including all concrete, reinforcing steel, rail, other materials, and labor. Reinforcing steel embedded below the curb, parapet or barrier shall be included in the deck slab, wingwall, approach or anchor slab.

The accepted quantities of Bridge Concrete Barrier, Type A, B, C, and 42" and Bridge Concrete Barrier Transition, measured as provided above, will be paid at the contract unit price, complete in place, including all concrete, reinforcing steel, rail, other materials, and labor. Reinforcing steel embedded below the barrier or transition shall be included in the superstructure, wingwall, approach or anchor slab as appropriate.

The accepted quantities of Reinforced Concrete Approach Slab, measured as provided above, will be paid for at the contract unit price, complete in place, including all concrete, reinforcing steel, labor, tools, equipment and incidentals.

The accepted quantities of Reinforced Concrete Anchor Slab, measured as provided above, will be paid for at the contract unit price, complete in place, including all concrete, reinforcing steel, labor, tools, equipment and incidentals. No payment will be made for furnishing all materials and constructing reinforced concrete anchor lugs and "sleeper" slabs, the cost being considered as included in the contract bid item for the reinforced concrete anchor slab.

(601PAINT, 07/15/91)

SECTION 601 - CONCRETE STRUCTURES: of the Standard Specifications is modified to add:

CONCRETE PAINT:

(1) Description:

An acrylic emulsion paint shall be applied to the following exposed concrete surfaces when painting is specified on the project plans:

- All surfaces of bridge superstructures including the sides and bottoms of cast-in-place box girders, both sides of precast girders, and the underside of decks exposed to traffic view,
- All surfaces of bridge piers, piles, columns, parapet walls and abutments, concrete retaining walls and noise barrier walls, to at least one foot below finished grade,
- All surfaces of bridge barriers and the sides and tops of permanent barriers not adjacent to the traveled way.

Top side of decks, sidewalks, inside of curbs, and downdrains shall be excluded from painting. Other areas to be excluded will be so specified on the project plans.

(2) Materials:

General Requirements:

Prior to application of the acrylic emulsion paint, the contractor shall provide the Engineer with three original copies of Certificate of Compliance for each lot or batch of paint supplied, in accordance with Subsection 106.05. The Certificate of Compliance shall certify compliance of the paint with each of the specified physical, chemical, and performance requirements for acrylic emulsion paint listed herein. In addition, product data sheets listing the paint constituents and their proportions as well as materials safety data sheets are required for any paint material supplied which is not on the Materials Section's approved list of acrylic emulsion paints for concrete surfaces.

Acrylic emulsion paint will be sampled and tested on a lot basis. At least one sample, not less than one quart in size, will be taken and tested. Random samples may be taken at the discretion of the Engineer.

The acrylic emulsion paint shall be ready-mixed at the manufacturer's plant.

Acrylic emulsion paint shall be furnished in new, unopened, air-tight containers which are clearly labeled with the exact title of the paint material, Federal Specification number (when applicable), name and address of manufacturer, date of paint manufacture and the lot or batch number. The containers shall conform to U.S. Department of Transportation Hazardous Material Shipping Regulations.

Precautions concerning the handling and the application of the paint shall be shown on the label of paint containers.

Physical And Chemical Requirements:

The water-borne acrylic emulsion paint shall conform to the requirements of Federal Specifications TT-P-19D for Paint, Acrylic Emulsion, Exterior. Deviations from the physical and chemical requirements of TT-P-19D may be allowed by the Engineer provided that the paint is an acrylic emulsion, applicable air pollution standards are met, and all performance requirements of TT-P-19D or as specified herein are met. The following are physical and chemical requirements for TT-P-19D paint which shall be adhered to unless otherwise approved by the Engineer.

Material Property	Requirement	Test Method
Resin	100% Acrylic	ASTM D2621
Volatile Organic Content (lb/gal)	2.1 max.	ASTM D3960
Total Solids by Weight (%)	50 min.	ASTM D2369
Total Solids by Volume (%)	40 min.	ASTM D2697
Nonvolatile Organic Content by Weight (%)	19 min.	ASTM D3723
Consistency (KU)	80-100	ASTM D562
Fineness of Dispersion	4 min.	ASTM D1210
Dry Time, Set-to-Touch	10 minutes min.	ASTM D1640
Dry Time, Through	2 hrs. max.	ASTM D1640

Unless otherwise shown on the project plans, the color of the paint shall approximate that of paint No. 30318, as specified by Federal 595a, when applied to either a concrete test specimen or to the surface of the concrete structures to be painted.

Performance Requirements:

(A) Resistance To Accelerated Weathering:

The paint shall be applied to concrete mortar panels and tested in a Q-U-V accelerated weathering tester according to ASTM G53, for 300 hours, utilizing UVB-313 lamps and the exposure cycle as specified in 4.3.5.2 of Federal Specification TT-P-19D. The paint weatherized in this manner shall show no appreciable change in color or appearance due to fading, chalking, or material reaction.

(B) TT-P-19D Requirements:

All performance requirements listed in Section 3 of Federal Specification TT-P-19D will be met as specified, when tested according to the applicable test methods as set forth in Section 4.

(C) Resistance to Peeling and Flaking:

The acrylic emulsion paint shall be applied to a concrete test specimen or to the final concrete surface and subjected to two methods of adhesion tape tests a minimum of 7 days of sunlight after application.

Adhesion shall be measured in accordance with the requirements of ASTM D3359.

Test Apparatus and Materials:

(a) Sharp razor blade, Exacto knife, scalpel, knife or other cutting device with a sharp cutting edge.

(b) Cutting Guide made of steel or other hard metal straightedge to ensure straight cuts.

(c) Tape, approximately one inch wide, semitransparent, pressure-sensitive, with an adhesion strength of 38 $\pm$ 5 oz./in. when tested in accordance with ASTM D3330.

(d) Rubber eraser on the end of a pencil.

(e) Illuminated magnifying glass to determine depth of cuts and evaluate adhesion.

X-Cut Test, Method A:

An X-cut is made in the film to the substrate, pressure-sensitive tape is applied over the cut and then removed, and adhesion is assessed qualitatively on a scale of 0 to 5. A rating of 3A will be required according to Section 6.7 of ASTM D3359.

Lattice Pattern Test, Method B:

A lattice pattern with six to eleven cuts in each direction is made in the paint film to the substrate, pressure-sensitive tape is applied over the lattice and then removed, and adhesion is evaluated by comparisons with Figure 1, ASTM D3359. By this method, adhesion is assessed qualitatively on a scale of 0 to 5. A rating of 2B will be required according to Section 11.9 of ASTM D3359.

(3) Construction Requirements:

Acrylic Emulsion paint shall be applied by an Arizona Licensed Painting Contractor that is acceptable to the manufacturer and the Engineer.

The method of application, the rate of application, the number of coats of application (minimum of two normally) and the surface temperature range of application shall be in accordance with the manufacturer's written recommendations. A copy of these recommendations shall be furnished to the Engineer prior to application of the paint.

The contractor shall furnish a preliminary sample of concrete with the required acrylic emulsion paint applied. The sample shall measure 2 feet by 2 feet and the concrete shall have a surface similar in pattern and texture to that to be used on the work. The paint shall be applied using the same methods that will be used to paint the concrete structures.

After the preliminary sample has been approved by the Engineer, a final sample shall be furnished measuring at least 4 feet by 10 feet. It shall be prepared as specified hereinbefore for the preliminary sample and shall be placed at the project site and left for three weeks for observation.

Inspection testing of the paint finish on both the preliminary and final samples will be performed by the Engineer. Such testing will consist of the same adhesion tests specified herein under Subsection 2.03(C) "Resistance to Peeling and Flaking," to verify penetration and adhesion of the paint finish.

No paint shall be applied on the project until the final sample has been approved by the Engineer.

All concrete shall be finished and cured in accordance with the requirements of the Specifications prior to the application of the paint.

Before the paint is to be applied, the concrete surfaces to be painted shall be sandblasted, then cleaned or washed in accordance with the paint manufacturer's written recommendations to remove all dirt, dust, curing agents, form release agents, efflorescence, scale or other foreign substances which could be detrimental to the paint application or color. All sandblasting shall be performed in strict compliance with regulations of local and governing authorities. All concrete surfaces to be painted shall be clean, completely dry, unless otherwise recommended by the paint manufacturer, and free of frost or other foreign substances at the time of the application of paint. Washing the sandblasted surface may be necessary to remove fine dust left over from blasting and to lower the pH of the surface to provide better paint adhesion.

The contractor shall provide such protection as is necessary to prevent damage to the work, or to property or persons, as a result of cleaning or painting operations.

After the structure has been prepared for the application of paint and prior to application, the contractor and a representative from the manufacturer of the paint shall inspect the surfaces to be painted and, if in agreement, shall notify the Engineer in writing that the surfaces are satisfactory for the paint to be applied. The contractor shall not commence application of the paint without specific direction from the Engineer.

Random inspection testing of the completed paint finish will be performed by the Engineer. Such testing shall consist of the same adhesion tests specified herein under 601-2.03(C) "Resistance to Peeling and Flaking," to verify adhesion of the paint finish. Any areas that show evidence of peeling or flaking shall be sandblasted and cleaned as previously specified, and refinished to match the paint finish of the surrounding concrete surfaces. The contractor shall repaint all damaged test inspection areas.

(4) Method of Measurement: and

(5) Basis of Payment:

No direct measurement or payment will be made for independent lab tests, sandblasting and cleaning surfaces, furnishing and applying acrylic emulsion paint, supplying samples and providing a manufacturer's representative as specified herein, the cost being considered as included in the cost of the concrete to be painted.

(602PRSTR, 12/15/94)

SECTION 602 PRESTRESSING CONCRETE:

602-1 Description: of the Standard Specifications is revised to read:

The work under this section shall consist of prestressing precast and cast-in-place concrete by furnishing, placing and tensioning of prestressing steel in accordance with the details shown on the project plans, and the requirements of these specifications.

The work under this section shall also include the furnishing and installation of any appurtenant items necessary for the particular prestressing system to be used, including ducts, anchorage assemblies and grout used for pressure grouting ducts for post-tensioning systems and strand deflection devices, such as hold-downs and hold-ups for pretensioning systems.

Prestressing for precast concrete members shall be performed by the pretensioning method. Prestressing for cast-in-place concrete structures shall be performed by the post-tensioning method.

602-2.01 Reinforcing Steel and Prestressing Steel: the last sentence of the fourth paragraph of the Standard Specifications is hereby deleted:

602-2.02 Ducts: of the Standard Specifications is revised to read:

Duct enclosures for post-tensioning steel shall be rigid galvanized ferrous metal.

602-2.03 **Grout:** The first paragraph of the Standard Specifications is revised to read:

Cement grout for bonding post-tensioning tendons shall consist of not more than five gallons of water to 94 pounds of portland cement and may contain an admixture if approved by the Engineer. The use of admixtures shall conform to the requirements of Subsection 1006-2.04(C). No admixtures containing chlorides or nitrates shall be used.

602-3.01 **Shop Drawings:** of the Standard Specifications is revised to read:

(A) **General:**

Shop drawings of the proposed prestressed concrete members shall be submitted in accordance with the requirements of Subsection 105.02.

The drawings shall show the method and procedure of jacking and the type, size, and properties of the strands and number of strands. The size, shapes, dimensions, and concrete cover shall be shown for the reinforcing steel, including any reinforcing steel to be relocated or added.

Calculations shall be submitted showing the elongation of the strands at the time of jacking, the initial forces in the strands, and the final working forces. These calculations may be submitted separately from the drawings, and should also include the latest calibration certifications for the jacking system. In addition, a graph shall be prepared showing the gauge pressure in pounds per square inch and force in thousands of pounds plotted through the whole range of the tensioning calibration. Not more than two years shall have elapse between any jack calibration.

In addition to all required working drawings, the contractor shall prepare composite drawings in plan, elevation and section which show to scale the relative positions of all items that are to be embedded in the concrete and their embedment depth for the portions of the structure that are to be prestressed. Such embedded items include the prestressing ducts, vents, anchorage reinforcement and hardware, reinforcing steel, anchor bolts, earthquake restrainers, deck joint assemblies, drainage systems, utility conduits and other such items. Such drawings shall be adequate to ensure that there will be no conflict between the planned positions of any embedded items, and that concrete cover will be adequate. If during the preparation of such drawings conflicts are discovered, the contractor shall revise his working drawing for one or more of the embedded items, or propose changes in the dimensions of the work as necessary to eliminate the conflicts or provide proper cover. Any such revisions shall be approved by the Engineer before work on an effected item is started.

(B) Pretensioning Method:

The shop drawings shall show the strand locations and harping points of the strands.

The drawings shall identify the type of finish or surface condition on the top of the precast member.

(C) Post-tensioning Method:

The drawings shall show the type, size, and properties of the strands or bars and the anchorage assemblies. The number of strands per tendon shall be shown. Details in addition to those shown on the contract plans shall be included for any additional reinforcing steel required to resist the concrete bursting stresses in the vicinity of the anchorage assemblies. The force or stress diagram shall be shown on the drawings. The sizes, shapes, dimensions, and concrete cover shall be shown for the ducts. Lay-out dimensions for locating the ducts along the tendon path shall not exceed 15 foot intervals. Vent locations and details of the vents shall also be included on the drawings.

Calculations shall be submitted showing the stresses in the anchorages and distribution plates.

The drawings shall include complete details of the method, materials, and equipment proposed for use in the prestressing operations. Such details shall outline the method and sequence of jacking, complete details of the prestressing steel, anchoring devices, type of enclosures, block-outs, and all other data pertaining to the post-tensioning system or operations.

602-3.02 Approval of Prestressing Systems: of the Standard Specifications is revised to read:

If post-tensioning system has been tested and approved by the California Department of Transportation, a copy of the approval letter from the Caltrans "Division of New Technology and Research" (including any details associated with the approval) shall be submitted with the shop drawings by the post-tensioning company.

The approval of any prestressing systems for cast-in-place structures not approved by the California Department of Transportation will be contingent on prequalification testing by the contractor, at his expense, of complete tendon assemblies as proposed for use and the submittal of written information as requested by the Engineer.

The contractor shall provide a calibration of the post-tensioning jacking system and shall provide the appropriate control settings for the Department's transducer, electro-hydraulic load cell system by testing the jacking system in a manner that has been pre-approved by the Engineer.

Any deviation from the approved materials and details will not be permitted unless new details are submitted by the contractor and approved in advance of use.

The approval of any proposed method, material or equipment shall not operate to relieve the contractor in any respect of full responsibility for successfully completing the prestressing in accordance with details shown on the project plans and the requirements of these specifications.

602-3.03 **Sampling and Testing:** of the Standard Specifications is revised to read:

Sampling and testing shall conform to the requirements of AASHTO M 203, AASHTO M 204 and as specified herein.

Samples from each size and each heat of prestressing bars, from each manufactured reel of prestressing steel strand, from each coil of prestressing wire, and from each lot of bar couplers to be used shall be furnished for testing. With each sample of prestressing steel wires, bars or strands furnished for testing, a Certificate of Compliance conforming to the requirements of Subsection 106.05 shall be submitted stating the manufacturer's minimum guaranteed ultimate tensile strength of the sample furnished.

All materials for testing shall be furnished by the contractor at his expense. The contractor shall have no claim for additional compensation in the event his work is delayed awaiting approval of the materials furnished for testing.

All bars of each size from each mill heat, all wire from each coil, and all strand from each manufactured reel to be shipped to the job site shall be assigned an individual lot number and shall be tagged in such a manner that each lot can be accurately identified at the job site. Each lot of anchorage assemblies and bar couplers to be installed at the job site shall be likewise identified. All unidentified prestressing steel, anchorage assemblies or bar couplers recovered at the job site will be rejected.

602-3.04 **Anchorage and Distribution:** the title for Subsection 602-3.04 of the Standard Specifications is revised to read:

602-3.04 **Anchorage and Distribution for Post Tensioned Structures:**

602-3.05 **Duct Installation:** the fourth paragraph of the Standard Specifications is revised to read:

Ducts for prestressing steel shall be securely fastened in place to prevent movement and displacement during concreting. Ducts shall be placed within ± 1/4 inch of the dimensions shown on the approved shop drawings.

602-3.05 **Duct Installation:** the title for Subsection 602-3.05 of the Standard Specifications is revised to read:

602-3.05 **Duct Installation for Post-tensioned Structures:**

602-3.06(A) **General:** the fourth paragraph of the Standard Specifications is revised to read:

All gauges shall be either a reading dial of at least six inches in diameter or a digital display indicator. The increments shown on the reading dial gauge shall not exceed two percent of the jacking force. The digital display indicator shall be readable by normal vision at a distance greater than ten feet. All gauges shall show a load accuracy of one percent of the load, from one percent to a hundred percent of the capacity of the gauge.

602-3.06(A) **General:** of the Standard Specifications is modified to add:

The tensioning process shall be so conducted that the force being applied and the elongation of the prestressing steel may be measured at all times. The actual elongation obtained from the calibrated force value shall be compared with the theoretical calculated elongation. If the actual measured elongation differs by more than five percent of the theoretical calculated elongation, the entire operation shall be carefully checked and the source of the error determined and corrected before proceeding with the tensioning. A record of the prestressing force and elongations shall be kept at all times and submitted to the Engineer for approval.

602-3.06(B) **Pretensioning Precast Concrete:** the first paragraph of the Standard Specifications is revised to read:

The tensioning force in pretensioned strands shall not be transferred to the member until tests on cylinder specimens made and cured under the same conditions as the member indicate the required compressive release strength has been attained. This shall constitute the end of the curing period.

602-3.06(C) **Post-Tensioning Cast-in-Place Concrete:** The fourth paragraph of the Standard Specifications is hereby deleted:

602-3.07 **Grouting of Post-Tensioned Members:** of the Standard Specifications is revised to read:

Post-tensioned prestressing steel shall be bonded to the concrete by completely filling the entire void space between the duct and the tendon with grout.

All of the tendons in a cast-in-place concrete structure shall have been fully tensioned and anchored prior to any grouting operation.

The grout shall be mixed in mechanical mixing equipment of a type that will produce uniform and thoroughly mixed grout. Water shall be first added to the mixer followed by cement. Retempering of grout will not be permitted. All grout shall pass through a screen with 1/8 inch maximum clear openings prior to being placed in the grouting equipment and shall be continuously agitated until it is pumped.

The quality of the grout shall be determined by the Engineer in accordance with the requirements of Arizona Test Method 311. The efflux time of a grout sample immediately after mixing shall be not less than 11 seconds.

The maximum temperature of the grout shall be 90 degrees F. and the minimum 50 degrees F.

Grouting equipment shall be capable of grouting at a pressure of at least 150 pounds per square inch and shall be furnished with a pressure gauge having a full scale reading of not more than 300 pounds per square inch. Maximum grouting pressure shall not exceed 250 pounds per square inch.

Standby flushing equipment capable of developing a pumping pressure of 250 pounds per square inch and of sufficient capacity to flush out any partially grouted ducts shall be provided and available at the job site. Equipment capable of providing dry, oil free compressed air for removing water from the ducts shall be available at the site.

All ducts shall be clean and free of deleterious materials that would impair bonding of the grout or interfere with grouting procedures. Compressed air used to blow out the ducts shall be oil free.

Grout injection pipes shall be fitted with positive mechanical shutoff valves. Ejection pipes shall be fitted with valves capable of withstanding the pumping pressures. Valves shall not be removed or opened until the day following the grouting operation, unless otherwise approved by the Engineer. Draped tendons exceeding 400 feet in length shall be vented at all high points. Grout vents shall be made of rigid tubing or pipe with threaded fittings and shutoff valves.

Grout shall be injected at the low end of the duct and continuously wasted at the outlet until no visible slugs of water or air are ejected. The outlet pipe shall then be closed and the duct shall then be pressurized. The pressurized duct shall maintain a minimum pressure of 75 pounds per square inch for a minimum time of one minute. The valve at the inlet shall then be closed while maintaining this minimum pressure.

When hot weather conditions would contribute to quick stiffening of the grout, the grout shall be cooled by approved methods as necessary to prevent blockages during pumping operations. The use of an approved chemical admixture should also be considered for increasing the pumping efficiency and/or time of set.

When freezing weather conditions will prevail during and following the placement of grout, the contractor shall provide adequate means to protect the grout in the ducts from damage by freezing.

The surfaces of concrete against which concrete encasement over anchorage assemblies is to be placed shall be abrasive blast cleaned and aggregate exposed after grouting of the ducts has been completed.

SECTION 602 PRESTRESSING CONCRETE: of the Standard Specifications is modified to add:

602-3.08 Finishing Precast Concrete:

The finishing of precast concrete bridge members shall comply with the requirements of Subsection 601-3.05. In addition, those exterior surfaces of exterior bridge members normally in the view of vehicular or pedestrian traffic shall be finished in accordance with the requirements for a Class II Finish.

Unless otherwise specified on the plans, the top surface of I-beams, box beams, and flat slabs shall be roughened with a hand tine rake while the concrete is still plastic.

All projecting strands that are not scheduled to remain for future embedment shall be cut off at the surface of the concrete. Strands that are to remain shall be cut and bent to the dimensions shown on the plans. If the end of the precast bridge member will not be embedded in cast-in-place concrete, then all the strands shall be cut or ground flush with the surface of the concrete and thoroughly coated with a bitumastic type sealant.

Exposed uncoated reinforcing bars and strand shall be cleaned of concrete laitance and other foreign materials. If concrete laitance are allowed to harden and other foreign materials to remain on the bars, then abrasive blast methods will be conducted for cleaning. The cleaning of exposed epoxy coated reinforcing steel shall be limited to methods not damaging to the coating, the actual cleaning to be completed while the concrete laitance are still plastic. Any damage done to the epoxy coating shall be repaired in accordance with Subsection 605-3.03(B).

The work described in this subsection shall be accomplished in the production yard of the precast manufacturer. When the fabrication of any precast bridge member has been successfully completed, as determined by inspection, the unit will then be approved for transportation.

SECTION 602 PRESTRESSING CONCRETE:

602-1 Description: of the Standard Specifications is modified to add:

The anchorage zone is the portion of the structure in which the concentrated prestresssing force is transferred from the anchorage device onto the concrete (Local Zone), and then distributed more widely into the structure (General Zone). The local zone is the volume of concrete surrounding and immediately ahead of the anchorage device, subjected to high local bearing stresses. The general zone is the region within which the concentrated prestressing force spreads out to a more linear stress distribution over the cross section of the member.

The Engineer of Record is responsible for the overall design and approval of working drawings for the general zone, including the specific location of the tendons and anchorage devices, general zone reinforcement, and the specific stressing sequence. The Engineer of Record is also responsible for the design of local zones for basic anchorage devices meeting the requirements of Subsection 602-3.02(A) and for the approval of special anchorage devices used under the provisions of Subsection 602-3.02(B). All working drawings for the local zone must be approved by the Engineer of Record.

Anchorage device suppliers are responsible for furnishing anchorage devices which satisfy the anchor efficiency requirements of Subsection 602-3.04. In addition, if special anchorage devices are used, the anchorage device supplier is responsible for furnishing anchorage devices that satisfy the acceptance test requirements of Subsections 602-3.02(B) and 602-3.02(C). This acceptance test and the anchor efficiency test shall be conducted by an independent testing agency acceptable to the Engineer of Record. The anchorage device supplier shall provide records of the acceptance test in conformance with Subsection 602-3.03(D) to the Engineer of Record and to the contractor and shall specify auxiliary and confining reinforcement, minimum edge distance, minimum anchor spacing, and minimum concrete strength at time of stressing required for proper performance of the local zone.

The contractor is responsible for the proper placement of all materials according to the design documents of the Engineer of Record and the requirements stipulated by the anchorage device supplier. The contractor shall exercise all due care and attention in the placement of anchorage hardware, reinforcement, concrete and consolidation of concrete in anchorage zones. Modifications to the local zone details verified under provisions of Subsections 602-3.02(B), 602-3.02(C) and 602-3.03(D) shall be approved by both the Engineer of Record and the anchorage device supplier.

602-2.05 **Portland Cement Concrete:** of the Standard Specifications shall be revised to read:

Portland cement concrete shall conform to the requirements of Section 1006 for the class and strength of concrete shown on the project plans.

For post-tensioned members, the Engineer of Record will verify the anchorage zone design based on the actual devices and configuration submitted by the anchorage device supplier. The required initial concrete strength will be verified by the Engineer of Record and clearly shown on the shop drawings.

602-3.01(C) **Post-tensioning Method:** of the Standard Specifications is revised to add:

The anchorage device supplier may submit one copy of the shop drawings directly to the Engineer of Record to allow the Engineer of Record to verify the anchorage zone design prior to final submittal of the shop drawings.

602-3.02 Approval of Prestressing Systems: the first two paragraphs of the Standard Specifications are revised to read:

Anchorage devices may be either basic anchorage devices or special anchorage devices. A basic anchorage device is an anchorage device meeting the requirements of Subsection 602-3.02(A). A special anchorage device is an anchorage device whose adequacy must be proven experimentally in the standardized acceptance test in accordance with Subsection 602-3.02(B). Both basic and special anchorage devices must also meet the anchor efficiency test criteria in accordance with Subsection 602-3.04.

602-3.02(A) Basic Anchorage Devices: of the Standard Specifications is revised to add:

A basic anchorage device is an anchorage device meeting restricted bearing compressive strength limits. The compressive stress on the concrete directly underneath the plate or anchorage shall not exceed the initial concrete strength shown on the project plans or the value specified in the AASHTO Bridge Specifications Division I, Article 9.21.7.2.2. The anchorage device shall also meet the minimum plate stiffness requirements specified in Article 9.21.7.2.3 and 9.21.7.2.4.

602-3.02(B) Special Anchorage Devices: of the Standard Specifications is revised to add:

Special anchorage devices that do not meet the requirements of a basic anchorage device may be used provided that they have been tested by an independent testing agency acceptable to the Engineer of Record according to the procedures described in Subsection 602-3.02(C) and meet the acceptance criteria specified in Subsection 602-3.03(D). For a series of similar special anchorage devices, tests are only required for representative samples . However, if the specific size of an anchorage device in a series is one that has not been tested, then the design requirements of the local zone including reinforcing provided shall be based on the next larger size anchorage device which has been tested.

602-3.02(C) Special Anchorage Device Acceptance Test: of the Standard Specifications is revised to add:

The test block for the special anchorage device acceptance test shall be a rectangular prism. It shall contain those anchorage components which will also be embedded in the structure's concrete. Their arrangement has to comply with the practical application and the suppliers specifications. The test block shall contain an empty duct of size appropriate for the maximum tendon size which can be accommodated by the anchorage device.

The dimensions of the test block perpendicular to the tendon in each direction shall be the smaller of the minimum edge distance or the minimum spacing specified by the anchorage device supplier, with the stipulation that the cover over any confining reinforcing steel or supplementary skin reinforcement be appropriate for the particular application and environment. The length of the block along the axis of the tendon shall be at least two times the larger of the cross-section dimensions.

The confining reinforcing steel in the local zone shall be the same as that specified by the anchorage device supplier for the particular system.

In addition to the anchorage device and its specified confining reinforcement steel, supplementary skin reinforcement may be provided throughout the specimen. This supplementary skin reinforcement shall be specified by the anchorage device supplier but shall not exceed a volumetric ratio of 0.01.

The concrete strength at the time of stressing shall be greater than the concrete strength of the test specimen at time of testing.

Either of three test procedures is acceptable: cyclic loading described in Subsection 602-3.03(A), sustained loading described in Subsection 602-3.03(B), or monotonic loading described in Subsection 602-3.03(C). The loads specified for the tests are given in fractions of the ultimate load F_{pu} of the largest tendon that the anchorage device is designed to accommodate. The specimen shall be loaded in accordance with normal usage of the device in post-tensioning applications except that load can be applied directly to the wedge plate or equivalent area.

602-3.03(A) Cyclic Loading Test: of the Standard Specifications is revised to add:

In a cyclic loading test, the load shall be increased to $0.8F_{pu}$. The load shall then be cycled between $0.1F_{pu}$ and $0.8F_{pu}$ until crack widths stabilize, but for not less than 10 cycles. Crack widths are considered stabilized if they do not change by more than 0.001 inch over the last three readings. Upon completion of the cyclic loading the specimen shall be preferably loaded to failure or, if limited by the capacity of the loading equipment, to at least $1.1F_{pu}$.

Crack widths and crack patterns shall be recorded at the initial load of $0.8F_{pu}$, at least at the last three consecutive peak loadings before termination of the cyclic loading, and at $0.9F_{pu}$. The maximum load shall also be reported.

602-3.03(B) Sustained Loading Test: of the Standard Specifications is revised to add:

In a sustained loading test, the load shall be increased to $0.8F_{pu}$ and held constant until crack widths stabilize but for not less than 48 hours. Crack widths are considered stabilized if they do not change by more than 0.001 inch over the last three readings. After sustained loading is completed, the specimen shall be preferably loaded to failure or, if limited by the capacity of the loading equipment, to at least $1.1F_{pu}$.

Crack widths and crack patterns shall be recorded at the initial load of $0.8F_{pu}$, at least three times at intervals of not less than four hours during the last twelve hours before termination of the sustained loading, and during loading to failure at $0.9F_{pu}$. The maximum load shall also be reported.

602-3.03(C) Monotonic Loading Test: of the Standard Specifications is revised to add:

In a monotonic loading test, the load shall be increased to $0.9F_{pu}$ and held constant for 1 hour. The specimen shall then be preferably loaded to failure or, if limited by the capacity of the loading equipment, to at least $1.2F_{pu}$.

Crack widths and crack patterns shall be recorded at $0.9F_{pu}$ after the one hour period, and at $1.0F_{pu}$. The maximum load shall also be reported.

602-3.03(D) Test Acceptance Criteria: of the Standard Specifications is revised to add:

The strength of the anchorage zone must exceed:

Specimens tested under cyclic or sustained loading . . . . . .1.1 F_{pu}
Specimens tested under monotonic loading . . . . . 1.2 F_{pu}

The maximum crack width criteria specified below must be met for moderately aggressive environments. For higher aggressive environments the crack width criteria shall be reduced by at least 50 percent. The type of environment, moderately aggressive or higher aggressive, shall be as specified on the plans.

(1) No cracks greater than 0.010 inch at $0.8F_{pu}$ after completion of the cyclic or sustained loading, or at $0.9F_{pu}$ after the 1 hour period for monotonic loading.

(2) No cracks greater than 0.016 inch at $0.9F_{pu}$ for cyclic or sustained loading, or at $1.0F_{pu}$ for monotonic loading.

A test series shall consist of three test specimens. Each one of the tested specimens must meet the acceptance criteria. If one of the three specimens fails to pass the test, a supplementary test of three additional specimens is allowed. The three additional test specimen results must meet all acceptance criteria in this section.

For a series of similar special anchorage devices, tests will only be required for representative samples of the anchorages in the series.

Records of the anchorage device acceptance test shall include:

(1) Dimensions of the test specimen.
(2) Drawings and dimensions of the anchorage device, including all confining reinforcing steel.
(3) Amount and arrangement of supplementary skin reinforcement.
(4) Type and yield strength of reinforcing steel.
(5) Type and compressive strength at time of testing of concrete.
(6) Type of testing procedure and all measurements required in Subsections 602-3.03(A) through 602-3.03(C).

602-3.04 Anchorage and Distribution for Post-tensioned Structures: of the Standard Specifications is modified to read:

All post-tensioned prestressing steel shall be secured at the ends by means of approved permanent type anchoring devices meeting the requirements of either a basic or a special anchorage device.

All anchorage devices for post-tensioning shall meet the following anchor efficiency requirements: the anchorage device shall hold the prestressing steel without exceeding anticipated set at a load producing a stress of not less than 95 percent of the guaranteed minimum tensile strength of the prestressing steel.

The load from the anchoring device shall be distributed to the concrete by means of approved devices that will effectively distribute the load to the concrete by meeting the requirements of a basic anchorage device or a special anchorage device.

605-5 Basis of Payment: the second paragraph of the Standard Specifications is revised to read:

Furnishing and placing reinforcement not shown on the project plans and required only for local zone reinforcement, anchorage zone recesses, blocks, duct ties and grillage assemblies, as required by the post-tensioning system used shall be considered as included in the lump sum price paid for prestressing cast-in-place concrete. Bursting and edge tension reinforcing in the General Zone have been designed based on an assumed number and type of anchorage devices and stressing sequence. Other systems may be used, but the cost of any additional General Zone reinforcing required shall be the responsibility of the post-tensioner and included in the lump sum price for prestressing cast-in-place concrete.

Assumptions used in the General Zone design shall be clearly stated on the plans. When the shop drawings are submitted, the Engineer of Record will verify the design based on use of the actual devices submitted by the anchorage device supplier.

No increase in the Bid price for concrete will be made for required increased concrete strengths based on the chosen post-tensioning system.

ITEM 6045011 - ACCESS BARRIER (PIPES)
ITEM 6045012 - ACCESS BARRIER (CULVERTS)

Description:

The work under this item consists of fabricating, furnishing all materials and placing access barriers at the locations and in accordance with the details shown on the project plans and the requirements of these Special Provisions and as directed by the Engineer.

Materials:

Refer to the project plans.

Construction Requirements:

The access barriers shall be installed in accordance with the details shown on the project plans. All steel for the access barriers shall be galvanized after fabrication.

Method of Measurement:

Measurement of this work will be made for each type of access barrier acceptably installed in place.

Basis of Payment:

Payment for this work will be made at the contract price for each access barrier for ITEM 6045011 and ITEM 6045012 which price shall be full compensation for the item complete in place.

ITEM 6050101 - PLACE DOWELS:

Description:

The work under this item consists of fabricating, furnishing all materials and placing dowels at the locations and in accordance with the details shown on the project plans and the requirements of these Special Provisions and as directed by the Engineer.

Materials:

Reinforcing steel shall conform to the requirements of Section 1003.

Construction Requirements:

The edge of the pavement shall be cleaned of all foreign or loosened material. Dowel placement shall consist of drilling or coring dowel holes, furnishing and placing setting materials and placing metal dowels in accordance with the details shown on the plans and the requirements of these special provisions.

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. The holes shall be drilled at mid-depth of the existing slab.

Setting materials shall be an approved epoxy adhesive unless otherwise specified on the plans.

Method of Measurement:

Measurement of this work will be made for each dowel acceptably installed in place.

Basis of Payment:

Payment for this work will be made at the contract price for each dowel for ITEM 6050101 which price shall be full compensation for the item complete in place.

SECTION 605 - STEEL REINFORCEMENT:

605-3.01 Construction Requirements: of the Standard Specifications is modified to add:

Before placing the pier column and superstructure reinforcement, the contractor shall insure that the vertical reinforcing steel will not interfere with the horizontal cap reinforcing steel and tendon ducts. Reinforcing steel shall not be cut to facilitate installations.

ITEM 6060080 - FOUNDATION FOR SIGN BRIDGE STRUCTURE (STA 299+00)

DESCRIPTION:

The work under this item consists of furnishing all materials and constructing a sign bridge foundation at the location and in accordance with the details shown on the project plans. This foundation provides support for Sign Structure No. 7 at Wall L9.

Materials:

Concrete for the drilled shaft and formed column shall be Class S (f'c=3,500 Psi) conforming to the requirements of Section 1006 of the Standard Specifications.

Reinforcing steel shall be Grade 60 and shall conform to the requirements of Section 1003 of the standard Specifications.

Construction Requirements:

Where the drilled shaft and/or formed column interfere with the footing and stem of Wall L9, the wall shall be coped to clear the shaft/column and the space between shall be filled with 1" polystyrene. Reinforcing in Wall L9 shall be terminated with 2" concrete cover to the coped surface. If the contractor elects to use a MSE wall system, the MSE working drawings shall show all details of the intersection between the shaft/column and Wall L9.

Construction requirements for the drilled shaft shall conform to Section 609 of the Standard Specifications.

Method of Measurement:

Measurement will be on a lump sum basis including concrete, reinforcing steel, polystyrene, anchor bolts, and all labor required to construct the drilled shaft/formed column foundation including all associated modifications to Wall L9.

Basis of Payment:

Payment for this item will be made at the contract lump sum price which shall be full compensation for the the item complete and in place as described herein and specified on the project plans and Standard Specifications.

SECTION 606 - OVERHEAD SIGN STRUCTURES:

606-1 Description: of the Standard Specifications is modified to add:

Based on the project plans the contractor shall recalculate all column lengths for all sign support structures. The column lengths shown on the project plans are approximate. The contractor shall submit a summary of column lengths to the Engineer along with the shop drawings of the structures prior to ordering any materials.

The contractor shall clearly mark the station locations of each sign structure on the shop drawings.

The cost of grading shall be included in the cost of foundations.

606-3.01 Shop Drawings: of the Standard Specifications is modified to add:

Due to clearance requirements and/or sign sizes, special designs may be required for tapered tube single beam sign support structures. Shop drawings for these sign support structures shall be accompanied by all calculations used to arrive at the proposed designs.

Shop drawings, calculations, and designs for tubular frame, tubular cantilever, and tapered tube single beam sign support structures shall be stamped and signed by a Registered Professional Engineer.

Standard drawings, B-40.10 and B-40.20 give the limits to which the standard designs for tubular sign structure drawings apply. For sign structures loaded beyond these limits, the following conditions shall apply:

The contractor shall submit three copies of calculations prepared and stamped by an Arizona Registered Structural Engineer, for review by the Engineer. Such review may not be comprehensive or complete, its principal purpose being to verify that suitable structural calculations have been made in the design of the sign support structures. The contractor and his Engineer shall be fully responsible for the completeness and accuracy of the calculations. The calculations shall utilize accepted standard engineering principles. If a computer program is utilized, the manufacturer shall furnish the Engineer with the necessary information to conduct a meaningful review. Nevertheless, if on completion of his review, the Engineer is not satisfied with any part of the calculations, he may return one copy with comments. The contractor shall then comply with such comments and resubmit the calculations. The process of calculation review shall be reiterated a maximum of three times until approved or rejected by the Engineer. If, after three submittals the Engineer has not been satisfied, the sign support structure(s) will be rejected and the contractor shall obtain another manufacturer and repeat this process at no additional cost. The contractor shall submit the sign support structure(s) design calculation package within 30 days of the Preconstruction conference.

Design calculations shall be based on a design wind load of 80 mph. The method of calculation shall take full account of secondary bending caused by axial loads in their final positions under full design wind and gravity loadings.

A preliminary set of shop drawings shall be submitted with the design calculations.

(606FBSGN, 03/31/93)

SECTION 606 - OVERHEAD SIGN STRUCTURES:

606-3.02 **Fabrication:** of the Standard Specifications is revised to read:

Fabrication of component parts of the sign structures shall be in accordance with the approved shop drawings and shall conform to the requirements of Division II, Construction, Section 11 - Steel Structures of the AASHTO Standard specifications for Highway Bridges.

SECTION 608 - SIGN PANELS: of the Standard Specifications is revised to read:

608-1 Description:

The work under this section shall consist of furnishing and installing sign panels in accordance with the details shown on the plans and the requirements set forth herein.

The sign panels shall be of the following types:

- Extruded Aluminum Sign Panels
- Overhead Sign Panels
- Overlaid Sign Panels
- Flat Sheet Aluminum Sign Panels With Demountable Characters
- Flat Sheet Aluminum Sign Panels With Direct Applied or Silk Screened Characters
- Warning, Marker, and Regulatory Sign Panels
- Route Shields for Installation on Sign Panels

608-2 Materials:

608-2.01 General:

Certificates of Compliance conforming to the requirements of Subsection 106.05 for all materials, including reflective sheeting, required for fabricating sign panels shall be submitted.

Shipment, storage, and handling of sign panels shall conform to the recommendations of the manufacturers of the sign panel components. Fabricated signs and overlay sheets shall be shipped on edge. Damage to the sign panel or legend resulting from banding, crating or stacking may be cause for rejection of the signs.

If characters are attached to overlay sheets during shipment, the characters shall be attached by removable screws. These screws shall be removed and replaced by rivets placed through the overlay sheet and substrate as the overlay sheet is permanently mounted on the substrate.

608-2.02 Extruded Aluminum Sign Panels

Panels shall be fabricated from 12-inch wide aluminum extrusions formed from Aluminum Alloy 6063-T6 conforming to the requirements of ASTM B 221 and fastened together by bolt connections as shown on the plans.

Panel facing shall be reflectorized sheeting of the color specified on the project plans. The reflective sheeting and color shall conform to the requirements of Section 1007.

The letters, numerals, symbols, borders and other features of the sign message shall conform to Subsection 608-2.14 Demountable Characters.

Panel surfaces to be covered with reflective sheeting shall be prepared in accordance with the recommendations of the sheeting manufacturer. Panel surfaces not covered with sheeting shall be etched in accordance with the recommendations of the extrusion manufacturer to reduce glare from reflected sunlight.

After all fabrication has been completed, including the cutting and punching of holes except holes for demountable letters, numerals, symbols and borders, the aluminum extrusions shall be degreased and the reflective sheeting shall be applied.

Aluminum extrusions shall be flat with a ¼-inch tolerance allowed on an eight-foot length, with proportionally greater tolerances permitted on lengths greater than eight feet. Flatness tolerance across the face of each extrusion shall be 0.005 inch per inch of width.

Aluminum extrusions shall be bolted together on 12 inch centers with a maximum allowable gap of 1/32 inch between extrusions.

Shop fabricated sub-assemblies shall be rigidly braced for transportation and erection. Hardware utilized to fasten panels to supports shall conform to the panel manufacturer's recommendations.

Each completed sign panel shall be provided with a side trim molding fabricated from extruded Aluminum Alloy 6063-T6 conforming to the requirements of ASTM B 221. The trim molding shall be fastened to each individual 12-inch aluminum extrusion with two, 5/32-inch diameter, self-plugging aluminum blind rivets 2½ inches from either edge. The exposed surface of the side trim molding shall be treated by etching as recommended by the manufacturer to reduce glare from reflected sunlight.

Each completed sign panel shall be shipped with sufficient bolt clamps placed to install the panel on the sign posts as shown in the plans. Bent bolt channels will be cause for rejection of the sign panel.

608-2.03 Deleted

608-2.04 Overhead Sign Panels:

Panels, except Warning and Regulatory Sign Panels, installed over traffic lanes or shoulders on Overhead Sign Structures shall consist of new extruded aluminum sign panels. The extruded aluminum sign panels shall conform to the requirements specified under Subsection 608-2.02.

The letters, numerals, symbols, borders and other features of the sign message shall consist of Demountable Characters conforming to Subsection 608-2.14.

The panels shall be shop fabricated and shipped complete or as sub-assemblies, the characters rigidly attached.

Shop fabricated sub-assemblies shall be rigidly braced for transportation and erection. Hardware utilized to fasten panels to supports and shipping braces shall conform to the panel manufacturer's recommendations.

608-2.05 Overlaid Sign Panels:

Panels shall be fabricated by attaching three-foot and four-foot widths of 0.063 inch thick, 5052-H38 aluminum overlay sheets to new or existing sign panel substrates as called for in the plans. The sheets shall be equal to the height of the sign to which applied. The substrate shall be Extruded Aluminum Sign Panels as specified under Subsection 608-2.02. One surface of the overlay sheet shall be prepared and covered in accordance with the recommendations of the reflective sheeting manufacturer with retroreflective sheeting. The color of sheeting shall be as called for in the project plans. The reflective sheeting on overlay sheets for each sign panel shall be color matched and shall be from the same manufacturing lot and run.

When the plans call for overlaying existing sign panels, the panels shall be lowered to the ground by removing the panels from the existing supports or by detaching the existing supports at the base or hinge plate. If the panels are removed from the existing supports they shall be braced on the back by attaching steel shapes of equal or greater weight to that of the existing supports with post clamps. Existing borders and sign message characters shall be removed by drilling through the heads of the mounting rivets or by shearing the rivets with a flathead shovel or trowel. Existing characters shall not be reused.

Before overlaying, bullet holes, dents and minor bent sections of existing extrusions shall be flattened with a hammer so that the sign face is free of projections or large indentations.

All overlay sheets shall be placed in accordance with Standard Drawing 4-S-3.03 except as noted herein.

For panels greater than six feet in height, the contractor shall uniformly warp the substrate panel in the vertical direction during the overlay procedure in such a manner that when the overlaid sign is complete and remounted in place, the overlay panels shall be flat against the substrate panel with no deformities visible from a distance of 50 feet.

Rivet all overlay sheets at the top and bottom using the following rivet pattern: Equally space rivets such that four-foot-wide overlay sheets have six rivets and three-foot-wide sheets have five rivets. One of these rivets shall be placed through the overlap of adjacent overlay sheets.

Place rivets at one-foot spacing on the seams starting at the vertical center and working toward the top and bottom.

Place rivets at two-foot horizontal and one-foot vertical spacing across the face of the overlay panel.

Panels having a minimum dimension of four feet or less shall be overlaid with one unspliced sheet.

After all border and copy is installed, all open edges on the panels shall be riveted at approximately one-foot intervals.

All rivets used shall be 5/32-inch diameter, self-plugging aluminum blind rivets anodized to the color of the sign panel face, border or letter in which placed except when placed in white, then plain silver may be used. Rivets placed in the characters shall be shoulder rivets at least ¾ inch in length. Rivets placed in the panel face shall be at least ½ inch in length. All rivets shall extend through the panel face and set tight.

When the plans call for modifying existing sign panels, the edge trim moldings shall be removed, cut to the new length, and reinstalled on the modified panel after it has been overlaid.

Overlay sheets shall be stored as described under Subsection 608-2.01.

Additional post clamps required to reinstall the sign panel shall be supplied by the contractor. Additional clamps shall be installed by grinding the flange of the substrate extrusion bolt channel to a sufficient width to insert the square head bolt. Bending of the bolt channel shall not be allowed.

608-2.06 Flat Sheet Aluminum Sign Panels With Demountable Characters:

Panels shall be fabricated from one piece of 0.125 inch thick, 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B 209.

Panel facing shall be prepared and covered with sheeting in accordance with the recommendations of the sheeting manufacturer. The color shall be as specified on the plans.

All surfaces not covered shall be etched to reduce glare from reflected sunlight.

The reflective sheeting and color shall conform to the requirements of Section 1007. Splicing of reflective sheeting shall not be allowed on sign panels having a minimum dimension up to and including four feet.

The letters, numerals, symbols, borders and other features of the sign message shall consist of Demountable Characters conforming to Subsection 608-2.14.

608-2.07 Flat Sheet Aluminum Sign Panels With Direct Applied or Silk Screened Characters:

Panels shall be fabricated from 0.125 inch thick, 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B 209.

Panel facing shall be prepared and covered with reflective sheeting in accordance with the recommendations of the sheeting manufacturer. The color of the sheeting shall be as specified on the plans.

All surfaces not covered shall be etched to reduce glare from reflected sunlight.

The reflective sheeting and color shall conform to the requirements of Section 1007. Splicing of reflective sheeting shall not be allowed on sign panels having a minimum dimension up to and including four feet.

Messages shall be reflectorized white Silk Screen or Direct Applied Characters. Messages which are called for as black shall be Demountable Characters conforming to Subsection 608-2.14.

608-2.08 Deleted

608-2.09 Warning, Marker, and Regulatory Sign Panels

Panels shall be fabricated from flat sheet aluminum and shall be reflectorized as specified herein.

Panels shall be fabricated in one piece from 0.125 inch thick, 5052-H38 or 6061-T6 Aluminum Alloy conforming to the requirements of ASTM B 209.

All surfaces of panels to be covered with reflective sheeting shall be prepared in accordance with the recommendations of the sheeting manufacturer. Surfaces not covered shall be etched to reduce glare from reflected sunlight.

Warning signs shall be reflectorized with yellow reflective sheeting.

Regulatory signs shall be reflectorized with silver-white reflective sheeting.

Reflectorized red signs shall be reflectorized with silver-white reflective sheeting. The red color shall be produced by silk screening.

Regulatory signs with reflectorized red circles and slashes shall be reflectorized with silver-white reflective sheeting. The red color shall be direct silk screened.

Interstate route markers shall be cut to shape. The colors and legend shall conform to the plans and shall be reflectorized with silver-white reflective sheeting. The Interstate route colors shall be silk screened. The numerals may be Silk Screened or Direct Applied Characters.

United States, State Route, and Cardinal Direction markers shall be reflectorized with silver-white reflective sheeting unless otherwise shown on the project plans.

Splicing of reflective sheeting shall not be allowed on sign panels having a minimum dimension up to and including four feet.

Sign panels shall be attached to the posts with bolts as shown in the plans and shall conform with the requirements of subsection 608-3.02. A nylon washer conforming to ANSI Standard having a diameter two times the bolt head diameter shall be placed between the bolt head and panel face. Fastening nuts shall be heavy hex. Standard nuts may be used if a flat washer is placed between the nut and sign post.

608-2.10 Deleted

608-2.11 Route Shields (For Installation on Sign Panels):

Route shields shall be cut to shape and shall consist of 0.063 inch thick, 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B 209. The aluminum shall be degreased and etched in accordance with the recommendations of the sheeting manufacturer. Reflective sheeting shall be silver-white and shall conform to the requirements of Section 1007. The size of the numerals shall be one-half the height of the shield.

Route shields shall be attached to the sign panel with self plugging aluminum blind rivets with a ¼-inch-thick nylon spacer on each rivet between the route shield and the sign panel.

608-2.12 Deleted

608-2.13 Reflective Sheeting:

Reflective sheeting shall conform to the requirements of Section 1007.

The colors specified for reflective sheeting shall match visually and be within the color tolerance limits shown on the appropriate Highway Color Tolerance Charts issued by the Federal Highway Administration.

608-2.14 Demountable Characters:

The letters, numerals, symbols, borders, and other features of the sign message shall consist of embossed aluminum frames in which prismatic reflectors are installed so as to be an integral part of the character or otherwise affixed to prevent their displacement in handling or service. Reflectors that are held in the frames by means of tape or adhesive will not be accepted. All items shall be fabricated from 0.040-inch-sheet Aluminum Alloy 3003-H14, conforming to ASTM B 209. Mounting holes shall be provided within frames to permit the use of screws, rivets, or other common fasteners. The size and spacing of reflector holes shall be such as to afford maximum night legibility and visibility to the finished cut-out figure. The reflectors shall conform to the requirements of Section 1008. The embossed aluminum frames shall be porcelain enameled white, baked enameled white, or triglycidyl isocyanurale thermosetting polyester powder coated white.

If black characters are called for in the project plans, they shall consist of embossed aluminum frames without reflectors or flat sheet aluminum. The frames shall be black porcelain enameled, baked enameled, or triglycidyl isocyanurale thermosetting polyester powder coated. The frames shall be fabricated from 0.040-inch-sheet Aluminum Alloy 3003-H14, conforming to ASTM B 209. Mounting holes shall be provided within flat sheet aluminum frames to permit the use of screws, rivets, or other common fasteners.

Porcelain enameling shall conform to the requirements of the Porcelain Enamel Institute. For baked enameling, the frames shall be chemically cleaned, deoxidized, and coated with a light, tightly adherent, chromate conversion coating free of any powdery residue in conformance with Section 5, "Recommended Processing Methods" of ASTM B 449. After the chromate finish is obtained, legend frames shall receive an electrostatic application of white thermosetting primer of 0.005 inch thickness. The white thermosetting primer shall be an epoxy-ester resin cross linked with an amino resin which properties include corrosion resistance, high adhesion, flexibility, and impact resistance to prevent chipping and flaking.

After priming, frames shall be finished with a high-gloss ceramic white thermosetting enamel or a high-gloss ceramic black thermosetting enamel as required using the electrostatic application method. The high-gloss ceramic white thermosetting enamel shall be a non-oxidizing alkyd resin cross linked with an amino resin to produce a non-yellowing, gloss-retentive coating. It shall contain sufficient chalk-resistant titanium dioxide necessary to meet the requirements of ASTM D 476, Type III and IV. The high-gloss ceramic black thermosetting enamel shall be a non-oxidizing alkyd resin cross linked with an amino resin to produce a gloss-retentive coating. Coating thickness shall be a minimum of 0.001 inch. The specular gloss shall be 50 minimum when tested in accordance with ASTM D 523. For triglycidyl isocyanurale thermosetting polyester powder coating, the front and back surfaces of the aluminum frames shall be chemically cleaned, deoxidized, and coated with a light, tightly adherent, chromate conversion coating free of any powdery residue in conformance with Section 5, "Recommended Processing Methods" of ASTM B 449. The triglycidyl isocyanurale thermosetting polyester powder coat shall be applied in accordance with the specifications issued by the manufacturer and shall have a minimum thickness of 0.002 inch. The specular gloss shall be 50 minimum when tested in accordance with ASTM D 523.

Letter design of the upper case and lower case letters and numerals shall be Series E of the Standard Alphabets for Highway Signs, modified by widening the stroke width to approximately one-fifth of the letter or numeral height. The uppercase letter shall be one and one-third times the loop height of the lower case letters.

Letter design of the capital letters shall be Series D of the Standard Alphabets for Highway Signs modified by widening the stroke width to approximately one-fifth of the letter or numeral height.

Self-plugging aluminum blind shoulder rivets or round-head wood screws, when used in black frames, shall be anodized black. All rivets used in embossed frames shall be 5/32 inch in diameter, self-plugging aluminum blind shoulder rivets. The length of the rivets placed in the characters shall be at least ¾ inch. All rivets shall extend through the panel face and set tight. Rivets used in flat sheet aluminum characters shall be 5/32 inch in diameter and at least 5/8 inch in length.

608-2.15 Silk Screened or Direct Applied Characters:

Silk screened letters, numerals, arrows, symbols, and borders shall be applied on the reflective sheeting background of the sign by direct or reverse screen process. Messages and borders of a color darker than the background shall be applied to the reflective sheeting by direct process. Messages and borders of a color lighter than the sign background shall be produced by the reverse screen process.

Opaque or transparent colors, inks, and paints used in the screen process shall be of the type and quality recommended by the manufacturer of the reflective sheeting.

The screening shall be performed in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use.

Signs after screening shall be air dried or baked in accordance with the manufacturer's recommendations to provide a smooth hard finish. Any signs on which blisters appear during the drying process will be rejected.

Direct Applied letters, numerals, symbols, borders, and other features of the sign message shall be cut from black opaque or reflective sheeting of the color specified and applied to the reflective sheeting of the sign background in accordance with the instructions of the manufacturer of the reflective sheeting and shall be applied by heat activation of the adhesive.

The reflective sheeting used for characters shall meet or exceed the minimum Specific Intensity Per Unit Area (SIA) of the background sheeting.

608-3 Construction Requirements:

608-3.01 Fabrication:

Fabrication of the sign panels shall be in accordance with the details shown on the project plans and the requirements of these specifications. If additional details for sign panel fabrication are required, the contractor shall submit shop drawings in accordance with the requirements of Subsection 105.02.

Panels shall be cut to size and shape and shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication.

Fabricated signs and overlay sheets shall be stored indoors and kept dry during storage. If packaged signs become wet, all packaging material shall be removed immediately and the signs allowed to dry. The signs may be repackaged using new dry materials. If outdoor storage is necessary, all packaging materials shall be removed. Signs shall be stored on edge, above ground, in an area where dirt and water will not contact the sign face. Materials used to support stored signs shall not contact sign faces.

608-3.02 Installation of Sign Panels:

The sign panels shall be installed on overhead sign structures and roadside sign supports in accordance with the details shown on the plans and in accordance with the recommendations of the manufacturers of the sign panel components.

Minor scratches and abrasions resulting from fabrication, shipping and installation of panels may be patched; however, patching shall be limited to one patch per 50 square feet of sign area with the total patched area being less than five percent of the sign area. Panels requiring more patching than the specified limit will be rejected. Patches shall be edge sealed by a method approved by the reflective sheeting manufacturer.

The heads of bolts on the panel face shall be anodized or painted to match the background or legend color in which they are placed. The nylon washers on the panel face shall be the color of, or shall be painted to match, the background or legend color in which they are placed. The sign manufacturer's name and date of installation shall be placed on the back of each sign in black, one-inch block letters. Use of felt markers for these purposes will not be permitted. Bolts shall be tightened from the back by holding the bolt head stationary on the face of the panel. Twisting of the bolt head on the panel face will not be allowed.

608-3.03 Miscellaneous Work (Sign Panels):

The work under this section shall also include, but is not limited to, furnishing all miscellaneous materials, tools, equipment and labor necessary to relocate exit panels to the right side of the parent sign panel, removal, cutting, and installation of side trims and new or salvaged aluminum extrusions to existing sign panels, relocation of large guide and exit gore signs, cutting of post tops on existing installations, as required on the project plans.

The contractor shall replace all fuse plates, retainer plates, shims, nuts, bolts, and washers with new hardware on all breakaway signs in the project.

608-3.04 Inspection:

An inspection of the completely installed sign panels will be made by the Engineer during the daytime and at night for proper appearance, visibility, color, specular gloss and proper installation.

Each sign panel face shall be cleaned thoroughly just prior to the inspection by a method recommended by the manufacturer. The cleaning solvent and cleaning material shall in no way scratch, deface or have any adverse effect on the sign panel components.

All apparent defects disclosed by the inspection shall be corrected by the contractor at his expense. If color variations or blemishes between sign panel increments are visible from a distance of 50 feet during either the day or at night, the panels shall be removed and replaced at the contractor's expense.

608-4 Method of Measurement:

Sign panels shall be measured by the square foot for each type or types of sign panels furnished and installed. The area of each sign panel, except for warning, regulatory and marker sign panels, will be measured per plans dimensions.

For warning, regulatory and marker sign panels, the area of each sign panel will be measured to the nearest square foot and the areas will be determined as follows:

The areas of each rectangular, square or triangular sign panel shall be determined from the dimensions shown on the project plans.

The area of irregular shaped signs, such as stop signs and route markers, will be determined by multiplying the maximum height in feet by the maximum width in feet, using the dimensions shown on the project plans.

Miscellaneous Work (Sign Panels) will be measured on a lump sum basis.

608-5 Basis of Payment:

The accepted quantities of each type of sign panel designated in the bidding schedule, measured as provided above, will be paid for at the contract unit price per square foot, complete in place.

Payment shall be made on the total area of each type of sign panel to the nearest square foot, except Route Shields and EXIT ONLY (For Installation On Sign Panels) which shall be paid for as part of the overall panel.

The contract unit price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for performing all the work involved in furnishing and installing the sign panels complete in place, including furnishing and applying all reflective sheeting, all fastening hardware, all necessary sign supports, stringers and post ties, all as shown on the plans and as specified herein.

The accepted quantities of Miscellaneous Work (Sign Panels), measured as provided above will be paid for at the contract lump sum price, which price shall be full compensation for the work complete in place as shown on the project plans and as described and specified herein.

ITEM 6110203 - PROTECTIVE RAILING:

Description:

The work under this item consists of furnishing all materials and installing protective railing at the location and in accordance with the details shown on the project plans and the requirements of these Special Provisions and as directed by the Engineer.

Materials:

Refer to the project plans.

Construction Requirements:

The protective railing shall be installed in accordance with the details shown on the project plans. The final coat of paint shall match the color of the concrete paint unless otherwise noted on the plans.

The protective railing is to be constructed so that the top rail is 42" above the top of the retaining wall.

Method of Measurement:

Measurement of this work will be by the linear foot of protective railing constructed, to the nearest foot. The linear foot measurement will be from end post to end post.

Basis of Payment:

Payment for this work will be made at the contract price per linear foot for ITEM 6110203 which price shall be full compensation for the item complete in place, including painting, as described and specified herein and on the project plans.

(701PDMPT, 12/15/95)

SECTION 701 - MAINTENANCE AND PROTECTION OF TRAFFIC: of the Standard Specifications is revised to read:

701-1 Description:

The work under this section shall consist of providing flagging services and pilot trucks, and furnishing, installing, maintaining, moving and removing barricades, warning signs, lights, signals, cones, and other traffic control devices to provide safe and efficient passage through and/or around the work and to protect workers in or adjacent to the work zone. The work shall be done in accordance with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and associated Arizona Department of Transportation supplements. When referred to herein, these documents will be referred to as MUTCD and associated ADOT Supplements.

The requirements of the MUTCD and associated ADOT Supplements shall be considered as the minimum standards for the protection of workers and the traveling public.

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 contractor desires to deviate from the provisions for maintaining traffic as described in this section, it 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 the contractor's work schedule and actual operations, shall be such that no condition that is considered to be unsafe, in the opinion of the Engineer, shall exist. The traffic control plan shall assure that miscellaneous operations occurring throughout the work, as well as during the final stages, are adequately protected. As a result of effective planning and efficient scheduling of the type and quantity of work, the duration, degree, length, amount, size, etc., of any traffic restriction or lane closures shall be limited to that absolutely necessary to provide a safe condition for both traffic and construction personnel.

701-2 Materials (Equipment, Workers, Devices and Facilities):

701-2.01 General:

Except as specified herein, all equipment, procedures used by workmen, devices and facilities shall conform to the requirements of the MUTCD and associated ADOT Supplements.

701-2.02 Flashing Arrow Panels:

Flashing arrow panels shall conform to the requirements of Section 4.5.2 of the MUTCD and associated ADOT Supplements with the following additions:

Each arrow panel shall have its own independent power source. The power source shall be capable of supplying adequate continuous power for the sign operation over extended periods of time. Fuel capacity shall be such as to provide for at least 12 hours of continuous operation without refueling. Panels may be solar powered with adequate energy source to provide for at least 12 hours of continuous operation without refueling or recharging.

701-2.03 Temporary Concrete Barrier:

Temporary concrete barrier shall conform to the requirements of Subsections 910-2 and 910-3 of the Standard Specifications for precast sections.

701-2.04 Temporary Impact Attenuation Devices:

Temporary impact attenuation devices shall conform to the requirements of Subsections 702-2 and 702-3 of the Standard Specifications for the type of device shown on the project plans or as approved by the Engineer.

701-2.05 Temporary Pavement Markings:

(A) Temporary Pavement Markers and Chip Seal Pavement Markers:

Temporary Pavement Markers may be Temporary Reflective Markers, Permanent Reflective Markers (used as Temporary) or Non-reflective Markers, as required on the Project Plans or as approved by the Engineer.

Temporary Pavement Markers shall be in conformance with Standard Drawings 4-M-2.02, 4-M-2.05, and Subsections 706-2 and 706-3 of the Standard Specifications and shall be included on a list of pre-approved products maintained by the Department.

Chip Seal Pavement Markers shall conform to Standard Drawing 4-M-2.05. The Chip Seal marker body and cover shall be manufactured from a polyurethane material conforming to the following requirements:

	Requirement	ASTM Test Method
Specific Gravity (Min.)	1.19	D- 792
Hardness (Min.)	80A	D-2240
Tensile Strength (Min. PSI)	4600	D- 412
Ultimate Elongation (Min. %)	330	D- 412
Modulus @ 300% PSI	1000	D- 412
Stiffness @		
-20 deg. F. (Min. PSI)	17000	D-1053
70 deg. F. (Min. PSI)	900	D-1053
Compression Set		
22 hrs. @ 70 deg. C	65	D- 395
Taber Abrasion		
CS17 wheel		
Wt. loss mg/1000 cycles	3	---------

(B) Pavement Marking Paint:

Paint for temporary striping, arrows, symbols and legends shall be white or yellow and shall conform to the requirements for permanent striping paint as set forth in Section 708 of the Standard Specifications and as indicated on the project plans or as approved by the Engineer. Paint for temporary symbols and legends shall be white and shall meet the same requirements as temporary striping.

(C) Preformed Pavement Markings:

Preformed Pavement Markings shall be either Type II (Temporary-Removable) or Type III (Temporary-Non removable), as indicated on the project plans or as approved by the Engineer. Preformed Pavement Markings shall be in conformance with the requirements of Section 705 of the Standard Specifications and shall be included on a list of pre-approved products maintained by the Department.

Reflective tape shall be metalized polycarbonate microprism retroreflective material with acrylic backing or equal. The tape shall have a minimum reflectance equal to or greater than 1800 candle power per foot-candle per square foot at 1/10 degree observation and 0 degree entrance angles.

701-2.06 Temporary Sign Supports:

Temporary Sign Supports may be wood, steel or aluminum, at the option of the contractor and shall be approved by the Engineer prior to installation. Wood posts shall be Southern Pine, Douglas Fir or other soft wood. Wood posts need not be treated.

Angle braces will not be allowed.

701-2.07 Delineators:

Delineators shall be as shown on the plans and shall be in conformance with Standard Drawing 4-M-4.01 and Subsection 703-2 of the Standard Specifications.

701-3 Construction Requirements:

701-3.01 General:

The contractor shall provide for the adequate protection of all vehicular and pedestrian traffic and workers through any portion of the work where construction operations interfere with, obstruct, or create a hazard to the movement of traffic.

At the Pre-construction Conference, the contractor shall provide the Engineer with the name of the contractor's employee who is responsible for implementing, monitoring, and altering, as necessary, the traffic control plan. The Engineer will then advise the local law enforcement agency, having jurisdiction, of the names of the contractor's representative and a representative of the Department who will act in a similar capacity. The contractor's designee shall be available at any time to respond to calls involving damage or displacement to barricades, lights, signs and other devices resulting from vandalism, traffic accident or other causes.

If, at any time, the Engineer determines that sufficient traffic control is not being provided or maintained, the Engineer 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 workers by the contractor, the Engineer may proceed 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 at no additional cost to the Department. Materials, vehicles and parked equipment shall be kept as far from the traveled way as practical. The contractor shall not park equipment or store materials within 30 feet of the edge of a traveled way unless an adequate barrier is present. Equipment may be parked and materials may be stored in the right-of-way only at locations approved by the Engineer.

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, at no additional cost to the Department. All such devices shall be replaced by the end of the work shift unless otherwise specified.

The Engineer shall be sole judge as to which signs may require embedded posts, portable stands or another type of support.

701-3.02 Maintenance and Protection of Traffic:

All traffic control devices necessary for the first stage of construction shall be properly placed and in operation before any construction is allowed to start. When work of a progressive nature is involved, such as resurfacing a roadway under traffic, the necessary devices shall be moved concurrently with the advancing operation. The use of temporary devices shall not be extended beyond the anticipated length of work of one shift production.

All traffic control devices shall be kept clean and free from dirt, mud, and roadway grime. Scratches, rips and tears in reflective sheeting shall be promptly corrected by the contractor, as approved by the Engineer.

Temporary pavement markings shall be applied in conjunction with changes in the traffic pattern. Placement of new pavement markings and removal of old markings shall be done immediately when the need for each arises. Temporary markings and devices shall be removed and new roadway marking shall be completed within 24 hours after any changes in traffic pattern unless otherwise directed by the Engineer. Obliteration of the temporary pavement markings shall be in conformance with Subsection 701-3.06 of the Standard Specifications.

Types of barricades, supports or devices not specifically described in the MUTCD and associated ADOT Supplements, but which would cause a hazard to traffic if used by the contractor, will not be permitted in the work area. The methods used by a contractor to control traffic when there are no details included in the contract, shall produce a safe condition for travel to the maximum extent possible at all times.

An off-duty law enforcement officer shall not work more than 12 consecutive hours unless an emergency situation exists which, in the opinion of the Engineer, requires that the officer remain in the capacity of a flagger.

701-3.03 Temporary Concrete Barriers:

Barriers shall be installed in accordance with the details and at the locations shown on the project plans or where directed by the Engineer. Sections of temporary barrier shall be fastened together as shown on Standard Drawing 4-C-2.01 to form a continuous chain. After placement, each unit shall be moved longitudinally to remove slack in the joints between the units. Where shown on the project plans or directed by the Engineer, the ends of the barrier run shall be flared back or fitted with an impact attenuation device. Attenuation devices shall be installed in accordance with the requirements of Subsection 701-3.04 of the Standard Specifications.

Barrier Markers shall be installed as shown on the project plans, or standard drawings.

Any unit which has been excessively damaged, as determined by the Engineer, shall not be used. Any unit damaged during or after installation shall be replaced with an undamaged unit by the close of that work shift, at no additional cost to the Department.

Temporary Glare Screen shall be installed on barriers at locations shown on plans, and on barriers used to separate opposing traffic on freeway construction contracts in urban areas. When barrier is used on freeway construction to separate traffic from construction operations, glare screen may be required when construction activity is continuous for at least 1500 feet adjacent to the active traffic lanes.

Temporary Glare Screen shall be expanded metal or plastic attached to the barrier by a method satisfactory to the Engineer. Temporary Glare Screen shall have the following characteristics:

(1) When hit, the device shall not penetrate the passenger compartment of the errant vehicle or present a hazard to workers and other traffic.

(2) The device shall perform in a predictable manner when hit.

(3) The device shall effectively reduce glare from oncoming vehicle head lights.

(4) The device shall be resistant to vandalism and vehicle damage, and shall be easy to repair.

701-3.04 Temporary Impact Attenuation Devices:

Energy absorbing terminals conforming to the requirements of Subsection 702-2.02 of the Standard Specifications shall be installed at the locations and in accordance with the details shown on the project plans and the manufacturer's instructions.

Devices that are damaged by the traveling public shall be repaired within 36 hours by the contractor utilizing a replacement parts package, which shall be on the job site whenever this system is in use. The replacement parts package supplied by the contractor shall be the one recommended by the manufacturer of the attenuation device in use. Upon completion of the work for which energy absorbing terminals are required, all terminals and replacement parts packages shall be carefully removed and stockpiled by the contractor within the limits of the project at a location specified by the Engineer and shall become the property of the Department.

Sand barrel crash cushions conforming to the requirements of Subsection 702-2.03 of the Standard Specifications shall be placed in accordance with the details shown on the project plans.

Crash cushions damaged by the traveling public shall be removed and disposed of by the contractor. New devices shall be furnished and installed by the contractor. The contractor shall repair any damaged installations within 36 hours. Sand barrel crash cushions will remain the property of the contractor upon completion of temporary use unless permanently incorporated into the project.

Upon approval of the Engineer, undamaged attenuation devices, sand barrels or metal type, may be used for permanent installation in accordance with the requirements of Subsections 702-2 and 702-3 of the Standard Specifications.

701-3.05 Temporary Pavement Markings (Application):

(A) General:

Application of temporary pavement markings shall conform to the requirements of Subsection 708-3, of the Standard Specifications, the MUTCD and associated ADOT Supplements and other provisions of these specifications as applicable. Placement of new markings shall be done immediately when the need for each arises, in conjunction with changes in the traffic pattern.

On intermediate lifts of overlay projects, pavement marking for temporary striping shall consist of four inch wide by four foot long strips of reflective material, either pavement marking tape or traffic paint, placed at 40 foot intervals. In situations involving severe degree of curvature, the Engineer may direct that the length and spacing be adjusted to two feet and 20 feet respectively. These requirements apply to white lane lines separating traffic moving in the same direction and to yellow centerlines for two-lane, two-way roadways in areas where passing is permitted. Temporary pavement marking shall be placed on each subsequent pavement course.

Pavement Markings may be required by the Engineer in lieu of barricades for temporary delineation when the duration of the traffic control plan may exceed five days or when lane widths are less than 12 feet.

(B) Temporary Pavement Markers:

The adhesive shall be applied uniformly to the cleaned pavement surface and the temporary pavement marker shall be placed in the correct position on the adhesive area with the application of pressure as specified by the manufacturer.

(C) Preformed Pavement Markings:

Preformed pavement markings for temporary applications shall be Type II (Temporary-Removable) and Type III (Temporary-Non removable) and shall conform to the requirements of Subsection 705-3 of the Standard Specifications.

Only Type II Preformed Pavement Markings shall be used on surfaces or finish pavement courses where eventual removal will be required.

Type III Preformed Pavement Markings shall only be used where removal of markings is not required due to obliteration, abandonment or overlaying the pavement surface. Temporary pavement marking paint may also be used where removal of markings is not required unless otherwise shown on the project plans or in the special provisions.

701-3.06 Obliteration of Existing Pavement Markings:

Pavement marking obliteration shall be accomplished by the contractor as indicated on the plans or as directed by the Engineer.

Pavement markings shall be removed to the fullest extent possible from the pavement by any method that does not materially damage the surface color, or texture of the usable pavement. Sandblasting, using air or water, is an acceptable method for removing pavement markings, however, other methods may be approved by the Engineer. Overpainting of markings with paint or asphalt will not be permitted.

Sand or other material deposited on the pavement as a result of removing pavement markings shall be removed as the work progresses. Accumulations of sand or other material, which might interfere with drainage or might constitute adverse safety conditions to traffic, shall be removed by the contractor.

Where blast cleaning is used for the removal of pavement markings or for removal of objectionable material, the residue, including dust, shall be removed immediately after contact between the sand and the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by the Engineer. Blast cleaning shall not be used within 12 feet of a lane occupied by public traffic unless a suitable barrier separates traffic from the area being cleaned.

Obliteration or removal of raised pavement markers shall include removal of the marker and adhesive pad, or adhesive pad alone if the marker is missing.

Any damage to the pavement caused by pavement marking removal shall be repaired by methods acceptable to the Engineer. When asphalt slurry is used to repair damage to the pavement caused by pavement marking removal or the obliteration of the marks remaining after the markings have been removed, the asphalt slurry shall be placed parallel to the new direction of travel and shall be at least two feet in width.

701-3.07 Truck Mounted Attenuator:

Trucks and truck mounted attenuators shall be furnished by the contractor at the locations shown on the project plans and/or as directed by the Engineer.

Trucks shall weigh between 10,000 and 24,000 pounds. Trucks shall be furnished with shoulder and lap restraint safety belts for both driver and passenger seats. These trucks shall be equipped with truck-mounted impact attenuators. All truck mounted attenuators shall meet NCHRP 230 requirements. The attenuators shall consist of three basic components:

(1) A back-up support structure for attaching the back-up to the truck.

(2) A back-up.

(3) A crushable cartridge containing an energy absorbing material.

The dimensions of the attenuator shall be approximately seven feet long, two feet high and eight feet wide and the total weight of the attenuator shall be approximately 1,000 pounds.

Attenuators shall have rear-mounted black and high intensity yellow chevron stripes and a standard trailer lighting system, including brake lights, turn signals, ICC bar lights, and two yellow rotating beacons mounted on opposite rear corners of the truck at approximately four and one half feet from ground level. When the attenuator is in position, roadway clearance shall be between 10 and 12 inches. The attenuator shall be designed to provide for quick and simple connection to the truck.

When impacted head-on at 45 mph, the truck-mounted attenuator shall perform as follows:

(1) For vehicles weighing from 1,800 to 4,500 pounds the average over-all longitudinal deceleration shall be less than 12 g's; the two foot flail space velocity shall be less than 40 feet/second; the roll-ahead distance of the truck, with wheels locked and parking brake set, on clean, dry pavement, shall be less than 15 feet.

(2) For vehicles weighing up to 1,800 pounds, the average over-all longitudinal deceleration shall be less than 15 g's; the two-foot flail space velocity shall be less than 40 feet/second; the roll-ahead distance of the truck, with wheels locked and parking brake set, on clean, dry pavement, shall be less than 10 feet.

It shall be the contractor's responsibility to keep the attenuator bright and clean for maximum visibility.

The contractor shall cease operations when a truck mounted attenuator is damaged. The contractor shall not resume operations until the attenuator has been repaired or replaced, unless authorized by the Engineer.

701-3.08 Changeable Message Board:

Changeable message boards, when required on a project, will be furnished by the Department and maintained by the contractor. The board consists of a portable, trailer mounted, lamp matrix, changeable message sign. The contractor shall transport the sign to, from, and within the work site as directed by the Engineer.

The contractor shall provide routine maintenance of the changeable message sign. Such maintenance shall include, but not be limited to, furnishing and installing oil, fuel, filters, and light bulbs and keeping the sign clean and in good operating conditions. The engine oil and oil filter shall be changed after each 250 hours of running time.

The contractor shall furnish a vehicle and driver to tow the message sign to and from the project site and to move the sign within the project site as directed by the Engineer.

The contractor shall provide safe storage for the sign when it is not being used during construction.

Upon completion of the work, the sign shall be cleaned and returned to the Department in good working condition.

The contractor will not be responsible for any damage to the sign which may occur as a result of incidents beyond the control of the contractor while the sign is in use during construction operations.

701-3.09 Chip Seal Pavement Marker:

Chip Seal Pavement Markers and covers shall be located and placed on the asphaltic concrete prior to any work being started on the chip seal coat, all in a manner as approved by the Engineer.

Immediately after application of the chip seal coat to the roadway pavement, the plastic covers shall be removed, exposing the reflective tape surfaces.

Chip Seal Pavement Markers that are damaged by the contractor shall be replaced by the contractor at his own expense.

701-3.10 Sign Sheetings:

All sign sheeting shall be Type II sign sheeting, conforming to AASHTO M 268, unless otherwise shown on the prjoect plans.

701-3.11 Temporary Removal or Covering of Signs:

Where existing signs are not applicable during construction, they shall be removed or have the affected legends covered in place. Unless otherwise stated in the plans, or if a discrepancy exists, the Engineer will approve the method or methods to be used.

Removed signs shall be properly shipped, stored, and handled in accordance with the manufacturer's recommendations and in a manner approved by the Engineer to assure that such signs will continue to be suitable upon reinstallation.

Where removal of a sign or legend is not practical, the sign face may be covered with an opaque porous cloth or fiber material, folded over the sign edges and secured at the rear of the sign in such a manner that the sign shall not be damaged.

Tape, hardware, ropes, cables, etc., used to secure the covering material shall not touch, place any pressure on, or damage the sign face.

The covering shall be maintained by the contractor until the Engineer directs removal or the contract ends.

The contractor shall restore the signs and legends to their previous conditions, as directed by the Engineer. The contractor shall repair any damage to the signs or shall replace the damaged signs, as directed by the Engineer when damage is the result of the contractor's operations.

701-3.12 Temporary Sign Supports:

Temporary Sign Supports installed in the ground shall be removed at the completion of the project, the post holes filled and compacted, and the immediate area restored to match the surrounding area.

701-4 METHOD OF MEASUREMENT:

701-4.01 General:

The Department will reimburse the contractor for the work of maintaining and protecting traffic on the basis of unit bid prices for the various Elements of Work. No additional measurement for payment to the contractor will be made for any Elements of Work other than those listed in the bidding schedule.

Elements of Work specified under this Subsection which are lost, stolen, destroyed, or are deemed unacceptable by the Engineer, while in use on a project shall be replaced by the contractor and, except as hereinafter specified for temporary impact attenuators, at no additional cost to the Department.

Elements of Work will be measured for payment as follows:

(A) Elements of Work (Complete-in-Place):

The Elements of Work listed herein under Subsection 701-5 will be measured for payment upon the satisfactory completion of the initial installation or obliteration. Except as hereinafter specified under Basis of Payment, no subsequent measurements will be made.

(B) Elements of Work (In Use):

The elements of work listed herein under Subsection 701-6 will be measured for payment from the time at which the element is put into active use on the project and accepted by the Engineer until such time that the Engineer determines that the element is no longer required.

701-4.02 Relocation of Work Elements:

Following the initial installation of an Element of Work described above, the Engineer may direct the contractor to move the Element of Work from one location and reinstall it at another location. Except as specified elsewhere herein, in Subsection 701-5.01 for Temporary Concrete Barrier (Installation and Removal), and Subsection 701-5.02 for Temporary Impact Attenuators (Installation and Removal), no measurement for payment will be made for relocation of Work Elements.

When work of a progressive nature is involved, such as resurfacing a road under traffic, or closing a lane or lanes for work to be accomplished during a shift, no measurement for payment will be made for setting up or relocating the necessary traffic control equipment, workers, devices, facilities, signs etc., that are moved concurrently with the advancing operation, or removal at the end of a shift.

701-4.03 Payment Exceptions:

(A) Deficient Elements of Work:

Any deficiencies in the traffic control plan, devices, equipment, services, or other elements of work listed herein under Subsection 701-4.01 (B) will be brought to the attention of the contractor by the Engineer and all deficiencies shall be corrected before the close of that work shift, unless otherwise specified.

The contractor shall not be paid for those deficient Elements of Work listed herein under Subsection 701-4.01 (B) unless restored to full usefulness prior to the close of the work shift in which notice of the defect is given, or within the time limits specified in Subsection 701-3. Measurement for payment will not resume until the beginning of the work shift following that work shift in which those elements are restored to usefulness.

(B) Substantial Deficiencies:

For each work day or work shift during which there are, as determined by the Engineer, substantial deficiencies in the contractor's traffic control plan, devices, and/or services, no payment will be made to the contractor for any Element of Work listed herein under Subsection 701-4.01 (B).

Measurement for payment will not resume for any Element of Work until the beginning of the work day or work shift following that work day or work shift in which all corrective measures have been performed by the contractor and approved by the Engineer.

In cases of serious or willful disregard for the safety of the public or the contractor's employees by the contractor, the Engineer may place the traffic control elements in proper condition and deduct the cost thereof from monies due or becoming due the contractor.

(C) Nondiligent Prosecution of Work:

In the event that the Engineer determines that the contractor's construction operations are not resulting in the diligent prosecution of the work under contract, no payment will be made to the contractor for the Elements of Work listed herein under Subsection 701-

4.01 (B) until such time as the Engineer determines that the contractor is devoting appropriate efforts toward completion of the work. Payment will be suspended effective with the end of the work day or work shift in which written notice is issued to the contractor by the Engineer notifying the contractor of his failure to prosecute the work. Payment will resume with the beginning of the work day or work shift following that work day or work shift in which the Engineer determines that satisfactory efforts are being made by the contractor toward completion of the work. In any case, the contractor shall continue to be responsible for maintaining all barriers, attenuators, signs, lights and other traffic control devices in proper functioning condition at all times.

(D) Non-Working Periods:

Measurement for payment of the Elements of Work listed herein under Subsection 701-4.01 (B) will begin on the day they are installed in place for traffic control and direction. When the elements are not needed for traffic control, they shall be removed or covered and will not be measured unless they are required to stay on site in anticipation of future use or emergency use as determined by the engineer. Should devices be required on site for these purposes they will be measured and paid for by the unit prices. During non-working periods such as holidays, Sunday, etc. the elements in place and in satisfactory condition will be measured for payment on the day following such downtime. During these non-working periods the contractor shall conduct a minimum of one check per day to verify that the elements are in place and in satisfactory condition.

No payment will be made to the contractor for the Elements of Work listed herein under Subsection 701-4.01 (B) for non-working periods resulting from a suspension of work that, in the opinion of the Engineer, is due to the fault of the contractor. In any case, the contractor shall continue to be responsible for maintaining all barriers, attenuators, signs, lights and other traffic control devices in proper functioning condition at all times.

(E) Limitation of Measurement:

Elements of Work listed herein under Subsection 701-4.01 (B) that are measured on a unit per day basis will be measured for payment for each 24 hour day. Measurement will be based on the maximum number of units of the specific element of work that are in simultaneous use during any given period regardless of the length of time that the elements are in use and regardless of the number of times the elements are relocated.

Measurement will be made after the initial installation and once weekly thereafter for items in continuous use and at any other times changes are made in the use of traffic control elements listed under Subsection 702-4.01 (B). The contractor shall notify the Engineer when any changes are made in the use or location of traffic control elements.

(F) Expiration of Contract Time:

No reimbursement will be made to the contractor for the Elements of Work listed herein under Subsection 701-4.01 (B) when they are required in association with construction work being performed after the expiration of the contract time and all approved extensions.

In any case, the contractor shall continue to be responsible for maintaining all barriers, attenuators, signs, lights and other traffic control devices in proper functioning condition at all times.

701-4.04 Measurement of Work Elements:

Measurement will be made as follows:

(A) Temporary Concrete Barrier will be measured by the linear foot along the center line of the uppermost surface upon its initial installation (Complete-in-Place). Barrier will be measured by Linear feet for each 24 hour day for the "In Use" condition.

(B) Temporary Impact Attenuators, such as Sand Barrels and Energy Absorbing Terminals, will be measured by the unit for each complete device upon its initial installation (Complete-in-Place).

(C) Truck mounted attenuators including driver will be measured by the day for each 24 hour day that a truck mounted attenuator and operator is used to protect the work site.

(D) Flashing Arrow Panels will be measured by the day for each 24 hour day that each panel is in place and operating.

(E) Pilot Vehicles, including Driver, will be measured by the hour for each approved hour of operation.

(F) Flagging Services will be measured by the hour for each hour that a civilian flagger is provided. Flagging Service (Uniformed Officer) will be measured for each hour that a uniformed, off-duty law enforcement officer and police vehicle is employed directly by the contractor as a flagger, when authorized in advance by the Engineer.

Flaggers and traffic control which are required to permit contractors' traffic to enter safely into normal traffic within the project limits will be paid under this item. Flaggers required by a written local permit agreement will be measured for payment under this item. Additional flaggers used within the project limits shall be measured for payment under this item, subject to the approval of the Engineer.

Flaggers and traffic control devices used outside the project limits will be measured under this item. The State will pay fifty percent of the unit bid price for flaggers and traffic control devices used as described in this paragraph, subject to the approval of the Engineer. The project limits are defined as the construction work zone as shown on the approved traffic control plan for the specific section of highway under construction.

Only Department of Public Safety officers shall be used on Interstate Highways and Urban Freeways. The contractor may obtain local officers and shall comply with local requirements on other highway construction projects.

Employees used for flagging Service (Uniformed Officers) may be employed through one of three methods:

1) As a direct employee of the prime contractor
2 As an independent employee/subcontractor
3) As a subcontractor employee obtained through a subcontractor flagmen furnishing service.

The prime contractor shall notify the engineer which method will be used and shall comply with the provisions of Subsection 108.01 and 107.25 of the Standard Specifications.

The contractor shall be responsible for obtaining and paying all costs for uniformed officers and vehicles.

The costs for DPS officers shall include a Base Salary Rate of $17.00 per hour, Federal and State Income Tax, FICA, and Workman's Compensation Insurance. The cost of the officer's vehicle is $2.50 per hour. These costs shall be included in the unit price bid for Flagging Services (Uniformed Officer) and paid by the contractor to the officer.

(G) Temporary Preformed Markings for Pavement, Type II and Type III, will be measured in accordance with the requirements of Subsection 705-4 of the Standard Specifications.

(H) Temporary Painted Markings for Pavement, will be measured in accordance with the requirements of Subsection 708-4 of the Standard Specifications.

(I) Obliterate Pavement Marking will be measured in accordance with the requirements of Subsection 708-4 of the Standard Specifications.

(J) Use and maintenance of the Changeable Message Sign will be measured by the day for each 24 hour day that the sign is utilized to maintain and control traffic.

(K) Obliterate Pavement Markers will be measured for each unit, Markers and Adhesive pad, or Adhesive pad alone where Markers are missing.

(L) Temporary Delineators (Std. Dwg. 4-M-4.01) and Temporary Pavement Markers will be measured as a unit for each delineator and marker furnished, utilized and subsequently removed from the project site. No measurement for payment will be made for delineators and markers that are furnished to replace damaged units as specified under Subsection 701-4.01.

(M) Vertical Panels, Barricades (Type II and III), Tubular Markers, Warning Lights (Type A, B and C), Traffic Cones (28 inch), High Level Flag Trees, Drums, Embedded Sign Posts, and Portable Sign Stands (Spring Type and Rigid), will be measured as a unit for each device furnished and subsequently utilized at the project site for each 24 hour day.

Temporary Signs will be measured as Small (less than 10 square feet) with either Type II or Type III/IV sheeting; and Large (10 square feet or more) either Type II or Type III/IV sheeting. Temporary Signs will be measured as a unit for each sign furnished and subsequently utilized at the project site for each 24 hour day. Quantities may be determined on a weekly basis for signs in continuous use.

Utilization shall be defined as including those devices ordered to remain on site or covered in accordance with Subsection 701-4.03 (D) and approved by the engineer.

(N) Specialty Signs are signs which are required on the job, as determined by the Engineer, or shown on project plans, and are not reusable as traffic control signs. Specialty signs shall contain information which is project and location specific. The sign sheeting shall be Type II, and the size, type and legend of the signs will be determined by the Engineer, unless specified on the project plans. Specialty signs will be measured for payment by the square foot, inclusive of borders. Any sign over twenty square feet in area shall be considered a specialty sign.

(O) Obliterate Pavement Legends or Arrows will be measured by each separate symbol, arrow or legend.

701-5 Basis of Payment for Elements of Work (Complete-in-Place):

701-5.01 Temporary Concrete Barrier (Installation and Removal):

Temporary concrete barrier, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the work, complete, as specified herein and as shown on the plans, including, furnishing, placing, dismantling, and removal. The price bid shall also include any required connection devices, barrier markers, and glare screen.

Should it be necessary to dismantle, pick up and relocate a portion of the barrier installation a lateral distance of more than 12 feet during construction, that portion of the removed and relocated barrier will be considered a new installation and measured for payment at the contract unit price.

For a lateral movement of 12 feet or less, or any vertical movement, the contractor will be paid for 50 percent of the length of the relocated Temporary Concrete Barrier (Installation and Removal), provided the contractor can demonstrate, to the Engineer's satisfaction, that it is not possible to move the barrier without dismantling and lifting. No payment will be made for portions of the barrier which the contractor can relocate without dismantling and picking up.

701-5.02 Temporary Impact Attenuators (Installation and Removal):

Temporary Impact Attenuation Devices shall include Sand Barrels and Energy Absorbing Terminals, measured as provided above, and paid for at the contract unit price, which price shall be full compensation for the work complete in place, as specified herein and as shown on the plans, including, but not limited to, furnishing the devices with replacement parts, and installing, realigning and adjusting, removing and stockpiling the devices.

Should it be necessary to dismantle, pick up and reinstall attenuation devices during construction, for use on the project site, the work of removing and reinstalling the devices will be measured for payment as a new installation.

The Engineer will be the sole judge as to whether devices are to be dismantled, picked up and reinstalled or are to be adjusted or realigned.

Measurement and payment for furnishing materials, equipment and labor and repairing attenuation devices that are damaged by the traveling public will be made in accordance with the requirements of Subsection 109.04 of the Standard Specifications.

No measurement or direct payment will be made for furnishing replacement parts and repairing devices damaged by other than the traveling public.

701-5.03 Temporary Preformed Markings for Pavement:

The accepted quantities of Temporary Preformed Markings, measured as provided above, will be paid for at the unit bid price for the type specified, which price shall be full compensation for the work, complete in place, including necessary pavement cleaning, and maintaining Type II and Type III temporary markings in construction work zones. Installation for accepted quantities shall be considered satisfactory when the markings are installed in conformance with the requirements of the plans.

When the type of temporary preformed marking is not specified, the contractor shall furnish Type II.

Additional reimbursement will be made for replacement of Temporary Markings when the contractor is required by the Engineer to install marking materials on distressed pavements or during adverse weather conditions and subsequent failure occurs. Distressed pavement conditions are defined as alligator cracking, bleeding, or spalling of bituminous pavements and spalling of PCC pavements. Adverse weather conditions are defined as any occurrence where application is required at pavement temperatures less than 50 degrees F. or when precipitation occurs within 24 hours before application.

The Department will pay for the replacement, where failures occur, at the unit bid price for the items. In the event a second failure occurs when markings have been reapplied on distressed pavements or under weather conditions described above, the Engineer shall determine if conditions require primer, alternate methods of marking or reapplication of Preformed Markings. Preformed markers and markings will be paid for at the unit bid price. Primers or other methods of markings deemed necessary by the Engineer will be paid for in accordance with the provisions of Subsection 109.04 of the Standard Specifications.

701-5.04 Temporary Painted Pavement Markings:

The accepted quantities of Temporary Painted Markings, Symbols, Arrows, and Legends, measured as provided above, will be paid for at the unit bid price for the type specified, which price shall be full compensation for the work, complete in place, including glass beads.

701-5.05 Obliterate Pavement Marking:

Obliterate Striping, measured as provided above, will be paid for at the unit bid price per linear foot which price shall be full compensation for the work, complete, including furnishing all labor and equipment required and restoring the pavement surface to a condition acceptable to the Engineer.

The accepted quantities of Arrows, Symbols or Legends obliterated shall be paid for at the unit bid price for each item.

701-5.06 Temporary Pavement Markers and Chip Seal Pavement Markers:

The accepted quantities of Temporary Pavement Markers and Chip Seal Pavement Markers measured as provided above will be paid for at the unit bid price each, which price shall be full compensation for the work, complete in place, as specified herein and as shown on the plans.

701-5.07 Obliterate Pavement Markers:

Obliterate Pavement Markers will be paid for at the unit bid price each, which price shall be full compensation for the work, complete, including adhesive pad.

701-5.08 Temporary Delineators (Std. Dwg. 4-M-4.01)

The accepted quantities of Temporary Delineators, measured as provided above, will be paid for at the unit bid price each, which price shall be full compensation for the work, complete, including subsequent removal as specified herein and as shown on the plans.

701-5.09 Specialty Signs:

The accepted quantities of Specialty Signs, measured as provided above, will be paid for at the unit bid price per square foot which price shall be full compensation for the work, complete in place, including manufacturing, delivery to the job site, erection and eventual removal. The price paid shall also include the cost of flags, ballasting, mountings, sign stands, and embedded posts as required.

701-5.10 Temporary Removal or Covering of Signs:

No payment will be made for Temporary Removal or Covering of Signs, including maintenance of storage facilities for the signs or sign legends and the maintenance of sign coverings. The cost being considered as included in the price of contract items.

701-6 Basis of Payment for Elements of Work (In Use):

701-6.01 Quantity Variances:

The following items, will be considered as major Items and subject to the provisions of Subsection 104.02 (D) (2) of the Standard Specifications.

(1) Temporary Concrete Barrier (In Use)
(2) Flagging Services and Flagging Services (Uniformed Officer)
(3) Barricades
(4) Temporary Signs

701-6.02 Temporary Concrete Barrier (In Use):

The accepted quantities of temporary concrete barrier, measured as provided above will be paid for at the unit bid price, which price shall be full compensation for the use of the barrier installation(s), including glare screen, and for furnishing all material, equipment and labor and maintaining, realigning and adjusting the barrier installation(s), as specified herein and as shown on the plans. No payment will be made for barrier not in service, such as, barrier in stockpiled configuration awaiting phase construction change.

There will be no payment for each day that the Engineer determines the barrier traffic reflectors are not in good reflective condition, or for each day that the Engineer determines the barrier is out of alignment.

701-6.03 Channelization Devices:

(A) Vertical Panels, Barricades (Type II), Traffic Cones (28 inch), and Tubular Markers:

The accepted quantities of Vertical Panels, Barricades (Type II), Traffic Cones (28 inch), and Tubular Markers, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in use).

The unit bid price for barricades includes the cost of ballasting as required.

(B) Barricades (Type III), and High Level Flag Trees:

The accepted quantities of Barricades (Type III) and High Level Flag Trees, measured as provided above will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in use).

The unit bid price for barricades includes the cost of ballasting and flags, as required.

When signs are to be mounted on Barricades (Type III) or High Level Flag Trees, the sign will be paid for as Temporary Signs, Subsection 701-6.04.

(C) Drums:

The accepted quantities of Drums, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in use).

Drums shall conform to Standard Drawing 4-M-2.07, and shall be included on the list of pre-approved products maintained by the Department or be an alternate plastic drum approved by the Engineer.

(D) Warning Lights (Type A, B and C):

The accepted quantities of Warning Lights (Type A, B and C), measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in use).

(E) Embedded Sign Posts, Portable Sign Stands (Spring Type or Rigid) and Portable Sign Posts-Barrier Mounted:

The accepted quantities of Embedded Sign Post, Portable Sign Stands (Spring Type and Rigid) and Portable Sign Posts-Barrier Mounted, measured as provided above will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in use).

The unit bid price for signs includes the cost of ballasting as required.

701-6.04 Temporary Signs:

The accepted quantities of Temporary Signs, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in use).

The unit bid price for signs includes the cost of flags and ballasting as required.

No separate payment shall be made for speed plates, distance plates, or other minor sign message boards that are attached to a temporary sign, or temporary sign post, as shown on the plans. If additional signs are attached to those shown on the plans, or to existing temporary sign installations, payments will be made as additional temporary signs.

701-6.05 Truck Mounted Attenuators:

The accepted quantities of truck mounted attenuators, measured as provided above, will be paid for at the unit bid price per day of work site protection, which rate shall be full compensation for the work, complete, including, but not limited to, furnishing all materials, equipment and labor (including the operator) and maintaining and repairing the truck and truck mounted attenuator as specified herein and on the project plans. It shall be the contractor's responsibility to replace any damaged or destroyed parts of the attenuator at no additional cost to the Department.

701-6.06 Flashing Arrow Panels, and Changeable Message Signs:

The accepted quantity of flashing arrow panels, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the work, complete, including, but not limited to, furnishing, operating, maintaining and relocating on the work site.

The accepted quantities of maintaining Changeable Message Signs, measured as provided above, will be paid for at the unit bid price per day, which price shall be full compensation for the work, complete, including, but not limited to, relocating, and maintaining the sign as specified herein.

701-6.07 Pilot Services, and Flagging Services:

The accepted quantities of pilot and relocation service trucks, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the work, complete, including, but not limited to, furnishing and maintaining the vehicle and furnishing the pilot truck driver. Overtime hours for pilot services worked will be paid at a rate determined by multiplying the straight time hours times a factor of 1.35.

Basis of payment for a uniformed off-duty law enforcement officer used as a flagger will be in accordance with the following:

	Hours/Day	Pay Rate
(1)	First eight hours:	straight time
(2)	Hours nine through twelve:	time and one half
(3)	Over 12 hours:	double time

Overtime hours will be converted into straight time hours for measurement.

The accepted quantities of flagging services, measured as provided above, well be paid for at the unit bid price, which price shall be full compensation for the work, complete, including, but not limited to, all overhead costs and fringe benefits.

(702SNDBL, 11/15/94)

SECTION 702 - ATTENUATION DEVICES:

702-2 **Materials:** of the Standard Specifications is modified to add:

A list of approved manufacturers and distributors of components for sand barrel crash cushions which meet the requirements of NCHRP 230 is given below:

(A) **Manufacturers:**

Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60611

Roadway Safety Service, Inc.
700-3 Union Parkway
Ronkonkoma, New York 11779

(B) **Distributors:**

Energy Absorption Systems, Inc.
8585 Thys Court
Sacramento, California 95828

Jerry Fondaw & Associates
P.O. Box 50280
Phoenix, Arizona 85076

Components supplied by manufacturers other than those listed above shall be approved by the Department prior to use.

702-2.03 **Sand Barrel Crash Cushion:** the second sentence of the third paragraph of the Standard Specifications is revised to read:

The sand, when placed in the module, shall have a dry unit weight of from 80 to 105 pounds per cubic foot and a moisture content of less than two percent, by weight.

702-3 **Construction Requirements:** the second paragraph of the Standard Specifications is revised to read:

Unless otherwise specified on the project plans, when the plans require the attenuation device to be placed on a paved pad the pavement shall be four inches thick and shall be made either of utility concrete or asphaltic concrete, at the option of the contractor. The soil under the pad, or under the impact attenuator when no pad is required, shall be compacted to not less than 95 percent of the maximum density found in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. When installation of the attenuation device is complete, all trash shall be removed from its area and the soil surface around it shall be smoothed to the elevation indicated on the project plans.

(704THRMO, 05/31/93)

SECTION 704 - THERMOPLASTIC STRIPES AND MARKINGS: of the Standard Specifications is revised to read:

704-1 **Description:**

The work under this section shall consist of cleaning and preparing pavement surfaces and furnishing and applying either white or yellow hot-sprayed thermoplastic reflectorized stripes or pavement markings to the prepared pavement at the locations and in accordance with the details shown on the project plans and the requirements of these specifications.

Screed or extrusion application of thermoplastic may be allowed, if approved by the Engineer, for short application work such as intersections.

704-2 **Materials:**

704-2.01 **General Requirements:**

The thermoplastic reflectorized material shall consist of a mixture of binder, white or yellow pigment, glass spheres, filler, and other materials in granular form specifically compounded for pavement stripes and markings that is applied to the pavement in a molten state. Upon cooling to normal pavement temperature, this material shall produce an adherent reflectorized stripe or marking of specified thickness capable of resisting deformation.

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted.

704-2.02 Composition:

The thermoplastic composition shall conform to the following requirements:

	Percent by Weight	
	White	**Yellow**
Binder	18-26	18-26
Titanium dioxide	8-15	-------
Basic lead chromate	-------	4-10
Reflective glass spheres	30-40	30-40
Calcium carbonate or equiv. filler	20-40	25-45

The ingredients of the thermoplastic composition shall be thoroughly mixed and in a free flowing granular form. The material shall readily melt into a uniform mixture and be free from all skins, dirt, foreign objects or any other ingredient which would cause bleeding, staining or discoloration when applied to the bituminous or concrete pavement.

The thermoplastic shall be one of the following two types based on the binder composition:

- Hydrocarbon - shall consist mainly of synthetic petroleum hydrocarbon resins with appropriate fillers and pigments.
- Alkyd - shall consist mainly of maleic modified glycerol ester of tall oil resin for the binder.

(A) Reflective Glass Beads:

In addition to incorporating glass beads in the thermoplastic mix, glass beads shall be applied to the surface of the molten material at a uniform minimum rate of 10 pounds of glass beads per 100 square feet of line (300 feet of four inch stripe).

(B) Filler:

The filler shall be a white calcium carbonate or equivalent filler with a compressive strength of at least 5,000 pounds per square inch.

(C) Titanium Dioxide:

Titanium Dioxide shall conform to the requirements of ASTM D-476 for Type II (92 percent).

(D) Lead Chromate Pigment:

The lead chromate pigment shall be silica encapsulated heat resistant lead chromate pigment.

704-2.03 Physical Characteristics of the Composition:

(A) General Requirements:

The thermoplastic material shall not exude fumes which are toxic or injurious when heated to the temperature range specified by the manufacturer for application. The material shall remain stable when held for four hours at this temperature, or when subjected to four reheatings, not exceeding a total of four hours, after cooling to ambient temperature. The temperature viscosity characteristics of the plastic material shall remain constant throughout the reheatings and shall show like characteristics from batch to batch. There shall be no obvious change in color of the thermoplastic material as a result of reheating, and the color of the material shall not vary from batch to batch.

(B) Color:

The thermoplastic material, after heating for four hours $\pm$ 5 min. at 425$\pm$3 degrees F. and cooled to 77$\pm$3 degrees F., shall meet the following:

White: Daylight reflectance at 45 degrees-0 degrees shall be 75 percent minimum.

The color shall match Federal Test Standard Number 595, color chip No. 17925.

Yellow: Daylight reflectance at 45 degrees-0 degrees shall be 45 percent minimum.

The color shall match Federal Test Standard Number 595, color chip No. 13538.

(C) Retroreflectance:

The white and yellow Thermoplastic materials shall have the following minimum retroreflectance values at 86.5 degrees illumination angle and 1.5 degrees observation angle as measure by a Mirolux 212 portable retroreflectometer 30 days after application to the roadway surface:

Product	Retroreflectance (Millicandelas)
White	200
Yellow	150

(D) Water Absorption and Specific Gravity:

The thermoplastic material shall not exceed 0.5 percent by weight of retained water when tested in accordance with the requirements of ASTM D 570.

The specific gravity of the material, as determined by Section 10 of AASHTO T 250, shall be between 1.85 and 2.3.

(E) Bond Strength:

After heating the thermoplastic material for four hours ± 5 min. at 425±3 degrees F., the bond strength to portland cement concrete shall be not less than 180 pounds per square inch. The bond strength shall be determined in accordance with the procedures specified in Section 6 of AASHTO T 250.

(F) Cracking Resistance at Low Temperature:

After heating the thermoplastic material for four hours ± 5 min. at 425±3 degrees F., applying to concrete blocks, and cooling to 15±3 degrees F, the material shall show no cracks when observed from a distance exceeding 12 inches. Testing for low temperature crack resistance shall be in accordance with the procedures specified in Section 7 of AASHTO T 250.

(G) Impact Resistance:

After heating the thermoplastic material for four hours ± 5 min. at 425±3 degrees F. and forming test specimens, the impact resistance shall be not less than 10 inch pounds when tested in accordance with Section 8 of AASHTO T 250.

(H) Softening Point:

After heating the thermoplastic material for four hours ± 5 min. at 425±3 degrees F. and testing in accordance with ASTM D 36, the thermoplastic materials shall have a softening point of 215±15 degrees F.

(I) Flowability:

After heating the thermoplastic material for four hours ± 5 min. at 425±3 degrees F., and testing for flowability in accordance with Section 5 of AASHTO T 250, the white thermoplastic shall have a maximum percent residue of 18 and the yellow thermoplastic shall have maximum percent residue of 21.

(J) Yellowness Index:

The white thermoplastic material shall not exceed a yellowness index 0.12 when tested in accordance with Section 3 of AASHTO T 250.

(K) Flowability (Extended Heating):

After heating the thermoplastic material for eight ± 1/2 hours at 425±3 degrees F., with stirring the last six hours, and testing for flowability in accordance with Section 11 of AASHTO T 250, the thermoplastic shall have a maximum percent residue of 28.

(L) Abrasion Resistance:

The abrasion resistance of the thermoplastic material shall be determined by forming a representative lot of the material at a thickness of 0.125 inch on a four inch square monel panel (thickness 0.050 ± 0.001 inch), on which a suitable primer has been previously applied, and subjecting it to 200 revolutions on a Taber Abraser at 25 degrees C., using H-22 calibrated wheels weighted to 250 grams. The wearing surface shall be kept wet with distilled water throughout the test.

The maximum loss of thermoplastic material shall be 0.5 grams.

(M) Flash Point:

The thermoplastic material shall have a flash point not less than 475°F. when tested in accordance with the requirements of ASTM D92.

(N) Storage Life:

The materials shall meet the requirements of this specification for a period of one year from the date of manufacture. The thermoplastic must also melt uniformly with no evidence of skins or unmelted particles for this one year period. Any material which does not not meet the above requirements, or which is no longer within this one year period at the time of application, shall be replaced by the contractor at no additional cost to the Department.

(O) Primer Sealer:

Primer Sealers for use on Portland cement concrete or hot mix asphaltic concrete surfaces prior to application of the thermoplastic material shall be either as recommended by the thermoplastic material manufacturer or especially compounded for use with the specified thermoplastic material.

704-2.04 Physical Requirements for Glass Beads:

Reflective glass beads shall conform to the requirements of Subsection 708-2.02.

704-3 Construction Requirements:

704-3.01 Equipment:

The equipment used to install hot applied thermoplastic material shall be constructed to provide continuous uniform heating to temperatures exceeding 400 degrees F. while mixing and agitating the material. The conveying portion of the equipment, between the main material reservoir and the line dispensing device, shall be configured to prevent accumulation and clogging. All parts of the equipment which will come in contact with the material shall be constructed for easy accessibility for cleaning and maintenance. The equipment shall operate so that all mixing and conveying parts, including the line dispensing device, will maintain the material at the plastic temperature. The use of pans, aprons or similar appliances which the dispenser overruns will not be permitted. The equipment shall provide for varying traffic marking application widths.

The application equipment to be used on roadway installations shall consist of either truck-mounted units, motorized ride-on equipment or manually pushed equipment, depending on the type of marking required. The truck-mounted or motorized ride-on units for center lines, lane lines and edge lines shall consist of a mobile self-contained unit carrying its own material capable of operating at a minimum speed of five miles per hour while applying striping. The hand applicator equipment shall be sufficiently maneuverable to install curved and straight lines, both longitudinally and transversely.

The application equipment shall be so constructed as to assure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off square stripe ends and shall provide a method of applying "skip" lines. The equipment shall be constructed so as to provide varying widths of traffic markings. The application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment operator shall be located in such a position as to enable full visibility of the striping apparatus.

A glass bead top dressing shall be applied to the completed thermoplastic stripe by an automatic glass bead dispenser attached to the striping machine in such a manner that the beads are applied to the molten thermoplastic material immediately after it has been applied. The bead dispenser shall utilize pressure type spray guns which will embed the beads into the stripe surface to at least 1/2 the bead diameter. The bead dispenser shall be equipped with an automatic cut-off synchronized with the cut-off of the thermoplastic material.

A special kettle shall be provided for uniformly melting and heating the thermoplastic material. The kettle must be equipped with an automatic thermostat control device and material thermometer for positive temperature control to prevent overheating or underheating of the material.

The heating kettle and application equipment shall meet the requirements of the National Fire Underwriters and the National Fire Protection Association and of the state and local authorities.

If screed or extrusion application of thermoplastic is allowed for short applications by the Engineer, the screed/extrusion application method shall be utilized wherein one side of the shaping die is the pavement and the other three sides are contained by equipment suitable for heating or controlling the flow of material. The equipment utilized shall form an extruded line which shall be uniform in shape having clear and sharp dimensions.

For handliner applications, a gravity bead dispenser may be allowed by the Engineer if it properly gauges and dispenses the correct amount of glass spheres.

704-3.02 Application:

The contractor shall remove all dirt, dust, grease, oil or other detrimental material from the road surface prior to application of the thermoplastic material. The method of cleaning the surface is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray. The cost for cleaning the surface, including sweeping and high-pressure air spray, shall be considered part of the cost for applying thermoplastic striping and no separate measurement or payment will be made for this work.

When thermoplastic striping, symbols or legends are to be applied to new portland cement concrete pavement, any curing compound present shall be removed by means of a high-pressure water jet or sandblasting, followed up by sweeping and high-pressure air spray. On both old and new portland cement concrete pavement a primer-sealer, as recommended by the thermoplastic manufacturer, shall be applied prior to placing the thermoplastic material to assure a satisfactory bond. The primer shall be free of solvent and water prior to the thermoplastic application.

The air and road surface temperature at the time of application shall not be less than 55 degrees F., and the pavement surface shall be absolutely dry. To insure optimum adhesion, the thermoplastic material shall be installed in a melted state at a temperature from 400 to 440 degrees F.

The thermoplastic striping and markings shall be a minimum of 0.060 inches thick in all applications. Random spot checks of the thermoplastic thickness will be made by the Engineer to ensure conformance with the above criteria. A suggested spot check procedure is to place a small strip of metal with a known thickness immediately ahead of the striping apparatus. After striping, remove the sample and using a suitable measuring device, i.e. micrometer, determine the thickness of the marking.

Longitudinal lines shall be offset at least 12 inches clear from construction joints unless directed otherwise by the Engineer.

It shall be the responsibility of the contractor to provide for adequate disposal of all empty material containers.

The finished thermoplastic line shall have well defined edges and be free from waviness. Lateral deviation of the thermoplastic stripe shall not exceed one inch in 100 feet. The longitudinal deviation of a painted segment and gap shall not vary more than six inches in a 40 foot cycle. The actual width of stripe shall be within the limits specified in the following table, according to the width of stripe called for on the plans:

Plan Width	Actual Width
4 inches	4 to 4 1/2 inches
8 inches	8 to 9 inches
Over 8 inches	± 1 inch

After application and sufficient drying time, the thermoplastic marking shall show no appreciable deformation or discoloration under local traffic conditions in an air and/or road temperature ranging from -10 degrees to +180 degrees F. The drying time shall be defined as the minimum elapsed time, after application, when the thermoplastic pavement markings shall have and shall retain the characteristics required herein and after which normal traffic will leave no impression or imprint on the newly applied marking. When applied at a temperature range of 412.5±12.5 degrees F and thickness of 0.060 inches to 0.185 inches, the material shall set to bear traffic in not more than 2 minutes when the air and road surface temperature is approximately 50±3 degrees F., and not more than ten minutes when the air and road surface temperatures is approximately 90±3 degrees F .

704-4 Method of Measurement:

Thermoplastic pavement stripes will be measured by the linear foot along the center line of the pavement stripe and will be based on a four inch wide stripe. Measurement for striping with a plan width greater or less than the basic four inches as shown on the plans or directed by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches) x Linear Feet}}{\text{4 (inches)}}$$

No measurement will be made of the number of linear feet of skips in the dashed line.

Thermoplastic pavement symbols and legends will be measured by each unit applied. Each pavement symbol and each legend, as shown on the plans, will be considered a unit.

Removal of curing compound from new portland cement concrete pavement and the application of primer-sealer, which is to be applied to both old and new portland cement concrete pavement, prior to application of thermoplastic striping or marking, shall be measured by the linear foot or unit each, respectively, depending on the nature of the work to be done, and in accordance with the items of work established in the bid schedule.

704-5 Basis of Payment:

The accepted quantities of thermoplastic pavement markings of the type specified in the bidding schedule, measured as provided above, will be paid for at the contract unit price, complete in place, including pavement surface preparation and glass beads.

The accepted quantities for removal of curing compound from new portland cement concrete pavement and the application of primer-sealer, measured as provided above, will be paid for at the contract unit price for each, respectively, under the items of work established in the bid schedule.

(705PVMRK, 07/31/90)

SECTION 705 - PREFORMED PLASTIC PAVEMENT MARKING:

705-2.01 Preformed Pavement Markings - Type I (Permanent): of the Standard Specifications is modified to add:

(D) Performance Testing:

The following are approved Type I Preformed Pavement Marking Materials:

Stamark Brand Series 5730/5731
3M Corporation
St. Paul, Minnesota 55144

Stamark Brand Series 350/351
3M Corporation
St. Paul, Minnesota 55144

Ferro/Cataphote
Ferro Corporation
P.O. Box 2369
Jackson, Mississippi 39225-2369

Materials other than those listed above may be used but must be approved by the Department prior to use.

(706PVMRK, 10/30/94)

SECTION 706 - RAISED PAVEMENT MARKERS:

706-2.01 **General:** the first paragraph of the Standard Specifications is revised to read:

Certificates of Compliance for raised pavement markers and adhesive conforming to the requirements of Subsection 106.05 shall be submitted to the Engineer at least 10 days prior to use. A minimum of one sample per lot per type of marker shall be taken by the Engineer. The pavement marker samples shall be tested to determine conformance to the applicable standard drawings and these specifications.

706-2.02 **Reflective Pavement Markers:** of the Standard Specifications is revised to read:

Reflective pavement markers shall be of the following type:

Type C	Clear, red
Type D	Yellow, two-way
Type E	Clear, yellow
Type G	Clear, one-way
Type H	Yellow, one-way

Reflective pavement markers shall be of the prismatic reflector type consisting of a molded methyl methacrylate or suitably compounded acrylonitrile butadiene styrene (ABS) shell filled with a mixture of an inert thermosetting compound and filler material. The exterior surface of the shell shall be smooth and contain one or two prismatic reflector faces of the color specified.

When illuminated by an automobile headlight, the color of the reflectors shall be an approved clear, yellow, or red as designated. Reflectors not meeting the required color may be rejected.

Permanent reflective pavement markers will be tested for compressive strength, abrasion resistance and specific intensity. Permanent reflective pavement markers shall have thin untempered glass or other abrasion resistant material bonded to the prismatic reflector face to provide an extremely hard and durable, abrasive resistant reflector surface.

The glass, or other abrasion resistant surface, is not required on the red faces of two way (Clear/Red) permanent reflective markers. The area covered by the glass, or other abrasion resistant surface, shall not be less than 3 sq. in.

Temporary reflective pavement markers will be tested for compressive strength and specific intensity. Temporary reflective pavement markers, or permanent reflective pavement markers used as temporary, will not be tested for abrasion resistance.

The strength by compressive loading shall be at least 2000 pounds for both permanent and temporary reflective pavement markers.

The original specific intensity of each reflecting surface for both temporary and permanent reflective markers shall not be less than the following:

Reflectance	Specific Intensity		
	Clear	Yellow	Red
0 Degrees	3.0	1.8	0.75
20 Degrees	1.2	0.72	0.30

Permanent reflective pavement markers shall be subject to an abrasion resistance test as follows:

Steel Wool Abrasion Procedure - Form a one-inch diameter flat pad using No. 3 coarse steel wool per Federal Specification FF-W1825. Place the steel wool pad on the reflector lens face. Apply a load of 50 pounds and rub the entire lens surface 100 times. After the lens surface has been abraded, the specific intensity of each clear and yellow reflective surface shall be not less than that required above for the original specific intensity.

706-2.05 **Bituminous Adhesive:** of the Standard Specifications is modified to add:

The bituminous adhesive for pavement markers shall be a hot-melt adhesive manufactured by one of the following approved manufacturers:

Signal Products Division
Amerace Corporation
7542 N. Natchez Avenue
Niles, Illinois 60648

or

Crafco, Incorporated
6975 West Crafco Way
Chandler, Arizona 85226

Materials by manufacturers other than those listed above may be used but must be approved by the Department prior to use.

(708PPMMA, 05/15/94)

SECTION 708 - PERMANENT PAVEMENT MARKINGS:

708-1 **Description:** of the Standard Specifications is revised to read:

The work under this section shall consist of cleaning and preparing the pavement surface, furnishing all materials and applying white or yellow, water-borne, lead-free, rapid-dry traffic paint and reflective glass beads at the locations and in accordance with the details shown on the plans, MUTCD, the requirements of these specifications, or as directed by the Engineer.

708-2 **Materials:**

708-2.01 **Pavement Marking Paint:** of the Standard Specifications is revised to read:

(A) General:

All material used in the formulation of the pavement marking paint shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted for each lot or batch of paint prior to its use.

(B) Composition Requirements:

The pavement marking paint shall be a ready-mixed, one component, water-borne lead-free traffic line paint, of the correct color, to be applied to either asphaltic or portland cement concrete pavement. The composition of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to produce a pigmented water-borne paint containing all the necessary co-solvents, dispersant, wetting agents, preservatives and all other additives, so that the paint shall retain its viscosity, stability and all of the properties as specified herein. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogen, as defined in 29 CFR 1910.1200. Lead content shall not exceed 0.06 percent by weight of the dry film, and the test for chromium content shall be negative.

No glass beads will be allowed in the pavement marking paint. Glass beads will be applied after the paint has been applied.

(C) Manufacturing Formulations:

The manufacturer shall formulate the pavement marking paint in a consistent manner and notify the Engineer of any change of formulation. The formulation of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to formulate paint which will meet the quantitative and qualitative requirements of this specification. Any change in the formulation of the paint must be approved by the Engineer.

(D) Quantitative Requirements of Mixed Paints:

	White	Yellow
Pigment: percent by weight, ASTM D3723, allowable variation from qualifying sample	± 2.0	± 2.0
Non-volatile Content: percent by weight, ASTM D2369, allowable variation from qualifying sample	± 2.0	± 2.0
Viscosity: Kreb Units at 77 ° F. ± 1 ° F., ASTM D562	70 - 85	70 - 85
Weight per Gallon: pounds at 77° F. ± 1° F., ASTM D1475, allowable variation from qualifying sample	± 0.3	± 0.3
Vehicle Composition: Vehicle Infrared Spectra, ASTM D2621, allowable variation from qualifying sample	None	None
pH: ASTM E70, allowable variation from qualifying sample	± 1.0	± 1.0
Fineness of Dispersion: HEGMAN, minimum, ASTM D1210	3.0	3.0

Volatile Organic Compounds: pounds per gallon of paint, maximum, ASTM D3960 according to 7.1.2.	2.1	2.1
Flash Point: Degrees F., minimum, ASTM D93, Method A	100	100
Dry time to No Pick Up: with no beads, minutes, maximum ASTM D711	10	10
Dry Through Time: Minutes, ASTM D1640 except no thumb pressure is used when thumb is rotated 90 degrees on paint film	20	20
Flexibility: TT-P-1952B	Pass	Pass

(E) Qualitative Requirements:

(1) Color of Yellow Paint:

The color of the yellow paint shall closely match Federal Standard 595b, Color No. 33538. The color shall be checked visually, and will be checked against Tristimulus Values for the color according to Federal Test Method Standard No. 141.

(2) Dry Opacity:

Dry opacity for the paint will be determined using a black-white Leneta Chart, Form 2C Opacity and a Photovolt 577 Reflectance Meter or equal. Using a 10 mil (0.25 mm) gap doctor blade, a film of paint is drawn down, covering both black and white portions of the chart. The film shall be allowed to dry 24 hours. After calibrating the Reflectance Meter according to the manufacturer's instructions, measure the reflectance over the white and black portions with the green Tristimulus filter. Dry opacity is calculated as follows:

Reflectance over black/reflectance over white = Dry Opacity

Dry Opacity for both white and yellow paint shall be a minimum 0.90.

(3) Yellowness Index:

Yellowness Index for white paint will be determined as described for dry opacity, only use a 15 mil (0.4 mm) gap doctor blade to draw down the paint. After 24 hours for drying, measure the reflectance of the paint film, using the green, blue and amber Tristimulus filters. Calculate the Yellowness Index as follows:

$$\text{Yellowness Index} = \frac{\text{Amber - Blue}}{\text{Green}} \times 100$$

Yellowness Index for the white paint shall be a maximum of 10.

(4) Reflectance:

Reflectance for both white and yellow paint will be determined using the same 15 mil draw down film as for the Yellowness Index. For white paint the same sample may be utilized for both the Yellowness Index and Reflectance. Measure the reflectance of the paint film, using the green Tristimulus filter. Reflectance for the white paint shall be a minimum of 85. Reflectance for the yellow paint shall range from 42 to 59, inclusive.

(5) UV Color Durability:

UV Color Durability shall be determined using a QUV Weatherometer, with Ultra Violet Light and Condensate Exposure according to ASTM G53, for 300 hours total. The repeating cycle shall be 4 hours UV exposure at 60° C. followed by 4 hours condensate exposure at 40° C. After 300 hours of exposure, the Yellowness Index for white paint shall not exceed 12, and yellow paint must closely approximate Federal Standard 595b, Color No. 33538.

(6) Static Heat Stability:

To determine static heat stability for the paint, place 1 pint (1/2 liter) of paint in a sealed can and heat in an air circulation oven at 120° F. ± 1° F. for a period of one week. Remove the paint from the oven and check the viscosity in Kreb Units at 77° F. ± 1° F. according to ASTM D562. The viscosity measured must be in the range from 68 to 90, inclusive. Also, check for any signs of instability.

(7) Heat-Shear Stability:

To determine heat-shear stability for the paint, one pint (1/2 liter) of the paint is sheared in a Waring Blender at high speed to 150° F. The blender should have a tight fitting lid taped onto it to minimize volatile loss. When the paint reaches 150 ° F., stop the blender and immediately pour the paint into a sample can and apply a cover to seal the can. Let the paint cool overnight and examine for jelling or other signs of instability. Measure viscosity in Kreb Units at 77° F. ± 1° F. according to ASTM D562. The viscosity measured must be in the range from 68 to 95 inclusive. If not within the upper limit, run total solids on the sheared paint and adjust solids, if necessary, by adding water to reach the original solids content. If the solids content required adjustment, again check the viscosity of the paint. The viscosity must be in the range from 68 to 95 inclusive.

(8) Scrub Resistance:

Scrub Resistance will be determined according to ASTM D2486. Use an appropriate doctor blade to provide a dry film thickness of 3 to 4 mils. Allow the paint to cure for 24 hours. Perform the scrub resistance test at 77° F. ± 1° F. and 50 ± 5% humidity. Record the number of cycles to remove the paint film. The number of cycles recorded must be a minimum of 800.

(9) Spraying Properties:

The paint shall be applied at a 15 mils wet film thickness in the field. The paint shall show the following properties at ambient temperatures of 50° F. to 100° F. with a paint spray temperature of 150° F., maximum, and 6 to 8 lbs. of post-applied glass beads per gallon of paint. Beads shall conform to Subsection 708-2.02 of the Standard Specifications.

(a) Dry to a no track condition in 5 minutes or less when the line is crossed over in a passing maneuver with a standard sized automobile.

(b) Produce a clean-cut, smooth line with no overspray or puddling.

(c) Paint shall accept glass beads so that the spheres shall be embedded into the paint film to a depth of 50% of their diameter.

(d) Paint when heated to the temperature necessary to obtain the specified dry time, shall show no evidence of instability such as viscosity increase, jelling or poor spray application.

(10) Freeze-Thaw Properties:

The paint viscosity or consistency shall not change significantly when the paint is tested for resistance to five cycles of freeze-thaw according to ASTM D2243.

(11) Road Service Rating:

Test stripes of the paint shall be applied transversely across the road, 4 inches in width and approximately 12 ft. long at a location approved by the Engineer.

Wet film thickness of the test stripes shall be approximately 15 mils as determined according to ASTM D4414 and ASTM D713 prior to test stripe application. To aid in obtaining the correct film thickness, a length of roofing paper placed by the side of the road can be used. Place a rigid metal test panel on the roofing paper in the path of a test line. Immediately after the test line is applied by the striper, measure the wet film thickness. If not satisfactory, adjust the spray pressure and repeat until the target wet film thickness is attained. It is important that no glass beads be present that would give a false wet film thickness. When the wet film thickness is correct, apply a test line across a tared metal test panel. After this, apply another test line across a different torn metal test panel, this time also adding the beads. These samples are necessary to determine the initial bead retention.

Glass beads conforming to the requirements of Subsection 708-2.02 of the standard specification (moisture proof type) will be applied after the paint has been applied, but during the same striping operation at a rate such that the initial bead retention on the test line is a minimum of 6 lbs. of beads per gallons of wet paint. The initial bead retention will be determined analytically by the ADOT Laboratory concurrently with the determination of the dry paint thickness utilizing torn metal test panels. The paint shall accept the glass beads so that the spheres are embedded into the paint film to a depth of 50% of their diameter. Test stripes will be observed for a period of 180 days from date of application. Paints will be evaluated for wear according to ASTM D821.

After 180 days of service, on a scale of 0 to 10, paints must have a rating of No. 7 or better to be acceptable. All ratings will be taken in the wheel track area. Glass beads shall show no more than a 30% loss after 180 days of test. This will be determined by taking close-up photographs of the paint film and by count, determining the average bead loss.

The road service test may be waived at the option of the Engineer or evaluated for a period of time less than 180 days.

(12) Workmanship:

Paint shall be free from foreign materials, such as dirt, sand, fibers from bags, or other material capable of clogging screens, valves, pumps, and other equipment used in a paint striping apparatus.

The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container, and shall not become granular or curdled. Any settlement of pigment in the paint shall result in a thoroughly wetted, soft mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sidewise manual motion of a paddle across the bottom of the container, to form a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement as described above, or due to any other cause, the paint shall be considered unfit for use.

The paint shall retain all specified properties under normal storage conditions for 8 months after acceptance and delivery. The contractor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The properties of any replacement paint, as specified herein, shall remain satisfactory for 8 months from the date of acceptance and delivery.

(F) Manufacturing Requirements:

(1) Inspection:

The manufacturer of the paint shall advise the Engineer when paint is to be manufactured and shall furnish the Engineer free access to all parts of the plant involved in the paint manufacture and shall furnish every reasonable facility for sampling both the paint and the raw materials during the process of manufacturing.

All materials used in formulation shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

All manufactured paint shall be prepared at the factory ready for application.

When paint is shipped to a distributor or paint applicator who will store the paint prior to its use, the distributor or paint applicator shall furnish the Engineer free access to all parts of the facility where paint is stored and shall furnish every reasonable facility for sampling the paint.

Paint shall normally be sampled at the place of storage either at a warehouse or on the site prior to application of the paint. Application of the paint will not be permitted until the paint has been approved by the Engineer. It is the contractor's responsibility to notify the Engineer a minimum of 14 working days prior to any traffic painting operation and to allow access at that time for paint sampling at the storage location.

A minimum of one paint sample shall be obtained from each lot of paint.

Check samples of finished paint while being applied will be taken at intervals as determined by the Engineer.

(2) Testing:

All tests will be conducted in accordance with the latest test methods of the American Society for Testing and Materials, Federal Test Method Standard No. 141, and methods in use by Materials Group, Highways Division, and the Arizona Department of Transportation as specified herein.

Evidence of adulteration or improper formulation shall be cause for rejection.

(3) Packaging:

All shipping containers for paint must comply with the Department of Transportation Code of Federal Regulations, Hazardous Materials and Regulation Board, Reference 49 CFR. The container and lids must be lined with a suitable coating so as to prevent attack by the paint or by agents in the air space above the paint. The lining must not come off the container or lid as skins.

Containers shall be colored white, including lids, and containers shall have an identifying band of the appropriate color around and within the top one third of the container.

All containers shall be properly sealed with suitable gaskets and shall show no evidence of leakage and shall remain in satisfactory condition for a period of 12 months after delivery to a distributor or paint applicator. The contractor shall be held responsible for all costs and transportation charges incurred in replacing paint and containers.

(4) Marking:

All containers of paint shall be labeled showing the manufacturer's name, date of manufacture, paint color, product code, manufacturer's batch number, and quantity or weight of paint on both the side of the container and also the lid. Containers shall be clearly marked or labeled Rapid or Fast Dry lead-free Water-Borne Traffic Paints.

All containers of paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of Arizona, Maricopa County.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are toxic, corrosive, flammable, etc., as outlined in the Code of Federal Regulations, Hazardous Materials and Regulations Board, Reference 49CFR.

(5) Unused Paint:

Disposal of unused quantities of traffic paint shall be the responsibility of the contractor and must meet all applicable Federal regulations for waste disposal. Paint which is saved to be used later shall be packaged as specified previously and shipped to a storage location. Unused paint must be identified on the container. Unused paint may be utilized on a future project provided the paint still conforms to all specifications contained herein.

708-2.02(B)(2) Roundness: of the Standard Specifications is revised to read:

When tested by the method provided in ASTM D-1155 (Procedure B except paragraphs (F) and (G) are deleted) beads retained on any screen specified in the gradation requirements shall contain a minimum of 75% true spheres.

708-3.02 Application: the first paragraph of the Standard Specifications is modified to add:

Painting shall not be performed when the atmospheric temperature is below 50° F. when using water-borne paint, nor when it can be anticipated that the atmospheric temperature will drop below said 50° F. temperatures during the drying period. Water-borne paints shall not be applied if rain is expected within one hour of its application, unless otherwise approved by the Engineer. Water-borne paint shall not be heated to a temperature greater than 150° F. to accelerate drying.

SECTION 730 - GENERAL REQUIREMENTS FOR TRAFFIC SIGNAL AND HIGHWAY LIGHTING SYSTEMS:

SECTION 730-1 Description: of the Standard Specifications is modified to add:

Traffic signal material and construction of the Cactus Road and Thunderbird Road signals shall conform to the requirements of Section 351 of the City of Phoenix Supplement to the Maricopa Association of Governments Uniform Standard Specifications.

SECTION 731 - STRUCTURAL SUPPORTS AND FOUNDATIONS FOR TRAFFIC SIGNAL AND HIGHWAY LIGHTING:

731-3.01 Foundations: of the Standard Specifications is modified to add:

Payment for anchorages including but not limited to anchor bars, anchor bolts, expansion bolts and groundwire for light poles mounted on roadway barriers or retaining wall barriers as shown in the project plans will not be paid separately but are included in the cost of the roadway barrier or retaining wall.

Foundations on bridge structures will be paid for under ITEM 9240104.

(731STRSP, 10/30/94)

SECTION 731 STRUCTURAL SUPPORTS AND FOUNDATIONS FOR TRAFFIC SIGNAL AND HIGHWAY LIGHTING:

731-2.02 (G) Anchor Bolts: the third paragraph of the Standard Specifications is modified to add:

High strength anchor bolts, washers and nuts shall be fabricated from steel which meets or exceeds the minimum requirements of ASTM A 325 and shall be electro-galvanized in accordance with the requirements of ASTM B 633. Welding shall not be performed on any portion of the body of these anchor bolts. Certificates of Analysis conforming to the requirements of Subsection 106.05 shall be submitted for high strength anchor bolts, washers, and nuts.

SECTION 732 - ELECTRICAL UNDERGROUND MATERIAL:

732-3.01 **Installation of Electrical Conduit and Pull Boxes:** of the Standard Specifications is modified to add:

Future use conduit ends shall be capped and the location marked with steel stakes not less than 2 feet in length and ½ inch in diameter. The stake shall project approximately 2 inches above ground and shall be painted a color acceptable to the Engineer.

Ground mounted pull boxes shall be installed with approximately one inch projection between the finished grade and pull box cover.

732-3.01 **Installation of Electrical Conduit and Pull Boxes:** the third paragraph of the Standard Specifications is revised to read:

The PVC conduit shall be cut square and trimmed to remove all rough edges. Conduit connections shall be of the solvent weld type. Purple primer (ASTM F656) shall be applied to the joined surfaces prior to use of cement. The joint cement shall be the gray PVC cement (ASTM D2564). Where a connection is made to steel conduit, the coupling used shall be a PVC female adapter.

732-3.04 **Service:** of the Standard Specifications is modified to add:

The contractor shall submit detailed shop drawings and specifications for each utility service load center and control cabinet to the utility company providing the electrical service. The contractor shall then submit the utility approved shop drawings to the Engineer. The contractor shall have approved shop drawings from the appropriate utility company and the Engineer for the service cabinets prior to ordering the service cabinets. Foundations and maintenance pads for load center cabinets shall be included in the Load Center Cabinet item.

ITEM 7320460 PULL BOX (BARRIER MOUNTED)

Description:

The work under this item includes the installation of a barrier mounted pull box utilizing the applicable requirements of Structures Section Standard Drawing B-21.30.

All work under this item shall be in accordance with Section 732 of the Standard Specifications and the provisions herein.

Barrier mounted pull boxes on structures will be included in the lump sum for each structure.

ITEM 7320713 UTILITY RELOCATION WORK (U S WEST):

Description:

The work under this item consists of trenching, backfilling, furnishing certain materials and installing materials furnished by others to construct complete continuous conduits in the Cholla Street and Cactus Road Underpass Structures for U S WEST facilities, in accordance with the details shown on the project plans, the requirements of the Standard Specifications, and these Special Provisions.

Materials:

Concrete and reinforcing steel will be provided by the contractor.

Conduit, bridge hardware, warning tape, measuring tape, and locate wire shall be furnished by U S WEST

Concrete shall be Class S (f'c=2,500 psi) conforming to the requirements of Section 1006.

Concrete slurry and other materials shall be in accordance with other requirements shown on the project plans.

For those materials to be provided by U S WEST, the contractor shall contact Gary Wierck (phone 582-8025) seven days in advance.

Construction Requirements:

Excavation and backfill shall be in accordance with the application requirements of Section 203 and the requirements shown on the project plans.

Conduits and manholes shall be installed in accordance with the requirements shown on the project plans.

Method of Measurement:

Work under ITEM 7320713 will be measured as a single unit of work.

Basis of Payment:

Payment for this work will be made at the contract lump sum price for ITEM 7320713, which price shall be full compensation for the item complete as described and specified herein and on the project plans.

ITEM 7320720 TRENCHING FOR SERVICE CONDUCTORS:

Description:

The work under this section shall consist of all trenching and backfilling necessary for the installation of service conductors. This item shall also include the installation of underground electrical service ducts, both primary and secondary, as specified herein, on project plans, or as directed by the Engineer.

Equipment and Materials:

All equipment and materials covered by this special provision shall be subject to acceptance of the service utility company, Arizona Public Service Company (APS).

Construction Requirements:

The contractor shall trench and install underground electrical ducts at the approximate locations indicated on project plans. Specific location of the trenches shall be coordinated with APS as the work progresses. Trenches shall be backfilled and compacted in accordance with Standard Specifications.

All work herein shall be in accordance with all the specifications and requirements of APS.

Method of Measurement:

Trenching for service conductors shall be measured by linear foot complete in place.

Basis of Payment:

The accepted quantities of trenching for service conductors, measured as provided above, will be paid for at the contract unit price for ITEM 7320720, for the unit specified in the bidding schedule. Direct payment will be not made for fill and compaction of trenched areas.

(734PATSC, 11/15/92)

SECTION 734 - TRAFFIC CONTROLLER ASSEMBLY:

734-2.01 (D) Pre-approval of Controller Equipment: of the Standard Specifications is modified to add:

The following signal controller units have been pre-approved by the Department as of August 1992:

1. Type MPS Controllers; Digital Microprocessor Special Programmable and System Applications:

   a. Eagle Signal Corporation:

      EPAC 300 with the following special programs:

MPS-S1	Computer Supervised Unit
MPS-P	Pre-emption
MPS-T-C	Time Base and Traffic Actuated Coordination
MPS-M	Arterial Master Controller

b. Econolite Control Products Inc.

ASC-8000 with the following special programs:

MPS-S1	Computer Supervised Unit
MPS-P	Pre-emption
MPS-T-C	Time Base and Traffic Actuated Coordination
MPS-M	Arterial Master Controller

c. Traffic Control Technology:

LMD - 8000 with the following special programs:

MPS-P	Pre-emption
MPS-T-C	Time Base and Traffic Actuated Coordination
MPS-M	Arterial Master Controller

d. Transyt Corporation

1880EL eight phase with the following special programs:

MPS-P	Pre-emption
MPS-T-C	Time Base and Traffic Actuated Coordination

e. Naztec, Inc.

NT-900 with the following special programs:

MPS-P	Pre-emption
MPS-T-C	Time Base and Traffic Actuated Coordination

f. Winko-Matic Signal Co. Multisonics Corp.

820A OSAM with the following special programs:

MPS-P	Pre-emption
MPS-T-C	Time Base and Traffic Actuated Coordination

2. N.E.M.A. Conflict Monitors:

a. Eagle

3 Channel - LT-213
6 Channel - LT-216
12 Channel - LT-222

b. Econolite

3 Channel - NCMU-3
6 Channel - NCMU-6
12 Channel - NCMU-12

c. E.D.I.

3 Channel - NSM-3L
6 Channel - NSM-6L
12 Channel - NSM-12L

d. Solid State Devices

3 Channel - NM(NP)-3L
6 Channel - NM(NP)-6L
12 Channel - NM(NP)-12L

e. Transyt Corporation

3 Channel - Model 300
6 Channel - Model 600
12 Channel - Model 1200

f. Traffic Control Technologies

3 Channel - LSM-3
6 Channel - LSM-6
12 Channel - LSM-12

12 Channel - LNM-12E

(735LOOP, 07/31/90)

SECTION 735 - DETECTORS: of the Standard Specifications is modified to add:

735-1 Description:

The work shall consist of furnishing all materials and installing a complete Detector Loop Traffic Counter System at the approximate location shown on the project plans and in conformance with the requirements of Section 735 of the Standard Specifications and Standard Drawings T.S. 7-1 and T.S. 7-3. The exact location will be specified by the Engineer. Installation shall be in accordance with ADOT's "Detector Loop Traffic Counter System Installation Procedures" Manual, dated September, 1986.

A complete traffic counter system for an undivided roadway shall consist of the number and size of loops and pullboxes necessary at one location in one roadway to cover all travel lanes. Each through lane shall contain a detector loop.

A complete traffic counter system for a multi-lane divided roadway shall consist of the number and size of loops and pullboxes required to cover all travel lanes in adjacent roadways for one location. Each through lane shall contain a detector loop.

735-2 Materials:

735-2.05 Detector Loop Traffic Counter System:

(A) General:

The contractor shall submit to the Engineer three copies of a complete list of the materials the contractor proposes to incorporate into the project, and three copies of shop drawings for each system indicating the project number and location (milepost and/or station number). The list of materials shall include the brand or trade names, identification numbers, type and quantity of materials to be used. The shop drawings shall include the size of loops, length of loop lead-ins, and location of pullbox(es), all in relationship to the roadway.

No material shall be ordered or installed without the approval of the Engineer.

(B) Loop Conductors:

The conductors for each inductive detector loop shall be No. 14 AWG stranded copper wires, Type THWN, 600 Volt, continuous and unspliced and inserted in polyvinyl chloride tubing.

(C) Conduit and Tubing - PVC:

The polyvinyl chloride tubing shall be UL FR-1 rated at 105 degrees, 31 mil minimum wall thickness, inner diameter .182 to .198 inch, dielectric strength 900 V/CM, moisture absorption less than one percent, and highly resistant to chemicals and oil.

Conduit shall be rigid nonmetallic (PVC) conforming to the requirements of the Specifications and shall be sized large enough to contain the number of loop lead-ins required and be a minimum of two inches in diameter.

(D) Pullboxes:

Pullboxes shall be No. 5 conforming to the requirements of the Specifications and to Standard Drawing T.S. 1-2.

(E) Saw Cut Sealant:

The sealant shall be an approved crack filler emulsion and sand, or epoxy loop sealant conforming to the requirements of Subsection 735-2.04.

735-3 Construction Requirements:

735-3.01 General:

When loops are to be placed in existing pavements, saw cuts shall be made and the loops placed in accordance with the details shown on Standard Drawings T.S. 7-1 and T.S. 7-3.

The saw cuts shall be cleaned with clean water and blown dry by means of an air stream free of oil or water. They shall be inspected for jagged edges or protrusions prior to the placement of the wire. The wire shall be placed as far down in the saw cut as possible and in such a manner that the insulation is not damaged. The bend in the wire at any one point shall not exceed 45 degrees. The wire shall be held in place during installation by strips of polyethylene foam sealant backers two inches in length, placed approximately two feet apart. Wires crossing pavement joints shall be protected with plastic sleeving extending a minimum of four inches each side of the joint.

735-3.02 Testing:

(A) General Requirements:

Any loop that fails to meet the requirements listed below, or will not tune when a detector is connected, shall be replaced at the contractor's expense.

(B) Preliminary:

The contractor shall perform the following tests on each loop in the presence of the Engineer both before and after the sealant has been poured and hardened:

1) Insulation Resistance to Ground - The insulation resistance to ground for each loop shall be measured with a megohmmeter connected to either loop lead-in and to the nearest reliable electrical ground, such as a metal light pole or fire hydrant, or to a metal rod driven three feet into the ground between the roadway and the pull box. The insulation to ground shall not measure less than 50 megohms at 500 volts DC.

2) Series Resistance - The series resistance of each six foot by six foot loop, measured by an ohmmeter, shall be between 0.1 and 0.5 ohms and the maximum resistance of any size loop including lead-ins shall not exceed 10 ohms.

The contractor shall submit two copies of the complete preliminary testing results to the Engineer.

(C) Final:

Final testing will be conducted by the Travel and Facilities Section of the Arizona Department of Transportation after the work is complete in place.

In addition to repeating the preliminary tests and recording the results, the following tests will be made:

1) Inductance - The inductance of each loop will be measured with an inductance tester. The inductance for a six foot by six foot loop with an 11 foot lead-in shall be in the range between 50 and 80 microhenries. The inductance may be greater with larger loops and longer lead-ins but in no case shall the total inductance exceed 700 microhenries.

2) Operation Test - A known working loop detector will be connected to each loop and the response observed under working conditions.

735-4 Method of Measurement:

The Detector Loop Traffic Counter System will be measured as a unit for each system installed and accepted.

735-5 Basis of Payment:

The work, measured as provided above, will be paid for at the contract unit price for each system, which price shall be full compensation for the work described and specified herein and on the plans.

SECTION 735 - DETECTORS: of the Standard Specifications is modified to add:

735-1 Description:

All loop detectors for the Freeway Management System in mainline roadway or ramps to be installed in portland cement concrete pavement (PCCP) areas shall be preformed loops with 600 volt AWG #16 stranded TFFN conductors within ⅜ inch diameter polypropylene tubing (equivalent to Schedule 40) with hot applied asphalt rubber sealant inside the tube. The loop tubing and homerun tubing shall be continuously filled with rubberized sealant. The rubberized sealant shall be in accordance with Subsection 735-2.04(C) of the Standard Specifications. The loop shall contain sealed expansion joints. The entire homerun approaching the pull box shall be fabricated from 250 P.S.I. ⅜" diameter hydraulic hose containing conductors thoroughly encased in the rubberized sealant. The preformed loop detectors shall also conform to the details shown on the project plans and shall be installed as shown on the project plans. The preformed loops shall be fabricated off the job site by the manufacturer. Contractor fabrication will not be acceptable. Each loop shall have five turns per loop.

The loop wires in the homerun tubing to the adjacent pull box shall be twisted together into two separate pairs (at least 4 turns per foot). Each loop shall have a separate twisted pair of conductors to the pull box.

The loops shall be tested in accordance with the Standard Specifications. The preformed loops and homerun tubing shall be placed in the base course with top of tubing flush with top of base in those areas where the PCCP is being placed over AB. In areas where the PCCP is being placed over ABC, the loops shall be sawcut into the ACB. Preformed loops and homeruns shall be protected from damage prior to and during concrete placement. Each homerun conductor pair shall be tagged by the manufacturer to identify current flow polarity (S=start & F=finish). All loop assemblies shall be tested before and after concrete pours.

Each homerun tube shall be tagged in the pullbox with a stainless steel band to identify each lane and loop combination. Example: 1AB, 1CD, 1EF, Lane #1 is defined as the outside lane near the right side curb.

ITEM 7350160 - LOOP DETECTOR FOR TRAFFIC SIGNALS (SAWCUT ONLY):

Description:

The work under this item shall consist of sawcutting and core drilling for quadrupole loops at the intersections of Cactus Road/SR 51 and Thunderbird Road/SR 51.

Construction:

Loop detector slots shall be to the depth and dimensions as shown on project plans. Sawcuts shall be completed within 48 hours after pavement is poured. The contractor will notify the City of Phoenix Traffic Signal Shop (262-6733) two working days prior to sawcutting.

Immediately following sawcutting and, if necessary, cleaning of the sawcut, the contractor shall furnish and install a rope in the sawcuts. The rope shall be slightly larger than the width of the sawcut, and shall be lightly tamped into the sawcut. All costs associated with furnishing and installing the rope in the sawcuts shall be included in the unit price per linear foot for ITEM 7350160 - LOOP DETECTOR FOR TRAFFIC SIGNALS (SAWCUT ONLY).

Measurement:

Measurement of this work will be made horizontally at each location to the nearest tenth of a linear foot.

Payment:

Payment for this work will be made at the contract price per linear foot for ITEM 7350160 - LOOP DETECTOR FOR TRAFFIC SIGNALS (SAWCUT ONLY), which price shall be full compensation for the work, as described and specified herein and on the project plans. Payment will be made on the total length of sawcut to the nearest foot.

ITEM 7360330 - TEMPORARY DETOUR LIGHTING:

Description:

This work shall consist of furnishing, installing and maintaining temporary lighting installations on three detours as shown on the project plans at the following locations:

- Cactus Road Detour
- Thunderbird Road Detour
- Cholla Street Detour

The temporary lighting installations shall remain in service until the Engineer directs that they be removed.

Work under this item shall include furnishing and installing wood poles, street lighting luminaires, mast arms, electrical service, pull boxes, and wiring as necessary.

Materials:

Poles:

Wood poles shall conform to Subsection 731-2.03.

Mast arms to support luminaires and their connections to the wood poles shall be submitted to the Engineer for approval.

The poles shall be erected at locations shown on the plans.

Luminaires:

The luminaires shall conform to the requirements of Section 736 and these Special Provisions.

The luminaires shall be 250 watt, high pressure sodium luminaires of the horizontal burning type. The light distribution shall by Type II cutoff. Each luminaire shall be equipped with a photoelectric cell. The lighting circuits shall be connected to the metering pedestals that will eventually be used for the interchange traffic signal.

Construction Requirements:

1. At the preconstruction conference the contractor shall submit detailed drawings indicating location, construction details and type of equipment proposed for use, for approval by the Engineer.

2. After written approval has been issued by the Engineer, the contractor shall install the temporary highway lighting as required to meet the construction schedule. Upon approval of the installation by the Engineer, the maintenance of the street lighting installations shall become the responsibility of the contractor until removal is directed by the Engineer.

3. The contractor shall be responsible for maintaining the street lighting in proper operating condition. Any damage to the temporary street lighting installation from any cause whatsoever shall be repaired by the contractor at his own expense. If, at any time, the contractor fails to perform any work deemed necessary by the Engineer to keep the temporary street lighting in proper operating condition, the Engineer may have the needed work performed by others. The cost of such work will be deducted from the amount due the contractor.

4. The contractor shall remove the temporary street lighting installation when notified to do so by the Engineer. The contractor shall be held responsible for the safekeeping of all salvageable materials until they are returned to the Arizona Department of Transportation. The contractor shall repair or replace at his own expense any material or equipment damaged, stolen or otherwise lost prior to receipt by the Department. The contractor shall be responsible for property disposal of unusable material. Any holes resulting from removal of the poles shall be backfilled and compacted by the contractor.

5. Underground conduit (including electrical conductors) and junction boxes, shall be installed as indicated on the project plans.

Method of Measurement and Basis of Payment:

The two temporary detour lighting installations will be paid at the contract lump sum price for ITEM 7360330 - TEMPORARY DETOUR LIGHTING, which price shall be full compensation for the item complete, including maintenance and removal when directed, all as described and specified herein and on the project plans.

ITEM 7360349 - UNDERDECK LIGHTING:

Description:

The work under this item consists of furnishing and installing underdeck mounted high pressure sodium luminaires, including lamps, ballast and hardware, in accordance with the project plan, and these Special Provisions. This shall also include all compliance calculations and meetings necessary for luminaire approval.

Materials:

The luminaire shall be a square prismatic refractor type. All units shall be pre-wired.

The underdeck luminaire shall consist of a rear die-cast bronze housing which encloses the ballast, lamp socket and reflector; and a refractor frame assembly. The refractor housing assembly shall fasten to the housing by concealed hinges and a single point, positive acting latch. There shall be two stainless steel retaining cables attached between the main housing and the refractor frame.

The refractor shall be one piece rectangular prismatic borosilicate thermal shock resistant glass 16" square by 1" deep, with internal splitting prisms and external fluting to provide precision light control. The ploycarbonate vandal shield shall surround the refractor such that the photometrics remain nearly unchanged and that access to the lamp and ballast is not restricted.

The reflector shall be of high specular anodized aluminum with multiple precision vertical contours which shall spread the lamp image over the entire surface of the prismatic refractor.

A positive sealing gasket of an approved neoprene material shall be securely fastened to the refractor door with a special grooved fit design, the gasket shall maintain a watertight and dust tight seal throughout the temperature ranges inherent with high intensity discharge lamps.

SECTION 805 SEEDING:

ITEM 8050014 - SEEDING (CLASS II) (HYDRAULIC):

Description:

Seeding consists of furnishing and planting shrub, wildflower, grass seed and furnishing, applying and affixing wood cellulose fibers and tackifier. The areas to be seeded are shown on the plans or as designated by the Engineer. Contractor is responsible for restricting access by the general public to those areas being seeded until a healthy stand of plants is established.

Materials:

Seed:

Application rates of seed as specified are for Pure Live Seed (PLS). PLS is determined by multiplying the sum of the germination and hard or dormant seed by the purity.

Seed to be mixed on site under direction of Resident Landscape Architect.

Weed content of seed shall not exceed 0.5% and shall conform to the requirements of Subsection 805-2.02 of the Standard Specifications.

All seed shall conform to the requirements of Subsection 805-2.02 of the Standard Specifications.

Fertilizer:

Chemical fertilizer shall conform to the requirements of Subsection 805-2.06 of the Standard Specifications and shall be the kind as hereafter specified.

The seed mix varieties and the Pure Live Seed (PLS) rate are as follows:

Seed Mix	Botanical Name	Common Name	Pounds Per Acre (PLS - Pure Live Seed)
Seed Mix 1	Cercidium Microphylum	Foothill Paloverde	2
	Ambrosia deltoidea	Bursage	4
	Encelia farinosa	Brittlebush	1
	Larrea tridentata	Creosote	4
	Sphaeralcea ambigua	Desert Globe Mallow	2
	Cassia covesii	Desert Senna	3
	Plantago insularis	Indian Wheat	3
	Bouteloua aristidoides	Needle Grama	2
Seed Mix 2	*Sphaeralcea ambigua	Desert Globe Mallow	2
	Baileya multiradiata	Desert Marigold	4
	Cassia covesii	Desert Senna	3
	Dyssodia pentachaeta	Dyssodia	0.25
	Lupinus sparsiflorus	Desert Lupine	3
	Eschscholtzia mexicana	Mexican Gold Poppy	1
	Penstemon parryi	Parry's Penstemon	1
	Plantago insularis	Indian Wheat	2
	Bouteloua aristidoides	Needle Grama	1
	Psilostrophe cooperi	Paperflower	1

* Hulled black seed only, pastel multi-colored plants only from central Arizona.

Wood Cellulose Fibers:

Subsection 805-2.03(D) of the Standard Specifications is modified to add:

The wood cellulose fibers shall have a maximum air-dry water content 12 percent plus or minus three percent at the time of manufacture, and shall have a pH range between 4.5 to 6.5. The mulch shall be from virgin wood.

Tackifier:

Tackifier shall consist of organic muciloid liquid concentrate diluted with water and a psyllium base containing no chemical agents toxic to seed germination. When applied, tackifier shall form a transparent crust permeable to air and water.

Construction Requirements:

General:

Seeding shall not be accomplished until all final grading has been accomplished. All erosion rills or wash outs and uneven areas shall be filled and leveled prior to the seeding operation. The acceptable dates for seeding shall be only in the spring between March 1st and May 1st and fall between September 1st and November 1st.

No seeding shall be carried out under wind conditions exceeding 5 mph..

Subsection 805-3.02 of the Standard Specifications is modified to add:

All areas intended for hydroseeding shall <u>not</u> be treated with any pre-emergent herbicide.

The application rates for seed mix materials shall be as specified below:

MATERIALS	POUNDS per Acre
Wood cellulose fiber	18,000
Tackifier	200
Ammonium Phosphate	200

The seed mix, wood cellulose fiber and tackifier shall be applied in the following two step process:

Step One - Mix seed with wood cellulose fiber (200 pounds per acre), tackifier (50 pounds per acre), and ammonium phosphate (200 pounds per acre) and water to form a slurry mix. This slurry mix shall be applied to the designated areas within 30 minutes to avoid detriment to the seed.

Step Two - Mix wood cellulose fiber (1600 pounds per acre), tackifier (150 pounds per acre), and water, to form a slurry mix.

The contractor shall be prepared to mobilize his seeding operation to reseed areas where a good stand of plant material is not growing as directed by the Resident Landscape Architect. Should reseeding of any of the areas be necessary the contractor will be notified in writing and shall be given a minimum of two (2) weeks notice to mobilize. Areas identified for reseeding shall be done with the identical type, method and seed mix as originally specified for each. The contractor will be paid contract price per acre for any areas he is requested to reseed.

Method of Measurement:

Areas to be reseeded will be measured by the acre, to the nearest hundredth acre, measured along the ground surface for the areas which have been reseeded and mulched, as determined by the Resident Landscape Architect.

Basis of Payment:

The accepted quantities of seeding, measured as provided above, will be paid for at the contract unit price per acre for ITEM 8050014 - SEEDING (Class II), which price shall be full compensation for the work complete, including all equipment, labor and materials required for planting as described and specified herein.

ITEM 8050151 - AMEND EXISTING SOILS:

Description:

The work under this item consists of furnishing all labor, equipment and materials and applying and incorporating soil amendments, including sulfuric acid/soil sulfur and chemical fertilizers, into plating material placed at the locations shown on the project plans in accordance with the requirements of these Special Provisions.

Materials:

The contractor shall submit Certificates of Compliance in accordance with the requirements of Subsection 106.05 of the Standard Specifications for the materials used in this work.

Sulfuric acid shall be a liquid solution with a minimum H_2SO_4 concentration of 92 percent.

All materials shall be stored and handled in accordance with the manufacturer's instructions. The contractor shall provide the Engineer with copies of these instructions.

Construction Requirements:

The amendment of existing soils shall be performed in all areas designated on the plans to receive plating material. Incorporation of soil amendments shall occur following placement of the plating material in its final position.

Soil amendments shall be applied as follows:

Amendment	Application Rate
Sulfuric Acid	5 Tons/Acre

The acid treatment can be sprayed on the surface or injected into the soil. After applying the acid, the area is to be flooded with water to a depth of 6"-8" either by flooding or sprinkler.

Method of Measurement:

Amendment of existing soils will be measured by the square yard of soil surface area amended.

The quantity shown on the Bidding Schedule for this item will be used for payment unless the contractor and Engineer agree that there is a variation in quantity in excess of ten (10) percent. If there is a variation, the Engineer will recompute the area; no field measurement will be done.

Basis of Payment:

Payment for this work will be made at the contract price per square yard for ITEM 8050151 - AMEND EXISTING SOILS, which shall be full compensation for the item complete as described and specified herein.

SECTION 808 - WATER DISTRIBUTION

808-1 Description: of the Standard Specifications is modified to add:

The work under this section shall include the furnishing of all materials, equipment and labor for the installation of new water lines and relocation of existing water lines, including excavation, backfill and pavement replacement, in conformance with the project plans and the requirements of these Special Provisions. The work includes connections, testing, and adjustments to existing facilities and related work as shown on the project plans. The work shall include all permits, signing and barricading per the State and City requirements to provide safe traffic control.

808-2 Materials: of the Standard Specifications is modified to add:

All water line pipe shall be asbestos cement or ductile iron, installed per Maricopa Association of Governments Standard Specifications and Details (MAG) latest revision.

All ductile iron water pipe shall be cement-mortar lined and coal-tar coated in accordance with AWWA C-104.

(1) Design Pressure

All pipe shall be designed for a minimum working pressure of one hundred fifty (150) psi with a forty percent (40%) surge.

(2) Earth Load Design Requirements

The pipe shall be designed for the height of cover as shown on the project plans, as a minimum.

(3) Pipe Design

The pipe shall be designed for a combination of internal working pressure plus water hammer, water load, pipe dead load, hydrostatic loading, and external earth load. The pipe shall be designed for the combination of external earth load plus vacuum. Ductile iron pipe shall be Class 52.

The pipe shall be designed for external loading from trucks and equipment on the backfill. Computations shall be based on an H-20 truck loading.

(4) Joint Restraint

The pipe shall be constructed to sustain pressure and resist movement at key locations by use of thrust blocks or joint restraint with tie rods per MAG Standard Detail 380 or 302-1, 302-2 or approved equal.

The contractor is responsible for verifying the suitability of soil to support thrust block segments.

(5) Handling and Stockpiling Water Pipe on Job Site

At the beginning of each work day, the contractor shall bring to the job site only that amount of water pipe that can reasonably be expected to be installed that work day. At the end of the work day, any water pipe on the job site not installed in the ground shall be removed and stored outside the project limits or at a location approved by the Engineer.

Incidental damage and breakage of the pipe during handling shall be the contractor's responsibility and the pipe will be replaced at no extra cost to ADOT. The unusable portions of pipe shall be disposed of by the contractor at his expense in a suitable manner and in accordance with all applicable City of Phoenix Ordinances, State, OSHA and EPA guidelines.

(6) Modifications

(a) Affidavit of Compliance

An affidavit of compliance shall be furnished to the Engineer for any deviation from these specifications.

(b) Cement

Cement used in the manufacture of pipe shall conform to ASTM C-150, Type II, low alkali.

(c) Concrete Admixtures

No concrete admixture shall be used except as approved in writing by the Engineer.

(d) Joints

Joints shall be the Carnegie Bell and spigot type with a single rubber gasket.

Mechanical joints shall be used at joints requiring joint restraint and retainer glands.

808-3 Construction Requirements: of the Standard Specifications is modified to add:

Water line construction shall conform to Maricopa Association of Governments (MAG) Specifications. Department specifications will apply for MAG references not listed herein.

The appropriate MAG Sections and City of Phoenix Supplements for water line construction and materials are as follows:

MAG 601 Trench Excavation, Backfill and Compaction
MAG 602 Encasement of Water or Sewer Pipe by Jacking or Tunneling Operations
MAG 610 Water Line Construction
MAG 611 Disinfecting Water Mains
MAG 630 Tapping Sleeves, Valves and Valve Boxes on Water Lines
MAG 701 Rock, Gravel and Sand
MAG 702 Base Materials
MAG 725 Portland Cement Concrete
MAG 735 Reinforced Concrete Pipe
MAG 750 Iron Water Pipe and Fittings
MAG 756 Fire Hydrants
MAG 765 Rubber Gaskets for Concrete Pipe
MAG 787 Gray Iron Castings

Corresponding MAG Standard Details to be used are:

MAG 301 Blocking for Water Gate and Butterfly Valves
MAG 302-1, 302-2 Joint Restraint with Tie Rods
MAG 360 Fire Hydrant Installation
MAG 380 Thrust Blocks for Water Lines
MAG 381 Anchor Blocks for Vertical Bends
MAG 391-1, 391-2 Valve Box Installation Type A & B
MAG 424 24" & 30" Manhole Frame and Cover

The following modifications are to be made to the MAG Specifications:

MAG SECTION 601 - TRENCH EXCAVATION, BACKFILLING, AND COMPACTION: is modified as follows:

(A) Trench Excavation

MAG Subsection 601.2.3 Trench Grade, the second paragraph is modified to read: For all pipe, the contractor shall over-excavate the bottom of the trench by a minimum of eight (8) inches. This overcut shall be filled with ABC or Select Material, Type "B" per MAG Section 702 and placed at a uniform density with minimum possible compaction (except as modified below).

(B) Bedding

MAG Subsection 601.4.2, Bedding, the first paragraph is modified to read: For all pipe, except as modified below, the bedding material from the bottom of the pipe to the springline of the pipe shall be ABC or Select Material, Type "B", per MAG Section 702 compacted to a minimum density for ninety-five (95) percent when tested by AASHTO T-99 (Method "A") with rock correction and T-191.

(C) Special Bedding Requirements for thirty (30) - inch VCP and RCP

The contractor shall over-excavate the trench by one (1) foot and install crushed rock per MAG Section 701 from the bottom of the trench to one foot over the top of the pipe. Roll and compact crushed rock to maximum rock interlock. No compaction test will be required on the crushed rock bedding. Shape rock bedded to fit pipe.

(D) Backfill Modifications

The backfill from five (5) feet above the top of the pipe to the surface may be native material found on the site and restrictions on material size are limited to the maximum depth of the lift thickness. From five (5) feet above the top of the pipe to one (1) foot above the top of the pipe the maximum material size shall be no larger than six (6) inches. Unless otherwise noted on the plans, all backfill around pipes shall be Type II backfill.

MAG SECTION 602 - ENCASEMENT OF WATER OR SEWER PIPE BY JACKING OR TUNNELING OPERATIONS:

(A) MAG SECTION 602.2 - GENERAL: is modified to add:

In accordance with Section 105.02 of these Special Provisions, the contractor shall submit to the Engineer, design data for the pipe to be jacked.

The inside diameter of the jacked reinforced concrete pipe shall be a minimum of twelve (12) inches larger than the largest outside diameter, including bells, of the carrier pipe or the size indicated on the plans, whichever is greater.

(B) MAG SECTION 602.3 - JACKING OPERATION: is deleted and the following is substituted:

Before starting the operations, the contractor shall submit detailed shop drawings of the jacking pit bracing, the pipe to be jacked, and the carrier pipe installation method and the bracing to prevent carrier pipe flotation and shifting.

The pipe to be jacked shall consist of ductile iron per Section 750 of MAG Standard Specifications.

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 test 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 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.

Excavation shall not be made in advance of the jacked pipe and every effort shall be made to avoid any loss of earth outside of the pipe. Excavated material shall be removed from the pipe as excavation progresses and accumulation of material within the pipe shall not be permitted.

Once the jacking operation has started, it shall be continued around the clock until the specified limits have been reached.

(C) MAG SECTION 602.6 - CARRIER PIPE PLACEMENT: is modified to delete the first and second paragraphs and add the following:

Carrier pipes shall be placed using casing spacers for alignment and grade. It shall be the contractor's responsibility to obtain the required alignment and grade for the carrier pipe. End seals shall be attached after the carrier pipe is installed.

Casing spacers shall be as manufactured by Cascade Waterworks Manufacturing Company, or approved equal and shall be installed per the manufacturer's recommendations.

(D) MAG SECTION 602.7 - MEASUREMENT AND PAYMENT: is deleted and the following is substituted:

Measurement for this work shall be at the ground surface and shall be the number of horizontal lineal feet of ground surface undisturbed by the cut and cover construction on the ends of the jacked pipe. Payment shall be made at the unit bid price per lineal foot. The payment shall be full compensation for furnishing al labor, materials, tools, and equipment required for the successful completion of the jacking or tunneling operation, including carrier pipe placement, in accordance with this section.

MAG SECTION 610 - WATER LINE CONSTRUCTION: is modified to add:

(A) MAG SECTION 610.18 - MEASUREMENT AND PAYMENT: is modified to add:

(a) Pipe

(1) Measurement of pipe includes the pipe installed through sleeves.

(2) Payment for pipe through sleeves is at the unit price bid per linear foot for that type and size of pipe and shall include the casing spacers, end seals and installation of the pipe in the sleeves.

SECTION 809 - SEWERAGE SYSTEM

809-1 Description: of the Standard Specifications is modified to add:

The work under this section shall include the furnishing of all materials and constructing or relocating sewer lines, including excavation and backfill, in conformance with the project plans and the requirements of these Special Provisions. The work includes connections, testing, adjustments to existing facilities and related work as shown on the project plans.

809-2 Materials: of the Standard Specifications is modified to add:

Materials shall be specified for each item herein or on the project plans:

(A) Sewer Pipe

(a) All eight (8), fifteen (15), and thirty (30) - inch Vitrified Clay Pipe (VCP) and Fittings

All eight (8), fifteen (15), and thirty (30) - inch sewer pipe shall be extra strength.

Vitrified Clay Pipe shall conform to MAG Section 743 except as modified on the project plans.

(b) All eight (8), and fifteen (15) - inch Ductile Iron Pipe (DIP) shall conform to MAG Section 750 except as modified on the project plans.

(c) All thirty (30) - inch Reinforced Concrete Pipe (RCP) shall conform to MAG Section 735 except as modified on the project plans.

(d) Lining

Polyurethane or High Density Polyethylene (HDPE) lining of the DIP shall cover the upper side of the pipe for 270 degrees.

(1) Earth Load Design Requirements

The pipe shall be designed for the height of cover as indicated on the plans.

In addition to the earth loads, the pipe shall also be designed for a uniformly applied external hydrostatic load condition. The minimum water surface elevation to be used for computing the hydrostatic loading shall be to the ground surface except in Indian Bend Wash where the loading shall extend to the top of the channel overbank elevation. This additional loading shall be applied when selecting pipe.

A design parameter to be used for calculating the earth loads on the pipe shall be as follows:

* **Saturated soil unit weight = 145 lbs. per cubic foot**

(2) Pipe Design

The pipe shall be designed for a combination of internal working pressure plus water hammer as specified, water load, pipe dead load, hydrostatic loading, and external earth load as specified elsewhere. The pipe shall also be designed for the combination of external earth load plus vacuum.

The pipe shall be designed for external loading from trucks or equipment on the backfill. Computations shall be based on an H-20 truck loading.

(3) Modifications to AWWA C-303

(a) Affidavit of Compliance

An affidavit of compliance as specified in Section 1.10 of AWWA C-303 and shall be furnished to the Engineer.

(b) Cement

Used in manufacture of pipe shall conform to ASTM C-150, Type II, low alkali.

(c) Concrete Admixtures

No concrete admixture shall be used except as approved in writing by the Engineer.

(d) Liquid Membrane-Forming Compounds

Liquid membrane-forming compounds shall conform to ASTM C-309. The use of such compounds shall be subject to approval of the Engineer.

The ACI Design Standards shall be used for the basis of the encasement design.

The contractor shall be responsible to construct the reinforced concrete where called for on the project plans.

All costs associated with the design, furnished and construction of the reinforced concrete encasements shall be included in the cost of the pipe. No separate measurement and payment will be made for this work.

809-3 CONSTRUCTION REQUIREMENTS: of the Standard Specifications is modified to add:

Sewer line construction shall conform to MAG Specifications, latest edition and updates. Department Specifications will apply for MAG references not listed herein.

The appropriate MAG Sections and City of Phoenix Supplements for sewer line construction and materials are as follows:

MAG 601	Trench Excavation, Backfilling and Compaction
MAG 602	Encasement of Water or Sewer Pipe by Jacking or Tunneling Operations (Refer to Section 808 - Water Distribution for modifications to this Section)
MAG 615	Sewer Line Construction
MAG 625	Manhole Construction and Drop Sewer Connections
MAG 701	Rock, Gravel and Sand
MAG 702	Base Materials
MAG 735	Reinforced Concrete Pipe
MAG 741	Lining for Reinforced Concrete Sanitary Sewer Pipe
MAG 743	Vitrified Clay Pipe
MAG 765	Rubber Gaskets for Concrete Pipe

Corresponding MAG Standard Details to be used are:

MAG 420	Pre-cast Concrete Sewer Manhole
MAG 422	Sewer Manhole and Cover frame Adj.
MAG 423	Water Tight 30" Manhole Frame and Cover

The following modifications are to be made to the MAG Specifications:

MAG SECTION 601 - TRENCH EXCAVATION, BACKFILLING, AND COMPACTION: is modified as follows:

(A) Trench Excavation

MAG Subsection 601.2.3 Trench Grade, the second paragraph is modified to read: For all pipe, the contractor shall over-excavate the bottom of the trench by a minimum of eight (8) inches. This overcut shall be filled with ABC or Select Material, Type "B" per MAG Section 702 and placed at a uniform density with minimum possible compaction (except as modified below).

(B) Bedding

MAG Subsection 601.4.2, Bedding, the first paragraph is modified to read: For all pipe, except as modified below, the bedding material from the bottom of the pipe to the springline of the pipe shall be ABC or Select Material, Type "B", per MAG Section 702 compacted to a minimum density for ninety-five (95) percent when tested by AASHTO T-99 (Method "A") with rock correction and T-191.

(C) Special Bedding Requirements for thirty (30) - inch VCP

The contractor shall over-excavate the trench by twelve (12) inches and install crushed rock per MAG Section 701 from the bottom of the trench to the springline of the pipe. Roll and compact crushed rock to maximum rock interlock. No compaction test will be required on the crushed rock bedding. Shape rock bedding to fit pipe. Construct the concrete encasement over the top of the pipe as detailed on the plans.

(D) Backfill Modifications

The backfill from five (5) feet above the top of the pipe to the surface may be native material found on the site and restrictions on material size are limited to the maximum depth of the lift thickness. From five (5) feet above the top of the pipe to one (1) foot above the top of the pipe the maximum material size shall be no larger than twelve (12) inches. Unless otherwise noted on the plans, all backfill around pipes shall be Type II.

MAG SECTION 615 - SEWER LINE CONSTRUCTION: is modified as follows:

(A) MAG Section 615.10 Testing: is modified to add:

(1) RGRCP Pipe - No leakage test will be required of the contractor. The liner plate shall be visually inspected. The liner plate and welds shall be tested in accordance with Section 741.2.5 of MAG.

The contractor will be required to use a feeler gauge (supplied by the pipe manufacturer) on each pipe joint to ensure that the rubber gasket has not been damaged or unseated. All damaged rubber gaskets shall be removed and replaced with new rubber gaskets. The Engineer will check the joints with the same feeler gauge used by the contractor prior to the joints being mortared, at his discretion. Any necessary repairs or corrections shall be made by the contractor at no additional cost to the owner.

(B) MAG SECTION 615.13 MEASUREMENT AND PAYMENT: is modified as follows:

The first paragraph shall read:

Measurement will be made horizontally through sleeves, manholes and fittings for the various types and sizes of pipe called for on the drawings.

The second paragraph shall include the following:

Payment for pipes through sleeves is at the unit price bid per lineal foot for that type and size of pipe and shall include the casing spacers, end seals and installation of the pipe in the sleeves. The unit price bid for the thirty (30) inch pipe shall include the special bedding requirements.

MAG SECTION 625 - MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

(A) MAG SECTION 625.3.1 MANHOLES: is modified to add:

All sanitary sewer manhole shafts shall be lined on the inside with PVC liner plate per MAG 741. The lining shall extend fully around the interior circumference from the bottom of the manhole shaft up through the cone excluding the adjustment rings. All joints in the lining shall be covered with a weld strip. All costs for the lining shall be included in the cost of the manhole.

(902FNCRT, 05/01/93)

SECTION 902 CHAIN LINK FENCE:

902-2.01 General: of the Standard Specifications is revised to read:

Certificates of Compliance conforming to the requirements of Subsection 106.05 of the Standard Specifications shall be submitted for all materials except for Subsection 902-2.08 Barbed Wire. Barbed Wire will be sampled and tested in accordance with methods used by the Department and will require written approval by the Engineer prior to being incorporated into the work.

(905GRDRL, 08/15/94)

SECTION 905 - GUARD RAIL: of the Standard Specifications is revised as follows:

905-3.03 Breakaway Cable Terminal or Guard Rail Anchor Assembly: the title and first paragraph of the text are revised to read:

905-3.03 Guard Rail Anchor Assembly:

Installation of guard rail anchor assembly shall be as shown on the plans. Concrete footings shall be poured against moist, undisturbed earth. The top of all footings shall be flush with the ground line and shall be steel troweled to a smooth finish with a slope to drain away from the post.

905-3.04 Construct Guard Rail from Salvage: the first paragraph is revised to read:

Salvaged guard rail, guard rail transitions, anchor assemblies and other guard rail systems shall be constructed at the locations shown on the project plans and in accordance with the provisions specified herein for new guard rail.

905-3.05 Reconstruct Guard Rail: the first paragraph is revised to read:

Existing guard rail, guard rail transitions, anchor assemblies and other guard rail systems shall be removed as required, and reconstructed at the locations shown on the project plans, and in accordance with the provisions specified herein for new guard rail.

905-3.06 Buried and Bolted Guard Rail Anchors: the title and text are revised to read:

905-3.06 Bolted Guard Rail Anchors:

Bolted guard rail anchors shall consist of bolting two steel brackets to the shortened post and to the box culvert roof as shown on the plans.

Where the elevation of the top surface of a concrete box culvert or other similar installation prevents the placement of a post of the specified length, the posts shall be shortened and anchored in accordance with the details shown on the plans.

ITEM 9050004 - GUARD RAIL, W-BEAM, SINGLE FACE (TEMPORARY)

Description:

The work under this item consists of furnishing all materials, constructing, removing, and salvaging approximately 250 linear feet of guardrail along each side of the Thunderbird Road detour (500 feet total).

Materials:

All materials shall conform to the requirements of Section 905 of the Standard Specifications for timber post blocked-out W-beam guardrails.

Construction Requirements:

Each temporary guardrail will terminate on each end with W-beam transitions to adjacent temporary concrete barriers. Construction details shall be in accordance with ADOT standard drawings C-10.20, C-10.30 and C-10.31. Each guardrail assembly shall be complete and in place prior to opening the Thunderbird Road detour to traffic.

Upon removal of the detour, guardrails shall be disassembled and the wood posts shall be removed in accordance with Section 202-3.09 of the Standard Specifications. All materials shall be salvaged in accordance with the salvage instructions of these Special Provisions (see General Requirements).

Method of Measurement:

Guard rail will be measured by the linear foot along the face of rail element from center to center of end posts. Guard rail transitions will be measured by the unit each.

Basis of Payment:

The accepted quantity of guardrail, measured as provided above, will be paid for at the contract unit price complete and in place including excavation, backfill, furnishing and placing concrete for post footings, removal and salvage.

The accepted quantity of guard rail transitions, measured as provided above, will be paid for at the contract unit price for each transition complete and in place including furnishing and installing anchor bolts into temporary concrete barriers, and removal and salvage.

SECTION 905 - GUARD RAIL: of the Standard Specifications is modified to add:

905-3.09 Nested Guard Rail:

This work shall consist of furnishing and constructing nested guard rail, type 1, 2, or 3, including all materials, in accordance with the requirements of the project plans.

Nested guard rail consists of additional steel w beam sections attached as an appurtenance to guard rail.

905-3.10 Guard Rail Extruder Terminals:

Installation of guard rail extruder terminals (GET's) shall be as shown on the plans and as specified in the manufacturer's installation guidelines.

The extruder terminals are available from Trinity Industries, 2525 Stemmons Freeway, Dallas, Texas 75207, (800) 644-7976.

SECTION 905 - GUARD RAIL: of the Standard Specifications is revised as follows:

905-4 Method of Measurement: the first three paragraphs are revised to read:

The limits of measurement for the various guard rail items are shown on the plans. Guard rail, of the type shown on the project plans, will be measured by the linear foot along the face of the rail element from center to center of end posts, exclusive of guard rail extruder terminals, guard rail anchor assemblies, and guard rail transitions.

Guard rail extruder terminals, guard rail anchor assemblies, and guard rail transitions will be measured by the unit each.

Nested guard rail, type 1,2, or 3, installed as an appurtenance to new guard rail, shall be measured by the linear foot of additional steel w beam, installed using guard rail hardware, complete in place and accepted, as shown on the plans.

905-5 Basis of Payment: is revised to read:

The accepted quantities of guard rail, measured as provided above, will be paid for at the contract unit price per linear foot for the types of guard rail installation designated in the bidding schedule, complete in place, including excavation, backfill and disposal of surplus material.

The accepted quantities of guard rail anchor assemblies, measured as provided above, will be paid for at the contract unit price each, complete in place, including excavation, backfill, disposal of surplus material, and furnishing and placing concrete for post footings.

The accepted quantities of guard rail extruder terminals, measured as provided above, will be paid for at the contract unit price each, complete in place, including guard rail, guard rail extruder, offset strut, anchor assembly, steel tubes, posts, hardware and delineation as required, excavation, backfill and disposal of surplus material.

Payment for furnishing and placing earthwork and surfacing material at the flares of guard rail extruder terminals will be measured and paid for under the respective contract items. If the contract does not include earthwork or surfacing items, payment will be made in accordance with the provisions of Subsection 104.02.

The accepted quantities of construct guard rail from salvage, or reconstruct guard rail, measured as provided above, will be paid for at the contract unit price, complete in place, including excavation, backfill and disposal of surplus or unusable materials.

The contractor will be paid in accordance with the provisions of Subsection 109.04 for furnishing new posts, blocks, rail elements or hardware to replace components deemed by the Engineer unsuitable for reuse, or to supplement insufficient existing quantities for reconstructing the various types of guard rail, or for constructing the various types of guard rail from salvage.

The accepted quantities of bolted guard rail anchors, measured as provided above, will be paid for at the contract unit price each, and shall be full compensation for the work, complete in place, including steel brackets, hardware, excavation, backfill, removing and replacing surfacing, cutting and fitting steel beam posts or timber posts, drilling anchor bolt holes in steel posts, timber posts and box culverts, and disposal of surplus materials.

The accepted quantities of nested guard rail, type 1,2, or 3, measured as provided above, will be paid for at the contract unit price per linear foot, complete in place.

The accepted quantities of rub rail, measured as provided above, will be paid for at the contract unit price each, complete in place, including rub rail, back blockouts, and hardware as required.

The accepted quantities of guard rail transitions to concrete barriers, measured as provided above, will be paid for at the contract unit price each, complete in place, including guard rail, posts, blocks, hardware, terminal connection, excavation, backfill and disposal of surplus material. Concrete barrier that is part of a guard rail transition shall be measured and paid for in accordance with the requirements of Section 910 for concrete barrier transition.

(908CURB, 11/15/92)

SECTION 908 - CONCRETE CURBS, GUTTERS, SIDEWALKS AND DRIVEWAYS:

908-1 **Description:** of the Standard Specifications is revised to read:

The work under this section shall consist of furnishing all materials and constructing portland cement concrete curb, curb and gutter, ramp curb, sidewalk, driveways, and valley gutters at the locations shown on the project plans in accordance with the details shown on the plans and the requirements of these specifications.

908-4 **Method of Measurement:** the first paragraph of the Standard Specifications is revised to read:

Concrete single curb and curb and gutter will be measured by the linear foot along the flow line. Lengths occupied by catch basins will be excluded from the measurement. No measurement will be made for ramp curb.

908-5 **Basis of Payment:** of the Standard Specifications is modified to add:

No payment will be made for ramp curbs, the cost being considered as included in the price of contract items.

SECTION 908 - CONCRETE CURBS, GUTTERS, SIDEWALKS AND DRIVEWAYS:

ITEM 9080245 - CONCRETE (BIKEWAY, 5"):

Description:

The work under this item consists of furnishing all materials and constructing portland cement concrete bikeway at the locations shown on the project plans and in accordance with the details shown on the plans and the requirements of these Special Provisions.

Materials:

Concrete shall be Class B concrete conforming to the requirements of Section 1006 of the Standard Specifications.

Materials for expansion joint filler and joint seal shall conform to the requirements of Section 1011 of the Standard Specifications unless otherwise shown on the project plans.

Other materials shall conform to the requirements of Section 908-2 of the Standard Specifications.

Construction Requirements:

Concrete bikeway shall be constructed in accordance with the details shown on the project plans and Section 908-3 of the Standard Specifications except as specified herein.

Concrete shall receive a stiff-broom finish.

No longitudinal construction joints will be allowed except at locations shown in the project plans or approved by the Engineer.

Transverse contraction (weakened plane) joints shall be constructed at 12-foot intervals, except where adjacent to curb and gutter in which case all joints (contraction and expansion) shall coincide with the curb and gutter joints.

Contraction joints shall either be formed or sawed, and shall be sealed. Formed joints and other exposed edges shall be tooled to a 1/4 inch radius.

Expansion joints shall be constructed at the locations and in accordance with the details shown on the project plans.

Method of Measurement:

Concrete bikeway will be measured by the square yard of area constructed.

Basis of Payment:

The accepted quantity of concrete bikeway, measured as provided above, will be paid for at the contract unit price per square yard, which price shall be full compensation for the work, complete in place.

(910CONCB, 04/01/94)

SECTION 910 - CONCRETE BARRIERS:

910-4 **Method of Measurement:** the last paragraph of the Standard Specifications is modified to add:

Sections of concrete barrier that transition from one shape, or type, to another shape, or type, and concrete barrier for guard rail transition, shall be measured by the unit each of concrete barrier transition that is not part of a structure.

910-5 **Basis of Payment:** of the Standard Specifications is modified to add:

The accepted quantities of concrete barrier transition, measured as provided above, will be paid at the contract unit price per each, which price shall be full compensation for the work, complete in place, including excavation, backfill, caissons, structural concrete, reinforcing steel, anchors, anchor assemblies, and dowels. Guard rail attached to concrete barrier will be paid for in accordance with the requirements of Subsection 905-5.

SECTION 910 - CONCRETE BARRIERS:

910-1 **Description:** of the Standard Specifications is revised to read:

The work under this section shall consist of furnishing all materials and constructing portland cement concrete barriers and portland cement concrete barrier transitions at the locations shown on the project plans and in accordance with the details shown on the project plans and the requirements of these specifications.

910-2 **Materials:** of the Standard Specifications is modified to add:

Joint filler material shall conform to the requirements of Subsection 1011-6.

Silicone joint sealant shall conform to the requirements of Subsection 1011-8.

910-3.01 **General:** of the Standard Specifications is modified to add:

Concrete shall be Class S (f'c = 2,500) conforming to the requirements of the Specifications for Section 1006.

The cost of concrete barrier gutters, barrier footings and transitions where called for on the project plans will be considered as included in the contract price for the respective concrete barrier items.

910-5 Basis of Payment: of the Standard Specifications is modified to add:

No measurement or direct payment will be made for costs associated with the construction of blisters or transitions necessary for sign structure or light pole supports, etc., the costs being considered as included in the cost of the concrete barrier, paid either by the linear foot or as part of the structure.

(913SLCMT, 11/15/94)

ITEM 9130401 - SOIL-CEMENT BANK PROTECTION:

(1) Description:

This work shall consist of the construction of soil-cement bank protection at the locations and in accordance with the details shown on the project plans and the requirements of these special provisions, including excavating, dewatering, backfilling and grading the channel and banks to the lines, grades and cross sections shown on the project plans or established by the Engineer; furnishing and mixing aggregate, cement and water; spreading and compacting the mixture and trimming the soil-cement to a smooth surface.

Soil cement for bank protection shall attain a minimum compressive strength of 750 pounds per square inch at seven days when tested in accordance with the requirements of Arizona Test Method 241, and shall contain no less cement than that percentage required to obtain 750 pounds per square inch plus two percent cement for erosion resistance.

(2) Materials:

Aggregate shall conform to the following requirements when tested in accordance with the requirements of Arizona Test Method 201.

Sieve Size	Percent Passing
1-1/2 inch	98 - 100
No. 4	60 - 90
No. 200	5.0 - 15.0

Plasticity index shall be a maximum of three when tested in accordance with the requirements of AASHTO T 90.

Clay lumps larger than one inch shall be screened out of the raw soil prior to mixing.

Hydraulic Cement, Flyash and Water:

Hydraulic Cement, Flyash and Water shall conform to the requirements of Subsection 1006-2.

Bituminous Material for Curing Seal:

Bituminous material for curing seal shall be emulsified asphalt, Grade SS-1, conforming to the requirements of Subsection 1005-2.

Mix Design:

The contractor shall determine the mix proportions of the soil aggregate, flyash, cement and moisture, and shall furnish soil cement conforming to the requirements specified herein. The job-mix design with the supporting test results shall be submitted to the Engineer for approval, prior to incorporating any of the material into the work. The "base" amount of cement shall be determined by laboratory testing by the contractor and shall continue to be monitored throughout the duration of the project with modification as required to meet existing field conditions.

The percent of cement to be used in the mix shall be calculated to be the weight of cement divided by the total weight of the dry compacted soil-cement.

Included in the job-mix design data shall be the grade of cement, brand of flyash, and the source of aggregate. A new mix design shall be submitted for approval any time the contractor requests a change in materials, or proportioning of the materials, from that given in the approved mix designs.

Preparation:

Before soil-cement placement begins, the area to be protected shall be graded and shaped to lines and grades as shown on the project plans or as directed by the Engineer. The subgrade shall be compacted to a minimum of 95 percent of the maximum density, as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. Immediately prior to placement of the soil-cement mixture, the subgrade shall be moistened if necessary. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

(3) Construction Requirements:

Mixing:

Aggregate, flyash and cement for soil-cement embankment shall be proportioned and mixed in a central mixing plant, unless otherwise permitted by the Engineer. The plant shall be either of the batch-mixing type using revolving blade, rotary drum mixers, or of the continuous mixing type, at the option of the contractor. The aggregate, flyash and cement may be proportioned either by weight or by volume.

Fly ash may be used at the option of the contractor. A maximum of fifteen percent of the total weight of cement may be replaced with fly ash, in accordance with the requirements specified in Section 1006 of the Standard Specifications.

The water shall be proportioned by weight or volume and there shall be means by which the Engineer may readily verify the amount of water required per batch or the rate of water flow required for continuous mixing. The time of the addition of water or the points at which it is introduced into the mixer shall be as approved by the Engineer.

The moisture content of the completed mixture shall be uniform and within two percentage points of the optimum at the point of delivery to the work. The optimum moisture content will be determined in accordance with the requirements of Arizona Test Methods 221 and 222. The flyash and cement shall be added in such a manner that it is uniformly distributed through out the aggregate during the mixing operation. There shall be safe, convenient facilities for sampling the cement and flyash in the supply line to the weight hopper or pugmill. The charge in the batch mixer or the rate of feed to the continuous mixer shall not exceed that which will permit complete mixing of all of the mix material.

Batch Mixing:

The mixer shall be equipped with a sufficient number of paddles of a type and arrangement to produce a uniformly mixed batch. The mixer shall be equipped with a timing device which will indicate, by a definite audible or visual signal, the expiration of the mixing period. The device shall be accurate to within two seconds.

The time of mixing a batch shall begin after all ingredients are in the mixer and shall end when the mixer is half emptied. Mixing shall continue until a homogeneous mixture of unchanging appearance is produced. The time of the mixing shall not be less than 30 seconds.

The batch-mixing plant shall provide sampling facilities which are satisfactory to the Engineer and which will allow representative samples of the soil-cement mixture to be obtained easily and safely.

Continuous Mixing:

Aggregate shall be drawn from the storage facility by a feeder or feeders which will continuously supply the correct amount of aggregate in proportion to the cement.

A control system shall be provided that will automatically close down the plant when the material in any storage facility approaches the strike-off capacity of the feed gate. The plant will not be permitted to operate unless this automatic control system is in good working condition.

The feeder for the aggregate shall be mechanically or electrically driven.

Continuous mix plants shall provide sampling facilities which are satisfactory to the Engineer, and which will allow representative samples of the aggregate and the soil-cement mixture to be obtained easily and safely.

The cement feeder and the aggregate feeders shall be equipped with devices by which the rate of feed can be accurately determined while the plant is in full operation.

Spreading:

Mixed materials shall be transported from the plant to the construction site in approved vehicles and spread on the moistened subgrade embankment, or previously completed soil-cement with spreading equipment that will produce layers of such widths and thicknesses as are necessary for compaction to the required dimensions of the completed soil-cement layers. Spreading shall be accomplished by the use of approved spreader boxes or finishing machines. The compacted layers of soil-cement shall not exceed eight inches in thickness, nor be less than four inches in thickness. Each successive layer shall be placed as soon as practicable after the preceding layer is completed, and certified.

All soil-cement surfaces that will be in contact with succeeding layers of soil-cement shall be kept continuously moist by fog spraying until placement of the subsequent layer, provided that the contractor will not be required to keep such surfaces continuously moist for a period longer than seven days. Mixing and placing shall not proceed when the soil-aggregate or the area on which the soil-cement is to be placed is frozen. Soil-cement shall not be mixed or placed when the air temperature is below 40 degrees F, unless the air temperature is at least 40 degrees F and rising, or when the temperature is expected to drop below 40 degrees F in the next 24 hours.

Compaction:

Soil-cement shall be uniformly compacted to a minimum of 95 percent with an average of 98 percent of maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. Optimum moisture and maximum density shall be determined in the lab in accordance with the requirements of Arizona Test Methods 221 and 222 by the contractor prior to construction. Wheel rolling with only hauling equipment will not be an acceptable method of compaction.

At the start of compaction, the mixture shall be in a uniform, loose condition throughout its full depth. Its moisture content shall be as previously specified herein. No section shall be left undisturbed for longer than 30 minutes during compaction operations. Compaction of each layer shall be accomplished in such a manner as to produce a dense surface free of compaction planes and shall be completed within one hour from the time water is added to the mixture. Whenever the contractor's operation is interrupted for more than two hours, the top surface of the completed layer, if smooth, shall be scarified to a depth of at least one inch with a spike-tooth instrument prior to placement of the next lift. The surface, after scarifying, shall be swept using a power broom or other method approved by the Engineer, to completely free the surface of all loose material prior to actual placement of the soil-cement mixture for the next lift.

Finishing:

After compaction, the soil-cement shall be further shaped, if necessary, to the required lines, grades, and cross-sections and rolled to a reasonably smooth surface.

Curing:

Temporarily exposed surfaces shall be kept moist as previously set forth. Care must be exercised to ensure that no curing material other than water is applied to the surface that will be in contact with succeeding layers.

Permanently exposed surfaces shall be kept in a moist condition for seven days, or they may be covered with bituminous curing material, subject to the Engineer's approval. Any damage to the protective covering within seven days shall be repaired to the satisfaction of the Engineer.

Regardless of the curing material used, the permanently exposed surfaces shall be kept moist until the protective cover is applied. Such protective cover is to be applied as soon as practicable, with a maximum time limit of 24 hours between the finishing of the surface and the application of the protective cover or membrane.

When necessary, the soil-cement shall be protected from freezing for seven days after its construction by a covering of loose earth, straw, or other suitable material approved by the Engineer.

Maintenance:

The contractor shall be required, within the limits of his contract, to maintain the soil-cement and curing seal in good condition until all work is completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the contractor at his own expense and repeated as often as necessary. Faulty work shall be replaced for the full depth of the layer.

(4) Method of Measurement:

The work will be measured by the cubic yard of completed soil-cement bank protection as constructed to the lines and grades and cross-sections shown on the project plans.

(5) Basis of Payment:

The accepted quantities of soil-cement bank protection will be paid for at the contract unit price per cubic yard of soil-cement bank protection. Such payment shall constitute full reimbursement for all work necessary to construct the soil-cement bank protection, including excavating, dewatering, backfilling and grading the river bed and banks to the lines, grades and cross sections shown on the plans or established by the Engineer; furnishing and mixing aggregate, cement and water; spreading and compacting the mixture; trimming the soil-cement to a smooth surface; and furnishing and applying curing seal as specified herein.

No payment will be made for any soil-cement wasted by the contractor during handling, mixing and placing operations.

ITEM 9140133 NOISE BARRIER WALL

Description:

The work under this item consists of furnishing all materials, equipment and labor to construct cast-in-place reinforced concrete noise barrier walls as shown on the plans and specified herein or at the contractor's option, proprietary noise wall systems as specified herein.

Masonry noise barrier walls shall be constructed in accordance with details shown on the plans, ADOT standard drawings referenced on the plans, and the Standard Specifications.

Where permitted on the plans, the contractor may opt to construct a proprietary noise barrier wall as designed and furnished by one of the following pre-approved noise wall manufacturers instead of the masonry noise wall shown on the plans:

Port-O-Wall Enterprises
P.O. Box 3326
Chico, CA 95927
(916) 342-1615

Prestress Engineering Corporation
P.O. Box 609
Algonquin, IL 60102
(708) 658-1173

Utility Vault Company
P.O. Box 610
Chandler, AZ 85244-0610
(602) 899-1937

The Department will not consider any other proprietary noise wall systems. Also, the Department will not consider alternatives to the masonry noise barrier walls shown on the plans where the plans do not indicate such alternatives to be allowed.

If the contractor elects to use a proprietary noise wall system from the above list of acceptable alternative systems, complete working drawings and calculations shall be submitted for each installation of the system in accordance with the provisions of Section 105.02 of the Standard Specifications. The contractor shall verify the existing and/or finished ground elevations at the site prior to preparing the working drawings. Working drawings shall contain all information required for the proper construction of the system

at each location and any required revisions or additions to drainage systems or other facilities. The working drawings shall clearly detail any special design requirements (i.e., transitions in top-of-wall elevations, etc.). The working drawings shall be supplemented as necessary with calculations for the particular installation. Working drawings and calculations shall be sealed by an engineer who is registered as a Civil or Structural Engineer in the state of Arizona. The contractor shall allow the Engineer three weeks to review and approve the drawings after a complete set has been submitted. The Engineer's review will be made to verify that the general scope of work is adequate. Review of the contractor's plans and methods of construction by the Engineer shall not relieve the contractor of his responsibility for the successful performance of the work.

The lengths and elevation of the top of the alternative noise wall systems shall not be less than those of the noise wall shown on the plans. The height of the alternative wall system may vary from that shown on the plans provided the bottom of the wall is a minimum of one foot below finished grade.

Heights and lengths of alternative noise wall systems may vary from, but shall not be less than, those of the noise wall shown on the plans.

If the contractor elects to construct one of the acceptable proprietary alternative noise wall systems, the structure shall be constructed to the lines and grades approved by the Engineer and the construction shall conform to the details shown on the approved working drawings, these Special Provisions, and approved proprietary system details.

Measurement and Payment:

Noise barrier walls will be measured by the square foot, regardless of the type of wall constructed. The square foot area for payment will be based on the vertical height and length of the noise wall shown on the plans. The vertical height will be taken as the difference in elevation measured from the top of footing to top of wall.

Payment for noise barrier walls will be made at the contract price per square foot and shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals; and for doing all the work involved in constructing the noise barrier wall including footings, rustication, paint, stain, grout, hardware, doors and accessories, blockouts, and reinforcing steel; complete and in place as shown on the plans, as specified herein, and as approved by the Engineer.

No separate measurement or payment will be made for excavation or backfill associated with noise barrier walls, the cost of such work being considered as included in the contract price paid for the walls.

Full compensation for revisions to drainage systems or other facilities made necessary by the use of an alternative noise wall system shall be considered as included in the contract unit price paid per square foot for retaining walls and no adjustment in compensation will be made.

ITEM 9140155 RETAINING WALL

Description:

The work under this item consists of furnishing all materials, equipment and labor to construct cast-in-place reinforced concrete retaining walls as shown on the plans and specified herein or at the contractor's option, proprietary retaining wall systems as specified herein.

Cast-in-place reinforced concrete retaining walls shall be constructed in accordance with details shown on the plans, ADOT standard drawings referenced on the plans, and the Standard Specifications, except that structural excavation and structure backfill measurement and payment will be as specified herein.

Where permitted on the plans, at the contractor's option one of the following acceptable alternative earth retaining systems may be constructed instead of the cast-in-place reinforced concrete retaining wall shown on the plans:

Mechanically Stabilized Earth (MSE) Retaining Wall Systems:

Reinforced Earth by Reinforced Earth Company,
6 Morgan Suite 100
Irvine, CA 92718-1912
(714) 587-3060

Retained Earth by VSL Corporation,
1671 Dell Avenue
Campbell, CA 95008
(408) 866-6777

Reinforced Soil Embankment by the Hilfiker Company,
3900 Broadway
Eureka, CA 95503
(707) 443-5093

Tieback (Soil Nail) Systems:

Schnabel Foundation Company,
3075 Citrus Circle, Suite 150
Walnut Creek, CA 94598
(510) 947-1881

Nicholson Construction Company
6782 Columbus Street
Riverside, CA 92504
(909) 351-4999

In addition to the requirements herein, construction of MSE walls shall be subject to the requirements of Section 9140158 of these Special Provisions.

In addition to the requirements herein, construction of Soil Nail walls shall be subject to the requirements of Section 9140156 of these Special Provisions.

The Department will not consider any other earth retaining systems. Also, the Department will not consider alternatives to the cast-in-place concrete retaining walls shown on the plans where the plans do not indicate such alternatives to be allowed.

If the contractor elects to use a proprietary earth retaining system from the above list of acceptable alternative systems, complete working drawings and calculations shall be submitted for each installation of the system in accordance with the provisions of Section 105.02 of the Standard Specifications. The contractor shall verify the existing and/or finished ground elevations at the site prior to preparing the working drawings. Working drawings shall contain all information required for the proper construction of the system at each location and any required revisions or additions to drainage systems or other facilities. The working drawing shall clearly detail any special design requirements (i.e., interlocking of the walls to bridge abutments, etc.). The working drawings shall be supplemented as necessary with calculations for the particular installation. Working drawings and calculations shall be sealed by an engineer who is registered as a Civil or Structural Engineer in the state of Arizona. The contractor shall allow the Engineer three weeks to review and approve the drawings after a complete set has been submitted. The Engineer's review will be made to verify that the general scope of work is adequate. Review of the contractor's plans and methods of construction by the Engineer shall not relieve the contractor of his responsibility for the successful performance of the work.

The lengths and the elevation of the top or coping of the alternative earth retaining system shall not be less than those of the retaining wall shown on the plans. The height to be used for any system shall be the minimum for the system that will effectively retain the earth behind the structure for the loading conditions and the contours, profile or slope lines shown on the plans or on the approved working drawings.

If the contractor elects to construct one of the acceptable proprietary alternative earth retaining systems, the structure shall be constructed to the lines and grades approved by the Engineer and the construction shall conform to the details shown on the approved working drawings, these Special Provisions, and approved proprietary system details.

Materials:

Backfill for cast-in-place concrete retaining walls shall meet the requirements of Section 203-5 of the Standard Specifications and as modified in these Special Provisions.

The fill material beneath cast-in-place concrete retaining walls constructed on fills shall be compacted to 95% of maximum dry density, determined in accordance with ASTM D698. The zone of compaction shall extend laterally beyond the perimeter of the footing a distance equal to the depth of fill beneath the footing.

Method of Measurement:

Retaining walls will be measured by the square foot, regardless of the type of wall constructed. The square foot area for payment will be based on the vertical height and length of the retaining wall shown on the plans. The vertical height will be taken as the difference in elevation measured from the top of footing to top of retaining wall as shown on the plans. Where retaining walls are integral with noise barrier walls, the vertical height will be measured to the top of the noise barrier wall. In such cases, no separate measurement or payment will be made for the portion of the noise barrier wall constructed integrally with the retaining wall.

Basis of Payment:

Payment for retaining walls will be made at the contract price per square foot and shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals; and for doing all the work involved in constructing the earth retaining structure including footings, rustication, paint, stain, grout, geotextile drains and fabric, hardware and reinforcing steel; complete and in place as shown on the plans, as specified herein, and as approved by the Engineer.

No separate measurement or payment will be made for structural excavation or structure backfill, barriers and gutter pans, and for foundations or appendages for wall mounted signs and lighting associated with retaining walls, the cost of such work being considered as included in the contract price paid for the retaining walls.

Full compensation for revisions to drainage systems or other facilities made necessary by the use of an alternative earth retaining system shall be considered as included in the contract unit price paid per square foot for retaining walls and no adjustment in compensation will be made.

ITEM 9140156 - RETAINING WALL (Soil Nail)

1.0 DESCRIPTION:

The work under this item consist of constructing a permanent soil nailed wall at the locations and in accordance with the requirements shown on the plans, and/or allowed as an alternative to the cast-in-place concrete retaining wall shown on the plans, the Standard Specifications for Concrete Structures, Section 601, and for Prestressing Concrete, Section 602, and these Special Provisions.

The plans show only conceptual details and/or minimum requirements. The information shown on the plans has not been designed and is not sufficient for construction purposes. The contractor shall design the soil nailed wall system with similar structural characteristics and design requirements shown in the plans and the requirements of these specifications.

Prior to the start of work, the soil nailing contractor shall submit a project personnel list identifying the Engineer or Superintendent, drill rig operators, and on-site supervisors assigned to the project. The superintendent shall have a minimum of two years experience and the drill operators and on-site supervisors shall have a minimum of one year experience installing soil nails or ground anchors.

All materials and workmanship shall conform to State of Arizona Department of Transportation (ADOT) Highway Division **Construction Manual for Road and Bridge Construction** and the requirements of the drawings. All existing dimensions and elevations shall be verified by General Contractor on site before proceeding with the work.

The work shall be done in accordance with these specifications and in reasonably close conformance to the lines and details shown on the construction plans or established by the Engineer.

The contractor shall submit plans, working drawings and specifications along with design calculations sealed by an Arizona Registered Professional Engineer in accordance with the requirements of subsection 105.02 of the Standard Specifications to the Engineer for approval. The submittal shall include:

- The design assumptions and design calculations.
- The working drawings showing vertical views of the nailed walls, typical cross sections, details of nail heads and tables of nail lengths, design loads and bar schedules.
- The proposed schedule and construction sequence.
- The method of staged excavation and descriptions of the excavation equipment.
- A description of the drilling method and equipment.
- A certified shotcrete mix design.
- Descriptions of the soil nail testing equipment including jacking frame, bracing and calibration records of jack pressure gauges.

The Engineer's review shall be made to verify that the general scope of work is adequate, and that the contractor is qualified to perform the work. Review of the contractor's plans and methods of construction by the Engineer shall not be construed to relieve the contractor in any way of his responsibility for the successful and safe performance of the work and the adequacy of design.

All testing and excavation work shall be performed after the approval of the submittal. All excavation shall be carried out in accordance with the construction sequence plan approved by the Engineer.

2.0 DESIGN ASSUMPTIONS

2.1 Soil conditions are detailed in the Geotechnical Investigation Report No's. 1, 2, and 3 for Squaw Peak Highway, Section 4, Shea Boulevard to Thunderbird Road, prepared by AGRA Earth and Environmental, AGRA Job No. E94-260.

2.2 A nominal soil unit weight of 120 pcf, and a general surcharge of 300 psf for overburden and light construction equipment shall be considered for the design. A friction angle of 33 degrees shall be used for the nailed wall. Cohesion of 500 pounds per square foot (psf) shall be used for the upper 10 feet of existing soils, a cohesion of 1,000 psf can be used for the soils below a depth of 10 feet.

2.3 Minimum auger hole diameter shall be 6 inches. Minimum length for upper two rows of nails shall be 20 feet. Minimum shotcrete wall thickness shall be 4 inches. At the fascias for the Cactus Road TI abutments, a minimum of two columns of nails between adjacent drilled shafts shall be designed.

2.4 Soil reinforcement shall be designed based on the following factors of safety (F.S.):

Nail Adhesion F.S. = 2.0 based on the soil parameters presented herein.

Nail Adhesion F.S. = 1.5 based on the results of the sacrificial nail tests.
General Shear Failure F.S. = 1.5
Reinforcing Steel Yielding F.S. = 1.67

2.5 The shear studs and plates that are embedded in the reinforced cast-in-place face wall shall be designed to resist the vertical dead loads associated with the face wall.

3.0 MATERIALS

3.1 Drainage Network

3.1.1 The drainage network shall consist of installing vertical prefabricated geocomposite drain and fabric and weep holes.

3.1.2 One geocomposite drain shall be located between each nail column. The geocomposite drain shall be 18 inches wide and shall be secured to the cut face, with the fabric side against soil, before shotcrete. Drains shall be continuous from the top of wall to the toe drain. The filter fabric on the drain shall be Trevira 1120 as manufactured by Hoechst Celanese Corporation or equivalent.

3.2 Nails

3.2.1 Nail bars shall be Grade 60 steel conforming to ASTM A 617 or Grade 75 thread bar conforming to ASTM A 722 and shall be single corrosion protected. All nail bars shall be sized such that the design load does not exceed 60 percent of yield strength of the steel. All nail bars shall be clean and free of excessive rust and mill scale at the time of installation. All bars shall be free of welds.

3.2.2 Nail grout shall comply to all applicable requirements of ACI 318 and ADOT specifications. Nail grout shall be a pumpable mixture with a minimum 28-day compressive strength of 3,000 psi. The contractor shall submit the mix design to ADOT for approval.

3.3 Welded Wire Fabric and Waler Steels

3.3.1 Welded wire mesh to be used in the shotcrete shall be minimum 6x6 W2.9xW2.9 and shall conform to ASTM A 82 and A 185, or approved equivalent.

3.3.2 Waler bars shall be #4 deformed steel bars conforming to ASTM A 615 Grade 60, or approved equivalent.

3.4 Shotcrete

Shotcrete applied to the facing of the nailed wall shall be a pumpable mixture with a minimum 28-day compressive strength of 3,000 psi. The contractor shall submit the mix design to ADOT for approval.

3.5 Structural Steel

Structural steel for the anchor plate and shear studs shall be in accordance with section 604-2 of the Standard Specifications.

4.0 INSTALLATION

4.1 Nails shall be installed at the locations, and to the lengths and inclinations shown on the approved working drawings. Welded wire mesh and the waler steel bars shall be installed at the locations shown on approved working drawings. Shotcrete shall be applied to the lines and thickness shown on the working drawings.

4.2 The allowable tolerances shall be:

Nail Position	- ± 1 foot in any direction
Nail Length	- - 0 feet
Nail Inclination	- ± 3 degrees
Shotcrete Thickness	- - 0 inches

4.3 Nails shall be installed in a horizontal sequence, with the ground level on the excavated side no more than 4 feet below the level of the nail to be installed.

4.4 Nail bars shall be placed in the predrilled holes to the length shown on the plans. At least two PVC centralizers for each bar shall be provided. Holes shall be drilled without loss of ground. If caving conditions are encountered, casing or auger-cast installation methods may be required.

4.5 Holes shall not be drilled with bentonite slurry or water.

4.6 After drilling is completed, clean bars with centralizers shall be placed in the hole, and the hole shall be tremie grouted. Drilling and grouting shall be completed in the same working day.

4.7 The space between the top of grout and the top of hole shall be filled with shotcrete, grout or drypack.

4.8 If water is encountered in the hole, the hole shall be flushed with air prior to grout placement, and the nail shall be tested as specified in Section 5.

4.9 Welded wire mesh shall be placed over exposed soil, as indicated on the working drawings.

4.10 Welded wire mesh shall be lapped 12 inches minimum.

4.11 Shotcrete shall be applied in the same work shift during which the soil is trimmed to final line. The Engineer may, if site conditions permit, extend the open time to maximum of 48 hours.

5.0 NAIL TESTING

5.1 Sacrificial Nails

5.1.1 Before the initiation of production nailing, sacrificial nails shall be installed with the same equipment and methods to be used for the production work. These nails shall be tested such that the soil-nail bond stress will reach the design ultimate value at the maximum test load. The sacrificial nails shall not be incorporated into the production nail schedule without the approval of the Engineer.

5.1.2 The details of the sacrificial nail testing arrangement, including the method of distribution of test load pressures to the excavation surface, nail bar size, grouted hole diameter and reaction frame dimensions, shall be developed by the contractor and submitted for approval by the Engineer.

5.1.3 Any change in equipment or methods, including but not limited to drill rigs, drill tools, and drilling and grouting sequences, shall require revalidation by installing one additional sacrificial nail in each soil type encountered.

5.1.4 Sacrificial nails shall have a minimum free length of 6 feet or as directed by the Engineer. Steel bars for the test nails shall be sized such that the test load does not exceed 80 percent of the yield strength of the steel. A total of 4 sacrificial test nails shall be installed as indicated below:

Depth of Nail Head (feet)	5
Design Adhesion (kip/ft)	See Note (1)
Bond Length (feet) (3)	8 to 10
Free Length (feet) (3)	6 to 10
Design Load (kips)	See Note (2)
Number of Tests	4

Notes:
(1) The design adhesion (A_h) shall be included in the working drawings as described in Section 1.4.
(2) The design load for sacrificial nails shall be calculated as 100 percent A_h times actual bond length installed. The final test load shall be 200 percent of design load.
(3) The contractor may vary the length and depth with the approval of the Engineer.

5.1.5 Sacrificial nails shall be installed at an inclination of 15 degrees or as directed by the Engineer. The locations of the sacrificial nails shall be determined by the Engineer such that they are representative of the field conditions.

5.1.6 Validation tests may be performed at shallower depths than indicated, at the contractor's option. However, additional overburden may be required to achieve the design adhesion.

5.1.7 Production nail lengths, diameters and/or spacings may be adjusted, with the approval of the Engineer, on the basis of the above test results such that there is a minimum factor of safety of 1.5 against pullout, shear failure and slope failure. However, the minimum diameter shall be 6 inches, and the minimum nail length for the upper two rows of nails shall be 70 percent of the wall height.

5.1.8 Sacrificial Nail Test Procedures

The sacrificial nails shall be tested as follows:

Measurements of the nail head displacement shall be taken to 0.001" using a minimum of two independent calibrated dial gages, using the top of ram as the position being measured. Gages to measure nail deformation shall be fixed to a tripod or similar reference point resting on the ground in front of the test nail and independent of the jack and the reaction block.

The nail shall be seated using a small load, which shall be released. The loading jack shall use a reaction frame to distribute the load over the soil face.

The nail shall be loaded in increments of approximately 25 percent of the design load, with each load held for 5 minutes, up to 200 percent of the design load. The nail deflection shall be noted at 0, 1 and 5 minutes. The deflection shall be noted at 0, 1, 2, 3, 5, 10, 20 and 30 minutes at design load, for creep measurements.

The plot of creep against log time shall be linear or show a decreasing rate of creep at the ultimate soil bond stress used in the design of production nails. In addition, the creep rate shall be less than 0.08 inch per log cycle at the final test load.

After the creep measurement, the nail shall be unloaded and reloaded to 200 percent of design load in increments of 25 percent of design load, with each load held for 5 minutes. The deflection shall be recorded.

The maximum total nail displacement at the design load shall not exceed, by more than 0.25 inch, the theoretical elastic deformation of the free length plus one-half of the bond length.

The testing procedure may be modified if necessary by the Engineer to obtain more meaningful results.

5.2 Production Nails

5.2.1 A minimum of three percent of the production nails shall be proof tested to 133 percent of design load. The nails to be proof tested shall be grouted only in the anchor zone and shall have an ungrouted free zone as specified in the approved working drawings as determined by the Engineer. Upon completion of testing, the free zone shall be tremie grouted with structural nail grout, specified in Section 3.2.2.

5.2.2 Temporary casing, such as PVC, shall be provided as necessary to prevent caving of the open portion of the drilled holes during testing.

5.2.3 The nails shall be tested as specified in Section 5.1 to 150 percent of design load as specified in the plans. The nail will be deemed acceptable if the maximum displacement meets the criteria described in 5.2.6.

5.2.4 Additional tests shall be performed in all holes that encounter water.

5.2.5 If a nail fails the proof test, additional proof testing shall be performed on an adjacent nail with the test results reviewed by the Engineer. Based on the test results, the Engineer shall give his approval or require additional nails be installed as designated and located by the Engineer without any additional cost to ADOT.

5.2.6 Production Nail Test Procedures

The production nails shall be tested as follows:

Measurements of the nail head displacement shall be taken to 0.001" using a minimum of two independent calibrated dial gages, using the top of ram as the position being measured. Gages to measure nail deformation shall be fixed to a tripod or similar reference point resting on the ground in front of the test nail and independent of the jack and the reaction block.

The nail shall be seated using a small load, which shall be released. The loading jack shall use a reaction frame to distribute the load over the soil face.

The nail shall be loaded in increments of approximately 25 percent of the design load, with each load held for 5 minutes, up to 150 percent of the design load. The nail deflection shall be noted at 0, 1 and 5 minutes.

The maximum total nail displacement at the design load shall not exceed, by more than 0.25 inch, the theoretical elastic deformation of the free length plus one-half of the bond length.

6.0 MONITORING

6.1 Surface settlement points shall be installed at ground level along the wall upon ADOT's request. In addition, survey points shall be installed on the wall face in two rows, one at the top row of nails and the second at the mid-height of the wall. These survey points shall be located at a horizontal spacing of 40 feet. Initial readings shall be obtained by a registered land surveyor or by ADOT at least one week prior to the start of excavation. All points shall be monitored by the contractor no less than twice weekly during excavation and twice a month thereafter until the permanent retaining wall is completed.

6.2 Inclinometers, if requested by ADOT, shall be installed by the Geotechnical Engineer within 3 feet of the wall facing to a depth of 25 feet below the final excavation level. Installation and initial readings shall be accomplished prior to any excavation. Inclinometers shall be read by the Geotechnical Engineer once a week during excavation, and then once a month thereafter until the permanent wall is completed. The cost of installation and measurement of inclinometers will be borne by ADOT.

6.3 One nail in each nail row, at the locations indicated by the Engineer, shall be instrumented with strain gauges at contractor's expense. The gauges shall be mounted to the bar in pairs at each location as directed by the Geotechnical Engineer. The gauge pairs shall be mounted on opposite sides of the bar. The bar shall be 1-inch threadbar conforming to ASTM A 615 Grade 60, and shall not be corrosion protected. The gauges shall be microwelded to the bar and the complete gauge, sensor, and wire assembly protected from moisture. The instrumented nails shall be installed in the drill holes with the strain gauges located on the sides of the nails. Centralizers for the instrumented nails shall ensure that the bar is located within 1.0 inch of the center of the hole. All wire connections shall be approved waterproof type. Installation and protection of the strain gauge and connections shall be in accordance with the manufacturer's specifications.

6.4 One control panel shall be located at the instrumentation sections. The control panel shall be attached to a post that shall be firmly secured in the soil. The control panel shall be located a minimum distance of 3 feet behind the top of the nailed wall. All instrumentation wiring to the control panel shall be done in accordance with the manufacturer's specification. The control panel shall be sealed and be completely waterproof. All above-ground wiring shall be enclosed in a PVC pipe that shall be firmly attached to the control panel. All instrument control panel wiring shall be done during instrument installation.

6.5 All monitoring reports, from both survey points and inclinometer measurements, shall be sent directly to ADOT within 24 hours after the data are recorded.

6.6 The contractor shall take precautions to prevent damage to the instrumentation. Instrumentation damaged during or after installation shall be replaced by the contractor to the satisfaction of the Geotechnical Engineer at the contractor's cost.

7.0 FORMWORK AND CONCENTRATED LOADS

7.1 If the design calculation does not indicate that the nails are designed to support additional loads from formwork, the capacity of the nails to support formwork must be reviewed and approved by the Engineer before the nails are used to take any such additional loading.

7.2 If the design calculation does not indicate that the nails are designed to support concentrated loads on top of excavation, heavy construction equipment shall not be placed within 15 feet of the wall facing without approval of the Engineer.

8.0 METHOD OF MEASUREMENT:

Soil nail retaining walls will be measured by the square foot. The square foot area for payment will be made based on the vertical height and length of the retaining wall shown on the plans. The vertical height will be taken as the difference in elevation measured from the bottom of wall to the top of wall as shown on the plans.

9.0 BASIS OF PAYMENT:

Payment for ITEM 9140156, Retaining Wall (Soil Nail) will be made at the contract price per square foot and shall include full compensation for designing and furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in designing, constructing, and testing the retaining structures, including rustication, paint, grout, nails, fabric, temporary shoring, all hardware and reinforcing steel, complete in place as shown on the plans, as specified herein, and as approved by the Engineer.

No separate measurement or payment will be made for structural excavation or structure backfill, barriers and gutter pans, and for foundatons or appendages for wall mounted signs and lighting associated with soil nail retaining walls, the cost of such work being considered as included in the contract price paid for retaining walls.

ITEM 9140157 - RETAINING WALL (TANGENT PILE)

DESCRIPTION:

The work under this item consists of furnishing all materials and constructing a tangent pile retaining wall at the location and in accordance with the details shown on the project plans.

The wall to be constructed under this item is designated on the project plans as Retaining Wall R4.

Materials:

Concrete for the fascia shall be Class S (f'_c=3,000) conforming to the requirements of Section 1006 of the Standard Specifications. Concrete for the drilled shafts shall be Class S (f'_c=3,500).

Shotcrete for the sub-fascia shall be a pumpable mixture with a minimum 28-day compressive strength of 3,000 psi and capable of a 3-day compressive strength of 2,500 psi minimum. The contractor shall submit the mix design to ADOT for approval.

Reinforcing steel shall be Grade 60 and shall conform to the requirements of Section 1003 of the Standard Specifications.

Welded wire mesh to be used in the shotcrete shall be 6"x6" W1.4/W1.4 and shall conform to ASTM A 185, or approved equivalent.

Structural steel for the plates shall be in accordance with Section 604-2 of the Standard Specifications.

Construction Requirements:

Construction requirements for the drilled shafts shall conform to Section 609 of the Standard Specifications.

Requirements for the construction of the shotcrete sub-fascia and cast-in-place fascia shall be as specified in the plans.

Method of Measurement:

Measurement of this work will be made by the square foot with the vertical height measured from the bottom of the cast-in-place fascia wall to the top of the noise barrier wall. No separate measurement or payment will be made for the portion of the noise barrier wall constructed integrally with the tangent pile wall.

Basis of Payment:

Payment for ITEM 9140157 Retaining Wall (Tangent Pile Wall) will be made at the contract price per square foot and shall include full compensation for furnishing all labor, materials, tools equipment, and incidentals; and for doing all the work involved in constructing the earth retaining structure including drilled shafts, rustication, paint, shotcrete, concrete, geotextile drains and fabric, hardware and reinforcing steel; complete and in place as shown on the plans, as specified herein, and as approved by the Engineer.

No separate measurement or payment will be made for excavation or backfill associated with the tangent pile wall, the cost of such work being considered as included in the contract price paid for the retaining walls.

ITEM 9140158 RETAINING WALL (MSE)

Description:

The work under this item consists of furnishing all materials, equipment and labor to construct mechanically-stabilized earth (MSE) retaining walls as shown on the plans and/or allowed as an alternative to the cast-in-place concrete retaining wall shown on the plans.

MSE retaining walls shall be constructed to the lines and grades shown on the plans, in accordance with the Standard Specifications, approved proprietary system details, and these Special Provisions.

Design criteria for MSE walls are as follows:

Minimum factor of safety against overturning 2
Minimum factor of safety against sliding 1.5
Minimum factor of safety against pullout 1.5
Minimum design life . . . . . 75 years

Soil conditions and foundation design criteria are reported in the Geotechnical Investigation Report for Squaw Peak Highway (SR 51) Section 4, Shea Boulevard to Thunderbird Road, by AGRA Earth & Environmental Report No's. 1, 2 and 3, AGRA Job No. E94-260.

In accordance with Section 105 of the Standard Specifications, the MSE wall supplier shall submit for review and approval plans, working drawings, specifications, and design calculations sealed by a Civil or Structural Engineer registered in the State of Arizona.

Materials:

All backfill material used in the structure volume shall be reasonably free of organic and otherwise deleterious materials and shall conform to the following gradation limits as determined by Arizona Test Method 201:

Sieve Size	Percent Passing
6 inch	100
3 inch	75-100
No. 4	25-60
No. 200	0-15

Backfill shall meet the following corrosion requirements:

Resistivity	2,000 ohm centimeters (min)
pH	6.0 to 9.0
Chlorides	200 ppm (max)
Sulfates	1000 ppm (max)

The resistivity and pH will be tested in accordance with Arizona Test Method 236. Chlorides and sulfate content will be tested in accordance with California Department of Transportation Test Methods 422 and 417, respectively.

In addition to the above requirements, backfill material for the Reinforced Earth system shall have a minimum angle of internal friction of 33° and the plasticity index shall not exceed 6 when tested in accordance with AASHTO T90.

Backfill not conforming to these specifications shall not be used without the written consent of the Engineer.

All soil reinforcing and connecting elements, and any other steel component in contact with the earth, shall be galvanized in accordance with Section 604 of the Standard Specifications.

Construction Requirements:

Excavation and backfill shall be accordance with Section 203 of the Standard Specifications, modified as follows:

Native material on which the MSE system is to be constructed shall be compacted to not less than 95 percent of the maximum dry density as determined by Arizona Test Methods 225, 226, 227, 230, or 232 for a depth of not less than one foot below the planned grade.

If metal anchorage reinforcement and/or components are to be positioned on native soil, the top one foot of native soil must meet all the requirements of the backfill material or be replaced with approved backfill material.

At column-supported bridge abutments where columns interfere with the normal placement of soil reinforcmeent, steel walers or other means shall be used to anchor wall panels into the backfill behind the bridge columns. Bridge columns shall not be considered to be a structural component of the wall system. Soil reinforcing shall not be cut for the purpose of avoiding interference with columns.

Backfill material shall be placed and compacted simultaneously with erection of the facing panels. Placement and compaction shall be accomplished without distortion of the soil reinforcement or facing panels.

Backfill material shall be placed in layers of uniform thickness. The loose thickness of each layer before compaction shall not exceed 8 inches.

Sheepsfoot or grid-type rollers shall not be used for compacting backfill material within the limits of soil reinforcement. Hand-held or hand-guided compacting equipment shall be used to compact backfill within 3 feet of facing panels.

At each level of the soil reinforcement the backfill material shall be roughly leveled before placing the next layer of reinforcement.

The exposed concrete surfaces of MSE walls shall be provided with rustication aesthetically consistent with the rustication shown on the plans for cast-in-place retaining walls, and as approved by the Engineer.

Acylic emulsion paint shall be applied to all exposed surfaces in accordance with Section 601 of these Special Provisions.

Method of Measurement:

MSE walls will be measured by the square foot of wall area. The square foot area for measurement and payment will be based on the vertical height and length of the wall shown on the plans. The vertical height will be taken as the difference in elevation measured from the top of footing to top of wall or coping. Where the MSE wall is integral with a noise barrier wall, the vertical height will be measured to the top of the noise barrier wall. In such cases, no separate measurement or payment will be made for the portion of the noise barrier wall constructed integrally with the MSE retaining wall.

Basis of Payment:

Payment for ITEM 9140158 Retaining Wall (MSE) will be made at the contract price per square foot and shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals; and for doing all the work involved in constructing the earth retaining structure including footings, copings, rustication, paint, stain, grout, geocomposite drains and fabric, hardware and reinforcing steel; complete and in place as shown on the plans, as specified herein, and as approved by the Engineer.

No separate measurement or payment will be made for structural excavation or structure backfill, barriers and gutter pans, and for foundations or appendages for wall mounted signs and lighting associated with MSE retaining walls, the cost of such work being considered as included in the contract price paid for the retaining walls.

Full compensation for revisions to drainage systems or other facilities made necessary by the use of an MSE system shall be considered as included in the contract unit price paid per square foot for MSE retaining walls and no adjustment in compensation will be made.

ITEM 9201006 - CONCRETE CHANNEL LINING (6")

Description:

The work under these items shall consist of furnishing all materials, equipment and labor for constructing concrete channel lining of the thickness specified and in accordance with the details shown at the locations designated on the project plans. The work includes excavation and backfilling for cutoff walls, furnishing and placing concrete and reinforcing steel, including dowels, support slabs, filter fabric and coring for thickness tests.

Materials:

Concrete shall be Class S, f'_c=3000 psi, max water/cement ration = .53; max slump = 3 inches, furnished in accordance with Section 601.

Reinforcing steel shall be Grade 60 as designated in the project plans and in accordance with Section 1003.

Construction Requirements:

Reinforcing steel shall be placed in accordance with Section 605.

Concrete shall only be placed on solid compacted material in accordance with Section 601. The channel shall be thoroughly sprinkled with water in a manner satisfactory to the Engineer prior to the placement of concrete. Prewetting using transit mix trucks will not be permitted.

The finished surface shall be free of all honeycomb, rock pockets, or voids. Areas containing honeycomb, rock pockets, or voids shall be removed and replaced at the expense of the contractor.

The finished surface shall be textured transversely with steel tines to produce a uniform rough texture.

Immediately following the surface finishing operation, liquid membrane compound shall be applied at a rate of one gallon per 100 square feet.

For the purpose of determining acceptability for thickness, the thickness of the lining will be determined by the average caliper measurement of cores taken by the contractor at locations designated by the Engineer. The cores will be measured in accordance with the AASHTO T 148 except that the nine length measurements will be read directly to the nearest 0.001 of an inch. The average of the nine measurements shall be reported to the nearest 0.01 of an inch.

A test unit shall be each 1,000 square yards, or fraction thereof, of concrete lining placed in each days operation. One core shall be obtained from each unit. Measurement of the cores will be made by the Engineer and compared with the thickness required by the project plans. The minimum diameter of cores shall be four inches. The contractor shall fill all coreholes as approved by the Engineer.

The length of each core will be considered to be the average thickness of the lined channel within the unit.

If the length of each core in each unit is not deficient by more than 0.25 of an inch, the unit will be measured for payment at the full contract price.

If the average length of the core in any test unit is deficient by more than 0.25 of an inch but less than 1.00 inch, two additional cores shall be taken at designated points within the unit and the length of these three cores will be averaged. In calculating the average length, core measurements which are in excess of the thickness shown on the project plans by more than 0.25 of an inch will be considered as the specified length plus 0.25 of an inch. If the average length of the three cores is deficient by more than 0.25 of an inch, the unit represented by these cores will be measured for payment at a unit price by the percentage shown under Basis of Payment corresponding to the deficiency of the average length of the three cores.

If the length of core in each unit is deficient in thickness by more than 1.00 inch, the unit will be considered unacceptable.

All cores will be checked for location of reinforcement for each unit. Reinforcement will be considered acceptable providing its location is as designated on the project plans with a permissible variation of plus or minus 1.0 inch, as measured from the finished surface of the cores. Additional cores will not be required to replace cores void of reinforcement due to core location.

A sample for strength tests will be taken at random for each 1,000 square yards of consecutively placed concrete.

Concrete represented by a strength test of at least 95 percent of the required 28-day compressive strength will be acceptable.

Method of Measurement:

Concrete channel lining will be measured by the square yard of exposed surface area placed to the specified thickness.

No measurement will be made of cut-off walls or the support slabs under pipes.

Basis of Payment:

The accepted quantities of concrete channel lining will be paid for at the contract unit price complete in place, including excavating, preparing the ground area, placing concrete and reinforcing steel, except that an adjustment to the nearest cent, in the contact unit price will be made for the units where the average length of the core indicates a thickness deficiency of more than 0.25 inch, but not more than 1.0 inch as shown in the following table:

Adjustment in Contract Unit Price for
Deficiency in Thickness of Concrete Lined Channel

Deficiency in Thickness as Determined by Cores, Inches	Proportional Part of Contract Unit Price Allowed, Percent
0.00 to 0.25	100
0.26 to 0.50	85
0.51 to 0.75	75
0.76 to 1.00	65

No measurement or direct payment will be made for coring or refilling holes made in coring.

ITEM 9210016 - MEDIAN PAVING:

Description:

The work under this item consists of furnishing all labor, equipment, tools, materials and performing all work necessary for the installation of decorative pavement at the locations and in accordance with the details shown on the project plans and these Special Provisions.

Materials:

The sand shall be clean washed sand with 100% passing a No 4 sieve and a maximum of 4% passing a No. 200 sieve, commonly known as "plaster" or "mortar" sand.

Concrete paving stones shall comply with ASTM C-936 and be clean and free of foreign materials before installation. Two samples of concrete paving stones and the matching precast edge units shall be submitted to the Engineer for approval.

Aggregate base shall be Class 2 and conform to the requirements of Section 303.

Construction Requirements:

Paving work shall be plumb, level and true to line and grade and shall be installed to properly coincide and align with adjacent work. The contractor shall lay the paving stones in a perpendicular pattern to the roadway.

The aggregate base shall be placed in accordance with the project plans. The aggregate base shall not vary more than 1/8" ± across the surface. Compaction of the aggregate base will be not less than 95% of the maximum density as determined in accordance with the requirements of Arizona Test Methods 225, 226, and 227.

The first 10 square foot area will be inspected and must be approved by the Engineer for quality of compaction, finish grade of sand and placement of the decorative pavement, before further work may continue.

The maximum thickness of the loose, screeded sand shall be 1 inch. Screed boards shall be used for screeding the sand to a uniform surface. The sand shall not be compacted, walked on or wet down.

After all sand is in place and not more than 2 hours prior to the installation in any one section or panel of the decorative pavement, the sand shall be treated with a pre-emergent herbicide, approved by the Engineer.

The decorative pavement shall be installed hand-tight and level on the undisturbed sand laying course.

A Roller Vibrator or Plate Vibrator shall be used to compact the decorative pavement and to vibrate the sand into the joints between the pavement units.

The vibration process shall be performed 2 times at 90 degrees to one another. Sand shall be spread over the vibrated pavement approximately 1/4" in thickness and vibrated again to complete the filling of the joints. Excess sand will be removed from the surface and disposed of off the site.

Any broken units shall be removed. New units shall be inserted and tamped into grade. Joints shall then be filled with sand. Any cutting of the pavement stone shall be accomplished with a saw.

The completed installation shall be washed down and cleaned to provide a clean finished installation.

The concrete retention curbs, edgings, etc., shall be straight and on grade. All edges of decorative pavement shall butt tight against the concrete header edges.

The paving material shall be "light duty", a minimum of 2" thick, solid concrete interlocking paving units conforming to ASTM C-936. The color shall be mottled red, dark brown and charcoal. The pattern shall be "Finetta", "I-Paver", "Fieldstone" or approved equal.

Method of Measurement:

Measurement of this work will be made by the square yard of decorative pavement installed.

Basis of Payment:

Payment for this work will be made at the contract price per square yard for ITEM 9210016 Median Paving (Decorative Pavers), which price shall be full compensation for the work, complete in place, including concrete headers, as shown on the project plans and in accordance with these Special Provisions.

ITEM 9210100 - GRASS UNIT PAVERS

Description:

The work under this item shall consist of furnishing all materials and installing grass unit pavers in accordance with the details shown on the plans and the requirements of these Special Provisions. Grass unit pavers shall be constructed at the locations and as shown on the project plans.

Materials:

Materials shall conform to the requirements of Section 601. Concrete shall be Class S, f'_c = 3000 psi topsoil shall conform to the requirements of Section 804.

Construction Requirements:

Concrete shall only be placed on solid compacted material in accordance with Section 601. Grass unit pavers may be cast-in-place or installed of pre-cast 2'x2' units. The natural ground surface shall be thoroughly sprinkled with water in a manner satisfactory to the Engineer prior to the installation of cast-in-place concrete. For precast units, joints between paver blocks shall have a maximum 0" to 1/4" space and the uniform surface between paver blocks shall have a maximum 0" to 1/8" deviation.

Immediately following the surface finishing operation, a liquid curing compound not detrimental to the growth of grass shall be applied at a rate of one gallon per 100 square feet.

The holes shall be filled with topsoil immediately after the concrete has cured.

Method of Measurement:

Grass unit pavers shall be measured by the square yard of exposed surface placed to the specified thickness. No measurement will be made for cut-off walls.

Basis of Payment:

The accepted quantities of grass unit pavers, measured as provided above, will be paid at the contract unit price per square yard, which price shall be full compensation for the work, complete in place, including excavation, preparing the ground area and furnishing and installing the grass unit pavers and the topsoil.

ITEM 9240104 - MISCELLANEOUS WORK (ELECTRICAL)

Description:

The work under this item consists of furnishing all materials and labor required to install conduit, foundations and anchorages for traffic control, signing, lighting devices and brackets, pull boxes, barrier mounted pull boxes, and junction boxes on each bridge structure and expansion fittings and abutment joints and pull rope at the pump station as shown on the project plans.

Construction Requirements:

Conduit, barrier mounted pull boxes, junction boxes, foundations and most anchorages for this item are not shown on the structure plans. It is the contractor's responsibility to insure that these necessary features be included in those structures as shown on the traffic control, signing, and lighting project plans and in accordance with the requirements of the Standard Specifications and these Special Provisions.

Method of Measurement:

Conduit, anchor bolts, barrier mounted pull boxes, junction boxes and other miscellaneous items related to traffic signals, signing and lighting shall be measured on a lump sum basis for each structure.

Luminaires and conductors will be measured on a lump sum basis at each bridge location under ITEM 7360349 - UNDERGROUND LIGHTING.

Basis of Payment:

Payment for this item will be made at the contract lump sum price, per structure, which price shall be full compensation for the item complete, as described and specified herein and as shown on the project plans.

Conductors will be paid for under their respective items.

(924CQC, 10/15/94)

ITEM 9240170 - CONTRACTOR QUALITY CONTROL:

(1) Description:

The work under this section shall consist of furnishing all personnel, materials, supplies, facilities,and equipment necessary to perform all certification of test equipment, sampling, testing, and other control actions. The work shall also include the preparation of linear control charts, Weekly Quality Control Reports, and other reports and records as described in Subsection 106.04 (C) of the Standard Specifications.

(2) Method of Measurement:

Contractor Quality Control will be measured for payment on a lump sum basis as a single unit of work.

(3) Basis of Payment:

The accepted quantities of Contractor Quality Control, measured as provided above, will be paid at the contract lump sum price, which price shall be full compensation for the work, complete, as described and specified herein.

Partial payments under this item will be made in accordance with the following provisions:

(1) The first partial payment price will be the lesser of twenty five percent of the contract lump sum price for Contractor Quality Control, or one percent of the original total contract bid amount.

(2) The remaining portion of the lump sum price will be prorated over the duration of the original contract on a monthly basis, and monthly progress payments will be made.

If adjustments to pay items covered under the Quality Control Plan are approved by supplemental agreement, an equitable adjustment to the lump sum amount for Contractor Quality Control may be made. Any adjustment to Contractor Quality Control shall be included in the supplemental agreement and the adjusted amount, less previous payments, will be prorated equally over the remaining contract period, including any related time extensions.

Failure of the contractor to submit Weekly Quality Control Reports, current to the most recent Wednesday submittal date, will be grounds for the Engineer to Withhold payment on a monthly basis for the Contractor Quality Control item until compliance is attained.

Withheld payments on which requirements have been met will be made on the next regular estimate.

(925SRVY, 07/15/91)

SECTION 925 - CONSTRUCTION SURVEYING AND LAYOUT:

925-1 **Description:** the last four sentences of the first paragraph of the Standard Specifications are revised to read:

The work shall be done under the direction of a registered professional engineer or a registered land surveyor employed by the contractor. The crew chief shall be NICET Certified Level III or a registered land surveyor. A minimum of 50 percent of the survey crew shall be NICET certified level II or possess a land surveyor-in-training certificate. All right-of-way monuments and lines shall be established by a registered land surveyor employed by the contractor.

925-3 **Construction Requirements:** of the Standard Specifications is modified to add:

Office Survey Work:

The contractor shall be compensated for office work associated with project survey under the following circumstances:

(a) When the project plans fail to provide information which renders it impossible to lay out the project or any part thereof.

(b) When the contractor performs office survey work based on erroneous plans information which results in the duplication of work.

(c) If the Department should change any plans information for which the contractor has already performed office work which results in the duplication of that work.

The contractor shall not be due compensation for any office survey work:

(a) When information is provided in the plans where additional information necessary for the complete layout of the project can be routinely calculated.

(b) When the contractor fails to inform the Engineer of discovered plan errors prior to the performance of any extra office survey work.

(c) That is included in any other existing pay item.

The contractor shall inform the Engineer in a timely manner of any omissions, ambiguities, or errors which the contractor feels may result in extra office survey work so as not to delay the project or create any unnecessary calculations.

All office survey work shall be documented by the contractor and verified by the Engineer for compensation. Documentation shall consist of at least a detailed office diary specifically addressing the work involved in the alleged problem area. The contractor may be required to provide the calculations, charts, graphs, drawings, or any other physical evidence which will verify the extra work.

925-4 **Method of Measurement:** the second paragraph of the Standard Specifications is revised to read:

Two, three, and four person survey party, and office survey technician will be measured by the hour to the nearest half hour.

925-5 **Basis of Payment:** the first sentence of the second paragraph of the Standard Specifications is revised to read:

If additional staking and layout are required as a result of additional work ordered by the Engineer, such work will be paid under ITEM 9250102 - TWO-PERSON SURVEY PARTY at the predetermined rate of $70 per hour, ITEM 9250103 - THREE-PERSON SURVEY PARTY at the predetermined rate of $85 per hour, ITEM 9250104 - FOUR-PERSON SURVEY PARTY at the predetermined rate of $95 per hour, and/or ITEM 9250105 - OFFICE SURVEY TECHNICIAN at the predetermined rate of $45 per hour.

925-5 **Basis of Payment:** of the Standard Specifications is modified to add:

The amount per hour for office survey technician shall include all necessary office supplies and equipment such as a calculator and or computer.

(1005BITM, 10/30/94)

SECTION 1005 - BITUMINOUS MATERIALS FOR SURFACING: of the Standard Specifications is revised as follows:

1005-3.01 Asphalt Cement: the fourth paragraph of the Standard Specifications is revised to read:

Adjustments in the contract unit price, in accordance with the requirements of Table 1005-6, will be made for quantities of material represented by the corresponding test results. Should test results indicate that asphalt cement falls within any of the deviation ranges shown for 40 percent of contract unit price allowed, the contractor may submit a written proposal to accept the material in place at 40 percent of the contract unit price. The proposal shall contain an engineering analysis of the anticipated performance of the material in which the asphalt cement is incorporated, if the material is permitted to remain in place. The engineering analysis shall detail any proposed corrective action and the anticipated effect of such corrective action on the performance. Material not allowed to remain in place will be rejected and removed at no additional cost to the Department, and replaced with material meeting the requirements of the applicable specifications.

1005-3.02 Liquid Asphalt: of the Standard Specifications is modified to add:

Adjustments in the contract unit price, in accordance with the requirements of Table 1005-7, will be made for quantities of material represented by the corresponding test results.

TABLE 1005-1 ASPHALT CEMENTS: The TEST ON ASPHALT CEMENT and AASHTO TEST METHOD specifications for Flash Point on page 709 of the Standard Specifications are revised to read:

TEST ON ASPHALT CEMENT	AASHTO TEST METHOD
Flash Point, Cleveland Open Cup, degrees F., minimum	T 48

TABLE 1005-1A **ASPHALT CEMENTS:** The TEST ON ASPHALT CEMENT and AASHTO TEST METHOD specifications for Flash Point on page 710 of the Standard Specifications are revised to read:

TEST ON ASPHALT CEMENT	AASHTO TEST METHOD
Flash Point, Cleveland Open Cup, degrees F., minimum	T 48

TABLE 1005-2 **EMULSIFIED ASPHALTS:** Note (3) on page 712 of the Standard Specifications is revised to read:

Note (3) Residue will be obtained in accordance with the requirements of Arizona Test Method 504 and shall conform to all the requirements of Table 1005-1 for AC-20, except that for CRS-2, the viscosity at 140 degrees F. shall be between 1800 and 2400 poises.

TABLE 1005-3 **RECYCLING AGENTS:** The TEST ON RECYCLING AGENT and TEST METHOD specifications for Flash Point on page 713 of the Standard Specifications are revised to read:

TEST ON RECYCLING AGENT	TEST METHOD
Flash Point, Cleveland Open Cup, degrees F., minimum	AASHTO T 48

SECTION 1005 - BITUMINOUS MATERIALS FOR SURFACING: of the Standard Specifications is modified to add Table 1005-6 and Table 1005-7:

TABLE 1005-6
ASPHALT CEMENT

DEVIATION RANGES

GRADE	ORIGINAL VISCOSITY, POISES	ORIGINAL PENETRATION		DUCTILITY ON RESIDUE FROM AASHTO T 240		VISCOSITY, POISES, ON RESIDUE FROM AASHTO T 240		PERCENT OF UNIT PRICE ALLOWED*
		1005-1	1005-1A	1005-1	1005-1A	1005-1	1005-1A	
AC-5	360-399 or 601-660	108-119	126-139	90-99	90-99	2001 -2200	2501 -2750	90
	300-359 or 661-750	90-107	105-125	75-89	75-89	2201 -2500	2751 -3125	60
	Less than 300 or greater than 750	Less than 90	Less than 105	Less than 75	Less than 75	More than 2500	More than 3125	40**
AC-10	720-799 or 1201-1320	63-69	72-79	90-99	90-99	4001 -4400	5001 -5500	90
	600-719 or 1321-1500	52-62	60-71	75-89	75-89	4401 -5000	5501 -6250	60
	Less than 600 or greater than 1500	Less than 52	Less than 60	Less than 75	Less than 75	More than 5000	More than 6250	40**
AC-20	1440-1599 or 2401-2640	36-39	54-59	67-74	67-74	8001 -8800	10001 -11000	90
	1200-1439 or 2641-3000	30-35	45-53	56-66	56-66	8801- -10000	11001 -12500	60
	Less than 1200 or greater than 3000	Less than 30	Less than 45	Less than 56	Less than 56	More than 10000	More than 12500	40**
AC-30	2160-2399 or 3601-3960	27-29	45-49	54-59	67-74	12001 -13200	15001 -16500	90
	1800-2159 or 3961-4500	22-26	37-44	45-53	56-66	13201 -15000	16501 -18750	60
	Less than 1800 or greater than 4500	Less than 22	Less than 37	Less than 45	Less than 56	More than 15000	More than 18750	40**
AC-40	2880-3199 or 4801-5280	18-19	36-39	40-44	67-74	16001- 17600	20001 -22000	90

2400-2879 or 5281-6000	15-17	30-35	34-39	56-66	17601 -20000	22001 -25000	60
Less than 2400 or greater than 6000	Less than 15	Less than 30	Less than 34	Less than 56	More than 20000	More than 25000	40**

*The percent of contract unit price allowed for the material represented by the corresponding test results shall be the lowest percent of contract unit price allowed for all properties shown.

**If allowed to remain in place.

NOTE: The information presented in this table does not apply to asphalt cement used for tack coats.

TABLE 1005-7
MC LIQUID ASPHALT

GRADE	VISCOSITY, CENTISTOKES DEVIATIONS	PERCENT OF CONTRACT UNIT PRICE ALLOWED
70	70 - 140	100
	63 - 69 or 141 - 154	90
	52 - 62 or 155 - 175	75
	Less than 52 or greater than 175	60*
250	250 - 500	100
	225 - 249 or 501 - 550	90
	187 - 224 or 551 - 625	75
	Less than 187 or greater than 625	60*
800	800 - 1600	100
	720 - 799 or 1601 - 1760	90
	600 - 719 or 1761 - 2000	75
	Less than 600 or greater than 2000	60*
3000	3000 - 6000	100
	2700 - 2999 or 6001 - 6600	90
	2250 - 2699 or 6601 - 7500	75
	Less than 2250 or greater than 7500	60*

* If allowed to remain in place

NOTE: Since volatile solvents utilized in the manufacture of MC Liquid Asphalt may volatilize in varying amounts during normal transporting, handling, and storage operations, whenever such Liquid Asphalts are used for prime coats or curing seals, deviations from the maximum specification limits greater than those listed may be permitted when justified. In such cases, when material is allowed to remain in place, 60% of the contract unit price is allowed.

(1006PCC, 12/15/94)

SECTION 1006 - PORTLAND CEMENT CONCRETE:

1006-2.01 **Hydraulic Cement:** the fifth paragraph of the Standard Specifications is revised to read:

Certificates of Analysis conforming to the requirements of Subsection 106.05 shall be submitted.

1006-2.01 **Hydraulic Cement:** the sixth paragraph of the Standard Specifications is revised to read:

Cement of different types or brands shall not be intermingled or used in the same batch. The contractor shall provide suitable means for storing and protecting the cement against dampness. Cement which for any reason has become partially set or which contains caked lumps shall not be used.

1006-2.03(A) **General Requirements:** of the Standard Specifications is modified to add:

The contractor shall maintain at least two full days worth of production of fine and coarse aggregate stockpiled at the batch plant for Class P concrete prior to starting and throughout the duration of portland cement concrete paving operations. This requirement is waived for the last two days of production.

The following test methods will be used to evaluate the quality of aggregates for concrete:

Sampling	ARIZ 105 & AASHTO T 2
Reducing field samples to testing size	AASHTO T 248
Clay lumps and friable particles	AASHTO T 112
Coal, lignite and lightweight particles	AASHTO T 113
Amount of material passing No. 200 sieve	ARIZ 201
Organic impurities	AASHTO T 21
Sieving aggregates	ARIZ 201
Soundness (Sodium Sulfate)	AASHTO T 104
Mortar-making properties	AASHTO T 71
Sand equivalent	AASHTO T 176
L.A. abrasion	AASHTO T 96
Crushed faces	ARIZ 212

1006-2.03(B) Fine Aggregate: of the Standard Specifications is revised to read:

Fine aggregate shall be a natural sand or other approved inert material with similar characteristics composed of clean, hard, strong, durable, uncoated particles. Fine aggregate, with the exception of quarried aggregate, shall be washed and shall conform to the requirements of AASHTO M 6 with the following exceptions:

The amount of deleterious substances in washed fine aggregate shall not exceed the following limits by dry weight:

Clay lumps	(AASHTO T 112)	0.50 %
Coal and lignite	(AASHTO T 113)	0.25 %
Shale and other materials having a specific gravity less than 1.95	(ARIZ 211)	1.00 %

The maximum amount of all deleterious substances listed above shall not exceed 1.25 percent by dry weight.

The grading shall meet the following requirements when tested in accordance with the requirements of Arizona Test Method 201.

Sieve Size	Percent Passing
3/8 inch	100
No. 4	95 -100
No. 16	45 - 80
No. 50	0 - 30
No. 100	0 - 10
No. 200	0 - 4.0

Fine aggregate shall have an average sand equivalent value of not less than 75.

Fine aggregates shall be subjected to testing under AASHTO T 21 for organic impurities. Aggregates producing a color darker than the standard shall be rejected unless the material passes the mortar strength specified in the following paragraph:

Fine aggregate shall be of such quality that, when made into mortar and subjected to the test for mortar-making properties the mortar shall develop a compressive strength at seven and 28 days of not less than 90 percent of that developed by a mortar prepared in the same manner with the same Type II cement and graded Ottawa sand having a fineness modulus of 2.40 0.10.

1006-2.03(C) Coarse Aggregate: the Standard Specifications is revised to read:

Coarse aggregate shall consist of crushed stone, gravel, or other approved inert material of similar characteristics, including cinders when specified, having hard, strong and durable pieces free of clay and other deleterious substances. The aggregate shall be washed. The coarse aggregate gradation shall conform to the appropriate size designation of AASHTO M 43, except as shown below, when tested in accordance with the requirements of Arizona Test Method 201.

The amount of deleterious substances in washed coarse aggregate shall not exceed the following limits by dry weight, when tested with the following test methods, except as noted:

Clay lumps	(AASHTO T 112)	0.25%
Coal and lignite	(AASHTO T 113)	0.25%
Material passing No. 200 sieve		0.50%*
Shale and other materials having a specific gravity less than 1.95	(ARIZ 211)	1.00 %

*When coarse aggregate is 100 percent crushed aggregate, the maximum requirement for material passing No. 200 sieve shall be 1.0 percent by weight.

The maximum amount of all deleterious substances listed above shall not exceed 1.25 percent by dry weight.

The percent of wear of coarse aggregate at 500 revolutions, when tested in accordance with the requirements of AASHTO T 96, shall not exceed 40.

1006-2.04(D) Fly Ash: of the Standard Specifications is revised to read:

Fly ash shall conform to the requirements of ASTM C 618 for Class C or F mineral admixture, except that the loss on ignition shall not exceed 3.0 percent.

Fly ash, when used as a replacement for portland cement, shall have an R factor less than 2.5. The R factor is defined as (C-5%)/F, where C is the calcium oxide content expressed as a percentage and F is the ferric oxide content expressed as a percentage. Fly ash shall not contain more than 1.5 percent available alkali as defined in ASTM C 311.

1006-2.05 Concrete Curing Materials: the last sentence of the first paragraph of the Standard Specifications is revised to read:

Type 1-D compound with either a Class A or Class B vehicle shall be used for other concrete items.

1006-3.01 Design Criteria: the seventh, eighth, ninth, tenth and eleventh paragraphs of the Standard Specifications are revised to read:

The minimum and maximum weights of hydraulic cement required are shown on Table 1006-A for each class of concrete. A fly ash admixture may be used at the option of the contractor only when portland cement is used. A maximum of 20 percent of the required weight of portland cement may be replaced with a fly ash admixture. A minimum of 1.2 pounds of fly ash shall replace each 1.0 pound of portland cement removed.

Class S concrete shall have a compressive strength of not less than that shown on the plans. Unless otherwise shown on the plans, the minimum required 28-day compressive strength of Class S concrete shall be f'c = 3,000 pounds per square inch. Class B and Class P concrete shall have minimum 28-day strengths of not less than those shown in Table 1006-A. Testing for compressive strength of cylinders shall be in accordance with the requirements of Arizona Test Method 314.

The coarse aggregate size designation for Class S and Class B concrete shall be chosen by the contractor and approved by the Engineer and shall conform to the size designation and grading requirements of AASHTO M 43. In choosing the size designation, the maximum size of coarse aggregate shall not be larger than 1/5 of the narrowest dimension between sides of adjacent forms, or 2/3 of the minimum clear spacing between reinforcing bars, or 1/3 the depth of the slab, whichever is least. If two or more stockpiles are utilized to manufacture an AASHTO M 43 size designation, at the time of proportioning for mixing, the aggregate from each stockpile shall be measured by weight and proportioned so that the resulting mixture of coarse aggregate meets the requirements for the chosen size designation.

Coarse aggregate for Class P concrete used to construct portland concrete pavement without load transfer dowels shall be separated into two stockpiles. At the time of proportioning for mixing, the aggregate from each stockpile shall be measured by weight and proportioned so that the resulting mixture of coarse aggregate meets the requirements for size designation No. 467. The percent of fractured particles for this coarse aggregate composite shall be at least 30 when tested in accordance with the requirements of Arizona Test Method 212.

1006-5.02 Hot Weather Concreting: of the Standard Specifications is modified to add:

Mix water may be cooled by refrigeration, liquid nitrogen, or well-crushed ice of a size that will melt completely during the mixing operation. Crushed ice may be substituted for part of the mix water on a pound for pound basis.

1006-6.02 (B) Low-Pressure Steam Curing: the last paragraph of the Standard Specifications is revised to read:

In the event the side forms are removed before the precast unit has attained the required release compressive strength, the curing method shall be continuous in maintaining the temperature and moisture level as described above, within the enclosure, as nearly as practical. There shall not be a delay in re-covering the girder or prestress member.

1006-7.02 Sampling and Testing of Concrete: of the Standard Specifications is revised to read:

A sample of concrete for determination of temperature, slump, and air content as well as for fabrication of test cylinders for compressive strength determination at 28 days will be taken at random at the specified sampling frequency for each type of concrete.

Samples of concrete shall be of sufficient size to perform all the required tests and fabricate the necessary test cylinders. The samples shall be taken in accordance with the requirements of AASHTO T 141, except as follows:

(1) Concrete for Class S or B shall be sampled only once during discharge in the middle portion of the batch. At the discretion of the Engineer, a sample may be obtained at the beginning of the discharge if, in his opinion, the properties of the concrete do not appear to be within the specification limits for slump or temperature.

(2) Concrete for Class P shall be sampled immediately before going into the paver or forms, or as otherwise directed by the Engineer.

If concrete is pumped to facilitate placement, at the discretion of the Engineer, samples may be taken from the truck and pump hose discharge to determine that the compressive strength specifications are met in the structure, and to correlate temperature, slump and air content results. If the correlation is satisfactory and meets with the approval of the Engineer, sampling may continue from the most convenient location with occasional re-testing for correlation. Rejection of concrete due to improper

temperature or slump may occur at either the truck or pump hose discharge; however, rejection of concrete due to improper air content will only occur due to a failing test for a sample obtained at the final point of discharge.

Temperature of the concrete mixture will be determined in accordance with ASTM C 1064. Slump of the concrete mixture will be determined in accordance with AASHTO T 119. Air content of the concrete mixture will be determined in accordance with AASHTO T 152. All compressive strength test cylinders will be fabricated in accordance with the requirements of AASHTO T 23. Testing for compressive strength of cylinders shall be in accordance with the requirements of Arizona Test Method 314.

A strength test will consist of the average strength of two cylinders or 95 percent of the higher strength cylinder, whichever is greater.

1006-7.03 **Sampling Frequency for Cast-in-place Concrete:** the first paragraph of the Standard Specifications is revised to read:

A sample of concrete for the required tests, as specified in Subsection 1006-7.02, will be taken for each 100 cubic yards, or fraction thereof, of continuously placed concrete, on a daily basis, for Class B concrete and for each strength classification of Class S concrete, from each batch plant or source. A sample of concrete will be taken for each 50 cubic yards placed, for air content testing, at altitudes above 3,000 feet. A sample for the required tests on daily placements of 20 cubic yards or less may be taken at the discretion of the Engineer. An additional sample or samples for any of the required tests may be taken, at an interval of less than 100 cubic yards, at the discretion of the Engineer on any batch or load of concrete. The Engineer will determine the quantity of concrete represented by each sample of concrete for any test performed.

1006-7.05 **Testing for Minor Precast Concrete Structures:** the second paragraph of the Standard Specifications is revised to read:

The compressive strength of the concrete will be determined from the average rebound number and the calibration chart established for the specific rebound hammer being used. The calibration chart will be established from rebound readings taken on concrete test cylinders fabricated at the precast plant and the actual compressive strength of the cylinders. The test cylinders will be fabricated in accordance with the requirements of AASHTO T 23. Testing for compressive strength of cylinders shall be in accordance with the requirements of Arizona Test Method 314.

(1006QCPC, 10/30/94)

SECTION 1006 - PORTLAND CEMENT CONCRETE:

1006-4.01 **General Requirements:** of the Standard Specifications is modified to add:

1006-4.01 (A) **Contractor Quality Control:**

The contractor shall perform the quality control measures described in Subsection 106.04(C). At the weekly meeting, the contractor shall be prepared to explain and discuss how the following processes will be employed.

(a) Aggregate Production, including crusher methods, pit extraction, and washing.

(b) Stockpile Management, including stacking methods, separation technique, plant feed technique, stockpile pad thickness, and segregation prevention.

(c) Mixing and Transport, including mixing time and revolutions, water and concrete temperature, integrity of mixing equipment, sight glass for water, slump meters, batch ticket, and travel time.

(d) Proportioning, including scale calibration, water added, water meter moisture correction, and bin loading.

The contractor shall obtain samples and perform the tests specified in the following table:

CONTRACTOR QUALITY CONTROL TESTING REQUIREMENTS

TYPE OF TEST	TEST METHOD	SAMPLING POINT	MINIMUM TESTING FREQUENCY
Fine Aggregate for PCC			
Gradation	ARIZ 201	Batch Plant Conveyor Belt or Stockpile	1 per 750 CY of Concrete
Sand Equivalent	AASHTO T176		
Coarse Aggregate for PCC			
Gradation	ARIZ 201	Batch Plant Conveyor Belt or Stockpile	1 per 750 CY of Concrete
Portland Cement Concrete			
Entrained Air	AASHTO T152	At Point of Discharge	1 per 40 CY of Concrete
Slump	AASHTO T119		
Portland Cement Concrete Pavement			
Entrained Air	AASHTO T152	At Point of Discharge	1 per 1000 CY of Concrete
Slump	AASHTO T119		

(1011JNT, 08/15/93)

SECTION 1011 - JOINT MATERIALS

1011-3 **Joint Sealant (Hot-Poured):** of the Standard Specifications is modified to add:

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted.

1011-4 **Joint Sealant (Cold-Application):** of the Standard Specifications is modified to add:

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted.

1011-5.02 **Strip Seals:** of the Standard Specifications is revised to read:

Strip seals shall be preformed non-reinforced, polychloroprene strip seal glands that mechanically lock into steel retainers. The steel retainers shall be anchored into the structure in accordance with the contract requirements.

The adhesive lubricant used to install the strip seal gland into the locking steel retainer shall be a one part moisture curing polyurethane compound, meeting the requirements of ASTM D 4070.

The strip seal gland shall be delivered to the job site in lengths suitable for continuous one piece installation for each individual expansion joint. Field splicing is not permitted.

All steel surfaces that come in contact with the strip seal gland shall be cleaned to meet the requirements of SSPC-SP6.

Special conditions such as mitres, tees, and crosses shall be shop fabricated in a mold under heat and pressure.

Strip seal gland installation at joint openings of less than 1 1/2" will not be permitted.

The elastomer for strip seal elements shall conform to the requirements of ASTM D 3542 modified as follows:

(a) Recovery testing is excluded

(b) **TABLE 1 Physical Requirements for Preformed Elastomeric Joint Seals:** is revised to read:

TABLE 1

PHYSICAL PROPERTIES FOR PREFORMED ELASTOMER STRIP SEALS

Property	Requirement	ASTM Test Method
Tensile strength, min. psi (MPa)	2000 (13.8)	D 412
Elongation at break, min. %	250	D 412
Hardness, Type A durometer, points	60 ± 5	F 2240 (Modified)[A,C]
Oven aging, 70 h at 212°F (100°C)		D 573
Tensile strength, loss, max. %	20	
Elongation, loss, max. %	20	
Hardness, Type A durometer, points change	0 to +10	D 2240 (Modified)[A,C]
Oil swell, ASTM oil 3 70 h at 212°F (100°C)		D 471
Weight change, max. %	45	
Ozone resistance 20% strain, 300 pphm in air, 70 h at 104°F (40°C)	No Cracks	D 1149 (Modified)[B]
Low temperature stiffening 7 days at 14°F (-10°C)		D 2240
Hardness, type A durometer, points change	0 to +15	D 2240 (Modified)[A,C]
Compression set, 70 h at 212°F (100°C), max. %	40	D 395 Method B (Modified)[A]

FOOTNOTES:

A The term "modified" in the table relates to the specimen preparation. The use of the strip seal as the specimen source requires that more plies than specified in either of the modified test procedures used. Such specimen modification shall be agreed upon by the purchaser and producer or supplier prior to testing.

B Test in accordance with procedure A of ASTM D 518 and ozone concentration is expressed in pphm.

C The hardness test shall be made with the durometer in a durometer stand as recommended in Method D 2240.

1011-6 **Preformed Expansion Joint Filler:** of the Standard Specifications is modified to add:

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted.

(1012GCRT, 11/30/93)

SECTION 1012 GUARD RAIL MATERIALS:

1012-1 **General Requirements:** the first paragraph of the Standard Specifications is revised to read:

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted. In addition, Certificates of Analysis conforming to the requirements of Subsection 106.05 shall be submitted for High Strength Anchor Bolts (3/4") as listed in Table 1012-1 of the Standard Specifications.

1012-2 **Fasteners, Elements, and Posts:** the title and first paragraph of the Standard Specifications are revised to read:

1012-2 **Fasteners, Elements, Posts and Blocks:**

Guard rail fasteners shall conform to the requirements of Table 1012-1. Guard rail elements shall conform to the requirements of Table 1012-2. Metal Guard rail posts and blocks shall conform to the requirements of Table 1012-3. Timber guard rail posts and blocks shall conform to the requirements of Subsection 1012-4.

TABLE 1012-1 - GUARD RAIL FASTENERS: of the Standard Specifications is revised to read:

TABLE 1012-1

GUARD RAIL FASTENERS

Part Name	ARTBA Drawing No.	Specification
Button Head Bolt (5/8") and Recess Nut	F- 3	
Hex Bolt		ASTM A 307
Heavy Hex Structural Bolt		ASTM A 325, Type 1
Hex Nut and Hex Thick Nut		ASTM A 563, Grade A
Heavy Hex Nut		ASTM A 563, Grade DH
Heavy Hex Screw		ASTM A 449
Plain Washer (Type A) and Plain Washer (Wide) (Type A)		ASTM F 436 and ANSI B 27.2
Plain Washer (Narrow)(Type A)	F-45	
Rectangular Plate Washer	F-12	AASHTO M 180, Class A, Type 1
BCT Sleeve	F-34	
BCT (Timber) Bearing Plate	F-36	
BCT Cable Assembly	F-37	AASHTO M 30, Class C
BCT Cable End Plate	F-38	
BCT (Steel) Tapered Washer	F-40	ASTM F 436
BCT (Steel) Bearing Plate	F-41	
Flat Plate Washer	F-43	ASTM F 436
High Strength Anchor Bolt (3/4")	F-44	

TABLE 1012-3 - GUARD RAIL POSTS: the title and table of the Standard Specifications are revised to read:

TABLE 1012-3

METAL GUARD RAIL POSTS AND BLOCKS

Part Name	ARTBA Drawing No.	Specification
G4 and MB4 Structural Shape Post and Block	P-10	
G4 and MB4 Bent Plate Post and Block (Steel)	P-52	ASTM A 570, Grade 40
G9 and MB9 Structural Shape Post and Block	P-54	
G9 and MB9 Bent Plate Post and Block (Steel)	P-56	ASTM A 570, Grade 40
BCT Terminal Post (Steel)	P-60	ASTM A 500, Grade B
BCT Terminal Post Foundation (Steel)	P-61	

The text following TABLE 1012-3 at the bottom of page 759 of the Standard Specifications is revised to read:

1012-4 Timber Guard Rail, Posts and Blocks:

Timber for posts and blocks shall be rough sawn (unplaned) or S4S with the nominal dimensions indicated. Any species or group of woods graded in accordance with the requirements for Timber and Posts of the Western Wood Products Association may be used.

Dimensions of timber BCT terminal posts shall conform to ARTBA P-59.

Timber shall be No. 1 or better, and the stress grade shall be as follows:

6" x 8" Post and Block	1200 psi
8" x 8" Post and Block	900 psi
10" x 10" Post and Block	900 psi

When the plans show guard rail systems using 8" x 8" timber posts and blocks, the contractor may use 8 1/4" x 8 1/4" nominal size posts and blocks with a stress grade of 825 psi.

At the time of installation, the dimensions of timber posts and blocks shall vary no more than plus or minus 1/2 inch from the nominal dimensions as hereinbefore specified.

The size tolerance of rough sawn blocks in the direction of the bolt holes shall vary no more than plus or minus 3/8 inch. Only one type of post and block shall be used for any one continuous length of guard rail.

All timber shall have a preservative treatment in accordance with the requirements of AASHTO M 133.

(SPECIAL PROVISION ELAS1013, 4056/L, 12/08/95)

SECTION 1013 - BEARING PADS: of the Standard Specifications is revised to read:

1013-1 Preformed Fabric Pads

Preformed fabric pads shall be composed of multiple layers of eight-ounce cotton duck impregnated and bound with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 pounds per square inch without detrimental reduction in thickness or extrusion.

Preformed fabric pad samples will be tested by the Department.

The manufacturer certification and sampling shall conform to the requirements of Subsection 1013-3.

1013-2 Elastomeric Bearing Pads:

1013-2.01 General:

The work shall consist of furnishing and installing elastomeric bearing pads. Bearings shall be constructed in accordance with the details shown on the plans and as specified in these specifications.

Prior to shipment from the point of manufacture, bearings shall be packaged in such manner to ensure that during shipment and storage the bearings will be protected against damage from handling, weather, or any normal hazard. All bearings shall be stored at the work site in an area that provides protection from environmental and physical damage. When installed, bearings shall be clean and free of all foreign substances.

Bearings shall be installed to the positions and orientations shown on the plans. Bearings shall be set level, in exact positions, and must have full and even bearing on all bearing planes. Bearings surfaces located at improper elevations or set not level and true to plane shall be corrected prior to placement of bearings. Elastomeric bearing pads shall be set directly on properly prepared concrete surfaces without bedding material.

Elastomeric bearing pads shall include unreinforced pads (consisting of elastomer only) and reinforced bearings with steel or fabric laminates.

Bearings shall be furnished with the dimensions, material properties and elastomer grade required by the plans. Unless otherwise specified on the plans, bearings which have thicknesses greater than 1/2 inch shall be reinforced with steel or fabric laminates. The design method (A or B) and the design load shall also be shown on the plans and testing shall be performed accordingly. In the absence of more specific information, bearings shall be Grade 3, an elastomer with 130 pounds per square inch shear modulus (55 durometer hardness), and shall be subjected to the load testing requirements corresponding to Method A design.

1013-2.02 Material Properties:

The sole polymer in the elastomeric compound shall be neoprene and shall not be less than 60 percent, by volume, of the total compound. The elastomer compound shall be classified as being of low temperature Grade 0, 2 or 3. The grades are defined by the testing requirements in Table A. A higher grade of elastomer may be substituted for a lower one.

The elastomer compound shall meet the minimum requirements of Table A except as otherwise specified by the engineer. Test requirements may be interpolated for intermediate hardness. The material will be specified by its shear modulus whose measured value shall lie within 15 percent of the specified value. A consistent value of hardness shall also be supplied for the purpose of defining limits for the tests in Table A. Laminated bearings shall not have a shear modulus greater than 200 psi. When test specimens are cut from the finished product, the physical properties shall be permitted to vary from those specified in Table A by 10 percent. All material tests shall be carried

out at 73 degrees F, ±4 degrees F, unless otherwise noted. Shear modulus tests shall be carried out using the apparatus and procedure described in Annex A of ASTM D4014.

TABLE A **Neoprene quality control tests.** Note in the table that ASTM D1043 refers to "modulus of rigidity" while ASTM D4014 refers to "shear modulus." The word "stiffness" is used here to cover both terms.

Physical Properties				
D 2240	Hardness (Shore A Durometer)	50±5	60±5	70±5
D 412	Tensile Strength, Minimum PSI	2250	2250	2250
	Ultimate Elongation, Minimum %	400	350	300
Heat Resistance				
D 573 70 Hrs at 212 Degrees F	Change in Durometer Hardness, Maximum Points	15	15	15
	Change in Tensile Strength, Max %	-15	-15	-15
	Change in Ultimate Elongation, Maximum %	-40	-40	-40
Compression Set				
D 395 Method B	22 Hours at 212 degrees F, Max %	35	35	35
Ozone				
D 1149	100 PPHM Ozone in Air by Volume 20% Strain 100 Degrees F ±2 Degrees F 100 Hours Mounting Procedure D518, Procedure A		No Cracks	
Low Temperature Brittleness				
D 746 Procedure B				
	Grade 0 No Test Required			
	Grade 2 No Test Required			
	Grade 3 Brittleness at -40 Degrees F		No Failure	
Instantaneous Thermal Stiffening				
D 1043	Grade 0 - Tested at -25 Degrees F	(1)		
	Grade 2 - Tested at -25 Degrees F	(1)		
	Grade 3 - Tested at -40 Degrees F	(1)		

(1) Stiffness at test temperature shall not exceed 4 times the stiffness measured at 73 degrees F

Low temperature crystallization

Quad Shear	Grade 0 - No Test Required	(2)
Test As	Grade 2 - 7 Days at 0 Degrees F	(2)
Described	Grade 3 - 14 Days at -15 Degrees F	(2)

(2) Stiffness at test time and temperature shall not exceed four times the stiffness measured at 73 degrees F with no time delay. The stiffness shall be measured with a quad shear test rig in an enclosed freezer unit. The test specimens shall be taken from a randomly selected bearing. A ±25% strain cycle shall be used, and a complete cycle of strain shall be applied with a period of 100 seconds. The first 3/4 cycle of strain shall be discarded and the stiffness shall be determined by the slope of the force deflection curve for the next 1/2 cycle of loading.

Certification, sampling and testing shall conform to the requirements of Subsection 1013-3.

1013-2.03 Plain and Fabric Reinforced Elastomeric Bearing Pads:

Pads less than or equal to 1/2 inch in thickness shall be all elastomer. Pads greater than 1/2 inch thick shall be laminated. The stacking of individual laminated pads to attain thicknesses over 1/2 inch will not be permitted; however, cold bonding of individual laminated pads will be permitted providing the bond between the pads has a minimum peel strength of 20 pounds per inch.

Laminated pads shall consist of alternate layers of elastomer and fabric reinforcement bonded together. The top and bottom layers of reinforcement shall be uniformly covered with a layer of elastomer. The thickness of elastomer cover shall not vary.

Laminated pads shall have reinforcement every 1/2 inch through the entire thickness. Fabric reinforcement shall be single ply at top and bottom surfaces of the pad and double ply within the pad. Fabric shall be free of folds and ripples and shall be parallel to the top and bottom surfaces. Variations in the location of the reinforcement from its theoretical location in excess of the specified Fabrication Tolerances will be cause for rejection.

Pads of all elastomer or with fabric reinforcement may be cut from large sheets. Cutting shall be performed in such a manner as to avoid heating of the material, to produce a smooth edge with no tears or other jagged areas, and to cause as little damage to the material as possible. The cutting method shall not cause any separation of the fabric from the elastomer for laminated bearings.

Flash tolerance, finish, and appearance shall meet the requirements of the latest edition of the Rubber Handbook, published by the Rubber Manufacturers Association, Inc., RMA F3 and T.063 for molded bearings and RMA F2 for extruded bearings.

The bond between elastomer and fabric shall be such that when a sample is tested for separation, it shall have a minimum peel strength of 30 pounds per inch.

Fabric reinforcement shall be woven from 100 percent glass fibers of "E" type yarn with continuous fibers. The minimum thread count in either direction shall be 25 threads per inch. The fabric shall have either a crowfoot or an 8 Harness Satin weave. Each ply of fabric shall have a breaking strength of not less than 800 pounds per inch of width in each thread direction when 3-inch by 36-inch samples are tested on split drum grips. The bond between double plies shall have a minimum peel strength of 20 pounds per inch. Holes in the fabric will not be permitted.

1013-2.04 Steel Reinforced Elastomeric Bearing Pads:

At the contractor's option, steel reinforced elastomeric bearing pads may be furnished in lieu of fabric reinforced elastomeric bearing pads that are 1/2 inch in thickness and over.

Steel reinforced elastomeric bearing pads shall conform to the requirements for steel laminated elastomeric bearings as specified in these specifications and the following:

The thickness of each bearing pad shall be as shown on the project plans. The bearings shall consist of N-1 internal elastomer laminates and N steel laminates, where N is equal to the bearing pad thickness shown on the project plans divided by 1/2 inch. The steel laminates shall be 14 gauge and shall be spaced every 1/2 inch, center-to-center. The top and bottom steel laminates shall have 1/4 inch of elastomer cover as measured from the center of the steel laminate to the pad surface.

The elastomer clear cover to the steel laminates at the sides of the bearings shall be 1/8 inch. If guide pins or other devices are used to control the side cover over the steel laminates, any exposed portions of the steel laminates shall be sealed by vulcanized patching.

Steel laminates used for reinforcement shall be made from rolled mild steel conforming to ASTM A36, A570, or ASTM A611, Grade D. Holes in plates for manufacturing purposes will not be permitted unless they have been accounted for in the design, as shown on the plans.

Bearings with steel laminates shall be cast as a unit in a mold and shall be bonded and vulcanized under heat and pressure. The mold finish shall conform to standard shop practice. The internal steel laminates shall be sandblasted and cleaned of all surface coatings, rust, mill scale, and dirt before bonding, and shall be free of sharp edges and burrs. External load plates (sole plates) shall be protected from rusting by the manufacturer, and preferably shall be hot bonded to the bearing during vulcanization. Bearings that are designed to act as a single unit with a given shape factor must be manufactured as a single unit.

Steel laminated bearings shall develop a minimum peel strength of 40 pounds per inch.

1013-2.05 Fabrication Tolerances:

Plain pads and laminated bearings shall be built to the specified dimension within the following tolerances:

1.	Overall Height		
	Design Thickness 1 1/4 inch or less	-0,	+1/8 inch
	Design Thickness over 1 1/4 inch	-0,	+1/4 inch
2.	Overall Horizontal Dimensions		
	36 Inch or Less	-0,	+1/4 inch
	Over 36 Inch	-0,	+1/2 inch
3.	Thickness of Individual Layers of Elastomer at any Point Within the Bearing		±20% of Design Value but no more than ±1/8 inch.
4.	Parallelism with Opposite Face		
	Top and Bottom	0.005	Radians
	Sides	0.02	Radians
5.	Position of Exposed Connection Members		
	Holes, Slots or Inserts	±1/8 inch	

6.	Edge Cover Embedded Laminates or Connection Members	-0, +1/8 inch
7.	Thickness Top and Bottom Cover Layer (if required)	-0, the smaller of +1/16 inch and + 20% of the nominal cover layer thickness
8.	Size Holes, Slots, or Inserts	±1/8 inch

1013-3 Certification and Testing:

1013-3.01 General Requirements:

(A) General:

A lot shall consist of a single type of bearing of the same design, material and thickness, delivered to the project site at the same time. Unless otherwise specified on the plans, certification and testing shall be as described in Subsection 1013-3.01(B) and (C).

(B) Testing by Manufacturer:

The contractor shall furnish the Engineer with certification from the manufacturer that the bearings to be furnished conform to all specified requirements. The certifications shall be supported by Certificates of Analysis conforming to the requirements of Subsection 106.05. Each reinforced bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the order number, lot number, bearing identification number, and elastomer type and grade number. The marking shall be on the face that is visible after erection of the bridge.

The ambient temperature tests on the elastomer described in Subsection 1013-3.02(A) shall be conducted for the materials used in each lot of bearings. In lieu of performing a shear modulus test for each batch of material, the manufacturer may elect to provide certificates from tests performed on identical formulations within the preceding year. Test certificates from the supplier shall be provided for each lot of reinforcement.

The three low temperature tests on the elastomer described in Subsection 1013-3.02(C) shall be conducted on the material used in each lot of bearings for Grade 3 material, and the instantaneous thermal stiffening test shall be conducted on material of Grades 0 and 2. For Grade 3 material, in lieu of the low temperature crystallization test, the manufacturer may choose to provide certificates from low-temperature crystallization tests performed on identical material within the last year. Low temperature brittleness and crystallization tests are not required for Grades 0 and 2 materials.

Every finished bearing shall be visually inspected in accordance with Subsection 1013-3.02(D).

Every steel reinforced bearing shall be subjected to the short-term load test described in Subsection 1013-3.02(E).

From each lot of bearings designed by Method B of Article 14.4, Division I of the AASHTO Specification, a random sample shall be subjected to the long-term load test described in Subsection 1013-3.02(F). The sample shall consist of at least one bearing chosen randomly from each size and material batch and shall comprise at least 10 percent of the lot. If one bearing of the sample fails, all the bearings of that lot shall be rejected, unless the manufacturer elects to test each bearing of the lot at his expense. In lieu of this procedure, the engineer may require every bearing of the lot to be tested.

(C) Testing by Contractor:

A minimum of two sample pads from every 100 pads furnished, or portion thereof, will be selected at random by the Engineer at the project site for testing. A minimum of one sample pad will be selected from each lot. Samples shall consist of complete pads as detailed on the project plans and as specified herein. The contractor shall furnish additional complete pads to replace those taken for testing. Pads shall be available for testing at least three weeks in advance of intended use.

The contractor shall, at his expense, have the sample elastomeric bearing pads tested by a testing laboratory. The testing laboratory shall be as approved by the Engineer, shall be independent of the bearing pad manufacturer, and shall be under the supervision of a registered professional engineer. The contractor shall furnish the Engineer with certification by the approved testing laboratory that the bearings tested conform to the specified requirements for dimensional tolerances and material properties. The following test shall be performed as appropriate: ambient temperature tests, heat resistance tests, low temperature tests, visual inspection, shear modulus test and the bond and peel strength tests. The certification shall be supported by Certificates of Analysis conforming to the requirements of Subsection 106.05.

The heat resistance tests shall be performed in accordance with Subsection 1013-3.02(B).

The shear stiffness tests shall be performed on material from a random sample of the finished bearings in accordance with Subsection 1013-3.02(F).

Cold bonding of individual laminated pads and peel strength tests shall be performed in accordance with Subsection 1013-3.02(G).

1013-3.02 Testing Requirements:

(A) Ambient Temperature Test on the Elastomer:

The elastomer used shall at least satisfy the limits prescribed in Table A for durometer hardness, tensile strength, and ultimate elongation. The bond to the reinforcement, if any, shall also satisfy the bond requirements in Subsection 1013-2.03 or 1013-2.04 and shall be performed in accordance with ASTM D429 Method B. The shear modulus of the material shall be tested at 73 degrees F using the apparatus and procedure described in Annex A of ASTM D4014. It shall fall within 15 percent of the specified value.

(B) Heat Resistance Tests on the Elastomer:

The elastomer used shall at least satisfy the limits prescribed in Table A for the change in durometer hardness, change in tensile strength, change in ultimate elongation, compression set and ozone.

(C) Low Temperature Tests on the Elastomer:

Grade 3 elastomer shall be subjected to low temperature brittleness tests (ASTM D746), instantaneous low temperature stiffness tests (ASTM D1043), and low temperature crystallization tests (ASTM D4014). Grades 0 and 2 elastomers shall be subjected to instantaneous low temperature stiffness tests (ASTM D1043). The tests shall be performed in accordance with the requirements of Table A and the compound shall satisfy all limits for its grade.

(D) Visual Inspection of the Finished Bearing:

Every finished bearing shall be inspected for compliance with dimensional tolerances and for overall quality of manufacture. In steel reinforced bearings, the edges of the steel shall be protected everywhere from corrosion.

(E) Short-Duration Compression Tests on Bearings:

The bearing shall be loaded in compression to 1.5 times its maximum design load. The load shall be held constant for 5 minutes, removed, and reapplied for another 5 minutes. The bearing shall be examined visually while under the second loading. If the bulging pattern suggests laminate parallelism or a layer thickness that is outside the specified tolerances, or poor laminate bond, the bearing shall be rejected. If there are three or more separate surface cracks that are greater than 0.08 inches wide and 0.08 inches deep, the bearing shall be rejected.

(F) Long-Duration Compression Tests on Bearings:

The bearing shall be loaded in compression to 1.5 times its maximum design load for a minimum period of 15 hours. If, during the test, the load falls below 1.3 times the maximum design load, the test duration shall be increased by the period of time for which the load is below this limit. The bearing shall be examined visually at the end of the test while it is still under load. If the bulging pattern suggests laminate parallelism or a layer thickness that is outside the specified tolerances, or poor laminate bond, the bearing shall be rejected. If there are three or more separate surface cracks that are greater than 0.08 inches wide and 0.08 inches deep, the bearing shall be rejected.

(G) Shear Modulus Tests on Material From Bearings:

The shear modulus of the material in the finished bearing shall be evaluated by testing a specimen cut from it using the apparatus and procedure described in Annex A of ASTM D4014, or a comparable nondestructive stiffness test may be conducted on a pair of finished bearings. The shear modulus shall fall within 15 percent of the specified value. If the test is conducted on finished bearings, the material shear modulus shall be computed from the measured shear stiffness of the bearings, taking due account of the influence on shear stiffness of bearing geometry and compressive load.

(H) Bond and Peel Strength Tests:

Cold bonding between individual laminated pads, if used, shall be tested in accordance with the requirements of California Test 663.

The peel strength test shall be performed in accordance with ASTM D429 Method B for both fabric and steel reinforced pads.

1013-4 Installation:

Bearings shall be placed on surfaces that are plane to within 1/16 inch and horizontal to within 0.01 radians. Exterior plates of the bearing shall not be welded unless at least 1 1/2 inches of steel exists between the weld and the elastomer. In no case shall the elastomer or the bond be subjected to temperatures higher than 400 degrees F.