COPIES OF THESE
STANDARD SPECIFICATIONS FOR
CONSTRUCTION OF PUBLIC IMPROVEMENTS,
CONTRACT PROJECTS
MAY BE OBTAINED FROM THE OFFICE OF THE CITY ENGINEER
CITY OF HUNTSVILLE, P. O. BOX 308, HUNTSVILLE, ALABAMA 35804-0308

PRICE PER MANUAL $25.00
FOREWORD

THIS BOOK HAS BEEN PREPARED TO PROVIDE A COMPILATION OF STANDARD SPECIFICATIONS FOR INSERTION BY REFERENCE TO THE DEPARTMENT CONSTRUCTION CONTRACTS AND PROJECTS.

INCORPORATED INTO THESE SPECIFICATIONS ARE SECTIONS FROM THE STATE OF ALABAMA HIGHWAY DEPARTMENTS STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, 1989 EDITION.

THE REQUIREMENTS IN THESE SPECIFICATIONS MAY BE REVISED OR AMENDED FROM TIME TO TIME BY SUPPLEMENTAL SPECIFICATIONS OR BY SPECIAL PROVISIONS APPLICABLE TO THE SPECIFIC CONTRACT OR PROJECT.
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STANDARD SPECIFICATIONS 1991 EDITION

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10.01 Definitions

Wherever the following terms or abbreviations (or pronouns in place of them) are used in these Specifications the intent and meaning shall be interpreted as follows:

(a) ABBREVIATIONS.
A.G.C. The Associated General Contractors of America, Inc.
A.H.D. Alabama Highway Department
A.I.A. American Institute of Architects
A.N.S.I. American National Standards Institute
A.R.A. American Railway Association
A.R.B.A. The American Road Builder's Association
A.R.E.A. American Railway Engineering Association
A.S.C.E. American Society of Civil Engineers
A.S.L.A. American Society of Landscape Architects
A.S.T.M. American Society for Testing and Materials
A.W.P.A. American Wood Preservers Association
A.W.S. American Welding Society
A.W.W.A. American Water Works Association
F.H.W.A. Federal Highway Administration
F.S.S. Federal Specifications and Standards, General
I.M.S.A. International Municipal Signal Association, Inc.
I.T.E. Institute of Transportation Engineers
L.V.D. Laboratory Vibrated Density
N.E.C. National Electric Code
N.E.M.A. National Electrical Manufacturers Association
S.A.E. Society of Automotive Engineers
U.L. Underwriters' Laboratories, Inc.

(b) TERMS.
Acceptance. The formal acceptance of the subdivision and all public improvements by the City of Huntsville upon the completion of all improvements in conformance with all City of Huntsville regulations and specifications.
Acceptance Plan. A prescribed method of sampling, measuring and testing together with criteria for the acceptability of a lot of material or construction.
Additive. A substance or agent added in small amounts to a basic ingredient of a mixture prior to mixing.
Article. An immediate subheading of a section of these Specifications consisting of Subarticles, Items, Sub-items and/or paragraphs which set forth details and requirements essential or necessary to form the Specifications. Specifications are divided into Divisions, Divisions into Sections, Sections into Articles, Articles into Subarticles, Items, Sub-items and paragraphs.

Backfill. Material used to replace or the act of replacing material removed during construction; also may denote material placed or the act of placing material adjacent to structures.

Back Slope. The sloping surface of a cut, of which the downward inclination is toward the roadbed.

Base Flood. The flood having a one percent chance of being equalled or exceeded in any given year.

Base. The layer or layers of specified materials of designed thickness placed on a subbase or a subgrade to support a pavement or surface.

Binder Layer. The lower layer of the surface, consisting of a plant mix of graded aggregate (generally open graded) and bituminous material.

Bituminous Concrete. A designed combination of dense graded mineral aggregate filler and bituminous cement mixed in a central plant, laid and compacted while hot.

Bluff. An abrupt vertical change in topography of more than ten (10) feet with an average slope steeper than two (2) feet of rise for one (1) foot of horizontal travel.

Borrow. Suitable material from sources outside the roadway prism, used primarily for embankments.

Bridge. A structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and have a length measured along the center of roadway of more than 20 feet between under-copings of abutments or extreme outside limits of the structure for multiple boxes.

Bridge Length. The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present; otherwise, end to end of the bridge floor; but in no case less than the total clear opening of the structure.

Bridge Roadway Width. The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or guard timber risers.

Building. Any structure built for the support, shelter, or enclosure of persons, animals, chattels, or movable property of any kind.

Bypass. An arterial highway that permits traffic to avoid part or all of an urban area.

Calendar Day. Every day shown on the calendar, beginning and ending at midnight. Sundays and holidays included.

Cave. Any natural subterranean cavity that is at least fifty feet in length and/or depth, or that contains obligatory cavernicalous fauna (animals obliged to live underground). The word "cave" includes, but is not limited to, cavern, pit, pothole, well (natural), sinkhole, and/or grotto.

City. City of Huntsville, Alabama.

Civil Engineer. An engineer whose training or occupation is in the practice of civil engineering and who is a Registered Professional Engineer in the State of Alabama.

Civil Engineering. The application of the knowledge of the forces of nature, principles of mechanics and the properties of materials to the evaluation, design and construction of civil works for the beneficial use of mankind.

Colluvium. Any soil, residuum, unconsolidated deposit, rock and debris, or combination thereof, that is affected by the force of gravity such that through time
it moves down slope until it reaches a permanent state of equilibrium between gravitational stress and material strength.

**Construction Joint.** A joint made necessary by a prolonged interruption in the placing of concrete.

**Contract.** A binding agreement between the Owner/Developer and the Contractor for the construction of the work.

**Contract Bonds.** The approved bonds furnished and executed by the Contractor and his surety to guarantee completion of the contract in accordance with its terms.

**Contract Payment Bond.** The bond furnished by the Contractor and his surety to guarantee payment of the debts covered by the bond.

**Contract Performance Bond.** The bond furnished by the Contractor and his surety to guarantee performance of the work in accordance with the contract.

**Contract Warranty.** The twelve month period guarantying the workmanship and materials.

**Contraction Joint.** A joint at the ends of a rigid slab to control the location of transverse cracking.

**Contractor.** The individual, partnership, firm, corporation, or any acceptable combination thereof.

**Controlling Item(s).** The current controlling item(s) or operation(s) includes any feature of the work considered at the time by the Engineer as essential to the orderly completion of the work and which, if delayed, will delay the time of completion of the contract.

**Culvert.** Any structure not classified as a bridge which provides an opening under the roadway.

**Cut.** Any artificial or mechanical act by which earth, sand, rock, or any other similar material is dug into, excavated, quarried, uncovered, removed, displaced, relocated or bulldozed and shall include the conditions resulting therefrom.

**Dense Graded Aggregate.** A well-graded aggregate so proportioned as to contain a relatively small percentage of voids.

**Department.** Engineer of Public Works Department as created by Ordinances of the City of Huntsville, Alabama.

**Detour.** A route provided for traffic to use in lieu of a regular route.

**Developer.** The owner of land proposed to be subdivided or his representative. Consent shall be required from the legal owner of the premises.

**Director.** Referred to herein as the Engineer of Public Works.

**Divided Highway.** A highway with separated roadways for travel in opposite directions.

**Dowel.** A load transfer element usually consisting of a plain round steel bar.

**Drainage Plane.** A plane for internal drainage of the roadbed, usually formed by a layer of water-permeable material.

**Easement.** Authorization by a property owner for the use by another, and for a specified purpose, of any designated part of his property.

**Embankment.** A structure of soil, soil-aggregate or broken rock between the embankment foundation and the subgrade.

**Embankment Foundation.** The material below the original ground surface the physical characteristics of which affect the support of the embankment.

**Employee.** Any person working on the project to which these specifications apply, and who is under the direction or control of, or receives compensation from the Contractor or Subcontractor.

**Engineer.** The Engineer of Public Works, acting directly or through his duly authorized assistants or representatives, who is responsible for engineering supervision of the construction.

**Engineer of Record.** The civil engineer registered and in good standing with the State Board of Registration for Professional Engineers and Land Surveyors of
Alabama and permitted to practice in the city and county, and who is originally responsible for coordinating and certifying as to the completeness and correctness of all information collected (by his/her efforts or those of his/her agents and/or subcontractors) and submitted for approval on behalf of the owner. In the event that the original engineer of record should change, all subsequent engineers of record shall be required to recertify all previously submitted documents and thereby accept responsibility for completeness and correctness of same. Should any subsequent engineer of record refuse to accept said responsibility, all applicable documents shall be deemed null and void and shall be required to be resubmitted with proper certification as outlined in the Subdivision Regulations of the City of Huntsville, Alabama.

Equipment. All machinery and equipment, together with the necessary supplies for operation and upkeep, maintenance, and protection, and also tools and apparatus necessary for the proper construction and acceptable completion of the work.

Erosion. The wearing away of the ground surface as a result of the movement of wind, water and/or ice.

Excavation. Any artificial or mechanical act by which earth, sand, rock or any other similar material is dug into, cut, quarried, uncovered, removed, displaced, relocated or bulldozed and shall include the conditions resulting therefrom.

Existing. The physical status as of the date of the Contractor's bids of any structure, base, surface, subgrade, road, bridge, detour, or other unit affected by a particular project or designated street.

Expansion Joint. A joint located to provide for expansion of a rigid slab, without damage to itself, adjacent slabs, or structures.

Fault. A fracture surface or fracture zone along which one side has been offset relative to the other.

Faulting. Differential vertical displacement of rigid slabs at a joint or crack.

Fill. Any artificial or mechanical act by which earth, sand, gravel, rock or any other material is placed, pushed, dumped, pulled, transported or moved to a new location above the natural surface of the ground or on top of the stripped surface and shall include the conditions resulting therefrom. The difference in elevation between a point on the original ground and a designated point of higher elevation of the final grade. The material used to make a fill.

Final Plat. A plat of a tract of land which meets the requirements of these regulations and is in the form for recording in the office of the Probate Judge of the county in which the subdivision is located.

Flagman. An individual with a flag, lantern, or other approved signaling device, whose duty is to signal vehicular traffic to: (1) come to a stop, (2) alter its speed and/or course, or (3) receive other instructions with reference to highway routes and their condition.

Flexible Pavement. A pavement structure which maintains intimate contact with and distributes loads to the subgrade and depends upon aggregate interlock, particle friction, and cohesion for stability.

Floodway. The channel of a river or other water course and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

Floodway Fringe. The area of the flood plain lying outside the floodway but still subject to inundation by waters of the base flood.

Frontage Road. A local street or road auxiliary to and located generally on the side of an arterial highway, for service to abutting property and adjacent areas and for control of access to the highway.

Front Slope. The sloping surface of an embankment or roadway side ditch of which the downward inclination is away from the roadbed.
Geotechnical Engineer of Record. A professional engineer registered in the State of Alabama with specific expertise in the science of soil mechanics.

Grade Separation. A structure, with its approaches, which provides for highway traffic to pass without interruption over or under a railway, street, or another highway.

Highway, Street or Road. A general term denoting a public way for purpose of vehicular travel, including the entire area within the right of way.

In Place. A term to denote that the unit price covers compensation for the item complete in place including all costs incidental to procurement, handling, hauling, and processing the item (including water) as required. The item will be measured and paid for in the manner provided in applicable sections of these specifications.

Inspector. The Engineer's authorized representative assigned to make detailed inspection of the work.

Interchange. A system of interconnecting roadways in conjunction with one or more grade separations, providing for the movement of traffic between two or more roadways on different levels.

Intersection. The general area where two or more highways join or cross, within which are included the roadway and roadside facilities for traffic movements in that area.

Joint. A designed vertical plane of separation or weakness.

Laboratory. Any testing laboratory which may be designated by the Engineer of Record, Design Engineer, or City Engineer.

Leveling Course. The layer of material placed on an existing surface to eliminate irregularities prior to placing an overlaying course.

Load Transfer Device. A mechanical means designed to carry loads across a Joint.

Local Road or Street. A street or road primarily for access to residence, business, or other abutting property.

Longitudinal joint. A joint normally placed between traffic lanes to control longitudinal cracking.

Lot. A uniquely defined quantity of material from a single source, or homogeneous segment of construction, on which decision is made for acceptance.

Major Street. An arterial street with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

Materials. Any substances specified for use in the construction of the project and its appurtenances.

Material Vendor. A corporation, firm or individual who sells or rents supplies, equipment, or materials to a Contractor or Subcontractor or whose materials are prepared away from the construction premises and are delivered in final form to the construction site; such delivery being merely incidental to the sale. Material vendor must be a separate legal entity with independent investment in facilities and equipment and an independent business organization and operation, exercising a prerequisite degree of independent initiative, judgment, and foresight. A corporation, firm or individual which establishes a temporary plant or facility of any kind on or near a project for the purpose of furnishing material for that project only will not be considered a "material vendor" but will be considered a "Subcontractor" as defined in these specifications.

Mayor. Chief Administrative Officer of the City of Huntsville, Alabama.

Median. That portion of a divided highway separating the traveled ways for traffic in opposite directions.

Median Lane. A speed-change lane within the median to accommodate left turning vehicles.

Original Ground. The ground surface just prior to the initiation of the proposed work.
Parking Lane. An auxiliary lane primarily for the parking of vehicles.

Pavement Structure. The combination of subbase, base, and surface placed on a subgrade to support the traffic load and distribute it to the roadbed.

Plans. The drawings, which show the location, character, dimensions, and details of the prescribed work, including layouts, profiles, cross sections, and other details or reproductions thereof.

Prime Coat. An application of a low viscosity liquid bituminous material to coat and bind mineral particles preparatory to placing a base or surface course.

Profile Grade. The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the contract.

Project. The specified section of the street or easement together with all appurtenances and construction to be performed thereon.

Questionnaire. The specified forms on which the Contractor shall furnish required information as to his ability to perform and finance the work.

Ramp. A connecting roadway between two intersecting highways, generally at a highway separation, or a sloping driveway giving access to a highway.

Random Sample. A small part of a lot which is used to represent the whole, so chosen that each portion of the lot has an equal probability of being selected.

Reinforcement. Steel embedded in a rigid pavement slab and in concrete structures to resist tensile stresses and detrimental opening of cracks.

Reprocessing. The renewal of an existing surface by scarifying, remixing with or without additional material, and relaying.

Resurfacing. The placing of one or more new courses on an existing surface.

Right of Way. A strip of land occupied or intended to be occupied by a street, off-street pedestrian walkway, railroad, road, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer main, or for another special use. The usage of the term "right-of-way" for land platting purposes shall mean that every right-of-way hereafter established and shown on a final plat is to be separate and distinct from the lots or parcels adjoining such right-of-way and not included within the dimensions or areas of such lots or parcels. Rights-of-way intended for streets, crosswalks, water mains, sanitary sewers, storm drains, or any other use involving maintenance by a public agency shall be dedicated to public use by the maker of the plat on which such right-of-way is established.

Rigid Pavement. A pavement structure which distributes loads to the subgrade having as one course a portland cement concrete slab of relatively high bending resistance.

Rigid Slab. A section of portland cement concrete pavement bounded by joints and edges, designed for continuity of tensile stress.

Road. A general term denoting a public way for purposes of vehicular travel including the entire area within the right of way.

Roadbed. The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulder. The top surface of the roadbed is the subgrade.

Roadbed Material. The material below the subgrade in cuts and embankments and in embankment foundations extending to such depth as affects the support of the pavement structure.

Roadside. A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

Roadside Improvement or Development. Those items necessary to the complete highway which provide for the preservation of landscape materials and features, the rehabilitation and protection against erosion of all areas disturbed by construction.
through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

Roadway. The portion of the highway within the limits of construction. A highway may have more than one roadway.

Seal Coat. A thin treatment consisting of bituminous material, usually with cover aggregate, applied to a surface course. The term includes but is not limited to sand-seal, chip-seal, slurry seal, contrast seal and fog seal.

Shop Drawings. Fabrication plans for any part of the work including, but not limited to, precast concrete items, structural steel items, or other metal items, and connections thereof which the Contractor is required to submit to the Engineer.

Sidewalk. That portion of the roadway primarily constructed for the use of pedestrians.

Sinkhole. Depression formed in soluble rock by the action of subterranean water and is a potential point of significant groundwater recharge.

Site. Any lot or parcel of land or contiguous combination thereof, under the same ownership, including joint ownership, where clearing and/or earthwork is proposed, performed or permitted.

Skew Angle - Skew. The complement of the acute angle between two centerlines which cross; for a structure centerline, skew right means the right side of the structure is ahead; skew left means the left side of the structure is ahead.

Soil Survey. The exploration of the site of the proposed improvements by borings and tests or other methods and the preparations of soil profiles showing the significant layers, bedrock, water table, and other features.

Solution Feature. Any cave, sinkhole, or solutionally enlarged fracture, joint, fault, bedding contact, or other specific natural feature that was produced from solution of soluble rocks.


Specifications. The compilation of provisions and requirements of prescribed work.

Springs. Locations on the land surface where the water table is exposed as on a valley side. The position of the water table changes seasonally, thus some springs flow only during wet weather or the wet season. Perennial springs flow year round.

Stabilization. Modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness, and resistance to weathering or displacement.

Standard Drawings. Drawings approved for repetitive use, showing details to be used where appropriate.


Station. One hundred linear feet measured horizontally.

Street. A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way applicable to travel ways in urban areas.

Structures. Bridges, culverts, basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other features which may be encountered in the work and not otherwise classed herein.

Subbase. A layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base or rigid pavement.
Subdivider. The person(s), firm(s), or corporation(s) owning land in the process of creating a subdivision or having completed a subdivision of said land. Includes any agent of the subdivider.

Subdivision. The division of a lot, tract or parcel of land into two or more lots, plats, sites or other divisions of land for the purpose, whether immediate or future, of sale or of building development or if a new street is involved. Such terms include resubdivision and, when appropriate to the context, relates to the process of subdividing or to the land or territory subdivided.

Subgrade. The top surface of the roadbed, upon which the pavement structure and shoulders are constructed.

Subgrade Treatment. Modification of roadbed material by stabilization.

Substructure. All of that part of the structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames; including backwalls, wingwalls, and wing protection railings.

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

Superstructure. All that part of a structure above, and including, the bearings of simple and continuous spans, skewbacks of arches and top of footings of rigid frames; excluding backwalls, wingwalls, and wing protection railings.


Surety. The corporation, partnership or individual other than the Contractor executing a bond furnished by the Contractor, licensed under the laws of Alabama.

Surface. One or more layers of a material designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion and the disintegrating effects of climate. The top layer is generally called the wearing layer and the lower layer the binder layer.

Surface Treatment. One or more applications of bituminous material and cover aggregate or thin plant mix on an old pavement or any element of a new pavement structure.

Tack Coat. An application of bituminous material to an existing surface to provide bond with a superimposed course.

Temporary Structure. Any structure required to maintain traffic during construction of the work, which will be dismantled if required when the work is completed.

Through Street. Every street or portion thereof on which vehicular traffic is given preferential right of way, and at the entrances to which vehicular traffic from intersecting streets is required by law to yield right of way to vehicles on such through highway in obedience to either a stop sign or a yield sign, when such signs are erected.

Tie Bar. A deformed steel bar or connector imbedded in the concrete across a joint to prevent separation of abutting slabs.

Traffic Lane. The portion of a traveled way for movement of a single line of vehicles.

Traveled Way. The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Typical Section. That cross section established by the plans which represents in general the lines to which the Contractor shall work in the execution of his contract.

Warranty. The twelve month period following the date of acceptance of improvements by the City of Huntsville guarantying the design, workmanship, and materials.

Work (The Work). Work shall mean the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all duties and obligations.
(c) AVOIDANCE OF REPETITION.

Wherever the terms "contemplated", or "required", "directed", "authorized", "considered necessary", "permitted", "approved", "suitable", "unacceptable", "designated", or terms of like import are used in these Specifications, they shall be construed to mean "to" or "by the Engineer" or "Director", unless context clearly indicates otherwise.
SECTION 20
PROPOSAL REQUIREMENTS AND CONDITIONS

20.01 Notice to Contractors (Advertisement).

(a) GENERAL.

Bids will be invited in a "Notice to Contractors," advertised as required by State laws. The advertisement will contain the date, time and place of opening bids; a description of the work; contract time; approximate quantities; a stipulation as to the character and the amount of the proposal guaranty; and instructions to the bidders as to access to plans and specifications. The Notice to Contractors will become part of the contract if award is made.

(b) QUANTITIES.

The quantities shown on the sheet headed "Notice to Contractors" and mailed to prospective bidders are to be considered as approximate only and may be amended in the proposal to include additional quantities or additional items or to decrease quantities or to exclude items of work before bids are to be received. This information sheet is to advise prospective bidders informally as to the type of work and approximate quantities involved.

20.02 Qualification of Bidders.

(a) PREQUALIFICATION.

Proposal forms will be issued only to prospective bidders who have qualified with the Department and have a valid certification of qualification under the terms of existing Ordinances of the City of Huntsville or State laws. All applicants for qualification shall file with the Engineer of Public Works a complete confidential financial statement, equipment questionnaire, and experience questionnaire under oath, on forms that will be furnished by the Department on request. To insure sufficient time for consideration, the applicant must have these forms properly filled out and submitted to the Department at least 14 days prior to the date of opening bids on which the applicant desires to submit proposals. Forms received at a later date will be considered whenever practicable. If the applicant is a corporation organized in a State other than Alabama, it shall furnish a certificate from the Secretary of State showing that it is qualified to transact business in Alabama. A corporation from another State can be issued a certificate valid for bidding only on projects involving Federal participation, without the certificate from the Secretary of State. Prospective bidders will not be prequalified who have a corporate officer or principal owner, as listed in the certification of incorporation, who is a corporate officer or owner of another firm which is presently disqualified by the Department.

(b) DISQUALIFICATION.

The Department reserves the right to disqualify or refuse to issue a proposal to a prospective bidder for the following reasons:

1. Lack of competency and adequate machinery, plant and other equipment as revealed by the financial statement and experience questionnaires required.
2. Uncompleted work which, in the judgement of the Department, might hinder or prevent the prompt completion of additional work if awarded.

3. Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of issuance of proposals.

4. Failure to comply with any pre-qualification regulations of the Department.

5. Default, as defined in Section 80.12, under a previous contract, or unsatisfactory work of any nature on previous work.

6. Actions in bidding or subcontracting which have the effect of limiting competition and violating the competitive bid process, or if any partner, association member, corporate official or individual owner, respectively, of any firm submitting a bid has been convicted of or entered into a guilty plea to (in any legal jurisdiction of the United States or any of the various States), Federal or State crimes that involve the restraint of trade or limiting competition in any manner.

Disqualification will be for an indefinite period, but may be reviewed each six months, if requested in writing by the disqualified firm. In addition to the above, disqualification for unsatisfactory progress of an ongoing contract will be administered as outlined in Subsection 80.04(c).

Disqualification applies to bidding as a prime contractor or doing any subcontract work for a prime contractor.

(c) REQUALIFICATION.

If a prospective bidder is disqualified from bidding under any of the provisions of these specifications, it will be required of the prospective bidder to again prequalify under the provisions of Subsection 20.02(a) above. When requalified, the qualification will be issued subject to continued examination and evaluation of the contractor's performance. The Contractor will be in probationary status for a period of one year following his requalification with the Department. If, during the period of probation, the Contractor is disqualified under any of the provisions of these Specifications, the Department may suspend the contractor's right to requalify for a maximum period of two years.

20.03 Contents of Proposal Form.

(a) GENERAL.

The Department will furnish bidders a blank proposal form showing the location and description of the work contemplated, the approximate estimate of the various quantities of the pay items of the work to be performed and materials to be furnished, and the amount of the proposal guaranty. The proposal form also will contain the special sheets headed "Notice to Contractors", "Supplemental Specifications" (if any), "Special Provisions" (if any), and any requirements that vary from, or are not included in, the approved standard Engineer of Public Works Department Specifications. All papers bound with or attached to the proposal form are a necessary part thereof and must not be detached or altered. The plans, specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not. The prospective bidder will be required to pay the Department the sum stated in the Notice to Contractors for each copy of the proposal form and each set of plans.
(b) CORRECTIONS.
Corrections and minor changes in the proposal form or plans may be
put into effect by written notice from the Director, notifying all prospective
bidders to whom proposal forms have been previously issued.

20.04 Interpretation of Quantities in Bid Schedule.

The quantities appearing in the bid schedule are approximate only
and are prepared for the comparison of bids. Payment to the Contractor will be
made only for the actual quantities of work performed and accepted or
materials furnished in accordance with the contract. The scheduled quantities
or work to be done and materials to be furnished may each be increased,
decreased, or omitted as hereinafter provided.

20.05 Examination of Plans, Specifications, Special Provisions and
Site of Work.

Before submitting a proposal, bidders shall examine carefully the
site of the proposed work, the general and local conditions, the proposal form,
standard specifications, supplemental specifications, special provisions, and
the bid bond form, and it is mutually agreed that the submission of a proposal
shall be prima facie evidence that the bidder has made such examination and
has judged for and satisfied himself as to the conditions to be encountered in
performing the work, and to the requirements of plans, standard
specifications, supplemental specifications, special provisions, contract, and
bonds. No adjustments or compensation will be allowed for losses caused by
failure to comply with this requirement. Boring logs and other records of
subsurface investigations are available for inspection by bidders. It is
understood that such information was obtained and is intended for City design
and estimating purposes only. It is made available to bidders that they may
have access to identical subsurface information available to the City and is not
intended as a substitute for personal investigation, interpretations and
judgement of the bidders. Bidders are advised that the City disclaims
responsibility for any opinions, conclusions, interpretations, or deductions
that may be expressed or implied in any of the information presented or made
available to bidders; it being expressly understood that the making of
deductions, interpretations, and conclusions from all of the accessible factual
information is the bidder's sole responsibility.

20.06 Preparation of Proposal.

(a) PROPOSAL FORM.
The bidder's proposal must be submitted on the complete original
proposal form furnished him by the Department. Unless otherwise provided
in the proposal, joint venturers may submit a proposal for a joint venture of
qualified bidders on a proposal form issued to one of them, provided each
venturer has taken out a proposal and provided the proposal is signed by each
colunteer.

(b) DETAILS.
On the proposal form the bidder shall enter in words and numbers a
unit price and the extended amount bid (unit price X quantity) in the
appropriate column for each bid item, exclusive of those items for which a
fixed contract unit price and extension amount are shown. On "lump sum"
items an entry shall be shown in the amount bid column. If a bidder wishes to
bid an item "free", then he shall enter 0 (zero) in both the unit price column and amount bid column. After all extensions are made, the bidder shall total the extended amounts of the bid items and show his total bid amount in the appropriate place on the proposal form. Where alternate designs are provided by the plans and proposal, the bidder shall enter prices only on the items for the design alternate that will be most economical for him to construct, and other bid items that will be common for all alternates. If any item on the proposal form permits a choice between alternate specified types of materials, the bidder shall indicate by a check mark the type of material he proposes to use. If more than one type or none is checked, the Department will make the selection. All figures shall be legibly shown in ink or typed. Any interlineation erasure or other alteration of a figure shall be initialed by the signer of the proposal. The Department will check the extension of each item given in the proposal and correct all errors and discrepancies. In case of a discrepancy between a unit bid price and the extension amount, the unit price shall govern. The sum of the extension amounts will be the contract bid price.

(c) SIGNING.

The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by one or more officers of a corporation or by an agent of the Contractor legally qualified and acceptable to the City. If the proposal is made by an individual, his name and post office address must be shown; by a partnership, the name and post office address of each partnership member must be shown; as a joint venture, the name and post office address of each member or officer of the firms represented by the joint venture must be shown; by a corporation, the name of the corporation and the business address of its corporate officials must be shown. The proposal bid bond, if bid bond is tendered, shall be properly signed by the bidder and the surety.

(d) COLLUSION.

Bidders will be required to execute a collusion affidavit conforming to the requirements of the laws and regulations cited in Section 70.05. Failure to execute an affidavit when such is a part of the proposal shall be cause for rejection of the bid. If there is any reason for believing that collusion exists among the bidders, any or all proposals may be rejected, and those participating in such collusion may be barred from submitting bids on the same or other work with the Department until they have been reinstated as a qualified bidder. Only the affidavit form provided in the proposal will be acceptable.

20.07 Irregular Proposals.

(a) GENERAL.

Proposals will be considered irregular and will be rejected if they contain any omissions, alteration of form, additions not called for, incomplete bids (includes failure to enter a unit bid price on a bid item or, in the case of an alternate, the alternate being bid by the Contractor), interlineations, erasures or alterations not initialed by the person signing the proposal, or other irregularities of any kind. Proposals may be rejected at any time prior to the execution of the contract by the Director. Any bidder using the same or different names for submitting more than one proposal upon any project will be disqualified from further consideration on that project. Evidence that any
bidder is interested, as a principal, in more than one proposal for work contemplated (for example bidding in a partnership, as a joint partnership or association, and as a partnership, association, or individuals) will cause the rejection of any such proposal. A bidder, however, may submit a proposal as principal and as a Subcontractor to some other principal, or may submit a proposal as a Subcontractor to as many other principals as he desires, and by so doing will not be liable to disqualification in the intent of these Specifications.

(b) UNBALANCED BIDDING.

In order that no party of the contract will be financially hurt over changes in the estimated quantities, a proposal may be rejected if any of the unit prices are obviously unbalanced. The Department will decide whether any unit prices are unbalanced either excessively above or below a reasonable cost analysis value determined by the Engineer, particularly if these unbalanced amounts are substantial and contrary to the interest of the Department.

20.08 Combination Bids.

Combination of bids for two or more projects shall be submitted on the proper forms. A separate and complete bid on the regular proposal forms for each project shall be included in the combination bid, and only projects on which individual bids are submitted will be considered as in the combination. Combination bids which state that a lump sum shall be deducted from the final estimate or retained percentage, or that a reduction in prices shall be made upon a percentage basis, will not be accepted. A statement in writing, submitted with a bid, which states that award of a job is contingent on being awarded another job will not be accepted and the bid with such letter is submitted shall be considered irregular and will be rejected. However, the bidder will be allowed to combine bids in the following manner:

1. By stating in writing that he is bidding on "All or None" of the work in his proposals, which is preferable, or

2. By specifying in writing any two or more projects that he wishes to submit for consideration in combination (in this case the bidder will be permitted to specify the reduction he will make in the unit price or one or more of the items in any of all of the proposals if awarded the combination; however, the bidder will not be permitted to make a reduction in any unit price that may be fixed by the Department in the proposal), or

3. By stating in writing that he is bidding on a number of projects or proposals but desires to be awarded work not to exceed a specified total amount or a specified number of contracts (in this case the City will select from his proposals those for award to him which are most advantageous to the City within his specified total amount or specified total number or contracts).

20.09 Proposal Guaranty.

No proposal will be considered unless accompanied by a properly certified check or bid bond of the prescribed form made available to the Director in the amount indicated in the notice to Contractors. The certified check shall have the name of the company submitting the bid and the project number on the check.
20.10 Delivery of Proposals.

Each proposal for each contract shall be placed, together with the proposal guaranty, in a sealed envelope on the outside of which is written in large letters "Proposals for Work" and so marked as to indicate the project name, project number, bidder name, and State license number. Proposals will be received by the Director or his representative unless otherwise provided, until the hour and date set in the notice to Contractors for the opening thereof. No proposal will be considered which has not been received prior to the hour and date set for the opening of bids. Proposals received after that time will be returned.

20.11 Withdrawal or Revision of Proposals.

A bidder may withdraw or revise a proposal after it has been deposited with the Department provided the request for such is received by the Department in writing or by telegram before the time set for opening proposals. No proposal can be withdrawn, modified or corrected after the hour set for opening such proposals.

20.12 Public Opening of Proposals.

Proposals will be publicly opened and bid totals read aloud at the place, time and date indicated on the notice to Contractors. Bidders or their authorized agents are invited to be present.

20.13 Blank.

20.14 Familiarity with Laws and Ordinances.

(a) GENERAL.

Bidders shall familiarize themselves with and shall comply with all Federal and State laws and local laws, ordinances, and regulations which may directly or indirectly affect the work or its prosecution, persons engaged in or employed on the work, and the equipment and tools used in the work. No adjustments or compensations will be allowed for losses caused by failure to comply with this requirement.

(b) LABOR RATES.

The bidders should investigate and the Contractor shall abide by any orders issued by the Wage Adjustment Board or any other Federal agency having jurisdiction over wage rates.

20.15 Material Guarantee.

The successful bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the work together with samples, which samples may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.
SECTION 30
AWARD AND EXECUTION OF CONTRACT

30.01 Consideration of Proposals.

After the proposals are opened and read, they will be compared on the basis of the summation of the products of the approximate quantities shown in the bid schedule by the unit bid prices. The results of such comparisons will be available to the public. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern. The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if, in the judgment of the awarding authority, the best interest of the City will be promoted thereby. A proposal will not be considered unless signed by the bidder or his authorized agent and accompanied by certified check or properly signed bid bond as required by law. The Department will not consider for award any bid proposals submitted by any contractor, and will not consent to subletting any portions of the contract to any subcontractor, of a foreign country during any period in which such foreign country is listed by the United States Trade Representative as discriminating against U.S. firms in conducting procurements for public works projects. In addition, no product of any such listed country shall be permanently incorporated into the project. For the purpose of this specification, any contractor or subcontractor who is a citizen or national of a foreign country or is controlled directly or indirectly by citizens or nationals of a foreign country, shall be considered to be a contractor or subcontractor of such foreign country. The terms contractor and subcontractor also include any partner in a joint venture. Any product, except steel materials, of which fifty percent or more of its cost is attributable to production or manufacturing in a foreign country, shall be considered to be a product of such foreign country.

30.02 Award of Contract.

(a) GENERAL.

The award of the contracts, if to be awarded, will be made within thirty (30) calendar days after opening of proposals to the lowest responsible bidder whose proposals comply with the requirements of Section 20 and the invitation to bid (Notice to Contractors). Should no award be made within the thirty (30) days, all proposals will be rejected unless the successful bidder agrees in writing to a stipulated extension in the time limit for award. The successful bidder will be notified by telegram or letter mailed to the address shown on his proposal that his bid has been accepted and that he has been awarded the contract.

(b) BIDDER LOW ON MORE THAN ONE CONTRACT.

Should any responsible bidder be low on more contracts or work than he is qualified to handle under his certificate of qualification issued by the Department, the City reserves the right to select from his submitted proposals those for award to him which are most advantageous to the City. His other submitted proposals will not be considered in making the awards.
30.03 Cancellation of Award.

The Director reserves the right to cancel the award of any contract at any time before the execution of the said contract by all parties, without any liability against the City. He may reject the bid of the lowest bidder if any of the conditions for disqualifying as noted in Section 20.02 are found to exist at any time prior to the execution of the contract by all parties, and may, at his discretion, award to the second lowest bidder, when it is determined to be in the best interest of the City.

30.04 Return of Proposal Guaranties.

All proposal guaranties, except those of the 3 lowest bona fide bidders, will be returned without undue delay after proposals have been checked, tabulated, and the relation to the proposals established. The proposal guaranty of the 3 lowest bona fide bidders will be returned as soon as the contract bonds and the contract of the successful bidder have been properly executed and approved. When the award is deferred for a period of time longer than 15 days after the opening of the proposals, all proposal guaranties except that of the successful bidder will be returned. Should no award be made, all guaranties will be returned. Should the successful bidder agree in writing to a stipulated extension in the time limit for award, the Director may, at his discretion, permit the successful bidder to substitute a satisfactory bidder's bond if a certified check was submitted with his proposal as a proposal guarantee. The Director reserves the right to return all proposal guaranties by registered mail and his responsibility shall end upon the mailing thereof.

30.05 Requirements of Contract Bonds.

All bonds (with the exception of the Bid Bond) shall be submitted to the city, at least ten (10) days prior to the commencement of work under the contract.

(a) BID BOND

The bid bond shall be required as part of the bid or proposal submitted to the City on contracts for construction, alteration, maintenance, or repair of any public work or structure. The bid bond shall be in an amount equal to five percent (5%) of the amount of the bid or proposal, and shall be executed by a Surety Company licensed and admitted to do business in the State of Alabama, and acceptable to the City.

(b) PERFORMANCE BOND.

The bidder to whom the award is made shall, within 10 days after the prescribed forms have been presented to him for signature (i.e. after date of award), furnish and file with the Director an acceptable surety bond on the form included in the proposal in an amount equal to 100 percent of the contract bid price of the contract as awarded. Said bond shall be furnished by a surety company qualified and authorized to make such bonds in the State of Alabama, and countersigned by an authorized agent resident in the State who is qualified to execute such instruments. The bond shall have attached thereto power of attorney of the signing official unless such power of attorney is already on file in the office of the Department. In case of default on the part of the Contractor, all expense incident to ascertaining and collecting losses
suffered by the City under the bond, including engineering, direct administration, and legal services, shall be charged against the contract bond for performance of the work.

(c) LABOR, MATERIALS, SERVICES, INSURANCE, FEED STUFFS, OR SUPPLIES BOND.

In addition thereto, the bidder to whom the award is made shall, within the same 10 days, execute and file with the Director an acceptable surety bond payable to the City in an amount not less than 100 percent of the contract bid price, with the obligation that the Contractor shall promptly make payment to all persons furnishing him or them with labor, materials, feed stuffs, services, insurance, bond, or supplies for or in the prosecution of the work, and for the payment of reasonable attorneys fees, incurred by successful claimants or plaintiffs in suits on said bond.

(d) CONTINUOUS BOND COVERAGE.

Surety bonds shall continue to be acceptable to the Director throughout the life of the contract. In event the surety executing the bonds, although acceptable to the Director at the time of execution of the contract, subsequently becomes insolvent, bankrupt, unreliable, or otherwise unsatisfactory due to any cause which becomes apparent after the Director's initial acceptance of the bonds, then the Director will require that the Contractor replace the bonds with like bonds drawn on a surety company which is acceptable to the Director. In such event, all costs of the premium for the new bonds will be borne by the Contractor.

(e) MAINTENANCE BOND COVERAGE.

The maintenance bond shall provide security that the construction work will be maintained in good and workable condition for a period of one year after completion of the work and acceptance thereof by the City, and that all defects in the work, whether they are latent or apparent, that shall become known to the entity, or the contractor or anyone else for a period of one year after the completion of the work and acceptance thereof by the City, shall be required by the contractor.

30.06 Execution of contract.

The contract shall be executed by the bidder to whom award is made, on the form included in the proposal, and returned to the Director with satisfactory contract bonds within 10 days after the prescribed forms have been presented to him for signature (i.e. after date of award). Should extenuating circumstances prevail, the Director may grant an extension in time not exceeding 5 days for the return of the contract and bonds as provided herein and in Section 30.05.

30.07 Approval of Contract.

A period of thirty days will be allowed for execution and approval of the contract by the Mayor and City Council, after its presentation by the successful bidder, unless the successful bidder agrees in writing to a longer period. No contract is binding upon the City until it has been executed and approved by the Mayor and Council of the City. The date of the final execution
of the contract shall be the date on which it is signed by the Mayor and
President of the City Council.

30.08 Failure to Execute Contract.

Should the successful bidder or bidders to whom the contract is
awarded fail to execute a contract and furnish acceptable contract security as
provided by Sections 30.05, 30.06 and 30.07, the Director shall retain from the
proposal guaranty, if it be a certified check, or recover from the principal or
the sureties, if the guaranty be a bid bond, the difference between the amount
of the contract as awarded and the amount of the proposal of the next lowest
responsible bidder but not to exceed the total amount of the proposal guaranty
shall be so retained or recovered as liquidated damages for such default. Any
sums so retained or recovered shall be the property of the City. In the event of
the death of the successful bidder (if an individual and not a partnership or
corporation) between the date of the opening of the bids and the 30 days
following the date of award of the contract as allowed in Sections 30.05 and
30.06 for furnishing contract security and executing contract, the Director
will return the proposal guaranty intact to the estate of the deceased
successful bidder. When the successful bidder or bidders fail to execute a
contract and the contract is awarded to the next lowest bidder, the original low
bidder will be prohibited from doing any work on the contract, either as a
subcontractor or in any other capacity. The original low bidder will also be
prohibited from bidding on the project if it is readvertised for letting. These
restrictions shall apply to any other name under which the same person,
individual, partnership, company, firm, corporation, association, cooperative,
or other legal entity may be operating in which the principal owners are
involved. Failure by the Department to return to the successful bidder his
approved contract and to issue a work order as required by law shall be just
cause, unless both parties agree in writing to a stipulated extension in time for
issuance of a work order, for the successful bidder to withdraw his bid,
contract, and bonds, without forfeiture of certified check or bid bond.
SECTION 40
TRAFFIC CONTROL

40.01 Sequence of Construction for Handling Traffic Through The Work and Construction and Maintenance of Detours.

(a) GENERAL.

No street or section of street or bridge shall be closed to traffic and no construction operations that will for any reason render the street generally unsuitable for use of the traveling public shall be started without approval from the Huntsville Department of Transportation, the City Engineer, and until adequate provisions have been made to detour or by-pass the traffic in safety and comfort. Special reference is made to Section 70.07 "Public Convenience and Safety" and such is approved in writing by the Director. The Contractor's attention is directed to the possible existence of pipe lines or other public utilities which may be buried within the limits of the work or adjacent thereto and which may or may not be shown on the plans. He shall be responsible for and shall take all necessary precautions to protect and preserve any and all such existing drains, sewers, pipes, conduits, and other underground structures or parts thereof which may be affected by his operations on the work, and which, in the opinion of the City Engineer, may be properly continued in use without any changes. He shall assume full responsibility for reimbursing the owners for any damage or injury to properties or interference with their service which may result from any of his operations or negligence. Also, he shall be responsible for any damage to utilities above ground, regardless of their location, where such damage results from any of his operations or his negligence. Attention is directed to Subsection 70.11(b). The Contractor shall repair, replace, relocate, extend, reconstruct or make any other change in any subsurface sewer or drain encountered in the prosecution of the work. Where mail delivery service is to be maintained during construction mail boxes within the limits of operations shall be removed by the Contractor before work is begun and set temporarily where they will be accessible both to the mail carrier and the patron. As soon as the state of the work permits all mail boxes shall be reset by the Contractor in permanent locations in compliance with Postal Regulations. Mail boxes or supports that have been damaged by the Contractor shall be replaced at his expense. When the Contractor performs any operations after daylight hours, he shall provide and maintain, at his expense, sufficient artificial lighting to permit proper construction and inspection. The Contractor must have written permission to work after daylight hours from the City Engineer and such work shall otherwise be in compliance with all Ordinances of the City.

(b) SIGNS AND WARNING LIGHTS.

All signs, barricades, etc. used along the project shall be in accordance with the provisions of Section "G" of the AMUTCD, the plan details and the following: Posts shall be appropriately sized for the sign of either timber (treated or painted) of not less than 4" x 4" (Nom.) cross section or metal (min. 2 lbs. "U" channel or equivalent) so spaced to rigidly support the sign. All signs, barricades, drums or other devices intended for use in controlling traffic shall be in accordance with the requirements of section "G" of the AMUTCD and the detailed plans, with reflectorization as noted therein. Reflectorization shall be accomplished using materials meeting the requirements of Section 880.02. All barricades, drums, signs or other devices shall be kept clean, legible, and in their proper position at all times. Damaged, defaced or dirty signs or barricades shall be repaired or replaced.
immediately. The City Engineer will insure compliance by periodic inspections and require replacements or repair as deemed necessary. In addition to the requirements of Section 70.09, where particular hazardous conditions exist or traffic volumes warrant, or where there is serious interference from extraneous light sources and a reflectorized sign is not likely to be effective, the Traffic Engineer may require any or all signs and barricades to be illuminated. Illumination of signs, barricades, etc. shall be accomplished by the use of 100 watt or greater, incandescent or equivalent fluorescent electric light bulbs, shielded to protect the driver from glare and so located that the sign shape and message is clearly visible to the driver. Street or highway lighting by itself is not regarded as meeting illumination requirements.

(c) SEQUENCE OF CONSTRUCTION.
Unless otherwise provided by the plans approved by the City Engineer, the sequence of construction for the work shall be the Contractor's provided the following requirements are met to the satisfaction of the City Engineer:

1. Provides for the orderly construction of the project within the time limit provided by the Subdivision Regulations and permits.
2. Provides for the control of erosion, siltation, and dust from the project site.
3. Provides for handling of traffic through the work in accordance with the details noted in Subsection (d) of this Section.
4. Provides for the working out of minor drainage problems and details of temporary or permanent access as they are encountered.

(d) HANDLING OF TRAFFIC.
Unless otherwise provided, the Contractor shall keep the road open to all traffic while performing the required improvements. The Contractor shall keep the portion of the project being used by public traffic, whether it be through or local traffic, in such condition that traffic will be adequately accommodated. He shall furnish, erect and maintain, barricades, warning signs, delineators, flagmen and pilot cars in accordance with Section "G" of the "Alabama Manual of Uniform Traffic Control Devices for Streets and Highways". He shall also provide and maintain in a safe condition temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, residences, garages and farms. The Contractor shall bear all expense of maintaining the traffic over the section or road undergoing improvements and of constructing and maintaining such approaches, crossings, intersections, and other features as may be necessary. It will also restrict the movement of some units of construction equipment and make necessary the use of flagmen for directing the traffic and protecting the work. Flagmen shall wear either an approved uniform or vest of Fluorescent Orange color and be equipped with a red flag or Fluorescent material. Construction adjacent to existing pavement will require the use of special warning lights on equipment working adjacent to travel lanes to warn traffic. (Such lights shall be all purpose 360 degree - two sealed beams revolving type of 8 inch minimum height, amber colored, mounted so as to be readily seen by traffic at a safe distance.) Unless otherwise provided, the Contractor shall repave and maintain all parts of any existing road disturbed by his work.

(e) ROADS USED BY CONTRACTOR
Haul roads constructed by the Contractor for his convenience shall be constructed and maintained by him. When the Contractor hauls materials over any detour or public road or street, he shall so regulate his loads as required by Section 50.14. Damage to the road, street, or structure by the Contractor's equipment shall be prima facie proof that the capacity has been exceeded. The Contractor and his surety shall be responsible for any specific damage that may result to the road, street, or
structures from failure to observe regulations governing traffic thereon. Resulting
damage shall be repaired by the Contractor without delay, otherwise, it will be
repaired by the City and the expense billed to the Contractor.

The Contractor and his surety shall indemnify and hold harmless the City,
its agents, and employees for damages arising out of the use of city roads and streets.

40.02 Final Cleaning Up.

Upon completion and before work will be finally accepted, the Contractor
shall perform the following work: (1) He shall clear and remove from the right of
way and adjacent areas not owned by him, all falsework, equipment, surplus and
discarded materials, temporary structures, rubbish, debris, and all other
objectionable litter, and dispose of them in a satisfactory manner. (2) He shall not
remove barricades, warning and direction signs, until directed by the Traffic
Engineer. (3) He shall remove from the site of other operations such as pits, quarries,
stream channels, structures sites, and storage yards, all weeds, portions of trees,
discarded materials, machinery, temporary structures, and equipment and dispose of
them in a satisfactory manner. Depositing such material on abutting property or
adjacent to the right of way with or without the consent of the property owner, will
not be accepted as satisfactory disposal. However, he may be allowed temporarily to
store equipment, surplus material, usable forms, etc., in a neat manner on a well-kept
site near the job site. (4) He shall restore all property, public and private, damaged
incident to the prosecution of the work, to the same or like condition which existed
prior to the prosecution of the work, and shall leave the right of way and sites of
structures in a neat and presentable condition.

40.03 Maintenance of Roads and Detours.

(a) GENERAL.

The Contractor shall maintain at his expense, except as explicitly outlined
hereinafter in this Section, all detours and haul roads, and all roads, streets, bridges,
and intersections within the project limits. This includes, but is not limited to, haul
roads and detours constructed by the Contractor for his convenience. It also includes
damage to the road, street, or structure caused by the Contractor's equipment.

The Contractor shall regulate his loads as required by Section 50.14 and he
and his surety shall be responsible for any specific damage that may result to the
road, street, or structures from failure to observe regulations governing traffic
thereon, or for negligence on his part.

The Contractor shall perform required repairs without delay; otherwise,
the City will perform the repairs and the cost thereof will be billed to the Contractor.
The Contractor and his surety shall indemnify and hold harmless the City, its agents,
and employees, from damages arising from the use of roads and streets.

(b) DETOURS.

Detours approved by the City Engineer shall be constructed and maintained
by the Contractor.

(c) HAUL ROADS.

Should the Contractor wish to use a city street as a haul road, he shall meet
with the local governing body, review the condition of the facility, and reach an
agreement as to the maintenance thereof.
50.01 Authority of the Engineer of Record.

The Engineer of Record will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor. The Engineer of Record shall have the authority to suspend the work wholly or in part due to failure of the Contractor to correct conditions unsafe for the workmen or the general public; failure to carry out provisions of the contract; failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions unsuitable for prosecution of the work; or for any other condition or reason deemed to be in the public interest.

The Engineer of Record will determine the amount, quantity, character, classification and quality of the several kinds of work performed and materials furnished. Explanations concerning the meaning of the of the Plans, Specifications and Contract, all directions necessary to complete or make definite the Plans, Special Provisions, Specifications or Contract and to give them due effect, will be given by the Engineer of Record and his findings shall be final and binding on both parties thereto. The Engineer of Record shall have the executive authority to enforce and make effective such decisions and orders that Contractor fails to carry out promptly. He shall decide disputes and mutual rights between Contractors under the Specifications.

50.02 Authority of the City Engineer.

(a) GENERAL.

The City Engineer, with the approval of the City Council, has established written standards, technical guidelines, construction specifications, and standard detail drawings (and any amendments thereto) as may be necessary to insure that all roads, streets, structures, bridges, and utility systems including drainage and sanitary sewer facilities are constructed to protect the public and provide adequate facilities to serve the proposed subdivision or construction site.

(b) REVIEW.

The City Engineer shall have the authority to review all proposed subdivision developments, building permit application, or any land disturbance plan which requires a grading permit, prior to any work being accomplished to ensure compliance with the adopted Engineering Standards, Subdivision Regulations, Standard Specifications for Construction, or the Stormwater Management Manual.

(c) INSPECTION OF SITE.

The City Engineer is authorized to enter upon the premises of any land within the City of Huntsville for which a grading permit, or building permit, or subdivision development application has been filed to inspect the site and work before, during, and upon conclusion of any land disturbance activity or construction to determine compliance with the permit conditions and the construction standards and specifications, regulations, and technical guidelines as adopted by the City Council.
(d) VIOLATIONS AND CITATIONS.
The City Engineer, or an employee of his department designated by him, is authorized to issue a citation to any person found by him to be in violation of the regulations, construction specifications and standards, and technical guidelines adopted by the City Council. The citation shall order the person to appear in the Municipal Court of the City of Huntsville, at a date and time certain to answer the charge(s) against him.

(e) STOP WORK ORDER.
The City Engineer is authorized to issue a "Stop Work Order" with regard to any land disturbance activity that is being done contrary to the provisions of the regulations, requirements, construction specifications and standards, and technical guidelines adopted by the City Council.

(f) ASSURANCE OF COMPLETION.
The City Engineer is authorized to require a bond in the form of cash, cashier's check, or an irrevocable letter of credit for assurance of completion of work.

50.03 Plans, Shop, and Working Drawings.

(a) SUBDIVISION PLAN REQUIREMENTS.
The City Engineer, or his authorized representative designated by him, will review all subdivision plans before preliminary approval is granted by the City of Huntsville, Planning Commission. A complete set of construction drawings including all the information as required by the Subdivision Regulations will be submitted to the City Engineer for his review. The City Engineer will require changes or additions be made to the subdivision plans as required to bring the plans into conformance with the City of Huntsville Subdivision Regulations, and other regulations, requirements, specifications, and guidelines as adopted by the City Council. After all changes, revisions, and additions are completed on the subdivision plans as required, the City Engineer will sign the necessary certificates of approval as required by the City of Huntsville Subdivision Regulations.

(b) BUILDING AND GRADING PERMIT PLAN REQUIREMENTS.
The City Engineer or his authorized representative designated by him, will review all building and grading permits as required under the City of Huntsville Stormwater Management Ordinance. Before any work commences, the City Engineer must approve the building and/or grading permit plan. A complete set of plans including all information as required by the City of Huntsville Stormwater Management Manual will be submitted to the City Engineer for his review and approval.

(c) CITY ENGINEER APPROVAL OF PLANS.
It is understood that the approval by the City Engineer of plans does not relieve the Engineer of Record of any responsibility for errors, omissions, and changes required to the plans, nor does it relieve the Contractor from the satisfactory completion of work according to the engineering standards or specifications.

(d) PLANS ON SITE.
The Contractor shall keep at least one set of approved construction plans and details available at the job site at all times. The Contractor shall also be required
to note on the set of approved plans any changes in location of the required improvements.

(e) BRIDGE PLANS.

Bridge plans will show in detail all dimensions of the work contemplated. The Engineer of Record will submit one set of construction drawings to the City Engineer for his review and approval. The City Engineer will review the plans and require changes or additions to be made to the plans as needed to bring the plans into conformance with the City of Huntsville standards and technical guidelines. Any bridge plans submitted to the City Engineer must be accompanied by the necessary hydrologic and hydraulic computations which show the affects of the bridge on the base flood elevation. Before construction approval is granted by the City Engineer, all Federal, State, and Local regulations must be met.

50.04 Responsibilities of the Engineer of Record.

(a) NOTIFICATION OF ERRORS.

The Engineer of Record shall be responsible for notifying the City Engineer of any errors or discrepancies he or the Contractor may discover on the plans. The Engineer of Record will be responsible for acquiring approval from the City Engineer for any changes made to the approved plans or any changes required due to conditions in the field.

(b) VERIFICATION OF CORRECTNESS.

The Engineer of Record shall be responsible for verifying the correctness of his plans and inspecting all work as shown on the approved plans prepared by him to insure that the work is accomplished according to the approved plans and specifications.

(c) "AS BUILT" DRAWINGS.

The Engineer of Record will be required to submit "as-built" construction drawings to the City Engineer before final acceptance of the work. The "as-built" construction drawings will show the location and elevations of all improvements constructed.

(d) CERTIFICATION.

The Engineer of Record will be required to certify to the City Engineer in writing that all improvements have been installed within dedicated rights-of-way and/or easements, and have been constructed in conformance with the City of Huntsville Engineering Construction Standards and Standard Specifications as adopted by the City Council.

50.05 Conformity with Plans and Specifications.

All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions and material requirements, including tolerances shown on the plans or indicated in the Specifications.

In the event the Engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and Specifications but that reasonably acceptable work has not been produced, he shall then make a determination that the work not be accepted.

Where definite tolerances are specified in the contract, such tolerances shall fix the limits of reasonably close conformity. Where tolerances are not
specified in the contract, the Engineer will determine the limits of reasonably close conformity in each individual case and his decision shall be final and conclusive and mutually accepted by all parties.

In the event the Engineer finds the materials furnished, work performed or the finished product are not within reasonably close conformity with the plans and Specifications, the work shall be removed and replaced or otherwise satisfactorily corrected by the Contractor.

50.06 Coordination of Plans, Specifications, and Special Provisions.

(a) GENERAL.
These specifications, the supplemental specifications, the plans, special provisions and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complimentary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions, unless obviously incorrect, shall govern over scaled dimensions. Supplemental Specifications shall govern over the Standard Specifications. Plans shall govern over Standard Specifications and Supplemental Specifications. Special Provisions shall govern over Standard Specifications, Supplemental Specifications, and Plans.

(b) ERRORS.
The Contractor shall not take advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer of Record. The Engineer of Record will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

50.07 Cooperation with Utilities and Non-Highway Public Facilities.

It will be the Engineer of Record's duty to notify in writing all utility owners or other parties affected, of the date they may begin adjustments of their facilities.

The owners or operators of private or public utilities shall have access to the work for the installation, adjustment, or repair of main line and service facilities. All frames of openings for valves, manholes, catch basins, or other fixtures encountered in areas to be covered by a pavement, shall be adjusted to the proper elevation before the pavement is placed. The Contractor shall coordinate his activities with those of utility owners while utility adjustments are being made. The Contractor shall investigate conditions of existing utilities prior to submitting his bid for the purpose of coordinating the work to the greatest extent possible. The Contractor's attention is directed to any utilities that may be involved on this project and are designated in the Plan Assembly. In any event, it shall be the Contractor's responsibility to determine the exact location of all existing utilities, whether shown on the Plans or not. Cooperation between the Contractor and the Utility Companies shall be expected in accordance with this Section. Any existing underground utilities, whether indicated on the plans or not, that have been abandoned by the Utility Companies within the limits of construction that require removing shall be removed by the Contractor. Any material removed in this manner shall become the property of the Contractor. Disposal of said material shall be at his discretion outside of the right-of-way limits.
50.08 Cooperation by the Contractor.

(a) GENERAL.

The Contractor will be supplied with a minimum of two (2) sets of approved plans and contract assemblies (except Standard Specifications) including Special Provisions. The Contractor shall purchase any required Standard Specifications from the City Engineer.

One set of approved plans and one copy of the contract assembly, including the Standard Specifications shall be kept available on the work at all times.

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

(b) CONTRACTOR'S SUPERINTENDENCE AND SUPERVISION.

The Contractor shall have on the work at all times, as his agent, a competent superintendent capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the type of work being performed, who shall receive instructions from the Engineer of Record or his authorized representatives. The Superintendent shall have full authority to execute orders or directions of the Engineer without delay and to promptly supply such materials, equipment, tools, labor and incidentals as may be required. Joint venture Contractors shall have one such superintendent for all ventures. Such superintendents shall be furnished irrespective of the amount of work sublet and shall have full authority over all subcontract work.

50.09 Cooperation Between Contractors.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed. Each contractor involved shall assume all liability, financial or otherwise, in connection with his contract. The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other contractors within the limits of the same project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others. The Engineer is empowered to regulate and coordinate the stages of progress of construction, or items of work of the respective Contractors to affect necessary cooperation and satisfactory performance and completion. The Engineer's decision shall be binding in any dispute involving the work arising between Contractors.

50.10 Construction Stakes, Lines, and Grades.

The Engineer of Record will set centerline or baseline, stakes for the Contractor establishing all the lines, and measurements necessary to the proper prosecution of the work. The location, alignment, and elevation of all parts of the work will be established by the Contractor, and he shall assume full responsibility for construction to the alignment, elevations, and dimensions as indicated by the stakes and/or plans. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall govern and execute the work. For all work, the Engineer of Record will furnish the Contractor elevations, and bench marks needed to lay out the work correctly. For control of elevations of base and
pavement layers, the Contractor will be required to set control elevation stakes. These
stakes will be set on grade at intervals of not more than 50 feet along and near each
side of each roadway, and at other points as needed for accurate grade control.

50.11 Inspectors, Assistants, and Representatives of The City Engineer.

(a) GENERAL.
The City Engineer may appoint such inspectors, assistants, or
representatives as he deems necessary, and they shall be granted full access to the
work and to the construction area in which material is being prepared for use.

(b) DUTIES OF THE INSPECTOR.
Inspectors will be authorized to inspect all work done and materials
furnished. Such inspection may extend to all or any part of the work and to the
preparation, fabrication or manufacture of the materials to be used. The inspector
will not be authorized to alter or waive the provisions of the contract. The inspector
will not be authorized to issue instructions contrary to the plans and specifications,
or to act as foreman for the Contractor; however, he shall have the authority to reject
work or materials until any questions at issue can be referred to and decided by the
Engineer of Public Works. This decision will be communicated back to the Contractor
and the inspector by letter form with the signature of the Engineer of Public Works.

50.12 Inspection of Work.
All materials and each part or detail of the work shall be subject to
inspection by the Inspector. The City Engineer and his Inspector shall be allowed
access to all parts of the work and shall be furnished with such information and
assistance by the Contractor as is required to make a complete and detailed
inspection.
If the City Engineer requests it, the Contractor, at any time before
acceptance of work, shall remove or uncover such portions of the finished work as
may be directed. After examination, the Contractor shall restore said portions of the
work to the standard required by the specifications.
Any work done or materials used without supervision or inspection by an
authorized Department representative may be ordered removed and replaced at the
Contractor's expense unless the Department representative failed to inspect after
having been given reasonable notice in writing that the work was to be performed.

50.13 Removal of Unacceptable and Unauthorized Work.
All work which does not conform to the requirements of the City of
Huntsville will be considered as unacceptable work.
Unacceptable work, whether the result of poor workmanship, use of
defective materials, damage through carelessness of any other cause, found to exist
prior to the final acceptance of the work, shall be removed immediately and replaced
with acceptable work. No work shall be done without lines and grades having been
given by the Engineer of Record. Work done contrary to the instructions of the
Engineer of Record, work done beyond the lines shown on the plans, or as given,
except as herein specified, or any extra work done without authority, will be
considered as unauthorized.
50.14 Load Restrictions.

The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the project. In the hauling of materials on city streets or county roads, it shall be the responsibility of the contractor to regulate his loads so that damage does not occur, regardless of the legal or posted load limit. Maintenance of public roads shall be as outlined in Section 40. A special permit will not relieve the contractor of liability for damage which may result from the moving of material or equipment. Within the project limits, loads shall be so regulated that damage will not occur to base or pavement layers and structures, but in no case shall loads exceed the legal load limit unless permitted in writing by the City Engineer under special conditions. No loads will be permitted on base, pavement or structures before the expiration of any required curing period. The Contractor shall be responsible for all damage by his hauling and other construction equipment within the project limits. Loads over the legal load limit may be incorporated in the project only under the provisions of the last paragraph in this Section. On loads of materials not accompanied by a gross weight ticket, the Contractor shall furnish, upon request of the City Engineer, the tare weight of any truck delivering such materials to the project. These truck tare weights, along with appropriate volumes and conversion factors, will be used by the City Engineer in determining approximate quantities of materials which may be hauled to the project and still remain within the legal load limit. At such times as the City Engineer has reason to believe that the legal load limit is being exceeded, he will order the Contractor to verify the weight of designated loads at an approved truck scale. Loads over the legal load limit may be incorporated in the project only under the provisions of the last paragraph in this Section.

50.15 Maintenance of the Work.

The Contractor shall maintain the work during construction until the entire project is completed and accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to maintain the project site in a safe condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations. The Contractor's attention is directed to Section 40 for maintenance of roads and detours.

50.16 Failure to Maintain Work.

If the Contractor, at any time, fails to comply with the provisions of Section 50.15, the City Engineer will immediately notify the Contractor of such non-compliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the City Engineer may immediately proceed to maintain the project, and the entire cost of this maintenance will be billed to the Contractor.

50.17 Acceptance.

(a) CONSTRUCTION ACCEPTANCE INSPECTION.

Whenever the Engineer of Record considers the work provided for and contemplated by the contract is nearing completion, or within five (5) days after being notified by the Contractor that the work is completed, the Engineer of Record
will inspect all the work in the contract. If the Engineer of Record finds that the work has not been satisfactorily completed at the time of such inspection, he will advise the Contractor in writing as to the work to be done or the particular defects to be remedied to place the work in condition satisfactory for final construction inspection.

(b) FINAL ACCEPTANCE

1. GENERAL.

Upon due notice from the Engineer of Record of presumptive completion of the entire project, the City Engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection.

If during the course of the heretofore mentioned inspections the City Engineer determines that all work has been satisfactorily completed save that of a substantial stand of grass on all or part of the work, he may recommend acceptance if the Contractor provides a cash bond covering all erosion control and related items. The face amount of the bond shall equal replacement costs of the erosion control items as determined by the Engineer. The time period to be covered by the bond will be sufficient to insure obtaining a satisfactory stand of growth, however, it shall not exceed 12 months. It shall be understood by all that such a bond is to insure replacement of the erosion control items should it become necessary and will in no way relieve the Contractor from the responsibility of damages caused by the lack of erosion control growth.

2. ACCEPTANCE FOR MAINTENANCE.

(a) The Engineer of Record will be required to certify to the City Engineer in writing that all improvements have been installed within dedicated rights-of-way and/or easements, and have been constructed in conformance with the City of Huntsville Subdivision Regulations, requirements, specifications, and guidelines as adopted by the City Council.

(b) The Engineer of Record will be required to submit "as-Built" construction drawings to the City Engineer. The "as-built" drawings will show the actual locations and elevations of all improvements constructed.

(c) Upon satisfactory completion of the work as noted in item 1 above, and the Engineer of Record's certification and "as-built" drawings, the City Engineer will recommend that the City of Huntsville accept the improvements into the City of Huntsville Maintenance program.

3. CONTRACTOR'S ADVERTISEMENT OF COMPLETION.

The Contractor, immediately after being notified that the work has been accepted by the City of Huntsville, shall give notice of said completion by an advertisement for a period of four successive weeks in some newspaper of general circulation published within the city limits of the City of Huntsville. Proof of publication of said notice shall be made by the Contractor to the Director, by affidavit of the publisher, and a printed copy of the published notice.

4. WRITTEN NOTICE OF FINAL ACCEPTANCE.

After completion of all requirements noted hereinbefore in this Section, the Engineer will give the Contractor written notice that the work has been accepted, and will specify the date of acceptance.
SECTION 60
CONTROL OF MATERIALS

60.01 Source of Supply and Quality Requirements.

(a) GENERAL.
Attention is directed to Section 800, Materials, which includes additional Specifications for materials. The materials furnished for use in the work shall be new unused materials, unless otherwise specified, meeting all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of his proposed sources of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce uniform and satisfactory products, or, if the product from any source proves unacceptable at any time, the Contractor shall furnish acceptable materials from other approved sources. The Engineer shall have the right to reject the entire output of any source from which he finds it is impracticable to secure a continuous flow of uniformly satisfactory materials.

1. Federal Participating Projects.
All steel materials, and all manufacturing processes for these materials, which are permanently incorporated into the completed project shall be produced in the United States, its territories or possessions, except that minor items of foreign steel may be used if their cost is less than one tenth of one percent of the total contract cost or $2,500, whichever is greater.

On projects financed entirely by the State of Alabama or any political subdivision thereof, the Alabama Legislature has passed Acts which require the exclusive use of American materials, products, and supplies as follows:

   a. Steel Products.
   Act No. 83-196, as approved by the Alabama Legislature of 1983, shall be applicable and is quoted in part as follows:

   "Section 1. Any contractor for a state, county or municipal construction project, financed entirely by the State of Alabama or any political subdivision thereof, within this State is hereby required to use steel produced within the United States when specifications in the construction contract require the use of steel. If, in the opinion of the Highway Director, the procurement of the above mentioned domestic steel products becomes impractical as a result of a national emergency, national strike, or other cause, the Highway Director may waive the above restriction for highway related projects.

   "Section 2. The construction contract with any contractor who violates the domestic steel requirements of Section 1 of this Act shall be automatically revoked and such contractor shall not be entitled to any set-off or recoupment for labor or materials used up to the time of such revocation."
b. Non-Steel Materials, Supplies and Products.

Section 1 of Act No. 876, as approved by the Alabama Legislature, shall be applicable and is quoted as follows:

"Section 1. The awarding authority contracting for the construction, repair or maintenance of any public building, bridge, road or other like project of public works to be financed entirely by the State of Alabama, or any political subdivision thereof shall stipulate or cause to be stipulated in the contract a provision whereby the person, firm, or corporation undertaking the project agrees to use in the execution thereof materials, supplies and products manufactured, mined, processed or otherwise produced in the United States or its territories, if the same are available at reasonable prices. Such contracts shall also contain a stipulation for payment of liquidated damages in an amount not less than $500 nor more than 20 percent of the gross amount of the contract in the event the contractor breaches his agreement to use domestic products."

The term reasonable prices shall mean that domestic prices shall not exceed foreign prices for the same grade of material by more than 6 percent. Prior to the use of any foreign material the Contractor will be required to submit support documentation to the Engineer for review showing that the price of the foreign material is reasonable (as defined in this paragraph). Unless waived by the Director, a minimum of three quotes from three different suppliers of the American (U.S.) material must be submitted to the Engineer for each material request. Such documentation may be submitted at any time during the life of the contract, however, prior approval for use of the foreign material must be obtained in writing from the Engineer. The use of foreign material under this provision, if approved, will not require price reductions on the bid prices of the affected pay items.

(b) GENERAL CONDITIONS GOVERNING USE OF LOCAL MATERIAL SOURCES AND WASTE AREAS.

The operations of any material pit or waste area shall be so conducted that it will blend into the surrounding landscape. Pit sites and waste areas shall be dressed to obliterate any unsightly appearance and treated in such a manner that erosion will not occur and result in the pollution of the watershed area. In general, sources will not be permitted at locations where resulting scars are visible from any highway. However, when approved, adequate space for conservation of existing natural screenings or to permit the installation of screen planting between the road surface and the disturbed area shall be provided. Unless otherwise provided on the plans, the Contractor shall submit to the Engineer for approval an erosion control plan for the pit or waste area outside the project right of way. The cost of executing the plan, unless otherwise noted in the contract, shall be absorbed in other items of work. Where access to a material source or waste area requires removal of fencing, the removal and replacement of fences, together with the protection of any livestock affected, shall be the responsibility of the Contractor, without direct compensation.

Use of existing public roads for hauling materials to be used in the work shall be governed by Section 40.07. All material pits (base, borrow, etc.) and all waste areas shall have a historical and archaeological clearance from the Alabama State Historical Preservation Officer on file with the Department. The clearance shall be obtained from the Alabama Historical Commission Office, 725 Monroe Street, Montgomery, Alabama 36130. In addition, all other required permits concerning
environmental issues such as endangered species, Section 404 permits, wetlands, floodplains etc. shall be on file with the Department before the pit or waste area may be used.

In some cases the Department will obtain material sources or waste areas, or possible sources or areas. If the necessary clearances and permits have been obtained, this information will be shown on the plans.

If the Contractor uses a material source or waste area, whether shown on the plans or not, for which the necessary clearances and permits have not been obtained, then he, the Contractor, shall obtain all necessary clearances and permits. Such clearances and permits shall include the aforementioned historical/archaeological clearance and a report by a professional biologist documenting that no threatened or endangered species on the Federal list and no wetland will be impacted by the use of the material source or waste area. All required clearances, permits, and reports shall be on file with the Department before the material source or waste area will be approved for use.

(c) DESIGNATED CITY OPTIONED SOURCES.

Information shown on the plans or in special provisions as to designated local sources of materials is the result of investigation by the Department and believed to be correct. It is not guaranteed that these indicated sources will furnish the desired quantity of satisfactory materials. The City will not be liable for any claim for loss or damage due to failure of a designated or substitute source to yield the expected quantity of satisfactory materials.

(d) CONTRACTOR SELECTED MATERIAL OR NO DESIGNATED MATERIAL SOURCES.

If the Contractor desires to use material from sources other than those designated, or no source is designated, he shall submit in writing a request for such, setting forth the location of the source to the Department for its approval. Such approval, however, will not in any manner represent approval of the material within the source. The use of materials from the source will not be permitted until representative samples have been taken, and test results presented to the Engineer for his approval for the use thereof. The Contractor shall accept full responsibility for the quality of the materials used. He shall make all necessary arrangements with the owners of the materials; pay the purchase price or royalty directly to the owners and bear all the expense of procuring and delivering the materials complete in place, including cost of ingress and egress, and including the cost of opening, developing, and operating such sources.

60.02 Samples, Tests, Cited Specifications.

All material used in the work shall be inspected, tested and approved by the Engineer, before incorporation in the work. Any work in which untested materials are used without approval or written permission of the Engineer shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the Engineer, shall be removed at the Contractor's expense. The Engineer may permit use prior to sampling and testing of certain materials accompanied by a signed materials guaranty on the form furnished by the Department guarantying the material conforms to Departmental Specifications. Such material may be tested at any time and if found unsatisfactory, shall be removed and replaced with satisfactory material at no additional cost to the Department. The Engineer reserves the right to refuse permission for use of materials on the guaranty basis at any time.
The Contractor shall furnish the Department, free of charge, ample quantities of such samples as are necessary or required by the Engineer to test adequately any and all materials. Samples will be taken by or under the supervision of a representative of the Engineer. Required or designated tests will be made by and at the expense of the City unless otherwise noted on the plans or in the specifications, in accordance with the most recent standard interim or tentative standard methods of AHD, AASHTO, ASTM or F.S.S. in force and on file with the Department at the date of advertisement for bids, indicated date of adoption notwithstanding, except where standard or special drawings are included in the plans then the AASHTO, ASTM, or F.S.S. in effect on the date of the latest revision to the drawing shall govern.

60.03 BLANK

60.04 Contractor's Statement of Material Sources.

Before work on any contract is started, the Contractor may be required to furnish a complete statement of the origin, composition and manufacture of any or all materials proposed to be used in the construction of the work, together with samples which may be subjected to the tests hereinafter provided in the contract to determine their quality and fitness for the work.

60.05 Handling and Storage of Materials.

(a) HANDLING MATERIALS.

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

(b) STORAGE OF MATERIALS.

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

60.06 Unacceptable Materials.

All materials not conforming to the requirements of the Specifications shall be considered as unacceptable and all such materials will be rejected and shall be removed immediately from the site of the work. No rejected material, the defects of which have been corrected, shall be used until approval has been given. In case of failure by the Contractor to comply promptly with any order by the Engineer to remove rejected materials, the Engineer shall have authority to have such rejected
materials removed by other means and to deduct the expense of such removal from any monies due or to become due the Contractor.

60.07 Department Furnished Material.

The Contractor shall furnish all materials required to complete the work, except those specified in the contract to be furnished by the Department. Material furnished by the Department will be delivered or made available to the Contractor at the points specified in the special provisions.

The cost of handling and placing all materials after they are delivered to the Contractor shall be considered as included in the contract price for the item in connection with which they are used. The Contractor will be held responsible for all material delivered to him, and deductions will be made from any monies due him to make good any shortages and deficiencies, from any cause whatsoever, and for any damage which may occur after such delivery, and for any demurrage charges.
SECTION 70
LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

70.01 Laws to be Observed.

The Contractor shall keep fully informed of all Federal and State laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees, and shall protect and indemnify the City and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by himself or his employees.

The Contractor shall provide for the safety of his employees and the public along with protection of property in the performance of the work. Particular reference is made to the Federal Occupation Safety and Health Act, Title 29, CFR Part 1926 (Published December 16, 1972, as amended) for construction work and Part 1910 (Published May 29, 1971, as amended) for general industry standards for those materials not covered in part 1926, which is a condition of the contract and shall be a condition of any subcontract entered into pursuant thereto.

70.02 Permits, Licenses and Taxes

The Contractor shall procure all permits, and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work.

70.03 Blank.

70.04 Restoration of Surfaces Opened by Permit.

The approval to construct or reconstruct any utility service in the highway or street or to request permits for same, must be approved by the Engineer of Public Works and the Contractor shall not be entitled to any Utility damages either for the excavation of the street or for any delay occasioned thereby.

When an individual, firm or corporation is authorized through a duly executed permit from the Department, the Contractor shall allow parties bearing such permits, and only those parties, to make openings in the road, street, or highway. The Contractor shall make in an acceptable manner all necessary repairs due to such openings and such necessary work will be paid for as provided in these specifications, and will be subject to the same conditions as original work performed.

70.05 Federal Aid Participation.

When the United States Government participates in the cost of the work, the work shall be under the supervision of the City but subject to the inspection and approval of the proper officials of the United States Government and in accordance with the applicable Federal Statutes and rules and regulations made pursuant thereto (Reference Title 23, U.S. Code as amended).

Such inspection shall in no sense make the Federal Government a party to this contract and will in no way interfere with the rights of either party hereunder.
70.06 Sanitary, Health and Safety Provisions.

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements of the City and local Board of Health, or of other bodies or tribunals having jurisdiction.

Attention is directed to Federal, State and local laws, rules and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his health or safety.

70.07 Public Convenience and Safety.

(a) CARE OF TRAFFIC.

The safety and convenience of the general public and residents along the work shall be provided for by the Contractor as specified under Section 40.

The Contractor shall have no greater length or amount of work under construction than he can prosecute properly with due regard to the rights of the public.

The Contractor shall immediately clean up any spillage resulting from hauling operations along or across any public traveled way. The Contractor shall notify the Engineer before starting any construction work that might inconvenience or endanger traffic and shall make such arrangements for the safety and convenience of traffic as required by the City or its authorized representative.

(b) GENERAL PUBLIC.

In general, vehicles of the traveling public shall have preference over those of the Contractor to the end that vehicles of the traveling public shall not be unduly delayed for the convenience of the Contractor. When so directed the Contractor shall station flagmen, whose sole duties shall consist of directing traffic safely and expeditiously through or around the work. If required by the Engineer, the Contractor shall provide a pilot car or interlocking traffic lights, at no additional cost to the Department, to control necessary one-way movements of traffic.

Materials and equipment on the right of way or near travel ways shall be so placed as to insure minimum danger to the traveling public.

Where traffic passes through construction, a suitable width shall be maintained level and smooth to provide satisfactory passage. This width shall be watered or treated with dust control agents as directed to prevent dust nuisance. Soil aggregate, aggregate, or other suitable material shall be spread where and as directed by the Engineer to facilitate movement of traffic over soft portions of this width. Traffic shall be maintained over or around structures and culverts.

(c) COOPERATION WITH POLICE AND FIRE DEPARTMENT.

The Contractor shall arrange his work so that there will be no undue or prolonged blocking of business establishments. Fire hydrants shall be kept accessible at all times. In the absence of local ordinances, no obstruction shall be placed within 15 feet of a fire hydrant. The Contractor shall notify the Chief of the Police and Fire Department in writing 24 hours before it becomes necessary to block a street.
70.08 Railway-Highway Provisions.

(a) NOTIFICATION.
No work of any character shall be commenced on the railroad right of way until the railroad company has been duly notified by the Contractor in writing (with a copy forwarded to the City Engineer) of the date he proposes to begin work and until an authorized representative of the railroad company is present, unless the railroad company waives such requirement. A copy of such waiver shall be forwarded to the City Engineer prior to the commencement of any work.

(b) INSPECTION BY RAILROAD COMPANY.
All changes in approved plans and all work performed by the Contractor involving railroad crossings shall be subject to the inspection and approval of the chief engineer of the railroad company, or his authorized representative. Any precautions considered necessary by said chief engineer to safeguard the interests of the railroad company shall be taken by the Contractor.

(c) TEMPORARY GRADE CROSSING.
The Contractor shall make all arrangements with Railway Companies for the establishment of any temporary crossing to be used by the Contractor for transporting materials and equipment across their tracks. Permission for such a crossing must be obtained from the Railway Engineer prior to establishment of the crossing.

70.09 Barricades and Warning Signs.
The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs, and other traffic control devices at the locations approved by the Traffic Engineer; shall provide qualified flagmen where necessary to direct traffic; and shall take all necessary precautions for the protection of the work and safety of the public. Streets or parts of the work closed to traffic shall be protected by effective barricades; obstructions shall be delineated; suitable warning signs shall be provided to properly control and direct traffic. All signs, barricades, etc. shall be reflectorized in an approved manner and supplemented with warning lights or illumination to increase their effectiveness. The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. All barricades, warning signs, lights, temporary signals, and other protective devices shall conform to the "Alabama Manual on Uniform Traffic Control Devices for Streets and Highways" and be approved by the Traffic Engineer.

70.10 Use of Explosives

(a) GENERAL.
It is the intent of this Section to provide general guidelines for the handling and use of explosives. Prior to any person detonating explosives within the City limits such person shall first obtain authorization for such activities from the Department of Natural Resources and Environmental Management as required by Ordinance No. 88-166. The Contractor shall be expected to use all precaution, control, and safety features outlined by this Section and Ordinance No. 88-166 as well as any additional measures which are necessary to insure the safety of life or property in the area of operations. The provisions of this Section are cumulative to, and not in
derogation of, any other laws or regulations applicable to the handling and use of explosives.

(b) CONTROL.
When the use of explosives is necessary for the prosecution of the work, the Contractor shall use the utmost care not to endanger life or property. Blasting operations shall be performed under the most skilled supervision. Where necessary and at any point of special danger, the Contractor shall use suitable mats or other approved methods to smother his blast. No loaded holes shall be left unattended.

Where blasting is to be done in streams, the Contractor shall notify the Conservation Department sufficiently in advance to permit on-the-site observation by Conservation Department personnel at the time of the blast. Where blasting is performed in urban areas or areas that are heavily populated extreme care shall be taken to minimize the amount and degree of ground vibration, noise, overpressure, and flying debris.

(c) STORAGE OF EXPLOSIVES.
All explosives shall be stored in a safe manner, in compliance with local, State, and Federal laws and ordinances.

(d) WARNING OF BLASTING.
The Contractor shall warn each utility company having structures in proximity to the blasting area of his intentions to use explosives. Such warning shall be sufficiently far in advance of blasting to enable the company to protect its property. Such warning, however, shall not relieve the Contractor of responsibility for any damage resulting from blasting. The Contractor shall erect suitable signs on all roads in the immediate vicinity of blasting operations, warning of blasting activity. The signs shall also include warning that all portable radio transmitters should be turned off while in the vicinity. If conditions deem it necessary, the Contractor shall control traffic by use of flagmen and guards in the danger zone of blasting.

In all urban areas, and other heavily populated areas, the Contractor or his insurer shall conduct a pre-blast survey of all structures to determine the existing or preblasting condition, such survey being a written description with special emphasis on defects and documented with appropriate photographs. This survey is intended to serve as a basis of comparison for any post-blast claims that may arise. The Contractor or his insurer shall obtain the services of a competent vibration or seismologist consultant to conduct both blast noise, vibration and overpressure surveys at periodic intervals during the progress of the blasting operations. It is the intent of this Section to serve as protection to the Contractor to minimize the post-blast claims and not to require unwarranted work. The Contractor shall use every precaution available and practical to minimize ground vibration, noise and overpressure.

The Contractor and his surety shall indemnify and save harmless the City, its agents, and employees, from all claims for damages arising out of the use, transportation, or storage of explosives.

70.11 Protection and Restoration of Property, Landscape, and Utility Facilities.

(a) PROPERTY AND LANDSCAPE.
The Contractor shall not enter upon private property for any purpose without first obtaining permission from the owners and lessees. He shall be responsible for preservation of all public and private property, utilities, monuments,
signs, etc. on or adjacent to the project. He shall not remove, injure, or destroy without proper authority trees or plants that are shown on the plans or ordered by the Engineer of Record to remain on or adjacent to the project site. He shall protect from disturbance all land markers. All concrete monuments, and other property markers which are disturbed by the Contractor due to negligence or in accomplishing the required work shall be reset by a Registered Land Surveyor at the expense of the Contractor. He shall notify the Engineer of Record immediately upon discovery of artifacts or other articles of possible archaeological value revealed by his operations, and shall carefully preserve them and prevent disturbance of the site until the Engineer of Record has had opportunity to arrange appropriate disposal. All signs and markers shall be carefully removed as the grading operations progress and stored in a manner to keep them clean and dry.

When the work affects the foundation support of any building along the work, the Contractor shall give property owners and lessees direct and sufficient notice to support such buildings. The Contractor and his surety shall hold the City, its agents, and employees harmless from any damage resulting from undercutting any such buildings and shall indemnify the City, its agents, and employees against any claims, losses, or damages resulting therefrom.

When any damage is done to public or private property due to any act, omission, or negligence of the Contractor he shall repair such damage at his own expense.

(b) UTILITIES.

1. Where the Contractor's operations are adjacent to utilities or other property, damage to which might result in expense, loss, or inconvenience, work shall not be begun until all arrangements necessary for property protection have been made.

The Contractor shall be responsible to the owners and operators of such property for any damage, loss, or inconvenience. He and his surety shall defend any suits, actions, or claims of any character brought due to injuries or damages resulting from performance of his work. He shall furnish a certificate of his public liability and property damage insurance to each utility company or individual owning or operating any of the properties affected by such work upon request by any such entity.

2. The Contractor shall cooperate with the owners of any utilities in their removal and rearrangement operations so that the utility companies may conduct their operations in a reasonable manner with a minimum of duplication of the work and interruption of services. The Contractor will be furnished information by the utility companies that is reasonably available in regard to existing or proposed new utilities, but the accuracy of such information is not guaranteed. It shall be the Contractor's responsibility to secure information necessary for proper handling and coordination of utility work. He shall give at least 48 hours written notice to owners or operators of all properties that may be affected by his operations before beginning such operations. He shall not hinder or interfere with utilities in protection or operations of the properties. When such properties are endangered, the Contractor at his own expense shall maintain flagmen or watchmen and other necessary precautions to avoid interruption of service or danger to life or property. He shall promptly replace, restore, or make good in an acceptable manner any injury or damage caused by his operations.

3. In event of interruption to utility services as a result of the Contractor's operations, he shall notify promptly the proper authority and cooperate with the said authority in restoration of service as promptly as possible.
70.12 Woodland Protection, Conservation, Abatement of Water Pollution and Quarantine Regulations.

The Contractor shall comply with all regulations of the City, State, or Federal regulatory body governing the protection of forests and other conservation areas, and the carrying out of work within such areas, and shall observe all laws and regulations with respect to the performance of work in such areas.

The Contractor's attention is directed to the requirements for control and abatement of water pollution and erosion control as noted in Section 70.21 along with the taking of all reasonable precautions to prevent and suppress fires and other detrimental items which may be caused by construction operations. This includes protecting streams, lakes and reservoirs from contamination by siltation or other harmful materials, and the use of conservation practices of the Conservation Services by the Contractor, his employees and subcontractors during the work, which include but are not limited to the following:

(a) Diligently undertake precautions for the prevention of fire and for suppressive action in the event of fire resulting from construction. This will require the Contractor to:

1. Comply with all City and State laws, rules and regulations for prevention and suppressive action for forest fires.

2. Prepare and submit to the City a fire prevention and control plan, which has been coordinated with the local governing authority. The fire prevention and control plan must be on file and in effect before work on the item of Clearing and Grubbing will be permitted.

3. Comply with the fire plan noted in Item 2 above and permit burning only when specific written permission is given by the City.

(b) Unmerchantable material including tops, branches, etc., may be disposed of by piling and burning as directed by the governing authority. Alternate methods of disposal, including any of the following methods or combinations of methods (lop and scatter, chip, broadcast, burn, remove, pile only) must be approved in advance by the governing authority.

(c) Protect and preserve the soil and vegetative cover and scenic and aesthetic values on the right of way and on adjacent lands so far as practicable and consistent with the construction, operation and maintenance of the project.

(d) The Contractor shall be responsible for the prevention and control of soil erosion and gullying within the right of way covered by the project and the lands immediately adjacent thereto as a result of the construction and shall revegetate with grass or other herbaceous plants where the soil has been exposed. Slopes in channel changes on all branches and creeks shall be seeded and fertilized above the water line and in no case will the toe of fill slopes be allowed to fall within stream or creek channels unless adequate slope protection is placed in accordance with the City of Huntsville Stormwater Management Manual. All disturbed soil shall be leveled off and/or dressed out and seeded or sprigged in a manner that will permit healing of ground surface and present a pleasant appearance.

(e) Construction operations shall be planned and conducted in such a manner so as to prevent pollution of streams, lakes and reservoirs with sediment or other harmful material used in the construction of the project.

(f) Waste, loose soil or other materials removed from the work or channel changes shall not be deposited in streams. Depositing material into the streams or stream channels will not be permitted. Disposal areas outside of the project area must be operated so as to blend into the surrounding area, utilizing an erosion control plan. Disposal areas within the project area shall be dressed and treated as prescribed by an erosion control plan.
(g) The hauling of materials, including logs, brush, and debris by fording live streams will not be permitted. Temporary bridges or other structures must be provided for this purpose.

(h) Operations of mechanized equipment in live streams or stream channels will not be permitted except in areas where channel changes, retaining walls, temporary or permanent bridges or other such work is required by the plans, or otherwise directed.

(i) Fuels, oils, bitumen or other greasy or chemical substances originating from construction operations shall not be allowed to enter or be placed where they may enter a stream.

(j) The discharge ends of all channel changes shall be so laid out and aligned as to provide direct flow into old stream beds without an abrupt direction change.

70.13 Blank

70.14 Responsibility for Damage Claims.

(a) GENERAL
The Contractor shall indemnify and save harmless the City, its officers, agents, and employees from all suits, actions, or claims of any character brought because of any injuries or damages received or sustained by any person, persons, or property due to the operations of the said Contractor; or because of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of said Contractor, or because of any claims or amounts arising or recovered under the "Workmen's Compensation Act" or any other law, ordinance, order, or decree; and so much of the money due the said Contractor under and by virtue of his contract as may be considered necessary by the Department for such purpose, may be retained for the use of the City; or, in case no money is due, his surety will be held liable until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the Department, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he is adequately protected by public liability and property damage insurance.

The City shall not be liable to the Contractor for damage or delays resulting from work by third parties or by injunctions or other restraining orders obtained by third parties.

(b) TEMPORARY STREAM CROSSINGS.
When the Contractor is required to construct temporary stream crossings, the responsibility of the Contractor as above set forth shall extend to and include such structures together with their approaches.

(c) REPORTING ACCIDENTS.
The Contractor shall submit a written report to the Engineer within 48 hours after the occurrence of any accident occurring on the work. Accidents involving fatalities shall be reported in writing within eight hours. The report shall contain complete information on the accident including names, addresses of persons involved, and names and addresses of witnesses.
70.15 Insurance Requirements.

The Contractor shall carry insurance of the following kinds and amounts in addition to any other forms of insurance or bonds required under the terms of the contract specifications. All insurance shall be by companies authorized to do business in Alabama involving these types of insurance. Before beginning work, the Contractor shall have on file with the City Engineer and the Engineer of Record certificates from his insurors showing the amounts of insurance carried and the risks covered thereby, or a copy of the required insurance policies.

The Contractor shall procure and maintain for the duration of the job until final acceptance by the City of Huntsville, insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Contractor, his agents, representatives, employees or subcontractors.

(a) MINIMUM SCOPE OF WORK

General Liability:
Insurance will be written on an occurrence basis. Claims-made coverage will be accepted only on an exception basis after Risk Management and Legal approval. General Liability Coverage and Owners Contractors Protective Insurance should be written by the same insurance company.

Commercial General Liability:
- Products & Completed Operations
- Contractual
- Personal Injury
- Explosion, Collapse & Underground
- Broad Form Property Damage

Operational Coverage:
The contractor agrees to maintain such completed operations coverage as is required in this section for a period of one year from the date of acceptance of the work by the Owner, whichever occurs first.

Railroad's Protective Bodily Injury Liability and Property Damage Liability Insurance:
In any case where contract involves work on or about a railroad right of way, the Contractor shall carry insurance for himself and insurance in the name of the Railroad Company in the amounts and under the terms specified in the special provisions for each contract.

Automobile Liability:
Business Automobile Liability providing coverage for any auto, or owned, hired and non-owned autos.

Worker's Compensation Insurance:
Statutory protection against bodily injury, sickness or disease or death sustained by employee in the scope of employment.

Employers Liability Insurance:
Covering common law claims of injured employees made in lieu of or in addition to a worker's compensation claim.

Owners, Contractors Protective Liability:
Insurance naming the City of Huntsville as the named insured.

Professional Liability:
When any architect, engineer or consulting firm performs work in connection with the contract, the architect, engineer or consulting firm shall maintain professional liability insurance. The policy shall include Prior Acts Coverage and an Extended Reporting Period.

(b) MINIMUM LIMITS OF INSURANCE
Contractors shall maintain limits no less than:

1. General Liability:
Commercial General Liability per occurrence for bodily injury and property damage:

$3,000,000 General Aggregate Limit.
$3,000,000 Products - Completed Operations Aggregate
$3,000,000 Personal & Advertising Injury
$3,000,000 Each Occurrence

2. Owners, Contractors, Protective:
Contracts with total costs less than $500,000:

$1,000,000 Aggregate
$1,000,000 Per Occurrence

Contracts with total costs of $500,000 or more:

$3,000,000 Aggregate
$3,000,000 Per Occurrence

3. Automobile Liability:
$3,000,000 Combined Single Limit per accident for bodily injury and property damage.

4. Workers' Compensation:
As Required by the State of Alabama Statute.

5. Employers Liability:
$500,000 Bodily Injury by Accident or Disease
$500,000 Policy Limit

6. Professional Liability:
Contracts with total cost less than $500,000.
Limits equal to $500,000. per claim.

Contracts with total costs in excess of $500,000.
Limits equal to $1,000,000 per claim.
Non-standard contracts or contracts with total costs exceeding $3,000,000, (i.e., bridges, overpasses, tunnels, etc.), refer to Risk Management for the insurance limit.

(c) OTHER INSURANCE PROVISIONS
The policies are to contain, or be endorsed to contain, the following provisions:

1. General Liability and Automobile Liability Coverages:
   a. The City, its officers, employees, agents and volunteers are to be covered as insureds as respects liability arising out of activities performed by or on behalf of the Contractor; products and completed operations of the Contractor; premises owned, occupied or used by the Contractor, or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to the City, its officers, officials, employees or volunteers.

   b. The Contractor's insurance coverage shall be primary insurance as respects the City, its officers, officials, employees, agents and volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees, agents or volunteers shall be excess of the Contractor's insurance and shall not contribute to it.

   c. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the City, its officers, officials, employees, agents or volunteers.

   d. The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

2. All Coverages:
   Each insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, cancelled by either party, reduced in coverage or in limits except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given to the City.

(d) ACCEPTABILITY OF INSURERS
Insurance is to be placed with insurers with a Best's rating of no less than A:VII.

(e) VERIFICATION OF COVERAGE
Contractor shall furnish the City with certificates of insurance reflecting the coverage required by this clause. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates are to be received and approved by the City before work commences. The City reserves the right to require complete, certified copies of all required insurance policies at any time.

(f) SUBCONTRACTORS
Contractor shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverage for subcontractors shall be subject to all of the requirements stated herein.
(g) HOLD HARMLESS AGREEMENT

[Name] agrees to defend, pay in behalf of, and hold harmless the City of Huntsville, its elected and appointed officials, employees, agents and volunteers and others working in behalf of the City of Huntsville; against any and all claims, demands, suits, loss, including all costs connected therewith, for any damages which may be asserted, claimed or recovered against or from the City of Huntsville, its elected and appointed officials, employees, agents, volunteers or others working in behalf of the City of Huntsville; by reason of personal injury, including bodily injury and death; and/or property damage, including loss of use thereof, which arises out of or is in any way connected or associated with this contract.

70.16 Developer's Responsibility for Work.

Until final written acceptance of the project by the City Engineer, the Developer 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 Developer shall rebuild, repair, restore and make good all injuries or damages to any portion of the work before final acceptance.

In case of suspension of work, the Developer shall be responsible for the project, provide for normal drainage and shall erect any necessary temporary structures, signs, or other facilities at his expense. During such period of suspension of work, the Developer shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings furnished under his contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

70.17 Blank.

70.18 Personal Liability of Public Officials.

In carrying out any of the provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Engineer, his Engineer, authorized representatives, or members of the City Council, either personally or as officials of the City, it being understood that in all such matters they act solely as agents or representatives of the City.

70.19 Blank.

70.20 Prevention of Soil Erosion.

The Contractor shall exercise planning and forethought in coordinating the work of protecting the project and adjoining properties from soil erosion by effective and continuous erosion control methods of either a temporary or permanent nature in accordance with these Specifications.

70.21 Environmental Protection.

The Contractor shall comply with all Federal, State and local laws and regulations controlling pollution of the environment. He shall take all reasonable precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels,
oils, bitumens, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

Attention is directed to portions of this Section concerning Woodland Protection, Conservation, Abatement of Water Pollution and Prevention of Soil Erosion. Attention is further directed to the City of Huntsville Department of Natural Resources and Environmental Management and its rules and regulations regarding air pollution matters, especially "open burning", "fugitive dust", and "asphalt batching plant" restrictions. A valid permit for "open burning" or operation of an "asphalt batching plant" will be required from the Department of Natural Resources and Environmental Management before such operations will be allowed.

**70.22 Hazardous and Toxic Waste.**

When the Contractor's operations encounter or expose any abnormal, or potentially abnormal, condition which may indicate the presence of a hazardous and/or toxic waste, such operations shall be discontinued in the vicinity of the abnormal condition and the Engineer of Record shall be notified immediately. The presence of barrels, discolored earth, metal, wood, visible fumes, abnormal odors, excessively hot earth, smoke or anything else which appears abnormal may be indicators of hazardous and/or toxic wastes and shall be treated with extraordinary caution.

The Contractor shall not resume operations in the vicinity of the abnormal condition until so directed by the Engineer of Record. Disposition of the hazardous and/or toxic waste shall be made in accordance with the requirements and regulations of the Alabama Department of Environmental Management.
SECTION 80
PROSECUTION AND PROGRESS

80.01 Subletting and Contract.

(a) LIMITATIONS
The Contractor shall not sublet the contract or any portion thereof, or of his right, title, or interest therein, without written consent of the Director. If such consent is given, the Contractor will be permitted to sublet a portion of the work, but shall perform with his own organization, work amounting to not less than 50 percent of the total contract cost. Any items designated in the contract as "specialty items" may be performed by sub-contract and the cost of such specialty items performed by subcontract may be deducted from the total cost before computing the amount of work required to be performed by the contractor with his own organization. No subcontracts, or transfer of contract, shall relieve the Contractor of his liability under the contract and bonds. The Department reserves the right to disapprove a request for permission to sublet when the proposed Subcontractor has been disqualified from bidding for those reasons listed in Subsection 20.02(a) and Section 30.03.

(b) SUBCONTRACTOR'S STATUS.
A Subcontractor shall be recognized only in the capacity of an employee or agent of the Contractor and his removal may be required by the Engineer, as in the case of an employee.

(c) ASSIGNMENT.
The performance of the contract may not be assigned. The Contractor may assign moneys due or to become due him under the contract, if such assignment is approved by the City, to the extent permitted by law, but any assignment of moneys shall be subject to all proper set-offs in favor of the Department and to allow deductions provided for in the contract. All money withheld, whether assigned or not, shall be subject to being used by the Department for the completion of the work in the event that the Contractor should be in default therein. An assignment by operations of law or assignment for the benefit of creditors, or the bankruptcy of the Contractor, shall not vest any right in this contract in the Trustee in bankruptcy, the Contractor's creditors, or the agent of the creditors. In no case will the Department make the warrant payable to anyone other than a party to the contract and; therefore, if the contractor assigns the proceeds of his contract to a bank or other individual or company, approval of the assignment by the City only constitutes an agreement to make the warrants payable to the contractor and for it to be mailed to the address of the party to which the contract is assigned.

80.02 Notice to Proceed.

(a) GENERAL.
A notice to proceed shall be issued by the Director within 15 calendar days after final approval of the contract by the City Council and execution by the Mayor, unless both parties agree in writing to a stipulated extension in time for the issuance of a notice to proceed. Unless the Contractor is otherwise notified in writing, it shall be understood that the mailing or delivery to the Contractor or his authorized agent, of a copy of the executed contract and bonds or the mailing of written notice by the Director or receipt of telegraphic notice from the Director, that the contract has been executed by the Mayor, shall constitute the notice to proceed. If the Contractor is notified in writing that none of the above shall constitute notice to
proceed, he shall not commence work until receipt of a written notice to proceed signed by the Director.

(b) TIME OF BEGINNING WORK.

Unless otherwise specified in the contract, the Contractor will be expected to begin work within 10 calendar days after issuance of notice to proceed.

80.03 Progress Schedule of Operations.

The contractor, within 10 days from the date he is given notice to proceed, shall submit for approval by the Director a satisfactory schedule of operations that will provide for completion of the work within the contract time limit. The schedule of operations shall contain the following information:

(a) Location at which clearing and grubbing will be started and approximate dates for starting and completing.

(b) Location at which grading work will be started and approximate dates for starting and completing.

(c) If the contract includes roadbed material, base, and/or pavement, a brief outline of the proposed schedule for placing the various materials.

(d) If the contract includes bridges, a brief outline showing the schedule for starting and completing each structure.

(e) A table or schedule showing the percentage of the total contract bid price to be completed each month if the contract is on a calendar date basis or each 18 working days if the contract is on a working day basis.

When a Critical Path schedule is required in the proposal, the method shall be used for determining the time schedule of operation for the project. In such cases the Contractor shall, within 10 days after award of the contract, submit for approval a satisfactory Critical Path draft, with its supporting data, along with his schedule of operation to affirm the completion of the contract within the time limit specified in the proposal.

80.04 Prosecution of Work.

(a) NOTICE OF INTENT.

The Contractor shall give the Director definite notice of his intention to start work at least 5 days in advance of beginning work and at least 24 hours in advance of beginning particular features of construction, such as driving piles, placing concrete, et cetera. Should prosecution of the work be discontinued by the Contractor with the consent of the Engineer, the Contractor shall give the Engineer at least 48 hours notice in writing before resuming operations.

(b) GENERAL.

The Contractor shall prosecute the work continuously and diligently in the order and manner set out in his schedule or prescribed by the Engineer. He shall provide sufficient satisfactory materials, labor, and equipment to guarantee the completion of the project in accordance with the plans and specifications within the time specified in the contract.

Should the Contractor fail to maintain a satisfactory rate of progress, the Engineer will require that additional forces and equipment be placed on the work to bring the project up to schedule and maintain it at that level. Failure to maintain the quality and progress of the work shall be cause for the Engineer to withhold all estimates which are or may become due, until satisfactory quality and progress are maintained; or the contract may be annulled as provided in Section 80.12.
(c) DISQUALIFICATION FOR UNSATISFACTORY PROGRESS.

Should the Contractor fail to maintain a satisfactory rate of progress in performance of the work, prior to expiration of the contract, the following regulation shall apply:

After preparation of the Contractor's monthly estimate, the Department will review the progress of the work comparing the dollar value of work performed to the percentage of contract time elapsed. If the percentage of the dollar value of work performed as compared to the percent of contract time elapsed is behind by more than 25 percentage points, a warning notice of possible disqualification will be sent to the Contractor by certified mail, return receipt requested (appropriate credit will be allowed for any extension previously approved in conformity with Section 80.09.

Said warning notice will note the unsatisfactory progress revealed by the computation and that ten (10) days will be allowed from the date of receipt of the warning in which to bring his progress within the allowed 25 percent or furnish acceptable reasons why he should not be given a final notice of disqualification.

At the end of the 10-day period, if the Contractor's progress is not within the allowed percentage, nor has acceptable reason been furnished to waive final disqualification, the Department will issue a final notice of disqualification. After the final notice of disqualification has been issued, the Contractor will be disqualified from further bidding or for approval as a Subcontractor so long as the unsatisfactory percentage ratio exists. Further bidding shall mean bidding as an individual, firm, partnership, corporation, joint venture, or any combination thereof.

Disqualification under the above provision will be removed immediately upon receipt of proof, in the form of a check period estimate or otherwise, that the percentage lag described above has been brought up within the specified limit.

80.05 Limitation of Operations.

The Contractor shall conduct the work at all times in such a manner and in such sequence as will insure the least interference with traffic. He shall have due regard to the location of detours and to the provisions for handling traffic. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional section if the opening of such section is essential to public convenience.

80.06 Character of Workmen, Methods, and Equipment.

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by these specifications.

All workmen shall have sufficient skill and experience to perform properly the work assigned to them. Workmen engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or by any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or Subcontractor employing such person, and shall not again be employed in any portion of the work without the approval of the Engineer.

Should the Contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until compliance
with such orders. All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no injury to the roadway, adjacent property, or other streets will result from its use.

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

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

80.07 Temporary Suspension of Work.

(a) AUTHORITY TO SUSPEND.

The Engineer shall have the authority to suspend the work wholly or in part by written order to the Contractor for such period or periods as he may deem necessary, due to (1) unsuitable weather or other essential conditions which he considers unfavorable for the suitable prosecution of the work in which case no working time will be charged, or (2) failure on the part of the Contractor to carry out orders given or to perform any provision of the contract in which case working time will be charged. No additional compensation shall be paid the Contractor on account of such suspension. Upon suspension, the work shall be put in proper and satisfactory condition, carefully covered and properly protected, as directed by the Engineer. (Reference is made to Section 50.13.)

(b) LEGAL STOPPAGE OR TERMINATION.

Should the progress of the work be stopped by a temporary injunction, court restraining order, process of judgment of any kind directed to either of the parties hereto, then such period or delay shall not be charged against the contract time nor shall the City be liable to the Contractor on account of such delay or termination of the work.

80.08 Determination of Contract Time.

(a) GENERAL.

The number of working days or calendar days allowed or the calendar date specified for completion of the work included in the contract will be fixed by the
Department, will be stated in the proposal and contract, and will be designated as the contract time. The period during which work is suspended by written order of the Engineer will be excluded from the contract time.

(b) BEGINNING AND END OF CONTRACT TIME.
Contract time charges shall begin when the Contractor begins work on a pay item or in no case later than 10 calendar days after date of issue of "notice to proceed." Time charges shall end upon satisfactory completion and final acceptance of the project.

(c) DAYS WORK NOT PERMITTED.
The Contractor shall not permit work on any pay item to be done on Sundays and the following holidays: Fourth of July, Labor Day, Thanksgiving Day and Christmas Day, except with permission of the Director.

80.09 Extension of the Contract Time.

(a) CONTRACTS ON A WORKING DAY BASIS.
When the time set for completion of the work is a number of working days, extensions of contract time will be handled as follows:

1. The Director shall grant an extension of contract time in the event that the total cost of the completed work exceeds the total contract bid price. The extension of contract time shall be in the same ratio as the increase in the total cost unless other contract time allowances are specified in a supplemental agreement.

2. If the Contractor finds it impossible for reasons beyond his control to complete the work within the contract time as specified or as extended in accordance with the provisions of this subsection, he may at any time prior to the expiration of the contract time as extended, make a written request to the Director for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Director finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

When final acceptance has been duly made by the Engineer as prescribed in Section 50.15, the daily time charge will cease.

(b) CONTRACTS ON A CALENDAR DAY OR CALENDAR DATE BASIS.
When the time set for completion of the work is a number of calendar days or a calendar date, working days are not applicable and no extension of time beyond the said calendar days or date will be made except as follows: When the notice to proceed is delayed more than 10 calendar days after execution of the contract, the date of completion will be extended the number of calender days in excess of 10 days between the date of execution of the contract and the date of actual issuance of the notice to proceed. Where work is suspended by order of the Engineer due to no fault of the Contractor, a time extension will be granted for the number of calendar days work is so suspended. Also where the total cost of the completed work exceeds the total cost shown on the proposal, an extension in calendar days will be granted the Contractor, as provided in Section 80.09(a)1.

The following are valid reasons for time extensions when delays due to these causes are considered by the Department to be beyond the control of the Contractor:
1. Utility Work being performed by others not under the Contractor's control that prohibits the Contractor's construction operations from proceeding with the normal working forces he would otherwise employ in performing the controlling item, or items, of work which normally would be in progress at the time said Utility work is being accomplished.

2. Recovery time as defined in Section 10.01.

3. If in the course of work material delivery time is in excess of that normally anticipated due to demands beyond the supplying industries' capabilities, provided such materials are necessary for the prosecution of the controlling items of work at that time and such can be substantiated by the Contractor in form of letters from suppliers, the Department will consider a time extension for the delay caused by the lack of available materials.

4. If in the course of this project the Contractor feels he has been unjustly penalized because of delays in Departmental decisions, he may submit for consideration by the Engineer written specific data covering the item or items and the time element involved. The Department will consider only an extension for the actual work delay caused by the delay in obtaining a decision.

5. If in the course of the work, strikes occur while the Contractor is working in good faith and such was not caused by action of the Contractor, the Department will consider a time extension for the delay caused by the strike

80.10 Failure to Complete Work Within Contract Time.

(a) ASSESSMENT OF LIQUIDATED DAMAGES

Time is an essential element in the contract. Should the Contractor, or, in case of default, the surety fail to complete the work within the time stipulated in the contract, or within such extra time as may be allowed as provided herein above, a deduction in the amount stipulated under Section 80.11. Schedule of Liquidated Damages will be made at the rate per day provided therein. If the contract time is on a working day basis, deductions will be made for each working day that any work remains uncompleted after expiration of the contract time; if the contract time is on a calendar day or date basis, deductions will be made for each calendar day that any work shall remain uncompleted after expiration of contract time.

(b) LIQUIDATED DAMAGES DEFINED

Liquidated damages assessed as provided in these specifications is not a penalty, but is intended to compensate the City for increased time in administering the contract, supervising, inspecting and engineering, particularly that engineering and inspecting which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.
80.11 Schedule of Liquidated Damages.

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80.12 Default of Contract.

The Contractor shall be deemed in default of the contract if he:
1. Fails to begin the work under the contract within the time specified in the "Notice to Proceed," or
2. Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or
3. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or
4. Discontinues the prosecution of the work, or
5. Fails to resume work which has been discontinued within a reasonable time after notice to do so, or
6. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
7. Allows any final judgement to stand against him unsatisfied for a period of ten (10) days, or
8. Makes an assignment without the consent of the surety and approval of the Department, or
9. Fails to furnish documentation necessary for final acceptance and payment, or
10. Fails to carry out provisions of the contract, or
11. For any other cause whatsoever, fails to carry on the work in an acceptable manner. The Engineer will give notice in writing to the Contractor and his surety for such delay, neglect, or default.

If the Contractor or surety, within a period of ten (10) days after such notice, does not proceed in accordance therewith, then the Director shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of the Contractor. The City may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Director will be required for the completion of said contract in an acceptable manner.

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

Notice to the Contractor shall be deemed to be served when delivered to the person in charge of any office used by the Contractor, to his representative at or near the work, or by certified letter, addressed to the Contractor at his last known place of business.

80.13 Blank.

80.14 Termination of Contractor's Responsibility.

(a) GENERAL.

The Contract will be considered complete when all work has been finished, the final inspection made by the Engineer and the Department has given written notice that the project has been accepted. The Contractor's responsibility will then cease, except as set forth in his bonds.

(b) SPECIAL CONDITIONS.

Should the City find that the Contractor is unable to complete his contract work due to the inability to obtain specified materials or satisfactory substitutes therefor or labor, because of laws, rules or regulations placed into effect or the inability of industry to produce specified materials within a reasonable time; the Director may, by written notice, relieve the Contractor from that portion of the contract which cannot be performed.

Also, should the City determine that further prosecution of the work on a project will not be in the best interest of the public, the Director may, by written notice, eliminate or delete any or all remaining items of work on a contract. The deletion or elimination of work under the above conditions will in no way affect the unit prices bid in the contract. Work actually performed will be paid for at the contract unit prices. Should relief from performance of the contract or any portion thereof directly cause the loss of any work or materials already furnished under the terms of the contract, the Contractor will be reimbursed for the actual cost of salvaging the materials or as mutually agreed to.

Materials obtained by the Contractor, which have been inspected, tested and accepted by the Director but not incorporated into the work may, by the option of the Director, be purchased in accordance with the provisions of Section 90.06. If, by the deletion of work items, the volume of work completed is too small to compensate for the organization and moving of equipment to and from the work, consideration will be given to reimbursement for actual costs thereof; the intent being that an equitable settlement be made; compensation for this, however, shall not exceed the percentage differentiation between plan quantities and actual quantities performed, and if 75% of the estimated work was performed, no compensation for the organization and moving of equipment to and from the work will be allowed. In no event will a claim for loss of anticipated profits be considered. The deletion or elimination of work under the above conditions shall in no way relieve the Contractor from his responsibility for work actually performed nor any just claims as a result thereof.

Final termination of the contract shall be as noted in Subsection (a) above, for the work completed.

(c) NATIONAL EMERGENCY.

The Director may, by written notice, terminate the contract or a portion thereof when the Contractor is prevented from proceeding with the construction
contract as a direct result of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense.

When contracts or any portion thereof, are terminated before completion of all items of work in the contract, payment will be made for the actual units or items of work completed at the contract unit price bid, or as mutually agreed for items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Reimbursement for organization of the work and moving equipment to and from the job will be considered where the volume of work completed is too small to compensate the Contractor for these expenses under the contract unit prices, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained by the Contractor for the work, that have been inspected, tested, and accepted by the Engineer, and are not incorporated in the work may, at the option of the Engineer, be purchased from the Contractor in accordance with the provisions of Section 90.06.

Final termination of the contract shall be as noted in SubSection (a) above, for the work completed.
SECTION 90
MEASUREMENT AND PAYMENT

90.01 Measurement of Quantities.

(a) GENERAL.
All work acceptably completed under the contract will be measured by the Engineer according to United States Standard Measures and Weights, unless otherwise provided on the plans or in the special provisions. No local rules or customs will be followed or considered.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, lumber, etc., and these items are identified by gauge, unit weight, section, dimensions, etc., such identification will be considered to be nominal weights and dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

(b) BASE LAYER AND PAVEMENT AREAS.
All longitudinal measurements for computing area of base layers and pavements will be made along the actual surface of the roadway and not horizontally and no deductions will be made for individual fixtures in the roadway having an area of 9 square feet or less. For all transverse measurements for area of base layers and pavements, the dimensions to be used in calculating the pay area shall be the neat dimensions shown on the plans or directed.

(c) STRUCTURES.
Structures will be measured according to neat lines shown on the plans or as ordered in writing, unless otherwise provided elsewhere in the specifications or in the special provisions.

(d) EXCAVATION.
In computing volumes of excavation, embankment and borrow, the average end-area or other acceptable method will be used. It is stipulated and agreed that the electronic computer and/or planimeter shall be considered as instruments of precision adapted to the computation and measurement of these volumes and areas. Completed final cross sections and computed quantities will be made available to the Contractor upon request but shall not be removed from the Engineer's office.

(e) LINEAR FOOT MEASUREMENTS.
All items which are measured by the linear foot, such as pipe culverts, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the plans or indicated in these specifications.

(f) GAGE.
The term "gage", when used in connection with the measurement of plates, shall mean the U.S. Standard Gage; when used with wire, shall mean U.S. Steel wire gage.
WEIGHT MEASUREMENTS.

1. GENERAL.

The term "ton" shall mean the short ton consisting of 2,000 pounds avoirdupois. If the Contractor is purchasing materials from accepted vendors within the City of Huntsville, the vendors will measure the material for the Contractor. If materials are being transported into the City, the procedure shall be as follows:

Scales for measuring materials shall be furnished by the Contractor, without extra compensation, at agreed locations. Scales shall be suitable for the type of service for which they are to be used, shall be sensitive to 10 pounds or less, and shall be operated by a competent, qualified operator. For items being paid for by the ton, weights may be recorded on the weight ticket to the nearest 20 pounds. Electronic load cell weigh systems shall be equipped with automatic zeroing devices. The maintenance tolerance of scales shall be 0.2 percent of the range in which they are to be used. The acceptance tolerance, applied to a new device or a device which has been condemned and repaired to be placed back in service, shall be 0.1 percent of the range in which they are to be used. Scales shall be checked and serviced by a reputable scales company in the presence of an authorized representative of the Engineer of Public Works. A check of the scales by City Personnel will be made as often as determined necessary by the Engineer to insure their accuracy; however, in no case shall the time between checks and servicing exceed four months. It is the Contractor's responsibility to maintain suitable acceptable scales and any time a check indicates the scales to be inaccurate the Director will reject them for use on the project until such time as they are recertified. Weights above the acceptable capacity of a set of scales will not be acceptable.

2. WEIGHT MEASURE FOR PAY PURPOSES.

All scales furnished for use in weighing materials, where permitted for pay purposes shall be capable of weighing the entire vehicle and material at one time. Under no condition will truck scales be used to measure weights greater than the certified scale capacity.

If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is paid for and is certified by a car weight obtained from a certified scale after the unloading. However, car weights will not be accepted for steel reinforcement, structural steel or materials that are to pass through a mixing plant. Trucks used to haul material being paid by weight shall be weighed empty daily, with the driver in the truck, and at such other times as directed by the Engineer and each truck shall bear a plain legible identification number.

3. WEIGHT MEASUREMENT FOR PROPORTIONING, ETC. OF MATERIALS.

Scales used for proportioning mixtures within mixing plants shall comply with the following unless otherwise noted:

The Contractor shall provide ten 50-pound weights for checking the accuracy of the scales.

a. Asphalt Mixing Plants.

Scales may be either springless dial, multiple beam, or electronic load cell type. For multiple beam scales, a tare beam for balancing and a telltale device for accurate weighing, visible to the plant inspector on the mixing platform, shall be provided.

b. Concrete Mixing Plants or Units.

For weighing materials at a central plant, beam, springless dial, or electronic load cell scales, suitable for this class of service, shall be
used. Unless separate weighing units are used for each kind of material weighed, the scales shall be equipped with a multiple weigh beam with enough beams so that the required weight of each material to be weighed can be separately set off and all material weighed without changing the settings.

Separate scales shall be provided for bulk cement and for bulk fly ash, as provided in Section 815.1. Scales of the suspended hopper type shall have a telltale dial, tare beam, or other device that indicates to the operator the approach of not less than the last 50 pounds of the required hopper load for structure concrete plants or the last 200 pounds for concrete pavement plants. Telltale dials shall clearly show when overload is on the scale, and suitable provisions shall be made for disconnecting such dials, when necessary for balancing the scales and again connecting the dial without affecting the dead load balance.

Dial faces shall be of a material not affected by moisture and shall have a suitable transparent protective cover for the dial face and dial indicator. An acceptable method of marking the correct dial indicator position when predetermined loads are in the hopper shall be provided. Plants with operational automatic cutoff devices shall be an acceptable substitute for providing markings for predetermined loads.

For weighing materials at the work site, scales shall be of appropriate capacity and shall meet the requirements noted above; however, for small structures in difficult locations use of platform scales suitable for weighing wheelbarrows will be permitted.

Scales for weighing wheelbarrows shall have beams so arranged that the weights of the wheelbarrow may be set separately from the weight of material. Separate scales shall be used for each aggregate, for bulk cement and for fly ash, unless the multiple beam type is used, with a separate beam for each material and release levers to throw each beam out of service. Suspended hopper weighing equipment shall be of an approved type complying with the requirements of this Section.

c. Base Course Mixing Plants.

Weighing equipment shall meet the requirements of Subsection b. above with separate bins for each size aggregate and separate bins and scales for additives (calcium chloride, cement, etc.).

(i) LOOSE MEASUREMENT (VOLUMETRIC).

All materials to be measured by the cubic yard, "loose measurement" or "measured in the vehicle", shall be hauled in approved vehicles and will be measured therein at the point of delivery. No allowances will be made for the settlement of material in transit. Approved vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. Each approved vehicle must bear a plainly legible identification mark indicating the specific approved capacity. All approved vehicles shall be loaded to not less than their water level capacity when they arrive at the point of delivery. Loads not hauled in approved vehicles or of a quantity less than the specifically approved quantity for the hauling vehicle, measured as hereinabove specified, will be rejected and shall be removed from the work. If rejected, no compensation will be allowed for the rejected load.

(j) CONVERSION OF WEIGHT TO VOLUME.

When requested by the Contractor and approved in writing, material specified to be measured by the cubic yard may be weighed and such weights will be converted to cubic yards for payment purposes. Ratios for conversion
from weight measurement to volume measurement will be determined periodically by the Engineer. Each ratio as determined shall be agreed to by the Contractor before such method of measurement will be used.

(k) TIMBER.
Timber will be measured by the thousand feet board measure (M.B.M.) actually incorporated in the structure with no allowance for any waste except beveled ends. Measurement will be based on nominal widths and thickness and the extreme length of each piece.

(l) LUMP SUM.
The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract. When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

(m) RECHECK OF FINAL QUANTITIES
In the event the Contractor is unwilling to accept the final quantities on a contract as computed by the Engineer and requests the City to make a resurvey which will require additional field and/or office work, the Engineer may grant such a request with the understanding that the Contractor will be paid the final survey and/or computed quantities whether they be more or less than the original final quantities. If a resurvey is made at the Contractor's request, the Contractor and the City shall share equally the additional cost of the resurvey and the Contractor's portion of this said cost shall be deducted from his final estimate.

90.02 Measurement of Liquid Bituminous Material.

(a) GALLONAGE.
When specified on the plans or in the proposal, liquid bituminous material will be measured by the gallon in the railroad car, tank truck, distributor tank, or drums. Each railroad tank, tank truck, drum or distributor tank of bituminous material delivered for the project will be measured. The measurement shall be taken when the bituminous material is of a uniform temperature and free from air bubbles.

(b) TEMPERATURE CORRECTION.
The volumetric measurement of the liquid bituminous material will be based upon a temperature of 60°F., using the following correction factors:
- 0.00035 per degree F. for petroleum oils having a specific gravity 60°F./60°F. above 0.966.
- 0.00040 per degree F. for petroleum oils having a specific gravity 60°F./60°F. between 0.850 and 0.966.
- 0.00025 per degree F. for emulsified asphalts.
- 0.00035 per degree F. for tars.

(c) SEPARATE PAYMENT
When separate payment is made for liquid bituminous material, only the quantities of liquid bituminous material actually placed in the work and accepted will be considered in determining the amount due the Contractor.
The weight of liquid bituminous material paid for separate will not be deducted from the weight of the plant mix on the road.

90.03 Scope of Payment.

(a) QUANTITIES.
The quantities listed in the bid schedule do not govern final payment. Payments to the Contractor for contract items will be made for the actual quantities of these items performed in accordance with the plans and specifications. If upon completion of the construction these actual quantities show an increase or decrease from those in the proposal, the contract unit prices will still govern except where modified by supplemental agreement or allowance made as provided in Sections 40.02 and 40.03. Quantities included in supplemental agreements will be paid for as stipulated therein. Force account work will be paid for as provided in Section 90.04.

(b) BASIS OF PAYMENT.
The Contractor shall accept the compensation as herein provided, in full payment for furnishing all materials, labor, tools, equipment and incidentals necessary to the completed work and for performing all work contemplated and embraced under the contract; also for all loss or damage arising from the nature of the work, or from the action of the elements except as noted in Section 70.17, or from any unforeseen difficulties which may be encountered during the prosecution of the work and until its final acceptance; also for all risks of every description connected with the prosecution of the work.

(c) UNIT PRICE COVERAGE.
In cases where the basis of payment clause in the specifications relating to any unit price in the bid schedule requires that the said unit price cover and be considered compensation for certain work or materials essential to the item, this same work or materials will not be measured or paid for under any other pay item which may appear elsewhere in the specifications. Reference is made to Section 10.01(c)1.

(d) REPAIR OR RENEWAL OF DEFECTIVE WORK.
The payment of any current estimate shall in no way affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damages due to such defects.

90.04 Extra and Force Account Work.

(a) GENERAL.
The Contractor will receive and accept payment for work performed under his contract either as contract items of work or as extra work. Contract items of work will be paid for at the unit prices stipulated in the contract. Extra work will be paid for at the unit prices or lump sum stipulated in supplemental agreement, or on a force account basis. Supplemental agreements shall be executed in accordance with Subsection 40.03(b). Extra work performed on a force account basis will be compensated for in the following manner.
(b) FORCE ACCOUNT BASIS.

1. LABOR.
For all labor and foremen employed on the force account work, the Contractor shall receive the agreed hourly wages or scale for the number of hours the said laborers and foremen were actually engaged in such work. The wages or scale shall be comparable to the wages or scale paid by the Contractor for work of a like nature on his contract pay items and shall be agreed upon in writing by the Contractor and Engineer before the said force account work is begun.

To this sum shall be added an amount equal to 20 percent thereof. No additional pay beyond the agreed hourly scale will be allowed for "overtime work" unless such overtime work is specifically ordered in writing by the Engineer.

2. BOND, INSURANCE AND TAX.
For public liability and property damage insurance and workmen's compensation insurance premiums, increased bond premiums, unemployment insurance contributions and social security taxes, the Contractor shall receive the actual cost, to which no percent shall be added; in addition projects to which the State Gross Receipt Tax is applicable may include said tax. The Contractor shall furnish satisfactory evidence of the rates paid for such bond, insurance, and tax.

3. MATERIALS.
For materials accepted by the Engineer and used, the Contractor shall receive the actual cost of such materials delivered on the work (exclusive of machinery rentals as hereinafter set forth) to which cost 15% will be added.

4. EQUIPMENT.
For rental rates of equipment (other than small tools) authorized by the Engineer for use on force account work, the Engineer will use the latest publication of the Rental Rate Blue Book published by Dataquest, Inc. of San Jose, California to determine payment to the Contractor. The base monthly rate will be adjusted as per the Rate Adjustment Tables and by the Regional Adjustment Factor for each equipment type. The adjustment factors are contained in the Blue Book. The hourly rate will be the monthly rate divided by 176; weekly and daily rates will not be used.

After the above adjustments are made to the base rates, the Estimated Operating Cost, shown in the Blue Book, shall be added based on the number of hours the equipment was actually operated.

The above shall be full compensation for all equipment costs except operator cost. Payment for operators will be under Section 90.04(b)1, Labor.

Payment will be made only for the actual time that authorized equipment is in operation on the force account work. No percentage will be added to the rental sum and no increase in rate will be allowed for overtime.

5. MISCELLANEOUS.
No allowance shall be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

6. COMPENSATION.
The compensation as set forth hereinabove in this Subsection shall be received by the Contractor as payment in full for extra work done on a force account basis. Said compensation shall cover all work, profit, administrative costs, and incidental costs of whatever nature incurred in the work whether performed by the Prime Contractor or an approved subcontractor. At the end
of each day, the Contractor's representative and the Inspector shall compare
records of the cost of work done as ordered on a force account basis.

7. STATEMENTS.

No payment will be made for work performed on a force account
basis until the Contractor has furnished to the Engineer duplicate itemized
statements of the cost of such force account work, detailed as to the following:
   a. Name, classification, date, daily hours, total hours, rate, and
      extension for each laborer and foreman.
   b. Designation, dates, daily hours, total hours rental rate and
      extension for each truck and other unit of machinery and equipment.
   c. Quantities of materials, prices, and extensions.
   d. Transportation of materials.
   e. Cost of public liability and property damage insurance and
      workmen's compensation insurance premiums, increased bond premiums,
      unemployment insurance contributions and social security tax.

Statements shall be accompanied and supported by original
receipted invoices for all materials used and transportation charges, provided
that, if materials used on the force account work are not specifically
purchased for such work but are taken from the Contractor's stock, then in lieu
of the original invoices the statements shall contained or be accompanied by
an affidavit of the Contractor certifying that such materials were taken from
his stock, that the quantity claimed was actually used, and that the price and
transportation claimed represent the actual cost to the Contractor.

90.05 Compensation for Altered Quantities.

(a) GENERAL.

When the accepted quantities of work vary from the quantities in
the bid schedule, the contractor shall accept as payment in full, so far as
contract items are concerned, payment at the original contract unit prices for
the actual quantities of work done. No allowance or other adjustment, except as
provided in Section 40.02, will be made for any increased expense, loss of
expected reimbursement, or loss of anticipated profits suffered or claimed by
the Contractor resulting either directly from such alterations or indirectly
from unbalanced allocation among the contract items of overhead expense on
the part of the bidder and subsequent loss of expected reimbursement therefor
or from any other cause.

(b) SUPPLEMENTAL AGREEMENT OR FORCE ACCOUNT ORDERS.

Additional work caused by alterations of plans or changes in
character of work included in supplemental agreements or force account
orders will be paid for as stipulated in such agreements or orders.

90.06 Omitted Items and Cancelled Work.

(a) ELIMINATION OF ITEMS.

Should any items contained in the proposal be found unnecessary
for the proper completion of the work contracted, the Engineer may eliminate
such items from the contract, and such action shall in no way invalidate the
contract and no allowance will be made for items so eliminated in making final
payment to the Contractor except for such actual work as may have been done,
materials actually purchased and bona fide equipment costs incurred for such
eliminated item prior to notification of the elimination of the items.
(b) UNUSED MATERIALS.

For materials ordered and delivered for the unfinished portion of such cancelled or omitted items, the City will pay actual certified cost (material and handling or transporting cost) plus ten (10) percent as an overhead and gross receipt tax charges; no anticipated profit will be considered. Material paid for shall become the property of the City and shall be disposed of as directed by the Director.

90.07 Partial Payment.

Once each month the Engineer will make an appropriate estimate on the regulation form of the work or portion of the work completed and the value thereof based on the contract Unit Prices or proportional part thereof for Lump Sum items less any assessed liquidated damages or other designated deductions.

This estimate may, if requested in writing by the Contractor and approved by the Engineer, include costs of certain commercial non-perishable items such as, but not limited to, base aggregates, reinforcing steel, bridge piling, structural steel, prefabricated bridge components, traffic signal equipment, electrical equipment, fencing materials, sign materials and others as may be authorized by the Engineer within the following limitations:

1. The location of the storage site shall be at the project site or other designated location in the vicinity of such construction whenever practical. Off-site storage may be approved if the Engineer considers off-site storage to be more practical. In either case, all conditions of this Section concerning stored (stockpiled) material shall be met.

2. Payment, unless otherwise provided under a specific item of work, shall not exceed 100% of the certified invoice cost (including applicable taxes) of the material actually delivered to the approved storage site or 75% of total bid price for the item of which the material is a part, whichever is less. No payment will be made on materials for any item of work whose total value is less than $2,500. Subsequent payments for additional materials shall be in increments of $2,500.00

3. As stockpiled materials are incorporated into the work, proportional deductions will be made in the monthly estimate for such partial payments.

4. Partial payment for materials on hand will not constitute acceptance and any faulty material will be rejected even though previous payment may have been made. The Contractor shall be solely responsible for furnishing and incorporating acceptable materials into the work and for any loss or damage, regardless of the cause, for any material on which partial payment is made.

From the total amount so ascertained will be deducted an amount equivalent to ten (10) percent of the whole to be retained by the City until work is fifty (50) percent complete. When work is fifty (50) percent complete, the City may, in writing, the withholding to five (5) percent of the dollar value of all work satisfactorily completed to date, provided that the Contractor is making satisfactory progress and there is no specific cause for greater withholding. When the work is substantially complete (operational or beneficial occupancy), the withheld amount may be further reduced below five (5) percent to only that amount necessary to assure completion. The City may reinstate up to ten (10) percent withholding if the City determines, at its discretion, that the Contractor is not making satisfactory progress or there is other specific cause for such withholding. The estimate, less any payments
DIVISION II
SECTION 101
CLEARING AND GRUBBING

101.01 Description.

This Section shall consist of clearing the entire area within the limits of construction and grubbing that portion within the construction limits which is necessary to complete the proposed improvements as shown on the construction drawings. Clearing and grubbing shall consist of cutting, removing, burning, and disposing of all trees, trash, stumps, limb wood, grass, weeds, roots, pole stubs, rubbish, street pavement, buildings, fences, structures, storm and sanitary structures, or other obstructions resting in, on, or projecting through the surface of the original ground.

101.02 Construction Methods.

(a) GENERAL.

All clearing and grubbing shall be performed far enough in advance of the grading operations so as to avoid possible delay. Before grading or filling operations start, the area cleared and grubbed must be approved by the Engineer of Record. Areas outside of the street construction limits shall be cleared and grubbed of trees, stumps, brush, etc., except such living trees as he may order left standing for shade or other purposes. Special care shall be taken to preserve and protect all trees and shrubs from injury or defacement that are designated to remain in place. All cut or scarred surfaces of trees or shrubs shall be treated with an asphaltum base paint especially prepared for tree surgery. Trees that are to be removed shall be felled within the construction limits and in such a manner as will not injure trees that are to remain.

(b) CLEARING.

All the area of the construction limits shall be completely cleared of all trees, logs, brush, stumps, grass, weeds, roots, pole stubs, rubbish, and other perishable or objectionable matters. Placing the material on abutting property, with or without the consent of the property owners, will not be considered satisfactory disposal. Trees and stumps outside the construction limits that are not to remain shall be cut off even with the ground surface. Branches of trees extending over the street shall be cut and trimmed. Timber, brush, etc., shall not be burned except with permission of the appropriate authority within the City of Huntsville. The contractor shall be responsible for any damage resulting from burning operations.

(c) GRUBBING.

All areas within the construction limits shall be grubbed of all objectionable matter on or projecting through the ground surface. All fill areas shall be grubbed to a depth at least one foot below the natural ground. Within the areas where excavation will be made, all logs, root systems, stumps, etc., shall be pulled or otherwise removed, and the entire area grubbed free from heavy vegetation, grass, roots and other perishable matter. All cavities, stump holes, and areas excavated below grade shall be refilled with suitable material sufficiently in advance of grading to provide ample time for settlement, and shall be brought to the same degree of compaction as the surrounding area.
(d) **STRIPPING.**

After all clearing and grubbing has been completed, any areas which are to be filled shall be stripped of topsoil to a required depth to remove all organic material, unsuitable soils, and deleterious material encountered. Deleterious material includes construction debris, unsuitable fill, trash, or other materials that could adversely affect the geotechnical stability of the site. Stripping shall be accomplished in accordance with other sections of these specifications.

101.03 **Method of Measurement.**

The area paid for under this item will be the entire area included within the construction limits when accepted and completed. In case changes in location or additions to the right of way width increase the area of right of way shown on the plans, appropriate allowance for the increase in acreage will be made.

101.04 **Basis of Payment.**

This item will be paid for at a contract lump sum price bid for clearing and grubbing the construction limits which shall be payment in full for furnishing all materials, equipment, tools, labor and incidentals necessary to complete the work. Stripping will be paid under Section 105 herein. When partial payments are made, they will be based on the completed percentage of the total Clearing and Grubbing specified.

101.05 **Exclusions.**

When no bid item is provided, the work under this Section will not be paid for directly but shall be considered incidental to the overall work, the cost of which being absorbed in other items of work.
previously made, will then be certified by the Director for payment, provided progress and quality of work are satisfactory and in conformity with Subsection 80.04(b).

No estimate or payment will be required to be made when the amount due is less than $2,500. A statement of any sum due the City for equipment, labor or supplies furnished under the provisions of these Specifications will be furnished along with the estimate and the amount of same will be deducted from the estimate before payment is made by the City.

Should any Contractor be behind the time schedule outlined in his contract by more than 20 percent, the Director reserves the right in his absolute discretion to continue to withhold 10 percent until the work is completed and approved as provided above.

The payment of any monthly estimate for any portion of the work as provided in the Specifications shall in no way affect the obligation of the Contractor to complete the work in accordance with the contract.

90.09 Payment for Work.

Payment for work will be made by the City by checks drawn against City funds that are legally available for such work.

All monies payable under the contract, or any part thereof, will be paid to the Contractor in accordance with the provisions of these specifications, and no assignment or order executed by the Contractor directing payment of any portion or all of such funds to any other person or persons will be recognized by the City unless such assignment or order specifies the amount to be so paid and the purposes for which the assignment or order is given. Such assignment or order shall have attached thereto, by endorsement or otherwise, the consent of the surety. No such assignment or order will be binding on the City.

90.10 Disputed Claims for Extra Compensation.

(a) PRIOR NOTICE OF INTENT REQUIRED

In any case where the Contractor deems that extra compensation is due him for work or materials not clearly covered in his contract and not ordered by the Engineer as extra work as defined herein, the Contractor shall notify the Project Engineer in writing of his intention to make claim for such extra compensation before he begins the work on which he bases his claim. If such notification is not given, and the Engineer is not afforded facilities for keeping strict account of actual cost as defined for force account construction, the Contractor's claim for extra compensation for such work will not be considered by the Department. Such notice by the Contractor, and the fact that the Engineer has kept account of the cost as aforesaid, shall not be construed as proving the validity of the claim. The validity of the claim must be passed upon by the Director. In case the claim is found to be just, it shall be allowed and paid. Nothing in this Section shall be construed as establishing any claim contrary to the terms of Sections 40.02 and 40.03.

90.11 Time Limit for Final Adjustment.

It is understood that the Director will not be bound to consider applications for correction of estimates and payments, including assessed liquidated damages, after the Contractor has signed his final estimate, or after 30 days from the date of the final inspection unless in the latter case the
Contractor submits written request within the 30-day period for adjustment of estimates and payment, including assessed liquidated damages.

90.12 Acceptance and Final Payment.

When the work has been accepted as provided in Section 50.15, the Contractor will prepare the final estimate of the quantities the various items of work performed. After approval of such final estimate by the Director, he will be paid the entire sum found to be due after deducting all previous payments and all amounts to be retained or deducted under the provisions of the contract.

All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

Final payment will be made within 30 days after the final estimate has been checked and approved by the Contractor, final advertisement completed for the benefit of creditors, and all other final requirements met.
SECTION 103
REMOVAL OF MISCELLANEOUS EXISTING
DRAINAGE AND OTHER FACILITIES

103.01 Description
The work under this section shall cover the removal, wholly or in part, and
the satisfactory salvaging or disposal of miscellaneous facilities and obstructions
which will not be permitted to remain within the right of way or easement except
those items removed and disposed of under other sections of these specifications.

103.02 Materials
All new material required shall meet the applicable requirements of
Division III, Materials.

103.03 Construction Requirements
No existing facility shall be removed or closed to traffic until satisfactory
provisions for the passage of traffic has been made.
On navigable streams, provisions shall also be made for waterway traffic in
accordance with US Coast Guard and/or Corps of Engineers, Rules and Regulations.
Use of methods or equipment which might damage completed structures,
structures to be retained, or portions of structures, will not be permitted.
Blasting shall be in accordance with the current City of Huntsville Blasting
Ordinance.
Where portions of existing pavement, curb and gutter, walks, and similar
items are to remain and join the surface of the new work, they shall be removed to an
existing joint or cut off to a neat line with vertical face using saws or other approved
equipment that will not damage the retained portion of the work.
Pipe that is not to be salvaged shall be removed or, if concrete, it may be
broken up in place.
In removing manhole, inlets, etc., any live sewers connected with them
shall be satisfactorily bypassed, rebuilt and reconnected.
Removing railway tracks shall include removal of all rails, paving,
switches, frogs, guardrails, ties, track, encasement, and other appurtenances. Ballast
and concrete foundations shall be included.
Removing pipe headwalls shall include removal and disposal of the encased
pipe.
When the plans provide for using old bridge substructures or parts of them
as permanent parts of a new structure, only those portions shall be removed which
areas so indicated on the plans. All portions of existing structures including debris,
above the bed of the stream or ground surface shall be removed unless otherwise
specified on the plans. Concrete and masonry piers or abutments under embankment
may be either removed entirely or broken down to an elevation of at least 3 feet
below subgrade.
Walls and foundations, not needed, shall be removed to an elevation at least
2 feet below excavation limits in excavation areas, 3 feet below subgrade in
embankment areas and to ground level elsewhere.
All trenches and excavations resulting from the removal or breaking down
of an old culverts or structures shall be filled with suitable materials placed in
accordance with Section 105.

103.04 Disposal of Materials
Materials and debris shall be disposed of in accordance with Section 101.
103.05 Method of Measurement

Each old bridge or portion thereof, each box culvert or culvert type structure, exclusive of pipe culverts to be removed and for which direct payment is to be made, will be designated on the plans by its station number and description, and for the purpose of measurement and payment will be considered a complete and separate unit.

Unless otherwise provided in the proposal, the removal of pipe culverts, curb and gutter, concrete pavement, sidewalks, headwalls, inlets, guardrail, railway tracks, and all other miscellaneous structures necessary for the completion of the work will not be measured for directly, but shall be absorbed in other related items of work.

103.06 Basis of Payment

(a) UNIT PRICE COVERAGE

When the contract contains a unit price for any pay item listed in this section, such item will be paid for at the contract unit price, which shall include removal, excavation, loading, and subsequent backfill incidental to removal, and furnishing all materials, tools, equipment, and labor and incidentals necessary to complete the work as described. It shall also include necessary and required salvage, preservation, storage, loading within the construction limits, or disposal of the materials, all as provided herein.

Payment for removal of all box culverts and similar culvert type structures will be made at the lump sum contract price for each culvert which shall include removal or partial removal as specified on the plans.

Unless otherwise provided within the proposal, payment for all pipe culverts, curb and gutter, concrete pavement, sidewalks, headwalls, inlets, manholes, guardrail, railway tracks, and other miscellaneous structures shall not be paid for directly, but the cost shall be absorbed in other related items of work.

Payment for removal or partial removal of old bridges at designated stations will be made at the lump sum contract price for each bridge removed or partial removal as specified.

Material required for backfilling structures removed, in excess of overlying material excavated in their removal, will be paid for at the contract unit price for material used.

(b) PAYMENT WILL BE MADE UNDER:

Removal of Bridge, Station_____ - per Lump Sum
Removal of Box Culvert, Station ____ - per Lump Sum
SECTION 105
EXCAVATION AND EMBANKMENT

105.01 Description

The work under this section shall cover the excavating, hauling, disposing or compacting of all materials not being removed under some other item which is encountered within the limits of the work and is necessary for all construction in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical section shown on the plans.

Attention is directed to roadbed treatment, Section 111, before the placement of subbase, base, or paving structure.

105.02 Materials

(a) GENERAL

All excavation within the right of way or easement limits will be known as Roadway and Drainage Excavation and shall be classified as Unclassified Excavation, Muck Excavation, Channel Excavation, or Solid Rock Excavation. Excavation outside the limits of the right of way or easement limits shall be classified as "Borrow Material".

Only suitable materials shall be used in the construction of embankments and backfills. No brush, roots (larger than one inch in diameter), rubbish, limbs, logs, stumps, heavy vegetation, topsoil contaminated soil, construction debris, soil containing boulders or cobbles, or other unsuitable material shall be incorporated or placed in the embankments. The Contractor shall be responsible for disposing of all unsuitable material. Grading operations in street, drainage, and sewer excavation shall be so conducted that all suitable material shall be used where required for the formation of embankments subgrade, shoulders, approaches, intersections, and for backfill around structures. The work shall be done in such a manner and sequence that the most suitable soil shall be reserved for the topping of the embankments as far as practical. The Engineer of Record shall be the sole judge of the suitability of material and may require such selection of materials as may be necessary to insure a satisfactory embankment (For Suitable Materials see Section 105.03).

(b) ROADWAY AND DRAINAGE EXCAVATION

Soils data, if provided, on the plans is for estimating purposes only. Material designated for the removal under embankment areas will be reclassified according to its condition at the time of removal.

1. Unclassified Excavation.

Unclassified Excavation shall consist of the excavation of all materials of whatever character encountered in the work, except Channel Excavation, Solid Rock Excavation, or Muck Excavation.

2. Channel Excavation

Channel Excavation shall consist of the excavation, removal, and disposition as noted of all materials necessary to provide inlet and outlet ditches or channels for drainage structures in accordance with plan details.

3. Muck Excavation

Material unsuitable for immediate reuse due to organic content, saturated to the extent it is somewhat fluid will be classified as muck.
4. Solid Rock Excavation

All rock in ledges, bedded deposits and unstratified masses in its original position that cannot be excavated without the continuous use of explosives and or the use of a current model Hydraulic excavator of one cubic yard capacity; and shall also include detached boulders and rock measuring thirteen (13) cubic feet or greater in volume.

(c) BORROW MATERIAL.

The Contractor shall have the full responsibility for the quality and quantity of the material used. Materials for borrow shall be in accordance with the following:

1. Embankment.

Materials furnished for embankment above water and below subgrade shall be any stable material which can be compacted to the specified density.

2. Improved Roadbed

Materials furnished for the improved roadbed shall be any stable material meeting the requirements of Soil Classification A-1, A-2, A-3, or A-4 as determined by AASHTO Specification M-145, within the following limitations:

a) Materials in the A-1 or A-3 classification will not require consideration of a CBR value.

b) Materials in the A-2 or A-4 classification shall have a CBR value of not less than 10.

105.03 Construction Requirements

(a) GENERAL

Prior to beginning excavation and embankment operations in any area, all clearing and grubbing of the areas shall have been performed in accordance with the provisions of Section 101 Clearing & Grubbing.

The excavation and embankment for the work shall be constructed and maintained so as to properly drain and have reasonable smooth and uniform surfaces. The final subgrade elevation and section of both cuts and fills shall be in reasonable close conformity to that specified by the plans (i.e. plus or minus one inch from the designated grade and slope elevations). Excavation operations shall be conducted so that material outside the limits of the slope will not be disturbed.

Special attention is directed to the requirements of the City of Huntsville Storm Water Regulations pertaining to the establishment of temporary erosion control requirements, and also Section 671 of these Specifications.

Choice of equipment to perform the work shall be of that of the Contractor. The type and number of units shall be such as to perform the excavation and embankment operations in conformity with these specification and secure the density specified. Supplemental equipment shall be furnished as necessary to keep the work properly shaped.

When the Contractor's excavation operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal.

The Contractor's attention is directed to the possible existence of public utilities buried within the construction limits which may or may not be noted on the plans. The Contractor shall be responsible for and will take all necessary precautions to protect any and all existing drains, sewers, pipes, conduits, and other underground structures or parts thereof which may remain in place without any
relocation. The Contractor shall notify the respective utility agency for specific locations of underground utilities prior to excavation. The Contractor shall assume full responsibility for reimbursing the owners for damage or injury to properties or interference with other services which may result from any of his operations or negligence.

(b) ROADWAY EXCAVATION

1. General

All intersecting roads, approaches, entrances, and driveways shall be graded and completed concurrently with the roadway grading and shall be kept passable at all times. During the grading operation, the area being graded shall be maintained reasonably smooth and well drained.

Old roadway pavements within the right of way shall be remove as directed on the plans.

2. Removal of Topsoil

Topsoil and other highly organic material within the construction limits shall be removed.

3. Selective Grading

Certain designated zones or portions of cuts which afford the more suitable soils for roadbed construction shall be reserved for use in forming the upper graded earth layer or layers for embankments or cuts, for backfilling, and other purposes.

4. Undercutting

Where the plans provide for an improved roadbed, all cuts shall be undercut and embankments graded to the elevation necessary for the placement of the improved roadbed. The surface of these undercut areas shall be further undercut if determined necessary for the removal of soft or yielding areas, then properly backfilled with suitable material and uniformly compacted to the density specified for embankment just prior to placing the improved roadbed layers. Limits of the undercutting operations will be specifically directed by the Engineer of Record. These undercut areas shall be promptly backfilled with suitable select material and compacted to the specified density.

Rock and other impervious material encountered in cuts shall be undercut to a depth of two feet below subgrade elevation where improved type roadbed is specified on the plans, and one foot below subgrade elevation elsewhere. All depressions in those undercut sections shall be cleaned out, provisions made for drainage, backfilled and compacted with selected materials.

5. Excavation and Backfill of Muck

Excavation and backfill of muck areas shall be performed in a manner that will not permit the entrapment of muck within the backfill. The backfilling of the excavated area shall follow immediately behind the excavation so that any soft material that is pushed ahead of the backfill can be removed.

The material used to backfill the excavated muck areas will be selected Unclassified Excavation or Borrow Material as shown on the plans.

6. Excavation Of Rock

All rock or boulders encountered in the roadway or easements shall be removed to the lateral limits shown on the plans and to depth as indicated previously in this section. Any material outside the designated side slopes that has been loosened or shattered by blasting shall be removed to provide a reasonably smooth surface and uniform slope. No rock shall project more than one foot inside the designated slope.

Rock from roadway excavation may be used under other sections of the specifications.

All rock that is not required for other construction shall be placed in embankment insofar as possible, in accordance with the provisions for
embankments. Large boulders that cannot be used in embankment shall be disposed of by the Contractor.

Special attention is directed to the current City of Huntsville Blasting Ordinance.

7. Benching

Where unstable soil conditions occur, the plans may designate the use of benching. The benching shall be accomplished by suitable drilling and blasting equipment. Benching may also be ordered to provide a more stable foundation for heavy embankment. Benching shall be accomplished by excavating horizontally along the hillside down to or into other suitable undisturbed foundation material, forming a series of stepped benches. Each bench shall be excavated for its entire width. The benches generally shall parallel contour lines. They shall be constructed at least 10 feet wide.

The base of each bench should be horizontal, and the adjacent upslope face should be sloped adequately to allow compaction equipment to compact the embankment soil at the face of the slope in all portions of the embankment. Compaction shall begin at the base of the slope and proceed upslope in horizontal lifts.

(c) BORROW MATERIAL

The Contractor shall supply the necessary borrow material as required in accordance with the plans and specifications and shall accept full responsibility for the quality of the material used. Material furnished shall conform to the appropriate specification under any condition.

All borrow material shall be free of all stumps, logs, brush, roots, and other debris. Material unsuitable for use in the work shall be disposed of in a satisfactory manner.

(d) EMBANKMENT

1. Fill Requirements.

(a) Soil

Fill soils shall be free of organics, deleterious material, debris, or rocks larger than three inches in diameter. The soil shall have a plasticity index (PI) of less than 30. The fill material shall be compacted to at least 95% of the soil's standard proctor maximum dry density unless otherwise specified. Variations of the fill soils shall be approved by the Geotechnical Engineer of Record.

(b) Rock

Two classes of rock based on size may be used to construct embankments. The rock classifications are: CLASS I - The maximum size of this stone shall be six inches in diameter. CLASS II - The maximum size of this stone shall be eighteen inches in diameter. All rock used as fill material shall be a clean, moderately well graded hard durable rock with less than 15% by weight passing the 200 sieve. The rock fill shall not have significant quantities of shale, soil, debris or organics. Fill that contains more than 15% soil shall be classified as soil fill and must be processed according to those criteria defined previously. Processing may be required to produce the rock fill. Processing may include but is not limited to special blasting techniques or crushing and passing the rock over a series of bars or grates - a grizzly.

2. Preparation for Embankment.

(a) General

Before beginning embankment construction, clearing and grubbing shall be performed as provided by Section 101. After clearing and grubbing, the site shall be stripped of topsoil. The site shall then be checked for the presence of
If deleterious materials are found, they shall be removed from the site and disposed of in a suitable manner. Deleterious materials include but are not limited to construction debris, unsuitable fill, trash or other materials that could adversely affect the geotechnical stability of the site.

After clearing and grubbing, stripping of topsoil and removing deleterious debris, areas to be filled shall be benched. Benching consists of excavating "stair steps" into the existing slope. The benches shall be excavated into strong embankment soil or rock. Lateral extent of the benches depends upon the quality of the foundation material. The benches shall be constructed as recommended by the Geotechnical Engineer of Record.

The base of each bench shall be horizontal and the adjacent upslope face shall be sloped adequately to allow compaction equipment to compact the embankment fill at the face of the slope in all portions of the embankment. Compaction shall begin at the base of the slope and proceed upslope in horizontal lifts. During the clearing and grubbing, stripping, and benching operations, the site shall be checked for the presence of conditions that might affect the stability of the embankment. Such items include but are not limited to wet weather springs, unanticipated shale seams, colluvium deposits, mine tailings, caves or sinkholes. Identified conditions shall be addressed by the Geotechnical Engineer of Record.

(b) Embankments Adjacent to Natural Ground Slopes or Old Embankments.

Where embankments occur adjacent to natural ground, which slopes more than twenty (20) degrees from horizontal, such slopes shall be (1) scraped of topsoil, (2) plowed or loosened to a depth of at least six (6) inches before filling is commenced and (3) the topsoil removed, stored or placed under embankment slopes. In cases where widening of embankments is necessary, the slope of the old embankment shall be stepped and plowed before placing additional material. Embankment shall be placed to a sufficient height and width so that after full shrinkage, settlement and subsidence and sloughing of the side slopes, the fills will be at the required grade and have the specified cross-section of all points. When the widening on either side of the centerline is less than six (6) feet, measured horizontally by cross-sections, stepping, parallel layer construction and density as specified herein will be required only in the two (2) feet below subgrade elevation.

(c) Embankments on Existing Roads or Pavement.

When the embankment is to be superimposed on old pavements or pavements having concrete bases (so called liquid types) the procedure shall be as follows: If the depth of new embankment (exclusive of new paving material and base course) is less than one (1) foot, the old pavement shall be removed and disposed of. If the depth of the new embankment (exclusive of new paving material and base course) exceeds one (1) foot, but is less than three (3) feet, the old pavement shall be broken, with a drop hammer of suitable weight, into pieces less than two (2) square feet in area, at the same time pounding or forcing such pieces into the Subgrade. Broken pieces shall subsequently be covered with sand, in amounts sufficiently to fill all cracks. If the depth of embankment (exclusive of new paving material and base course) is three (3) feet and over the old pavement shall not be disturbed. When embankment is to be superimposed upon any other type of pavement, or surface, the existing pavement or roadway surface shall (regardless of depth of embankment to be placed thereon) be scarified to such a degree as will provide ample bond between old and new material.
3. Embankment Formation.
   (a) General.
   In embankment construction, the materials shall be deposited and spread in successive uniform layers for the full width of the required cross-section, and shall be kept level or parallel to the finished subgrade by the use of blade graders, except around bridge ends and structures leveling shall be done with bulldozers and hand methods. Each layer of embankment shall be rolled and compacted to specified density as hereinafter provided. Embankments and slopes shall be finished true and straight, in conformity with the lines and grades of slopes set by the plans, and all slopes, whether old or new, shall be maintain with true and even surfaces.
   
   (b) Fill Placement and Testing.
   1. Soil.
   Soil shall be placed horizontally in lifts of eight (8) inches maximum thickness, then compacted to 95% of the soils standard proctor maximum dry density and tested prior to placing additional lifts. Fill density testing shall be performed to check the compaction process. Test locations shall be evenly distributed throughout the fill area. Tests and retests shall be performed at the frequencies shown in the following table:

<table>
<thead>
<tr>
<th>AREA</th>
<th>METHOD OF PLACEMENT AND COMPACTION</th>
<th>INITIAL TEST FREQUENCY</th>
<th>RETEST FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>General site where each lift covers more</td>
<td>Large self-propelled equipment</td>
<td>One test per 500 cubic</td>
<td>Three retests</td>
</tr>
<tr>
<td>than one acre</td>
<td></td>
<td>yards</td>
<td>per failed test</td>
</tr>
<tr>
<td>Each lift covers less than one acre</td>
<td>Large self-propelled equipment</td>
<td>One test per 100 cubic</td>
<td>One retest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>yards</td>
<td>per failed test</td>
</tr>
<tr>
<td>Small areas, trench backfill and behind</td>
<td>Hand-guided equipment</td>
<td>One test per 50 linear</td>
<td>One retest</td>
</tr>
<tr>
<td>retaining walls</td>
<td></td>
<td>feet per six inches</td>
<td>per failed test</td>
</tr>
</tbody>
</table>

   Compaction shall continue until test results are acceptable. Compaction requirements shall apply to all excavation/backfill operations.
   
   2. Rock Fill.
   Construction of embankments from CLASS I or CLASS II rock shall be performed as follows: The rock shall be placed in level uniform layers. CLASS I rock shall be placed in layers 18" thick or less. CLASS II rock shall be placed in layers 30" thick or less. Each layer shall be placed and the material distributed in such a manner that prevents segregation of the rock sizes and maintains level uniform lifts. Each lift shall be compacted to the required degree of compaction noted on the plans.
(c) Embankment Across Low Swampy Ground.

Unless specific preparatory treatment is provided, where low swampy ground will not support the hauling vehicles, the thickness of the bottom layer may be increased to a depth not greater than required to support the said vehicles while placing subsequent layers which shall be constructed and compacted as above provided. In some cases of this type, tree stumps on the area when designated may be left undisturbed.

(d) Embankment Predominantly Rock.

When embankments are being constructed principally of rock, the stones, broken rock and boulders shall be placed in layers and all voids shall be completely filled with suitable earthy materials and thoroughly compacted. No layer of such rock material shall be placed within nine (9) inches of the Subgrade of finished earth shoulders. Where rock excavation is used in embankment all excavation, of whatever class in the vicinity, shall be managed so that all coarse rock will be placed and embedded in the embankment before all available fine rock and earth have been used.

(e) Embankment Over, Under, and Around Structures.

Embankments over, under and around pipes, culverts, arches, bridges and other structures shall be of selected embankment materials placed and tamped and compacted in a manner and by methods that will avoid unbalanced loading, and that will not cause movement or place undue strain on any structure. The embankments that are placed against or immediately adjacent to bridge abutments, retaining or wing walls, open end bents, and culverts shall be built in horizontal layers not exceeding six (6) inches loose and must be compacted by mechanical tamping and/or rolling. This method of building embankments will be required for such distance from these structures until rollers can effectively tamp embankment.

(f) Erosion Control.

The Contractor will be required to conserve and use suitable coarse rock in constructing the stream side of all embankments which are adjacent or parallel to streams. Material deposited in any stream channel that in any way whatsoever obstructs or impairs the flow of the stream or endangers the roadway to stream bank, shall be removed by the Contractor. Side ditches or gutters emptying from cuts to embankments or to otherwise shall be so constructed as to avoid damage to embankments by erosion.

4. Embankment Compaction.

(a) General.

Embankments shall be rolled as stipulated herein unless otherwise specified in Plans. The density of each layer (except the top 6" of subgrade layer) of material composing the embankment shall be not less than ninety-five (95) percent of the standard proctor maximum dry density. The top 6" or subgrade layer shall be as provided by Section 201. Each layer of embankment material which does not contain sufficient moisture to compact thoroughly shall be sprinkled and mixed with water. Watering may also be done before material is removed from cuts or pits. Material containing excess moisture shall be permitted to dry out to the proper consistency before compaction is attempted. Successive layers shall not be placed until the layer under construction has been compacted.

(b) Very Sandy Soils.

When the embankment is of a very sandy nature and it is impractical to compact it with rollers, the material shall be spread in six (6) inch maximum layers and each layer watered, then rolled with the tracks or treads of a ten
(10) ton tractor which shall cover the entire surface of the layer. When provided by the plans, density test for this type material may be waived.

5. MAINTENANCE AND STABILITY
The Contractor shall be responsible until the final acceptance for the stability of all embankments and shall replace portions which have become misplaced.

(e) USE OF MATERIALS
All suitable materials removed from the roadway excavation may be used insofar as practicable in the formation of the embankment, roadbed, base layers, slopes, bedding and backfill for culverts, and for such other purposes. Suitable materials shall be defined as those suitable for any of the above listed uses.

(f) BLANK

(g) FINISHING AND DRESSING
All the completed work shall be dressed and maintained substantially to the lines, graded and cross sections shown on the plans. Slopes shall be shaped, rounded finished or trimmed in a neat workmanlike manner to conform to the slope lines shown on the plans. Care shall be exercised that no material be loosened beyond the required slopes.

(h) EROSION CONTROL
The Contractor shall incorporate into the work all permanent erosion control features at the earliest practical date. Particular attention is directed to the City of Huntsville Storm Water Regulations concerning erosion control.

105.04 Method of Measurement

(a) GENERAL
Measurement for all accepted Excavation will be made by the cubic yard of the material in its original position computed from the cross section by the average end area method.

Embankment will not be measured for payment. All of the operations required for embankment formation described hereinbefore shall be considered necessary work incidental to and for which compensation is included in the contract unit prices for the pay items of the material composing the embankment.

Muck Excavation will be measured by the average end area method. The volume will be measured immediately after completion of muck excavation and before backfill is placed. No measurement or allowance will be made for necessary excavation of material for sloughing, subsidence, flattening sides, slumps, or rehandling materials or for shaping and dressing disposal areas. The sloughing, subsidence, flattening, or slump of side slopes in muck will not be classed as slides.

Borrow Material will be measured at the point of delivery, inside the delivery truck less 30 percent for shrinkage.

(b) MEASUREMENT LIMITATIONS
Measurement of pay quantities will not include any excavated material used for purposes other than those designated. Where material has been excavated beyond the designated slope line and wasted, the unauthorized wasted material will be measured and deducted from the excavation quantities. Also, if an excess of Borrow Material is placed, such amount will be promptly be removed at the Contractor's
expense without payment. When a borrow area is adjacent to the right of way, the dividing line between the unclassified excavation and the borrow pit shall be either a vertical plane through the right of way or the proposed backslope as shown on the plans whichever is more advantageous to the City of Huntsville.

105.05 Basis of Payment

(a) UNIT PRICE COVERAGE

1. Roadway and Drainage Excavation

The accepted yardage of Unclassified Excavation, Muck Excavation, Channel Excavation, Solid Rock Excavation when provided in the plans or proposal, measured as provided above will be paid for at the unit prices bid for these items which shall be payment in full for: excavation; disposal of surplus and unsuitable materials; hauling; formation and compaction of embankment; preparation and completion of subgrade and shoulders except when this work is included in other pay items; the completion of all cuts, embankment, and channels excavation to conform to the lines, grades, and cross section indicated on the plans or otherwise directed; and the completion of the roadway together with its appurtenances of intersecting roads, streets, driveways, approaches, temporary drainage facilities and other related incidental work for which the proposal contains no contract unit prices. The said contract unit prices for the excavation item shall be payment in full for all equipment, tools, labor, and incidentals necessary to complete the work.

If no contract items for Channel Excavation, Muck Excavation, or Solid Rock Excavation are provided, such work will be paid for as Unclassified Excavation.

Exceptions to the above will be made in the event of the following:

a) If a backslope already completed and dressed is destroyed by a slide or if the Engineer orders additional material taken from a completed and dressed backslope, any redressing will be considered for extra compensation.

b) If a slide occurs after the completion of the subgrade to the line and grade or during subsequent work in the immediate area and is such a nature and extent that the Engineer, in order to avoid damage to the previous work, directs its removal, and such requires equipment other than equipment normal to the project, an adjustment in price may be made. However, in no case shall such increase exceed 25 percent of the Unclassified Excavation contract unit price.

2. Borrow Material In Place.

The accepted yardage of borrow material if designated in the proposal will be paid for at the contract unit price for the bid items, said unit price shall be payment in full for the royalty and other expenses incidental to procurement, construction, and maintenance of haul road, clearing and grubbing, stripping, excavating, loading, hauling, source moves, dumping, spreading, and also for the formation and compaction of embankment, trimming slopes, disposing of surplus materials, preparation and completion of subgrade, shoulders and intersecting roadways and furnishing all equipment, labor and incidentals necessary to complete the work. This pay item also includes any necessary work as may be required by the Engineer or Owner in the final dressing of the pit, including grassing or other landscape work.
(b) PAYMENT WILL BE MADE UNDER:
- Unclassified Excavation _____ per cubic yard
- Channel Excavation _____ per cubic yard
- Muck Excavation _____ per cubic yard
- Solid Rock Excavation _____ per cubic yard
- Borrow Material _____ per cubic yard in Place
SECTION 107
STRUCTURE EXCAVATION AND BACKFILL FOR
DRAINAGE STRUCTURES AND MINOR STRUCTURES

107.01 Description

(a) GENERAL
   The work under this Section shall consist of the removal and disposal of all
   excavated materials of any nature required for the construction of all box type
   culverts (including bridge type), pipe culverts (including pipe arches), storm drains
   and other minor structures in accordance with these Specifications and to reasonable
   close conformity with the lines and grades shown on the plans. This Section shall
   further include the backfill of structure foundations with suitable material in
   accordance with the plan details.

(b) CLASSIFICATION OF MATERIALS
   1. Excavation
      All excavation for structures below natural ground or the designated
      subgrade whichever is lower, will be classified as Structure Excavation and shall
      include all material encountered regardless of their nature, exclusive of water or
      other liquids which will not be classified as excavated material, necessary for the
      proper construction of the structure.
      Excavation for ditches at the inlet and outlet of each drainage structure
      and any other ditches indicated on the plans shall be constructed under "Roadway
      and Drainage Excavation" items.

   2. Backfill
      (a) Foundation Backfill
          Special selected material ordered placed under a structure to provide
          a suitable foundation for the structure shall be classified as Foundation Backfill.

          b) General Backfill
          Material used for ordinary backfill shall include special material for
          areas immediately adjacent to weep holes.

107.02 Materials

(a) FOUNDATION BACKFILL
   Foundation Backfill is a special selected material suitable (approved free-
   draining commercial or local material) for use as a foundation for the structure.

(b) GENERAL BACKFILL
   Material used for general backfill shall be a compactable soil of acceptable
   quality except that material for areas immediately adjacent to weepholes shall be free
   draining material conforming to the following:
   1. Local material shall have a permeability coefficient of at least 0.01
      cm/sec measured by the AASHTO T-215 constant head permeameter, with 90% passing
      the 3/4 inch sieve and a maximum of 10 % passing the No. 8 sieve.
   2. Commercial material shall be aggregate meeting the requirements of
      AHD 467 or AHD 57.
107.03 Construction Requirements

(a) GENERAL

Foundation excavation shall be of the size and to the depth conforming to the outline for the structure shown on the plans. Unsuitable foundation material below the normal design elevation shall be removed.

Where rock, gravelly soil, hard pan or other unyielding material is encountered, it shall be removed for a depth of at least six (6) inches below the designated grade. This extra depth of excavation shall be backfilled with suitable, approved material.

Attention is directed to the special requirements for placement of pipe culverts in embankment areas noted on the plans.

(b) EXCAVATION

Choice of equipment to perform the excavation within the limits of the lines and grades noted hereinafter in this section shall, in general, be that of the Contractor provided such produces the desired results without injuring any adjacent or adjoining work.

Special care shall be taken not to disturb or loosen foundation material below designated foundation limits.

Unless otherwise indicated in the plans, all sheeting and bracing in making structures excavation shall be removed by the contractor following the completion of the work.

(c) BACKFILLING

1. Foundation Backfill

Foundation Backfill shall be deposited uniformly for the full width of the excavation in horizontal layers not to exceed six (6) inches in thickness with each layer compacted as specified in the appropriate Section.

2. General backfilling consisting of all backfill except foundation backfill shall be performed in accordance with the requirements of Section 105 and Section 527 with particular attention directed to the requirements for protecting structures.

No backfill shall be placed against a newly constructed masonry or concrete structure for a period of seven days. Large Masonry and concrete structures such as box culverts and retaining walls shall have approximately one cubic foot of approved local or commercial free draining material placed at each weephole. This material must conform to the requirements as specified in Subsection 107.02(b). Also small structures such as inlets, top of culvert slabs, etc., shall have one cubic foot of free draining material placed at each weephole.

Placing of the material at each weephole shall be done in such a manner as to provide maximum depth of filtering effect.

Prior to the placing of any free draining material each weephole shall be protected by rough stones, a grooved concrete block or hardware cloth to permit seepage yet prohibit loss of material through the weephole.

107.04 Method of Measurement.

(a) STRUCTURE EXCAVATION

When Structure Excavation is specifically indicated on the plans or in the proposal the quantity of excavation removed under this item will be made in the number of cubic yards, measured in its original position, acceptably excavated in conformity with the plans or as directed and the following:
1. For retaining walls and similar structures, measurement will be made of material removed from the area bounded by the vertical planes one foot outside the neat lines of the footings and parallel thereto, and to the elevations shown on the plans or directed by the Engineer to provide installation on a suitable foundation. No measurement or payment will be made for material excavated outside these limits.

2. For box, arch, and pipe culverts with wing walls or headwalls or other minor structures including storm sewers, measurement will be made of the material removed in accordance with the following:

   The excavation shall be considered to be a trench with vertical sidewalls. No separate measurement for minor structures (inlets, junction boxes, manholes, catch basins, etc.) other than noted below, such being considered incidental to the work.

   The length of the excavation shall be the actual length of the structure (including inlets, junction boxes, etc.) measured along the flowline plus one foot at each end. When headwalls or wing walls are used, the net length shall be the average net length of the structure, tip to tip of wings.

   The width of the excavation shall, in the case of the pipe structures, be considered the inside diameter of the pipe plus three (3) feet. For box culverts, the width shall be the outside width of the the barrels plus four (4) feet. On all culvert structures, no allowance will be made for the wing flares or toe walls.

3. The depth of excavation will be as deep as required to install the structure on a suitable foundation to the flowline indicated. This depth shall then be measured in accordance with the following:

   a. Pipe of inside diameter of 48 inches or less shall be laid in a trench extending at least one foot above the elevation of the top of the pipe. The depth of excavation shall be measured from a point one foot above the top of the pipe, or subgrade elevation in cut sections.

   b. For box culverts and pipe larger than 48" inches in diameter, cross sections of the original ground will be taken at major breaks in the ground line profile and at changes in the culvert barrel widths along the length of the culvert as defined in Item 2. above.

4. The average end area method shall be used in computing the volume and no measurement for payment will be made for material excavated outside of the limits noted above.

5. No measurement or payment will be made for excavation for side drain pipe of any size or for side drain culverts unless so provided by the plan details. The cost of such excavation shall be included in the price bid for the items, however pipe designated on the plans as storm sewer pipe will not be classified as side drain pipe.

   If no item for structure excavation is provided in the plans or in the proposal, the material excavated for all structures will not be measured for directly and the cost shall be absorbed by other appropriate items.

(b) FOUNDATION BACKFILL

Foundation Backfill will be measured to the depth, width, and length of the volume of material excavated which it replaces that lies between the bottom of the structure and the bottom elevation of the trench ordered excavated. Where satisfactory structure foundation is provided by the normal process of removing and backfilling unsuitable material under fill areas, none of such backfill will be classified as foundation backfill.
107.05 Basis of Payment.

(a) STRUCTURE EXCAVATION
Payment will be made for the number of cubic yards measured as detailed when provided in the proposal at the contract unit price bid for Structure Excavation.

Such payment shall be payment in full for furnishing all materials, equipment, tools, labor, pumping, draining, and all other incidentals necessary to complete the work and shall include installation and removal of any cribs, cofferdams, shoring, sheeting, or other protection, the satisfactory disposal of any unsuitable material from the excavation, and the placement and compaction in backfill or embankment of the material excavated and suitable for such use.

When no item is provided for Structure Excavation in the proposal, the Contractor shall absorb the cost of such excavation in other appropriate items of work.

(b) FOUNDATION BACKFILL
Payment for the calculated cubic yards of this material as noted hereinbefore will be made at the contract unit price bid which shall be full compensation of the item complete in place and includes furnishing of all material, placement, compaction, and all equipment, tools, labor and incidentals necessary to complete the work.

(c) PAYMENT WILL BE MADE UNDER:

<table>
<thead>
<tr>
<th>Item</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure Excavation</td>
<td>per Cubic Yard *</td>
</tr>
<tr>
<td>Foundation Backfill</td>
<td>per Cubic Yard</td>
</tr>
</tbody>
</table>

* When not provided in the proposal Structure Excavation will be absorbed in other appropriate items.
SECTION 108
EXCAVATION FOR BRIDGES

108.01 Description

The work under this section shall cover foundation excavation for bridge structures which includes the removal of all material, of whatever nature, necessary for the construction of foundations and substructures, including backfill, all in accordance with the plans. It shall, unless otherwise stipulated by the plans, include the furnishing of all necessary equipment and the construction of all sheeting, and shoring, cribs, cofferdams, caissons, dewatering, etc., which may be necessary for the execution of the work. It shall also include the subsequent removal of these items and the placement of all necessary backfill as hereinafter specified. It shall also include the disposing of excavated material, not required for backfill.

Particular attention is directed to Section 505 Structure Foundation.

108.02 Classification of Material

Excavation for bridges shall include all material except water or other liquids. Excavation of material for bridges not within the classification of roadway or drainage excavation will be Unclassified Bridge Excavation.

108.03 Construction Requirements

(a) INSPECTION

1. Notification and Approval

Ample opportunity shall be given the Engineer of Record for the inspection of the foundation pits and the measurements of material removed. In no case shall a foundation be closed to view until it has been inspected and approved.

2. Change in Foundation Elevations

When in the Contractor's opinion, rock or other firm foundation material of adequate bearing value is encountered at an elevation above that shown for the footing and at a location not subject to erosion or scour, the Contractor shall notify the Engineer of Record in order that he may investigate and determine if it is advisable to raise the bottom of the footing.

When the excavation for a footing has been completed to the approximate elevation shown on the plans without encountering satisfactory foundation material, the Contractor shall notify the Engineer of Record in order that he may make an inspection and investigation, such investigation to consist of drilling, probing or jetting by the Contractor, a maximum of 4 holes per footing, each hole a maximum depth of 20 feet.

3. Drilling or Probing

When, in the opinion of the Contractor, satisfactory foundation material has been reached, the Engineer of Record may require the Contractor to drill or probe not more than 4 exploratory holes of a maximum depth of 10 feet for confirmation. No direct payment will be made for this operation.

(b) DEPTH AND SIZE OF EXCAVATION

The excavation for the bottom of the footing shall be carried to the depth on the plans or as designated. The design and elevation of footings are based on soundings taken at certain points for design purposes only. These soundings may or
may not be representative of the actual conditions encountered during the construction.

The size of the excavation shall in all cases be ample to accommodate necessary forms down to rock, marl, or similar hard material suitable for embedment of footings; excavation in such materials shall be as near as possible to the neat lines of the footing and the footings poured without the use of forms. In hard materials which cannot be cut to neat lines with pneumatic spade, line drilling along the neat lines not to exceed 9 inches centers will be required. In dry soils, suitable for footing embedment, capable of providing stable, neat footing lines, the Contractor may pour footings without the use of forms; otherwise, the excavation shall be sufficient for forming the foundations.

Cofferdams or sheeting and shoring will be required in foundation excavation work when such is specified on the plans, when work is adjacent to pavement, sidewalks, utilities, etc., when the material encountered is unstable or when such excavation will present hazardous or undesirable conditions. Attention is directed to the requirements of Sections 505 and 507.

(c) GENERAL BACKFILL
All material used for backfill shall be soil of an acceptable quality. All spaces excavated and not occupied by abutments, piers or other permanent work shall be backfilled. Backfill around all units of a structure shall be completed as soon as practical after the unit has obtained the required strength. Bracing, forms, and rubbish shall be removed from the excavated area before backfilling is commenced.

Backfill within the limits of the roadway shall be as required by Section 105; all other backfill, except that placed below water level, shall be tamped and compacted as required in accordance with these Specifications.

(d) FOUNDATION BACKFILL
If the surface upon which the footing is to placed becomes soft or muddy and will not dry out after the excavation has been dewatered, a foundation course of approved free draining commercial material, as specified in Subsection 107.02 shall be used under the footing.

(e) PRESERVATION OF STREAM BANKS AND CHANNELS
The natural ground adjacent to the structure shall not be disturbed. No excavation shall be made outside of caissons, cribs, cofferdams, steel piling or sheeting. The natural stream bed adjacent to the structure shall not be disturbed. If any excavation or dredging is permitted at the site of the structure before caissons, cribs or cofferdams or pilings are placed, the Contractor shall, after the foundation is in place, backfill all such excavations to the original ground surface or stream bed with satisfactory material. No material or debris shall be deposited in any designated navigation channel during construction except approved in the permit of the regulating authority. Such material or debris shall be removed to the normal navigation channel depth prior to completion and acceptance. Any material or debris resulting from the Contractor's operations deposited outside any designated navigation channel or other streams during construction except such fill as may be ordered as a permanent part of the work shall be removed and the channel freed from all obstructions before completion of the work.

(f) DISPOSAL OF SURPLUS AND UNSUITABLE MATERIAL
Surplus excavated material, after piers and abutments are backfilled, shall be used to obliterate construction scars at or near the bridge site, to smooth out depressions in and near the stream banks.
108.04 Method of Measurement

(a) GENERAL

When listed as a pay item in the contract, the quantity of Unclassified Bridge Excavation will be the number of cubic yards of material excavated, measured and calculated in its original position, subject to the following Subsection.

(b) LIMITATIONS

1. For bridge piers and abutments, excepting pile abutments and pile encasements, the volume measured will be that actually removed; however, no measurement will be made for material removed outside of the area bounded by the vertical planes one foot outside the footing and parallel thereto down to hard material described in Subsection 108.03(b) or material excavated outside neat lines of footings in such hard material. For stepped footings the volume will be measured and computed separately for each step. When the size of a footing is reduced after the Contractor excavated for a larger footing as directed, the excavation will be measured based on the larger footing.

2. Water or other liquid will not be classed as excavated material and no measurement or direct payment will be made for their removal.

3. No measurement or payment will be made for excavation in pile abutments nor for any pile encasements.

4. No measurement will be made for material removed below the elevation designated to be the bottom of the footing, unless removal of said materials ordered. Excavation necessary and incidental to the cleaning or excavating of crevices in the floor of a foundation pit below the established footing elevation will not be measured for payment.

5. No measurement will be made for the removal of material raised by driving piles or for the removal of material that flows through or over cofferdams or caissons.

108.05 Basis of Payment

(a) UNIT PRICE COVERAGE

Payment for the yardage of Unclassified Bridge Excavation as provided above shall be payment in full for the furnishing of all material, equipment, tools, labor, pumping, bailing, drainage, sealing crevices, backfilling (including foundation backfill), compacting of excavated material, and for all incidentals necessary to complete the work in accordance with the plans and these specifications. It shall include the cost of furnishing, installing, removing and satisfactory disposal of any cofferdams or other temporary construction used in the prosecution of the work unless otherwise provided for in the plans or proposal.

If a footing is lowered below the elevation shown on the plans, adjustments in the unit price bid for Unclassified Excavation for the Footing involved will be made as follows:

<table>
<thead>
<tr>
<th>Depth lower below plans</th>
<th>Bid Price Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 -3 Feet</td>
<td>0%</td>
</tr>
<tr>
<td>3 -6 Feet</td>
<td>50%</td>
</tr>
<tr>
<td>6 -10 Feet</td>
<td>75%</td>
</tr>
<tr>
<td>Over 10 Feet</td>
<td>100%</td>
</tr>
</tbody>
</table>

For stepped footings, the above adjustments will be computed separate for each step.
(b) PAYMENT WILL BE MADE UNDER:

Unclassified Bridge Excavation per Cubic Yard
SECTION 109
LANDSLIDE CORRECTIONS

109.01 Description

This Section shall cover the work of correcting a landslide in an existing roadway within the designated areas shown on the plans, all in accordance with the details shown on the plans or noted hereinafter in this provision.

109.02 Materials

Materials furnished for use shall conform to the appropriate requirements of the Specifications for the type work preformed or noted hereinafter.

(a) The fabric may be either woven or non-woven. It shall meet the requirements of Section 817.

(b) The drainage pipe shall be schedule 80, type II PVC, 1 1/2 inch ID pipe conforming to the requirements of US Commercial Standard CS-207-60 or ASTM D- 1785 - modified to include the following:
   The pipe shall be furnished in lengths suitable for use with the drilling equipment approved for use.
   The ends of the pipe shall be machined to provide a smooth wall slip coupling when joined using appropriate solvent welding material plus precluding the use of conventional slip couplings. Fittings necessary for the outfall connections outside the drilling limits shall be rigid PVC, Type II high impact fittings having a bursting strength equal to or greater than the pipe noted hereinbefore. All pipe and fitting connections shall utilize solvent weld joints.
   Slotted pipe shall have 2 rows of slots circumferentially cut 120 degrees apart. The average configuration shall be 46 slots per row, per foot using .010 inch slots or 42 slots per row, per foot using .020 inch slots. The configuration shall be as designated on the plans.
   Perforated pipe shall have 3 rows of 3/8 inch diameter holes, 2 rows which shall be 180 degrees apart with the third row located halfway between the 180 degrees holes. The holes shall be spaced approximately three inches apart with the center row staggered in relation to the side holes.

109.03 Construction Requirements

(a) GENERAL
   In general, the work necessary to connect a landslide is dependent upon the insitu conditions and extent of damage existing at each site and will vary according to the details shown on the plans.
   Basic procedures may require any combination of the following work items:
   1. Excavation for the removal of loose or unwanted material. Unclassified Excavation as provided in Section 105 will apply unless otherwise noted by the plan details.
   2. Construction of paved flumes, installation of underdrains systems (Standard Underdrainage as provided in Section 603 or Special Underdrainage System as noted hereinafter or detailed in the plans) or other methods of removing surface or underground water from the area.
   3. Construction of retainage structures (Standard Retaining Wall, Reinforced Earth Wall) as noted on the plans details to stop slippage of slope material.
4. Restoration of backslope or front slope to a designated slope angle utilizing removed material, ordinary or special borrow material as designated by the plans. This work requires the preparation of the surface by rolling or otherwise compacting the area as directed to receive the backfill material. The backfill material shall be placed in the same manner as prescribed in subsection 105 for embankment.

5. Restoration of the erosion control over the repaired area.

(b) EXCAVATION

The area designated for the treatment shall be excavated to the depth indicated by the plans to remove loose or otherwise unacceptable material. Removed material not designated for re-use shall be disposed of as required in Section 101. Unless stockpiled areas are designated on the plan details, the Contractor shall provide satisfactory storage areas.

(c) DRAINAGE SYSTEM

1. Surface drainage systems, when required, will be classified and constructed in accordance with plan details.

2. Underdrainage systems, when required, will be one of the following classifications as indicated by the plan details:
   a. Standard underdrain constructed under the provisions of Section 603.
   b. Special underdrains constructed in accordance with the details in the plans for size, shape, and content.
   c. Special filter Blanket constructed in accordance with the details provided in the plans and specifications for size shape, content and type. If an aggregate blanket is required, the type of aggregate shall be as designated on the plans; if a fabric blanket is required, the type of fabric, woven or non-woven, shall be designated on the plans.

   The filter blanket fabric shall be placed in the manner and at the locations shown in the plans. At the time of installation, fabric shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The fabric shall be protected at all times during construction from contamination by surface runoff and any fabric so contaminated shall be removed and replaced with uncontaminated fabric. Any damage to the fabric during its installation or during placement of backfill material shall be replaced by the Contractor. The work shall be scheduled so that 30 days does not expire between the placement of the fabric and the covering of the fabric with backfill. Backfill Aggregate shall not be dropped on the fabric from a height greater than one foot. Greater drop heights will be permitted if the Contractor provides a cushioning layer of sand on top of the fabric before dumping any stone. The combination of drop height for stone and sand cushion layer thickness must be demonstrated not to puncture or damage the fabric. Any damage to the fabric material during placement of aggregate shall be corrected prior to proceeding with the work.

   d. Horizontal drains constructed in accordance with the following details at locations, etc. shown on the plans.

      (1) Horizontal drains shall cover the work of drilling appropriate size horizontal holes (angle and slope designated on plans) into backslope or frontslope and the installation of a designated size of perforated or slotted PVC drainage pipe to facilitate drainage of ground water.

      (2) The installation procedure requires the holes be drilled with rotary drilling equipment capable of providing 3 inch to 6 inch diameter holes up to 600 feet in length to the designated lines and grades through soil and rock formations.
The drilling equipment shall allow the installation operation to be accomplished by inserting the plastic drain pipe inside the drill hole the full length of the drill hole.

The installation operation of the drain pipe shall be done in such a manner that the drain pipe will be cemented together where necessary to form a continuous tube and will not be telescoped or damaged to the extent that its drainage efficiency will be impaired when completed.

The entrance end of the pipe shall be plugged with a rounded or pointed extension. The space between the drilled hole and the pipe shall be tightly plugged with earth for a length of at least 2 feet at the outlet end of the hole.

Water used for drilling and water developed during drilling operations shall be disposed of by the Contractor in such a manner that no damage will result to the work.

Unslotted PVC pipe approximately 10 feet in length, shall be provided at the mouth of the collector structure.

(d) SLOPE RETAINING STRUCTURES
1. Retaining Walls, if required, shall be constructed, measured and paid for as provided in Section 525.
2. Reinforced Earth Walls, if required, shall be constructed in accordance with the plans.
3. Rock Buttress, if required, shall be constructed, etc, in accordance with the following requirements:
   a. General
      The construction, in general, consist of the excavation of a trench, preparation of a bedding to receive a rock buttress and the construction of a rock buttress to the line, grades and slopes detailed on the plans.
   b. Excavation of Trench
      The excavation necessary to prepare the trench to the lines, grades, slopes, and section shown on the plans shall be classified as provided on the plans.
   c. Preparation of Trench Bed
      The preparation of the trench bed shall be detailed on the plans. Special bedding, if required, will be noted on the plans. Materials used in the special bedding shall conform to the specified sections of the Specifications.
   d. Rock Buttress
      The rock buttress material, unless otherwise noted on the plans, shall be hard durable stone obtained by normal quarrying operations and will be limited to sand stone, limestone, dolomite, or granite free of dirt and debris. The rock buttress shall be placed, in the prepared trench to the slopes indicated on the plans, in approximately 2 foot layers. Material used shall be approximately in size to that of a Class 2 to Class 3 Riprap. Boulders larger than 2 feet may be used provided they are spaced so as to permit filling and densification of the intervening space in the 2 foot layers. The rock shall be selected in a manner that will provide a choking material for filling voids. Densification of the rock backfill will be required; however, no density test will be required on the rock backfill.
      Furnishing of the rock for the construction for the buttress shall be the responsibility of the Contractor; however, the use of suitable materials within the limits of the regular excavation as provided in Section 105 will be given consideration.

(e) RESTORATION OF SIDE SLOPE
Restoration of Side Slope (front or back) shall consist of preparing the area to receive the replacement material by the shaping and compaction of the area as
prescribed in Section 105 for embankments. The material in place shall be compacted as noted in the plan details or appropriate Sections of these Specification. The backfill may be material previously removed, ordinary borrow or special backfill material of the type designated in the plans. Said backfill shall be placed in layers and compacted as prescribed in Section 105 or noted by plan details.

Erosion control items provided in the plans shall be used to reestablish the ground cover damaged or destroyed by the landslide or the restoration work.

109.04 Method of Measurement.

(a) GENERAL ITEM
Construction items not specifically provided hereinafter in this Section will be classified, measured and paid for under the respective pay items for such work provided in the contract.

(b) ROCK BUTTRESS FOR LANDSLIDE CORRECTION
The item of Rock Buttress for Landslide Correction, when provided in the plans or proposal, will be the tonnage of rock used in construction of the buttress, measured on approved scales.

Measurement of any special bedding, if required, will be as specified for the respective pay item used for bedding.

(c) SPECIAL UNDERDRAIN
The item of Special Underdrain, when provided in the contract, will be measured in linear feet, of each special type detailed in the plans, along the center of each line or lateral center of junctions and/or fittings.

(d) SPECIAL FILTER BLANKET
The item of Special Filter Blanket, when provided in the contract, will be measured in square yards to the nearest 0.1 square yard, complete in place, for the material placed and accepted.

(e) HORIZONTAL DRAINS
Horizontal drains will be measured by the linear foot of drain pipe installed in the holes drilled, including the extension necessary to discharge into the collector structure.

(f) SPECIAL BACKFILL FOR SLIDE CORRECTION
1. When the item of Special Backfill For Slide Correction per ton in place is provided in the contract, the material ordered and accepted will be measured in tons on approved scales.

2. When the item of special backfill for slide correction per cubic yard in place is provided in the contract, the accepted yardage of backfill will be measured in cubic yards complete in place by the cross section and average end area method. Cross sections shall be taken of the material in its original position, whether from a borrow pit, stockpile, or other approved source, before placing of the backfill and recrosssectioned after placing the backfill. The volume computed between these cross sections shall be the volume of backfill.

109.05 Basis of Payment

(a) UNIT PRICE COVERAGE
1. When the Item of Landslide Correction is provided in the plans or proposal, the accepted tonnage, measured as noted above, will be paid for at the
contract unit price bid. Said contract unit price bid shall be payment in full for furnishing, and/or producing material, royalties, loading, hauling, placing, consolidating, shaping and for all equipment, tools, labor and incidentals necessary to complete the work.

2. The accepted Item of Special Underdrain, measured as noted above will be paid for at the contract unit price bid per linear foot, which shall be full compensation for the underdrain complete in place. Said unit price includes excavation of the trench, backfill and compaction thereof, furnishing and installation of any pipe, fittings or filler necessary thereto, furnishing and placing of a connection to an outfall pipe or collector structure, the disposal of excess material, and for all equipment, labor, and incidentals necessary to complete this item of work.

3. The accepted Item of Special Filter Blanket, measured as noted above will be paid for at the contract unit price bid per square yard, which shall be full compensation for the item complete in place and includes the furnishing of all materials, preparation of the area to receive the filter blanket, installation of the blanket and for all equipment, tools, labor and incidentals necessary to complete this item of work.

4. The accepted Item of Horizontal Drain, measured as noted above, will be paid for at the contract unit price per linear feet, which shall be full compensation for furnishing and installation of the drains complete in place and connected to the collector structure. Said unit price includes full compensation for furnishing all materials, services, equipment, tools, labor and incidentals necessary to complete this item of work.

5. The Items of Special Backfill for Landslide Correction, ordered, accepted and measured as noted above, will be paid for at the appropriate unit prices bid per ton or cubic yard, complete in place, which shall be full compensation for the furnishing of the type material designated for preparation of the area to be treated, loading, hauling, placement, compaction and dressing of the area to the designated slope and includes all equipment, tools, labor and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Price</th>
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<tr>
<td>Rock Buttress for Landslide Correction</td>
<td>per Ton in Place</td>
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<tr>
<td>Special Underdrain</td>
<td>inch Diameter per Linear Foot</td>
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<td>Special Filter Blanket</td>
<td>per Square Yard</td>
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<tr>
<td>Horizontal Drain</td>
<td>Inch Diameter per Linear Foot</td>
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<tr>
<td>Special Backfill fill for Landslide Correction</td>
<td>per Ton in Place</td>
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<td>Special Backfill fill for Landslide Correction</td>
<td>per Cubic Yard</td>
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SECTION 111
STABILIZED ROADBED

111.01 Description
This Section shall cover the work of preparing a roadbed for receiving a base and pavement structure by stabilizing it with an approved local or commercial material. The work shall consist of scarifying the roadbed, incorporating the stabilizing material into the roadbed and the compaction thereof to proper grade section and density.

111.02 Materials
The stabilizing material to be incorporated shall be a local or commercial material of the type provided by the plans.

111.03 Construction Requirements
(a) GENERAL
Choice of equipment to perform the work under this section shall, in general, be that of the contractor provided such produces the desired results noted hereinafter and does not damage or injure any completed work or facility designated to be incorporated into the work.

(b) PREPARATION OF THE ROADBED
The roadbed shall have been prepared in accordance the provisions of Section 105. The designated sections of the roadbed of the width specified on the plans of both cuts and fills shall then be scarified or otherwise loosened for the depth specified by the plans. Certain equipment capable of mixing the stabilizing material and the material in place without pre-working the in-place material may be used combining this step with the requirements of Subsection (c) below.

(c) PLACEMENT AND PROCESSING OF STABILIZING MATERIAL
The approved stabilizing material shall be spread uniformly over the roadbed at the rate specified on the plans spreading equipment.
The stabilizing material shall then be mixed with the subgrade material until uniform in color and texture and compacted to the required grade, section and density.

(d) DENSITY REQUIREMENTS
Density and surface requirements shall be the same as specified in Section 206.

(e) PROTECTION AND MAINTENANCE OF ROADBED
Protection and maintenance of roadbed shall be the same as specified in Section 50.

111.04 Method Of Measurement
All accepted stabilizing material ordered and accepted will be measured in cubic yards, loose measure, or per ton.
111.05 Basis of Payment

The accepted volume of Roadbed Stabilizing Material, measured as noted above in accordance with the method provided in the contract (Cubic Yard or Ton) will be paid for at the contract unit price bid which shall be full compensation for the item complete in place on the roadbed. Said unit price shall include all cost of procurement, hauling, spreading, scarifying, mixing, and processing as required to incorporated the stabilizing material to the specified depth, to obtain and maintain the required grade, section and density of the roadbed until covered by an overlying layer of ordered material and includes all equipment, tools, labor and incidentals necessary to complete the work.

Payment Will Be Under:
Roadbed Stabilizing Material (Type) per Cubic Yard
Roadbed Stabilizing Material (Type) per Ton
SECTION 113
DETOUR BRIDGES

113.01 Description

The work under this Section shall cover the work of furnishing all materials, construction, maintenance, and removal of any temporary detour bridge structure and the necessary roadway approaches at the approximate locations shown on the plans.

113.02 Materials

All timber used shall be a minimum of dense No.1 structure grade pine or equivalent grade of other wood.

Steel or other types of bridging material may be used.

Other materials shall conform to the requirements Division III, Materials, for the type of material used.

113.03 Construction Requirements

(a) GENERAL

The alignment, length of detour, length of bridge, grade, typical cross-section and type base and surface will be shown on the plans.

Warning and direction signs with traffic markings shall be provided as required by plan details and/or the Alabama Manual on Uniform Traffic Control Devices.

All roadway construction shall be consistent with the requirements for the type work involved as noted in other portions of these Specifications.

(b) BRIDGE REQUIREMENTS

If the detour bridge is not shown on the plans, then, before construction of a detour bridge may be begun, the Contractor shall submit to the City Engineer, for approval, a minimum of four (4) prints of detailed plans for the structure he proposes to furnish. The structure shall be designed to carry the legal load for the State of Alabama. The Contractor, at his discretion, may exceed these requirements to reduce his maintenance or replacement expense.

No work shall be performed on the structure until after the plans have been forwarded to the City Engineer and distribution has been made to the Engineer of Record and Design Engineer. The Contractor will be required to comply with the details of the plans as approved.

The Contractor shall take full responsibility for the proper structural design, construction, and maintenance of the facility.

113.04 Method of Measurement

No direct measurement or payment will be made for a detour bridge unless it is listed in the pay items of the contract. The detour bridges listed in the proposal will be identified by the station number of its location and measured as a Lump Sum Unit.

Measurement of quantities for items used in construction of roads will be specified under the appropriate item of work.
113.05 Basis of Payment

(a) UNIT PRICE COVERAGE

Detour Bridges for which an item is provided in the proposal will be paid for at the contract unit price bid. Said lump sum shall be payment in full for furnishing all materials, equipment and labor necessary for the construction, maintenance and removal (if required) of the detour bridge required including the providing of barricades, signs, lights, and watchmen necessary to safeguard the public.

Payment for items used in the construction of detour roads will be specified under the appropriate items required.

No direct payment will be made for detours which the Contractor builds for his own convenience.

(b) PAYMENT WILL BE UNDER

Detour Bridges at Station per Lump Sum
SECTION 201
SUBGRADE

201.01 Description.

The work covered by this section of the specifications consists of constructing a subgrade of suitable soil material as specified by the construction plans in accordance with these specifications and in reasonable close conformity with the lines, grades, and cross sections shown on the construction plans. The subgrade shall be considered as that portion of the road bed on which the dense graded base course or concrete curbs and gutters are to be placed. After the earthwork has been substantially completed and after all underground utilities and storm drains have been completed, the subgrade shall be brought up to the lines, grades and cross sections as shown on the construction plans and finished in accordance with these specifications.

201.02 Materials.

Subgrade material will consist of selected compactible soil from Unclassified Excavation or Borrow, or Class I or Class II rock as specified in Section 105, or suitable compactible in place soil. Subgrade soil must have a Plasticity Index (PI) of 30 or less, and a Liquid Limit (LL) of 55 or less. Soils which do not meet these limits as determined by an approved soil testing laboratory will not be approved as a suitable subgrade material. The City Engineer will consider a modified roadbed and pavement design, otherwise, all unsuitable subgrade soil will be removed and replaced with a material or solid that will meet all the subgrade requirements.

No construction materials such as concrete and brick will be allowed in the subgrade material. Solid rock may be allowed in the subgrade if approved by the Engineer of Record and is at least 12 inches below the finished subgrade elevation.

201.03 Construction Requirements.

The subgrade shall be constructed so that it will have, as nearly as practical, uniform density throughout. No base course, surfacing or pavement shall be constructed on the subgrade until the specified density is obtained (as confirmed by a Soils Testing Laboratory), and the elevations are in close conformity to that specified by the plans (i.e., plus or minus five hundredths of a foot (0.05') from the designated grade and slope elevations) and until all test reports required by these specifications are checked and the subgrade construction is approved by the Engineer of Record and the City Engineer. If the density requirements are not met, then the Contractor will rework the failed sections of the subgrade until the required density is obtained.

Any pumping of subgrade will be reworked by removing the underlying wet material replacing with a suitable subgrade material, compacted to the required density and reshaped and graded to the planned elevation and grade.

(a) UNDERCUTTING.

Where undercutting is required to remove unsuitable subgrade material, all the unsuitable soil shall be removed and replaced with suitable soil.

(b) SUBGRADE PREPARATION.

Choice of equipment to perform the required work shall be that of the
Contractor. The equipment and work shall be performed in a manner to meet the lines, elevations, cross sections and grades as shown on the constructions plans and to secure the density specified.

The contractor shall remove all unsuitable materials from the subgrade. All boulders, concrete, or similar large solid items that cannot be removed with excavation type equipment can remain in place, provided that the items are removed to a depth of at least twelve (12") inches. Stone and crushed rock meeting the specifications for Class I or Class II rock as defined in Section 105 if used in the construction of the subgrade shall be placed and compacted in accordance with Section 105 - Excavation and Embankment of these specifications. All other large rock shall not be used in the subgrade construction.

Any depressions and holes resulting from excavation and all other low sections, holes, or depressions shall be brought to the required grade with selected suitable material, and the entire subgrade shaped to the planned line, grade and cross section, as shown in the construction plans.

Both cuts and fills shall be graded to the elevation designated on the construction plans in accordance with Section 105 of these specifications and to the Typical Section shown on the construction plans. After the roadbed has been constructed to the required subgrade elevation in the specified layers using the designated selected materials, the top six (6) inch layer of the entire width of the roadbed shall be thoroughly pulverized, blended, and mixed until uniform in texture and appearance insofar as practical. The six (6) inch layer shall be graded, rolled, watered if required, and compacted to the specified density and cross section. The finished and approved section shall be maintained until placement of the overlying subbase, base, or concrete curbs and gutters, or paving.

When the unsuitable subgrade requires the incorporating of stabilizing material, approved in accordance with these Specifications, the subgrade will be scarified to the depth directed by the Engineer of Record and the approved stabilizing material shall be worked into the subgrade. The Contractor shall regrade, shape, roll, and compact the stabilized roadbed to the specified grade, lines and cross sections. A density test shall be required in accordance with this specification.

(c) DENSITY REQUIREMENTS.

The subgrade in both cuts and fills shall be compacted to a density of one hundred (100) per cent of the maximum density in the top six (6) inch layer, and ninety-five (95) per cent of the maximum density below six (6) inches in depth as determined by the AASHTO T-99 Compaction Test.

Moisture content at the time of in-place density tests shall be within + or - 2% of the optimum moisture content established during the control density test.

(d) SURFACE REQUIREMENTS.

The graded earth surface and the finished subgrade surface after being properly compacted shall be checked by use of blue tops, strings, and templates to insure that the subgrade surface is at the planned grade and section. Variations from the designated grade up to plus or minus five hundredths of a foot (0.05") will be allowed, provided that the variation does not increase or decrease by more than 1/2 inch in 100 feet; however, at bridge structures a plus tolerance will require additional fine grading to prepare a suitable grade tie-in.

(e) PROTECTION AND MAINTENANCE OF THE SUBGRADE.

The Contractor shall be responsible for the protection and maintenance of any existing roads or any subgrade constructed. The subgrade shall be maintained free from ruts and other depressions, in a smooth and compacted condition and true to the required lines, grades, and cross sections. Any rutting or raveling or damage
caused to the subgrade before placing the overlying layers of base and pavement will be repaired by the Contractor.

All intersecting roads, approaches, entrances, and driveways will be graded with the roadway and shall be kept passable at all times. When roadways cannot be closed to traffic, crushed stone material must be placed on the subgrade as designated by the construction plans as a temporary surface to permit public use of the roadway while construction is progressing. The Contractor will be responsible for keeping the temporary surface reasonably smooth, well-drained and watered.

201.04 Sampling and Testing Requirements.

The subgrade shall be sampled and tested by the Engineer of Record to determine the Atterberg Limits and Density of the subgrade and to insure that all requirements are met.

(a) ATTERBERG LIMITS.

1. Fill Material.

Before construction of any subgrade in a fill section, the soil shall be sampled and tested to determine the Plasticity Index (PI) and Liquid Limit (LL) of the soil. One test will be required from each type of soil encountered based on a visual inspection of the soil. No fill shall begin until the soil tests have been completed and the soil is approved for use as a subgrade material by the Engineer of Record in accordance with the provisions of Section 206.

2. Cut Material.

Subgrade material in cut sections shall be sampled and tested to determine the Plasticity Index (PI) and Liquid Limit (LL) of the in-place soils. One test will be required from each type of soil encountered based on a visual inspection of the soil. If the subgrade material does not meet the requirements of this specification, the Engineer of Record may submit to the City Engineer for his consideration a modified roadbed and pavement design considering the unsuitable subgrade material.

(b) DENSITY REQUIREMENTS.

The density of the constructed subgrade shall meet the requirements of Subsection 201.03(c) of this section and of Sections 105 and 206. The number of density tests shall be no less than the following:

1. In fill sections, one (1) standard proctor test for each type of soil encountered and one (1) density test for every two hundred (200) cubic yards of fill compacted in place. When the subgrade is placed in several layers, each layer shall be tested and approved by the Engineer of Record before successive layers are constructed.

2. In cut sections, density tests shall be performed on the subgrade at various depths not to exceed two hundred (200) feet between test sections. Density tests shall be performed at depths of three (3) inches, eight (8) inches, and twelve (12) inches minimum.

3. Density testing will be required at selected areas in the subgrade where trenches and other excavations have been performed.

The Engineer may randomly select any location where density tests will be required.

201.05 Basis of Payment.
No measurement or direct payment will be made for subgrade work, but it shall be considered necessary work covered under the contract prices bid for other related items of work in the Contract. All testing and retesting required by this specification shall be accomplished without additional compensation to the Contractor except as provided in Section 201.04(b) herein, but payment for same shall be included in other contract prices bid for other related items of work. Payment for undercutting will be made at the Contract Unit Bid Price for Unclassified Excavation whenever there is a contract Bid Item and Price for Unclassified Excavation. If unclassified excavation is not paid for as a separate bid item, the undercutting will be paid for at the Contract Unit Bid Price for the type of material (borrow, dense grade base, embankment) used to fill the undercut area. Payment for undercutting shall be full compensation for all hauling, placing of material, compacting, shaping, and testing required to construct the fill material to the designated lines, grades and elevations as shown on the construction plans or as directed by the Engineer.
SECTION 205
DENSE GRADED AGGREGATE BASE COURSE

205.01 Description.

This section of the specifications shall cover the work of furnishing all materials necessary to form an approved dense graded aggregate base course material and to construct the designated layer of dense graded aggregate base course to the specified thickness, elevation, and cross section as shown in the construction plans. The Dense Graded Aggregate Base Course shall be composed of well controlled aggregate sizes, water mixed, placed and compacted in accordance with these specifications and the applicable sections of Section 206 of these Specifications.

205.02 Material.

(a) GENERAL.

Coarse aggregate shall consist of crushed stone, free from adherent coatings and conforming to the requirements of Section 826 and 801.

(b) DELETERIOUS SUBSTANCES.

The amount of deleterious substance in coarse aggregates shall not exceed the following limits:

1. Soft Fragments 2%
2. Coal and Lignite 0.25%
3. Clay Lumps 0.25%
4. Material Passing the No. 200 Sieve 0.25%
5. Thin or Elongated Pieces (Length Greater than 5 Times Average Thickness) 10%
6. Other Local Deleterious Substances 2%
7. Total of 1., 2., 3., and 6 above. 3%

205.03 Construction Requirements.

(a) GENERAL.

1. Preparation of Subgrade

Subgrade shall be constructed as provided in Section 201. Final rolling within 500 feet of the point of placing the required base course shall be performed with a steel wheel roller as hereinbefore provided, and shall be performed even after subgrade and subbase course compaction requirements have been met. The subgrade shall be constructed so that it will be uniform in texture and have as nearly as practicable uniform density throughout. No base course or subbase course shall be placed on the subgrade until specified density is obtained and until the subgrade conforms to the lines, grades and cross-sections shown on the Plans. The density of the top six (6) inches of subgrade shall be not less than one hundred (100) per cent of the maximum density as determined by the AASHTO compaction test (T-99). In no case shall any roadbed material, base course, pavement or surface course be placed on a frozen, muddy or excessively dirty subgrade. Storage or stockpiling of material on the subgrade will not be permitted.

The Contractor shall provide at all times, adequate and suitable equipment of such capacity and character as will insure uniform mixing, placing,
and consolidation of the base course. Aggregate spreading machines or approved spreader boxes shall be used for placing base course. Final surface shaping may be performed with a motor grader as specified in Section 205.03. Rolling of the subgrade or subbase and shoulders immediately ahead of the placing of base course shall be by use of a steel wheel roller as provided in Section 205.03. A large pug mill or rotary mixer or other mechanical mixer of proven performance and adequate capacity may be used to premix the wet aggregates for the base course if premixing is elected. Any rolling or vibrating equipment that will secure consistency and maintain the required compaction and consolidation may be used. Surface watering shall be performed without force of water on the base course, preferably by means of an inverted or indirect spray bar.

2. Placing Base Course Material.

In mixing, handling, and placing the base material, care shall be taken to prevent segregation. The material shall be spread by mechanical spreader or approved spreader box. The base course material shall be placed in not more than six (6) inch compacted layers on an accepted subbase or subgrade.

The surface of the base course material shall be immediately and continually machined with motor graders, maintaining the required section until it has been thoroughly compacted and consolidated. The base course shall be compacted by use of equipment until it reaches one hundred (100) per cent of the (LVD) Maximum Density established in the laboratory by the tentative standard vibratory test method. Rolling shall extend over the edges of the base material for a distance of three (3) feet on the shoulders. When compacted, the base course shall be smooth, hard, dense, unyielding and well bonded.

3. Tolerances.

It is the intent of these Specifications that the completed base course shall be constructed strictly in accordance with the thickness shown on the Plans. Where any portion of the base found not so constructed, the following conditions shall govern the addition of base course material or the re-shaping to the specified cross section:

a. The base shall be cored at intervals of not more than five hundred (500) linear feet, measured along the centerline of the roadway. Measurements shall be made at the center or at right of left of center one (1) foot from the edge of the base course.

b. Measurements of depth shall be made to the nearest 1/4 inch.

c. The average of three (3) measurements shall not be deficient by more than 1/2 inch.

d. No single measurement or core taken at any point of the base course shall be deficient by more than one (1) inch.

4. Mixing.

Premixing of the materials for the base course will be permitted. They shall be mixed by a mobile mixing plant, pulvimixer or other approved mechanical mixer. Water shall be added during the mixing operation in an amount to make the total moisture content of the mixture not less than five (5) per cent by weight, and sufficient to make a workable mixture. At no time during the mixing operation shall the moisture content exceed the designated optimum by more than two (2) per cent. In case the material becomes too dry before compaction, water shall be added by the Contractor. For the top layer only, calcium chloride may be added during the mixing operation at the rate of ten (10) pounds of flakes per loose cubic yard of mixture.

5. Bituminous Layer.

Bituminous Prime Coat shall be applied to the Dense Graded Aggregate
Base Course when shown on the construction plans. Bituminous Prime Coat shall meet the criteria as specified in the applicable portions of Section 401 and Section 807.

(b) EQUIPMENT.
      The equipment outfit used by the Contractor shall be made up of suitable units properly balanced quantitatively and qualitatively with respect to each other, including at least:
      A. One (1) road machine weighing not less than ten thousand (10,000) pounds and/or one (1) motor grader weighing not less than fourteen thousand (14,000) pounds; each shall be of at least two hundred (200) inch wheelbase, equipped with pneumatic tires, scarifier and a blade not less than twelve (12) feet in length and supplied with adequate power to blade and maintain the roadbed.
      B. One (1) three (3) furrow gang turning plow (Mold or Disc Type), capable of plowing to a depth of twelve (12) inches, or a self-powered rotary tiller of equivalent capacity.
      C. One (1) disc harrow (discs at least twenty-two (22) inches in diameter) of an approved width and type for proper mixing, or a self-powered rotary tiller of equivalent capacity.
      D. Sufficient tractors of proper type, size and power to handle equipment.
      E. One (1) water distributor, capable of transporting and uniformly supplying water, as required.
      In lieu of harrow, plow, or equipment with blade for base course mixing equipment, the Contractor may use any approved device or machines specially developed for the purpose.
   2. Rollers.
      Steel wheel rollers shall be of the self-powered three-wheel type, weighing not less than ten (10) tons each (ten (10) ton tandem type rollers meeting the further requirements of this Section may be used). Three rear wheels shall produce a compression of not less than three hundred and thirty (330) pounds per inch of tread. All rollers shall be equipped with devices for keeping the roller wheels clean and damp during rolling operations. The steel wheel three (3) to six (6) ton roller and the pneumatic tired roller will not be permitted for these two (2) treatments. Maximum rolling speed of rollers shall be 2.0 miles per hour.

(c) TESTING
   1. General.
      The stabilized dense graded aggregate base course shall be sampled and tested at intervals as directed by the Engineer of Record and in accordance with these specifications but such intervals shall not exceed five hundred (500) feet along the roadway. Sampling and Testing shall be accomplished by an approved soils laboratory, and each base layer shall meet the requirements of this specification before any overlying layer of base or surface is placed.
      The City Engineer shall be furnished copies of the test reports on gradation, materials, and density. The dense graded aggregate base course will not be accepted until all test are satisfactorily completed in accordance with their specifications. Any tests which do not meet the requirements of density, or composition shall be retested. If the tests continue to fail the specified requirements, the Contractor will be responsible for correcting areas of deficient density, and/or composition by removing and replacing the deficient area. Any areas reworked shall be sampled and tested and the results furnished to the City Engineer for determining acceptance of the work in accordance with these Specifications.
2. Graduation and Density Test.
One sample shall be taken by cutting three cores for the full depth of the material, one on the center and one near each corresponding edge (about one foot inside), and combining the material as one sample representing the base course material at that point. The cores shall be of such size as to accommodate the twelve (12) inch density ring. The in-place density shall be tested in at least one of the core holes. The Contractor shall repair the test holes promptly.

3. Roll Test.
When all density and composition test have been completed and passed and the base course is at the planned grade and cross section and prior to overlaying the base course with additional layers of ban, or pavement, the completed dense graded aggregate base course shall be rolled with a loaded dump truck to check for any areas that are pumping or unstable. The Contractor shall furnish the loaded truck and driver, and the Engineer of Record and City Engineer will be present at the time of the test roll. The loaded truck will be driven along the roadway length as many times as deemed necessary to cover the entire roadway width. Any area found to be pumping or unstable shall be removed and reworked. If deficient areas are not found, then the base course will be approved by the Engineer of Record and the City Engineer will accept the work as ready to receive the next layer of construction. No overlying layers of base material or construction will be permitted until the dense graded aggregate base course has been approved and accepted by the Engineers.

(d) MAINTENANCE
During the construction of the project, the entire roadway shall be maintained, and areas found to be defective shall be corrected, and if necessary, the subgrade and base shall be replaced with acceptable materials. Maintenance shall include maintaining the shoulders to a uniform grade and slope, keeping all drainage ditches free from loose earth, and other objectionable materials, and the roadbed drained at all times until the next layer of base, bituminous binder layer, or concrete curbs and gutters are constructed. The base course shall be machined and graded as often as necessary and as directed to maintain it smooth and to grade and cross section until the next layer of base, bituminous binder layer, or concrete curbs and gutters are constructed.

Traffic Control shall be accomplished in accordance with Section 709.

205.04 Method of Measurement.

(a) DENSE GRADED AGGREGATE BASE COURSE.
The volume of accepted Dense Graded Aggregate Base Course will be determined by measuring the area covered by the dense graded aggregate base course and multiplying the area by the thickness as required by the construction plans or directed by the Engineer, and computing the number of cubic yards compacted in-place.

(b). WATERING, COMPACTING, GRADING, AND TESTING.
No measurement or payment will be made for watering, compacting, grading, or testing as required by these specifications and as required to construct an acceptable Dense Graded Aggregate Base Course.

205.05 Basis of Payment.

(a) UNIT PRICE COVERAGE
The quantity of accepted Dense Graded Aggregate Base Course as determined
in Subsection 205.15(a) will be paid for at the Contract Unit Bid Price per cubic yard of material compacted in-place. Price and Payment shall be full compensation for mixing, watering, hauling, placing, compacting, testing, rolling and consolidating all materials and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:
Dense Graded Base Course ___ - per Cubic Yard
SECTION 206
DENSITY REQUIREMENTS FOR COMPACTION

206.01 Description

This section shall establish the density requirements for earth work, subbase, base, shoulder, surface and pavement layers.

206.02 Material

Material involved shall comply with the appropriate Section under which work is to be performed.

(a) GENERAL

The control density testing procedures are based on the current AASHTO testing procedures.

In the event the mean density of a test section, (roadway or shoulder) does not conform to the applicable requirements stated hereinafter, the Contractor will be required to cease his laydown operations and continue his compactive effort, reworking the entire test section as necessary, until the required mean density is obtained. In the event an individual test value does not conform to the requirements stated hereinafter, the Contractor shall concentrate his compactive effort in the defective area or rework the entire area represented by that test as necessary to obtain the required density.

(b) DENSITY FOR EMBANKMENT LAYERS.

CONTROL TEST.

AASHTO T-99 Method A, C, or D

Method A will be used when material has 10 percent or less aggregate retained on the No. 4 sieve with the retaining aggregate discarded.

Method C will be used when material has more than 10 percent less aggregate retained on the No. 4 sieve, and less than 20 percent retained on the 3/4" sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

Method D will be used when material has more than 20 percent retained on the 3/4" sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

IN-PLACE DENSITY REQUIREMENTS -95% for Method A or C, or 98% for Method D.

Embankment layers that are composed predominantly of rock (approximately 70%) shall be rolled until firm, but no in-place density test will be required.

MOISTURE CONTENT.

Strict moisture control will not be required. However, compaction in a semi-dry condition will not be permitted.

(c) DENSITY FOR MODIFIED AND IMPROVED ROADBED LAYERS.

CONTROL TEST.

AASHTO T-99 Method A, C, or D

Method A will be used when material has 10 percent or less retained on the No. 4 sieve with the retained aggregate discarded.
Method C will be used when the material has more than 10 percent aggregate retained on the No. 4 sieve and less than 20 percent retained on the 3/4 inch sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

Method D will be used when the material has more than 20 percent retained on the 3/4 inch sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

**IN-PLACE DENSITY REQUIREMENTS- 100 % MOISTURE CONTENT**

Moisture content at the time of in-place density test shall be within + or - 2 % of the moisture content established during the control density test.

(d) **DENSITY FOR ROADBED OR LIME STABILIZATION.**

**CONTROL TEST**

AASHTO T-99 Method A, C, or D for materials without chemical additives.

Method A will be used when material has 10 percent or less retained on the No. 4 sieve with the retaining aggregate discarded.

Method C will be used when the material has more than 10 percent aggregate retained on the No. 4 sieve and less than 20 percent retained on the 3/4 inch sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

Method D will be used when the material has more than 20 percent retained on the 3/4 inch sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

**IN-PLACE DENSITY REQUIREMENTS- 100 % MOISTURE CONTENT.**

Moisture content at the time of the in-place density test shall be to the satisfaction of the Engineer of Record, but in no case will be more than + or - 5 % of the established optimum moisture content.

(e) **DENSITY FOR SUBBASE AND BASE LAYERS CONTROL TEST**

AASHTO T-180, Method A, C, or D for material containing natural soil binders without chemical additives.

Method A will be used when material has 10 percent or less retained on the No. 4 sieve with the retaining aggregate discarded.

Method C will be used when the material has more than 10 percent aggregate retained on the No. 4 sieve and less than 20 percent retained on the 3/4 inch sieve and the test performed in accordance with Note 8 of the AASHTO procedure.

Method D will be used when the material has more than 20 percent retained on the 3/4 inch sieve and the test performed in accordance with Note 8 of the AASHTO procedure.

AHD 223 for materials containing natural soil binders with Portland cement, calcium chloride or other chemical additives, excluding bituminous materials.

AHD 140 for materials composed of all crushed aggregates with or without chemical additives, excluding bituminous materials.

AASHTO T-209, unless otherwise specified by the plans, shall be used for bituminous mixtures.
IN-PLACE DENSITY REQUIREMENTS

Table I

<table>
<thead>
<tr>
<th>In-Place Density Test</th>
<th>STANDARD METHODS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AASHTO T-180</td>
<td>AHD 223</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Sand Method AHD 221</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>AASHTO T-166</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear Gage AHD 222</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>AHD 350 *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* For bituminous layers having a designated rate of placement of 300 lbs/s.y. or less.

Moisture Content

Moisture content at the time of in-place density test shall be within + or - 2% of the moisture content established during the control density test except for crushed aggregate bases which shall be a minimum of 5% and excluding all bituminous mixtures.

(f) BLANK

(g) DENSITY FOR BITUMINOUS PAVEMENT LAYERS CONTROL TEST

Bituminous pavement layers shall be compacted to the applicable requirements shown in Tables II and III with AASHTO T-209 method unless otherwise specified by the plans.
### TABLE II

<table>
<thead>
<tr>
<th>In-Place Density Test Method</th>
<th>CONTROL TEST METHOD PERCENT REQUIRED IN-PLACE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Method AASHTO T-209</td>
</tr>
<tr>
<td>AASHTO T-166</td>
<td>92</td>
</tr>
<tr>
<td>AHD 222</td>
<td>92</td>
</tr>
<tr>
<td>AHD 350 *</td>
<td>92</td>
</tr>
</tbody>
</table>

### TABLE III

<table>
<thead>
<tr>
<th>In-Place Density Test Method</th>
<th>CONTROL TEST METHOD PERCENT REQUIRED IN-PLACE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Method AASHTO T-209</td>
</tr>
<tr>
<td>AASHTO T-166</td>
<td>92</td>
</tr>
<tr>
<td>AHD 222</td>
<td>-</td>
</tr>
<tr>
<td>AHD 350 *</td>
<td>92</td>
</tr>
</tbody>
</table>

* For layers having a designated rate of placement of 300 lbs/s.y. or less

### 206.03 BASIS OF PAYMENT

No separate payment will be made for the density requirements noted hereinbefore in this Section, such being considered incidental to the requirements of placement of the material involved.
SECTION 401
BITUMINOUS SURFACE TREATMENTS

401.01 Description.

(a) GENERAL.
The work covered by this Section consists of basic bituminous treatments such as prime coat, asphalt flush coats, liquid seals and bituminous surface treatments.

Each bituminous treatment shall consist of one or more hot applications of bituminous material and, except for prime coats, includes a specified cover aggregate which shall be spread after each bituminous application.

The work also includes the cleaning of the existing surfaces as well as furnishing and applying all materials, and necessary incidental work thereto, all in accordance with plan details and these Specifications.

(b) BITUMINOUS TREATMENT TABLE.
The following table shows the amount of bituminous material and the size and amount of cover aggregate required for the various types of bituminous treatments. The types are designed in the table by letters of the alphabet such as A, B, C, D, etc. The Contractor may select one of the kinds of bitumen, if not in conflict with other provisions of these Specifications, permitted by the table. All other requirements of the tabular line opposite the type designation shall apply.

(Example: A bituminous treatment Type AKG, specifies a prime coat with the quantities specified on line "A", covered by a single surface treatment with the quantities specified on line "K", covered in turn by a seal treatment with the quantities shown on line "G").

Bituminous materials shall be placed within the tolerance specified by the table for the type treatment involved. Any variation outside of the designated limits shall be cause for ordering the treatment to be removed and replaced.

The rate of aggregate coverage shown by the table is the approximate rate found to produce an acceptable coverage when properly applied. Regardless of the rate shown, the Contractor shall provide aggregate in sufficient quantities and so spread the aggregate that the bitumen is uniformly and evenly covered.
## BITUMINOUS TREATMENT TABLE
Section 401.01(b)

<table>
<thead>
<tr>
<th>Designated Letter</th>
<th>Type Treatment</th>
<th>Aggr. Ø</th>
<th>Aggr. Ø</th>
<th>Gals. of Bituminous Material of Treatment</th>
<th>Per Sq. Yd. Cutback or Emls. Asph</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Prime Coat</td>
<td>Sand</td>
<td>0.15</td>
<td></td>
<td>.22 to .25*</td>
</tr>
<tr>
<td>B</td>
<td>Flush Coat &quot;B&quot;</td>
<td>9</td>
<td>0.2</td>
<td></td>
<td>.16 to .19</td>
</tr>
<tr>
<td>C</td>
<td>Flush Coat &quot;C&quot;</td>
<td>78 or</td>
<td>0.25</td>
<td>.18 to .21</td>
<td>.18 to .21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89</td>
<td></td>
<td></td>
<td>.20 to .23</td>
</tr>
<tr>
<td>D</td>
<td>Liq. Seal &quot;D&quot;</td>
<td>78</td>
<td>0.25</td>
<td>.22 to .25</td>
<td>.22 to .25*</td>
</tr>
<tr>
<td>E</td>
<td>Liq. Seal &quot;E&quot;</td>
<td>78</td>
<td>0.25</td>
<td>.26 to .29</td>
<td>.26 to .29</td>
</tr>
<tr>
<td>F</td>
<td>Liq. Seal &quot;F&quot;</td>
<td>78</td>
<td>0.27</td>
<td>.26 to .29</td>
<td>.26 to .29</td>
</tr>
<tr>
<td>G</td>
<td>Liq. Seal &quot;G&quot;</td>
<td>78</td>
<td>0.27</td>
<td>.26 to .29</td>
<td>.31 to .34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.35 to .38</td>
</tr>
<tr>
<td>H</td>
<td>Liq. Seal &quot;H&quot;</td>
<td>6</td>
<td>0.4</td>
<td>.31 to .34</td>
<td>.31 to .34</td>
</tr>
<tr>
<td>J</td>
<td>Surf. Treat. &quot;J&quot;</td>
<td>6</td>
<td>0.42</td>
<td>.33 to .36</td>
<td>.33 to .36</td>
</tr>
<tr>
<td>K</td>
<td>Surf. Treat. &quot;K&quot;</td>
<td>5</td>
<td>0.5</td>
<td>.35 to .38</td>
<td>.35 to .38</td>
</tr>
<tr>
<td>L***</td>
<td>Surf. Treat. &quot;L&quot;</td>
<td>4</td>
<td>0.9</td>
<td>.35 to .38</td>
<td>.35 to .38</td>
</tr>
<tr>
<td></td>
<td>1st Application</td>
<td>78</td>
<td>0.2</td>
<td>.35 to .38</td>
<td>.35 to .38</td>
</tr>
<tr>
<td></td>
<td>Dry Choke</td>
<td>78</td>
<td>0.25</td>
<td>.55 to .58</td>
<td>.55 to .58</td>
</tr>
<tr>
<td></td>
<td>2nd Application</td>
<td>78</td>
<td></td>
<td></td>
<td>.52 to .65</td>
</tr>
</tbody>
</table>

* On cement treated layer, reduce prime bituminous amounts 20 percent.

** For shoulders, different amounts of aggregate and bitumen may be shown on plans or in the proposal.

Multipurpose cationic Emulsified asphalts shall be in the same quantities as shown above for Emulsified asphalt. Conversion of aggregate volumes to weight, when required, shall be in accordance with AASHTO T-19.

The application rate of bituminous materials shown above are based on the materials being at 60°F.

*** Aggregate for this treatment shall be crushed aggregate.

Ø Approximate rate of application for uniform coverage.
401.02 Materials.

All materials shall comply with the requirements of Division III Materials, except as noted hereinafter. Special reference is made to the following:

(a) BITUMINOUS MATERIALS.

The grade of bituminous material shall be within the following limits unless the kind and grade are specified on the plans.

1. PRIME:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Grades (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsified Asphalt AE-P</td>
<td>RT 2 or RT 3</td>
</tr>
<tr>
<td>Tar</td>
<td>MC30 or MC70 for tight bases; MC250, RC70 or RC250 for open bases.</td>
</tr>
<tr>
<td>Cutback Asphalt</td>
<td></td>
</tr>
</tbody>
</table>

2. ASPHALT FLUSH COAT:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Grades (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsified Asphalt RS 1</td>
<td></td>
</tr>
<tr>
<td>RS 2</td>
<td></td>
</tr>
<tr>
<td>CRS 1</td>
<td></td>
</tr>
<tr>
<td>CRS 2</td>
<td></td>
</tr>
</tbody>
</table>

3. LIQUID SEALS AND SURFACE TREATMENTS:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Grades (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Cement AC 5, AC 10</td>
<td></td>
</tr>
<tr>
<td>Cutback Asphalt RC 250, RC 800, RC 3000, MC 800, MC 3000</td>
<td></td>
</tr>
<tr>
<td>Emulsified Asphalt RS 1</td>
<td></td>
</tr>
<tr>
<td>RS 2</td>
<td></td>
</tr>
<tr>
<td>CRS 1</td>
<td></td>
</tr>
<tr>
<td>CRS 2</td>
<td></td>
</tr>
<tr>
<td>Tar</td>
<td>RT 9, RT 10, RT 11, RT 12</td>
</tr>
</tbody>
</table>

Where conditions require the placement of a bituminous plant mix overlay over a bituminous surface treatment or liquid seal, a curing period of 3-21 days will be required before placement of the plant mix overlay. If the plans require the surface treatment or liquid seal to be covered the same day as placed, asphalt cement shall be used in the surface treatment or liquid seal.

(b) AGGREGATE.

Coarse aggregates for bituminous treatments shall be crushed aggregate meeting the requirements of Section 801. The kind of aggregate materials used shall be at the Contractor's option within the following limits:

1. Aggregates for the final application (wearing layer) shall be limited to siliceous aggregates such as granite, slag including reclaimed open hearth slag from cold piles or light weight aggregates (expanded clays or shales produced by the Rotary Kiln Method). The use of carbonate stone such as limestone, dolomite or aggregate tending to polish under traffic will not be permitted. The above will not apply to shoulder surfacing or detours.

2. Crushed gravel may be used for all applications which are to be covered with a bituminous plant mix layer, for all applications on roads having an average daily traffic count (ADT) of less than 1500 vehicles, and for all applications of shoulder surface treatment work.
401.03 Construction Requirements.

(a) EQUIPMENT.
In general, it shall be the Contractor's responsibility to select the proper sizes and amount of equipment to provide the desired results, but the following basic items shall be provided. In addition, all equipment necessary for the proper prosecution of the work shall be assembled on the site and must be approved and in good working order before permission to start any treatment will be given. All equipment approved for use shall be on a trial basis, and should, after a short test section, the equipment prove unsatisfactory, it shall be removed, replaced or supplemented as deemed necessary to accomplish the desired results.

1. CLEANING EQUIPMENT.
Cleaning equipment shall be capable of cleaning the surface thoroughly without cutting, tearing or otherwise damaging the surface.

2. PRESSURE DISTRIBUTOR.
A pressure distributor shall be required and shall be so designed and operated that it will distribute the contents, at a pressure between 30 to 75 psi, in a uniform spray for the full width of the treatment area without atomization, at the rate and within the limits specified. Heating equipment shall be provided. Distributors shall be capable of circulating or agitating the bitumen throughout the heating process providing a uniform temperature, with the ranges specified hereinafter, and suitable means shall be provided for determining such temperatures. Suitable measuring equipment for accurately measuring the gallonage of the contents shall be provided. The distributor shall be equipped with a spray bar of adjustable height, hand hose and nozzle.

3. AGGREGATE SPREADER.
A self-propelled aggregate spreader with mechanically actuated spreading attachments and adjustable widths of satisfactory design and performance will be required, however, when the area to be processed is of such size or shape that to require the use of a mechanical spreader would be impractical, the aggregate may be spread manually.

4. ROLLERS.
A self-propelled steel wheel roller weighing between 5 and 8 tons shall be required immediately behind the aggregate spreader followed by a self-propelled pneumatic tired roller. Only one coverage shall be made with the steel wheel roller.

(b) TEMPERATURE AND WEATHER LIMITATIONS FOR PLACEMENT OF SURFACE TREATMENTS.
All bituminous treatments shall be applied in strict conformity with the following:

1. SEASONAL
No Bituminous Surface Treatment, which will be exposed to traffic, including shoulder paving, shall be placed between the dates of September 15 and May 15. This seasonal limitation will not apply to Prime Coat.

2. WEATHER.
Bituminous material shall not be placed on a wet surface or when the air temperature is below 60°F, or when weather conditions are otherwise unfavorable. No Bituminous material shall be placed when the temperature is expected to fall below freezing during the night regardless of the daytime temperature.
3. MOISTURE IN AGGREGATE.

Aggregates spread when the temperature is 70°F. and above may be surface damp but not wet. Aggregates spread when the temperature is below 70°F. shall be surface dry. Aggregates found to contain excessive moisture or free water at the time of use shall be rejected.

(c) PREPARATION OF EXISTING SURFACE.

Loose material, dust, dirt, caked clay, or any foreign material shall be removed. Cleaning shall be continued until the surface is clean or, in case of application on a soil or aggregate surface, all the loose dirt is removed and the surfaces of the larger size aggregate in the road surface are exposed but not dislodged. All cleaning of the area to be treated shall be completed before any bituminous material is applied.

(d) APPLICATION OF BITUMINOUS MATERIAL.

1. GENERAL.

No bituminous material or treatment shall be applied until the base or underlying surface has been approved as provided in Section 205.

2. PREPARATION OF BITUMINOUS MATERIAL.

Bituminous materials used for each treatment shall be heated as previously noted. The material shall be maintained within the specific temperature range during application. Any material which has not been maintained within the specified range shall be rejected. The following temperature (F.) ranges shall apply:

<table>
<thead>
<tr>
<th>TYPE OF BITUMEN</th>
<th>PRIME</th>
<th>HOT APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Cement</td>
<td>100°-150°</td>
<td>275°-350°</td>
</tr>
<tr>
<td>Cutback Asphalt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC-70, MC-30, MC-70, MC-250, RC-250</td>
<td>100°-150°</td>
<td>125°-180°</td>
</tr>
<tr>
<td>RC-800, MC-800</td>
<td></td>
<td>170°-240°</td>
</tr>
<tr>
<td>RC-3000, MC-3000</td>
<td></td>
<td>215°-270°</td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td>120°-170°</td>
<td></td>
</tr>
<tr>
<td>Tar</td>
<td>120°-150°</td>
<td>120°-170°</td>
</tr>
</tbody>
</table>

It is recommended that, in general, asphalt cements or tars be used June through September and either emulsified asphalt or cutback be used the remainder of the season.

3. APPLICATION OF BITUMEN.

The bitumen shall be applied uniformly over the area to be treated. Where the treatment width is 26 feet or less, the entire width shall be treated in one application. Where only a partial width is treated in one application, extreme care shall be used to insure a slight overlap of adjacent treatments, but not in excess of 4 inches.

The spray bar shall be adjusted to the proper height for exact single or double overlap of spray area without partial overlap. Uniformity of discharge shall be checked before beginning application and at other times as directed. Streaked areas and any other areas lacking uniform distribution shall immediately be made uniform. In all cases the distributor shall be stopped before the application begins to run light (just before the distributor tank is completely empty). A method of making joints shall be used that will insure that in beginning and ending the distribution of each load, a proper junction is made with the preceding and succeeding work without excessive bituminous material at the joints.
In applying bituminous materials, the Contractor shall use effective means to protect structures, walls, curbs, etc. from discoloration or spattering.

4. SPECIAL DETAILS.

Before applying a prime coat, the surface shall be prepared as provided in Subsection 401.03(c) above and, if necessary, it shall be sprinkled with water. After the prime coat has been applied the contractor shall keep all traffic off the road until the prime coat is dry and cured.

No overlying surface shall be placed until the prime coat has been approved by the Engineer of Record in accordance with these Specifications.

The Contractor shall, without extra compensation, maintain the prime treatment and the surface of the base intact until it is covered by an application of a surfacing material. Maintenance shall include satisfactory repair to all holes, ravels, depressions, and areas deficient in prime so that the prime surface shall be smooth and of uniform texture before placing of an overlying surface.

(e) SPREADING AND EMBEDDING AGGREGATE.

The size and amount of aggregate used shall be in accordance with provisions of Subsection 401.01(b) for the type treatment required by the plans.

Spreading of aggregate shall follow application of bituminous material as closely as practicable using mechanical aggregate spreaders. Sufficient aggregate to cover each distributor load, in loaded trucks along with an adequate crew of workmen equipped with brooms standing by, shall be at the site before bituminous application begins.

Spreading of the aggregate shall begin and continue immediately behind the application of the bituminous material. However, if excessive rolling of the aggregate occurs during spreading, the Engineer of Record may allow the chip spreader to delay slightly in order to hold aggregate rolling to a minimum. Rolling shall begin immediately behind the spreading operation. Sufficient rollers shall be furnished to insure that the initial pass of the roller is made within five (5) minutes of the spreading of the aggregate. Rolling shall be continuous, providing coverage of the entire area of treatment to insure thorough embedment of the aggregate.

Unless a sufficient number of rollers are in operation to complete the above requirement, the next load of bituminous material shall not be applied until the rolling of the previous application is completed.

When the aggregate has been thoroughly embedded, rolling shall cease and the Contractor shall, without delay, remove all excess aggregate from the treatment area.

(f) SPECIAL CONSTRUCTION REQUIREMENTS FOR PLACING OF BITUMINOUS TREATMENT "L".

When placing surface treatment "L", special emphasis will be placed on not allowing either public or construction traffic over the work while placing of the treatment; if this cannot be avoided, it shall be well controlled and kept to a minimum.

The sequence of placement of the material shall be as follows:

1st Step - Cleaning of surface and applying the first application of bitumen at the rate shown in Subsection 401.01(b).

2nd Step - Placement of cover aggregate so as to have a uniform cover in contact with the asphalt. The surface should then be rolled with a light roller to key the aggregate with the asphalt.

3rd Step - Place dry choke aggregate and continue rolling and brooming until voids are filled.

4th Step - Apply 2nd application of hot bitumen at rate shown in Subsection 401.01(b).
5th Step - Apply 2nd application of aggregate and continue brooming and rolling until the voids are filled and the aggregate is keyed to the asphalt.

401.04 Maintenance and Protection of Surface and Traffic.

Maintenance shall include immediate repair of any failures or defects that occurs, repeated as often as is necessary to keep the surface continuously intact and acceptable.

The Contractor shall handle traffic through the work and over the surface except while bituminous material is actually being applied and covered with aggregate. It shall be his responsibility to take whatever steps are necessary to protect both the work and the traveling public.

401.05 Method of Measurement.

Measurement will be made of the number of square yards of accepted bituminous treatment, complete in place.

The length shall be the actual length measured along the surface of the treatment. The width shall be the designated width of completed surface. Where the pay item specifies a prime coat plus an overlying treatment, the measurement will not include the additional width of the prime coat. Where the pay item specifies a prime coat only, the width will be the specified width of the prime coat.

401.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Payment for accepted bituminous surface treatment, measured as provided above, will be paid for at the contract unit price per square yard complete in place for the type of bituminous treatment specified in the proposal by the type designation letter or letters; except that adjustments in the contract unit price shall be made as follows: When changes in amounts of treatment materials are ordered as provided in Section 401.01, the contract unit price will be adjusted upward or downward accordingly. Adjustment will be based on the increase or decrease in amounts per square yard, at the verified cost, f.o.b. delivery point plus 2 cents per gallon for the bitumen, and the verified cost per cubic yard for the aggregate delivered to the spreader. The contract unit price or adjusted contract unit price for the accepted yardage complete in place shall be payment in full for furnishing all material, placement of materials, maintenance thereof and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER

Bituminous Treatment Type designation letter/letters Type of bitumen, if specified per Sq Yd Comp In Place
SECTION 402
SLURRY SEAL COAT

402.01 Description.

This Section shall cover the work of constructing a surface course approximately 1/8 to 3/8 inch in thickness placed on existing paved surfaces in accordance with these specifications and within reasonably close conformity to the lines, grades, and widths shown on the drawings.

402.02 Materials.

(a) ASPHALT EMULSION.

(SS-1h Anionic) or (CSS-1h Cationic) shall meet the requirements of Section 807.

(b) AGGREGATE.

Aggregate shall meet the appropriate requirements of Section 801 and 805 with light weight aggregate and manufactured sand made from limestone added to the list of approved stones.

(c) BLANK.

(d) WATER.

The water shall be potable and free from harmful soluble salt. If water exceeds 9 grains hardness, sufficient water softener shall be added to reduce the hardness to below 9 grains.

(e) COMPOSITION OF MIXTURES.

The aggregate, asphalt emulsion, water and, if required, filler meeting the requirements herein specified, shall conform to the composition by weight percentages as specified in Table A of this section.

Type I. This aggregate blend is used to seal cracks and fill voids. It should be used on areas where a minimum wearing surface and a maximum seal is desired. This fine gradation requires an application rate of 4 to 10 pounds of dry aggregate per square yard.

Type II. This aggregate blend is used to give crown corrections and a moderate wearing surface. This surface course shall be used in areas that require this size of aggregate to fill in voids and leave a substantial wearing surface. This gradation requires an application rate of 10 to 20 pounds of dry aggregate per square yard resulting in a surface thickness of approximately 1/8" to 3/8".

The slurry seal shall meet the requirements of Subsection 410.02(b) where applicable.
TABLE A
Composition by Weight Percentages
(Based on Square Opening Laboratory Sieves)
Combined Aggregate Gradations

<table>
<thead>
<tr>
<th>Passing Sieve</th>
<th>Type I</th>
<th>Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>95-100</td>
<td>90-100</td>
</tr>
<tr>
<td>8</td>
<td>70-95</td>
<td>70-95</td>
</tr>
<tr>
<td>16</td>
<td>50-90</td>
<td>45-70</td>
</tr>
<tr>
<td>50</td>
<td>20-42</td>
<td>15-35</td>
</tr>
<tr>
<td>200</td>
<td>7-20</td>
<td>5-15</td>
</tr>
<tr>
<td>Asphalt residue, Percent by Weight</td>
<td>7.0-16.0</td>
<td>6.0-15.0</td>
</tr>
</tbody>
</table>

402.03 Construction Requirements.

(a) WEATHER LIMITATIONS.
The weather limitations as specified in Section 410.03(b) shall apply except that slurry seal shall not be placed when the air temperature is 50°F or lower; nor when the temperature of the pavement on which it is to be placed is 50°F or lower.

(b) EQUIPMENT REQUIREMENTS.
The slurry seal mixing equipment shall be an approved self-propelled, continuous-flow apparatus consisting of a composite of all the required units herein described. The apparatus shall be capable of proportioning, combining and mixing accurately the specified components into a homogeneous mixture with an asphalt film of sufficient thickness to furnish the desired binding properties.

This apparatus shall contain bins, tanks and receptacles of sufficient size and volume, proportioning feeders, liquid measuring meters or devices mechanical mixer and distributor for placing the finished mixture. All units shall be integrated, mechanized and synchronized to deliver the component to the mixer simultaneously and in time adjusted sequence.

(c) MIXER.
The mixer shall be of the spiraled, multi-blade type. The mixing chamber shall have a stated capacity which shall not be exceeded and it shall be mechanically equipped to regulate the mixing time up to but not to exceed 4 minutes. It shall be equipped to pre-wet the aggregate prior to aggregate contact with the asphalt emulsion. It shall have a gate for controlling the discharge of the mixture into the distributor spreader.

(d) SPREADING EQUIPMENT.
A mechanically operated type squeegee distributor shall be integrally assembled with the slurry mixer. The strike-off shall be lined with a flexible material to prevent loss of the slurry mixture during spreading. The strike-off shall have vertical adjustment available for changing grade and crown to assure uniform spreading of the mixture. The apparatus shall be equipped with a pressure system and a fog type spray bar adequate for placing a complete fog coat of water with a
maximum application of 0.05 gallon per square yard over the pavement surface immediately preceding the spreading of the mixture.

Hand squeegees, shovels, surface cleaning machines, and hand equipment as necessary, shall be provided to perform the work.

(e) **CONDITIONING OF EXISTING SURFACE.**
Conditioning of the existing surface shall be in accordance with Subsection 410.03(c).

(f) **PLACEMENT.**
The temperature of the components of the completed mixture shall be so controlled that the application temperature of the slurry seal shall be not less than 50°F nor more than 125°F.

(g) **JOINTS.**
1. **TRANSVERSE JOINTS.**
   Transverse joints shall be constructed by either overlapping the previously cured slurry with ten to fifteen feet of fresh slurry or by lightly wetting the area that the spreader box will touch while the slurry is still in a completely uncured, semi-fluid condition.

2. **LONGITUDINAL JOINTS.**
   Longitudinal joints shall be constructed when the slurry is completely uncured or when it is totally cured. Should the slurry be completely cured, the cured slurry at the joint area shall be wetted by the spray bar. Should the slurry be completely uncured, the slurry shall not be wetted. A burlap drag, or other suitable device, that will cause the fresh slurry coming from the spreader box to distribute itself evenly over the joint, shall be pulled along the joint seam.

(h) **CURING.**
Treated areas shall be allowed to cure until such time as the Engineer of Record shall permit their opening to traffic.

(i) **ROLLING.**
Any rolling required for the slurry seal shall be done with a pneumatic roller. The roller shall be capable of exerting a contact pressure during rolling of 50 to 65 pounds per square inch. Rolling shall consist of not less than four complete coverages over the specified areas.

(j) **TACK COAT.**
When specified, a tack coat shall be placed in accordance with Section 405.

402.04 **Method of Measurement.**
The amount of slurry seal coat applied as directed and accepted will be measured in square yards. The length will be the actual length measured along the surface. The width will be the actual width sealed as shown on the plans or directed.

402.05 **Basis of Payment.**
(a) **UNIT PRICE COVERAGE.**
The number of square yards, measured as provided above, will be paid for at the Contract Unit Price per Sq. Yd. for the item of Slurry Seal Coat of the type specified on the plans, complete in place, which price shall be payment in full for
furnishing all materials and constructing the Slurry Seal Coat, and for all equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:
Slurry Seal Coat, Type * ____ Per Sq. Yd.
*Indicate I or II
SECTION 405
TACK COAT

405.01 Description.
The work under this Section shall cover the furnishing and placing of a bituminous tack coat on an existing surface which is to be covered by a bituminous plant mix material in accordance with these specifications and in reasonable close conformity with the lines shown on the plans.
The work shall include the cleaning of the existing surface prior to application of the tack coat.

405.02 Materials.
Bituminous material for tack coat shall be Emulsified Asphalt, Grade SS-1, SS-1h, RS-2, or CRS-2, or Asphalt Cement, Grade AC-10, AC-20, AC-30, or AC-40. If Emulsified Asphalt is used, the emulsion shall not be diluted prior to application. All materials shall meet the requirements of Section 807.

405.03 Construction Requirements.
(a) EQUIPMENT.
In general it shall be the Contractor's responsibility to select the proper size and amount of equipment to provide the desired results. Equipment furnished shall meet the requirements of Subsection 401.03(a).

(b) TEMPERATURE AND WEATHER LIMITATIONS.
The bituminous tack material shall be applied in conformity with the following:
1. WEATHER - Tack material shall not be applied on a wet surface or when weather conditions are not suitable.
2. TEMPERATURE - Temperature requirements for placement of tack coat material shall be the same as specified in Subsection 410.03(b) for plant mixed pavements.

(c) PREPARATION OF EXISTING SURFACE.
Loose material, dust, dirt and all foreign matter shall be removed from the surface to be treated. Approval of the surface before application of the tack material is required.

(d) APPLICATION.
Tack coat material shall be applied in an amount up to a maximum of 0.10 gallon per square yard for emulsified asphalt and 0.07 gallon per square yard for asphalt cement.
An asphalt distributor shall be provided for use on all accessible areas; Areas which are not accessible, such as around manholes, etc. may be coated by other methods.
When applying tack coat, it shall be applied to all contact surfaces of curbs, gutters, manholes, and adjacent pavement edges. Adjacent surfaces, such as gutters and the like, that are not to be in contact with the mix, shall be adequately protected from the spray, by means of heavy paper securely fastened in place or other methods.
satisfactory means. Any such surface soiled by tack coat material shall be cleaned and restored to its previous condition.

Tack coat material shall be spread only far enough in advance to permit the construction to progress consistently, uniformly, and continuously after the curing period and shall not be applied so far in advance that the viscous quality will be reduced by traffic prior to construction thereon. Tack coat that loses its viscous quality before being covered shall be renewed and any which has been damaged shall be replaced.

405.04 Method of Measurement.

The amount of bituminous material used as directed for tack coat will be measured in gallons.

405.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The amount of bituminous material used as directed for tack coat measured as noted above, will be paid for at the contract unit price bid per gallon which shall be full compensation for furnishing the bituminous material, hauling, heating, application, curing, maintaining and for all equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Tack Coat _____ per Gallon
SECTION 406
REPAVED BITUMINOUS PAVEMENTS

406.01 Description.
The work under this Section covers the in place recycling process of bituminous pavements of the plant mix type. Unless specified otherwise by this Section, all of the requirements of Section 410 shall apply to recycled bituminous pavements.
This work shall consist of heating, scarifying, leveling, applying specified liquid additives, mixing the scarified material with the liquid additives, laying the recycled mix as a leveling course, and concurrently applying an even surface layer of new hot bituminous plant mix to form a monolithic pavement layer conforming to the lines, grades, and dimensions shown on the plans or specified in the proposal.

406.02 Materials.
(a) GENERAL.
The City, prior to letting of contract, will take cores of the existing material and will make an analysis of the composition of the material. The results of these tests will be shown on the plans, and it will be the Contractor's responsibility to determine and add the type and amount of asphalt rejuvenator to the repaved material to bring the total bituminous material to meet the requirements of the tests on residue from Thin-Film Oven Test of Table 2 of AASHTO M-226 for asphalt cement, grade 20 through grade 40. The type of asphalt rejuvenator shall be approved by the City prior to its use on the project.

(b) COMPOSITION OF MIXTURES.
The in place recycled asphalt concrete leveling course shall be a homogeneous mixture of reclaimed material removed from the existing pavement and asphalt rejuvenator. The new hot bituminous plant mix placed on the top of the leveling course to form a monolithic layer shall be the type mix specified on the plans (411-A, 416-A, etc.).

406.03 Construction Requirements.
The requirements of Section 410.03 shall be in effect with the requirements of Subsection 410.03 (a) modified such that the equipment used to perform the in place recycling shall be manufactured for the intended purpose of recycling existing bituminous plant mix pavements at a rate that will minimize delay and inconvenience to the traveling public. In addition the recycling machinery shall meet the following minimum requirements:
It shall be able to uniformly apply sufficient radiant heat to the pavement surface to allow the pavement to be scarified up to an average depth of one inch. For depths of more than one inch, two machines may be used with the second machine following closely behind the lead machine. The heating and scarifying must be able to be done without damaging the bituminous material or allowing the surface of the pavement to exceed 450°F. The heater shall be capable of heating the pavement to a sufficient temperature as to allow the recycled mix to be within a 175°F. to 250°F. temperature range at the time the new hot bituminous plant mix is placed on the top of the recycled mix.
It shall be equipped with pressure loaded scarifiers with teeth sufficiently spaced so as to cut to the specified depth, a surface conforming to the desired finished profile of the pavement.
It shall be capable, immediately after scarifying, to coat the reclaimed mix evenly with the asphalt rejuvenator.

It shall be equipped with a cutting and leveling blade that gathers the reclaimed material.

It shall be so designed and equipped as to mix the reclaimed material and asphalt rejuvenator, evenly spread the mixture and compact it with a screed that lays the recycled mix as a leveling course in alignment with the plan profile.

It shall be so equipped, unless specified otherwise by the plans or permitted by the Engineer, as to receive, spread, and initially compact the new bituminous plant mix material.

Standing edges of previous adjoining passes shall be heated and cut back a minimum of two inches during the next paving pass.

Under no circumstance shall the new plant mix bituminous material be incorporated in such a way as to become a homogeneous mixture with the reclaimed recycled material.

406.04 Method of Measurement.

Measurement will be made of the number of square yards to the nearest 0.1 square yard, of repaved bituminous pavement acceptably placed. Measurement of new bituminous plant mix will be as provided in Section 410.08.

406.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
Payment for accepted repaved bituminous pavement, measured as provided above, will be paid for at the contract unit price per square yard complete in place for the approximate average depth specified on the plans. The contract unit price shall be payment in full for furnishing all materials, including asphalt rejuvenator, placement of material, maintenance thereof, and for all equipment, tools, labor, and incidentals necessary to complete the work.

Payment for the new plant mix bituminous material, measured as provided above, will be paid for under the appropriate item for the type mix placed (411-A, 416-A, etc.).

(b) PAYMENT WILL BE MADE UNDER:
Repaved Bituminous Pavement ____ per Square Yard.
SECTION 408
PLANING (MILLING) OF EXISTING PAVEMENT

408.01 Description.

This Section shall cover the work or removing, by planing (milling), existing pavement for one or more of the following reasons: To lower the finished surface adjacent to existing curb, to remove excess surface material, to correct faulting, to improve surface drainage or to improve the riding characteristics prior to resurfacing.

The work specified in this Section also consists of transporting the removed pavement material to the asphalt plant site and stockpiling it to be used in a recycled asphalt concrete mix where applicable. The amount, or height, of reclaimed material stored in a stockpile for use in recycling should be kept to a minimum, usually 8 to 12 feet in height, to prevent moisture buildup or reconsolidation of the material.

The removed material shall become the property of the Contractor. If the Contractor elects not to use this material in a recycled mix, he may dispose of it in such location and manner as approved by the Engineer.

408.02 Equipment.

The equipment for this operation shall be a machine capable of maintaining a depth of cut and cross slope which will achieve the results specified herein. The machine shall be equipped with automatic grade controls which operate by sensing from one or more skids moving along the pavement surface and if required shall produce a skid resistant surface texture.

The machine shall be equipped with a means to effectively limit the amount of dust escaping from the removal operations.

If the machine is equipped with preheating devices, special attention is directed to the fact that local environmental and other regulations governing the operation of this type of equipment may vary considerably from place to place. It shall be the Contractor's responsibility to familiarize himself and comply with all such local regulations, as well as State and Federal rules, and to obtain all necessary permits.

408.03 Construction Requirements.

The existing pavement shall be removed to varying depths in a manner which will restore the pavement surface to a uniform longitudinal profile and cross section as specified herein. Removal shall be to the depth and cross slope as specified on the plans.

The longitudinal profile of the planed surface shall be established by a skid sensor on the side of the cut nearest the centerline of the road. The cross slope of the planed surface shall be established by a second skid sensing device near the outside edge of the cut or by an automatic cross slope control mechanism. The plans may waive the requirement for automatic grade or cross slope controls where the situation warrants such action.

The Contractor may elect to make multiple cuts to achieve the required pavement configuration or depth of cut.

The planing machine shall be operated to effectively minimize the amount of dust being emitted from the machine. Prewetting of the pavement may be required.
Prior to opening to traffic an area which has been planed, the pavement shall be thoroughly swept with a power broom or other approved equipment to remove, to the greatest extent practicable, fine material which will dust under traffic. This operation shall be conducted in a manner so as to minimize the potential for creation of a traffic hazard and to minimize air pollution.

Material removed by the planing machine shall be disposed of as detailed in Section 408.01. Material swept from the pavement shall be disposed of in areas as specified in the plans or directed by the Engineer.

408.04 Finished Surface.

If the planed surface is to be the final surface of the pavement, it shall have either continuous or intermittent striations or any other pre-approved pattern which will provide an acceptable level of skid resistance. If pavement is to be constructed over the planed surface, it shall have a texture which will provide good bonding.

The finished surface shall have a reasonably uniform texture and shall meet the surface requirements specified in Subsection 410.05(a).

Areas varying from a true surface in excess of the above stated tolerance may be accepted without correction if the Engineer determines that they were caused by a pre-existing condition which could not have reasonably been corrected by the planing operation. Any unsuitable texture or profile, as determined by the Engineer, in accordance with the plans and specifications, shall be corrected by the Contractor at no additional compensation.

The Engineer may require replaning of any area where a surface lamination causes a non-uniform texture to occur.

408.05 Method of Measurement.

The planing of pavement ordered and accepted will be measured in square yards computed from surface measurements taken to the nearest tenth (0.1) of a foot on the planed pavement.

408.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The planing of pavement ordered and accepted, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the planing of the pavement, the transporting and stockpiling of the removed surplus material, the removal of grinding residue and the satisfactory disposal thereof, the cleaning of the pavement and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Planing Existing Pavement____per S. Y.
SECTION 410
BITUMINOUS PLANT MIX PAVEMENTS

410.01 Description.

The work under this Section covers the general requirements that are applicable to all types of bituminous pavements of the plant mix type. Deviations from these general requirements will be indicated in the specific requirements for various type of mixes noted in the following Sections of these Specifications.

This work shall consist of one or more courses of bituminous plant mix constructed in accordance with these specifications and the specific requirements of the type of mixture required and in reasonably close conformity with the lines, grades thicknesses, and typical cross sections shown on the plans.

This work shall also include the preparation of the underlying surface on which the plant mix is to be placed, including patching and/or leveling as shown on the plans.

In addition, this work shall also include the placing of widening at locations shown on the plans. In general, widening shall consist of (1) narrow width build-ups required for widening existing pavement, (2) paving for turn-outs beyond three feet from the edge of pavement, (3) paving crossovers, and (4) turning lanes for crossovers. Paving used on turnouts for intersecting paved roads and shoulder paving will not be considered as widening unless shown on the plans.

410.02 Materials.

(a) GENERAL.

All materials furnished for use shall conform to the appropriate provisions of Section 807 for Bituminous Materials, Sections 801, 805, and 826 for Aggregates, and the following:

Any mix utilizing gravel or granite as a coarse aggregate will require the use of an approved heat stable anti-stripping agent in the bitumen. The amount of anti-stripping agent, when required, shall be 0.5 to 1.0 percent by weight of the bitumen content.

The anti-stripping agent shall be added to the bitumen by on-line blending equipment either at the refinery or the Contractor's mixing plant within + or - 10% of the specified rate. Verification test for the presence of the anti-stripping agent will be made at the mixing plant using AHD-255.

Silicone may be used in asphalt cement, not to exceed 2 oz. per 5000 gallons. Other additives shall not be added to the bitumen. The use of any unauthorized additive will be cause for rejection of the mixture.

(b) COMPOSITION OF MIXTURES.

1. GENERAL.

The bituminous plant mix shall be composed of a mixture of aggregate, and bituminous material. Various aggregate fractions shall be combined in such proportions that the resulting mixture meets the gradation requirements within the general composition of each particular mix/section. When the aggregate is crushed limestone, a minimum of 10 percent sand shall be used. The sand shall have at least 80 percent passing the No. 8 sieve, no more than 10 percent passing the No. 100 sieve, and no more than 5 percent passing the No. 200 sieve.

The combined materials passing the No. 8 sieve shall not have a clay content greater than 4 percent adjusted to the total sample.
The project designated weights per square yard of the plant mix layers are designed assuming a compacted mix unit weight of not greater than 158 pounds per cubic foot for dense graded mixes (light weight aggregates excepted.) Hence, a correction to the plan designated weight per square yard will be made in accordance with the following:

If the compacted mix unit weight as determined in the job mix formula design exceeds 158, or is below 130, pounds per cubic foot, the correction will be based on the formula

\[ x = \frac{ab}{158} \]

Where: \( x \) = corrected weight per square yard
\( a \) = laboratory compacted mix unit weight in pounds per cubic foot as shown in the job-mix formula.
\( b \) = project designated weight per square yard of plant mix as shown on the job plans

If the laboratory compacted unit weight is between 130 pounds per cubic foot and 158 pounds per cubic foot, no correction will be made to the pounds per square yard designated by the plans or proposal.

If the plans provide for the use of light weight aggregate (expanded clay or shale), the pounds per square yard of the layer shown by the plans will not be adjusted.

If the plans provide for the use of an "Open Graded" plant mix layer, the pounds per square yard of the layer shown by the plans will not be adjusted.

2. JOB-MIX FORMULA.
   a. General.

   No work shall be started under this Section on a specific project, nor any mixture accepted therefor until the Contractor has submitted and received approval from the Engineer of Record of his intended material sources and his job-mix formula. At least two working days prior to beginning work, the Contractor shall furnish the City Engineer a copy of the approved job mix with the project number inserted. A copy of the approved job mix shall be available at the plant any time material is being delivered.

   The Contractor shall submit to the Engineer of Record for approval, a job mix for each mixture to be supplied from a specific plant. The submitted formula shall be within the master composition range specified for the particular type of bituminous plant mix involved and shall include any additive by type and trade name and be accompanied by samples from the material sources he proposes to use in producing the mix. The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, a single percentage of any additive, and a mixing temperature range suitable for the type, grade, etc. of bitumen to be used in the mix. Each job-mix formula shall be accompanied by a test report from an approved source certifying that all current design test parameters have been met.

   b. Design.

   The job-mix formula shall allow for a minimum of a five percent difference in the percent passing on each sieve larger than the #100 on which there is material retained, and this difference shall be maintained during production.

   Bituminous mixtures shall be designed using AHD-307. The gradation of the mixtures shall be reasonably close to, but not coincident with, the Maximum
Density Curve for the given aggregate as defined by the FHWA 45 Power Gradation Chart. Mixes shall satisfy a minimum VMA requirement as shown for each type of mix/section. Mixes shall be designed for 4 percent Air Voids. Mixes shall be produced with 3 to 5 percent Air Voids as determined by AHD 353. Flow criteria shall be 8-18 on 50 blow designs and 8-16 on 75 blow designs.

(c) BLANK.

(d) SAMPLING AND INSPECTION.
Production of required gradation in the mix shall be the Contractor's responsibility.

The right is reserved to take samples of aggregates from stockpiles and asphalt from storage tanks at the asphalt plant and to make tests as needed as a basis for continued acceptance of the materials.

Samples of the mixture in use will be taken and tested as many times daily as deemed necessary, and the mixture must be maintained uniform throughout the project within the given tolerances. Composition limits (by weights) of the completed mixture shall be determined by AHD Test Procedures 258 and 319.

The Contractor shall cut samples with mechanical equipment from the compacted pavement for testing. Samples not smaller than four inches square or four inches in diameter for the full depth of the course to be tested shall be taken at random locations directed by the Engineer. Furnishing of suitable approved cutting equipment, the cutting of the samples, and the immediate repair of the sample holes with similar type of material shall be performed by the Contractor.

410.03 Construction Requirements

(a) EQUIPMENT.
In general, choice of equipment will be left to the Contractor and it shall be his responsibility to provide proper sized and amounts of equipment that will produce, deliver to the roadbed, spread, and compact the plant mixed material in sufficient quantities for the continuous movement of the spreaders under normal operating conditions.

The mixing plant, hauling, spreading and compaction equipment shall meet the requirements listed below, however, other equipment that will produce equally satisfactory results, such as electronically or automatically controlled devices of proven performance, will be considered for use in lieu there of.

The Contractor shall secure approval of all equipment prior to beginning work and any equipment found unsatisfactory shall be promptly replaced or supplemented.

1. REQUIREMENTS FOR ALL PLANTS.
Mixing plants shall comply with the requirements of AHD-324 Mixing Plant Requirements for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

2. SCALES.
A digital recorder shall be installed as part of the platform truck scales. The recorder shall produce a printed digital record on a ticket of the gross and tare weights of the delivery trucks along with a time and date print for each ticket. Provisions shall be made so that scales may not be manually manipulated during the printing process, and so interlocked as to allow printing only when the scale has come to rest. The scales and recorder shall be of sufficient capacity and size to
accurately weigh the heaviest loaded truck or tractor trailers that are used for the
delivery of the bituminous concrete from that plant.

In lieu of plant and truck scales, the Contractor may provide (1) an
approved automatic printer system which will print the weights of the material
delivered, provided the system is used in conjunction with an approved automatic
batching and control system. (Such weights shall be evidenced by a weight ticket for
each load), or (2) an electronic load cell weigh system with associated computer
hardware and automated printing system.

The Contractor may provide a "weigh batcher" system utilizing a weigh
hopper equipped with load cells that determine the net amount of mix delivered from
the weigh hopper. An automated weight printing system shall be provided to
accurately print the weight of material delivered, the time and the date for each
ticket.

3. HAULING EQUIPMENT.

Trucks used for hauling bituminous mixtures shall have tight clean,
smooth metal beds which have been thinly coated with a minimum amount of
paraffin oil, lime solution or other approved material to prevent the mixture from
adhering to the beds; the use of gasoline, kerosene or other volatile material is
prohibited. Each truck shall be equipped with a cover of canvas or other suitable
material of such size as to protect the mixture from adverse conditions. Each truck
shall have a hole in the side of the body, approximately 5/16" in diameter and
suitably placed, to allow for temperature measurement of the bituminous mix. When
the air temperature is below 60°F., or hauling time exceeds 30 minutes, or
threatening weather exists, no mixture shall leave the plant unless it is covered
entirely and the cover securely fastened.

4. BITUMINOUS PAVERS OR SPREADERS.

Bituminous pavers or spreaders shall be self-contained and of sufficient
size, power and stability to receive, distribute, and strike off the bituminous material
at rates and widths consistent with the specified typical section requirements, details
shown on the plans and noted in Section 410.03(f)2.

When laying mixtures, the paver shall be capable of being operated at
forward speeds consistent with satisfactory laying of the mixture, providing a
finished surface of the required evenness and texture without tearing, gouging or
shoving of the mixture.

All asphalt paving machines shall be equipped with automatic grade
and slope controls. Equipment operating together must have the same type controls.
The automatic controls may operate either from control grade wires or ski; however,
when a ski is used the lead spreader shall have a ski of not less than 30 feet in length.
Both grade and slope controls shall be in good working order at all times; in the event
of a malfunction of the automatic control system, the spreading operation shall be
discontinued after one hour until the equipment is repaired and restored to first class
working order.

5. COMPACTION EQUIPMENT.

Compaction equipment shall be self-propelled, capable of compacting
the mixture to the required density throughout the depth of the layer while it is still
in a workable condition without damage to the material.

The compaction shall be accomplished with the use of a steel wheel
breakdown roller, followed by a multi-wheel pneumatic tired roller and a steel wheel
finish roller. On thin layers, those less than 150 pounds per square yard, and for
leveling, the requirement for the initial steel wheel roller will be waived, as long as
acceptable results are achieved, thereby allowing the pneumatic tired roller to serve
as a breakdown and compactive roller.
(b) WEATHER AND TEMPERATURE LIMITATIONS.

All bituminous plant mixtures shall be applied in compliance with the following:

1. WEATHER.

The mixture shall be laid only upon an approved underlying course which is dry and only when weather conditions are suitable. The Engineer of Record may, however, permit work of this character to continue when overtaken by sudden rains, up to the amount which may be in transit from the plant at the time, provided the surface just ahead of the placing is swept clear of water and the mixture is within the temperature limits specified. The layer placed under such conditions shall be at the Contractor's risk and shall be removed and replaced by him should it prove unsatisfactory.

2. TEMPERATURE CONTROL.

Bituminous plant mix layers of 200 pounds per square yard or less shall not be placed when the air temperature is below 40°F.; air temperature shall be 40°F. before the spreading operation is started. Spreading operations shall be stopped when the air temperature is below 45°F. and falling. Rolling and finishing operations shall be completed during daylight hours. For bituminous plant mix layers over 200 pounds per square yard, the above temperature may be lowered five (5) degrees.

(c) PREPARATION OF UNDERLYING SURFACE.

1. GENERAL.

The underlying surface must be approved by the Engineer of Record and the City Engineer before the placing of a plant mix application will be allowed. The underlying surface, whether an old surface or a new surface, shall be thoroughly cleaned of all foreign or loose material and maintained in such condition in advance of the surfacing work.

2. PATCHING.

When patching of an existing surface is provided by the plans, the designated areas shall be trimmed to neat vertical lines for the depth of the unstable material. The loose faulty material shall be picked up and removed from the area. The newly exposed patch area shall be cleaned and treated with prime or tack material before placement of patching material. The bituminous patching material shall be placed and compacted until the patch area is filled to the elevation of the surrounding surface. Compaction of the patching material shall be to the degree that further consolidation of the patching material is not anticipated.

3. LEVELING.

When leveling of an existing pavement or base is provided by the plans, the surface shall be brought to proper grade and cross section with plant mix material. The surface to be treated shall be prepared as noted hereinbefore and approved before placing the new material.

4. WIDENING.

When widening is provided by the plans, the widening shall be placed at the locations designated by the plans. The requirements for placing of the widening shall be the same, as far as practical, as for the placing of the normal roadway.

(d) PREPARATION OF MIXTURES.

1. BITUMEN.

The bituminous material shall be heated in a manner that insures the even heating of the entire mass under efficient and positive control at all times. Any bituminous material which has been damaged shall be rejected.
2. AGGREGATE.
   a. Aggregate Used for Batch Mixing and Continuous Mixing Operations.
      All aggregates shall be dried so that the moisture content at the time of mixing is less than 0.5 percent by weight. The temperature of the aggregate at the dryer shall not exceed 350°F.
      The aggregate, immediately after being heated shall be screened into three or more sizes and conveyed into separate bins, ready for batching and mixing with bituminous material. However, for mixes using aggregate of one-half inch maximum size, the number of bins may be reduced to two.
      Maintenance of a uniform aggregate gradation is essential for a dryer drum operation, hence, caution and care shall be exercised in stockpiling of materials to avoid segregation.

3. MIXING.
   a. Batch Mixing.
      The dried mineral aggregate, and measured mineral filler when used, prepared as prescribed above, shall be combined in uniform batches by weighing and conveying into the mixer the proportionate amounts of each aggregate required to meet the job-mix formula. The largest size aggregate shall be introduced first, then small sizes progressively, with mineral filler last, or all mineral components may be added simultaneously. The mineral components shall be thoroughly mixed. The required quantity of bituminous material for each batch shall be measured by weight using scales or a bituminous material metering device attached to the bituminous material bucket.
      After the mineral components have been mixed, the bituminous material shall be added and the mixing continued for a period of at least 45 seconds or longer if necessary to produce a homogeneous mixture. Each batch must be kept separate throughout the weighing and mixing operations.
      The mixture shall be uniform in composition, free from lumps or balls of material containing an excess quantity of asphalt, or from pockets deficient in asphalt.
   b. Continuous Mixing.
      Components shall be introduced and proportioned volumetrically by continuous methods utilizing equipment specified hereinbefore for continuous plants. The amounts of aggregate and bituminous material entering the mixer, and the rate of travel through the mixer shall be so coordinated that a uniform mixture of specified gradation and bitumen content will be produced.
   c. Dryer-Drum Mixing.
      Components shall be proportioned by weight as noted hereinabove in Section 410.03(a)1 for this method of mixing. The amounts of aggregate and bituminous material entering the mixer, and the rate of travel through the mixer shall be so coordinated that a uniform mixture of specified gradation and bitumen content will be produced. An anti-stripping agent may be required to insure adequate coating of the aggregates.
      The temperature of mixing shall not exceed the temperature equivalent to the kinematic viscosity of 150 centistrokes of the asphalt cement as determined by AASHTO T-201.
      The moisture content of the mix as discharged from the mixer shall not exceed 0.5% by weight.

4. RECYCLED MIXTURES.
   a. New Aggregate Temperature.
      The temperature of the new aggregate shall be superheated to the point where, when combined with the reclaimed material, the specified discharge or
delivery temperature is produced; however, in no case shall the temperature of the new aggregate exceed 600 degrees Fahrenheit.

b. Mixing.

The plant shall be designed and operated so that heat transfer will take place in the mixing unit without damage to or vaporization of the bituminous material. For batch type plants, a minimum dry mixing cycle of 15 seconds shall be required for the new aggregate and reclaimed material before introduction of the new bituminous material.

(e) TRANSPORTING MIXTURE.

The mixture shall be transported in appropriate equipment. The equipment shall be in sufficient numbers to deliver the material to the roadbed without delay in the quantity required. No loads shall be delivered too late in the day to be spread, compacted, and finished during daylight hours.

(f) PLACING THE MIXTURE.

1. RATE OF PLACEMENT.

The average weight per square yard of plant mix to be placed will be specified by the plans; however, this rate may require correction to adjust for the compacted mix unit weight as determined in the job mix formula design. The Engineer of Record may direct in writing that the designated weight be increased or decreased in certain areas if rate correction is required. It shall be the Contractor's responsibility to place and spread the material uniformly to such thickness as will produce the specified average weight per square yard, separately for each layer of base, binder, and surface, and to maintain a continuing check on tonnage and yardage throughout the day's operation to insure uniform specified weight.

Unless otherwise provided in the following sections of these specifications, the average weight per square yard placed and compacted in one layer shall not exceed 350 pounds for base or binder layers, and 200 pounds for surface layers. Where the amount to be placed exceeds these limits, it shall be placed and compacted in 2 or more approximately equal layers.

2. SPREADING.

a. General.

Spreading of the bituminous mixture shall be performed by equipment meeting the requirements of Section 410.03(a)4, except as noted hereinafter in this Section. Approved specialized equipment may be employed to spread the bituminous material where standard full scale equipment is impractical due to size and irregularity of the area to be paved.

Spreading operations shall be so correlated with plant and hauling equipment that the spreading operation, once begun, shall provide an uninterrupted forward movement of the spreaders. Uninterrupted forward movement of the spreader requires the use of hauling vehicles capable of supplying the spreader with bituminous material while the spreader is in motion. Repetitive interruptions or stopping of the spreader shall be cause for the Engineer of Record to stop the work until the Contractor evaluates the cause of the stoppage and has provided a definite action plan for correction of the interruptions. Any interruption will require the thorough check of the area immediately under the spreader and any variances shall be corrected immediately or the material removed and replaced.

Material placed in the spreader shall be immediately spread and screeded to such uniform depth that the average weight of the mixture required per square yard is secured. Alignment of the outside edges of the pavement shall be
controlled by preset control lines, and shall be finished in conformity with these controls.

Any spreading operation which cannot produce acceptable joints within the surface tolerances and density requirements shall be cause for requiring the Contractor to modify his operations to include additional spreading equipment.

b. Spreading By Motor Grader.

For areas of a bituminous plant mix surface inaccessible to the mechanical spreader, patching of pot holes and correcting failures in existing pavement, the plant mix may be dumped in low areas, windrowed, spread and compacted to bring the elevation and section to the desired level.

If shown on the plans, the Contractor shall use a motor grader to perform the spreading for the leveling operation. The motor grader shall be equipped with smooth faced tires.

c. Spreading By Hand.

For areas inaccessible to mechanical spreading equipment, and when patching potholes and minor pavement failures, hand spreading of the bituminous mixture may be permitted. The mixture shall be distributed immediately into place by means of suitable tools and spread in a uniformly loose layer.

(g) COMPACTING.

As soon as the mixture has been spread and has set sufficiently to prevent undue cracking or shoving, rolling shall begin, using equipment specified in Section 410.03(a). A delay in the initial rolling will not be tolerated and the initial or breakdown rolling should in general be performed by rolling longitudinally, beginning at the sides and proceeding toward the center of the surface. When paving abuts a previously placed lane, the longitudinal joint shall be rolled in the first pass. On superelevated curves rolling shall begin at the low side and progress toward the high side. The roller shall not compact within six (6) inches of the edge of the surface where an adjacent lane is to follow, while the surface is still hot.

If any displacement occurs during rolling, it shall be corrected at once. To prevent adhesion of surface mixture to the rollers, the wheels shall be kept adequately moistened with water and a non-foaming detergent, but an excess of water will not be permitted.

Adequate precaution shall be taken to prevent dropping of gasoline or oil on the pavement. In places inaccessible to a roller, compaction shall be obtained with hand or mechanical tampers of adequate weight to produce required density.

(h) JOINTS.

1. GENERAL.

Placing of bituminous paving layers shall be as continuous as possible. All joints shall be made in a careful manner in such a way as to provide a smooth, well bonded and sealed joint, meeting the density and surface requirements of Sections 410.04 and 410.05. Failure to meet requirements noted above shall be cause for ordering the removal and reconstruction of the joint.

The contact surface of concrete structures shall be treated with a thin coat of bituminous material (Tack material or the bituminous material used in the mix) prior to construction of the joint. The same treatment noted above shall be used on cold bituminous joints.

2. LONGITUDINAL.

Longitudinal joints in the wearing surface shall conform with the edges of proposed traffic lanes insofar as practical. Any necessary longitudinal joints in underlying layers shall be offset so as to be at least 6 inches from the joint in the next overlying layer.
3. TRANSVERSE.

Transverse joints shall be carefully constructed, rollers shall not pass over the unprotected edge of the freshly laid mixture unless laying operations are to be discontinued. To facilitate the expeditious removal of the plant mix joint when laying operations are resumed, the Contractor shall place a heavy wrapping paper on the underlying surface across the joint and place plant mix on top of the paper. Upon resumption of the work a neat joint shall be formed by cutting back vertically into the previously laid material to expose the full depth of the layer. The fresh mixture shall be raked and tamped to provide a well bonded and sealed joint meeting surface and density requirements.

410.04 Density Requirements.

Density tests will be made promptly during and upon completion of compaction, not later than the next day, so that density deficiencies may be corrected while the mixture is still workable. Areas of deficient density not corrected shall be removed and replaced.

410.05 Surface And Edge Requirements.

(a) SURFACE SMOOTHNESS REQUIREMENTS.

1. GENERAL.

Surface smoothness and roadway section will be checked by the use of string, Engineer's level and straight edge.

The Contractor shall furnish string, straightedges and the necessary personnel to handle them under the supervision of the Engineer.

Surface smoothness tests shall be made continuously during and immediately after rolling so that irregularities may be eliminated to the extent possible by rolling while the material is still workable, otherwise deficiencies shall be corrected as provided in Section 410.06.

2. REQUIREMENTS FOR ALL SURFACES.

The finished surface of all base, binder, and wearing surface layers shall not vary more than 1/4 inch from the required section measured at right angles to the pavement centerline. The finished surface shall not vary more than 3/8 inch in any 25 foot section from a taut string applied parallel to the surface and roadbed centerline at the following locations: one foot inside of the edges of pavement, at the centerline, and at other points as designated. The variance from the designated grade shall not increase or decrease more than 1/2 inch in 100 feet.

The surface shall not vary more than 1/4 inch from a 16 foot straightedge placed parallel to the centerline at points directed. A 16 foot rolling straightedge, equipped with marking capability, may be used in lieu of the fixed straightedge.

(b) EDGE REQUIREMENTS.

Surface, binder and leveling pavement edges not confined by curbing or other structures shall be lightly tamped, generally with a lute and immediately behind the placement operation, to form an approximately 1:1 slope as a preventative measure against cracking and bulging during the rolling process. This procedure shall also be required on the initial edge of a longitudinal cold joint. These edges shall be neatly shaped to line behind the breakdown roller and shall be trimmed as necessary after final rolling, to an accurately lined string or wire providing a maximum tolerance of 2 inches outside the theoretical edge of pavement, with a maximum variation from a true line of 1/2 inch in 10 feet and a slope not flatter than 1:1. Edges that are distorted by rolling shall be corrected promptly.
410.06 Defective or Deficient Areas.

Deficiencies in surface smoothness shall be remedied to the extent practicable by rolling while the material is still workable. Otherwise the layer shall be removed and replaced as necessary to obtain required smoothness. "Skin patching" of a surface layer to correct low areas or heating and scraping to correct high areas will not be permitted. Overlays of not less than 80 pounds per square yard may be used for surface smoothness deficiencies.

All areas containing excessive or deficient amounts of bitumen, all areas showing segregation of materials and all areas unbonded after rolling shall be removed and replaced.

Areas found deficient in density shall be removed and replaced or re-rolled until density is in accordance with these Specifications; however, re-rolling shall not begin later than the next working day after being placed.

410.07 Maintenance and Protection.

Sections of newly finished work shall be protected from all traffic until they become properly hardened. Maintenance shall include immediate repairs of any defects that may occur on the work; such repairs shall be repeated as often as necessary to maintain the work in a continuously satisfactory condition. The Contractor will be responsible for the protection of the work and protection of any traffic using the work.

410.08 Method of Measurement.

(a) PLANT MIX.

The accepted quantity of bituminous plant mix used as directed will be measured in either tons of 2000 pounds or square yards of specified thickness, compacted in place, as indicated on the proposal.

No adjustments to the actual total tonnage placed will be made where the laboratory compacted mix unit weight is below 158 pounds per cubic foot.

No adjustments to the actual tonnage placed will be made when the use of light weight aggregate (expanded clay or shale) is designated.

For determining weight, each load of bituminous mixture shall be weighed on approved certified scales furnished by the Contractor without direct compensation.

The weight measurement shall include all components of the mixture. No deductions will be made for any of the components, including the bituminous material, contained in the mixture.

(b) TACK COAT.

Tack coat bituminous material used as directed will be measured and paid for as specified in Section 405.

(c) WASTED AND EXCESS MATERIALS APPLIED.

Deductions in measurement will be made for all material wasted or lost due to negligence of the Contractor or applied beyond the limits of the work.
410.09 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Compensation for plant mix material, measured as provided above, shall be full compensation for construction of the bituminous plant mix layer complete in place on the roadbed as indicated or directed, including all materials, procurement, handling, hauling, and processing cost, and includes all equipment, tools, labor and incidentals required to complete the work, with the following exception:

Tonnage placed in excess of the tolerance specified in Section 410.03(f) will be paid for at eighty (80) percent of the contract unit price bid for the type of plant mix involved. No adjustment will apply for patching, leveling and widening.

Patching and/or leveling of an existing wearing surface or base will be paid for at the contract unit price per ton for the appropriate patching and/or leveling mix which will be payment in full for the items, including all materials, procurement, handling, hauling, and processing costs, complete in place and all excavation necessary and incidental to the patching and/or leveling. Such payment shall be compensation in full for all equipment, tools, labor, and incidentals required to complete the work. When patching and/or leveling are required, the plans and/or proposal will so specify.

Widening, as defined in Section 410.01, will be paid for at the contract unit price which will be payment in full for the item, including all materials, procurement, handling, hauling, and processing costs, complete in place, and includes all equipment, tools, labor and incidentals required to complete the work.

Unless otherwise covered by a separate pay item, the cost of excavation for widening, compacting the subgrade, backfilling, spreading or disposing of excess excavated material, removal and disposal of old pavement, removal and resetting of roadway signs and mailboxes, and removal of pavement markers shall be subsidiary obligations of the associated plant mix pay item, and no additional payment will be made for performing the work.

No payment will be made for unacceptable material; for material furnished or used in excess of the amount indicated or directed, except as provided in Subsection 410.03(f); for material used in replacing defective or condemned construction; for material wasted in handling, hauling, or otherwise; or for maintaining the work.

(b) PAYMENT WILL BE MADE UNDER:

See Appropriate Section for Type of Plant Mix Involved.
SECTION 411
HOT BITUMINOUS PAVEMENT

411.01 Description.

The work covered by this Section shall consist of constructing one or more courses of hot bituminous plant mixed pavement on a prepared surface in accordance with these specifications and in reasonable close conformity with the lines, grades, typical cross section and the approximate number of pounds per square yard shown on the plans.

411.02 Materials.

The materials furnished for use shall conform to the requirements of Section 410 and the following:

(a) GENERAL.
All mixes in this Section, regardless of the type aggregate used, will require the use of an anti-strip agent. The Air Void Content shall be designed and produced within 3-8 percent. The minimum VMA for Mix A is 16 and the minimum for Mix B is 14.

(b) AGGREGATES.
Coarse aggregates for an actual wearing surface shall be limited to siliceous aggregates such as gravel, granite, slag, sandstone, or a combination of the proper sizes of these materials that will produce an acceptable job mix within the gradation limits shown. The use of carbonate stone such as limestone, dolomite, or aggregates tending to polish under traffic will not be permitted. Carbonate stone will be permitted in shoulder paving and when used in widening.
Coarse aggregates for mixes used in other than an actual wearing surface may be any aggregate meeting the requirements of Section 801.
Fine aggregate shall be sand or crushed aggregate or a mixture of these meeting the requirements of Section 805.04 or Subsection 826.02.
The coarse and fine aggregates shall be combined in a total blend that will produce an acceptable job mix within the limits shown below. The job mix shall be designed by the Marshall Method to produce a minimum of 750 pounds stability.
Unless otherwise noted on the plans, Mix A shall be used for all layers having a specified rate of placement of 125 pounds per square yard or less and Mix B shall be used for all layers having a specified rate of placement greater than 125 pounds per square yard.
### GENERAL COMPOSITION

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>PERCENT PASSING BY WEIGHT (Square Mesh Type)</th>
<th>Mix A</th>
<th>Mix B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch Sieve</td>
<td></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>3/4 inch Sieve</td>
<td></td>
<td>85 - 100</td>
<td></td>
</tr>
<tr>
<td>1/2 inch Sieve</td>
<td></td>
<td>100</td>
<td>70 - 95</td>
</tr>
<tr>
<td>3/8 inch Sieve</td>
<td></td>
<td>90 - 100</td>
<td>62 - 86</td>
</tr>
<tr>
<td>No. 4 Sieve</td>
<td></td>
<td>64 - 84</td>
<td>45 - 67</td>
</tr>
<tr>
<td>No. 8 Sieve</td>
<td></td>
<td>44 - 64</td>
<td>33 - 52</td>
</tr>
<tr>
<td>No. 50 Sieve</td>
<td></td>
<td>10 - 28</td>
<td>10 - 24</td>
</tr>
<tr>
<td>No. 100 Sieve</td>
<td></td>
<td>6 - 20</td>
<td>6 - 16</td>
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<tr>
<td>No. 200 Sieve</td>
<td></td>
<td>3 - 12</td>
<td>3 - 10</td>
</tr>
</tbody>
</table>

(c) BITUMEN.

Unless the type of bitumen is specified on the plans, the Contractor may select for use either asphalt cement, grade AC-20, AC-30, or AC-40. The proportion of bitumen to total sample by weight shall be 4.5 percent to 9.0 percent. The exact proportion shall be fixed by the job-mix formula.

### 411.03 Construction Requirements.

Construction requirements shall be the same as specified in Section 410.

### 411.04 Method of Measurement.

The accepted quantities of Hot Bituminous Pavement, Patching, Leveling and Widening will be measured as provided in Section 410.08.

### 411.05 Basis of Payment

(a) UNIT PRICE COVERAGE.

Hot Bituminous Pavement, Patching, Leveling and Widening, measured as noted above, will each be paid for at the contract unit price bid in accordance with Section 410.09.

(b) PAYMENT WILL BE MADE UNDER:

- Hot Bituminous Pavement - per ____SY ____Inches Thick
- Hot Bituminous Pavement, Patching ____SY ____Inches Thick
- Hot Bituminous Pavement, Leveling - per Ton
- Hot Bituminous Pavement, Widening ____SY ____Inches Thick
  * Specify Quantity
  ** Specify Thickness of Pavement
SECTION 414
BITUMINOUS CONCRETE BINDER LAYER

414.01 Description.

The work covered by this Section shall consist of a hot bituminous plant mixed binder layer placed on a prepared surface and to be covered by a bituminous wearing surface in accordance with these specifications and in reasonable close conformity with the lines, grades, typical cross section and the approximate number of pounds per square yard shown on the plans.

414.02 Materials.

The materials furnished for use shall conform to the requirements of Section 410 and the following:

(a) General.

The minimum VMA for mixes in this Section is 12.

(b) Aggregates.

Fine aggregate shall be sand or crushed aggregate or a mixture of these, meeting the requirements of Section 805.04 or Subsection 827.02(b). Coarse aggregate shall be gravel, crushed gravel, and gravel, crushed slag, crushed stone, crushed sandstone, or combinations thereof, meeting the requirements of Section 801 or Subsection 827.02(c).

When gravel is used as the aggregate for a mix, at least 50% by weight of material retained on the No. 8 sieve shall be crushed material passing the 3/4-inch sieve. When gravel is used in a blend with other aggregates, at least 50% by weight of material retained on the No. 8 sieve shall be slag or stone passing the 3/4-inch sieve.

The coarse and fine aggregates shall be combined in a total blend that will produce an acceptable job mix within the gradation limits shown below. The job mix shall be designed by the Marshall Method to produce a minimum of 1400 pounds stability.

Mix A shall be used unless otherwise noted on the plans.

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>PERCENT PASSING BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Square Mesh Type)</td>
<td>Mix A</td>
</tr>
<tr>
<td>1-1/2 inch Sieve</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch Sieve</td>
<td>80 - 95</td>
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<tr>
<td>1/2 inch Sieve</td>
<td>75 - 90</td>
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<td>3/8 inch Sieve</td>
<td>54 - 76</td>
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<td>No. 4 Sieve</td>
<td>40 - 58</td>
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<td>No. 8 Sieve</td>
<td>28 - 46</td>
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<td>8 - 22</td>
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<tr>
<td>No. 100 Sieve</td>
<td>5 - 15</td>
</tr>
<tr>
<td>No. 200 Sieve</td>
<td>3 - 10</td>
</tr>
</tbody>
</table>
(c) **Bitumen.**

Unless the type of bitumen is specified on the plans, the Contractor may select for use either asphalt cement, grade AC-20, AC-30, or AC-40. The proportion of bitumen to total sample by weight shall be 3.5 percent to 6.0 percent for Mix A and 3.5 percent to 6.5 percent for Mix B. The exact proportion shall be fixed by the job-mix formula.

414.03 **Construction Requirements.**

Construction requirements shall be the same as specified in Sections 410.03 through 410.07.

414.04 **Method of Measurement.**

The accepted quantities of Bituminous Concrete Binder Layer and Bituminous Concrete Plant Mix, Patching, Leveling and Widening will be measured as provided in Section 410.08.

414.05 **Basis of Payment.**

(a) **UNIT PRICE COVERAGE.**

Bituminous Concrete Binder Layer and Bituminous Concrete Plant Mix, Patching, Leveling and Widening, measured as noted above, will each be paid for at the contract unit price bid in accordance with Section 410.09.

(b) **PAYMENT WILL BE MADE UNDER:**

414-A Bituminous Concrete Binder Layer

414-B Bituminous Concrete Plant Mix, Patching

414-C Bituminous Concrete Plant Mix, Leveling

414-D Bituminous Concrete Plant Mix, Widening

* Specify Quantity

** Specify Thickness of Pavement
SECTION 416
BITUMINOUS CONCRETE WEARING SURFACE

416.01 Description.

The work covered by this Section shall consist of constructing a hot bituminous concrete wearing surface on a prepared surface in accordance with these specifications and in reasonable close conformity with the lines, grades typical cross section and the approximate pounds per square yard shown on the plans.

416.02 Materials.

The materials furnished for use shall conform to the requirements of Section 410 and the following:

(a) GENERAL.

All mixes in this Section, regardless of the type aggregate used, will require the use of an anti-strip agent. All gravel aggregates shall be washed prior to crushing. All mixes in this Section shall be designed on the fine side of the Maximum Density Curve on the No. 8 sieve.

(b) AGGREGATES.

Aggregates shall meet the appropriate requirements of Section 801 and 805 with attention directed to Section 805.04 and the following:

(c) COARSE AGGREGATE.

Coarse aggregates for an actual wearing surface shall be limited to siliceous aggregates such as gravel, granite, slag, sandstone, or a combination of the proper sizes of these materials that will produce a mix within the required gradation limits. Carbonate stone such as limestone, dolomite, or aggregates which tend to polish under traffic will be permitted only in underlying layers, shoulder paving, and widening as defined by Section 410.01. All coarse aggregate shall be crushed aggregate meeting the requirements of Section 801.

(d) FINE AGGREGATE.

Round, pea, or shot gravel, defined as an uncrushed gravel passing the 3/8 inch sieve with more than 50% retained on the No. 8 sieve, will not be permitted as a material to be blended in this mix. A sand stockpile may be rejected if it appears that this type gravel has been blended with a natural sand.

Natural fine aggregate used in this mix shall be reasonably clean, free from a coating of injurious material, lumps of clay, loam, organic matter, or other foreign matter and uniformly graded. All of the aggregate shall pass the 3/8 inch sieve and at least 85% shall pass the No. 4 sieve.

Manufactured fine aggregate used in the mix shall have 100% passing the 3/8 inch sieve with 95% of the material retained on the No. 8 sieve having at least one freshly fractured face.

The aggregates shall be combined in a blend in which at least 80% of the total material retained on the No. 4 sieve, shall have at least two freshly fractured faces, and will produce an acceptable job mix within the gradation limits shown below. The job mix shall be designed by the Marshall Method to produce a minimum
stability of 1600 pounds, and a minimum VMA of 15 for Mix A, 14 for Mix B, and 16 for Mix C.

Unless otherwise noted on the plans, Mix A shall be used for all layers having a specified rate of placement of 125 pounds per square yard or less and Mix B shall be used for all layers having a specified rate of placement greater than 125 pounds per square yard.

<table>
<thead>
<tr>
<th>SIEVE (Square Mesh Type)</th>
<th>PERCENT PASSING BY WEIGHT</th>
<th>Mix A</th>
<th>Mix B</th>
<th>Mix C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch Sieve</td>
<td></td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4 inch Sieve</td>
<td></td>
<td>100</td>
<td>95 - 100</td>
<td></td>
</tr>
<tr>
<td>1/2 inch Sieve</td>
<td></td>
<td>95 - 100</td>
<td>76 - 90</td>
<td>100</td>
</tr>
<tr>
<td>3/8 inch Sieve</td>
<td></td>
<td>80 - 95</td>
<td>66 - 84</td>
<td>90 - 100</td>
</tr>
<tr>
<td>No. 4 Sieve</td>
<td></td>
<td>54 - 74</td>
<td>46 - 66</td>
<td>65 - 82</td>
</tr>
<tr>
<td>No. 8 Sieve</td>
<td></td>
<td>38 - 56</td>
<td>34 - 50</td>
<td>45 - 62</td>
</tr>
<tr>
<td>No. 30 Sieve</td>
<td></td>
<td>16 - 36</td>
<td>16 - 30</td>
<td>22 - 38</td>
</tr>
<tr>
<td>No. 50 Sieve</td>
<td></td>
<td>10 - 26</td>
<td>10 - 22</td>
<td>14 - 28</td>
</tr>
<tr>
<td>No. 100 Sieve</td>
<td></td>
<td>6 - 18</td>
<td>5 - 14</td>
<td>8 - 20</td>
</tr>
<tr>
<td>No. 200 Sieve</td>
<td></td>
<td>4 - 12</td>
<td>4 - 10</td>
<td>4 - 14</td>
</tr>
</tbody>
</table>

(e) BITUMEN.

Unless the type bitumen is specified on the plans, the Contractor may select for use either asphalt cement, grade AC-20, AC-30, or AC-40. The proportion of bitumen to total sample by weight shall be 4.7 percent to 9.0 percent for all mixes. The exact proportion shall be fixed by the job-mix formula.

416.03 Construction Requirements.

Construction requirements shall be the same as specified in Sections 410.03 through 410.07.

416.04 Method of Measurement.

The accepted quantities of Bituminous Concrete Wearing Surface and Bituminous Concrete Plant Mix, Patching, Leveling and Widening will be measured as provided in Section 410.08.

416.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Bituminous Concrete Wearing Surface and Bituminous Concrete Plant Mix, Patching, Leveling and Widening, measured as noted above, will each be paid for at the contract unit price bid in accordance with Section 410.09.

(b) PAYMENT WILL BE MADE UNDER:

416-A Bituminous Concrete Wearing Surface \_\_SY \_\_\_Inches Thick
416-B Bituminous Concrete Plant Mix, Patching \_\_SY \_\_\_Inches Thick
416-C Bituminous Concrete Plant Mix, Leveling - per Ton
416-D Bituminous Concrete Plant Mix, Widening \_\_SY \_\_\_Inches Thick
SECTION 501
STRUCTURAL PORTLAND CEMENT CONCRETE

501.01 Description

The work under this Section shall cover the furnishing of Portland cement concrete to be used in construct concrete structures. Structures shall include but are not limited to bridges of all types, box culverts, headwalls, retaining walls and other miscellaneous structures.

501.02 Materials

(a) GENERAL

Handling, storage, and control of materials shall comply with appropriate portions of Section 60. All materials shall conform to the requirements set forth in Division III Materials. Specific reference is made to applicable portions of the following Sections:

- Section 801 - Course Aggregate
- Section 805 - Fine Aggregate
- Section 809 - Fly Ash
- Section 811 - Water
- Section 813 - Air Entraining Additives
- Section 815 - Retarders and Reduces
- Section 823 - Cement
- Section 827 - Local Sand for Misc. Use
- Section 829 - Concrete Curing Material
- Section 832 - Concrete Joint Fillers, Sealers and Water Stop
- Section 837 - Steel Reinforcement

(b) SPECIAL REQUIREMENTS

Aggregate from different sources, which are to be used for concrete Types 2, 3, and 4 as specified in Section 501, may be stockpiled together provided material from each source meets the requirements of Section 801 and the specific gravity of the aggregate from each source does not vary more than plus or minus 0.05.

In the event the course aggregate shows a tendency to segregate in the stock pile, the Engineer may order the course aggregate be furnished and batched in two fractions from two separate stockpiles.

The Contractor may be required to adjust the size of the course aggregate for the concrete used around steel in heavily reinforced members.

(c) PROPORTIONING MATERIALS

1. General

A master Proportion Table has been provided for the use as a guide in proportioning components of mixes. If needed, the exact amounts of aggregate and additives will be established by the Engineer in the form of a job mix formula furnished to the Contractor. Substitute mixes designs will not be accepted unless the plans or proposal designated the design of the mix as a responsibility of the Contractor.
### 2. Master Proportion Table

<table>
<thead>
<tr>
<th>Concrete Class Type</th>
<th>A-1a</th>
<th>A-2a</th>
<th>B-3</th>
<th>A-1c</th>
<th>C-4</th>
<th>E-6a</th>
<th>S-7a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Factors</td>
<td>620</td>
<td>620</td>
<td>508</td>
<td>620</td>
<td>620</td>
<td>658</td>
<td>696</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Max. Water (Gallons)</td>
<td>36</td>
<td>39</td>
<td>36</td>
<td>33</td>
<td>33</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>Fine Aggregate (lbs)</td>
<td>1088</td>
<td>1204</td>
<td>1487</td>
<td>1097</td>
<td>1504</td>
<td>947</td>
<td>1096</td>
</tr>
<tr>
<td>Course Aggregate (lbs)</td>
<td>1839</td>
<td>1829</td>
<td>1712</td>
<td>1857</td>
<td>1677</td>
<td>1974</td>
<td>1696</td>
</tr>
<tr>
<td>Entrained Air % by Volume</td>
<td>3-5</td>
<td>None</td>
<td>None</td>
<td>4-6</td>
<td>None</td>
<td>3-5</td>
<td>3-5</td>
</tr>
<tr>
<td>Maximum Consistency slump</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>7</td>
</tr>
<tr>
<td>Course Aggregate Size No.</td>
<td>57/67</td>
<td>57/67</td>
<td>57/67</td>
<td>57/67</td>
<td>57/67</td>
<td>57/67</td>
<td>57/67</td>
</tr>
<tr>
<td>Minimum PSI Strength 28 Days</td>
<td>3000</td>
<td>3000</td>
<td>2000</td>
<td>4000</td>
<td>3000</td>
<td>4500</td>
<td>3000</td>
</tr>
<tr>
<td>Special Requirement Notes</td>
<td>b,e</td>
<td>b,e</td>
<td>b,e</td>
<td>a,e</td>
<td>b,e</td>
<td>a,e</td>
<td>c,d</td>
</tr>
</tbody>
</table>

**Notes:**

a. The Class A Type 1c mix and Class E mixes will require an acceptable water reducer or a water reducing set retarder in the job mix in order to obtain the 3.5 inch slump.

b. Acceptable water reducers or watering set retarders may be used to increase the slump to 4.0 inches in unusual conditions, provided prior approval for such is given by the Engineer of Public Works. The increased slump, when approved will be considered the specified slump when applying tolerances specified in Section 501.

c. Seal Concrete used as an integral part of a bridge system will require the use of washed gravel course aggregate Type II cement and Class "F" fly ash to aid in reducing the heat of hydration. Fly ash use in mixes shall be as specified in Section 501. Seal concrete not used as an integral part of a bridge support system does not require the use of washed gravel course aggregate, Type II cement or fly ash.

d. Acceptable water reducers or water reducing set retarders may be used to obtain a flowable concrete mix if necessary, within the allowable slump range, provided approval for such is given by the Engineer of Public Works. In no case shall the water to cementitious material (cement plus fly ash) ratio shown in the Master Proportion Table be exceeded in order to increase the slump.

e. Fly ash use in mixes shall be as specified in Section 501.

**Explanation of Table**

The following construction code numbers identify the kind of work on which a designated mix is to be used:

- **Type 1** - Mix "a", Bridge substructure concrete, box culverts, retaining walls and concrete safety barriers. Mix "c", bridge superstructure concrete.
- **Type 2** - Mix "a", headwalls, inlets and miscellaneous concrete units.
- **Type 3** - Slope Paving
- **Type 4** - Machine laid curbs, gutters or combination curbs and gutters.
- **Type 6** - Bridge concrete for use when the structure is exposed to salt water, where shown by the plan details.
- **Type 7** - Underwater concrete

Substitution of Type 1 mixes for Type 2 and Type 3 mixes or the substitution of a higher strength mix for one of a lower strength may be permitted if such is requested in writing.

The mixes shown by the table were designed on a specific gravity of 2.65 for sand and 2.60 for course aggregate (bulk, saturated, surface dry). The design weight will be adjusted on the job mix formula to reflect the specific gravity of the actual aggregates being used. These mixes were designed to use either AHD NO. 57 or AHD

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No. 67 course aggregate. If requested, the use of No. 7 may be permitted in Type 4 mixes and the use of AHD No. 357 or AHD No. 467 may be permitted in Type 7 mixes.

The basic design fineness modulus for sand is 2.60. Reference is made to Section 805.02(g) for gradation uniformity.

3. Job Mix Formula

The job mix formula will be based on the Master Proportion Table. These formulas have proven they will produce concrete of strength in excess of that shown in the Master Proportion Table provided the aggregate is from an approved source, is clean and not segregated and proper batching and mixing methods are used. The actual job mix may not be exactly as shown in the Master Proportion Table due to local variations in material or special design considerations.

During the progress of the work the relative proportions between the fine and course aggregate, and between aggregate and water, may be varied as needed for best results, but the cement factor (weight of cement in pounds per cubic yard of concrete) and the water to cementitious material (cement plus fly ash) will not be changed except as noted below:

The water content may be decreased to produce concrete of the desired consistency with an appropriate increase in fine aggregate to maintain yield. If it is impossible to produce concrete having the desired consistency without exceeding the maximum allowable water content specified in the Master Proportion Table, the cement content shall be increased as directed by the Engineer so as not to exceed the maximum water to total cementitious material (cement plus fly ash) ratio.

If the Engineer finds it is advisable to increase the minimum design strength of the concrete and orders the cement factor increased, the City of Huntsville will reimburse the Contractor for the actual amount only of the additional cement used, based on actual f.o.b. destination prices.

The Master Proportion Table is based on the use of Type I, II, or IP cement. The Contractor may select either of these type cements for use, except that type IP cement will not be permitted in fly ash mixes. The Contractor may, at his own convenience and without additional compensation, use additional cement or substitute Type III cement, provided prior notice is given to the Engineer of Public Works.

It shall be the Contractor's responsibility to furnish suitable aggregate and carry out uniform construction practices which will produce concrete of not less than the minimum psi strength indicated by the Master Proportion Table. Should the concrete not produce the required minimum strength, the Engineer of Public Works shall be notified so that additional tests and evaluations can be made prior to ordering the removal of the affected concrete. Should low breaks occur consistently, the Engineer may order such corrective action as deemed necessary, all without additional cost to the City. Special note is made of the following:

When type IP cement is used, it will be necessary to provide two (2) additional cylinders for a 90 day break should the 28 day test show strength less than that specified by the Master Proportion Table.

Where the conditions require the use of low tricalcium aluminate, the plans or proposal will designate Type II cement. In such case, if requested and approved, Type I cement containing a maximum of eight (8.0) percent tricalcium aluminate may be used. Should Type III cement be permitted, a maximum of 8.0 percent tricalcium aluminate shall still apply.

4. Additives

An approved air entraining agent shall be used when such is specified in the Master Proportion Table. The percent of air entrainment shall be maintained, at the point of delivery, within plus or minus one (1) percentage point of the amount specified in the job mix formula. Occasional loads having an air content of minus two (2) percentage points from that specified may be allowed.
Other acceptable chemical admixtures, necessary due to unforeseen conditions, may be used if prior approval is obtained from the Engineer, except that calcium chloride will not be permitted.

Standard methods and equipment for measuring and adding additives shall be approved by the Engineer. Equipment which will not accurately dispense the correct amount of additive in an acceptable manner will not be approved.

No separate payment for additives used in the mix will be made.

5. Slump

The consistency slump shown in the Master Proportion Table for each mix is considered the specified slump. When the specified slump is three and one half (3 1/2) inches or less, a tolerance of plus 1/2 inch will be acceptable for the mixture delivered at the work site; when the specified slump is greater than three and one half(3 1/2) inches, a tolerance of plus one (1) inch will be acceptable. Any mix delivered with a slump less than the specified slump will be acceptable provided the mix is workable.

If it becomes necessary or desirable to change the slump due to unusual placing requirements or to the use of a high range water reducer, the slump will be designated in the original, or revised, job mix formula.

6. Fly Ash

Fly ash may be used in any job mix formula except where it is specified otherwise by the plans or proposal. If fly ash is used, the Master Proportion Table will be used as a guide in proportioning the mix components. Fly ash may be substituted for cement up to a maximum substitution rate of twenty percent for Class F fly ash and thirty percent Class C fly ash by weight. The minimum substitute ratio of fly ash to the cement it replaced will be one pound of fly ash to one pound of cement.

When fly ash is substituted for cement in any job mix formula, the letter "F" will be added in the class designation (ie Class A-1a becomes Class AF-1a, Class A-1c becomes Class AF-1c). Due to the differences in the specific gravities of fly ash and cement, adjustments will be made to the aggregate weights shown in the Master Proportion Table to correct the yield of the mix back to one cubic yard. The maximum gallons of water shown in the table for the mixes without fly ash will remain the same when fly ash is used, but field experience has shown that the water requirement is usually less with fly ash in the mix. When water is withheld due to slump requirements, a correction of the yield will be made by replacing the volume of water removed with an equal volume of fine aggregate. In no case shall the water to total cementitious material (cement plus fly ash) ratio shown in the table be exceeded.

When fly ash is required by the plans or proposal for the propose of reducing the heat of hydration of a concrete mass, the class of fly ash to be used will be Class F. Where seal concrete is an integral part of a bridge support system, the required fly ash will be Class"F" ash.

(d) SAMPLING AND INSPECTION

Aggregates from approved sources will be accepted in stockpiles provided there is no segregation, but production of required gradation in the mix shall be the Contractor's responsibility.

Cement, aggregates, water and all additives shall be accepted on the basis of requirements currently listed in these specifications or as specifically outline in the proposal.

The right is reserved to take samples of aggregate from stockpiles and cement from storage bins at the mixing or batching plant and to make further tests as needed as a basis for continued acceptance of the materials.
The Contractor shall furnish, without extra compensation, samples of the materials and concrete mixture for making tests and test specimens as required. Additional testing may be required if necessary.

501.03 Construction Requirements

(a) GENERAL
All materials, labor, equipment, tools, and machinery necessary for forming, mixing, placing, furnishing and curing shall be available as required and all necessary equipment for the proper construction and completion of any section of work shall be in satisfactory working condition before the Contractor will be permitted to start placing concrete.

(b) EQUIPMENT
1. General
The Contractor shall furnish equipment capable of producing concrete meeting the requirements noted in this section in sufficient quantities to provide for orderly construction of the project. All equipment must be in good working order and so maintained throughout the requirement for its use.
Specific requirements for certain types of equipment are designated in subsequent items of this section.

2. Mixing and Transporting Equipment
Concrete for all major structure work (bridges, culverts, retaining walls) shall be ready-mixed concrete. Ready-mixed concrete is defined as portland cement concrete manufactured for delivery and delivered to the work site in accordance with AASHTO M-157 Modified* and the requirements written herein in other parts of these specifications. In case of discrepancy these specification shall govern.

*Modification of AASHTO M-157 are as follows:
The requirement of Paragraph 8.1 shall include the following:
Should this method of weighing fly ash cumulatively with cement produce unsatisfactory results, it shall be discontinued and separate scales and hoppers provided for these ingredients.

Concrete for minor structure work (headwalls, inlets, junction boxes and other miscellaneous individual concrete units requiring three (3) cubic yards or less of concrete along with such items as slope paving, sidewalks, curbs and gutters, and combinations thereof) may be mixed in mixers as noted above or an approved type of mobile mixing plant designed with separate bins for fine aggregate, course aggregate, cement, water, additives, etc., that will automatically proportion all concrete aggregates either by weight or volume and be capable of combining the ingredients into a uniform mass and discharging such without segregation. It shall have an approved equipment which will determine the volume of concrete dispatched. Said alternate type mobile mixing plant shall be capable of providing the job mix formula as specified in this section. Prior written approval of such alternate equipment shall be obtained before it is allowed on the project. Basis for this approval will be upon the satisfactory performance of the equipment when checked in accordance with the provisions of AASHTO M-241. The cost of all materials and labor furnished to performed the above mention test shall be absorbed by the Contractor.

If the Contractor requests to use portable mixers, the Engineer may approve their use and will furnish written requirements covering such mixers.
All mixing and transporting shall be supplied in sufficient amounts to provide continuous delivery of the concrete as needed for an acceptable, satisfactory
operation. The volume of concrete mixed or transported in a concrete truck mixer shall not be less than 15% of the gross volume of the drum.

Each transit mixer shall be equipped with an approved automatic counter that will record the number of drum revolutions turned at mixing speed; or in lieu thereof, it may be equipped with an approved automatic counter, that will record the number of revolutions regardless of drum speed, provided the drum is turned the required number of revolutions at mixing speed before leaving the batching plant.

3. Vibrators

Vibrators shall be of an approved internal vibrating type and design unless special authorization for others is given by the Engineer. Vibrators shall be capable of transmitting vibrations to the concrete at frequencies of not less than 4500 impulses per minute. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. At least one stand-by vibrating unit in workable order shall be available before the start of any placement of concrete.

(c) RETEMPERING

No retempering of the concrete will be allowed.

(d) TIME AND TEMPERATURE LIMITATIONS

1. Time of Hauling and Placing Concrete

Ready-mix concrete shall be transported and delivered as outline in AHD 170 except that the time limits shall be 15 minutes less when Type III cement is used. If the use of retarders is authorized in writing by the Engineer of Public Works, the time limit for delivery of the mixed concrete may be extended by an amount recommended by the manufacturer. The Engineer may permit mixing and the adding of the cement additives at the work site in trucks, in order to meet the time limitation requirements.

Type IP cement is classified as producing a retarded concrete; therefore, the delivery time thereof in excess of that allowed by paragraph one above according to the manufacturer.

2. Light

All concrete shall be placed and finished during daylight hours, unless written permission to the contrary is given. Such permission will not be given unless an adequate lighting system is available for all operations after sundown.

3. Weather

a. General

The temperature of the concrete, at the time of placing in the forms shall not be less than 50 °F nor more than 90 °F unless otherwise provided or directed.

b. Cold Weather Operations

No concrete shall be placed when the ambient temperature is below 35 °F or below 40 °F and falling without written permission of the Engineer. If the Contractor proposes to place concrete during seasons when there is a probability of temperatures lower than 40 °F, the Contractor shall have available on the project such suitable approved equipment and materials as necessary to enclose the uncured concrete and keep the air temperature inside the enclosure within the following ranges and for the minimum times noted hereinafter.

If there are indications there will be temperatures below 40 °F during the first three days after placement of concrete, it shall be protected from cold
temperatures by keeping the surface at a temperature above 50 °F for the first 72 hours after placement and above 32 °F an additional 72 hours. However, the protective covering shall be retained in place until the temperature inside the protective covering reaches that of the surrounding atmosphere.

When the Contractor is permitted to place concrete at temperatures below 35 °F the aggregates and/or mixing water shall be heated as necessary to keep the temperature of the plastic concrete above 50 °F from the time of placement until initial set; however, in no case shall the materials be heated in excess of 150 °F, nor shall aggregates from frozen stockpiles be incorporated into the mix. Care shall be taken to heat all materials uniformly and avoid hot spots which will burn or overheat the materials.

The Contractor will assume all risk and added cost connected with mixing, placing, and protecting of the concrete during cold weather. Permission given by the Engineer to place concrete during such time will in no way relieve the Contractor of responsibility for the satisfactory results. Should it be determined at any time that the concrete placed under such conditions is found to be unsatisfactory, it shall be removed and replaced with satisfactory concrete by the Contractor without extra compensation.

(c) HOT WEATHER OPERATIONS

The Contractor shall submit in writing at the pre-construction meeting his proposed plan for controlling the concrete mix temperature during hot weather operations for approval by the Engineer.

When the temperature of the plastic concrete is above 90 °F but less than 95 °F an approved retarder shall be used in the mix. When the temperature of the plastic concrete is 96 °F or above the Contractor shall take such necessary action as may be required to reduce the temperature of the mix to meet the requirements as noted above. However, in no instance shall a Type Ic mix be placed when the temperature of the plastic concrete is above 90 °F.

(e) HANDLING AND PLACING CONCRETE

1. General

In preparation for the placement of concrete all sawdust, chips and other construction debris and extraneous matter shall be removed from the interior of the forms. Temporary struts, stays or braces serving to hold the forms in place until the concrete is poured shall be removed prior to being encased in the concrete. All permanent struts, stays or braces shall be precast concrete struts or at the Contractor’s option, approved steel struts; no wooden struts will be permitted to remain.

During the placing of concrete, the Contractor shall continuously check the alignment of the forms and immediately correct any yielding of the forms or falsework. Concrete shall be deposited continuously for each monolithic section of the work by placing the fresh concrete in horizontal layers of approximately twelve inches in thickness. Each layer shall be placed and compacted before the preceding layer has taken its initial set, 45 minutes for mixes without retarder and 60 minutes for mixes with retarder.

For vertical members the maximum height of a pour shall not exceed 20 feet, except for underwater concrete. Any vertical member exceeding 20 feet in height shall be broken into two or more pours.

When succeeding pours are necessary, the next pour will not be permitted until the underlying pour has aged at least 12 hours.
The forms shall not be jarred nor shall any strain be placed on reinforcing bars partially encased in concrete that will cause damage to the bond. All accumulations of mortar splashed on the reinforcing steel and surfaces of forms shall be removed.

When it is necessary to pump water from the excavation during placing of concrete to deposit the concrete in the dry, the sump for the intake hose shall be located outside the forms.

The use of aluminum pipes, chutes, or other devices made of aluminum that come into direct contact with the concrete shall not be utilized in the handling and placing operations.

a. Use of Chutes, Pipes, Belts
Concrete shall not be dropped a distance of more than 5 feet unless confined in an approved mortar tight downspout of not less than four inches in diameter. Downspouts shall be equipped with suitable hoppers at their inlet end and shall be provided in sectional lengths that will permit adjustments of the level of the outlet during placement.

The number of downspouts furnished shall be sufficient to insure the concrete placement in horizontal layers. Depositing large quantities of concrete at one point in the form and running, flowing or working the concrete along the forms will not be permitted.

In wall sections where a 4 inch downspout cannot be utilized without displacing the reinforcing steel, the concrete may be dropped in excess of five (5) feet as previously noted, provided such does not to displace the reinforcing steel nor produce segregation of the concrete.

(1) Chutes, pipes or power belts may be used to convey the concrete mixer or transporting vehicles to the forms, and they shall convey it to its final position without segregation and without displacing the reinforcing steel. If the use of this equipment results in honeycombed or otherwise inferior concrete, the Engineer will require it to be changed or its use discontinued.

(2) Chutes, pipes and powerbelts shall be flushed with water after each run and this water shall be discharged free of the freshly placed concrete. All hardened concrete shall be promptly removed.

b. Pumping.
Direct placement of concrete by an approved pumping device will be permitted. The equipment shall be so arranged that no vibrations result which might be damage freshly placed concrete. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be used shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After each placement the equipment shall be cleaned to prevent improper results on subsequent operations.

c. Compacting and Vibrating.
Concrete shall be thoroughly compacted by a mechanical vibration applied internally, during and immediately after depositing. The application of a vibrator or vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms. Vibration shall be supplemented by as much spading as is necessary to insure smooth and dense concrete.
The vibrators shall be methodically inserted and withdrawn from the concrete. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but vibrators shall be withdrawn before segregation and localized areas of grout result.

Vibration shall not be applied directly or through reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. Vibrators shall not be used to make concrete flow in the forms over distances so great as to cause segregation.

2. Culverts
   See Section 523 for specific details not covered in this Section.

3. Retaining Walls.
   See Section 525 for specific details not covered in this Section.

4. Bridges.
   See Section 511 for specific details not covered in this Section.

(f) CONSTRUCTION JOINTS
1. General
   Construction joints shall be placed only at the locations shown on the plans. In case of an emergency, if a construction joint is permitted, it shall be placed as directed by the Engineer.

2. Horizontal Joints
   Generally horizontal joints shall be made by pouring the concrete slightly above grade of the construction joint, and after the surface has reached its final set, the surface shall be prepared as outlined in Item 4 below. Insert form work shall be used to obtain neat horizontal lines.

3. Vertical Joints
   Vertical joints shall be formed with substantial bulkheads or headers as required. Feather edge joints will not be permitted.

4. Bonding
   Before placing concrete against any construction joint, the surface of the hardened concrete shall be scarified in such a manner that all foreign matter, laitance, and loose material is removed to expose sound concrete. The prepared concrete at the construction joint shall be kept wet for a minimum of one hour prior to pouring against it. Keyways and dowels shall be placed as shown on the plans or directed.

5. Waterstops
   Waterstops shall be furnished and placed as required by the plans. They shall form continuous watertight joints.

(g) EXPANSION JOINTS
   All joints shall be constructed according to the details shown on the plans providing the design width designated for the expansion joint. The insertion and removal joint forming material shall be accomplished without chipping or breaking the corners of the concrete. Expansion material, when required, shall be placed as shown on the plans.

(h) FORMS
1. General
   Reference is made to Section 50.02 concerning the working drawings and other details which require submission.

   Forms shall be substantial and unyielding and so designed and constructed that the finished concrete will conform to the plans dimensions and contours within tolerances listed in other portions of these Specifications.
Basis bridge plan design is for removal forms and plan concrete quantities computed accordingly. Hence, removal forms are to be used unless stay-in-place forms are allowed by contract plan notes and details. When shown by contract plan details, the Contractor will be allowed the option of using permanent steel forms under deck slabs between girders, beams, or stringers provided the cost of extra concrete and materials by this type of form is at the Contractor's expense.

2. Design
   a. Removable Forms
      All removable forms shall be designed so that they may be removed without damage to the concrete. Forms shall be so constructed that portions where finishing is required can be removed for that purpose without loosening supports or disturbing portions of forms that must still remain in place.
   b. Permanent Steel Bridge Deck Forms
      The forms and supports shall be zinc coated (Galvanized) steel conforming to ASTM Specification A-446 (Grade A-E) with coating Class GI65 according to ASTM Specification A-525 and shall otherwise meet all requirements relevant to permanent steel forms and the placing of concrete as specified herein and as noted on the plans. Miscellaneous fastener hardware (bolts, nuts, metal screws, and washers) shall be common stock hardware items galvanized to provide a zinc coating equal to or better than that required by ASTM B-633.
      The following criteria shall govern the design of permanent steel bridge deck forms:
      (1) The steel forms shall be designed on the basis of dead load of form, reinforcement and plastic concrete plus 50 pounds per square foot for construction loads. The unit working stress in the steel shall not be more than 0.725 of the specified minimum yields strength of the material furnished, but not to exceed 36,000 pounds per square inch. The uncoated thickness of the forms shall not be thinner than 0.0359 inch.
      (2) Deflection under the weight of the forms, the plastic concrete and reinforcement shall not exceed 1/180 of the form span or 1/2 inch, whichever is less, but in no case shall this loading be less than 120 PSF total. The permissible form camber shall be based on the actual design load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits.
      (3) The design span of the form sheets shall be clear span of the form plus 2 inches measured parallel to the form flutes.
      (4) Physical design properties shall be computed in accordance with the requirements of the American Iron and Steel Institute Specification for the Design of Cold Formed Steel Structural Members, latest published edition.
      (5) The plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck shall be maintained. A minimum concrete cover of 1 inch shall be maintained for the bottom slab steel.
      (6) Welding of the forms to bridge elements fabricated from non-weldable grades of steel or to flanges in tension will not be permitted. Plan details will indicate stringer and girder top flange tension limits.

3. Construction
   a. Removable Forms
      (1) Forms shall be mortar tight and placed and maintained true to designated lines and grades until the concrete has been placed and hardened. Forms found unsatisfactory in any respect shall not be used, and if rejected shall be removed from the immediate work site.
(2) All moldings, panel work, and bevel strips shall be straight and true with neat mitered joints and all corners in the finished work shall be chamfered at all sharp corners except where angles exceed 90°, such as the face of bridge curbs and deck overhangs. Unless otherwise shown on the plans, the equal sides on triangular molding or chamfer shall be 3/4 inch, except that for small members the width shall be 1/2 inch.

(3) For narrow walls, columns, et cetera, the Engineer may require daylight and inspection holes at vertical intervals.

(4) Bolts or ties shall be used to prevent forms from spreading. All such bolts or ties shall be arranged so that at least one inch of that part adjacent to the concrete surface can be removed or broken off.

(5) Anchor devices may be cast in the concrete for later use in supporting forms only if they are detailed on approved formwork or falsework plans.

(6) The inside of all forms shall be in accordance with a non-staining oil to prevent the concrete adhering to them. Extreme care shall be exercised to insure that form oil does not come in contact with structural or reinforcing steel.

(7) The forms shall be inspected before placing the concrete and the interior dimensions carefully checked to insure that the concrete will be of the form and dimensions shown on the plans. The inside faces of the form shall be thoroughly examined and any projections, ridges, depressions, offsets, spaces or other unevenness corrected so that the surface of the concrete will be smooth even and true, and mortar tight. All forms shall be wetted immediately prior to placing the concrete, but no excess water shall remain in the forms.

(8) To permit proper surface finishing, forms shall be removed as soon after the concrete has set as is practicable and safe. In the determination of the time for removal of forms, except those listed in Section 501 consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the material used in the mix. Methods of form removal likely to cause over-stressing of the concrete shall not be used. Forms shall not be removed without the approval of the Engineer.

b. Permanent Steel Bridge Deck Forms

(1) All forms shall be installed in accordance with these specifications.

(2) Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1 inch at each end. Form supports shall be placed in direct contact with the flange of stringer or floor beam. All attachments shall be made by permissible welds, bolts, clips, or other approved means. However, there shall be no welding of form supports to flanges of steels not considered weldable or to portions of flanges excluded in Section 501. Welding and welds shall be in accordance with the provisions of Section 839 pertaining to fillet welds except that 1/8 inch fillet welds will be permitted. All welds shall be cleaned of slag and wire brushed just prior to placing of the deck concrete.

(3) Any permanently exposed form metal where the galvanized coating has been damaged shall be thoroughly cleaned, wire brushed and painted with two coats zinc oxide-zinc dust primer, Federal Specification TT-P-641, Type II, no color added. Minor heat discoloration in areas of welds need not be touched up.

(4) The Contractor’s method of construction shall be carefully observed by the Engineer during all phases of the construction of the bridge deck slab.

(5) Transverse construction joints shall be located at the bottom of the flute and 3/8 inch weep holes shall be field drilled at no more than 12 inches apart along the line of the joint.
(i) FALSEWORK

1. Design and Construction
   a. Working drawings, if required, shall be submitted in accordance with Section 50.02.
   b. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Screw jacks and/or hardwood wedges shall be used to take up any settlement in the formwork either before or during the placing concrete.
   c. Falsework which cannot be founded on a satisfactory footing shall be supported on piling which shall be spaced, driven and removed in an approved manner.
   d. All spans shall be given a temporary camber to allow for deflection, shrinkage and settlement. Bridges shall have a permanent camber only where shown on the plans or directed.

2. Removal of Falsework
   No falsework supporting concrete shall be removed or wedges loosened without the consent of the Engineer.
   If adequate test cylinders have been made, falsework may be removed when the cylinders indicate that the concrete has developed a minimum compressive strength of 2400 pounds per square inch, otherwise falsework shall be removed according to the following time limitations:

   Falsework may be removed after expiration of 14 days exclusive of days when for four hours or more the temperature is below 40 °F. Falsework under slabs of less than six (6) foot spans may be removed after seven (7) days with the same temperature limitations.

   Falsework shall be gradually and uniformly released in such a manner as to avoid injurious stresses in any part of the structure. Wedges shall be removed first under slabs and transverse beams, starting at the center of the span and working both ways; then wedges under longitudinal girders and beams shall be removed also starting at the center of the span and working both ways simultaneously.

   All falsework piles at the time of removal or cleanup shall be pulled out or cut off at an elevation not more than six (6) inches above the bed of the stream. Piles not in water shall be removed or cut off flush with or below the ground surface of the stream bed. Piles within road bed limits shall be cut off at least three (3) feet below subgrade elevation. Other piles within roadway limits shall be cut off at least one foot below the finished surface of the front slope, ditch, or backslope.

(j) CURING CONCRETE

1. Exposed Surfaces
   Whenever the Engineer determines that weather conditions are such that evaporation from the surface may cause shrinkage cracking, a fog or mist spray may be required at intervals as needed during and after finishing until curing material can be applied so that the surface will be at all times damp but not excessively wet.

   The Contractor shall give careful attention to the proper curing of the concrete. All surfaces not covered by forms shall be protected with membrane curing compound, dampened burlap, Polyethylene Film* (White Opaque), White Burlap-Polyethylene sheet*, cotton mats, or wetted sand, as soon after placing the concrete as possible without marring the surface, except for bridge decks slabs which shall be treated as noted in item 2 below. Immediately upon removal of forms, other surfaces shall be treated by one of the approved curing methods.
Unless membrane curing compound is used, all curing materials shall be kept wet and shall remain in place for seven days, except that small portions only may be temporarily removed during actual finishing operations.

*Note: When polythylene film or white burlap-polythylene sheeting is used, it shall be installed and maintained in such a manner that a complete, moisture tight enclosure over the surface to be cured will be provided.

2. Bridge Decks Slabs
Immediately after the final finish and texture has been applied to the wearing surface, the entire top portion of the slab shall be covered with white membrane curing compound meeting the requirements of Section 829 applied under pressure at a rate of one gallon to not more than 200 square feet. Application shall be with a spray nozzle in such a manner as to cover the surface being treated with a uniform film. As soon as possible (in no case later than the following day) after the membrane curing compound has been placed and surface smoothness has been checked and corrections made, the slab shall be covered with cotton mats, burlap, wetted sand, Polythylene film (Opaque White) or white Burlap-Polythylene Sheet and kept dampened for 10 days. The cover shall then be retained in place for an additional 10 days after which it may be removed at the contractor's discretion.

3. Protection of Concrete During Curing
Green concrete shall be protected against jarring or other movement which might cause damage. No traffic or other superimposed load will be permitted over bridges or culverts until the following criteria have been met:

(a) Bridges - The decks concrete shall have reached a minimum of 4000 psi compressive strength as determined from the test cylinders.

(b) Culverts - The culvert concrete shall have reached a minimum of 3000 psi compressive strength as determined from the test cylinders or 28 days have passed since the last concrete was poured exclusive of days when for 4 hours or more the temperature was below 40 °F.

(k) FINISHING CONCRETE
1. General
The details set forth hereinafter in this Section cover the requirements for the several classes of surface finishes which shall be applied to the various parts of concrete structures.

These various classes of surface finishing will be used in accordance with the following:

Class 1 - required on all concrete surfaces except wearing surfaces and surfaces poured in direct contact with natural ground or embankment.

Class 2 - required on all exposed concrete surfaces within the requirements noted in Section 501 unless another class is specified.

Class 3 - may be used on designated bridge structures when specified by plan details.

Wearing surface finish for bridge deck travelway shall be as specified in Section 501, and also for sidewalks.
Exposed surfaces or sidewalks, driveways, curbs and gutters shall have a textured finish obtained by the use of a burlap or cotton drag, brush or broom so that a uniform gritty texture is obtained. Exposed surfaces of concrete flumes and slope paving shall have a float finish.

2. Class 1 Finish (Ordinary Surface Finish)
This class finish will require the concrete surface to be free from objectionable projections, swells, fins, ridges, depressions, waves, holes, and other defects. This will require that immediately after the forms are removed, metal ties shall be removed for a minimum depth of one (1) inch from the face of the concrete. All cavities or depressions resulting from this removal, or from other causes, shall be carefully filled and pointed with a mortar of sand and cement, and the surface left smooth and even. The proportions of cement to sand, measured by volume shall be one to two unless otherwise specified by plan details. The surface film of all pointed areas shall be carefully removed before setting occurs. Any fins, ridges or projections shall be struck off smooth with the surface of the concrete. Particular care shall be taken throughout the progress of this operation to use one of the curing methods covered in Section 501.

If a Coated Surface Finish is to be applied in a later finishing operation, the coating material may be used in lieu of mortar to fill small air holes in the concrete surface, however this must be given time to take set prior to applying the Coated Surface Finish.

3. Class 2 Surface Finish
   a. General
      This class surface finish requires that in an addition to a Class 1 finish, the exposed surfaces of bridges, culverts, headwalls, inlets, etc, as defined in item (d) below, receive an additional surface finish in accordance with the following:

      If only one brand and type of cement from the same mill is used in a structure or unit (substructure or superstructure), the Contractor may elect to either apply a Rubbed Surface Finish or apply an approved Coated Surface Finish. If more than one brand of cement is used in a structure, the Contractor shall apply a Coated Surface Finish. The same type of surface finish shall be used throughout the entire structure unless otherwise authorized in writing by the Engineer.

   b. Rubbed Surface Finish
      As soon as the Class 1 surface finish has been completed and the pointing has set sufficiently to permit it, the entire surface except chamfers shall be wetted with a brush and rubbed with a No. 16 carborundum stone or an abrasive of equal quality, bringing the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, producing a smooth dense surface without pits or irregularities. The material which, in the above process has been ground to a paste, shall then be carefully spread or brushed uniformly over the entire surface and allowed to dry. Curing shall continue on this surface as required in Section 501.03(k).

      The final finish shall be obtained by a complete rubbing with a No. 30 carborundum stone or an abrasive of equal quality. This rubbing shall continue until the entire surface is a smooth texture and uniform in color.

   c. Coated Surface Finish
      Only approved coating materials may be used. Any material incapable of providing the desired results shall be rejected by the Engineer and replaced with a suitable coating necessary to complete the work.
The application of the coating shall be in an approved manner (normally in accordance with the manufacturers' recommendations) by competent and experienced personnel. The overall coated finish shall be uniform in coverage, texture, and color after the coating material has taken set and cured. Failure to obtain uniformity of coverage, texture, and color shall be cause for the Engineer to require such remedial action as deemed necessary to obtain the desired results.

The following actions must be taken before the application of any coated finish:

1) A Class 1 surface finish applied and all pointing completely set.
2) Surface clean and free from foreign matter.
3) If membrane curing compound was used to cure the concrete, the curing compound shall have weathered for a minimum time period of six (6) weeks. Special care shall be taken to insure that areas not to be treated are protected to prevent treatment from overlapping onto these designated areas.

d. Exposed Surfaces

Exposed surfaces for this class finish is defined as all surfaces, including bottom chamfers and fillets except (1) the wearing surface of roadway slabs and sidewalks, (2) those surfaces having immediate contact with embankment or excavation, (3) those surfaces below water level and or below newly established ground line after backfilling excavation or excavated channels, (4) underside and interior faces of girders, beams, and slabs, and underside of sidewalks where the edge beam extends three (3) inches or more below the bottom of the sidewalks, (5) top surface of all type caps, (6) those parts of minor structure, box culverts and bridges culverts that are not readily visible from a travelway.

4. Class 3 Surface Finish

This class surface finish requires that in addition to the Class 1 surface finish that only the designated exposed surfaces of a bridge structure noted below be given an additional finish of either a rubbed or coated finish in accordance with the provisions for such noted before.

Exposed surfaces shall be defined as the inside, top, and outside surfaces of barrier rail to bottom slab overhang, and all portions of the bridge abutments outside the edge of the exterior girders which are not in immediate contact with embankment or excavation. All other structure surfaces, exposed and unexposed, shall receive a Class 1 finish immediately after the forms are removed.

(I) PRECAST CONCRETE UNITS

1. General

All concrete furnished for use in any precast portland cement concrete items shall comply with the requirements of the preceding provisions of this Section except for modifications provided hereinafter in this Section the detailed plans or special provisions outlined in the proposal.

2. Construction Details And Manufacture

The method of construction of precast units shall be that of fabricator provided such conforms to the following requirement:

(a) Units shall be the size and shape shown on the plans.
(b) The reinforcing system shall be rigidly wired or fastened at all intersections and held to true positions in the form by approved devices.
(c) Units shall be cast on level, tight platforms that will not settle during the casting or curing. Forms shall conform to the general requirements of this Section for concrete form work. The casting location shall be accessible for vibrating and consolidation of the concrete. Under normal curing methods, side forms may be removed at any time after the concrete has taken its initial set (not less
than four hours after casting of the concrete); however, the entire unit shall not be subjected to any handling stress until the concrete has reached a strength of 2400 psi.

(d) Mixing and placing of concrete shall conform to the preceding requirements of this Section. Piling shall be cast in a horizontal position. Casting in tiers will not be permitted. Special care shall be exercised to vibrate and consolidate the concrete around the the reinforcement and along and against the forms. Concrete shall be placed continuously in each unit with special care being exercised to avoid horizontal or diagonal cleavage planes.

All reinforcement shall be accurately placed and rigidly secured at the location shown by the plans or approved drawings and special care shall be exercised that the reinforcement is properly imbedded in the concrete in the completed unit in accordance with the position indicated on the plans.

(e) As soon as the forms are removed, the unit shall receive an ordinary surface finish. No other finish will be required on foundation piling and that portion of trestle piling which will be below the ground surface, or piles to be used in alkali soils. The complete unit shall be free from honeycomb, porous areas or other defects. Exposed portions of piling and other surfaces as defined in Section 501.03(1), shall have a Class 2 finish unless otherwise specified.

3. Curing Precast Concrete Units

After casting, all exposed concrete shall be protected by wet burlap or other approved material to prevent excessive loss of moisture during the initial set period. After the concrete has obtained its initial set (not less than four hours after casting) the side forms may be removed and the curing continued by one of the following methods:

Standard Curing Method

After removal of the side forms the units shall be kept covered with saturated burlap (double thickness) or tarpaulin for three (3) days after which the curing shall be continued by the use of membrane curing compound, covering with polyethylene sheeting, immersion in water or by covering with a heavy layer of sand which is kept wet for a period of seven days or until the concrete has reached a designated strength of 2400 psi.

Steam Curing Method

After the concrete has obtained its initial set, steam shall be applied in such a manner as to raise the temperature of the air surrounding the units at a rate not to exceed 40°F per hour to a temperature not to exceed 150°F. This raised temperature shall be maintained for a period of 24 hours; however, if a compressive strength of 2400 psi has not been obtained at the end of 24 hours, the steam curing shall be continued until the required strength is obtained. If a compressive strength of 2400 psi is obtained before the end of the minimum hours noted, the steam curing procedure may be stopped if the units are covered with polyethylene sheeting for an additional 24 hour period to compensate for the shorter period of steaming.

As an exception to the curing procedure, when a compressive strength of 4000 psi is obtained no further curing will be required.

Units requiring a compressive strength of 4000 psi for removal from the forms may have the steam curing procedure stopped prior to obtaining 4000 psi provided that the units remain covered until the 4000 psi is obtained. No further curing will be required.
4. Handling and Storage

The method of handling and storage shall be such as to preserve true and even edges and corners. Any cast unit which becomes chipped, cracked, or marred before or during the process of installation shall be rejected and ordered removed from the work, or if the damage does not affect the structural integrity of the unit, it may be repaired by approved methods.

No precast unit shall be transported or installed in the work until the required strength has been obtained, verified by cylinder test.

501.04 Inspection

(a) GENERAL

The Contractor shall give the Engineer sufficient advance notice before starting to place concrete in any section of a structure to permit the inspection of forms, placing of reinforcements, and of preparation for placing. Any defective falsework or forming shall be corrected, or removed and replaced as necessary to the satisfaction of the Engineer, all at the expense of the Contractor.

Authorization of the Engineer shall be secured before concrete is placed in any portion of a structure. Any concrete placed in violation of this provision or in the absence of the Inspector shall be removed and renewed at no additional cost to the City of Huntsville.

(b) REMOVABLE FORMS

After the forms have been removed, any defective work discovered shall be removed. If the surface of the concrete is bulged, sagged, uneven, or honeycombed to such an extent that it cannot be repaired, the entire section shall be removed and renewed at no additional cost to the City.

(c) STAY IN PLACE FORMS

After the concrete deck has been in place for a minimum period of two days, the concrete shall be tested for soundness and bonding of the forms by sounding with a hammer at points specified by the Engineer. The number and locations of the forms to be tested shall be as selected by the Engineer. If areas of doubtful soundness are disclosed by this procedure, the Contractor will be required to remove the forms from such areas for visual inspection after the pour has attained a minimum compressive strength of 2400 psi. Care will be exercised to distinguish the sound of broken bond from the sound of defective concrete.

At locations where sections of the forms are removed, the Contractor will not be required to replace the forms, but the adjacent metal forms and supports shall be repaired to present a neat appearance and assure their satisfactory retention. As soon as the forms are removed, the concrete surfaces will be examined for cavities, honeycombing and other defects. If irregularities are found, and in the opinion of the Engineer these do not justify rejection of the work, the concrete shall be repaired. If the concrete where the forms are removed is unsatisfactory, additional forms, as necessary shall be removed to inspect and repair the slab, and the Contractor's method of construction shall be modified as required to obtain satisfactory concrete in the slabs. All unsatisfactory concrete shall be removed or repaired as directed by the Engineer.

The Contractor shall provide all facilities as are reasonably required for the safe and convenient conduct of the Engineer's inspection procedures. No additional compensation will be allowed the Contractor for compliance with the above inspection procedures.
SECTION 503
STEEL REINFORCEMENT

503.01 Description

This Section shall cover the work of furnishing and installing reinforcement steel for concrete structure in accordance with the detailed plans and these Specifications.

503.02 Materials

(a) GENERAL REQUIREMENTS
All materials shall conform to applicable portions of Division III, Materials. Special reference is made to Section 837 Steel Reinforcement.

Steel mesh shall be used only when as shown on the plans.

Rail steel reinforcing bars in sizes not greater than No. 6 will be permitted for all culverts and other concrete structures except bridges. In bridges their use shall be limited to curbs and handrail and to floor slabs with a clear span of less than 10 feet measured parallel to the main bar reinforcement.

The supplier of the reinforcing steel shall furnish the Engineer a copy of an itemized list of all steel included in each shipment. Such list shall show the mark of the bar, bar number, grade, length, and weight of all steel for each structure requiring reinforcing steel.

(b) BAR BENDING DIAGRAMS
When bar lists and bending diagrams are shown on the plans, the Contractor shall verify their accuracy from the drawings. Errors in the bar bending schedules and bar list shall not be cause for adjustment of contract unit prices.

503.03 Construction Requirements

(a) GENERAL
All reinforcement received on the project shall be placed in approved storage; shall be maintained clean, intact, and free from distortion. Reinforcement shall be free from loose or thick rust which would impair the bond of the steel with the concrete. Rust that produces only discoloration without reducing the cross section of the steel will not be considered objectionable. Only such reinforcement shall be distributed along the construction as is needed for immediate use.

(b) EQUIPMENT
All equipment necessary for the proper fabrication, bending, handling, and installation of reinforcement must be available when required, in first class working condition, and shall be approved before fabrication and construction will be permitted to begin.

(c) HANDLING AND PLACING REINFORCEMENT
1. Bending
Reinforcement shall be bent in accordance with CRSI Manual of Standard Practice MSP-2-81, accurately to the form and dimensions shown on the plans without heating. In bending, care shall be taken not injure the steel and only appliances and competent workmen shall be employed on the work. The radius of bends shall be 3 or more times the diameter of the bar unless shown on the plans. Abrupt bends shall be avoided. Any reinforcement bent during shipment or handing shall be properly reshaped, without heating to a higher temperature than
that producing a dark cherry-red color, before being placed in the work. Bars with kinks or bends and bars appreciably reduced in cross-sectional area shall be rejected.

2. Cleaning
Metal reinforcement before being placed shall be cleaned of loose mill scale and coatings of dirt, paint, oil, grease, or other foreign substance.

3. Placing
All reinforcing steel shall be accurately placed and firmly held in position shown on the plans during the placing and hardening of the concrete. A 1/4" inch vertical placement tolerance will be allowed on top of the reinforcing steel in the bridge deck.

4. Wiring and Supporting
a. All reinforcement shall, as elected by the contractor, be (1) rigidly wired, or (2) if approved by the Engineer, spot welded. Suitable provisions shall be made for supporting reinforcement in position during placing of concrete. No construction operation shall be permitted which tends to bend or displace the reinforcement from its correct position. All reinforcement shall be placed securely, wired, spaced, and blocked before placing concrete in any section. Railing post reinforcement shall be installed before placing the curb concrete. In no case shall reinforcing steel be driven or forced into concrete after it has set.

b. All reinforcing metals shall be maintained at the proper distance from the forms or in the case of layer, form each layer by means of approved stays, mortar blocks, metal chairs, ties, hangers or other approved supports.

Mortar blocks shall be precast from a mortar mix composed of one part portland cement to two parts sand with wires cast into them for fastening to the steel. Blocks shall be moist cured (other curing methods may be accepted) for at least three days before use. The blocks basis shape shall be square (2X2 Min) with appropriate height as required to hold the steel in its designated position (+ 1/8 inches). The size and shape shall be approved before use. The wires shall be 16 gage (.064 inch) minimum diameter.

Metal supports shall be in accordance with CRSI Manual of Standard practice MSP-2-81 for Class 3 bar supports except that supports which are to be in direct contact with removable forms shall be Class 1 supports. Any premolded Class 1 support tips that do not provide a tight snug fit shall be rejected and removed from the work.

The use of pebbles, pieces of broken, stone or brick, metal pipe and wooden blocks will not be permitted.

5. Inspection
a. Reinforcement in any member shall be placed, and then inspected and approved before the placing of concrete begins. Concrete placed in violation of this provision shall be rejected and removed at no additional cost to the City of Huntsville.

b. Extreme care shall be taken to insure that the final location of bars in the top of the floor slabs, sidewalks, curbs, and beams are not lower than the clear distance from the top of the finished slab as shown on the plans.

(d) SPLICING, LAPPING, AND BUTT WELDING

1. Splicing
Whenever it is necessary to splice reinforcement at points other than those shown on the plans, drawings showing the locations and details of each splice shall be submitted by the Contractor and approved before the reinforcing steel is ordered by the Contractor. Splices shall be avoided at points of maximum stress; they
shall, where possible be staggered, and shall be designed to develop the strength of steel without exceeding the allowable unit bond stress.

Unless otherwise shown on the plans, bars shall be lapped 24 bar diameters to make the splice in the slab and in the bottom of beams and girders, and not less than 35 diameters in walls, columns, haunches, and near the tops of beams and girders having more than 12 inches of fluid concrete under the bars.

In lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance not less than the minimum clearance distance to the surface of the concrete. Welding of reinforcing steel shall be done only if detailed on the plans or if authorized in writing. Welding shall conform to the current specification for welding highway and railway bridges of the American Welding Society.

2. Lapping

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

3. Butt Welding

Reinforcing bars shall be butt welded only when specially shown by the detailed plans. This type of welding, when allowed, shall be limited to Shielding Metal Arc Welding (SMAW) and shall be in accordance with the plan details and the "AWS Structural Welding Code - Reinforcing Steel" required by the special Provision welding.

503.04 Method of Measurement

No direct measurement will be made for reinforcing steel and will not have a specific pay item. The cost of reinforcement shall be absorbed in the appropriate items contained within the proposal. The following table is given only for reference and is to be referred to when calculations are necessary to determine weights or loads.

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</tr>
<tr>
<td>10</td>
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<td>1.270</td>
<td>1.27</td>
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<tr>
<td>11</td>
<td>5.313</td>
<td>1.410</td>
<td>1.56</td>
</tr>
</tbody>
</table>

No allowance will be made for any device, material or method which may be made for splicing, clamping, typing, butt welding and keeping reinforcement in proper position.
503.05 Basis of Payment

No direct payment for steel reinforcement will be made, and the cost shall be absorbed in other appropriate items of work. This shall include fabricating, furnishing, placing and butt welding all materials, and for all labor, equipment, tools, and incidentals necessary to complete the work in accordance with plan details.
SECTION 505
STRUCTURE FOUNDATION

505.01 Description

The work under this section shall cover preparing foundations for bridges, box culverts and other miscellaneous structures. These foundations shall be built in accordance with the details shown on the plans and the provisions provided hereinafter in this Section.

505.02 Materials

Materials used in the work required under this section shall conform to the applicable requirements elsewhere in these Specifications.

505.03 Construction Requirements

(a) GENERAL
In the construction of foundations is the intent that the foundations be constructed in the dry as so far as practical. Excavation shall be in accordance with Section 107 or 108, which ever is applicable.

Where excavation is near a railroad track, the Contractor shall install without extra compensation such shoring and sheeting as is required under these Specifications to meet the requirements of the Railroad company involved. Provisions of Section 70.08 shall govern.

Where the excavation is near a building, utility or other property, the Contractor shall install shoring and sheeting and perform such other work as shown on the plans for proper protection of the property, and in addition, shall comply fully with the requirements of Section 70.12 regarding the protection of property.

(b) DEPTH AND SIZE OF FOOTINGS
The elevation of the bottom of footings, as shown on the plans shall be considered as approximately only, and the Engineer may order, in writing, such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation.

(c) PREPARATION OF FOUNDATION FOR FOOTINGS

1. General
All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, either level, stepped, or roughened, as may be directed by the Engineer in accordance with Section 105. Where seams, voids cracks, or crevices exist in rock, they shall be cleaned out and filled with Class A, Type 1 Concrete when determined by the Engineer to be necessary to provide a solid and firm footing foundation. On other hard foundation materials these areas shall be cleaned out and filled, when directed by the Engineer, with foundation backfill or concrete.

When the footing is to rest on an excavated surface other than rock, special care shall be taken not disturb the bottom of the excavation and the final removal of the foundation material to grade shall not be made until just before the footing is to be placed.

2. Stable Material
Where rock or hard foundation material is available, excavation for the footings shall be to neat lines and the concrete poured against the excavated walls
without forms. Concrete used to replace rock or hard foundation material excavated outside to the neat lines will not be measured for payment.

3. Unsuitable Material
If the material encountered at the elevation shown on the plans for the bottom of a footing is of a soft and unstable nature lacking in the required bearing value, and tests show the existence of satisfactory material of sufficient thickness and bearing value at a depth of less than 10 feet below the elevation shown on the plans for such footing, the Engineer may order that the footing be lowered into the satisfactory material and/or that the dimensions of the footing be increased.

4. Piling Footings
If, in the opinion of the Engineer, footings cannot be founded at a reasonable depth on rock or other satisfactory foundation material, piling shall be driven. If satisfactory foundation is more than 10 feet below the bottom of the footing shown, pile footings shall be used unless otherwise directed. In streams where excessive erosion is probable, piling may be ordered as protection against scour even though the soil in its natural state has adequate bearing value. Where foundation piles are used, the excavation of each pit shall be completed before the piles are driven. After driving is completed, all loose and displaced material shall be so removed as to leave a smooth solid bed to receive the footing.

5. Foundation Backfill
Foundation Backfill shall be used as required under these Specifications. Attention is directed to Section 107 and 108 whichever is applicable.

6. Adjustments in Footings
The construction adjustments permitted above shall not be considered as materially altering the original plans and shall not be a waiver of any condition of the contract nor invalidate any of the provisions thereof.

(e) CLASS OF CONCRETE
The class of concrete required for the specific type of work involved shall be in accordance with the provisions of Section 501.

(f) CONSTRUCTION JOINT
In general, each footing shall be constructed as a monolith. If construction joints are required, they shall be constructed as provided in Section 501.03 (f).

(g) FINISH
Concrete surfaces shall be finished in accordance with the provisions of Section 501 for Class 1 with exposed surfaces receiving a Class 2 finish unless otherwise specified by the proposal or by plan requirements.

505.04 Method of Measurement

(a) EXCAVATION AND BACKFILL
Excavation and backfill when provided by the plans, proposal, or directed will be measured and paid for under the applicable provisions of Section 107 and 108.

(b) SUBFOOTING CONCRETE
Concrete ordered and accepted for filling voids, cracks, and crevices, as required in Section 503. 05( c) will be measured by the cubic yard delivered to the work site and acceptably placed, minus any concrete wasted.
505.05 Basis of Payment

(a) UNIT PRICE COVERAGE
Concrete for Rock Subfootings
If not provided in the proposal, the contractor will be paid the delivered invoice cost, minus waste and including any applicable sales taxes, to the project plus 15 percent. This price includes the concrete, gross receipt tax, labor, materials, incidentals, and the placing of the concrete in the designated locations.

(b) PAYMENT WILL BE MADE UNDER:
Subfooting Concrete - per Cubic Yard
SECTION 507
PILING

507.01 Description

This Section shall cover the work of furnishing and driving to the required penetration, piles of the kinds and dimensions shown on the plans or designated, in conformity with these Specifications. The required bearing along with spacing and lines for the piling will be shown on the plans. A minimum tip elevation will be shown on the plans for precast concrete piles.

507.02 Materials

All materials shall conform to applicable portions of Division III Materials. Specific reference is made to Section 835, Piling. Dimensions and weights of metal piling (all types) shown on the plans are nominal dimensions accepted as standard practice and unless more stringent tolerances are noted herein in these specifications, manufacturing tolerances established by the industry will be accepted.

507.03 Construction Requirements

(a) BEARING VALUES FOR PILES

1. General

The location, character of the soil penetration, character of the material under the pile tip, conditions affecting driving, spacing, grouping, sizes and lengths of the piles involved, and computed load per pile shall be given due consideration in determining the penetration and bearing required.

Calculated safe bearing values for steel piles and precast concrete piles shall be determined after driving test piles and analyzing the test pile result data. After test pile results have been determined to be satisfactory for bearing requirements, all other piles in the structure (represented by the test pile) shall be driven to approximately the same minimum calculated bearing and penetration as has been established to be satisfactory, using the same hammer and driving energy as used in driving the test pile. The Engineer shall determine the minimum computed bearing (or driving resistance) to be used in driving all piles after analyzing the test pile result data.

If the plans show minimum tip elevations for the piles, two requirements must be met: (1) The contractor must provide the necessary equipment to drive the piles to the designated elevation, and (2) after reaching this elevation, the piles must obtain the required bearing.

2. Precast Concrete Piles

These piles shall develop the computed bearing value determined to be satisfactory by loading tests.

3. Steel Piles

These piles shall develop the computed bearing value determined to be satisfactory by loading test, or shall be driven to refusal on rock or to practical refusal. Practical refusal shall be defined as when the pile has penetrated into a hard stratum, such as a soft rock, marl, soapstone, Selma chalk or other hard material, and further driving will damage the pile.
4. Cast-in-Place Concrete Piles

Unless the piles are seated on rock or other hard stratum, the safe bearing value shall be determined by loading tests.

(b) LOAD TESTS

1. General

When required, the length of piles to be driven shall be determined by actual loading test of any designated pile in the structure to twice the design load shown on the plans. In general, these tests shall consist of the application and removal of a test load placed upon a suitable platform supported by the pile, or static pressure exerted on the pile through approved rigging, together with suitable apparatus for accurately determining the superimposed weight of pressure and the settlement of the pile under each increment of load. The safe allowable load shall be considered as 50 percent of that load which after 48 hours application, causes a permanent settlement, measured at the top of the pile, of nor more than 1/4 inch. If additional time of application is required, it will be so stated on the plans or in the proposal.

2. Prerequisites Required Prior to Applying A Loading Test

a. Precast Concrete Piles

The pile to be loaded shall be driven to the minimum tip elevation shown on the plans prior to applying the loading test. If jetting or a combination of jetting and driving is approved and used to obtain adequate penetration, the last three (3) to ten (10) feet (depending on soil conditions) shall be obtained by driving alone without the use of jets.

b. Steel Piles

The following minimum requirements shall be met before a loading test is imposed on a steel pile:

The pile shall be driven in the location directed to not less than 30 feet penetration and calculated bearing of 15 tons or shall be driven to a bearing of 20 tons if reached prior to 30 feet penetration, using the formula in this Section. The Engineer may direct that a load test be applied when penetration of 45 feet has been obtained even though 15 ton calculated bearing value has been obtained, if in his opinion, the pile will withstand twice the design load shown on the plans. (Note: In some soils, a bearing value in excess of 20 tons may be required to withstand a loading test even though the pile has penetrated in excess of 45 feet). If refusal on rock or practical refusal as defined above is obtained during the driving operation, the loading test may be omitted.

3. Load Test Procedure

A pile shall not be load tested until a minimum time period of 36 hours has elapsed after completion of driving of the pile to be tested. Increment loads of five (5) tons shall be placed on the pile until twice the design load is reached, and then unloaded in increments of five (5) tons after twice the design load has been applied and maintained for 48 hours. Pile settlement shall be recorded after each increment load has been applied or removed, and each hour while twice the design load is on the pile. After unloading, if the top of the pile has settled 1/4 inch or less, the bearing of the pile will be considered satisfactory. If the permanent settlement exceeds 1/4 inch or if during the test pile settles 3/4 inch or more, the bearing of the pile will be considered unsatisfactory. The pile shall then be driven to a bearing value of five (5) tons in excess of the previous calculated bearing or to a penetration of ten (10) feet or greater than before the test and reload as before. Loading tests shall be repeated as many times as necessary until the pile passes a test.
4. Hydraulic Jacks and Load Gages
   When hydraulic jacks and gages are to be used for the superimposed load, the jacks and gages shall have been calibrated with each other within the last six (6) months of the date of their use; however, should the Engineer have any doubt of their accuracy, he will require their recalibration. Gages shall be of the size that will provide ease of reading (approximately 4 1/2" diameter) with graduations for two (2) tons or less for loads under 100 tons and graduations of five (5) tons or less for loads over 100 tons.

5. Temporary Shelter
   All load tests will be continually inspected by the Engineer. The Contractor shall provide a suitable temporary shelter for the protection of the Engineer's instruments during the test period.

(c) TEST PILES
   1. Location
      Unless otherwise directed, steel, precast, or cast-in-place concrete piles shall be driven at such locations as will be permitted their use in the finished structure; however, the exact location will be determined by the Engineer.

   2. Length
      The Contractor shall furnish and drive test piles of sufficient length to provide the required penetration and bearing. These piles shall be of greater length than the assumed in design in order to provide for any variation in soil conditions. In no case shall precast concrete piles be less than 10 feet longer than the estimated length of piling shown on the plans. Concrete or steel test piles shall be of the same size and weight as provided for other piles in the structure. Test piles specified to be used as permanent piles in a structure shall have sufficient length to be cut off at plan grade for top of pile.

   3. Inspection
      The Engineer shall be given sufficient notice before the driving of any test pile in order that an Inspector may be placed on the work to keep an accurate record on the regular form provided for this purpose, and no piling shall be driven unless an Inspector is present.

(d) FORMULAS FOR COMPUTING BEARING VALUE
   1. The formulas provided below may be used only as a guide for driving precast concrete and steel piles in determining when to apply a loading test.

   Formula (1): \[ P = \frac{2 \cdot WH}{S + 1.0} \] for gravity drop hammers

   Formula (2): \[ P = \frac{2 \cdot WH}{S + 0.1} \] for open type, single-acting power hammers

   Formula (3): \[ P = \frac{2 \cdot E}{S + 0.1} \] for all closed type power hammers

   *Formula (4): \[ P = \frac{2 \cdot H (W + Ap)}{S + 0.1} \] for open type double or differential acting power hammers
* Formula (3) may be in lieu of Formula (4) provided the Engineer assures himself that the factors "H" and "p" will be maintained constant to provide the manufacture's rated striking energy.

Power Hammers- Air, Steam and Diesel Hammers.

\[ P = \text{Bearing Value (pounds)} \]
\[ W = \text{Weight of striking parts of hammer} \]
\[ H = \text{Height of fall of hammer or ram as measured in field (feet)} \]
\[ E = \text{Manufacturer's rated energy output (foot-pounds)} \]
\[ A = \text{Area of piston (square inches)} \]
\[ p = \text{Pressure in hammer cylinder (pounds per square inch)} \]
\[ **S = \text{Average penetration in inches per blow for the last 5 to 10 blows for a gravity hammer and the last 10 to 20 blows for a power hammer.} \]

** If driving resistance is recorded in blows per foot, "S" in formula may be determined by dividing the number of blows by the number of blows per foot of penetration into 12 inches/foot.

The effective energy per blow to be used in the formula shall be considered as being 80 percent WH or E when using power hammers.

The above formulas are not applicable unless:

- a. The hammer has a free fall
- b. The head of the pile is not broomed or crushed.
- c. The penetration is reasonably quick and uniform
- d. There is no perceptible bounce after the blow.
- e. The product of the factors "Ap" in the formula is less than the weight of the casing of the hammer.

2. Twice the height of bounce shall be deducted from the height of fall to determine the value of H in the formula when using gravity hammers. If the pile begins to kick or stagger under the blow or if the hammer bounces unduly, driving shall be discontinued immediately and the Contractor shall use other means as directed to obtain the required penetration and bearing.

(e) PILE DRIVING EQUIPMENT
1. General

All equipment shall be in first class working condition. If the size of the hammer furnished and used in accordance with the following specifications is found to be unsatisfactory, it shall be replaced with a larger or smaller hammer as necessary to produce satisfactory results. Power sources such as steam boilers and air compressors along with connecting hoses shall be capable of continuously maintaining at the intake of the hammer the pressure recommended by the manufacture of the hammer used. The boiler or compressor shall be equipped with an accurate pressure gage at all times, and another pressure gage shall be supplied for occasional use at the hammer intake to determine the pressure drop between the boiler or compressor and the hammer. Steam lines from the boiler to the hammer shall be kept out of water to prevent undue drop in steam pressure.

2. Hammer For Steel Piles

Steel piles shall be driven with power or gravity hammers. Gravity Hammers shall weigh not less than 3000 pounds and the blow delivered to the pile shall not exceed 30,000 foot pounds. Power hammers shall develop a blow of not less than 12,000 foot-pounds, nor more than 30,000 foot-pounds.
3. Hammers for Concrete Piles
   a. Precast, Prestressed Concrete Piles
      Only power hammers shall be used to drive this type of piling. They shall develop an energy per blow within the range specified below for the size of piling shown.

<table>
<thead>
<tr>
<th>Pile Size</th>
<th>Required Energy (Ft-LB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10&quot;-12&quot; Solid</td>
<td>15000-30000</td>
</tr>
<tr>
<td>14&quot;-16&quot; Solid</td>
<td>22000-35000</td>
</tr>
<tr>
<td>18&quot;-24&quot; Solid</td>
<td>32000-42000</td>
</tr>
<tr>
<td>20&quot;-24&quot; Voided</td>
<td>32000-42000</td>
</tr>
<tr>
<td>30&quot; Voided</td>
<td>40000-60000</td>
</tr>
<tr>
<td>36&quot;-54&quot; Voided</td>
<td>50000-80000</td>
</tr>
</tbody>
</table>

b. Precast, Non-prestressed Concrete Piling
   Only power hammers shall be used to drive this type of piling. The minimum energy rating for the hammer shall be 12,000 foot pounds, or an energy per blow at each full stroke of the piston of not less than 4000 foot-pounds for single acting hammers (3500) foot-pounds for double and differential acting hammers) per cubic yard of concrete in the pile being driven, whichever is greater.

c. Cast-in-place Concrete Piling
   Only power hammers shall be used in driving shells for cast-in-place concrete piles. Driving energy shall not exceed 30,000 foot-pounds.

4. Leads
   Leads shall be constructed in such a manner as to afford freedom of movement of the hammer. Fixed leads shall be used with gravity (drop) type hammers for all piling except foundation piling. Swinging leads may be used in driving foundation piling with the gravity hammer. Either fixed leads or swinging leads may be used with power hammers. Fixed leads are as defined as leads attached to the crane boom at the top by a pin or swivel and rigidly held in position to prevent movement of the leads. Swinging leads when used with any type hammer shall be in combination with rigid templates or satisfactory collars at the bottom to align the leads and pile in the same plane. Also, if swinging leads are used, the travel of the hammer shall be maintained in line with the axis of the pile. Regardless of the type leads used, the Contractor shall be responsible for driving the piles within the tolerances specified without injury to the piles. Piles for trestle bents shall be so driven that the cap may be placed in its proper position without inducing excessive stresses in the piles. Any leads that do not produce satisfactory end results in the driving of piling shall be ordered removed from the work. Pile driver leads shall be constructed so that the piles may be accurately driven vertically or to the batter shown on the plans. The leads shall be of such length that a follower piles in driving piling will not be permitted.

5. Water Jets
   Jetting shall be used only when directed or permitted by the Engineer. Jetting may be required with the use of any type of hammer, any type of piling, and at any site. Two jets will be required for precast concrete piles; however, a single jet will be permitted provided it is cast integrally into the pile. Sufficient power shall be provided to operate the pumps and jets. The volume and pressure of the water shall be sufficient to freely erode the material under and adjacent to the pile. The final bearing of a pile shall be obtained by driving alone after jetting has ceased. Jetting will be considered incidental to the work and no direct payment will be made for this operation.
6. Driving Heads

The heads of all piles shall be protected from injury in driving by metal driving heads and shock cushions. The driving head, mandrel or other device shall be so designed that the driving energy will be evenly distributed throughout the cross section of the pile. Shock cushion, if necessary, composed of timber, plywood, rope, or other suitable material, shall be used in conjunction with the metal driving head to prevent the piles from being damaged by the hammer. Where reinforcing rods extend out of the top of concrete piles, the cushioned driving head shall be so designed and arranged that the reinforcing bars will not be displaced or damaged or during driving.

(f) PILING LENGTH

The estimated length of piles shown on the plans and in the proposal are for bid purposes only. The Contractor shall be responsible for providing the lengths of these piles necessary to obtain the bearing and penetration required as determined from results obtained in driving representative test piles or other pertinent data. It is expected that there will be variations in final tip elevation due to differences in driving resistance. The final tip elevation of each pile will be determined by the Engineer during the driving operation. The Contractor shall furnish to the Engineer, for review, the proposed pile lengths for use in each bent of a structure before driving the piles. Not more than three pieces (two splices) of steel pile will be permitted in making up one full length of proposed pile. In no case shall there be more than two splices exposed to view in any length of piling after driving is completed.

(g) PREPARATION FOR DRIVING

1. General

Foundation piles shall not be driven until after excavation is complete except where (1) shown on the plans or (2) deemed necessary and permitted in writing.

2. Pilot Holes

When the material to be penetrated is a hard or firm material and will not permit the piling to penetrate by ordinary driving or the plans specify the use of pilot holes, the Contractor shall drill pilot holes vertically or battered as required, so that the piling may be placed to the depth required and driven to a specified resistance as follows:

Pilot holes shall be of a diameter approximately two (2) inches greater than the least side or diameter of the piling and shall be sunk to the depth required to obtain a designated penetration as shown on the plans or as directed.

Where pilot holes are required through material that consist of loose sand or gravel overlying a hard clay or shale, which cannot be sealed off by ordinary "mudding" or drilling methods, a casing pipe of the proper diameter and sufficient length to extend down through the loose material into a firm material shall be used around the boring device, and shall be held in position until the pilot hole has been completed, and the pile driven enough so that sand or other loose material will not drop into the pilot hole.

(h) METHOD OF DRIVING PILING

The method of driving the piling will, in general, be at the option of the Contractor unless otherwise specified, provided such is within the requirements noted herein in this Section.
The Contractor may be required to spud, punch, drill or jet to penetrate firm hard material, or subsurface obstructions in order to obtain the desired penetration. Cost of such type operation will be considered incidental to the work.

(i) PENETRATION REQUIRED
The Engineer will determine, during the driving operation, the elevation to which piling shall be driven, in general, the penetration for any pile. Even though sufficient bearing value has been secured shall not be less than 10 feet in firm material and not less than 1/3 the length of the pile nor less than 20 feet in soft material. Piling shall be driven below the probable depth of scour as determined by the Engineer. Pile tips shall not be stopped above a layer of soft material. Piling used to penetrate a very soft upper stratum overlying a hard stratum shall penetrate the hard material sufficient distance to firmly fix the ends. In case the Engineer determines that it is necessary to remove any obstruction in order to obtain the total required penetration, the Contractor shall remove such obstruction which shall be considered incidental to the work.

Piles placed in embankments shall be driven to penetrate the underlying natural ground a minimum of 10 feet, unless refusal is reached at a less depth. After the minimum penetration is reached, the required bearing must then be obtained.

(j) ALLOWABLE VARIATION IN PILING
Piles shall be driven as nearly possible in the exact position designated; however, a maximum deviation of 1 1/2 inches from the exact position will be permissible in pile trestle bents and pile abutments, and a maximum deviation of 3 inches from exact position will be allowed for a foundation pile footings of piers or abutments. Care shall be taken during driving to prevent and correct any tendency of concrete or steel piles to twist or rotate. Footings and encasements shall be formed around the piles to give at least the minimum concrete cover shown on the plans. Piles that are to be sway braced shall be aligned as necessary so the sway bracing can be properly welded to the piles. After all piling in a bent are aligned within the tolerances specified hereinbefore in the Section, the bent cap shall be placed on the piles in exact position.

(k) DEFECTIVE PILES
1. Removal and Replacement
Any pile damaged while driving, or any pile driven out of its proper location shall be removed and replaced without additional compensation.
2. Concrete or steel piles driven below the fixed cut-off elevation shall be extended upward by splicing as provided in this section.
3. Piles Pushed Upward
Piles pushed up by the driving of adjacent piles or by any other cause shall be driven down again without extra compensation.

(l) SPLICING PILES
1. General
Full length piles shall be used wherever practical. when splicing is necessary and cannot be avoided, the method shown on the plans shall be used. If details are not shown on the plans, then the method shall be approved by the Engineer.
2. Precast Concrete Piles
a. Precast, Non-Prestressed Concrete Piles
After the driving is completed, extensions on precast concrete piles shall be made by carefully cutting away the concrete at the end of the pile, leaving the reinforcing steel exposed for a length of at least 40 diameters. The final cut of
the concrete shall be perpendicular to the axis of the pile. Such final cutting shall not cause undue spalling of the sides of the pile adjacent to the cut. Reinforcement of the same kind and size as that used in the pile shall be securely fastened to the projecting steel and the necessary form work shall be placed, care being taken to prevent leakage along the pile. The concrete shall be of the same quality as that used originally in the pile. The provisions of Section 501 shall govern the bonding of the joint of the pile and the splice. Removal of form curing and protection, and finishing shall be as provided in Section 501 also.

b. Precast, Prestressed Concrete Piles
Splicing of prestressed concrete piles shall be in accordance with the details shown on the plans and the applicable portions above.

3. Steel Piles and Steel Shells for Cast-in-place Concrete Piles
Splicing of these piles shall be made in accordance with details shown on the plans or furnished. Welded connections for splices shall be used. All work shall be done with approved methods, materials, and experienced welders of structural steel. All welding shall be done in accordance with the American Welding Society Structural Welding Code D1.1-80 modified in accordance with the provision of AASHTO Standard Specification for Welding of Structural Steel Highway Bridges, dated 1981 and any applicable special provisions. All welding shall be subject to the inspection and approval by the Engineer or his representative.

(m) ELEVATION
The tops of all piling shall be cut to a true plane(square or level) as required by the plan details and at the elevation fixed by the plan details.

(n) INSPECTION
No pile shall be driven except in the presence of an Inspector. An accurate driving record will be kept by the Engineer using the regular forms provided for this purpose.
At all times prior to the placing of concrete in the driven shells, the Contractor shall have available a suitable light for the inspection of each shell throughout its entire length. Any improperly driven, broken, or otherwise defective shells shall be corrected to the satisfaction of the Engineer by removal and replacement, or the driving of an additional pile, at no extra cost to the City. All water shall be removed from the shell before placing any concrete.

(o) PILE PAINTING AND PROTECTION
All exposed surfaces of steel piling not encased in concrete shall be painted in accordance with the requirements of Section 509 for Structural Steel. Storage and Handling shall be in accordance with Section 835.

(p) SHEET PILING
1. Temporary
Such temporary sheet piling as required for foundation and in conjunction with bridge excavation not designated for payment shall be furnished, driven and if directed removed all without extra compensation. Attention is directed to Sections 108 and 505.

2. Permanent
Permanent sheet piling shall be new piling and shall be furnished and driven by the Contractor as provided on the plans or designated in the proposal.
3. Construction Details, Permanent Steel Sheet Piling
   and Concrete Sheet Piling
   a. All construction methods for steel sheet piling and precast concrete sheet piling shall conform to the respective requirements prescribed herein for steel and concrete bearing piling as directed.
   b. Precast Concrete sheet piling may require the use of some tapered units in order to maintain vertical alignment of the sheet pile wall.
   c. Sheet piling shall be driven to the correct elevation and where it necessary to cut off same, cutting shall be done by approved methods and in a satisfactory manner.

507.04 Methods of Measurement

(a) TEST PILES
   The actual number of acceptable test piles driven as directed in conformity with these specifications, will be measured complete in place. Piles paid for as test piles will not be included in the measurement of pay footage. No measurement or direct payment will be made for (1) test pile cut-offs, (2) splices necessary to lengthen test piles.

(b) LOADING TESTS
   The number of loading tests measured will be the actual number of accepted tested ordered and completed in conformity with these specifications. In case the pile does not carry the load after the load is placed according to the specifications, and it becomes necessary to re-drive the pile and place another load, this will be deemed an additional stage of loading. Each time the pile is driven to additional penetration and reloaded, each loading will be measured as an additional stage of loading, not an additional load test.

(c) METAL PILE POINTS OR SHOES
   The number of pile shoes shall be the number of shoes of approved design ordered and used on accepted piles.

(d) SPLICES
   No measurements or payment will be made for splices

(e) BEARING PILING
   1. The lengths of accepted piling that remain in the furnished structure will be measured in linear feet, complete in place.
   2. No measurement for payment will be made of pile cut-offs.
   3. Pile cap plates and cap channels will not be measured for directly but considered incidental to the work.
   4. Piling damaged or injured by the Contractor in handling or driving will not be accepted.
   5. If City loaned piling is damaged or used, the Contractor shall replace with piles of equal quality.

(f) EXTENSION OF CONCRETE PILES
   In case extensions are necessary on concrete piles, the extended lengths will be the actual footage of extensions, with no allowance for splicing of the main reinforcement or the cut off necessary to secure the splice.
(g) PERMANENT SHEET PILING

1. The quantity of permanent steel piling measured for payment shall be the quantity in pounds of such piling actually remaining in the completed structure and accepted. The weights shall be theoretical weights and shall be computed on the basis of the manufacturer's standard unit weights and the lengths used being lengths under cutoffs.

2. The quantity of permanent concrete piling to be measured for payment shall be the quantity in linear feet of such piling actually remaining in the completed structure and accepted. In computing the linear feet the lengths shall be those lengths under cutoffs.

507.05 Basis of Payment

(a) GENERAL

The contract unit price for the various type piling covered by this Section shall be full compensation for furnishing and installing all materials required by each item of work, and for all equipment, tools, labor and incidentals necessary to complete the work. Each pay item includes fabrication, treatment, transportation, handling, driving, jetting, drilling, pilot holes, spudding, splicing, cutting off, capping, painting and finishing where necessary and as required by other portions of these specifications and the plans. No payment will be made for falsework piling and no additional payment will be made for piles made on a batter.

(b) ACCEPTED PILING

The quantity of acceptable piling (including test piles) in place after all cut-offs have been made will be paid for at the respective contract unit price for the type of piling listed in the contract. All cut-offs will become the property of the Contractor.

(c) LOADING TESTS

Accepted Loading Tests will be paid for at the contract unit price for Loading Tests per each, complete in place, which shall be payment in full for all materials, equipment, and labor incidental to the constructing the loading platform, instrument shelter, procuring and placing the loading material, and/or equipment, and removing and disposing of the platform and material and/or equipment. For each additional stage of loading as described above, payment in the amount of 50 percent of the contract unit price for Loading Tests Per Each, will be made.

(d) PERMANENT SHEET PILING

The contract unit price bid for this item shall also include any necessary excavation unless an item of excavation is also provided in the contract.

(e) METAL PILE POINTS OR SHOES

The Contractor will be paid the delivered invoice cost, including any applicable sales taxes, plus 20 percent for Metal Pile Points or Shoes only if they are not shown on the plans and or ordered to be used by the Engineer. This price shall be full compensation for the pile point or shoe, gross receipt tax, welding, and all other materials, labor and incidentals necessary to complete the work. If they are shown on the plans, their cost shall be included in the unit price for the piling.
(f) CONCRETE PEDESTAL FOUNDATIONS

Where hard marl, solid rock condition are encountered that make it necessary or desirable to place piles in concrete pedestal foundations, the net length of piling so placed in the structure will be paid for at the contract unit price for the respective kinds of piling. No additional compensation will be allowed for such construction except as follows: The concrete used in the pedestals will be paid for at the contract unit price for Bridge Substructure Concrete. The reinforcement and other steel items will be classified as Steel Reinforcement. Payment for such items shall be full compensation for all other items of work, including drilling dowel holes and setting dowels necessary or incidental to completion of the pedestal foundations.

(g) PILOT HOLES

If the plans do not require the use of pilot holes and the Engineer orders their use, the Contractor will be reimbursed for the drilling work at a rate of 25 percent of the contract unit price bid per foot of piling for each foot of pilot hole ordered drilled. If pilot holes are shown on the plans, the cost of drilling the pilot holes shall be included in the unit price for piling.

(h) PAYMENT WILL BE MADE UNDER:

Type Test Piles - per Each
Loading Tests - per Each
Type Piling - per Linear Feet
Permanent Concrete Sheet Piling - Per Linear Feet
SECTION 509
STRUCTURAL STEEL AND MISCELLANEOUS METALS

509.01 Description

The work under this section shall cover the furnishing, fabricating, erecting, and painting (both shop and field) all structural steel and metal work. All work shall be in conformity with the dimensions, shapes, and designs shown on the plans. Erected materials shall conform to lines and grades shown on the plans.

Structural metals covered in this section shall include structural steel shapes (except piling) and plates, bolts, and other types of fasteners, welding, special and alloy steels, steel forgings and castings, and all types of metal casting as well as incidental metal construction not covered in other Sections.

Welding of structural steel and other metals shall conform to the requirements of Section 839 and any modification thereto provided in the contract. Applicable requirements of Sections 511 and 520 shall also apply to this Section.

509.02 Materials

(a) GENERAL

All materials shall conform to the provisions of Division III Materials, specific reference is made to the following:

1. Section 839 - Structural Steel, Fasteners and Misc. Metals
   Section 859 - Paints, Oils, and Pigments

2. Except where otherwise provided, all members shall be of structural carbon steel.

3. Pipe for railing shall be as specified on the plans.

4. Forgings shall be of carbon steel and shall be annealed before machine finishing.

5. Castings shall be made of the type metal specified by the plans, but in general, cast iron shall be used only for unimportant parts.

6. High strength steel fasteners shall conform to the requirements of Section 839. High strength steel lock-pin and collar fasteners will not be permitted unless noted in the plan details.

7. Materials for Bridge Deck Drainage System shall conform to the requirements shown on the plans. Galvanizing, if required, shall conform to ASTM A-120 for pipe, ASTM A-123 for forgings, shapes, etc. and ASTM A-153 for Nuts, Bolts, and miscellaneous hardware.

509.03 Construction Requirements

(a) GENERAL

Attention is directed to the requirements of Section 50.02 and 839 concerning the approval of drawings, mill orders and shipments statements, and notice and facilities for inspection before fabrication of structure members.

All exposed structural steel surfaces, including piling not in the contact with concrete shall, unless otherwise noted by the plans or proposal, be painted in accordance with the provisions of Section 520 utilizing green bridge paint for paint for the top coat. The painting of the steel and the cost thereof is considered incidental to the furnishing of the structural steel.

When a structure utilizing weathering steel is designated to be unpainted, the steel shall be cleaned after fabrication (includes drilling and reaming) in accordance with the provisions of Section 520. Any foreign material which adheres
to the steel after fabrication and before acceptance shall be removed by the Contractor without additional compensation.

(b) SHOP FABRICATION
Reference is made to the requirements of Section 839 for such work.
Within 30 days after the award of the contract, the Contractor shall notify the Engineer of Public Works in writing of the name and address of the fabricator of the structural steel. The notification shall include the fabricator's proposed fabrication schedule.
Shops fabricating main Structural steel member shall be certified by the American Institute of Steel Construction for Category I for simple rolled beam bridges and category III for all other steel bridges.

(c) STORAGE
All materials shall be stored in such manner as to prevent corrosion or loss of minor parts. Is shall be placed on skids above the ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection. All storage and storage sites are subject to the provisions of Section 60.05

(d) ERECTION
1. Working Drawings
Working drawings outlining a procedure and the equipment to be used for erection of all continuous span steel units, trusses, and other metal work requiring field splices shall be submitted for distribution in accordance with Section 50.02. If falsework is to be used as part of the erection procedure, these plans, etc, shall be submitted along with the erection procedure.

2. Bearing and Anchorage
a. Bridge bearings shall be set level in except position and shall have full and even bearing on the masonry and shall not be placed on masonry bearing areas which are irregular or improperly formed.
b. Where rocker bearings are used, the masonry plates shall be placed on alternate layers of canvas and metal primer paint (red lead or zinc chromate) applied as follows:
Swab the top surface of the bridge seat bearing area with primer coat-paint and place upon it three layers of 12 to 14 ounce duck, each layer being thoroughly swabbed on its top surface with primer coat paint.
Place in position the superstructure shoes while the paint is plastic.
c. Rocker Bearings shall be adjusted so that they will be in vertical position at an ambient temperature of 70 °F.
d. Masonry plates for self-lubricating bronze bearing plates or PTFE coated bearing plates shall be set 1/2 inch (minimum) into the cap in portland cement mortar not more than 3/4 inch thick and depression filled with mortar so that no water will be trapped. No superstructure or other load shall be placed thereon until this mortar has been allowed to set for at least 96 hours in a well moistened condition throughout this period. Prior to erecting girders, the top of the plate shall be rotated to fit the grade of the girder and the bearing plate shall be adjusted for temperature so that it will be centered on the masonry plate at 70 °F.
e. All holes for anchor bolts shall be drilled or formed in the concrete in correct location, perpendicular to the plane of the bridge seat, so that the anchor bolts will be in the center of the hole at 70 °F. The reinforcing steel in the concrete shall be adjusted prior to pouring so it will not interfere with the drilling or forming
of the hole. The holes shall be large enough to provide for any necessary adjustment in the superstructure unit. All holes shall be plugged during cold weather to prevent water from freezing therein. On short spans, not requiring rocker bearings, the Engineer may permit the anchor bolts to be cast into the concrete provided satisfactory templates are used.

f. Anchor bolts shall not be grouted until after the superstructure unit has been erected and adjusted. Also, the holes shall be thoroughly cleaned and moistened with water just prior to grouting. In setting the holes shall be filled about 2/3 full with portland cement grout (1:1 mix) of suitable consistency. The anchor bolts shall then be gently tapped or pushed into the grout until the hole is filled with grout and the anchor nut and washer are in contact with the shoe. The anchor bolts shall again be tapped or vibrated lightly after initial shrinkage of the grout (approximately 30 minutes after mixing). No further jarring of the bolts shall be permitted until after a 48 hour setting period. Nuts at expansion bearings shall be left loose enough to permit free movement of the span.

3. Handling Members

All members shall be carefully handled to prevent damage to them and in a manner that any camber put into them will not be changed. One pick-up point will be permitted on pieces 50 feet or less in length. Two pick-up points, located at or between the 1/4 and 1/3 points, will be required on pieces over 50 feet in length. Calculations showing that the pieces will not be damaged, along with erection plans, will be required when pick-up points are requested to be located outside of these areas. This data shall be submitted in accordance with Section 50.02.

4. Erection Assembly

The parts shall be accurately assembled as shown on the plans and any match marks shall be strictly followed. Splices and field connections shall have at least 50% of the holes filled using bolts (either erection or untorqued permanent bolts) and an adequate number (Minimum 10%) of forged barrel drift type erection pins for fit up and alignment. The diameter of the erection pins shall be 1/32 inch larger than the diameter of the bolts. Splices and connections carrying traffic during erection shall have 3/4 of the holes so filled. Fitting up bolts shall be tightened to snug tight condition. Snug tight is defined as the tightness such as can be produced by one or two solid blows from an impact wrench or effort of a man using an ordinary spud wrench. Before beginning high strength bolting, the structure shall be adjusted to correct grade and alignment. For truss spans a slight excess camber will be permitted while the bottom chords are being bolted, but the correct camber and relative elevations of panel joints shall be secured before bolting the top chord joints, top lateral system and sway bracing. All nuts on bearing assembly pins shall be tightened and the pins so located in the holes that the member will take full and even bearing upon them.

Bolts and nuts for bolted beam and girders splices shall be placed so that (1) flange splices have nuts on the exterior face of the splice, (2) web splices have bolt heads on the outside face of exterior beams or girders.

Filler plates for bolted beam and girder splices have been based on theoretical dimensions, the thickness of the plates shall be adjusted in the shop to take care of any difference greater than 1/16 inch between the theoretical and actual dimensions. Splices in members of the same theoretical size will require filler plates if the actual dimensions vary more than 1/16 inch. Filler plates shall be tack welded to beams or girders in the shop.

Erection bolts shall be used on all channel diaphragms and angle crossframes where field welding is required. Two (2) bolts shall be used in each end of a channel diaphragm with angle cross-frames using one (1) bolt on each angle end. Said connection shall utilize 1/2 inch diameter bolts with washers placed in a 13/16
inch round hole. The field welding of these members shall be performed prior to pouring of the deck slab. These bolts shall be left in place on structures and removed from structures to be left unpainted.

5. Defective or Damaged Material
   Any material that is damaged, distorted or in any way defective and is considered to be repairable shall be corrected by means approved in writing by the Engineer of Public Works. The Contractor shall submit a detailed proposed procedure for approval prior to making any corrections. Minor misfits involving occasional reaming of holes will not require the Engineer's approval.

6. High Strength Bolting
   a. General
      High tensile strength bolts shall be used for all field fasteners unless other type fasteners are permitted by the plans and/or proposal. The bolts shall be used in holes slightly larger (no more than 1/16 inch) than the nominal bolt size. All bolt heads and nuts shall be hexagonal shaped.
      All high strength bolts, nuts, and washers shall conform to the requirements of Section 839. Attention is directed to the requirements of Section 511 concerning testing and calibration of the bolts, nuts, and washers before actual installation.
   b. Bolted Parts.
      Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. Holes shall be punched, subpunched and reamed, or drilled as required by the plans.
      When assembled, all joint surfaces, including those adjacent to the washers, shall be free of scale except tight mill scale. They shall be free of dirt, loose scale, burrs, and other defects that would prevent solid seating of the parts. Contact surfaces within the friction type joints shall be free of oil, paint lacquer, or galvanizing.
   c. Installation
      Bolts shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. A flat washer may be used when the abutting surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolted axis, a smooth beveled washer shall be used to compensate for lack of parallelism.
      Before tightening the bolts to the required minimum tension, all bolts in the splice shall first be tightened to snug tight condition, progressing from the most rigid part of the joint toward the free edges. See item 4 above for definition of a snug tight condition. At "snug", all joining surfaces should be firmly in contact. All fasteners shall then be tightened to give the minimum tension values shown in Table 1. Tightening shall be done with properly calibrated wrenches or by the turn-of-nut method. The element not being turned (bolt or nut) shall be held with a wrench during the tightening to prevent rotation of the fixed element.
      The Contractor shall furnish a suitable calibration device and all wrenches to properly install and inspect the high strength bolts. The calibration device (bolt tension calibrator) shall be calibrated by an approved laboratory. Prior to using, the Contractor shall submit to the Engineer the necessary documents related to the calibration of the instrument. The calibration results shall be valid for a six (6) month period after the date of the calibration under normal conditions. The Engineer may request that the calibration device be calibrated at any time.
The Contractor shall take special care in storing bolts, nuts, and washers to prevent them from rusting. Any bolts, nuts or washers will be rejected if they are rusted to the extent that erratic readings are produced during the calibration of the wrench.

Table 1

<table>
<thead>
<tr>
<th>Bolt Size (inches)</th>
<th>Bolt Tension * (Pounds)</th>
</tr>
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<tbody>
<tr>
<td>1/2</td>
<td>12050</td>
</tr>
<tr>
<td>5/8</td>
<td>19200</td>
</tr>
<tr>
<td>3/4</td>
<td>28400</td>
</tr>
<tr>
<td>7/8</td>
<td>39250</td>
</tr>
<tr>
<td>1</td>
<td>51500</td>
</tr>
<tr>
<td>1-1/8</td>
<td>56450</td>
</tr>
<tr>
<td>1-1/4</td>
<td>71700</td>
</tr>
<tr>
<td>1-3/8</td>
<td>85450</td>
</tr>
<tr>
<td>1-1/2</td>
<td>104000</td>
</tr>
</tbody>
</table>

* For ASTM A-325 High Strength Bolts Only

(d) Calibrated Wrenches

Wrenches shall be calibrated on the project at least once daily and for each lot of nuts and bolts to be used. Calibration shall be accomplished by tightening in a device capable of indicating actual bolt tension, not less than 3 typical bolt of each lot to be installed. Power wrenches shall be adjusted to stall or cutout at a tension slightly greater than the minimum required. If manual torque wrenches are used, the torque indicated corresponding to the calibrating tension shall be noted and used in the installation of all bolts of the tested lot. Nuts shall be in tightening motion when torque is measured. When using calibrated wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the prescribed amount. Impact wrenches shall be of adequate capacity and sufficiently supplied with air to perform the required tightening in approximately 10 seconds.

(e) Turn-of-Nut-Method

If this method is selected for final tightening of the high strength bolts, all bolts must first be brought to snug tight condition as described above, then the nuts or bolts shall be turned an additional fraction of a turn as specified in Table 2.
Table 2
Turn of Nut Method

| Bolt Diameter | From Snug Tight | Rotate Nuts *
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1/2 turn</td>
</tr>
<tr>
<td>3/4 and 7/8</td>
<td>5 in. and under</td>
<td>above 5 in.</td>
</tr>
<tr>
<td>1 and over</td>
<td>8 in. and under</td>
<td>above 8 in.</td>
</tr>
</tbody>
</table>

* Permissible tolerance: 1/4 turn over nothing under.

Where faces (under both nut and head) are sloped from normal to the bolt axis up to 1 to 20 and bevel washers are not specified, a minimum 3/4 turn from snug tight is required for all bolt diameters.

(f) Inspection

The Engineer shall satisfy himself that all requirements of these specifications are met. Spot checks shall be made with a manual torque wrench that has been calibrated as previously specified herein for the minimum required tension. All deficiencies shall be corrected prior to painting the bolts and splice plates.

7. High Strength Steel Lock-Pin and Collar Fasteners
   a. General

High strength steel lock-pin and collar fasteners may be used for field fasteners only when permitted by the plans. All pertinent specifications relating to the use of high strength bolts not in conflict with the following requirements, shall apply.

b. Installation

(1) Installation of high strength Lock-pin and Collar Fasteners shall be in accordance with the manufacturers recommended practices which will assure pre-load tension values equal to or exceeding those prescribed for ASTM A 325 bolts. Hardened washers need not be used except where an other face of the connected parts has a slope of more than 1:20 with respect to a plane normal to the fasteners axis. Where this occurs, a beveled washer should be used to compensate for the lack of parallelism. A sufficient number of fasteners shall be partially swaged to insure that the parts of the joint are brought into full contact. The remaining fasteners and fasteners with partially swaged collars shall then be completely installed progressing from the most rigid part of the joint to the free edge.

(2) At least three lock-pin fasteners of each diameter of bolts being installed shall be tested at least once each working day by tightening the fasteners with the job installation tool in a device capable of indicating actual bolt tension. Adherence of the installed fasteners to the prescribed dimensions as recommended by the manufacturer and approved by the Department of Public Works shall be confirmed by visual inspection and random gaging. The inspection and acceptance of the installation of the fasteners shall be the responsibility of the Engineer and his decision will be final.
c. Inspection
The procedures for inspecting and testing the lock-pin and collar fasteners and their installation to assure that the required pre-load tension is provided shall be as recommended by the manufacturer and approved by the Engineer.

This procedure shall be such that there is no doubt as to the installation meeting the pre-load tension requirements. If such a procedure cannot be established that meets the approval of the Engineer, the use of this type fasteners will not be permitted.

The Contractor will be required to furnish certified test reports showing that the fasteners meet all physical and chemical requirements of ASTM A325 as noted hereinbefore.

8. Bolted Connections
All bolts shall extend past the nuts approximately 1/4 inch after tightening. In bolted connections, other than high strength bolts, the bolts shall be drawn up tight and the threads burred at the face of the nut with a pointed tool.

9. Welded Shear Connector Studs
These studs shall be shop welded unless otherwise specified on the plans or in the proposal. If field welding is permitted, the procedure and requirements shall be specified in Section 839 for shop welding.

10. Painting
Painting shall conform to requirements of Section 520.

11. Name Plates
No permanent plates or makers other than shown on the plans or approved will be permitted on any structure. Any marks or signs painted on structural steel by the fabricators shall be obliterated prior to applying the first field coat by painting over the marks or signs with paint of the same type used for the shop coat.

(e) FIELD INSPECTION
The Engineer shall be given all facilities required for all necessary inspection. Material and workmanship not previously inspected will be inspected after its delivery to the site of the work. Whether shop inspections are made or not, workmanship and materials which do not conform to the Specifications may be rejected at any time prior to acceptance of the project.

(f) CLEANING UP OF WORK SITE
Upon completion and before final acceptance, the contractor shall remove all falsework and other temporary construction, and shall leave the site in a condition as good or better than the original site.

509.04 Method of Measurement

(a) STRUCTURAL STEEL
No direct measurement will be made for the item of structural steel including all bolts, nuts, washers, channels, angles, and all other miscellaneous metal components of a structure which will be considered incidental to the work and the cost shall be absorbed in other appropriate items contained within the proposal.
(b) **STRUCTURAL STEEL SUPERSTRUCTURE**

The number of unit measured will be the accepted number of structural span units complete in place. Any weight shown on the bidding plans or proposal are approximately only and the contact price for each item shall include full compensation for the specified structural unit, complete in accordance with the plans and specifications, regardless of the final weight required and no claim will be allowed for any increase over the estimated weight of a structural unit unless same is caused by a change in plans or specifications. The cost of any additional work caused by a change in plans or specifications will be paid for as Extra Work.

(c) **BEARING PLATES**

Unless otherwise specified on the plans, the Contractor will have the option of furnishing either self-lubricating bronze bearing plates or PTFE coated bearing plates.

The bearing plates furnished will be measured Lump Sum. This shall include all necessary bearing plates required for each structure. Steel plates used in the bronze plate assembly or any other steel plates used in the PTFE plate assembly shall be absorbed in the cost of Bearing Plates if applicable.

(d) **BRIDGE DECK DRAINAGE SYSTEM**

When separate payment is designated for a bridge deck drainage system, the complete system required to drain each separate structure in accordance with the plan details will be measured as one unit per bridge structure. When no separate payment is designated for a bridge deck drainage system, the cost of such will be considered incidental to the work and absorbed in the unit price bid for other items of work.

**509.05 Basis of Payment**

(a) **STRUCTURAL STEEL**

No direct measurement will be made for Structural Steel, but will be considered incidental to the work and the cost shall be absorbed in other appropriate items contained in the proposal or as noted on the plans.

(b) **STRUCTURAL STEEL SUPERSTRUCTURE**

Accepted metal superstructure span units will be paid for at the contact unit price bid for each respective unit complete in place, which shall be payment in full for furnishing, fabricating, transporting, erecting, and painting all materials and for all labor, equipment, tools, falsework, cleaning up and incidentals necessary to complete the work. This item includes all structural steel in the superstructure unit, including bearing devices, except the PTFE coated bearing plates, which support the unit. Joint armor plates, channels, angles, anchor bolts, etc, for sealed interior and exterior bridge joint design shall be as specified in Section 521 and not as a part of this item. This item does not include reinforcing steel and concrete.

Partial payments will be made on monthly estimates based on the following schedule:

<table>
<thead>
<tr>
<th>Fabrication and Delivery to Site</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erected</td>
<td></td>
</tr>
<tr>
<td>Steel Cleaned and Field Painted</td>
<td>100%</td>
</tr>
</tbody>
</table>

(See Section 90 Stored Materials)
(c) BEARING PLATES
Payment for Bearing Plates furnished, complete and installed as shown in the plans will be made at the contract unit price Lump Sum, which shall be compensation in full for furnishing and installation and for all tools, labor, and incidentals necessary to complete the item. Partial payments will be made on monthly estimates based on the following schedule:
Fabrication and delivery to Approved Storage Site *
Erection (in place on caps) 100%

Note: * Reference is made to Section 90 concerning storage sites and payments for stored material.

(d) BRIDGE DECK DRAINAGE SYSTEM
Accepted bridge deck drainage systems, measured as noted above, will be paid for at the contact unit price bid for each system, complete in place. Said Lump Sum price bid shall be payment in full for furnishing and installing of all materials, fabrication of materials, paint (if required) and for all tools, equipment, labor and incidentals necessary to complete the work.

(e) PAYMENT WILL BE MADE UNDER:
Structural Steel Superstructure - Specialty Item per Each
Bearing Plates - per Lump Sum
Bridge Deck Drainage System - per Lump Sum
SECTION 511
BRIDGES

511.01 Description

The work under this section shall cover the construction of bridges, or parts thereof. When widening or modification of an existing facility is required, the work under this section shall include the cutting or breaking away of portions of the existing structural material and preparation of the exposed structural material for joining of new materials for joining of new materials to the lines and grades shown on the plans or as directed.

511.02 Materials

All material incorporated in the structure shall be new except where otherwise specified on the plans or in the proposal. The requirements set forth in the Sections listed in this Section, together with any other specifications contributing to the complete structure shall be applicable to this Section.

Section 108 Excavation for Bridges
Section 501 Structure Concrete
Section 503 Steel Reinforcement
Section 507 Piling
Section 509 Structural Steel And Misc. Metals
Section 513 Prestressed Concrete Bridge Members
Section 520 Bridge Painting

All steel reinforcement used in a cast-in-place concrete bridge deck shall be Grade 60 unless otherwise specified on the plans or in the proposal.

511.03 Construction Requirements

(a) GENERAL

1. Bridges shall be constructed in accordance with lines, grades, dimensions, and other details shown on the plans and in conformity with these specifications.

2. Construction requirements of Sections 108, 501, 503, 507, 509, 513, and 520 shall also apply to this section.

3. Concrete tolerances except for bridge decks shall be as follows:
   Width and dimensions of girders, handrails, and columns shall not vary more than 1/8 inch per foot and not more than 1/4 inch total from plan dimensions.
   For handrail, overhang, and curb, horizontal and vertical alignment shall not vary more than 1/8 inch in 10 feet and not more than 1/4 inch total from that shown on the plans.
   The finished concrete shall be free from objectionable projections, swells, ridges, waves, holes, and other defects.

4. Attention is directed to Section 501 for concrete curing and concrete finishing.

5. Attention is directed to the requirements of Section 70 concerning safety.

(b) SUBSTRUCTURES

1. Foundations shall be prepared in accordance with the plans and Section 505.
2. Concrete and Steel Substructures
   See construction requirements of sections 501, 503, and 508

3. Piling
   See Section 507

4. Drainage
   The fill material back of abutments and wing walls shall be drained by
   means of a system of tiling, french drains or other construction as shown by the
   plans. Drains shall be so located that the stream of water cannot wash away fill
   material thorough the openings. The drainage water shall be discharged through
   abutment, wing or pier walls in such manner and at such locations as to eliminate as
   far as possible any objectionable discoloration of exposed concrete surfaces.
   Drainage intakes where directed, shall be protected against clogging as provided in
   Section 107.

(c) SUPERSTRUCTURES

1. General
   No superstructure load shall be placed upon finished piers or abutments
   until directed. Moreover, before any superstructure load is placed on concrete
   portions of a substructure, one of the following shall be accomplished: (1) A
   minimum time of 14 days, exclusive of days when four (4) hours or more the
   temperature is below 40 °F., shall be allowed for the hardening of concrete, or (2) the
   concrete shall indicate a development of minimum compressive strength of 2400
   pounds per square inch from cylinders prepared in conformity with AASHTO
   Designation T-23.

2. Bearing and Anchorage
   See Item 509.

3. Steel Girders
   See Section 509

4. Prestressed Concrete Bridge Members
   See Section 513

5. Cast in Place Concrete Girders
   See Section 501 and 503. Camber due to dead load and vertical curvature
   shall be put into the falsework and formwork as required to produce the finished
   lines and grades shown on the plans.

6. Reinforced Concrete Bridge Decks
   a. Pre-Pour Conferences
      Pre-pour conferences shall be held between the Contractor and
      Project Engineer prior to placing any bridge deck concrete. As a minimum, this
      conference shall include a discussion of the rate of pour, personnel, and equipment
      to be used, type of finish and curing details.

   b. Placing Concrete
      In addition to the requirements of Section 501, the following shall also
      apply. The rate of pour shall be controlled so that all concrete between construction
      joints can be placed and compacted in a continuous operation before initial set takes
      place in contiguous of the concrete. In case of breakdown of equipment or other
      reasons necessitating suspension of placing and compacting the concrete for a
      period in excess of 45 minutes for mixes without retarder or 60 minutes for retarded
      concrete, and part of the work involved is such that a construction joint will not be
      permitted, all of the previously placed concrete in that section shall be removed and
      replaced by the Contractor without extra compensation.
A deck pour shall not be started when it is raining or threatening rain. Should inclement weather develop during the pour, it will be the Contractor's responsibility to protect the plastic concrete so that placing and finishing operations can be satisfactorily complete without damage to the concrete or concrete surface. Should damage occur, the concrete shall be removed and replaced at the Contractor's expense. The placing of skin patches (the scabbing on of concrete or grout) on a bridge deck will not be permitted. All concrete deck slabs shall be placed full thickness in one operation.

On all continuous spans, a pouring sequence will be shown on the plans. All lower numbered or lettered pours shall be made prior to proceeding to the next higher number or lettered pour. Adjacent pours shall not be made until after the previously placed concrete has reached an age of 24 hours.

Simple spans shall be constructed in one pour, except on simple spans over 50 feet in length transversely slab construction joints will be permitted. On simple spans over 80 feet, transverse slab construction joints will be required. Where slab construction joints are used on simple composite spans, construction joints shall be placed at approximately the quarter points of the span; after pouring the center portion of the span when the concrete has reached a compressive strength of 2400 psi by cylinder tests, or after four days, the end slab portions of the span may be poured.

Consideration will be given to reducing the number of construction joints specified above where transverse screeding is to be employed; however, all request for changes to pouring sequences must be submitted in writing to the Engineer of Public Works. If the number of construction joints is reduced, a minimum pour rate of 30 cubic yards per hour may be required, and an approved retarder may be required in the deck concrete.

During the placing operation, the concrete shall be placed in strips just ahead of the screen for the entire length or width of the pour which ever is applicable. A small roll of grout shall be kept on the leading edge of the screed so that all depressions ahead of the screed will be filled.

c. Finishing

**General Screed Requirements**

All screeds shall be mechanically operated. Screed and screed supports shall be so designed so that they may be pre-set to provide the finished grade and cross section of the concrete deck surface shown on the plans. They shall be of substantial construction so that the proper settings will be maintained throughout the pour. Screed supports shall be placed and adjusted to properly provide for the deflection of the forms, falsework, and structural supporting members which will occur during the placement of concrete. Immediately before concreting operations are started, the screed shall be operated over the full length and width of the bridge segment to be paved. This test run shall be made with the screed adjusted to its finishing position. While operating the screed during this test, all aspects of the screed and supports shall be checked for proper adjustments. After the Contractor has satisfied himself that the finishing equipment has been adjusted to conform with plan and specification requirements, another test run shall be made for the Engineer for the purpose of recording slab thickness and steel clearance measurements prior to the pour being made.

**Longitudinal Screeds**

Longitudinal screeds shall be supported at the ends by transverse headers or by a section previously poured. Screeds must be long enough to span the entire pour as required by the plans and specifications. Intermediate screed supports between approved construction joints will not be permitted. Screeding shall
be accomplished by working the longitudinal screed parallel to the centerline of the road (from low side to high on superelevated curves) in such a manner that laitance, surplus water and inert materials are removed from the surface.

**Transverse Screeds**

Transverse screeds shall be of sufficient weight to strike off the plastic concrete placed in front of the screed without "riding up" on the concrete. Transverse screeds shall be supported by vertically adjustable rails set a sufficient distance from the gutter line to allow free movement of the screed from gutter line to gutter line. Supports for the screed rail shall be located a maximum of 18 inches center to center with the slab overhang supports brackets located a maximum of 24 inches center-to-center. Satisfactory means of load distribution with minimum rail deflection shall be provided. The screed rails for any deck pour shall be completely in place for the full length of the pour and shall be firmly secured to making test runs and subsequently placing deck concrete. In making the test runs, a "tell-tale" device attached to the screed carriage may be used to check the proper clearance on the top mat of reinforcing steel.

**Work Bridges**

Portable work bridges shall be provided and used to preform finishing and inspection work on the bridge deck after the screeding operation. Surface tolerances as described in Section 511 shall be accomplished before tining or grooving the deck surface.

**Final Finishing**

The final finish and texture behind the screed shall be obtained by either wood floating or burlap drag, and by the formation of transverse grooves.

If transverse screeding is employed, a mechanical tining machine will be required to produce the grooved finish. This machine shall travel on the same rails as used to support the transverse screed. The grooves produced shall be as prescribed below for the broom finish.

If longitudinal screeding is employed, a manual finish shall be applied with either an approved broom type device or with an approved cylindrical metal roller.

The broom shall have rectangular shaped, square end, steel tines protruding between 5 and 6 inches beyond the last point at which their flexibility is restricted. The tines shall be approximately 1/8 inch wide and 0.060 inch thick and shall be unevenly spaced and randomly varying between 5/8 inch and 1-1/8 inches increment. The angle formed between the tines and the surface of the concrete shall be maintained between 10 and 15 degrees.

The roller shall have machined grooves which create flat uncupped disks 1/8 inch wide, unevenly spaced and randomly varying between 5/8 inch and 1-1/8 inch using 1/8 inch increments. The grooves shall be sufficiently deep to prevent a buildup of concrete in the grooves. The roller device shall be so constructed as to allow the shaft containing the disks to rotate freely during the grooving operation.

The broom or roller shall produce transverse grooves, approximately 1/8 inch in depth, in the concrete. The grooved finish shall be at right angles to the centerline of the right-of-way on all bridges, regardless of skew, and shall extend across the roadway from 2 feet inside the face of the curb or barrier rail to 2 feet inside the face of the opposite curb or rail. Each pass with the broom or roller shall be adjacent to the previous pass, without overlapping, and shall be accomplished as the finisher walks along the work platform. The length of passes shall be as long as
practical; subsequent passes shall connect to those previously placed without overlapping the ends.

The grooving shall be done as soon as possible after the screeding. Care shall be taken to insure that the moisture of the concrete and downward pressure on the grooving device remains as nearly constant as possible so as to produce a uniform grooved surface. The tearing out of aggregate will not be permitted and shall be cause to bar an apparatus from being used.

The completed grooved surface finish shall be uniform in appearance and free of irregular, rough, or porous areas. Any grooved surface damaged or destroyed may be restored if the concrete is still plastic; otherwise, it shall be regrooved after the concrete has obtained its design strength. Grooving after the concrete has hardened shall be done by equipment designed especially for grooving pavements.

d. Surface Tolerance

The floor shall be constructed to correct elevation, including vertical curvature, within a tolerance of 1/8 inch, except that camber in spans of 100 feet and longer may exceed the designated amount by 1/4 at the midpoint of span. A slight excess of camber is preferred. As soon as the surface has set sufficiently, it shall be straight-edged by the Contractor under the direction of the Engineer and all areas exceeding 1/8 inch in 10 feet from the longitudinal and transverse lines shown on the plans shall be marked and corrected by approved methods. The 10-foot straight-edge shall be lapped at least five (5) feet over the prior 10 foot check point.

e. Curing

See Section 501

f. Drainage

Deck drains or scuppers shall be installed in the gutters at locations and in accordance with details shown on the plans.

g. Slab Overhang

The under surface of overhang slabs shall be provided with a continuous "V" groove 3/4 inch in depth at a point not more than six (6) inches from the outside face for the purpose of arresting water, and thus preventing staining.

h. Expansion Joints.

Plates, channels, or other structural shapes shall be accurately shaped in the shop to conform to the section of the concrete floor. The fabrication and painting shall conform to the requirements of these specification and/or the plans covering those items. Care shall be taken to insure that the surface in the finished plane is true and free from warp. Positive methods shall be employed in placing the joints to keep them in correct position during the placing of concrete. Unless shown on the plans, the joint opening shown on the plans is the opening when the temperature of the structure is 70 °F. Special care shall be taken to insure that all expansion joints devices and expansion joint openings are correctly set prior to pouring the concrete adjacent to the joint.

Expansion joints shall be so constructed as to permit freedom of movement of the spans. Open joints shall be cleared of all mortar and other obstructions as soon as possible after pouring the spans.

Sealing of joints, if required, shall be in accordance with plan details.
i. Protective Coating
See Section 515

7. Concrete Railings, Curbs, Sidewalks, And Parapets
In no case shall concrete railing, sidewalks, and parapets be placed until the falsework for the span has been released, rendering the span self-supporting.

The surface of all bridge sidewalks shall have a wood-float finish or broom finish as required by the plan details.

8. Grounding
If grounding is required by the plans, each exterior girder of bridges or portions of the bridges using steel girders shall be made electrically continuous by means of copper bonding jumpers across each expansion joint. Jumpers shall be extra flexible copper conductor No. 2AWG or larger. They shall be exothermically welded on the inside of the web close to the bottom of the flange. Jumpers shall be sized to permit 10 inch movement between girders without straining the jumper or connections. Grounding fields shall be provided at each end of such bridges or portions of bridges. Where end of bridge terminates at an abutment, the field shall consist of one or more driven ground rods as required to give a resistance to ground not to exceed 25 ohms. Multiple grounds or sectional ground rods will be acceptable. Connection between ends of bridge and ground field shall be copper conductor No. 6 or larger, protected against mechanical injury in all exposed portions by galvanized steel conduit. Resistance measurements shall not be made within 48 hours after a rain shower, or until the ground is reasonably dry after prolonged rainy weather. Where steel sections of bridges terminate at intermediate bents, the grounding field shall consist of No. 20 rods, whichever extends to the lowest depth, and a 2 foot or longer section of copperweld grounding rod extended 4" above the bent cap adjacent to the end of steel section. All welds shall be exothermic. Connection between ground rod and structure shall be a No. 2 AWG or larger, extra flexible electric copper conductor with provisions for not less than 12" horizontal movement of the structure at a point of connection. Reference is made to Section 839 for additional material requirements.

511.04 Method of Measurement

(a) GENERAL
The quantities of concrete and steel reinforcement, structural steel, piling, and other various contract items which constitute the completed and accepted structure shall unless otherwise provided hereinafter, be measured for payment according to the specifications for the individual contract pay items provided.

Accepted work constructed to the dimensions shown on the plans or ordered in writing will be used to determined the quantities of the respective pay items involved, all in accordance with the provisions of applicable Section of these specifications.

Attention is directed to the major items of work such as Section 503 for reinforcing steel, Section 509 for Structural Steel, and Section 507 for Piling.

(b) BRIDGE SUBSTRUCTURE CONCRETE
1. Volumetric Measure
The volume of accepted concrete within the neat lines of the structure as shown on the plans or revised at the written direction of the Engineer, will be computed in cubic yards. The method of average end areas will not be used where
results obtained differ from those obtained by more accurate mathematical computation.

2. Deductions.
No deductions will be made for the volume of concrete displaced by steel reinforcement, drainage scuppers, weep holes, service pipes, conduits, anchor bolts, castings of grillages, or structural shapes and plates. No deductions will be made for chamfers of less than three (3) inch leg measurements.
The volume of precast concrete pile heads imbedded in concrete will be deducted.

3. Additional Cement or Concrete Used.
No payment will be made on account of additional cement used or additional volume of concrete used if unless ordered in writing. No payment will be made for footing concrete used outside line drill limits or other neat lines shown on the plans, where no forms are used. Additional cement ordered used will be paid for as provided in Section 501

(c) SUPERSTRUCTURE CONCRETE
Each accepted Reinforced Bridge Concrete Superstructure unit will be measured for as a lump sum payment. Partial payments will be allowed on monthly estimates in accordance with Section 511.

511.05 Basis of Payment

(a) UNIT PRICE COVERAGE
The accepted structural concrete measured as noted above will be paid for under the respective unit price bid for the appropriate item or items provided for in the proposal. Said unit price bid shall be full compensation for the concrete, complete in place, which shall be payment in full for all backfilling, compacting, disposal of surplus material, all falsework piling, falsework forms, bracing, all materials except as specified below, and for all equipment, tools, labor, and incidentals necessary to finish and complete the items in accordance with the plans and specifications. Non-metal expansion joints, scuppers and drains, electrical conduit and equipment, and reinforcing steel for Superstructure Concrete shall be included in the bid price for the concrete, unless otherwise provided on the plans or in the proposal. In case of widening or extension of an existing structure, the breaking away of existing concrete to the approximate lines shown on the plans and disposing of broken concrete and preparing steel reinforcement for splicing as required, will be paid for under Section 103.
No additional payment will be allowed for constructing or placing expansion joints, scuppers, drains, weep holes, or for placing service pipes or conduits, anchor bolts, plates, castings, grillages or metal bearings or appurtenances, as such are considered incidental to the placing of concrete or other items of the work, unless otherwise noted by the plans or proposal.

(b) SUBSTRUCTURE CONCRETE
Payment for concrete measured on a cubic yard basis as described above will be made at the contract unit price per cubic yard, complete in place, for the various classes of concrete listed on the plans and the proposal.

(c) SUPERSTRUCTURE CONCRETE
Payment for each accepted Reinforced Concrete Bridge Superstructure unit will be made at the contract lump sum price bid for each unit, complete in place.
Partial payments will be made on monthly estimates based on the percentage of total work performed on each unit as estimated by the Contractor and Engineer.

The number of cubic yards shown on the plans and in the proposal is approximate only and the lump sum amount bid for each unit will not be increased or decreased except as outlined below.

This pay item also covers the reinforcing steel required by plan details. Structural steel and precast-prestressed concrete units are covered by other pay items.

An increase or decrease, in the approximately quantity of reinforced concrete bridge superstructure required from that shown on the plans which is caused by a design change after the contract has been let will result in an increase or decrease, in the compensation due the Contractor. This compensation will be made, either increase or decrease, as a proportional amount of the contract unit price of Superstructure Concrete.

(d) PAYMENT WILL BE UNDER:
Bridge Substructure Concrete, Class A - Per Cubic Yard
Bridge Superstructure Concrete, Station - Per Lump Sum
SECTION 513
PRESTRESSED CONCRETE BRIDGE MEMBERS

513.01 Description

(a) GENERAL
This Section shall cover the furnishing of precast-prestressed members and the incorporation of these members in any structure to the neat lines and grades designated by the plans or directed.

The size, dimension and cross-section and other details of the members will be shown in the plan details. All required accessories and fittings necessary for the incorporation of such members into a structure are considered incidental to and included as part of the member furnished.

The requirements provided for Bridges, Section 511; for Reinforcing Steel Section 503; and Structural Steel Section 509 and for Structure Concrete, Section 501; shall apply in all respect to precast concrete bridge members, except where otherwise indicated by specific requirements given hereinafter in this Section or noted by plan details.

Pretensioned-Prestressed concrete girders will be classified by "type" according to the current AASHTO Classification, that Type I, II, III, etc.

(b) DEFINITION
The term "pretension-prestressed concrete" refers to concrete in which the prestressing stands or wire are in tension prior to placing the concrete and released after the concrete has gained sufficient strength to retain the prestressing force by bond.

The term "post-tension prestressed concrete" refers to concrete in which the stressing steel is installed in voids or ducts cast within the concrete member, and is stressed and anchored after the concrete has developed a specified strength. As a final operation, the voids or ducts are filled with grout under pressure.

The definition of all other terms pertaining to prestressed concrete shall conform to the latest report of the AASHTO Committee on Bridges and Structures and Prestressed Concrete Institute Joint Committee.

513.02 Materials

(a) GENERAL
All materials used in the fabrication and installation of the precast members shall comply with the appropriate requirements of Division III, Materials, and the requirements noted hereinbefore in this Section unless otherwise modified by plan details.

(b) REINFORCEMENT
1. Stressing Steel
Stressing Steel shall be in accordance with the following unless otherwise specified by plan details:
   Stressing Cable-ASTM A-416-250 KSI Tensile Strength
   Designs using other strands may be submitted for consideration by the Engineer.
   Stressing Bars- (For Span Sections Only) ASTM A-722
   Type I with Mill test report including Supplementary requirements S1, S2, S4
2. Steel Reinforcement

All reinforcing steel and wire fabric for concrete reinforcement shall met the requirements of Section 837 unless otherwise specified on the plans.

(c) CONCRETE

1. The Contractor shall submit a design to the Engineer for approval of all concrete to be used in the prestressed members. Prestressed concrete shall have a minimum 28-day cylinder strength of 5000 psi or the minimum 28-day cylinder strength specified by the plans.

2. An approved air entraining agent shall be used to obtain an air content of four (4) percent plus or minus one (1) percentage point.

Other approved admixtures may be used to increase workability of the concrete. Slump requirements shall be a maximum of three (3) inches plus 1/2 inch tolerance except when a water reducing agent is used, then a maximum slump of four (4) inches plus 1 inch tolerance may be used. When a high range water reducing agent is used, a slump requirement greater than four (4) inches may be requested by the Contractor in the concrete mix design submitted to the Engineer for approval.

3. The size of coarse aggregate shall not be larger than \( \frac{1}{15} \) of the narrowest dimension between sides of the forms of the member being cast nor larger than \( \frac{3}{4} \) of the minimum clear spacing between individual reinforcing bars or bundle of bars.

4. All materials used in manufacturing the concrete shall comply with the requirements of these Specifications.

513.03 Construction Requirements For Manufacture and Installation

(a) GENERAL

All materials, details, and procedure shall be as specified herein, or noted on the plans.

The manufacture of prestressed member shall be in accordance with "Standards for Prestressed Concrete Piles, I-Beams and Box Beams for Bridges and a Manual for Inspection of Such Construction, Prepared by a Joint Committee Composed of Six Members of the AASHTO Committee on Bridges and Structures and Six Members of the Prestressed Concrete Institute". The Engineer's interpretation of the above manual will be final. The suggested and recommended specifications in the above manual shall apply and will be used in the manufacture of prestressed members unless otherwise specified by plan details or this specification.

(b) MANUFACTURE

The Contractor shall submit to the Engineer for approval shop drawings showing complete details of prestressed AASHTO concrete girders and his proposed tensioning and detensioning procedure.

Within 30 days after the award of the contract, the Contractor shall notify the Engineer of Public Works in writing of the name and address of the fabricator of bridge members. The notification shall include the fabricator's proposed fabrication schedule.

Each production line shall be equipped with a complete set of forms so that all members can be cast in one operation. Members shall be cast and cured in one operation and movement of forms from or within a production line will not be permitted until the next day.

Bearing and anchorage of the prestressed concrete members shall be in accordance with the plan requirements.
Forms for prestressing members shall be so designed and aligned that they will not restrict the longitudinal movement of the casting when the prestressing force is transferred.

For prestressed I-shaped bridge beams of depths not more than 4 feet 0 inch, the concrete should be placed in at least two continuous horizontal layers in the forms and in at least three layers for prestressed I-Beams of greater depth, unless otherwise specified.

Forms for post-tensioning members shall be so designed that members will not be damaged when prestressing force is transferred. Unbalanced post-tensioning will not be permitted.

Forms shall be inspected and approved by the Engineer prior to authorizing casting operations. Keyways, countersunk keys and other configuration shown by the plans shall be built into the forms. Tops of headers shall be in the same plane as the top of side forms. The dimensional location of the top of the headers and side forms shall be the same on all forms used in the production of a particular type or size member. Worn, damaged or otherwise unacceptable forms shall be repaired before casting operations will be authorized.

The transfer of prestressing force shall be done when the concrete has reached a strength of 4000 psi, unless otherwise specified by plan details.

Curing of units shall be in accordance with the provisions of Section 501.

(c) TESTING

1. Concrete
   At least six (6) standard test specimens shall be prepared at the time the concrete is deposited for each production line to determine the concrete strength of the casting at different ages. The Contractor shall provide adequate equipment and facilities to test and store the concrete cylinders in accordance with AASHTO requirements on or near the fabrication yard. The equipment shall include a hydraulic compression testing machine which has been properly calibrated.

2. Stressing Steel and Reinforcing Steel
   Sampling and testing shall be in accordance with current City of Huntsville Specifications.

3. Miscellaneous Items and Accessories.
   Sampling and testing of miscellaneous items and accessories shall be in accordance with the provisions for the type item under the appropriate Section in Divisions III, Materials, and the current City of Huntsville Policy.

   Miscellaneous hardware for precast deck span sections such as machine bolts, nuts, washers, plates, etc, shall be hot dipped galvanized common stock hardware items unless otherwise specified by plan details.

4. Dimensional and Surface Tolerances
   In addition to the requirements noted in the AASHTO Inspection Manual, roadway surfaces of span sections shall not vary more than 1/8 inch from a 10-foot straight edge.

5. Camber of Members
   For span sections at the time of shipment, the total camber shall be between 0 and plus 1/2 inch.

   For pretensioned AASHTO girders the camber shall be as indicated by plan details.

(d) SURFACE FINISH OF UNITS

All units shall receive a Class I finish and in addition all outside AASHTO girders shall receive a Class 2 finish, all in accordance with the provisions of Section 501, unless otherwise provided in the proposal or by plan requirements. When a Class 2 finish is required, it shall be the same as to be used on other portions of the
bridge structure, and the final finish shall not be applied until after the concrete deck is placed on the girders. It will not be necessary to fill small holes in the surface of the prestressed AASHTO girders caused by entrapped air where a Class 2 Surface finish is not required.

The roadway surface of precast span sections shall receive a wood float finish.

(e) HANDLING, STORING and TRANSPORTING

The Contractor shall be responsible for the proper handling, storage and transporting of precast members. While lifting or storing precast members, the tops of each shall be placed upward. Lifting hooks or similar devices for lifting shall be at points close to each span. They shall be of sufficient strength and embedment to provide safe handling of the elements. Blocking under units during storage and handling shall be placed close to ends of the span only. Lifting devices shall be of sufficient size and capacity to insure safe handling during moving of units.

(f) ERECTING AND PLACING

1. General
Any unit cracked or otherwise damaged in either handling or placing will be evaluated by the Engineer as to whether the damaged is minor and may be repaired, or whether it will be rejected. Any repair shall be made in a manner acceptable to the Engineer and the Engineer's ruling on the unit's acceptability will be final.

2. Pretension-Prestressed Girders
The moving and placement of the girders shall be such that the units are lifted and/or supported at the points shown on the plans or at the supporting points of the unit when it is put into service.
Care shall be taken to insure proper placement on anchor bolts and that the anchor bolts are tightened and secured as noted in the plan details.

3. Prestress Concrete Span Sections
In the installation of span sections care shall be taken to match the units so that the surface differentiation between adjacent units do not exceed one quarter inch. Span sections which do not meet the surface tolerance requirements will be rejected; however, the rejected unit may be used in a different position in the structure or in another structure provided the tolerance are met.

After placing the units in a structure, they shall be bolted together as shown by plan details to provide a snug fit. If the flat washers, bolt heads or nuts do not indicate uniform bearing on each other and the concrete, an appropriate size beveled washer shall be provided. Snug tight is defined as the tightness such as can be produced by one or two solid blows from an impact wrench or by full effort of a man using an ordinary two foot spud wrench. After obtaining the proper bolt fit, the treads shall be burred to prevent removal.

Upon satisfactory completion of the bolting up operation, the concrete keyway shall be poured using 4000 psi concrete (the Contractor shall have a design mix for the concrete, approved in the same manner noted above) which has been retempered. This pouring operation requires the following sequence: 1. Standard mixing of the concrete shall be completed a minimum of 45 minutes in advance of placing; 2. The mix shall be retempered by remixing the concrete without additional water just prior to placing; 3. The concrete mix shall be placed in the keyway, tamping and packing the mix as necessary to insure complete filling of the joint; 4. The exposed surface of the joint shall be struck to the same elevation of the adjoining sections and the surface given a wood float finish.
(g) ACCEPTANCE OF UNITS

Preliminary acceptance of units will be based on compliance with plan dimensions, the details noted hereinbefore and concrete cylinder tests. Final acceptance of the units will be based on the preliminary approval and the satisfactory installation of the units in the structure in accordance with the plan requirements.

513.04 Method of Measurement

(a) PRETENSIONED-PRESTRESSED CONCRETE GIRDERS

The linear footage of pretensioned-prestressed concrete girder measured for payment will be the ordered length of each type ordered, installed and accepted. The length measured for payment will be the casting length shown on the approved shop drawings for each girder.

(b) PRECAST CONCRETE SPAN UNITS

The number of precast (post-tension or pretensioned) concrete span sections of each type and dimension complete in place and accepted will be the actual number of units ordered and accepted complete in place in a bridge structure.

(c) RELATED ITEMS

Items not specifically covered by unit price coverage noted in this section necessary to complete the bridge structure will be measured and paid for under the appropriate item of work noted elsewhere in Section 501, 503, 509 and 511 of these Specifications.

513.05 Basis of Payment

(a) UNIT PRICE COVERAGE

1. Pretensioned-Prestressed concrete girder measured as noted above will be paid for at the respective unit price bid for each of the type girders designated on the plans or proposal, which shall be full compensation for obtaining Class 2 Surface finish on the outside of all girders, furnishing all materials, manufacturing and installing of the girders complete in place, in the bridge, including neoprene bearing pads, premolded bituminous filter, all necessary accessories, for all items cast into the concrete girders and for all other materials, equipment, tools, labor, and incidentals necessary to complete and place the girders into proper position in the bridge.

The placement of the concrete slab and other related items of work which are to be measured for payment separately will be paid under their respective items of work.

2. Pretension Concrete Deck Spans

Accepted pretension concrete deck span sections measured as noted will be paid for at the respective contract unit prices each, for the respective type member of the depth, width and length desired. Said unit price shall be full compensation for the manufacture for the furnishing of the member complete in place in the bridge, for necessary accessories, for all items cast into the concrete, for tie bolts, for expansion and bearing materials, for cover concrete over fittings, for grout and grouting, for placement of keyways, for surface finishing and for all other material equipment, tools, labor, and incidentals required to complete the bridge, except handrail.
3. Partial Payment

Partial payments will be made in accordance with the following schedule:

Fabrication and Delivery to Approved Storage Site*
Erected
Deck Poured and the required finish applied to Girder units or the bolting up and casting of keyway on deck units

90%

100%

*Reference is made to Section 90.07 Concerning Stored Materials

(b) PAYMENT WILL BE UNDER:
Pretensioned-Prestressed Concrete Girders Type - per LF
Prestressed Concrete Interior Span Sections (Dimensions) per Each
Prestressed Concrete Exterior Span Sections (Dimensions) per Each
SECTION 515
LINSEED OIL PROTECTIVE COATING
FOR BRIDGE DECKS

515.01 Description

This section shall cover the work of furnishing and applying a protective coating of linseed oil to bridge decks. Such treatment shall consist of two (2) applications of the linseed oil as noted in this Section.

515.02 Materials

The same protective coating mixture shall meet the requirements of AASHTO M233. Samples shall be taken in accordance to the job control schedule and producers shall furnish certification in accordance with AASHTO M233 section 2.4.

515.03 Construction Details

(a) SURFACES TO BE TREATED

The protective treatment shall be applied to the entire top surface of all bridge decks from gutter to gutter.

(b) PREPARATION OF SURFACES

The concrete shall be at least 60 days old before the first application is applied. The concrete surface shall have had a 48-hour drying period just prior to the application of the mixture and shall be cleaned of all oil, dirt, and loose particles which will prevent the mixture from penetrating the concrete. Immediately before the application of the mixture, an air blast shall be directed over the surface to be treated so that all dust will be removed.

Areas where grinding was required to correct surface irregularities shall be etched by an application of a 10 percent hydrochloric acid solution. Any area treated with the acid solution shall be thoroughly clean with water as soon as the effervescence has stopped, and shall be allowed tho thoroughly dry before the protective coating is applied.

(c) APPLICATION

The temperature of concrete shall be 50 °F or higher at the time of application. The mixture shall be applied by spraying at a pressure of not less than 30 psi nor more than 40 psi.

The protective coating shall be applied in two (2) applications. Each coat shall be applied at a rate so that one gallon (minimum) of the mixture is applied to each 50 square yards of deck area. The spray nozzle shall be held within 12 inches of the concrete surface during application of the mixture. Hand methods may be used only if written approval of the Engineer is obtained. The interior of the equipment shall be thoroughly cleaned each time prior to placing the mixture therein.

The second application of the protective coating mixture shall not be made until the concrete, in the opinion of the Engineer, has regained its dry appearance, and not earlier than the day following the previous application.

When practical, the treated surfaces shall be closed to all traffic, except the sealing equipment, until the concrete has regained its dry appearance.
Caution: The linseed oil-petroleum spirits has a low flash point and is highly flammable. All fires, including cigarettes and sparks shall be kept a safe distance from the mixture.

515.04 Method of Measurement

Measurement of the protective coating will be made in square yards, based on computations of measurements made parallel to the surface ordered treated.

515.05 Basis of Payment

(a) UNIT PRICE COVERAGE
The actual quantity of protective coating ordered and accepted, measured as noted above, will be paid at the contract unit price bid, which shall be full compensation for applying both coats of the oil and includes the furnishing of all materials, preparation of the surface, application of the material, and for all equipment, labor, tools, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE UNDER:
Linseed Oil Protective Coating - per Square Yard
SECTION 517
BRIDGE AND SIDEWALK HANDRAIL

517.01 Description

This section shall cover the work of fabricating, furnishing, and installing handrail on structures in accordance with details and at the location shown on the plans, all conforming with the requirements noted hereinafter or shown on the plans.

517.02 Materials

Materials used in fabrication and installation shall conform to the applicable Section of the Specifications that the structure to which the railing is to be attached was constructed, the details shown on the plans and the following:

Galvanized Steel Pipe Handrail. Galvanized steel pipe shall meet the requirements of ASTM A120; standard weight pipes shall be used for rail elements and extra strong weight pipe shall be used for posts.

Steel shapes, plates and accessories shall be structural or alloy steel galvanized in accordance with ASTM A123.

Bolts, nuts, washers and other fasteners shall be galvanized in accordance with ASTM A 153, Class C, with nuts tapped after galvanizing in accordance with ASTM A563.

Ordinary Alloy Steel Handrail. Ordinary Alloy Steel shall be structural or alloy steel in accordance with ASTM 120.

Nuts, bolts, washers, and other fasteners shall be galvanized in accordance with ASTM A-153 Class C, with nuts tapped after galvanization in accordance with ASTM A-563.

Aluminum or Galvanized Steel Sidewalk Handrail. Materials for use in aluminum or galvanized steel sidewalk handrail shall meet the requirements specified on the plans or in this Section.

Concrete Handrail. Concrete handrail shall be cast in place type conforming to the appropriate requirements of Section 501 and the details shown on the plans.

517.03 Construction Requirements

Rail shall be erected in accordance with the best construction practices and in conformity with lines, elevations and other details indicated on the plans.

The plans will show construction details and will specify the type or alternate type of handrail to be used.

Where the Contractor is permitted to choose the type of rail he wishes to use, he shall indicate in the proposal his choice. One type, once selected, shall be used throughout the project.

517.04 Method of Measurement

The accepted bridge and sidewalk handrail will be measured in linear feet, to the nearest one-tenth of a foot, along the axis of the top rail between extreme limits of the handrail without deductions for laps, posts or joints.

All stair railing, post and appurtenances for one stair tower, including pipe railing on the superstructure but not a part of the bridge or sidewalk handrail, installed and accepted complete in place will be measured as one set of stair railing.
No measurement or separate payment will be made for post or miscellaneous hardware required for installation of handrail and stair railing, such being incidental to the installation of the rail.

517.05 Basis of Payment

(a) UNIT PRICE COVERAGE

The number of linear feet of bridge and/or sidewalk handrail and the number of sets of stair tower handrail, measured as provided, will be paid for at the contract unit price of the appropriate pay items complete in place, which shall be payment in full for all materials including rail elements, posts, hardware and paint; forms for constructing, bracing, and erecting; and for all equipment, tools, labor and incidentals necessary to complete the items in accordance with plans and specifications.

(b) PAYMENT WILL MADE UNDER:

Alloy Steel Handrail - per Linear Foot
Type Railing Stair Railing - per Set
Aluminum/Galvanized Steel Handrail - per Linear Foot
SECTION 519
REPAIR OR RAISING EXISTING BRIDGES

519.01 Description

This section shall cover the work of furnishing all materials, tools, equipment, labor, falsework, or cribbing and all incidental items necessary to repair members or portions of an existing bridge or change the elevation of an existing bridge as may be required by the detailed plans.

The work shall also include the removal and satisfactory disposal of all waste material, damaged portions replaced and all falsework and/or temporary bracing, etc.

519.02 Materials

Since the majority of the work required under this Section is primarily a work item, materials not to be incorporated into the completed structure shall be of such quality as to serve the needs adequately. However, any material which is to become part of the completed structure shall meet the requirements of Division III, Materials, for the respective type of member or part involved.

519.03 Construction Requirements

(a) REPAIRING OF EXISTING BRIDGES

The Contractor shall assemble all materials and equipment required to complete the repairs on any particular member of the bridge and shall adequately strut and brace members which are to be cut to ensure maintaining correct distance between joints and provide temporary load carrying members and supports during such time as members are cut, prior to the cutting of any main member. Prior to beginning, the Contractor shall submit to the Engineer his plans for bracing main members for approval.

(b) RAISING EXISTING BRIDGES

The Contractor shall furnish sufficient equipment of adequate capacity to raise any particular unit of the bridge, or the entire bridge, without injury to same, giving (1) uniform support and bearing at sufficient intervals and (2) adequate falsework, each as approved by the Engineer to support safely the portion of or the entire bridge while being raised until it is set on its new permanent supports. Prior to beginning work the Contractor shall submit to the Engineer (1) his plans for falsework and (2) list of equipment proposed for use. Both of these must be approved before the actual raising begins.

519.04 Method of Measurement

Each existing bridge to be repaired, raised or bridge having a portion or portions of same to be repaired or raised will be shown on the plans and in the proposal by its station number, and for the purpose of measurement and payment will be considered a complete and separate unit.
Basis of Payment

(a) UNIT PRICE COVERAGE

1. Repairs to Existing Bridge
   Payment for repairs to existing bridge shall be made at the contract unit price (lump sum) which shall be payment in full for all material, equipment, tools, labor, falsework, struts, supports, and incidentals necessary to complete the work required by this section and detailed in the plans.

2. Raising Bridge or Portions of Bridge
   Payment will be made at the respective contract lump sum price for items of raising bridges or portions of existing bridges at designated stations listed in the contract only, said lump sum price shall be payment in full for the furnishing of all equipment, tools, labor, falsework, and/or cribbing, storage area and incidentals necessary to complete the work including the removal and satisfactory disposal of falsework and/or cribbing.

(b) PAYMENT WILL BE MADE UNDER
   Repairs to Existing Bridges - per Lump Sum
   Raising Existing Bridges - per Lump Sum
   Raising Portion of Existing Bridge - per Lump Sum
SECTION 520
STEEL BRIDGE PAINTING

520.01 Description

This Section shall cover the work of shop and field painting of structural steel portions of bridges. The details hereinafter described are applicable regardless of whether the painting of a new structure is included in the cost of the steel or the proposal provides for separate payment for field painting. Included also is the cleaning, conditioning and field painting of an old bridge for which the proposal provides for payment. The term "old" being interpreted to mean "not newly constructed".

520.02 Materials

Materials shall conform to the provisions of Division III Materials. Specific reference is made to Section 839, Structural Steel Fasteners and miscellaneous metals and to Section 859, Paints, Oils, and Pigments.

520.03 Construction Requirements

(a) GENERAL

1. Storage and Sample Paint

Paint shall be stored in the field only in original containers. Paint for field painting shall be factory mixed and shall be thoroughly remixed in the field before use. No thinner shall be used without written instructions from the Engineer. If necessary in cold weather to thin paint to spread properly, this shall be done only by heating in hot water or steam.

From time to time during the progress of the work, samples of the paint being used may be taken and subjected to a laboratory test. A material different in composition or working quality of these samples, as compared with the original samples or as compared with manufacturer’s guaranteed analysis may be considered sufficient cause for rejection of the defective material and suspension of payments on work already done with them.

2. Application

Paint may be applied by brush or spray. Rollers may be permitted on flat surfaces.

Regardless of the method of application, the paint shall be applied uniformly to insure complete coverage and to give the required thickness on all metal. All runs and sags shall be evenly brushed out.

The paint shall be kept properly mixed at all times during application. Equipment for spraying shall have the ability to produce satisfactory results without the use of thinner. Only skilled operators shall be used for spray equipment. If paint drift becomes a problem, the Engineer may require spraying be suspended until conditions are favorable. Spray equipment shall include tarps or separators to remove oil and water from the compressed air. Care shall be taken against excessive evaporation of solvent or loss by overspraying. The spray equipment shall be kept clean so that dirt or dried paint or other foreign materials are not deposited in the paint film.

Brushes may be round, flat or oval; however, they must be of a grade, etc., capable of producing a uniform film of paint of appropriate texture.
3. Weather Limitations

Paint shall not be applied when the air temperature or temperatures of the steel is below 40 °F or when the temperature of the steel is above 125 °F. It shall not be applied upon damp or frosty surfaces, nor shall it be applied when the relative humidity of the air is over 85 % determined by a hydrometer at the work site.

4. Number, Thickness and Color of Coats

All metal work on which the prime coat has been applied in the mill or shop shall be painted with two coats after erection and all metal work that has not been painted in the mill or shop shall be painted three coats on the work in conformity with the following requirements: The primer shop coat shall meet requirements of Section 859 for all coats as applicable. The minimum dry thickness of coats shall be 1.5 mils. for primer and 1.0 mils for each field coat.

The color of each succeeding coat shall be sufficiently different from that previously applied to permit readily the discovery of an incomplete application of the paint coat. Unless shown otherwise by the plans or proposal, the second field coat shall be green bridge paint meeting the requirements specified in section 859.

(b) NEW CONSTRUCTION

1. Shop or Primer Coat
   a. General

   All metal work shall be painted in the shop (except for certain contact surfaces covered in item c below) with one shop coat of the prescribed paint or coating, as provided by Section 859, unless otherwise specified on the plans.

   b. Shop Cleaning

   Surfaces that are to be painted shall be cleaned in accordance with the "Steel Structures Painting Council's Surface Specification No. 6 Commercial Blast Cleaning". Visual Standard SSPC-Vis 1-67T may be used to establish the final appearance of the blast cleaned steel before painting. The shop coat of paint shall be applied within twenty-four (24) hours after cleaning. Under no circumstances shall the steel be permitted to rust before painting, regardless of the time elapsed. The height of profile (anchor pattern) shall be from one (1) to four (4) mils after blasting. Oil and grease shall be removed by the use of a suitable solvent. Bristle brushes or compressed air shall be used for removing loose dirt. On welded work, care must be taken to remove all weld splatter, flux, slag, fume, and other objectionable deposits and to neutralize the area of the weld with suitable chemicals.

   c. Painting

   Shop contact surfaces shall to be painted. Surfaces not in contact but which will be inaccessible after assembly or erection shall be painted two coats after primer coat has dried and before assembly or erection.

   Immediately after all fabrication work is completed and has been accepted as such, all surfaces not painted before assembling shall be painted one shop coat of the specified paint, except as specified in Section 839 and as follows:

   Surfaces within two inches of field welds shall not be shop painted.

   Members embedded or in contact with concrete slabs will not require painting unless specified by plan details. Painting of these areas or partial coverage due to overspray, etc. will be allowed provided the paint coverage does not exceed the requirements of the adjacent painted areas. Surfaces of members in contact with web walls shall be painted.
d. Protection of Shop Coat.

The freshly painted material shall not be handled or moved, except when unavoidable, until the paint is dry and all handling and storing shall be done in such a manner that the paint will not be removed or covered with dust, dirt, or other foreign material. Material shall not be loaded for shipment until the paint is dry.

e. Erection Marks

Erection marks corresponding to those erection diagrams shall be plainly painted upon painted surfaces.

2. Field coats

a. Field Cleaning

Field cleaning shall cover the cleaning of all surfaces to be painted of rust, loose scale, dirt, mortar, grease or other foreign matter. In general the choice of cleaning equipment shall be the Contractor's provided satisfactory results are obtained. Oil and grease shall be removed by the use of a suitable solvent. Care shall be taken not to damage an underlying paint coat; however, if damage occurs, the underlying coat or coats shall be immediately repaired. On welded work all slag, flux and spatter shall be removed prior to painting.

b. Erection Painting

Immediately after erection of materials (all connections complete) all splice plates, bolts, nuts, washers and other portions of the structure (except portions in contact with the concrete slab) which have not received a shop primer coat shall be field cleaned and painted with a coat of the same paint used in the shop. Likewise, all surfaces that have been scrapped, chipped or otherwise damaged during erection or areas that have deteriorated since the shop coat was applied, shall be renewed prior to application of the first field coat.

All of the above is considered a part of the erection process and must be completed before consideration will be given for partial payment under the category erected as covered in Section 509.

c. Field Painting

The field coats shall not be applied until the requirements of Subitems a and b above have been accomplished. The painting of spans with a concrete floor shall not be done until after the floor is placed. All concrete spills and splashes shall be washed from the structural steel prior to the mortar taking a set.

In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the paint film. All small cracks and cavities which have not become sealed in a water tight manner by the first field coat shall be filled with paint paste before the second field coat is applied.

3. Protection of Field Paint Coats and Surroundings.

The paint coats shall be protected from discoloration or disfigurement by dust, insects, or other cause until dry. The Contractor shall protect pedestrian, vehicular and other traffic upon or underneath the bridge and also all portions of the bridge not to be painted against damage or disfigurement by spray, spatters, splashes, and smirches of paint or paint material. If traffic produces an objectionable amount of dust, the Contractor shall, without extra compensation, allay the dust for the necessary distance on each side of the bridge and taken any other precautions to prevent dust and dirt coming in contact with freshly painted surfaces. It shall be the Contractor's responsibility to protect all property, public and private, from paint damage.
(c) REPAINTING OLD BRIDGES

1. Cleaning Metal

Portions of steel and other metals that are unacceptable as a base for application of the shop painting and/or over application of the first field coat of paint provided by items 2 and 3 below shall be cleaned and scaled. Steel and other metals shall consist of the metals of the substructure and superstructure structural steel areas and contiguous metal surfaces and such surfaces as galvanized pipe, conduits, and junction boxes, metal ladders, gratings, railings, platforms, metal drains on steel spans and surfaces of all machinery housing and parts that do not require lubrication. The cleaning and scaling of such metal as listed herein shall be accomplished by use of sand blasting equipment. Any cleaning and scaling that is deemed by the Engineer to be harmful to the metal shall be discontinued.

Surfaces that are designated to be cleaned in accordance with the "Steel Structure Painting Council's Surface Preparation Specification No. 6 Commercial Blasting Cleaning". Visual Standard SSPC Visl-67T shall be used to establish the final appearance of the blast cleaned steel before repainting. The height of profile (anchor pattern) shall be from one (1) to two and one-half (2-1/2) mils after blasting. Oil and grease shall be removed by the use of a suitable solvent. Bristle brushes or compressed air shall be used for removing loose dirt.

2. Spot Painting

No paint shall be applied until the surface to be painted has been inspected and approved, this applying to additional coats as well as the surface of the steel after dirt, rust, and loose paint have been removed.

Spot painting shall consist of applying a primer coat to all surfaces ordered cleaned and scaled as provided in Item 1 above.

The primer coat of paint shall be applied within twenty-four (24) hours after cleaning. Under no circumstances shall the steel be permitted to rust before cleaning, regardless of the time elapsed.

3. First and Second Field Coats

Following spot painting, repainting shall consist of applying (1) a first field coat using paint of a grade provided by Section 859 and (2) a second field coat using paint of a grade provided by Section 859. Unless shown otherwise by the plans or proposal, the second field top coat shall be green bridge paint meeting the requirements specified in Section 859. These 2 field coats shall be applied to all metal surfaces listed in Item 1 above with film thicknesses as noted in this Section

4. Protection of Paint Coats.

This shall conform to the above requirements of this Section

(d) CLEANING UP

Upon completion and before final acceptance of the work, the Contractor shall remove all falsework, unused or useless materials and rubbish, and shall leave the bridge site and adjacent right-of-way, neat presentable, and in a satisfactory condition.

520.04 Method of Measurement

The completed and accepted work shall be measured in lump sum units, each unit defined by station number in the proposal.
520.05 Basis of Payment

(a) UNIT PRICE COVERAGE
   Separate payment for painting a new bridge will be made only when the proposal includes a pay item for this work. Otherwise, payment for this work shall be included in the price of other related items of work.
   The painting of a new bridge or old bridge as provided above will be paid at the contract lump sum prices for the specified units. These prices shall be full compensation for all shop or field cleaning of metal and for furnishing and applying paint, and for all materials, equipment, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE UNDER:
   Painting New Bridge at Station - per Lump Sum
   Painting Old Bridge at Station - per Lump Sum
SECTION 521
BRIDGE JOINT SEALS

521.01 Description

This Section shall cover the work of furnishing and installing bridge joint seals at the location shown by the plans or directed, all in accordance with this specification and plan details. Said seals are for the purpose of preventing the passage of water and other materials through the joint.

Types of bridge seals have been classified as follows: Compression Seals and Diaphragm Seals.

521.02 Materials

Materials furnished for use under this Section shall conform to the appropriate requirements of Division III, Materials and the plan details.

521.03 Construction Requirements

(a) GENERAL

The sealing of bridge joints shall be limited to those joints noted by the plans to be sealed.

The plans and proposal will designate the "total joint movement" for which a joint is to function. Shop drawings of the bridge joint seal system designated by the plans or if allowed, selected by the Contractor from the plan designated alternates, must be approved by the Engineer of Public Works.

Shop drawings, etc, of the seal system shall be submitted to the Engineer for approval. After final approval of the drawings, the Contractor shall resubmit four copies of the drawings plus one (1) set of reproducible (Mylar or Equal) for distribution.

(b) FORMING OF JOINT

Special attention shall be given to joint construction to insure that proper allowances for temperature, skew, etc, are made in forming the joint width. In the same manner the anchorage system (bolts, plates, etc.) or joint armor shall be carefully set in the form work to insure proper anchorage and functionality of the complete joint. All elements of the joint seal system shall be on hand before commencing forming of the joint.

(c) INSTALLATION OF BRIDGE INTERIOR JOINT

It shall be the Contractor's responsibility to insure that the joint width, alignment, etc, is in accordance with the bridge details and approved shop drawing. Any deviation from the plans and approved shop drawings shall be reported and corrective remedial action taken before installing the seal element.

Installation of the seal element shall be in accordance with the manufacturer's recommendation. Care shall be taken to insure the proper cleaning of the joint and use of lubricants, adhesives or combination lubricant adhesive during the installation. Splicing of the seal elements will not be permitted in a joint system unless so noted by the plan details or the approved shop drawings.

(d) INSTALLATION OF BRIDGE END JOINTS

The Bridge Contractor shall install that portion of the bridge end joint anchorage system required to be installed in the bridge deck in accordance with bridge plan details and approved shop drawings. The remaining elements shall be
matched marked properly as directed until such time as the bridge end slab is
constructed or the contract is terminated, at which time the stored element shall be
turned over to the Engineer.

The Contractor constructing the bridge end slab shall have the
responsibility of incorporating that portion of the joint seal system required by the
bridge plans and approved shop drawings into the bridge end slab. It shall be the
Contractor's responsibility to insure that the joint width, alignment, etc, is in
accordance with above noted requirements, any deviation shall be reported and
corrective remedial action taken before installing the seal element. The portion of
the joint system to be installed in the bridge end slab and the seal element will be
made available to the bridge end Contractor along with installation details if such is
not provided by plan details. The Contractor shall have full responsibility for
protection, etc, of elements of the joint seal system furnished him until the joint seal
system is accepted. Any damage to the elements caused by his operations shall be
corrected as directed without additional compensation. Installation of the seal
element shall be as noted in this Section.

521.04 Method of Measurement

(a) FURNISHING AND INSTALLING BRIDGE JOINT SEAL SYSTEM (Total
Joint Movement)

Ordered and accepted sealed joints will be measured in linear feet along the
top surface of the designated joint between the bridge gutters to the nearest 1/10
foot. No measurement will be made for that portion of the seal required by plan
details to extend through or above the gutter line, being considered incidental to the
sealing of the joint.

(b) FURNISHING AND INSTALLING BRIDGE JOINT SEAL SYSTEM

When provided, these items will be measured as a lump sum unit for the
designated bridge structure. Said measurement will cover the sealing of all bridge
joints of the type designated, interior or end, all in accordance with the plan
requirements and the details noted hereinbefore in this Section.

521.05 Basis of Payment

(a) FURNISHING AND INSTALLING BRIDGE JOINT SEAL SYSTEM (Total
Joint Movement)

The accepted sealed bridge joints measured as noted above will be paid for at
the contract unit price bid for each designated joint width, which shall be full
compensation for the fabrication and furnishing of all materials necessary to
provide a complete functional sealed joint (armor plates, anchor bolts, extrusions,
channels, seal elements, etc, ); for the incorporation and installation of all elements
into the structure, and for all equipment, tools, labor, and incidentals necessary to
provide a complete operational sealed joint.

(b) FURNISHING AND INSTALLING BRIDGE JOINT SEAL SYSTEM

The accepted sealed bridge joints measured as noted will be paid for at the
contract unit price bid which shall be full compensation for the fabrication and
furnishing of all materials necessary to provide a complete functional joint seal
system (armor plates, anchor bolts, extrusions, channels, seal elements, etc.) for the
structure; for the incorporation and installation of all elements into the structure,
and for all equipment, tools, labor, and incidentals necessary to provide the
structure with complete functional joints.
(c) PAYMENT WILL BE UNDER:
Furnishing and Installing Bridge (Interior or End) Joint Seal System

" Total Joint Movement per LF

Furnishing and Installing Bridge (Interior or End) Joint Seal System
Station _____ per Lump Sum.
SECTION 523
REINFORCED CONCRETE BOX CULVERTS

523.01 Description

The work under this Section shall cover the furnishing of materials and constructing reinforced concrete box culverts (including bridge type) or portions thereof in accordance with the lines, grades, and dimensions and other details shown on the plans or provided in the proposal, in accordance with these Specifications.

When widening or modification to an existing facility is required or directed, the work under this section shall include the cutting or breaking away of portions of the existing structural material and the preparation of the exposed structural material for joining with the new materials to the lines and grades shown on the plans or directed.

This Section shall also cover the work of furnishing and installing precast reinforced concrete box culvert units to form structures in accordance with plan details and the requirements noted hereinafter in this Section.

523.02 Materials

All materials incorporated in the structure shall be new except where otherwise specified on the plans or in the proposal. The requirements set forth in this sections listed hereinafter in this Section together with any other specification contributing to the complete structure in each case shall be applicable to the work required under this section.

Section 107 Structure Excavation and Backfill for Drainage Structures and Minor Structures

Section 501 Structural Concrete

Section 503 Steel Reinforcement

Precast reinforced concrete box culverts units shall be manufactured in accordance with provisions of AASHTO M273 (ASTM C850) for culverts with less than two feet of fill height and of AASHTO M259 (ASTM C789) for culverts with two feet or more of fill height amended to conform to the requirements noted in the detailed plans and the following:

If shown on the plans, culvert units meeting the requirements of AASHTO M259 (ASTM C789) may be used for non-bearing traffic bearing installations having less than two feet of fill height.

Concrete materials shall conform to the appropriate requirements of Section 501.

The Contractor shall submit a design mix having a 28-day cylinder strength of 5000 psi, to the Engineer for approval of all concrete to be used in the precast units. Acceptance of the precast units will be based on visual inspection and compressive tests of the concrete cylinders, cast and cured along with the units, obtaining a compressive strength of 5000 psi.

Joint sealer for precast units shall be one of the types meeting the requirements of Section 847, unless specified otherwise by the plans.
523.03 Construction Requirements

(a) EXCAVATING AND BACKFILLING
Excavation and backfilling shall be in accordance with the provisions of Section 107.

In addition for precast culverts the foundation requirements of Section 107 shall be modified to require a bedding material of at least four (4) inch compacted layer of foundation backfill placed between graded forms set one (1) foot outside each outside wall of the box culvert. The foundation backfill shall be fine graded off the forms, compacted, and shaped to fit the bottom of the precast sections, the forms may be removed.

(b) STRUCTURE CONSTRUCTION
1. General
   Unless modified hereinafter the construction, forming and pouring of the culvert shall be in accordance with the applicable provisions of Section 501, Structural Concrete.
   The concrete used in the structure shall, unless otherwise provided by plan details be a Class A, Type I Mix as provided in Section 501.

2. Cast-in-Place Units
   a. Placing of the concrete
      In general, the base slab of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. Suitable provisions shall be made for bonding the sidewalls to the culvert base.
      In the construction of box culverts eight (8) feet or less in height, the sidewalls and top slab may be constructed as a monolith. When this method of construction is used, any necessary construction joints shall be vertical and at right angles to the axis of the culvert.
      In the construction of box culverts more than eight (8) feet in height, the concrete in the walls shall be placed and allowed to set before the top slab is placed.
      Before concrete is placed in the sidewalls, the concrete wall base shall be thoroughly cleaned of all shavings, sticks, sawdust, or other extraneous material and the surface carefully roughened in accordance with the method of bonding construction joints as specified in Section 501.
      Each wing shall be constructed, if possible as a monolith. Construction joints, where unavoidable, shall be horizontal and so located that no joint will be visible in the exposed face of the wing wall above the ground line.
   b. Construction Joints
      Construction joints shall be provided on all culverts over 60 feet in length with spacing of the joints set to provide approximately equal section of the culvert lengths.
      One construction joint will be required for culvert lengths between 60 feet and 90 feet.
      Two construction joints will be required for culvert lengths between 91 feet and 135 feet.
      Three construction joints will be required for culverts between 136 feet to 170 feet in length.
      For culverts over 170 feet in length, construction joints shall be spaced approximately equal intervals of not less than 40 feet nor more than 55 feet.
      All construction joints shall be constructed normal to the center line of the culvert.
3. Precast Units

Precast units shall be manufactured in accordance with the provisions of AASHTO M273 (ASTM C850) or AASHTO M259 (ASTM C789), whichever is applicable, the plan details and these specifications with special attention directed to Section 501.03.

Precast units shall be laid to the same line and grade requirements noted in Item 527 for pipe. The method of joining the sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even. Unless specified otherwise by the plans, the Contractor shall have the option to use any type joint sealer specified for rigid pipe in Section 847. If, in the opinion of the Engineer, the type of joint sealer selected by the Contractor will fail to perform the intended function, the Contractor shall be required to select a different sealer specified in Section 847. The method of sealing the joints shall be, as nearly as practicable, the same as for concrete pipe as specified in Section 527.03.

End sections for precast barrel units, if required, shall be constructed in accordance with plan details. Those installations not requiring end sections will, unless otherwise shown on the plans or directed, require similar parapets and toe walls, except for length, as shown for installations having end sections.

Precast units shall be backfilled the same, as nearly as practicable, as for pipe specified in Section 547.03.

4. Concrete Surfaces Tolerances

The finished concrete shall be within reasonable close conformity to the line, grades, and dimensions shown on the plans or directed, and from objectionable cavities or projections. Concrete surfaces shall be finished in accordance with the provisions of Section 501.03 for Class 1 with exposed surfaces receiving a Class 2 finish unless otherwise specified by the proposal or by plan requirements.

523.04 Method of Measurement

(a) CAST-IN-PLACE UNITS

The accepted work constructed to the dimensions shown on the plans or ordered in writing, will be used to determine the quantities of the respective pay items involved, all in accordance with the provisions of applicable Section of these specifications.

The volume of concrete in the structure measured for payment will be the net volume of concrete (without deduction for reinforcing steel) measured in accordance with the provisions of Section 511.04. Reinforcing steel will not be measured directly for payment, and the costs being absorbed in the item of culvert concrete.

If provided by the proposal, excavation and backfill will be measured and paid for under Section 107.

(b) PRECAST UNITS

The accepted length of work constructed to size, line and grade shown by the plan details will be measured in linear feet along the center line of the structure. This measurement will be made from the mouth of the culvert, that is, from the point where the wing walls attach to the culvert; however, in no case will a length be allowed greater than the sum of the nominal laying lengths of the culvert sections used nor greater than the length of the culvert ordered by the Engineer. Measurement of multiple barrel structures will include only the length of the structure, not the combined lengths of the individual barrels.
The number of precast end sections measured for payment will be the actual number of units of the designated size, complete in place, on each designated box culvert.

If provided in the proposal, excavation and backfill will be measured and paid for as provided in Section 107.

No separate payment will be made for any other item of work involved.

523.05 Basis of Payment

(a) UNIT PRICE COVERAGE

1. Culvert Concrete and Culvert Extension Concrete

No direct payment will be made for an individual structure under these items, but the quantities measured as noted above will be paid for at the contract unit price bid for the appropriate item. Such payments shall constitute full compensation for the completed structure ready for use including any cofferdam construction, temporary diversion channels, flood protection, falsework, form material, or other erection expenses and for furnishing, hauling, and incorporating all prescribed and necessary materials into the structure, and for all labor, tools, equipment, and incidentals necessary to complete the work.

2. Precast Concrete Box Culvert and Precast End Sections

The accepted quantities of these items at the designated location measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for furnishing all materials and constructing the culvert structure complete in place, for any cofferdam construction, temporary diversion channels, flood protection, falsework, form material, or other erection expenses and for furnishing, hauling, and incorporating all prescribed and necessary materials into the structure, and for all labor, tools, equipment, and incidentals necessary to complete the work.

Payment for parapets and toe walls required on culverts not having end sections will be included in the price bid for Precast Concrete Box Culvert.

(b) PAYMENT WILL BE UNDER:

Culvert Concrete - per Cubic Yard
Culvert Concrete, Extension - per Cubic Yard
___Span X ___Rise * Bbl, Precast Concrete Box Culvert per L.F.
___Span X ___Rise * Bbl, Precast Concrete Box Culvert
End Section - per Each

*Specify number of barrels, e.g. single, double, triple, etc.
SECTION 525
CONCRETE RETAINING WALLS AND CRIBBING

525.01 Description

The work under this Section shall cover the furnishing and constructing of reinforced concrete retaining walls and concrete cribbing; all in accordance with these specifications at the designated locations and in conformity with the dimensions, lines, and grades shown on the plans.

525.02 Materials

All materials incorporated into the structure shall be new, except where otherwise specified on the plans or in the proposal. The requirements set forth in the Section listed hereinafter in this Section, together with any other specification contributing to the complete structure in each case shall be applicable to the work required under this section.

Section 107 Structure Excavation and Backfill for Drainage Structures and Minor Structures.

Section 501 Structure Concrete

Section 503 Steel Reinforcement

525.03 Construction Requirements

(a) RETAINING WALLS
1. Excavation and Backfill
   Excavation and backfill shall be in accordance with the provisions of Section 107.
2. Structure Construction
   Unless otherwise modified on the detail plans, forming and pouring of the concrete shall be in accordance with Section 501, Structure Concrete. Concrete used in the structure shall, unless otherwise provided by plan details, be a Class A, Type I mix as provided in Item 501.02
3. Concrete Surface Tolerances
   The finished concrete shall be within reasonable close conformity to the lines, grades, and dimensions shown on the plans or directed, and free from objectionable cavities or projections.
4. Concrete Surface Finish
   Concrete surfaces shall be finished in accordance with the provisions of Section 501.03 for Class I with exposed surfaces receiving a Class 2 finish, unless otherwise specified by the proposal or by plan requirements.

(b) CONCRETE CRIBBING
1. Excavation and Backfilling
   The foundation or bed for the cribbing shall be excavated as required, and shall be firm and stable and shall have been approved before any crib member is placed. If unsuitable material is encountered at the proposed elevation for the cribbing bed, it shall be removed and replaced as directed with foundation backfill as specified in Section 107.
Backfill material shall be selected from the roadway excavation in such a manner as to provide the most porous type of material available for the backfilling operations, no vegetable matter or chalky soil shall be used.

2. Construction

Unless otherwise modified by plan details, concrete used shall be produced in accordance with the provisions of Section 501, with rib members made of Class D, Type 5 concrete as provided in Item 501.02. The details of crib members and their arrangement shall be as shown on the plans. If specific details for reinforcement are not shown on the plans, or if the contractor uses factory-made crib members, he shall submit detailed specifications and plans; such plans and specifications must be approved before delivery of the material is started.

All members shall be cured and finished as required under Section 501, free from depressions and spalled, patched or plastered surfaces or edges, or any other defect likely to impair their strength or durability. Cracked or otherwise defective members shall be rejected. Exposed portions of crib walls shall have a surface finish as noted in above.

Unless otherwise provided by the plans or proposal, the inside of the crib and two (2) feet back of and beyond the ends of the crib shall be backfilled with selected portions of roadway excavation. Backfilling shall follow closely the erection of the cribbing tier units. The crib wall shall not be laid more than three (3) feet above the backfilled portion.

The backfill shall be placed carefully to avoid distortion of the crib wall, in layers not to exceed eight (8) inches in thickness and tamped or consolidated uniformly as directed by means of mechanical compactors. The puddling method of backfilling shall not be used.

525.04 Method of Measurement

(a) RETAINING WALLS

The volume of concrete in the retaining wall measured for payment will be the net volume of concrete (without deduction for reinforcing steel) in the accepted structure. Reinforcing steel shall be included in the unit price for retaining walls.

Excavation and backfill shall also be included in the unit price for retaining walls.

(b) CONCRETE CRIBBING

The volume of concrete cribbing measured for payment will be the actual net volume (without deduction for steel reinforcement) in the accepted crib members placed as ordered in the completed structure. No separate measurement will be made for the steel reinforcement, excavation necessary for the cribbing, steel dowels or sleeves, the cost being absorbed in the unit price of concrete cribbing.

Foundation backfill, when ordered, shall be measured and paid for as specified in Section 107.

No separate measurement will be made for backfilling of the cribbing.

525.05 Basis of Payment

(a) UNIT PRICE COVERAGE

1. Retaining Walls

The yardage of retaining walls measured as provided above shall be paid for at the contract unit price bid per cubic yard which shall be full compensation for
furnishing of all materials, including reinforcing steel, and the incorporation of the materials into the finished structures, for all formwork, excavation, falsework and erection cost and for all equipment tools, labor, and incidentals necessary to complete this item of work.

2. Concrete Cribbing
   The yardage of concrete cribbing measured as provided above will be paid for at the contract unit price bid per cubic yard which shall be payment in full for furnishing, transporting, handling, excavating, installing the concrete members, backfilling of the crib as noted above, and for all labor, tools, equipment and incidentals necessary to complete the work until final acceptance.

   (b) PAYMENT WILL BE UNDER:
       Retaining Wall Concrete  - per Cubic Yard
       Concrete Cribbing        - per Cubic Yard
SECTION 527
STORM SEWER PIPE

527.01 Description

This Section shall cover the work of furnishing, excavation and installing pipe type culverts of the size, shape, type material and appropriate strength designated on the plans or proposal. The installation shall be at the locations shown on the plans or designated in conformity with the lines and grades shown by the plans. The work shall include the furnishing and construction of such joints, cutting, and connections to other pipes or structures as may be necessary to complete the work as shown on the plans.

The following abbreviations will be used:
- Reinforced Concrete Pipe- RCP
- Reinforced Concrete Arch Pipe- RCAP
- Corrugated Steel- C.S.
- Corrugated Aluminum- C.A.

The Contractor, at his option, may furnish a stronger grade pipe than specified provided written permission is given and no additional cost is incurred by the City for such installation. The Contractor shall also have the option of using Horizontal Elliptical (H.E.) pipe in lieu of Concrete Arch Pipe provided the Horizontal pipe equals or exceeds the arch pipe in strength and equivalent opening. If the Contractor elects to use horizontal elliptical pipe, he shall still be paid under the Pay Item for which the pipe replaces.

527.02 Materials

All materials furnished for use shall conform to applicable portions of Divisions III Materials. Special reference is made to the following:
- Section 845 - Round and Arch Corrugated Metal Pipe
- Section 847 - Pipe Culvert Joint Sealers
- Section 849 - Circular and Arch Concrete Pipe

If H.E. pipe is used as outlined above, the pipe shall meet the requirements of AASHTO M-207. The test reports shall also state the size and class of arch pipe which the H.E. pipe substituted.

527.03 Construction Requirements

(a) GENERAL

1. Pipe Inspection
   Pipe shall be laid only after the Engineer or his authorized representative has approved the trench, and shall not be covered until approved also. Pipe installed contrary to this requirement will be rejected and shall be replaced by the Contractor without additional compensation.

2. Grade and Alignment
   The pipe shall be laid with ends abutting and with not more than one inch variation from established alignment at the vertical centerline or from grade at the flowline.
3. Pipe Extensions.
Existing pipe culverts shall be extended in the same manner as specified for installing new culverts.

4. Corrugated Steel or Aluminum Pipe
Where specifically designated by plan details and proposal the use of Corrugated Steel or Aluminum Pipe shall be installed in accordance with plan details.

(b) EXCAVATION OF TRENCH
Details of trenching and bedding of pipe will be shown on the plans. All pipe 48 inches or less in horizontal diameter shall be laid in a trench extending at least one foot above the elevation of the top of the pipe. For such pipe, where the ground surface is less than one foot above the elevation of the top of the pipe, the Contractor shall first construct and compact the fill to a minimum height of one foot above the elevation of the top of the pipe of a minimum distance of 10 feet in each direction from the outside edge of the pipe. The trench shall then be excavated as specified in Section 107. Caution shall be used to keep the sides of the trench vertical and to the specified dimensions. Where trench excavation exceeds the current OSHA regulations, the Contractor will construct the necessary shoring. This cost shall not be paid for directly but will be absorbed in other appropriate items of work. Excavation above subgrade will be classified and paid for as roadway excavation. Excavation for storm sewer pipe will not be measured directly, and the cost of such work being absorbed in the unit price for the appropriate storm sewer pipe.

For pipe over 48 inches in horizontal diameter trenching will be required only where the original ground line is above the elevation of the bottom of the pipe, and backfilling shall be performed as specified in Section 105.03.

(c) PIPE BEDDING
All pipe placed under this section shall be placed in accordance with the plan details. Unless otherwise specified in plan details, bedding material shall be Alabama Highway Department (AHD) No. 78 commercial aggregate as defined in Section 801.

1. Non-Traffic Areas
The pipe shall be bedded with ordinary care in a loosened soil foundation shaped to fit the lower part of the pipe exterior with reasonable closeness for at least 10 percent of its overall height. Use of a template for shaping will not be required. The shaped foundation shall be loosened by pulverizing the soil to a minimum depth equal to 1/8 the diameter of the pipe or three (3) inches maximum.

Where soft, unyielding soil, rock or hard pan is encountered at the culvert site, the pipe shall be bedded as follows: The material shall be excavated below the bottom of the pipe, or pipe bell for a minimum depth of at least six (6) inches and to the satisfaction of the Engineer. This extra excavation shall be paid for under Unclassified Excavation. The width of the excavation shall be one foot greater than the outside diameter or span of the pipe and shall be filled with AHD No. 78 commercial stone and then lightly compacted in six (6) inch lifts and shaped as specified above.
2. Traffic Areas

When the culvert pipe is to be installed under traffic areas or other areas where the pipe will be subjected to superimposed loads, the pipe shall be bedded as follows:

The pipe shall be placed as specified above with a minimum of six (6) inches of AHD No. 78 stone beneath the pipe. The pipe shall then be backfilled with the approved crushed stone in six (6) inch lifts and compacted to 95% PDR the entire depth of the trench up to the subgrade. This material shall be paid for as Foundation Backfill.

(d) PLACING PIPE

1. General

Proper equipment shall be provided for lowering the sections of pipe into the prepared trench.

The pipe laying shall begin at the downstream end of the pipe line. The lower segment of the pipe shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid pipe shall be placed facing upstream.

2. Multiple Pipe Culverts

Where multiple lines of pipe are used, they shall be spaced far enough apart to permit thorough tamping of earth between adjacent lines. To this end, adjacent sides of circular pipe shall be at least \( \frac{1}{2} \) the nominal pipe diameter apart, or three feet, whichever is less. Spacing for arch pipe shall be as shown by the plans.

3. Joining Pipe

a. Rigid Pipe

Rigid pipe may be of bell and spigot, tongue and groove, or other approved design unless a specific type is specified. The method of joining pipe sections shall be such that ends are fully entered and inner surfaces are reasonably flush and even.

Joints shall be sealed with mortar, bituminous plastic cement, rubber type gaskets, or other type sealers that may be approved. Joints shall be thoroughly cleaned before being sealed and shall be sealed for the full circumference of the joint if indicated on the plans.

When mortar is used for sealing joints, the procedure shall be as follows: Before each succeeding section of pipe is laid, the hub of the pipe shall be moistened and the lower half filled on the inside with cement mortar of sufficient thickness to bring the inner surfaces abutting pipes flush and even. After the pipe is laid, the remainder of the joints shall be moistened and filled with mortar and sufficient additional mortar used to form a bead around the joint. No joint shall be entirely cemented until the next two joints in advance, if any, are laid. The inside of the joint shall be wiped and finished smooth. Mortar on the outside of the pipe shall be protected from the air and sun by one of the curing methods provided for concrete, Section 501.

When bituminous plastic cement or other mastic sealers are used, the interior surface of the hub beginning at the lip of the normal interior surface of the pipe, shall be coated with a layer of sealing material that will cover at least \( \frac{1}{3} \) of the distance, measured along the surface of the hub, parallel to the normal length of the pipe. The thickness of the mastic placed shall be such that will provide a uniform seal between the edges of the pipe sections being joined (approximately \( \frac{1}{2} \) inch on the inside shoulder of the hub and approximately \( \frac{1}{8} \) inch of material on the remaining area to be covered). No joint shall be considered satisfactory when the space between the edges of the pipes being joined exceed \( \frac{1}{2} \) inch for more than \( \frac{1}{3} \)
the circumference of the pipe. The inside of the joint shall be wiped and finished smooth.

When rubber or other types of gaskets are used for sealing joints, they shall be installed as recommended by the manufacturer.

4. Inspection
All pipe shall be inspected before any backfill is placed. Any pipe found to be out of alignment, unduly settled, or damaged shall be taken up and relaid or replaced.

(e) BACKFILLING PIPE
1. General
After the pipe has been installed, the pipe trench shall be backfilled with the best material suitable from the excavated trench; if none of this excavated material is suitable, material from the roadway shall be used or suitable material shall be hauled in and used with payment being made under the classification of the material ordered used. For backfilling above a point one foot above the top of the pipe, material from the trench may be used unless unsuitable for embankment.

Backfilling will not be permitted until authorized by the Engineer. When mortar joints are used, backfilling shall not begin until the joints have cured.

2. Placing and Compaction of Backfill
The backfill material shall be compacted at near optimum moisture content in layers not exceeding six (6) inches compacted thickness, to a density not less than 95 percent of AASHTO T-99 density by methods of Section 105. Mechanical tampers shall be used unless another method of compaction is approved in writing; inundated or jetting will not be permitted unless specified on the plans. Care shall be exercised to thoroughly compact the backfill under the haunches of the pipe and to insure that the material is in intimate contact with the pipe. The backfill shall be brought up evenly in layers to on both sides of the pipe for its full length until the trench is filled or up to subgrade elevation if the trench is in cut.

When the top of the pipe is exposed above the top of the trench, embankment material shall be placed and compacted for a width on each side of the pipe equal to at least twice the horizontal inside diameter of the pipe, or 12 feet whichever is less. The embankment on each side of the the pipe, for a distance equal to the horizontal inside diameter of the pipe, shall be of the same material and compacted in normal manner, except where otherwise specified. All pipe after being bedded and backfilled as specified in this Section should be protected by two (2) foot cover of fill before heavy equipment is permitted to cross during construction of the roadway.

3. Protection of Pipe
The Contractor shall exercise necessary care in installing and backfilling and it shall be his responsibility to see that the pipe is not damaged by lateral forces backfilling by heavy loads, operating over the pipe or caused by other forces. All damaged pipe shall be replaced or repaired by the Contractor at his own expense.

Any pipe not true to designated alignment and grade within specified tolerances, or any pipe that shows settlement due to faulty installation shall be relaid or replaced by the Contractor without additional compensation. Any pavement that settles or breaks over a pipe shall be relaid or replaced by the Contractor without additional compensation. All pipe lines shall be thoroughly cleaned out prior to final acceptance.
527.04 Method of Measurement

The accepted length of pipe culverts laid as ordered will be measured along the bottom flowline or invert, of the pipe complete in place. Measurements will be made between inside walls of designated structures (junction boxes, inlets, etc.) and along the centerline of the flowline of special fittings (elbows, wyes, etc.). The above applies to round or arch, beveled or unbeveled pipe. However, in no case will measurement be made for lengths greater than the sum of the nominal laying lengths of the pipe sections used or for lengths greater than the length of culvert. No separate measurement for payment will be made for excavation and/or backfill yardage needed to reroute water for temporary drainage which might be necessary for the proper installation of the pipe or to perform the imperfect trench method of installation.

527.05 Basis of Payment

(a) UNIT PRICE COVERAGE

The accepted footage of pipe culverts measured as above provided will be paid for at the respective contract unit prices for the various sizes, and types of pipe provided in the proposal, complete in place, which shall be payment as herein provided and also for all work, equipment, materials, and incidentals connected with the execution of the bedding specified for installation, except that Foundation Backfill shall be paid for separately.

(b) PIPE SIZE AND CLASSIFICATION

The internal diameter of circular pipe, the span and rise of arch pipe, the class of pipe, bedding material, if appropriate, will be shown in the item name.

(c) Payment Will Be Made Under:

"RCP, Class ___ Complete In-Place - per LF"

"Span____" Rise RCAP, Class___ Complete In-Place - per LF
SECTION 531
RELAID PIPE

531.01 Description

This Section shall cover the work of relaying pipe, regardless of size, in accordance with the requirements of these specifications, at the locations shown on the plans or designated and in accordance with established lines and grades. The item shall include furnishing and constructing of such joints, necessary cutting and connections to other pipes, the removal and preservation of that portion of pipe culverts, in place, which are to be replaced by new or relaid pipe; it shall also include furnishing and construction of such joints, necessary cutting and connections to other pipes, catch basins, endwalls, etc. as may be required to complete the work shown on the plans or directed.

531.02 Materials

(a) SALVAGED PIPE
Pipe to be relaid shall be selected salvaged pipe which is approved for relaying.

(b) JOINT MATERIAL
An applicable type of joint sealer required by Section 527 shall be used.

531.03 Construction Requirements

(a) REMOVING PIPE IN PLACE
With respect to removal of pipe, attention is directed to Section 103, the provisions which are applicable to this section.

(b) LAYING PIPE
Pipe shall be handled so that there will be no loss or damage, before relaying. Pieces or sections of pipe found satisfactory by the Engineer shall be relaid in accordance with the requirements of the appropriate sections governing culvert pipe. Special reference is made to construction details of Section 527.

531.04 Method of Measurement

Relaid pipe will be measured in the same manner as specified in Section 527.04. Excavation and foundation backfill for relaid pipe will not be measured separately for payment but the cost thereof shall be included in the contract unit price bid for the relaid pipe.

531.05 Basis of Payment

(a) UNIT PRICE COVERAGE
1. The accepted footage of Relaid Culvert Pipe measured as noted above will be paid for at the contract unit bid for either Roadway Pipe relaid regardless of size or type of pipe. Said unit costs shall be full compensation for the salvaging of the pipe in condition for reuse and the reinstallation of the pipe in accordance with the provisions for Roadway Pipe as covered by Section 527 including all equipment, tools, labor, and incidentals necessary to complete the work.
2. No payment will be made for the removal of existing pipe lines replaced by new or relaid pipe.

(b) PAYMENT WILL BE UNDER:
Culvert Pipe Relaid - per Linear Foot
DIVISION II, PART 5

SECTION 601
ENGINEER'S FIELD OFFICE

601.01 Description.

This section shall cover the furnishing and maintaining of a field office for the exclusive use by the Engineer during the life of the contract. The field office shall be available and ready for use no later than the date of the "Notice to Proceed" and will be vacated by the Engineer no later than 30 days after the date of final acceptance of all work on the project. The field office shall remain the property of the Contractor.

The field office shall conform to all state and local requirements.

601.02 Field Office Requirements.

(a) LOCATING

A site for the location of the field office shall be arranged for and provided by the Contractor subject to the approval of the Engineer. The site shall be on or near the right-of-way and readily accessible by automobile over an all weather road, with all weather parking facilities for at least eight vehicles adjacent to the building. If no adequate site is available on the project right-of-way, or the Contractor selects a site off the right-of-way, he shall assume all expenses in connection with obtaining and leasing the site.

(b) BUILDING

The field office building shall be separate and apart from any buildings occupied by the Contractor. The building shall be weather tight and insulated, suitable for year round use with heating, air conditioning, electric power, and indoor sanitary facilities (complete with lavatory and running water). The office space shall be no less than 10 feet wide, 20 feet long and 7 feet high and have two windows and an outside door. It shall contain suitable work benches and drawers.

(c) AREA SECURITY

The Contractor shall be responsible for the security of the field office and its immediate area against vandalism and entry by unauthorized persons.

601.03 Utilities and Service

The field office shall be provided with adequate lighting, heating, sanitary, drinking water, and telephone facilities. All installation and monthly charges for utilities and the telephone shall be paid for by the Contractor.

All utility installations shall be in accordance with applicable local or State codes, ordinances, rates, and regulations.

The field office and its facilities shall be maintained in a satisfactory state of repair until released by the Engineer.

601.04 Basis of Payment

The furnishing and maintaining of the field office shall be considered as incidental to the work and compensation shall be included in the Contract unit prices for pay items of the work.
SECTION 603
PIPE UNDERDRAIN

603.01 Description.

This Section shall cover the work of furnishing pipe underdrain of the type and sizes provided on the plans or in the proposal in accordance with the requirements of these specifications, and installing such pipe at the locations shown on the plans or designated in the proposal and in substantial conformity with the established lines and grades. The work shall include the furnishing and construction of such joints and connections to other pipes, catch basins, endwalls, etc., as may be required to complete the work, as shown on the plans or directed, together with filter material as shown on the plans. Designations for the various types of pipe shall be as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Kind</th>
<th>Abbreviations</th>
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<tbody>
<tr>
<td>1</td>
<td>Concrete Pipe</td>
<td>C.P.</td>
</tr>
<tr>
<td>2</td>
<td>Corrugated Steel</td>
<td>C.S.</td>
</tr>
<tr>
<td>3</td>
<td>Coated Corrugated Steel</td>
<td>C.C.S.</td>
</tr>
<tr>
<td>4</td>
<td>Vitrified Clay</td>
<td>V.C.</td>
</tr>
<tr>
<td>5</td>
<td>Corrugated Aluminum</td>
<td>C.A.</td>
</tr>
<tr>
<td>6</td>
<td>Coated Corrugated Aluminum</td>
<td>C.C.A.</td>
</tr>
<tr>
<td>7</td>
<td>Bituminous Fiber</td>
<td>B.F.</td>
</tr>
<tr>
<td>8</td>
<td>Asbestos Cement</td>
<td>A.C.</td>
</tr>
<tr>
<td>9</td>
<td>Poly (Vinyl Chloride)</td>
<td>P.V.C.</td>
</tr>
<tr>
<td>10</td>
<td>Acrylonitrile Butadiene Styrene</td>
<td>A.B.S.</td>
</tr>
</tbody>
</table>

Unless specific types of pipe are specified by the plans or proposal, the Contractor may, at his option, use any of the approved types provided herein. However, an installation once started shall have the same type pipe unless otherwise noted in the plans or directed in writing.

603.02 Materials.

Materials shall meet the requirements specified in Section 851, Pipe Underdrain, including filter material. All materials will be subject to further inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

603.03 Construction Requirements.

(a) STANDARD PIPE INSTALLATION.

Trenches shall be excavated to the dimensions and grade required by the plans or as directed. A minimum 3-inch bedding layer of filter material of the size shown on the plans shall be placed in the bottom of the trench for its full width and length and compacted to the density required in Section 206.

Subdrainage pipe of the type and size specified shall be embedded firmly in the bedding material.

Perforated pipe shall normally be placed with the perforations down and the pipe sections shall be joined securely with the appropriate coupling fittings or
bands.

Non-perforated pipe shall be laid with the bell end upgrade and with open joints, wrapped with acceptable material which will permit entry of water, yet prevent loss of filter material or unwrapped if so specified. Upgrade ends of all subdrainage pipe installations shall be closed with suitable plugs to prevent entry of soil materials.

After the pipe installation has been inspected and approved, filter material meeting the requirements of Section 851.09 shall be placed as specified on the plans to a height of 12 inches above the top of the pipe. Care shall be taken not to displace the pipe or the covering at open joints. The remainder of the filter material shall then be placed and compacted to the required height. Any remaining portion of trench above the filter material shall be filled with granular or impervious material, as provided in these Specifications, and thoroughly compacted, consistent with the location of the trench within the work.

(b) UNDERDRAIN OUTLETS.

Trenches for underdrain outlets shall be excavated to the width and depth shown on the plans. Pipe shall be laid in the trench with all ends firmly joined by applicable methods and means. Perforated pipe shall be laid with holes up and covered with roofing paper, or non-perforated pipe meeting the same requirements of the perforated pipe may be used. After inspection and approval of the pipe installation the trench shall be backfilled with suitable soil in layers and compacted as provided for drainage pipe. Filter material will not be required for outlet trenches unless specified on the plans.

603.04 Method of Measurement.

The accepted length of pipe underdrain, complete in place, of each specified size and type will be measured in linear feet along the center of each line or lateral, center to center of junctions and fittings.

In cases where underdrain is needed in a backslope and a bench must be cut to work from, the removal of the material for the bench will be paid for as unclassified excavation. This payment includes backfilling the material and redressing the slope. The trench depth of the underdrain will be measured from the bottom of the bench.

603.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted footage of each kind and size of pipe underdrain will be paid for at the contract unit price for pipe underdrain, complete in place, which shall be payment in full for all excavation and its disposal, foundation preparation, backfilling, furnishing, hauling and placing of all materials including fittings, cutting for connections, joint material, bands, and filter (or cover and bedding layer materials.)

2. No separate payment will be made for excavation. The provisions of Section 105.04 are not applicable to this Section.
(b) PAYMENT WILL BE MADE UNDER ITEM:
Underdrain Pipe, Type __*— per L.F.

* Note specific type or types of pipe if required. See Section 603.01 for approved types.
SECTION 605
RIPRAP

605.01 Description.

This Section shall cover the work of furnishing and constructing the several classes or types of rip-rap, each of which shall consist of a protective course of stone or other approved materials on embankment slopes, in channels, at bridge piers and abutments, or other work as shown on the plans or directed, with or without a Filter Blanket, all in accordance with these specifications and in conformity with the lines, and grades noted in the plan details.

605.02 Materials.

All materials shall conform to the requirements of Division III, Materials. Specific reference is made to Section 821, rip-rap Materials.

605.03 Construction Requirements.

(a) GENERAL.
All slopes to be treated with rip-rap shall be trimmed to the lines and grades indicated by the plans or directed; loose material shall be compacted by approved methods or removed.
Slopes which require a filter blanket under the rip-rap shall, in addition to the above, be prepared as noted in section (b) below.
Placement of any rip-rap on a filter blanket shall be by such means that will not damage or destroy the blanket. Any damage to the blanket shall be repaired without additional compensation.
Unless otherwise authorized, rip-rap protection for bridge ends shall be placed immediately following the grading operations. The bridge Contractor shall protect any slope protection material in place during the bridge construction and shall be responsible for any damage due to negligence on the part of his operations.
All outer edges and the top of rip-rap where the rip-rap terminates shall be formed so that the surface of the rip-rap will be embedded and even with the surface of the ground and/or slope.
All rip-rap construction shall begin at the bottom of the slope and progress upward.

(b) FILTER BLANKET.
1. General.
The Contractor may select one of the filter blanket materials provided in Section 821.03 for construction of the filter blanket except that a fabric blanket will not be allowed for soils with 85% by weight passing the No. 200 sieve (U.S. Std.).
If an aggregate blanket is used, the blanket shall be constructed using the designated material to a minimum thickness of six (6) inches unless otherwise shown by the plans, all in accordance with the provisions noted hereinafter in this Section and the plan details.
If a fabric blanket is used, the Engineer will evaluate the material to be protected as noted in paragraph 6 of Section 821.03(c) and designate the "EOS" and "percent open area" the fabric shall meet. The blanket shall then be constructed in accordance with the provisions noted hereinafter in this Section and the plan details.

2. Foundation Preparation.
Areas on which filter blankets are to be placed shall be uniformly
trimmed and dressed to conform to cross sections shown by the plans within an allowable tolerance of plus or minus three (3) inches from the theoretical slope lines and grades.

3. Placement.
   a. Aggregate Blankets (Gravel or Crushed Stone).
      Filter blanket material shall be spread uniformly on the prepared base in a satisfactory manner, to a thickness of not less than 1/2 inch from that specified and to neat lines as indicated on the plans. Placing or spreading of material by methods which will tend to segregate particle sizes within the filter layer will not be permitted. Any damage to the surfaces of the filter blanket foundation during the placing of the filter blanket shall be repaired before proceeding with the work. Compaction of the filter material will not be required, but shall be finished to present a reasonably even surface free from mounds, depressions, or windrows.
   b. Fabric Blanket (Polymeric Filter Fabric)
      Polymeric filter fabric shall be placed in the manner and at the locations shown in the plans. At the time of installation, fabric shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The fabric shall be placed with the long dimension parallel to the centerline of the channel or shoreline, and shall be laid smooth and free of tension, stress, folds, wrinkles or creases.
      The strips shall be placed to provide a minimum width of 36 inches of overlap for each joint with the upstream strip of fabric overlapping the downstream strip. Overlap joints and seams shall be measured as a single layer of cloth. Securing pins with washers shall be inserted through both strips of overlapped cloth at not greater than the following intervals along a line through the midpoint of the overlap.

      | Pin Spacing | Slope           |
      | 2 ft.       | Steeper than 3:1|
      | 3 ft.       | 3:1 to 4:1      |
      | 5 ft.       | Flatter than 4:1|

      The fabric shall be turned down and buried two (2) feet at all exterior limits except where a stone filled key is provided below natural ground.
      Additional pins regardless of location shall be installed as necessary to prevent any slippage of the filter fabric. Overlaps in the fabric should be placed so that any upstream strip of fabric will overlap the downstream strip. Should the Engineer direct that the fabric be placed with the long dimension perpendicular to the centerline of the channel or shoreline, the lower strip of fabric shall underlap the next higher strip. Each securing pin shall be pushed through the fabric until the washer bears against the fabric and secures it firmly to the foundation. The fabric shall be protected at all times during construction from contamination by surface runoff and any fabric so contaminated shall be removed and replaced with uncontaminated fabric. Any damage to the fabric during its installation or during placement of rip-rap shall be replaced by the Contractor. The work shall be scheduled so that 30 days does not expire between placement of the fabric and the covering of the fabric with rip-rap. Rip-rap shall not be dropped on the fabric from a height greater than one foot. Greater drop heights will be permitted if the Contractor provides a cushioning layer of sand on top of the fabric before dumping of stone. The combination of drop height for stone and sand cushion layer thickness to be approved must be demonstrated to not puncture or damage the fabric. No measurement or separate payment shall be made for a sand cushion layer placed for
the purpose of allowing an increased drop height of stones. Any damage to the filter material during placement of rip-rap shall be corrected prior to proceeding with the work.

(c) STONE RIPRAP

1. General.

Unless otherwise shown by the plan details, stone rip-rap shall not be placed on slopes steeper than the natural angle of repose of the rip-rap material. Placement of stones may, unless otherwise noted hereinafter in this Section, be placed by methods and equipment suitable for the purpose of placing the rip-rap in accordance with the requirements for the class rip-rap involved without damaging any existing facility or construction feature.

2. Class 1.

Class 1 rip-rap is essentially designed for hand placement and use with minimal water currents. Stones shall be laid with close broken joints and resting on the embankment slope. The stones shall be of such shape and shall be so laid as to produce a single layer of stone of the thickness shown on the plans, measured perpendicular to the slope. The bottom course shall be laid in a trench excavated to such depth below the toe of the slope that all parts of the bottom course will be three (3) feet below the toe. Trenching will not be required where the toe of the slope is below water level. The back of the trench shall be on the same slope as the fill. The laying of the courses shall progress upward, the larger stones being placed in the lower courses. The individual pieces of stone in each horizontal course shall be laid so that they will break joints with the stones in the course below the tops sloped to drain away from embankment. Open joints shall be filled with spalls, or small stones in such manner that all stones are tightly wedged or keyed. The finished surface shall present a reasonably uniform appearance and shall not vary more than six (6) inches from the average surface. The finished surface at the ends of the rip-rap shall be flush with the adjacent earth fill surface.

3. Class 2 and 3.

Class 2 and 3 rip-rap are designed for use in areas with minimal to medium water currents and wave action. The stones shall be placed in such a manner as to produce a reasonably well graded mass of rock with the minimum practical percentage of voids. The rip-rap shall be constructed to the lines, grades and thickness shown by the plans or directed within a tolerance of plus 15 inches or minus 3 inches from the designated finish surface of the rip-rap, except that either extreme of such tolerance shall be reached as a uniform rate over an area greater than 200 square feet. Rip-rap shall be placed in its full course thickness in one operation and in such a manner as to avoid displacing the filter blanket material, where filter blanket is required. The larger stones shall be well distributed and the entire mass of stones in their final position shall conform to a reasonable uniform gradation. The finished rip-rap shall be free from objectionable pockets of small stones and clusters of larger stones. Placing rip-rap by dumping into chutes or by other methods likely to cause segregation of sizes will not be permitted. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the source, by controlled dumping of successive loads during final placing, or by other methods of placement which will produce the specified results. Rearranging of individual stones by mechanical equipment, or by hand will be required to the extent necessary to obtain a reasonably well graded distribution of stone as specified above.
4. Class 4 and 5.

Class 4 and 5 rip-rap are designed for use in medium to high water currents and wave actions for the protection of bridge piers and abutments, and protection of channel slopes. Stones may be placed without strict gradation controls provided sufficient small sizes are included to choke the larger stones. Dumping of the stones will be allowed; however, mechanical equipment to dress the material to a reasonable uniform slope will be required. Stones deposited contrary to directions will be considered wasted and will not be paid for.

(d) CONCRETE SACKED RIP-RAP.

Immediately following mixing, as noted in Section 821.02, the mixture shall be placed in the bags, tied (so that when laid in position they will flatten out and give a thickness of not less than six (6) inches and placed flat on the area designated. Bags shall be rammed against each other to form closed joints, with tied ends of sacks all laid in the same direction. When required to be placed under water, special care shall be taken to see that bags are closely jointed to give the same tight joints as required on dry slopes. After the rip-rap is placed, it shall be sprinkled with water as directed and kept damp for not less than three (3) days. No Concrete Sacked rip-rap shall be mixed in freezing weather.

(f) MAINTENANCE.

The Contractor shall maintain all rip-rap until the contract is accepted, and shall replace, without additional compensation, any damaged or lost rip-rap.

605.04 Method of Measurement.

Loose Rip-rap of the class designated by the plans or proposal will be measured in square yards, computed from measurements taken parallel to the surface of the rip-rap or in tons as specified in Section 90.01(h), whichever is specified by the plans or proposal.

Concrete Sacked Rip-rap and Filter Blanket will be measured in square yards computed from measurements taken parallel to the outer surface of the rip-rap or the filter blanket, whichever is applicable.

605.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Loose rip-rap, Concrete Sacked Rip-rap and Filter Blanket measured as noted above and accepted will be paid for at the appropriate respective contract unit price bid which shall be payment in full for items complete in place including the furnishing and hauling of all materials, preparation of the area, the placing of the materials and for all equipment, tools, labor and incidentals necessary to complete these items of work.

(b) PAYMENT WILL BE MADE UNDER:

Loose Rip-rap, Class . ___" Thick—per Sq. Yd.
Concrete Sacked Rip-rap—per Sq. Yd.
Loose Rip-rap, Class ___—per Ton.
Filter Blanket, *____ (**)—per Sq. Yd.

* If a specific type of blanket is required, so designate (aggregate or fabric).
** If a specific kind of fabric blanket is required, so designate (woven or non-woven).
SECTION 607
MORTAR FOR MASONRY

607.01 Description.

This Section shall cover the work of furnishing Mortar made in accordance with these specifications, for the various classes and kinds of masonry when its use is required.

607.02 Materials.

Materials shall conform to the provisions of Division III, Materials. Specific reference is made to the following:
- Masonry Cement, Section 823.06.
- Sand, Section 827.03.
- Water, Section 811.01.

607.03 Construction Requirements.

The Mortar shall be composed of one part of cement and two parts of sand by volume, on basis of dry sand, and sufficient water to make a mortar of such consistency that it can be easily handled and spread with a trowel. If directed, hydrated lime, not to exceed 15 percent of cement by weight, shall be added, except that if masonry cement is used hydrated lime will not be required. Mortar shall be mixed only in quantities required for immediate use. Unless an approved mortar mixing machine is used, the sand and cement shall be mixed dry in a watertight box until the mixture assumes a uniform color, after which water shall be added as the mixing continues until the mortar attains the proper consistency. Mortar which is not used within 45 minutes after water has been added shall be wasted. Retempering of Mortar will not be permitted.

607.04 Method of Measurement.

No measurement will be made for Mortar or Masonry.

607.05 Basis of Payment.

Payment for mortar or masonry shall be included in unit prices of pay items for various kinds of masonry, and no direct payment will be made for Mortar.
SECTION 609
RUBBLE MASONRY

609.01 Description.

This Section shall cover the work of furnishing and constructing Rubble Masonry consisting of approved stones laid in mortar as a means of constructing structures or parts of structures in accordance with these specifications to the lines and dimensions shown on the plans or designated.

Rubble Masonry as herein specified shall include the Types commonly known as Coursed Rubble, Uncoursed Rubble, and Rustic Rubble.

609.02 Materials.

Materials shall conform to the provisions of Division III, Materials. Specific reference is made to Type I and Type III, Masonry Stone, Section 819.01(a) and (c), respectively.

Mortar shall meet the requirements of Section 823, Mortar for Masonry.

609.03 Construction Requirements.

(a) SHAPING STONE.
   The stones shall be roughly squared on joints, beds and faces. All shaping or dressing of stone shall be done before the stone is laid and no dressing or hammering which will loosen the stone will be permitted after it is placed.
2. Rustic Masonry Stone.
   Only shaping required will be that to eliminate sharp points and projections.

(b) WEATHER LIMITATIONS.
Stone masonry shall not be constructed in freezing weather or when fresh mortar may be subject to freezing.

(c) LAYING DETAILS.
1. The masonry shall be laid to line and in courses roughly leveled. The bottom or foundation courses shall be composed of large, selected stones; and all courses shall be laid with bearing beds roughly parallel to the natural bed of the material. The stone and the layers shall decrease in thickness from bottom to top of wall. Stones of each color shall be uniformly distributed in exposed surfaces so that walls do not present a patched appearance. Selected stone, roughly squared and pitched to line, shall be used at all angles and ends of walls. Headers shall be evenly distributed and preferably arranged to interlock. Each stone shall be cleaned and saturated with water and shall be damp while being set, and the bed which is to receive it shall be cleaned and well moistened. All stones shall be well bedded in freshly made mortar. The mortar joints shall be full and the stones carefully settled in place before the mortar has set. No spalls will be permitted in the beds. Joints and beds shall have an average thickness of not more than one inch. The minimum thickness of mortar between stones shall be at least 1/2 inch. Whenever possible the face joints shall be properly pointed before the mortar becomes set. Joints which cannot be so pointed shall be prepared for pointing by raking them out to a depth of 1-1/2 inches before the mortar has set. The face surfaces of stones shall not be smeared with the mortar forced out of the joints or that used in pointing. The vertical joints in each course of coursed masonry shall break joints with those in adjoining
courses at least six (6) inches. In case any stone is moved or the joint broken, the stone shall be removed, the mortar cleaned from bed and joints, and the stone reset in fresh mortar. Weepholes shall be constructed where indicated on the plans or designated. Immediately after laying and while the mortar is fresh, all face stones shall be cleaned of all mortar, and mortar stains and kept clean and free from mortar stains.

2. In Coursed and Uncoursed Rubble Masonry, headers shall hold in the heart of the wall the same or larger size than shown in the face. They shall extend not less than 12 inches into the core or backing and in walls two (2) feet or less in thickness shall extend entirely through the wall. They shall occupy not less than 1/5 of the face of the wall.

3. In Rustic Rubble Masonry, stone shall be laid without regard to courses or patterns, have close joints and reasonably smooth faces and, if not coped, reasonably true lines on top of structure.

(d) COPINGS, BRIDGE SEATS, AND BACKWALLS.

Copings, bridge seats and backwalls shall be of the materials and size shown on the plans and when not otherwise specified by the proposal shall be Minor Structure Concrete which shall conform to the requirements for Section 620. Concrete copings shall be made in sections extending the full width of the wall, not less than eight (8) inches in thickness and from 5 to 10 feet long. The sections may be cast in place or precast and set in place in full mortar beds.

(e) POINTING.

Pointing shall not be done in freezing weather or when the stone contains frost. Joints not pointed at the time the stone is laid shall be wet with clean water and filled with mortar. The mortar shall be well driven into the joints and finished with an approved pointing tool. The wall shall be kept moist while pointing is being done and in hot dry weather the pointed masonry shall be protected from the sun and kept wet for a period of at least three (3) days after the mortar has set, or be cured as provided by Section 501. After the pointing is completed and the mortar set, the wall shall be satisfactorily cleaned and left in a neat and workmanlike condition.

609.04 Measurement.

Accepted Mortar Rubble Masonry will be measured complete in place, and the volume actually constructed within the neat lines of the work shown on the plans or designated will be computed in cubic yards.

609.04 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted volume of masonry measured as above described will be paid for at the respective unit prices bid per cubic yard for Coursed Rubble Masonry and Uncoursed Rubble Masonry and Rustic Rubble Masonry, complete in place, which shall be payment in full for all material, equipment, tools, labor and incidentals necessary for the satisfactory completion of the work.
(b) CONCRETE.
Concrete used in conjunction with the Rubble Masonry will be paid for as provided under Minor Structure Concrete, Section 620.

(c) PAYMENT WILL BE MADE UNDER:
Type Rubble Masonry — per Cubic Yard
SECTION 611
BRICK AND CONCRETE BLOCK MASONRY

611.01 Description.

This Section shall cover the work of constructing Brick or Concrete Block Masonry in accordance with these specifications at the locations and to the dimensions, lines, and grades as shown on the plans.

611.02 Materials.

All materials shall conform to the requirements of Division III, Materials. Specific reference is made to the following:

Building Brick (Grade MW clay or shale brick unless otherwise specified on the plans or Concrete Brick and Concrete Block.)
Section 607- Mortar or Masonry.

611.03 Construction Requirements.

(a) BRICK MASONRY.
The foundation shall be constructed firm and dry. All brick shall be damp at the time of laying. Bricks shall be laid in courses in full, close, uniform joints of mortar. Adjoining courses shall break joints by one-half length as nearly as practicable. The courses shall be level in all places. All exposed surfaces shall be smooth and clean and the tie joint shall not exceed $\frac{1}{16}$ inch in width. Broken or chipped bricks shall not be used in the faces of the masonry. The joints shall be cleaned and pointed before the mortar sets. The exposed surfaces of the bricks shall not be smeared with mortar forced out of the joints or that used in pointing, but shall be kept clean and free from mortar stains. For straight masonry walls, at least one course in seven shall be a header course. No masonry work shall be done in freezing weather.

(b) CONCRETE BLOCK MASONRY.
When so specified on the plans or in the proposal, masonry walls may be constructed of hollow concrete blocks instead of bricks. Applicable construction details shall be the same as for brick masonry.

(c) MANHOLES, INLETS and CATCH BASINS.
Brick masonry for manholes, inlets and catch basins shall conform to details shown on the plans. Construction details shall be as specified in Section 611.03(a). Where shown on the plans the faces of these and similar structures shall be given a plaster coat. Mortar for this coat shall be of the same mix as used in laying the brick and the coat shall be not less than $\frac{1}{4}$ inch in thickness. Before applying the plaster coat, the brick shall be thoroughly wetted and the surface allowed to dry sufficiently to insure proper bond of the plaster coat. Full mortar beds shall be provided for setting castings required by the plans. Castings shall be set carefully to the specified elevations.
611.04 Method of Measurement.

The quantity of Brick or Concrete Block Masonry will be measured in cubic yards of completed and accepted masonry, except that when the proposal specifies payment by the unit for manholes, inlets and the like, measurement will be by the completed and accepted units.

611.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of cubic yards of Brick Masonry or Concrete Block Masonry, measured as provided above will be paid for at the respective contract unit prices for these items, which shall be payment in full for excavating except as specified in Section 105 laying, backfilling and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

Manholes, inlets, catch basins, and the like will be paid for as specified in Section 621.

(b) PAYMENT WILL BE MADE UNDER:

Brick Masonry—per Cubic Yard
Concrete Block Masonry—per Cubic Yard
SECTION 613
SLOPE PAVING

613.01 Description.

This section shall cover the work of paving with concrete any fill or cut slopes as shown on plans or designated. The slope paving shall be laid to line, grade, and dimensions shown on the plans unless otherwise directed.

Slope paving shall include but not be limited to paving of slopes at bridge ends, under grade separation structures, concrete slope drains, paving of side ditches, median ditches, special ditches, and other designated areas for control of erosion. Slope paving shall include any wire mesh, steel reinforcement, dowels, all joints, or other type of reinforcement and incidentals necessary to complete the paving in accordance with the Contract Drawings.

613.02 MATERIALS.

The concrete used in the construction of the bottom portion of the slope paved channel shall be Class "A" concrete with a minimum 28-day compressive strength of 3000 psi. Concrete used along the sides of the slope paved channel shall be Class "A" concrete meeting the requirements of Section 501. Consideration will be given to the use of local or manufactured fine aggregate meeting the requirements of Section 805; if approved, the aggregate proportion shall be varied as directed.

Steel reinforcement shall meet the appropriate requirements of Section 837.

Joint filler and sealers shall meet the appropriate requirements of Section 831.

613.03 CONSTRUCTION REQUIREMENTS.

The slope to be paved shall be uniformly dressed and compacted with mechanical tampers to the density specified in Section 206 before placing the concrete. The concrete shall be mixed, placed, and covered in accordance with the requirements of Section 501, which is applicable to this work. Weep holes approximately three inches in diameter shall be placed in alternate runs of the pavement as indicated on the plans. After placing, the concrete shall be finished smooth and when partially set, shall be cut with a finishing tool as shown on plans. Where reinforced concrete slope paving is specified on the plans, reinforcement shall be placed in accordance with details shown on the plans, and in conformity with requirements of Section 503.

Unless otherwise shown on the plan details, joints for slope paved areas shall be in accordance with the following:

1. Contraction Joints
   This type joint is essentially provided to control cracking and may be formed by tooling, sawing or other approved methods 1/4 the depth of the concrete. Except for sawed joints, all joints shall be finished with a 1/4 inch edging tool.
2. Construction Joints

The use and spacing of construction joints shall be consistent with the planned contraction and expansion joints for the paved area and the contractors paving plan. The edges of all construction joints shall be finished with a 1/4 inch edging tool.

3. Expansion Joints

Unless otherwise shown by plan details, expansion joints 1/2 inch thick shall be placed as follows:

Where the slope paving joins drainage structures and other rigid structure supports.

To line up with expansion joints of adjoining pavement, curbs, gutters, etc., but in no instance more than 75 feet between joints.

Where continuous runs of slope paving are 75 feet or longer, transverse expansion joints shall be provided; one joint for each additional 75 feet, or fraction thereof, of length.

Where slope paving is confined longitudinally by other concrete units and the width of the slope paving is in excess of 15 feet, one longitudinal expansion joint will be required for each additional 15 feet, or fraction thereof, of width.

Paved islands of 200 square feet or less may be poured as a monolith.

613.04 METHOD OF MEASUREMENT

Slope paving will be measured in cubic yards of paving, complete in place.

613.05 BASIS OF PAYMENT:

(a) Unit Price Coverage.

The accepted yardage as determined above shall be paid for at the contract unit price for slope paving, which shall be payment in full for all excavating, backfilling, compacting slopes to be paved, disposal of surplus material, furnishing all materials, mixing, covering, hauling and placing all materials, weep holes, steel reinforcement, joints, and for all labor, equipment, tools and incidentals necessary to complete the item.

(b) Payment Will Be Made Under:

Slope Paving - per Cubic Yard
SECTION 615
GROUTED RIP-RAP

615.01 Description.

This Section shall cover the work of constructing grouted rip-rap in accordance with the plans and these specifications and to the established lines, grades, and cross section shown on the plans.

615.02 Materials.

(a) GENERAL.
The materials shall conform to the requirements of Division III Materials. Specific reference is made to Section 812.01(b), Type II, Masonry Stone, and Section 821, Rip-Rap Materials.

(b) GROUT.
Grout shall meet the requirements of Section 607, Mortar for Masonry, except that it shall be of wetter consistency to flow as indicated in Section 615.03(c).

(c) BASE COURSE MATERIAL.
Material shall be taken from sources shown on the plans or other approved sources of equal quality and class.

(d) Filter Fabric Material
Filter Fabric material shall be in accordance with Section 817.

615.03 Construction Requirements.

(a) FOUNDATION.
The foundation shall be formed at a depth of not less than eight (8) inches below and parallel to the finished surface of the slope drain. All soft or other unsuitable material shall be removed, and the foundation shall be compacted and finished to a smooth, firm surface.

(b) FILTER BLANKET.
If a filter blanket is required by plan details, placement shall be in accordance with Section 605.03 (b).

(c) STONE RIP-RAP
1. Type I Placement
Placement of stone rip-rap shall be in accordance with Section 605.03 (c).

2. Type II Placement
When indicated on the plans this method shall be used to obtain exposed stone surfaces. The finished surface shall present a reasonably uniform appearance consisting of a close gradation of selected stone of the Class specified on the plans, firmly grouted in place. The finished rip-rap shall be free from objectionable pockets of small stones and clusters of large stones. Rearranging of individual stones by mechanical equipment or hand will be required to the extent necessary to obtain a reasonably well graded distribution of stone. The face surfaces of the stone shall not be smeared with cement grout or any other objectionable matter. All stones shall be laid in horizontal courses in a full bed of fresh cement grout. Cement grout shall be poured on top of each completed course of rip-rap, and worked into the voids.
between the individual stones before additional courses are laid. Weepholes shall be constructed where indicated on the plans or designated.

(d) FINISHING.

1. Type I Grout Finish

   The cement grout shall be poured and broomed into the spaces between and over the stones, this operation being continued until the grout remains flush with the tops of the stones. The slope drain shall be protected by wet burlap until the grout hardens, then kept moist for at least three (3) days after grouting. No grout shall be poured in freezing weather.

2. Type II Grout Finish

   The cement grout shall be worked into any space left between and over the stones. Any cement grout that has been left on the exposed surfaces of the stone shall be removed immediately. The finished surface of the stone rip-rap shall be cleaned to restore the original color of the stone.

615.04 Method of Measurement.

   Accepted Grouted Rip-Rap will be measured complete in place, along the finished surface both longitudinally and transversely, and computed to the nearest 1/10 square yard.

615.05 Basis of Payment.

   (a) UNIT PRICE COVERAGE.

       The accepted Grouted Rip-Rap will be paid for at the contract unit price per square yard, complete in place, which shall be payment in full for excavating and preparing the foundation bed, placing and grouting the stone and for furnishing all materials, tools, labor and incidentals necessary to complete the work.

   (b) PAYMENT WILL BE MADE UNDER:

       Grouted Rip-Rap—per Square Yard
SECTION 617
CONCRETE SIDEWALKS AND DRIVEWAYS

617.01 Description.

This Section shall cover the work of constructing a portland cement concrete sidewalk or driveway, with or without reinforcement as shown on the plans, in one course on a prepared subgrade in accordance with these specifications, and of the thickness and typical cross-section shown on the plans. Lines and grade shall be as shown on the plans or established. "Subgrade" in this Section shall mean the prepared foundation on which the sidewalk or driveway is constructed.

617.02 Materials.

All materials furnished for use shall comply with the appropriate requirements of Division III, Materials, and the following:

Concrete shall meet the requirements for a Class A, Type 2 mix as provided in Section 501.

Reinforcing steel shall meet the requirements of Section 503 and plan details.

617.03 Construction Requirements.

(a) EQUIPMENT.

The equipment used for mixing concrete shall conform to the requirements of Section 501.

The Contractor may use forms or, if requested in writing and approved by the Department, an approved automatic extrusion type paving machine.

Forms shall be of wood, or metal, and shall be sufficiently staked to hold them true to line and grade while concrete is being deposited against them. If of wood, they shall be 2-inch or 3-inch stock lumber surfaces on all sides. If of metal, they shall be of approved section having a base width of at least 4 inches and shall have a flat surface on top. The depth of the forms shall equal the depth of the sidewalk or driveway. Adequate means shall be provided for securely fastening the ends of forms together.

Any automatic extrusion machine considered must be demonstrated to produce a consolidated concrete section conforming to the dimensions, cross section, line and grades shown on the plans or directed within the requirements noted herein in this Section.

(b) SUBGRADE.

All soft or other unsuitable material in the subgrade shall be removed and replaced with suitable material. All fills and filling material shall be placed and compacted by rolling with an approved roller or hand tamped with approved tamping devices in layers not exceeding 6 inches in thickness. Any existing areas that have been previously compacted by traffic to a greater degree than the remainder of the subgrade, shall be loosened and the whole subgrade uniformly compacted as specified in Section 201.

(c) FOUNDATION BACKFILL.

Where provided by the plans and/or proposal, foundation backfill shall be placed and constructed as provided in Section 107. No direct payment will be made for foundation backfill unless provided in the proposal and/or such is ordered placed by the Engineer.
(d) SETTING FORMS.
Forms shall be set to true line and grade and rigidly held in place by stakes or braces. Ends of adjoining form sections shall be flush. Forms and division plates shall be cleaned and oiled before placing concrete against them. Unless otherwise shown on the plans or designated, the finished surface of the sidewalks or driveways shall slope toward the roadway pavement at the rate of 1/4 inch per foot.

(e) HANDLING, MEASURING, PROPORTIONING AND MIXING MATERIALS.
The method of handling, measuring, proportioning and mixing concrete materials shall conform to Section 501, Structure Concrete. Where metal reinforcement is shown on the plans and/or provided in the proposal, it shall be placed in accordance with Section 503.

(f) PLACING CONCRETE.
A template resting upon the side forms and having its lower edge at the exact elevation of the subgrade shall be drawn along the forms and the subgrade shaped true before any concrete is deposited. The subgrade shall be moist and shall be free of debris and all foreign material when concrete is deposited upon it. The freshly mixed concrete shall be placed promptly on the prepared subgrade to the depth required to complete the sidewalk or driveway in one course. It shall then be vibrated and/or tamped and struck off with an approved straightedge resting upon the side forms and drawn forward with a sawing motion. The concrete shall then be floated with a wooden float until the surface is true. Concrete laid during cold weather shall conform to the requirements of Section 501.03(d).

(g) JOINTS.
Unless otherwise shown by plan details, the surface of sidewalks and driveways shall be marked in squares or rectangles not exceeding 40 square feet in area by using an approved marking tool. The marking tool shall provide a groove approximately one-half inch (1/2") in depth and with rounded edges.

Unless otherwise specified by plan details, bituminous expansion joints 1/2 inch (min.) wide shall be placed as follows:
At all curb returns and where the walks or drives join other concrete units.

To line up with expansion joints of adjacent curbs, drives, etc., but in no instance more than 75 feet between joints.

Where continuous runs of walks or drives are 75 feet or longer, transverse expansion joints shall be provided; one joint for each additional 75 feet or fraction thereof, of length.

Where walks or drives are confined longitudinally by other concrete units and the width of the walk or drive is in excess of 15 feet, one longitudinal expansion joint will be required for each additional 15 feet, or fraction thereof, of width.

Expansion joints shall be formed using a filler and sealer specified in Sections 831.01 and 831.02.

Unless shown otherwise by plan details, the joint filler shall be from the bottom of the walks or drives to one inch from the top, the sealer shall be 1/2 inch thick and shall be recessed 1/4 inch from the top.
(h) CURING AND PROTECTING.
Immediately after the finishing operations have been completed, the entire surface of the newly laid concrete shall be protected against rapid drying out and cured as provided in Article 501 unless the Contractor elects to use Type III portland cement, in which case the total curing time may be reduced. No vehicles shall be permitted on the new concrete for seven (7) days and pedestrians shall not be permitted thereon for at least 72 hours unless the Contractor elects to use Type III portland cement, in which case the time limit will be reduced to 24 hours for walks and four (4) days for driveways.

(i) BACKFILLING.
After the concrete has set sufficiently, the side forms shall be removed and the spaces on both sides shall be backfilled with suitable material. This backfill shall be compacted to a level flush with the walk or driveway and left in a neat and workmanlike condition.

617.04 Method of Measurement.
The yardage of accepted sidewalks or driveways will be measured, complete in place, and the area computed in square yards. Measurement for separate payment for foundation backfill will only be made when it is provided in the proposal and such is ordered by the Engineer.

617.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
The accepted yardage of sidewalk or driveway will be paid for at the contract unit price for Concrete Sidewalks or Concrete Driveways complete in place, which shall be payment in full for furnishing all materials (including joints), for the hauling, preparation and placing of all materials, for the preparing of the subgrade, backfilling, and for all labor, equipment, tools and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:
Concrete Sidewalk, ___" Thick—per Square Yard
Concrete Driveway, ___" Thick—per Square Yard
SECTION 619
PIPE CULVERT END TREATMENTS

619.01 Description.

This Section shall cover the work of constructing a pipe culvert end treatment in accordance with these specifications and the plan details, at the locations shown on the plans.

Unless specified otherwise on the plans or in the proposal, the Contractor may, for the required end treatment, either furnish and install a prefabricated pipe culvert concrete end section or construct a slope paved headwall, all in accordance with plan details and these specifications.

Class 1 shall designate those end treatments which do not require a grate. Class 2 shall designate those end treatments which do require a grate.

619.02 Materials.

All materials furnished for use shall conform to the appropriate requirements of Section 823, Division III, Materials, plan details, and the following:

Concrete end sections shall comply with the requirement shown by plan details and Section 849 for Class 3 pipe except that the three-edge-bearing test will not be required.

Concrete end sections with metal sleeves shall comply with the provisions noted above. The metal sleeve shall comply with the appropriate provision of Section 845. Metal sleeves used in conjunction with coated and/ or paved invert pipe shall be coated using the same coating, with the exception of paved invert, used in the pipe culvert to which the sleeves are attached. In lieu of the bituminous coating, the Contractor may substitute a polymeric coating meeting the requirements specified in Section 845.03(b).

Safety grates, when required, shall be fabricated in accordance with plan details.

619.03 Construction Requirements.

(a) EXCAVATION AND BACKFILL.

All excavation involved shall be in accordance with the provisions of the Sections for the type pipe involved and Section 107. Backfilling shall be as specified under Sections 105, 107 and the applicable Pipe Culvert Section.

(b) INSTALLATION OF END TREATMENTS.

When prefabricated end sections are used, they shall be installed and securely affixed to the pipe line as shown on the plans, all in conformity with the established lines and grades for the structure.

When slope paved headwalls are used, they shall be constructed as shown on the plans.

619.04 Method of Measurement.

The number of end treatments measured for payment will be the actual number of end treatments of the designated size and class, complete in place, on each designated pipe culvert.
(a) UNIT PRICE COVERAGE.

The ordered and accepted pipe culvert end treatment of the designated class for each size and appropriate type of pipe to which the end treatment is attached, measured as noted above, will be paid for at the contract unit price bid for the end treatment. Such price shall be full compensation for the furnishing of all materials and the excavation, installation, and backfill thereof, necessary for the complete construction of the end treatment, and for all labor, tools, equipment, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

__" *Pipe End Treatment, Class ___—per Each.

__" Span, ___" Rise *Pipe End Treatment, Class ___—per Each.

*Specify Roadway of Sidedrain.
SECTION 620
MINOR STRUCTURE CONCRETE

620.01 Description.

This Section shall cover the work of constructing minor concrete structures such as pipe culvert headwalls, inlets and junction boxes, concrete steps, coping walls, and other miscellaneous items. All of which shall be constructed in accordance with the details shown on the plans and these specifications to the lines and grades established by the plans or directed.

620.02 Materials.

All materials furnished for use shall conform to the requirements of Division III, Materials, and the following:

Section 501, Structure Concrete
Section 503, Reinforcing Steel

620.03 Construction Requirements.

(a) GENERAL.
The concrete mix used for minor structure work shall be Class "A", Type 2 unless otherwise provided by plan details, all in accordance with the appropriate provisions of Section 501.

(b) EXCAVATION AND BACKFILL.
Excavation and backfill shall be in accordance with the provisions of Sections 105 and 107.

(c) FORMING AND PLACING OF CONCRETE.
Construction, forming, placing, etc. of the structures shall be in accordance with the appropriate requirements of Section 501.03.

(d) FINISHING AND CURING.
Attention is directed to the provisions of Section 501.03(1) requiring that all surfaces receive a Class 1 surface finish and that all exposed surfaces receive a Class 2 surface finish unless otherwise specified in the proposal or by plan requirements.

In order to permit proper surface finishing, forms may be removed as soon as the concrete has set sufficiently that form removal will not damage the green concrete, but in no event less than 12 hours after completion of the placing. Immediately after the pouring operations, surfaces not covered by forms shall be covered with one of the curing materials specified in Section 829. Immediately after the removal of the forms, the surface finishing operations noted in Section 501.03(1) shall commence, and the curing operations continued for at least 72 hours after the finishing operation, using one of the curing materials specified in Section 829 and the related curing method required with the material used. Failure to apply the initial surface finish or perform the curing operation as noted herein shall be just cause for rejection of the concrete. Removal and replacement of rejected concrete shall be at no additional cost to the City.
(e) CONCRETE SURFACE TOLERANCES.

The finished concrete shall be within reasonable close conformity to the line, grades and dimensions shown on the plans, and free from objectionable cavities or projections.

620.04 Method of Measurement.

The volume of accepted concrete within the neat lines of the structure as shown on the plans or revised at the written direction of the Engineer will be computed in cubic yards. The method of average end areas will not be used where results obtained differ from those obtained by more accurate mathematical computation.

No deduction will be made for the volume of concrete displaced by steel reinforcement weep holes, or conduits, anchor bolts, or for chamfers of less than three (3) inch leg measurements.

Attention is directed to Section 503 for Reinforcing Steel, and Sections 105 and 107 for Excavation and Foundation Backfill.

620.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted Minor Structure Concrete measured as noted above will be paid for at the contract unit price bid which shall be full compensation for the concrete complete in place including furnishing all materials except reinforcing steel, form work, finishing and for all equipment, tools, labor and incidentals necessary to complete the item in accordance with plan details and these specifications. In case of modification to an existing structure, the breaking away of the concrete to the approximate lines shown on the plans and the disposal of the broken concrete and the preparation of the retained steel reinforcement for splicing as required shall be considered incidental to the work and the cost thereof absorbed in the unit price bid.

(b) PAYMENT WILL BE MADE UNDER:

Minor Structure Concrete ___ — per Cubic Yard
SECTION 621
INLETS, JUNCTION BOXES, MANHOLES AND
MISCELLANEOUS DRAINAGE STRUCTURES

621.01 Description.

This Section shall cover the work of furnishing and installing miscellaneous drainage structures including necessary metal frames, grates, covers, etc. in accordance with the plan details and these specifications at the locations and to the grades shown on the plans.

The various units will be further designated by type to distinguish shape, size, etc. by plan details. Certain units or portions of units may be constructed of cast-in-place concrete, precast concrete and/or masonry as specified by plan details.

621.02 Materials.

All materials shall conform to the appropriate requirements of Division III, Materials, and the following:

Concrete and steel for cast-in-place units and for precast units or parts of units not covered by other requirements shall conform to the requirements of Sections 620 and 503.

Precast concrete units or portions of units shall conform to the appropriate requirements of ASTM C-478 unless otherwise provided by plan details.

Masonry materials shall conform to the requirements of Section 613 utilizing brick or block meeting the following requirements:

- Clay or Shale - ASTM C-32 Grade SS, MS or MM.
- Concrete brick - ASTM C-55, Type I, Grade N.
- Concrete block - ASTM C-90, Type I or II, Grade N.

Castings shall conform to the requirements of Section 839 with attention directed to Section 839.04, 839.05, 839.06 and 839.07. They shall be sound, smooth, clean, and free from blisters and other defects and where necessary planed to provide flat true surfaces.

Welded grates, grate seats, etc. shall be fabricated from ASTM A-36 material unless otherwise denoted by plan details.

Inlet and outlet pipe shall conform to the appropriate requirements of the section of the specifications covering the kind of pipe to which they are to connect.

Galvanization of grates, grate seats, nuts, bolts and miscellaneous metal hardware, when specified on the plans, shall be hot-dipped galvanized after fabrication by one of the following methods:

- Casting, grates and seats fabricated from rolled, pressed or forged steel shapes - ASTM A-123. Nuts, bolts and miscellaneous hardware - ASTM A-153.

621.03 Construction Requirements.

(a) EXCAVATION.

Excavation shall be performed in accordance with the appropriate requirements set forth under Section 107, Structure Excavation and Backfill for Drainage Structures and Minor Structures.
(b) CONCRETE UNITS.

Concrete units may be either poured-in-place or precast. Construction requirements relative to the two types shall conform to the following:

1. Poured-in-place units:
   Construction shall conform to the requirements of Section 620.

2. Precast Concrete Units:
   Holes for connector pipes in base section shall be cast with connector pipe holes of the specific number and dimensions necessary to incorporate the unit into the drainage system as shown by the plans. Should installation conditions require additional pipe holes for which no holes were cast, the Contractor may make such holes as necessary provided he performs said work in a workmanlike manner and he replaces or repairs any damaged unit to the satisfaction of the Engineer.

   Pipe connections to the base sections shall be made using either concrete or masonry mortar.

   Precast bases shall be set to within + 1/2 inch of grade on a bed of compacted foundation backfill material approximately four (4) inches thick. Sectional precast sections used to form units shall have all joints sealed and wiped clean using one of the appropriate type sealers noted in Section 527.03(d)3a.

(c) MASONRY.

Bricks shall be laid with full mortar joints not more than 1/2 inch thick. Courses shall be level and at least one course in every seven shall be a header course, unless otherwise directed. All units shall be plastered on the inside of the unit with not less than 1/2 inch of mortar (same as used in the laying) to a height of at least six (6) inches above the top of the outfall structure. When specified, the outside of the structure shall be plastered with 1/2 inch of mortar for the height of the masonry. All brick shall be dampened during laying and plastering to insure proper bond with mortar. The masonry shall be cured by approved methods which will insure the mortar has sufficient set before allowing backfilling operations.

When so specified on the plans or in the proposal, masonry units may be constructed of concrete blocks instead of bricks. Applicable construction details shall be the same as for brick masonry.

(d) INLET AND OUTLET PIPE.

Pipe shall be laid in accordance with the appropriate requirements of the Section of these specifications covering the kind of culvert pipe used. Pipe placed in masonry for inlet or outlet connections shall extend through the walls and beyond the outside surface of the walls a sufficient distance to allow for connections, and the masonry shall be carefully constructed around them so that there will be no leakage around the outer surface of the pipe.

Pipe connections to masonry or precast units shall be made using either concrete or masonry mortar.

(e) PLACING CASTINGS.

Castings shall be set in full mortar beds or otherwise secured as shown on the plans. The mortar used for setting castings shall conform to Section 607, Mortar for Masonry. Castings shall be set below the finished grade of the pavement about 1/16 inch.

(f) BACKFILLING.

Backfilling shall be performed in accordance with the appropriate requirements of Sections 105 and 107.
(g) CLEANING.
All junction boxes, inlets, manholes and similar structures shall be cleaned of all form material, excess mortar and all foreign matter and shall be free from such at the time of final inspection and acceptance.

621.04 Method of Measurement.

(a) INLETS AND JUNCTION BOXES.
Inlets and junction boxes will be measured as individual units including footings, bottom slab, walls, cover, lid, grating, etc., of the type, size, and shape shown on the plans. Measurements will be from the top of the bottom slab to the top of the cover, grating, or lid.

(b) MANHOLES.
Manholes will be measured as an individual unit including footings, bottom slab, walls, cover, lid, grating, etc. of the type, size and shape shown on the plans.

621.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
The accepted number of junction boxes, inlets, and manholes measured as provided above will be paid for at the respective contract unit prices for each which shall be payment in full for furnishing all materials including gratings, covers, and other fittings and for all form work, disposal of surplus material, and for all labor, equipment, tools and incidentals necessary to complete the work hereinabove specified.

(b) EXCAVATION AND BACKFILL.
Excavation and backfill will be considered incidental to the cost of the structures, and shall be absorbed in the appropriate items of work.

(c) PAYMENT WILL BE MADE UNDER:
Junction Boxes, Type —per Each.
Inlets, Type —per Each.
Manholes, Type —per Each.
SECTION 623
MANHOLES FOR SANITARY SEWERS

623.01 Description

This Section shall cover the construction of manholes for sanitary or storm sewers complete with the necessary metal frames, covers and steps in accordance with the plans and specifications at the locations and to the grades shown. All manholes shall be precast concrete units unless otherwise approved in writing by the Engineer to be constructed of brick masonry.

623.02 Materials

All materials shall meet the requirements as specified in the following sections:

Concrete Section 823.
Reinforcing Steel Section 837.
Brick Materials Section 820.
Manhole Frames, Covers and Steps Section 839.

Pre-cast manholes shall meet the requirements of ASTM C 478.
Inlet and outlet pipe shall conform to the appropriate requirements of the Section of the Specifications covering the kind of pipe or tile with which they are to connect.

623.03 Construction Requirements

(a) GENERAL

Excavation for manholes will be made of sufficient size and depth so as to allow the construction of the manhole as shown on the Plans. The manhole shall be excavated to a depth of six (6) inches below the structure to allow for stone bedding. In the event rock excavation is necessary, the manhole shall be excavated to a depth of 12 inches below the structure to allow for stone bedding. In the event additional bedding material is required, it shall be AHD #57 or AHD #78 crushed stone and will be paid for as "Foundation Backfill". In either case, no extra payment shall be made for manhole excavation which shall be considered incidental to the work. Attention is also directed to Section 107.

Backfill of all manholes shall be in accordance with Section 107 and plan details.

Castings set within the surface of paved streets or streets to be paved shall be set even with the paved surface. (Castings need not be set level but must be graded to fit paving grade.) Castings set in gravel streets or in gravel shoulders shall be set level and two (2) inches above the finished ground line. Castings set in rear yard easements or side yard easements shall be set level and four (4) inches above finished grade unless otherwise indicated on plans. Castings set in open fields shall be set level and two (2) feet above finished grade unless otherwise indicated on plans.

Drops at manholes shall be constructed of the same type pipe and fittings as the pipe with which they are to connect. Drops are required if there exist a vertical
drop of 18 " inches or more at the manhole. The drop connection shall be encased entirely in concrete as shown on the City of Huntsville Standard detail drawings. All manholes shall be cleaned of all form material, excess mortar, silt, debris, or foreign matter of any kind.

(b) MANHOLES OVER EXISTING SEWERS.
In general manholes constructed over existing sewer lines shall be performed in the following sequence:
1. Construct new bottom or base under and around the existing line
2. Set the pre-cast sections over the existing line as specified by plan details.
3. Break out the existing pipe within the new manhole, cover the edges with mortar, and trowel smooth.

The Contractor shall maintain flow through the existing sewer lines at all times, and protect new concrete and mortar work for a period of seven (7) days after concrete has been placed.

If the Contractor elects to divert the sewage flow, he must obtain the Engineer's approval in writing before starting. The Engineer's approval will not relieve Contractor of his/her responsibility for maintaining adequate capacity of flow.

(c) CONNECTION TO EXISTING MANHOLES.
When connecting sewers to existing manholes, the Contractor will provide all diversion equipment and perform all work necessary to maintain sewage flow in existing sewers during connection to manholes. Connections shall be made by breaking-out existing manhole wall at the proper elevation, installing the seal, and inserting the pipe, and grouting around the connection to insure a watertight seal. If resilient connectors are not applicable for the pipe to manhole connection, then the Contractor shall provide a Press Wedge II seep ring gasket as manufactured by Press-Seal Gasket Company or an approved equal. Non-shrink grout will be applied to complete the connection. If the invert of the existing manhole is disturbed, it shall be regouted to provide smooth flow into and through the existing manhole.

(d) BRICK MANHOLES
1. Brick masonry.
The concrete foundation on which brick are to be laid shall be firm and dry. All brick shall be damp at the time of laying. Bricks shall be laid in courses in full, close joints of mortar. The courses shall be level in all places, except where otherwise directed. All exposed surfaces shall be smooth and clean. Broken or chipped bricks shall not be used in the exposed faces of the masonry. Joints shall be cleaned in a neat workmanlike manner before the mortar sets. Shortly after the laying of the brick, the manhole shall be plastered with mortar to thicknesses as indicated on the plans.

2. Mortar
The mortar shall be mixed and placed in accordance with Section 607, Mortar for Masonry.

3. Entrance and Exit Pipe
Entrance and or exit pipe shall be laid in accordance with the applicable sections of these Specifications covering the kind of pipe used. Pipe placed in masonry for inlet or outlet connections shall extend through the walls and beyond the outside surface for half the length of one joint of the type pipe used. The masonry shall be carefully placed around the pipes so that there will be a watertight
4. Paved Invert.

The invert may be formed directly in the concrete base slab in the initial pour or built up with cement mortar. If the manhole is a line manhole, the pipe may be laid directly through the manhole and then the top half of pipe may be neatly cut out after the base slab is poured so that the remaining bottom half of the pipe forms the paved invert. Regardless of the type of paved invert, the workmanship must be such that the grade and pipe diameter are maintained, and all surfaces must be smoothed.

(e) PRE-CAST MANHOLES

1. General

Holes for connector pipes in base sections shall be cast with connector pipe holes and with the proper type boot or seal of the specific number and dimensions necessary to incorporate the unit into the system as shown by the plans. Should installation conditions require additional pipe holes for which no holes were cast, the Contractor may make such holes as described above, provided he replaces or repairs any damaged unit.

Precast bases shall be set to within plus or minus 1/2 inch of the grade on a bed of compacted foundation backfill material approximately six inches thick as outlined above. All precast units must be installed level and plum.

When jointing sections of precast units, the Contractor shall clean the joints of all foreign materials and shall inspect the joint for any chips, cracks, or honeycombs. The O-ring shall be seated in the groove prior to placing the next section and greased with the manufacturer’s standard lubricant prior to placing. Precast manhole sections range from 48 to 96 inches in diameter, and must conform to ASTM C 478. Concentric cones shall be required for all manholes unless otherwise specified. The Contractor shall use a manhole section with a minimum height of 48 inches whenever possible to limit the number of joints. Sections shall be cast with special attention given to providing a smooth wall bearing surface for the resilient manhole pipe connectors. For large diameter interceptors, two separate pre-cast sections shall provide the same formed diameter and wall smoothness requirement as would result if the formed pipe hole were in one monolithic precast section. A maximum of three lift holes will be permitted in each precast section. An approved joint sealer shall be furnished with the pre-cast manhole units to provide a "water-tight" and flexible joint between the manhole units, as shown on the detail drawings. Joints shall be manufactured, designed, and tested in accordance with ASTM C 448, (standard specification for Joints for Circular Concrete Sewer and Culvert Pipe, using rubber gaskets).

The manufacturer of the pre-cast manholes shall provide at least six (6) standard test specimens at the time the concrete is deposited for each production line to determine the concrete strength of the casting at different ages. The manufacturer shall provide adequate equipment and facilities to test and store the concrete cylinders with AASHTO requirements or test shall be performed by an approved testing laboratory at the expense of the manufacturer. In addition to the above requirement, the Engineer may require compression test specimens in the amount of five (5%) percent of the total order, but not to exceed two cylinders for each day’s production.

Permissible tolerances in manhole sections shall be in accordance with ASTM C 478. The average compressive strength of all cylinders tested shall be equal to or greater than the specified design strength. Not more than ten (10%) of the cylinders tested shall fall below the specified design strength. Whenever a greater quantity than ten (10%) percent of the concrete specimens fall below the design
strength, the manufacturer shall cull his entire stock of perform core tests from the
manholes in accordance with ASTM 478. The manhole sections will not be accepted
by the Engineer until all tests have been performed and they conform to the test
requirements. All pre-cast manhole units will be inspected by a representative from
the Engineer. Any units not true to the designated plans or within reasonable
tolerances shall be replaced by the manufacturer or supplier without additional
expense to the Owner.

Manhole sections shall be subject to rejection on account of failure to
conform to any of the specification requirements. In addition, individual sections of
manhole sections may be rejected because of any of the following:

(1) Fractures or cracks passing through the wall.
(2) Defects that indicate imperfect proportioning, mixing and molding.
(3) Surface defects indicating honeycombed or open texture.
(4) Damaged or cracked ends.
(5) Any continuous crack having a surface width of 0.01 inches and
extending for a length of 12 inches or more, regardless of position in
the wall. The following shall be clearly marked on each manhole
section:

(1) Date of manufacture.
(2) Name or trademark of manufacturer.

Marking shall be indented into the manhole risers and top sections, or shall be
painted thereon with waterproof paint.

2. Pre-Cast Base Sections, Bases, and Flat Slab Tops.

When, pre-cast base sections, manhole bases, or flat slab tops are to be
used may be used, base sections shall have the base slab integral with sidewalls.(Tie
reinforcing steel to wall steel). Base slab and flat slab tops shall meet the
requirements of ASTM C 478 or as detailed on the Plans, whichever will support the
greater load.

3. Manhole Extensions.

Concrete grade rings for extensions shall be a maximum of six (6)
inches high and shall be approved by the Engineer before installation. In general,
manhole extensions will be used on all manholes in roads or streets or in other
locations where a subsequent change in existing grade may be likely. Extensions
will be limited to a maximum height of 12 inches. Finish grade for manhole covers
shall conform to finished ground in residential areas or street surface. Along creeks
and through undeveloped areas, manholes shall have a finished grade of two (2) to
three (3) feet above above the ground surface or as shown on the plans.


Non-shrink grout shall conform to the Corps of Engineers Specification
for Non-shrink Grout, CRD-C588-76 and other applicable sections of these
Specifications.

Grout shall be nonmetallic. The grout shall be a non liberating type,
cement base product, premixed produce requiring only the addition of water for the
required consistency. All components shall be inorganic.
5. Manhole Steps.

Manhole steps shall be polypropylene plastic with 1/2 inch encapsulated steel reinforcing rod. Steps meet the requirements outlined in ASTM 2146-68 under Type II, Grade 16906. The steel used in manufacturing of this product is a deformed 1/2 inch reinforcing rod. This material is Grade 60 and conforms to all the requirements of ASTM A 615. The manhole step shall be as manufactured by M.A. Industries, Inc., Peachtree City, Georgia or an approved equal. The installed steps shall be located so as to provide a continuous ladder with steps equally spaced vertically in the assembled manhole at 12 to 16 inches. The bottom step shall be a maximum of two (2) feet above the fillet. They shall be capable of withstanding a force of 350 pounds, applied at any place on the step and in any direction which projects from the point of application through a diameter of the step cross-section at that point, with no permanent deformation resulting.


Connectors shall conform to ASTM C 923 and be of type as manufactured under trade names of Lock Joint or PSX or an approved equal.

7. Manhole and Interceptor Connection.

The contractor factory manufactured pipe joints not more than two (2) feet from manhole walls. Pipes to the joint shall be laid on firmly compacted base rock to undisturbed earth. The Contractor shall install resilient connectors of elastomeric or rubber boots or couplings to form a flexible, watertight connection installed as the recommended by manufacturer.

8. Temporary and Permanent Pipe Plugs.

a. When permitted by plan details, the Contractor may install temporary plugs in pipe until final new sewer construction can be connected to existing facilities. The plugs shall prevent soil and water from entering the new sewers.

b. Permanent plugs as shown in the Drawing details shall be installed and at the locations designated on the Drawings for pipe stubouts for future sewer connections.

9. Manhole Vacuum Testing

(a) Each manhole shall be tested immediately after assembly and prior to backfilling.

(b) All lift holes shall be plugged with an approved non-shrinking grout.

(c) All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.

(d) The test head shall be placed at the inside of the top of tie cone section and the seal inflated in accordance with the manufacturer's recommendations.

(e) A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine (9) inches. The manhole shall pass if the time is greater that 60 seconds for 48 inches diameter, 75 seconds for 60 inches, and 90 seconds for 72 inch diameter manholes.

(f) If the manhole fails the initial test, necessary repairs shall be made with a non-shrinking grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.
623.04 METHOD OF MEASUREMENT.

Manholes, "each" shall be the complete structure including excavation, backfill, foundation, bottom slab, walls, frame, cover, and steps of the type size and dimensions provided by the Plans or ordered. Measurement of depth of manholes shall be made by measuring from the invert of the lowest pipe to the center of the cover. The number and depth of manholes measured for payment will be the actual number and depth of each as defined here, ordered, completed, and accepted. Measurement of Drop Manhole shall be made according to the diameter of the pipe in the top clean-out pipe to the invert of the lower pipe entry into the manhole. The size and length of Drops at Manholes measured for payment will be the actual size and linear feet of each as defined here, ordered, completed and accepted.

623.05 BASIS OF PAYMENT.

The accepted number of manholes measured as provided above will be paid for at the respective Contract unit prices for each manhole according to depth, which shall be payment in full for all materials, labor, equipment services, and incidentals necessary to complete the work.

PAYMENT WILL BE MADE UNDER:

Sanitary Sewer Manholes ___to___ Depth - per Each

* Indicate Depths
625.01 Description.

This Section shall cover the work of constructing portland cement concrete gutter, curb, or combination curb and gutter, constructed with or without metal reinforcement. All of which shall be constructed in accordance with the plan details and these specifications at the locations shown on the plans or established in conformity with the lines, grades, dimensions and cross sections shown on the plans or designated.

625.02 Materials.

All materials shall conform to the requirements of Division III, Materials. Concrete shall conform to requirements of Section 501. Expansion joint filler shall be as specified in Section 831.

625.03 Construction Requirements.

(a) CONCRETE MIXES.

Concrete mixes shall be as provided by Section 501, with a Class A Type 2 mix, being used with standard forms and either a Class A or Class C mix modified to fit the type curbing machine being used.

(b) FOUNDATION.

The foundation shall be constructed or excavated to the required depth below the finished surface in accordance with the cross section shown on the plans or as designated. All soft or other unsuitable material shall be removed and replaced with suitable material, in layers not to exceed six (6) inches compacted. The foundation shall be compacted as provided for the applicable types of material involved.

(c) FOUNDATION BACKFILL.

If provided by the plans or proposal, foundation backfill to replace unsuitable material shall be placed and constructed as provided in Section 107. No direct payment will be made for foundation backfill, except when the proposal includes a unit price for this pay item.

(d) FORMS.

1. General.

The Contractor shall use standard type metal forms as noted hereinafter or if requested in writing and approved by the Department, an approved automatic extrusion type curb and gutter machine.

2. Standard Forms.

These forms shall be metal, except for radial sections, straight and free from warps and of sufficient strength, when staked, to hold the concrete true to line and grade without distortion. They shall provide the approved typical section and depth of the section shown on the plans. Radial or curved forms may be of flexible metal or a wood form of approved design. Bent or damaged forms shall not be used.

All forms shall be securely staked, braced and held together to the exact lines and grades established and shall be kept sufficiently tight to prevent leakage of
mortar. All forms shall be cleaned and oiled with a suitable oil immediately before concrete is placed against them.


Any automatic extrusion type curb and/or gutter machine considered for approval must be demonstrated to produce a section conforming to the dimensions, cross-sections, lines and grades shown on the plans within the tolerances provided in Section 625.03(h)2 for formed curbs and/or gutters. Failure to consistently produce an acceptable product shall be cause to withdraw approval of the machine and order the use of standard forms. All types of curbs, gutter and combinations shall be placed in one operation, to the depth of cross section specified on the plans, the use of a two stage operation will not be permitted.

(e) SECTIONS.

Gutter, curb and combination curb and gutter shall be constructed in sections of the lengths shown on the plans. The length of section may be reduced where necessary to form closure.

(f) HANDLING, PROPORTIONING AND MIXING MATERIALS

The handling, storing, proportioning, and mixing of concrete shall conform to the requirements of Section 501.

(g) JOINTS

All expansion, contraction, and construction joints shall be constructed as shown on the plans and in accordance with the requirements of Section 501.03. If not shown on the plans, joints shall be placed as follows:

(1) Expansion joints shall be placed in curb and/or gutter to match those in concrete pavement where the two are adjacent.

(2) Expansion joints 1/2 inch wide shall be placed where curb and/or gutter terminates against rigid objects.

(3) Expansion joint filler and sealer shall meet the requirements of Sections 831.01 and 831.02. Expansion joint filler shall extend from the bottom of the curb and/or gutter to within one inch of the top; the sealer shall be 1/2 inch thick and shall be recessed 1/4 inch from the top.

(4) Contraction joints shall be placed in curb and/or gutter to match those in concrete pavement where the two are adjacent, but in no instance more than 25 feet between joints. The contraction joints shall be sawed or otherwise cut 2 inches deep by 1/8 inch wide and shall extend 2 inches below the pavement surface.

(h) PLACING AND FINISHING CONCRETE - STANDARD METHOD.

1. Placing.

The subgrade and forms shall be checked and approved just prior to placing concrete against them. All debris or other foreign material shall have been removed from the space to be occupied by the concrete. The subgrade shall be moist but not wet or muddy. After mixing, the concrete shall be placed in the forms and shall be tamped, spaded or vibrated sufficiently to produce a dense homogeneous mass and to bring the mortar to the surface. Particular attention shall be given to spading the concrete along and against the surface of the forms to prevent honeycombing and secure a smooth, uniform surface.

2. Strike-Off and Finishing.

When the forms are filled, the concrete shall be struck off with a template, cut to the curb edge design. The exposed concrete surface shall then be finished smooth with a wooden float in a manner that will compact the mass and produce a true, even top surface. Plastering with mortar to build up or finish will not be permitted. The surface of the gutter and the face and top of the curb shall be
checked with a ten (10) foot straightedge and any irregularities more than 1/4 inch in ten (10) feet corrected. The alignment and grade shall not at any point vary more than 1/2 inch from that established by the elevation control stakes. Excessive troweling with a steel trowel will not be permitted. A textured finish shall be provided on the exposed surface just before the concrete becomes nonplastic by the use of a burlap or cotton fabric drag, brush or broom, which will produce a uniform gritty texture along the length of the curb, gutter or combination curb and gutter. The upper edges of curb and gutter shall be rounded with an approved edging tool to the radius shown on the plans. The joint templates shall be set during the placing of the concrete and allowed to remain in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

The forms shall be left in place until concrete has set sufficiently so that they can be removed without damage to the work, but they shall be removed within 24 hours after the concrete has been placed. Immediately after the removal of the forms, the repair of any minor defective areas shall be accomplished.

(i) PLACING AND FINISHING CONCRETE - MACHINE LAID.
The requirements of Section 625.03(h) are applicable except that fixed forms are not required.

(j) CURING AND PROTECTION.
Immediately after the finishing operation is completed, the concrete shall be cured as provided by Section 501.03(j). If mats are used they shall be kept continuously moist for a period of at least 72 hours. During this period, and until completion and acceptance of the work, it shall be protected from damage by the elements or other cause.

(k) BACKFILLING.
After the concrete has set sufficiently, spaces along the front and back sides of the gutter, curb or combination curb and gutter, shall be backfilled to the required elevation with suitable material which shall be compacted by tamping with approved metal tamps or mechanical tamps in layers not more than four (4) inches thick until firm and solid.

625.04 Method of Measurement.

Accepted Concrete Gutter, Concrete Curb, and Combination Curb and Gutter will be measured in linear feet, complete in place, to the nearest 1/10 foot along the base of the curb face or along the flow line of the gutter. No payment will be made across driveways, alleyways and other entrances. Measurement for separate payment for Foundation Backfill will only be made when it is provided in the proposal.

625.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
The accepted footage of accepted Concrete Gutter, Concrete Curb, and Combination Concrete Curb and Gutter, measured as provided above, will be paid for at the respective contract unit prices, complete in place, which shall be payment in full for all excavation, backfilling, disposal of surplus material, all joints, all special construction at driveways and other entrances and other points furnishing all materials, hauling and placing materials, and for all labor, equipment, tools and incidentals necessary to complete the work in accordance with the specifications including all approaches through curb and gutter indicated on the plans.
(b) PAYMENT WILL BE MADE UNDER:
   Concrete Gutter___—per Linear Foot
   Concrete Curb, Type ___—per Linear Foot
   Combination Curb & Gutter, Type ___ —per Linear Foot
SECTION 627
CONCRETE MEDIAN AND SAFETY BARRIER

627.01 Description.

This Section shall cover the work of constructing a concrete median or safety barrier at the location shown on the plans, proposal or directed. Barriers shall be basically classified as to "Type" which will designate the size, shape, height, etc. all in accordance with details shown in the plans. Barriers may be cast in place, extruded by slip form equipment or precast and installed in a permanent manner.

627.02 Materials.

All materials furnished for use shall conform to the appropriate requirements of Division III, Materials, and the following:

Concrete, unless otherwise specified by plan details, shall meet the requirements of Section 501 for Class A, Type 1 concrete.

Steel reinforcement shall meet the requirements of Section 503.

627.03 Construction Requirements.

(a) GENERAL.
The concrete mix, construction, placing of the concrete, curing and finishing shall be in accordance with the appropriate provisions of Section 501 unless otherwise provided hereinafter in this Section or noted in the plan details.

(b) EXCAVATION AND BACKFILL
Excavation and backfill for permanent barriers shall be in accordance with the provisions of Section 107.

(c) SLIP FORM METHOD
Barriers constructed by the use of a slip form extrusion machine shall be well compacted, dense concrete meeting all the requirements of Section 501, except for the requirement for fixed forms.
The forming portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine so that the top of the barrier can be maintained at the predetermined grade.

(d) CONCRETE SURFACE TOLERANCES AND FINISHING
The finished concrete shall be within reasonable close conformity to the lines, grades, and dimensions shown on the plans or directed; the barrier shall present a smooth uniform appearance free from objectionable cavities or projections, a ten (10) foot straightedge, laid on the top faces of the barrier, shall not vary more than 0.02 foot from the edge of the straightedge except at grade changes and curves and be free of humps, sags or other irregularities.

Concrete surfaces shall be finished in accordance with the provisions of Section 501.03(1) for Class 1 with exposed surfaces receiving a Class 2 finish unless otherwise specified by the proposal or by plan requirements.
(e) **JOINTS**

Joints shall be in accordance with the provisions of Section 501, except as follows: Surface edges on exposed vertical contraction joints shall be rounded with 1/4 inch edger or sawed. Vertical expansion joints may be open or sealed in accordance with plan requirements.

**627.04 Method of Measurement**

Concrete barriers will be measured for payment by the appropriate method designated by the plans or proposal in accordance with the following:

- **Concrete Median or Safety Barrier** - linear foot measured to the nearest 1/10 foot along the top surface barrier.
- **Concrete Median or Safety Barrier** - cubic yards of concrete with volumetric measure computed by the average end area method except where results obtained differ from those obtained by a more accurate mathematical computation.
- **Concrete Median or Safety Barrier End Section** - unit measurement where each end section is in accordance with the size, shape and length designated by the plans.

Excavation and backfill shall be measured in accordance with the provisions of Section 107.

**627.05 Basis of Payment.**

(a) **UNIT PRICE COVERAGE.**

The various "Types" of Median or Safety Barriers and End Sections ordered and accepted, measured as noted above, shall be paid for at the appropriate unit price bid provided in the proposal. Said unit price bid shall be full compensation for the furnishing of all materials and the construction of the barrier complete in place, including all equipment, tools, labor and incidentals necessary to complete the work.

(b) **PAYMENT WILL BE MADE UNDER:**

- Concrete Median or Safety Barrier, Type  - per Lin. Ft.
- Concrete Median or Safety Barrier, Type  - per Cu. Yd.
- Concrete Median or Safety Barrier End Section - per Each.
SECTION 629
GUARDRAIL AND BARRIER RAIL

629.01 Description.

This Section shall cover the work of the furnishing and installing of complete sections of steel or aluminum beam guardrail, guardrail end anchor systems, and shaped tube type barrier rail, at the locations shown on the plans or designated and in conformity with the detailed requirements of the plans and these specifications. The plans will designate the Class of guardrail to be used, and in the case of steel rail, also the Type to be used. When it is optional as to the choice of either steel or aluminum, the alternate, once selected, shall be used throughout the contract. Unless specified otherwise, Class A guardrail will be used for roadways and Class B guardrail will be used for bridges.

629.02 Materials.

Materials shall conform to the requirements set forth in Division III, Materials. Specific reference is made to Section 869, Guardrail Materials, and detail drawings provided in the plans. Spot checks will be made from material delivered to the project. The material may be accepted or rejected based on these tests.

629.03 Construction Requirements.

(a) ERECTION OF POSTS AND END ANCHORS.

1. Posts

Unless otherwise provided by the plans or proposal, the Contractor may use one of the optional type posts shown on the plans; however, once selected, the same type shall be used throughout the contract. Posts shall be erected in such a manner that they shall be vertical with their top inside edges within 1/4 inch of their correct position for both vertical and horizontal alignment. The posts shall be erected to the dimensions shown on the plans and compacted by tamping, puddling, or as directed, to obtain a rigid installation. Where posts are driven, the tops shall be protected by a suitable driving cap and the adjacent area compacted. If raising or other movement of the post is required, the earth shall be compacted to fill any voids caused by such movement. All posts damaged in any way during erection shall be removed and replaced without additional compensation.

2. End Anchors

The Contractor shall use one of the Type End Anchors provided by the plans, or directed. The anchor assemblies shall be erected to the dimensions shown on the plans, and the area backfilled with suitable material and compacted as provided in paragraph 1 above. Posts that are attached to the anchor assembly shall be erected to the requirements for individual posts as provided in paragraph 1 above.

(b) ERECTION OF RAIL.

1. All metal except concrete reinforcement shall be fabricated in the shop. No punching, cutting, burning, or welding shall be done in the field. Holes for special details in exceptional cases may be made in the field when approved, after it has been demonstrated that punching will not result in damage to the surrounding metal.

2. The rail may be erected in any manner resulting in a smooth continuous rail closely conforming to the established line and grade of the surface the rail parallels. The top of the rail shall be constructed to the height designated on the plans.

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3. Rail shall be erected so that the bolts at expansion joints shall be located at the centers of the slotted holes. Bolts may be retreaded after galvanizing if necessary. All bolts, except where otherwise required at expansion joints, shall be drawn tight; however, bolts through expansion joints shall be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least 1/4 inch beyond the nuts. Except where required for adjustments, bolts shall not extend more than 1/2 inch beyond the nuts. Bolts through variable thickness posts shall be cut off 1/4 inch beyond the nuts and burred.

(c) METAL TREATMENTS.
1. General.
   All steel elements (posts and rail), including all accessories used in the construction of guardrail and barrier rails shall be galvanized, except when otherwise provided by the plans or proposal. Aluminum elements (posts and rail) and accessories will require no special treatment, except where otherwise noted on the plans or proposal.
2. Steel.
   a. Galvanized.
      Painting of galvanized steel will not be required except that any damage to galvanizing or any bare areas developed during construction shall be painted with two coats of approved galvanizing repair paint, or an approved zinc spelter paint. However, should any galvanized metal be required by the plans or proposal to be painted, the surface shall be treated with a wash of eight (8) ounces of copper or zinc sulphate dissolved in one gallon of water prior to the application of the required paint surface.
   b. Not Galvanized.
      All metal not galvanized shall be cleaned and painted with one (1) primer coat and two (2) coats of paint, Structural Steel Second and Third Coats (Section 859), unless otherwise provided on the plans or in the proposal.
3. Aluminum.
   Aluminum elements of guardrail or barrier rail require no special preservative treatment unless otherwise noted on the plans.

(d) SAFETY OF TRAVELING PUBLIC.
At locations where public traffic is adjacent to the guardrail or barrier rail work, all materials required to complete the work at any one location shall be available before beginning the work at that location.

Posts shall be erected only far enough in advance to permit the construction to progress consistently, uniformly, and continuously. All posts shall have the rail attached to them the same day that the posts are erected. For installations in which neither end adjoins a fixed object, the installation of the rail shall progress in the same direction as the traffic in the adjacent lane.

The intent of this specification is that each guardrail or barrier rail installation erected under traffic be completed, including end anchors and/or attenuating devices, before nightfall of the day on which work on that installation began. In the event that unforeseen conditions prevent the completion of an installation before nightfall, the contractor will be required, at his expense, to protect and delineate the uncompleted installation by the use of reflectorized devices or other acceptable means. The minimum requirement for this protection and delineation will be one or more reflectorized drums with a Type B warning light on each drum.
If the existing guardrail or barrier rail is to be removed and reset, replaced, or relocated, then only one installation ahead of the placing operation may be removed. At any site where the rail has been removed and the new installation has not been completed, the Contractor will be required at his expense to protect the site with reflectorized drums, with a Type B warning light on each drum.

629.04 Method of Measurement.

Posts will not be measured for payment separately. The length of the beam guardrail or barrier rail constructed and accepted will be measured in linear feet to the nearest 1/10 foot from the end of each continuous installation, exclusive of designated anchor assemblies along the centerline of the top of the rail posts for guardrail and of the rail element for barrier rail.

Standard guardrail installations cover one rail element, its supports (post) and accessories. When installations are to cover special installations such as double faced rail (2 rail elements) mounted on a single post, a separate pay item will be provided and the special condition so noted in the description of the pay item.

End Anchor Assemblies shall be measured separately in individual unit assemblies, complete in place, including all hardware and accessories to complete the type anchor assembly ordered placed in accordance with plan details.

629.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Accepted guardrail or barrier rail measured as provided above, will be paid for at the contract unit price bid per linear foot for Beam Guardrail or Barrier Rail which shall be payment in full for excavating, backfilling, disposing of surplus material; for furnishing, transporting, erecting of posts and rail; for all incidental material, bolts, brackets, etc., as shown on the plans; and for all equipment, tools, labor and incidentals necessary to complete the work. Accepted Guardrail End Anchor Assemblies, measured as provided above, will be paid for at the contract unit price per each, which shall be full compensation for excavating, backfilling, disposing of surplus materials, for furnishing, erecting the anchor assembly and all incidental materials necessary to install the assembly, complete in place, as shown on the plans, and for all equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Steel Beam Guardrail, Class Type—per lin. Ft.
Aluminum Beam Guardrail, Class—per Lin. Ft.
Guardrail End Anchor, Type—per Each
Barrier Rail, Steel Rectangular Tubing—per Lin. Ft.
Barrier Rail, Extruded Aluminum Tubing—per Lin. Ft.
SECTION 631
CHAIN LINK INDUSTRIAL FENCE

631.01 Description

This Section shall cover the work of furnishing and installing, complete in place, commercial chain-link fence on posts and frames with either standard ground mounting or mounted on structures (bridges, retaining walls, etc.) as required by the plans, at locations shown on the plans or designated, all in accordance with the details shown on the plans and these specifications.

631.02 Materials

(a) GENERAL
All materials shall conform to the requirements of Division III, Materials, and shall be in accordance with details shown on the plans. Special attention is directed to Section 871.

(b) SPECIAL MOUNTED FENCE
When the fence is to be installed on structures which cannot utilize the standard method provided by the regular fence drawings, the type of post installation, etc., will be shown on the plans. Requirements for such installations will be shown on the plans. All miscellaneous steel used in such installations or mounting assemblies shall be of ASTM A-36 steel or approved equal and galvanized in accordance with ASTM A-123, unless such is otherwise provided by the plans.

631.03 Construction Requirements

(a) GENERAL
All construction methods and equipment employed in the setting of fence shall be in accordance with requirements of the specifications of the manufacture of the fence materials being used and such that the resulting structure will provide the expected service and be durable and complete in every detail.

(b) CLEARING FENCE LINE.
All brush, stumps, logs, large roots, humps of earth, boulders or debris which would interfere with proper construction of the fence in the required location and prevent a pleasing and acceptable profile along the tops of posts shall be removed before starting fencing operations. Sound standing trees in the fence line shall be removed or trimmed as directed to provide adequate working room. The clearing and/or grading of the fence line and the disposal of material removed shall be accomplished in such a way that trees and shrubs on the remainder of the right of way will not be damaged.
Breaks in profile of the fence shall be spread over vertical curves of sufficient length to insure a pleasing appearance.

(c) SETTING POSTS.
Posts and anchorages shall be set at intervals shown on the plans or directed. The posts shall be set plumb and true in alignment on the side which the fabric is to be attached. All end and corner posts, brace posts, pull posts and gate posts shall be set in concrete in accordance with plan details. Line posts may be set in place by one of the following methods: (1) set in concrete in the same manner detailed in the plans for brace posts, (2) driven, provided soil conditions are suitable and full embedment depth is obtained. When posts are driven, methods shall be used
to protect the posts from damage due to driving operations. Damaged posts shall be repaired or removed and replaced without additional cost to the City. Regardless of the installation method used, a stable fence frame shall be obtained. Where unstable soil is encountered, the use of longer posts, concrete anchorage or other approved post stabilization methods shall be required. Where fence is over solid rock or other hard unyielding material is encountered, appropriate treatment may be authorized.

When installing fence through areas where other than ground installations are required, special attention shall be given to the attachment of the mounting assemblies to the structure. Anchor bolts, etc. shall be cast into structures wherever possible. Other types of attachments, if permitted by the plans, must be approved by the Engineer before use. In any event, anchorage must be so installed as to present a neat workmanlike appearance.

(d) CONSTRUCTING FENCE.

Chain link fence shall be stretched taut and securely fastened to each post by means of approved metal bands or No. 9 gage wire spaced not more than 12 inches apart on posts and not more than 15 inches apart on the rail. The method of attaching at end posts, gates, and corner posts shall be as shown on the plans.

If barbed wire is specified on the plans, the barbed wire, barbed wire arms, and method of attachment shall be as shown on the plans. Wires shall be stretched taut and spaced as shown on the plans.

631.04 Method of Measurement.

The quantity of chain link fence of each separate height and variation shall be the accepted lengths, exclusive of gates, measured along the top rail overall in linear feet to the nearest foot, complete in place. The quantity of gates shall be the actual accepted number of gates classified according to type and width of gates.

When the item of Protective Cage (Industrial Fence) is provided in the Plans or Proposal, the accepted Protective Cage shall be the complete cage structure installed in accordance with plan details for the designated bridge type structure.

631.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted linear feet of fence, measured as provided above, will be paid for at the respective contract unit prices of each separate height and variation, complete in place, which shall be payment in full for all preliminary clearing, grubbing, excavating, and filling; for all materials, including concrete for posts, hardware, fittings and appurtenances; for erecting, bracing and aligning, and for all equipment, tools, labor and incidentals necessary to finish and complete the work. The accepted number of gates of each size measured as provided above will be paid for at the respective contract unit prices, complete in place, which shall be payment in full for furnishing and erecting all materials, all hinges, braces and other necessary fittings, including lock, 2 keys and one master key for each gate, and for all equipment, tools, labor and incidentals necessary to finish and complete the work.

When the item of Protective Cage (Industrial Fence) is provided in the plans or proposal, the accepted complete unit, measured as noted above, will be paid for at the contract lump sum price for each respective unit, complete in place, which shall be payment in full for furnishing all materials, fabrication and erection of all pipe framework including the connectors and inserts necessary for the installation of the fabric, and for all equipment, tools, labor and incidentals necessary to finish and complete the work.
(b) PAYMENT WILL BE MADE UNDER:
Industrial Fence, ' High—per Lin Ft
Industrial Fence, ' High, plus Barbed Wire, (45° Arms)—per Lin Ft
Industrial Fence, ' High, plus Barbed Wire (Vertical Arms)—per Lin Ft.
Gate, ' Wide, Complete with Fittings (With Barbed Wire) or (Without
Barbed Wire)—per Each
Industrial Fence, ' High, Special Mounting—per Lin Ft
Protective Cage (Industrial Fence)—per Lump Sum
SECTION 633
WOVEN WIRE FENCE

633.01 Description.

This Section shall cover the work of furnishing and erecting fences of woven wire and barbed wire, together with appropriate gates. Posts shall be wood or metal in accordance with details shown on the plans and/or proposal. Fences shall be erected at the locations and elevations shown on the plans or designated and shall comply with these Specifications. When it is optional as to the choice of the post type to be used, the alternate, once selected, shall be used throughout the project.

633.02 Materials.

Materials shall conform to requirements of Division III, Materials with specific reference to Section 871, and the details shown on the plans.

633.03 Construction Requirements.

(a) GENERAL.
   All construction methods and equipment employed in the setting of fence shall be in accordance with requirements of the Specifications of the manufacturer of the fence materials being used and such that the resulting structure will provide the expected service and be durable and complete in every detail.

(b) CLEARING FENCE LINE.
   All brush, stumps, logs, large roots, humps of earth, boulders or debris which would interfere with proper construction of the fence in the required location and prevent a pleasing and acceptable profile along the tops of the posts shall be removed before starting fencing operations. Sound standing trees in the fence line shall be removed or trimmed as directed to provide adequate working room. The clearing and/or grading of the fence line and the disposal of material removed shall be accomplished in such a way that trees and shrubs on the remainder of the right of way will not be damaged.

(c) SETTING POSTS.
   All posts and anchorage shall be set at intervals shown on the plans. The posts shall be set plumb and in true alignment on the side on which the wire is attached. Holes shall be dug to the minimum diameter and depth shown on the plans except that special treatment may be authorized when the fence is over solid rock. Steel or wood posts, excluding posts that are to be set in concrete, may be driven if the soil conditions are suitable. Methods shall be used to protect the posts and galvanized coating or wood preservative during the driving operation. The heads of all posts shall be protected from damage by caps or driving heads of approved design. Heads of wood posts shall be protected by a suitable cushion of wood, rope or like material and by a metal driving head. Posts that are damaged in any way shall be removed and replaced without additional cost to the City.

(d) INSTALLING WIRE AND GATES.
   The woven wire fabric shall be stretched taut and securely fastened to each post by use of wire and an approved fencing tool so that the top of the fabric and lines of barbed wire are properly spaced from the top of each post as shown on the plans. The stretching shall be done with an approved stretcher that will produce equal tension in each line of wire in the fabric. At each end, corner or gate post each
strand or line of wire shall be wrapped around the post and securely fastened near the post by winding the end about the same wire.

Where the fence crosses short depressions, longer posts may be required and the space below the bottom of the fence filled in with additional strands of barbed wire tied to posts as directed.

Where the fence crosses deep depressions or ravines the Engineer shall require that posts likely to be lifted when the fence is stretched be anchored in concrete as required for corner posts.

The fence shall be connected to culvert and/or bridge wing walls in accordance with the details shown on the plans.

The Contractor, however, may submit for consideration by the Department an alternate method of attaching the fence to the wing walls, provided no additional cost to the project is incurred, the method submitted presents a pleasing appearance to the eye, and accomplishes the desired results.

633.04 Method of Measurement.

All woven wire fences completed in compliance with these specifications at designated locations and accepted will be measured in place, along the top of the posts overall between the extreme limits of each section, excluding gates, in linear feet to nearest foot. Each gate completed in compliance with the plans and these specifications and accepted will be counted as a unit, complete in place.

633.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. Fences constructed and measured as above provided will be paid for at the contract unit price per linear foot for Woven Wire Fence complete in place, which shall be payment in full for clearing, grubbing, and preparatory shaping for the fence line; for disposing of waste materials; for excavating for posts and braces and pouring concrete foundations where required, for furnishing all materials; for setting posts and braces, installing wire and other incidentals and for all equipment, tools and labor required to complete the work.

2. The accepted number of gates of each width constructed and accepted as above provided will be paid for at the respective contract unit prices for each width, which shall be payment in full for furnishing and installing gates together with all necessary fittings, hinges, braces, locks, keys, and other specified accessories, and for all materials, equipment, tools and labor necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Woven Wire Fence—per Linear Foot
Gate, 1' Wide—per Each
SECTION 635
BARBED WIRE FENCE

635.01 Description.

This Section shall cover the work of furnishing and erecting barbed wire fences of the type and size shown on the plans and/or proposal. Posts shall be wood in accordance with details shown on the plans or proposal. Fences shall be erected at the locations and elevations shown on the plans or designated and shall comply with these specifications.

635.02 Materials.

Materials shall conform to requirements of Division III, Materials with specific reference to Section 871 and the details shown on the plans.

635.03 Construction Requirements.

(a) CLEARING FENCE LINE.
All brush, stumps, logs, large roots, humps of earth, boulders or debris which would interfere with proper installation of fence in the required location and prevent a pleasing and acceptable profile along the tops of posts shall be removed before starting fencing operations. Sound standing trees in the fence line shall be removed or trimmed as directed to provide adequate working room. The clearing and/or grading of the fence line and the disposal of material removed shall be accomplished in such a way that trees and shrubs on the remainder of the right of way will not be damaged.

(b) SETTING POSTS.
All posts and braces shall be set to the required depths and intervals. The posts shall be set plumb and in true alignment on the side on which the wire is attached. Holes shall be dug to the minimum diameter and depth shown on the plans except that special treatment may be authorized when the fence is over solid rock. Posts may be driven if the soil conditions are suitable. Methods shall be used to protect the posts during the driving operations. The heads of all posts shall be protected by a suitable cushion of wood, rope or like material and by a metal driving head. Posts that are damaged in any way shall be removed and replaced without additional cost to the City. The backfill shall be well tamped into place.

(c) INSTALLING WIRE.
The barbed wire shall be stretched taut and securely fastened to each post by use of wire or staples and an approved fencing tool so that the lines of barbed wire are properly spaced on each post as shown on the plans. The stretching shall be done with an approved stretcher that will produce equal tension on each line of wire. At each end or corner post each strand or line of wire shall be wrapped around the post and securely fastened near the post by winding the end about the same wire.

Where the fence crosses short depressions, longer posts may be required and the space below the bottom strand of the fence filled with additional strands of wire tied to the posts as directed.
635.04 Method of Measurement.

All barbed wire fences completed in compliance with these specifications and details shown on the plans at designated locations, and accepted will be measured in place along the top of the posts in linear feet to the nearest 1/10 foot.

635.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Barbed Wire Fences constructed and measured as provided above will be paid for at the contract unit price per linear foot for barbed wire fence complete in place, which shall be payment in full for clearing, grubbing and preparatory shaping for the fence line; for disposing of waste materials, for excavating for posts and braces; for furnishing all materials; for setting posts and braces, installing wire and other incidentals and for all equipment, tools, and labor required to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Barbed Wire Fence, Strands, _' High—per Lin Ft
SECTION 641
WATER PIPE

641.01 Description.

This Section shall cover the work of either furnishing and installing new water pipe and water mains or removing and relaying existing water pipes and water mains as indicated on the plans or as directed, and substantially to the established locations, lines and grades.

Water pipe is defined here as lateral lines leading from water mains to buildings. The kind and size of pipe or main will be shown on the plans or in the proposal.

641.02 Materials.

All materials shall conform to the provisions of Division III, Materials. Specific reference is made to Section 867, Water Pipe. Pipe to be removed and relaid shall in each case be that indicated on the plans or proposal. Kinds of pipe, other than Galvanized Steel and Cast Iron Water Pipe to be relaid, shall have joint and other incidental materials in accordance with original installation unless otherwise required by local codes or regulations.

641.03 Construction Requirements.

(a) GENERAL.

1. All pipes to be removed and relaid shall be cleaned. The Contractor will be required to replace without extra compensation sections of pipe damaged through carelessness or use of improper methods. Pipe shall be approved before relaying.

2. The construction methods employed in the placement of the pipe shall be in accordance with the current codes and practices of the operating utility company. All work performed shall be under the supervision of an experienced supervisor for this type of work.

3. Reaction or thrust backing shall be required on all mains 4" in diameter or larger at all ties, plugs, caps and bends deflecting 22 1/2 degrees or larger, or other approved anchorage provided. Cost of this anchorage shall be considered incidental to the work and the cost thereof absorbed in the unit price bid for the mains.

4. When installing non-metallic water pipe, the Contractor shall install a metallic tape on top of the pipe or provide other suitable means whereby the installation can be relocated by electronic detection devices.

(b) EXCAVATION, FOUNDATION PREPARATION AND BACKFILL.

1. Excavation.

The trench shall be excavated to the designated line and grade. The trench width shall be sufficient to permit work on the pipe and inspection of the work. Mains shall have a trench width of 16 inches plus the outside diameter of the pipe with the depth sufficient to provide for foundation preparation as noted in item 2 below.

2. Foundation Preparation.

Mains shall be placed on a firm foundation of sand or sandy loam either from approved selected portions of the excavation or an approved source obtained by the Contractor. This foundation shall consist of a minimum six (6) inches of approved material, unless otherwise specified, which has been compacted to the satisfaction of the Engineer and which has been shaped to fit the pipe and joints to insure full bearing of the pipe section for its entire length on the trench floor.
3. Backfill.

After installation of the pipe the trench shall be backfilled with the best of the suitable material taken from the excavation, if this material is not suitable other acceptable material shall be obtained. The backfill shall be compacted to the density specified in Section 206 within the roadbed, consistent with the surrounding material for areas outside the roadbed. Any subbase, or base or pavement cut in the trenching for the pipe shall be backfilled with materials of the same quality as removed and the surface restored to its original smoothness.

All pipe shall be pressure tested as noted in Section 641.03(c), or the method prescribed by the utility company whose system is involved, whichever is the more stringent, before complete backfilling of the pipe will be permitted.

(c) PRESSURE TESTING OF INSTALLED LINES.

1. General.

All lines installed under this Section shall be pressure tested as noted hereinafter in this Section. The Contractor shall have the option of testing the mains under one of the following conditions:

a. Lines uncovered
b. Lines partially covered with joints and valves exposed. Partial cover shall be placed as noted Section 641.03(b)3.
c. Lines completely covered

Service lines to be tested as outlined below shall meet condition a or b

2. Testing.

a. Mains.

When a section of pipe is approved by the Engineer for testing the Contractor shall furnish all materials, equipment, and labor to properly carry out the testing operation. This will include, as a minimum, a test pump and a means of accurate measurement of water necessary to maintain the required pressure during the prescribed time of testing. The Contractor shall furnish, install, and remove any temporary bulkheads, flanges, and plugs, as well as corporation stops at high points in the pipe line and at the test pump, when such are necessary for the testing operation.

All pipe mains, including corporation stops, shall be tested before service lines are installed. If the high pressure testing of the mains must be done after service lines are in place, the service lines shall be shut off at the corporation stops.

After necessary joints, corporation stops, bulkheads, etc. have been installed, temporary corporation stops, if no other means can be provided, shall be placed in the high points of the pipeline and at the pumps as required, and the pipe blown free from air according to accepted procedure.

The test pressure shall equal 150 percent of the working pressure, but shall not be less than 100 psi nor more than the pressure class of the pipe being tested. The minimum test period shall be six (6) hours. However, if additional testing is necessary, the Contractor shall perform the procedure with no additional compensation. Leakage shall not exceed four (4) gallons per inch of pipe diameter per mile per six (6) hours. Suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage under the test pressure.

When service lines cannot be shut off from the section to be tested or other conditions exist where pressure testing as described above may cause damage, the Engineer may approve the line be tested under normal operating pressure.
SECTION 637
FENCE RESET

637.01 Description.

This Section shall cover the work of the resetting of fences, gates, stiles, and cattle chutes, required to be removed from their original position, or erecting fences, gates, etc. using new material of the type furnished to the Contractor (usually by the owner of the abutting land) instead of materials removed.

637.02 Materials.

Existing materials shall be utilized to the fullest extent possible. Replacement for materials damaged or destroyed due to negligence on the part of the Contractor shall be of at least the same grade of material used in the original fence. Approval of the replacement material shall be made by the Engineer in writing; no testing of this material will be required unless such is deemed necessary.

637.03 Construction Requirements.

(a) GENERAL.

Attention is directed to the general construction requirements for construction of Chain Link Industrial Fence, Section 631; Woven Wire Fence, Section 633; and Barbed Wire Fence, Section 635.

The Contractor will be required to remove and reset the fence to the location on and beyond the right of way lines as designated, using the material from the original fences, and shall leave all fences in as good condition as before removal from their original location.

In case resetting of a fence will completely re-enclose a previously enclosed area, the Contractor shall be responsible for all damages of any nature arising from the removal of the fence or delay or negligence in resetting. No such fence shall be cut or disturbed until the Contractor has made adequate provisions for immediate repair or reconstruction. Watchmen to control livestock where fence is being reset shall be provided by the Contractor as necessary without extra compensation.

In case resetting of a fence will not re-enclose a previously enclosed area, it shall not be cut or moved without a written order from the Engineer. Pending issuance of such written order, the Contractor will be permitted to install at his expense, temporary fences and gates or other means of access. The Contractor, provided reasonable caution is used, will not be held responsible for damage arising from removing and resetting fence after receiving a written order for its removal.

(b) INSTALLATION.

Reset fences shall be true to line and grade with all wires taut and well fastened, and shall present a workmanlike appearance.

(c) GATES.

All gates shall be moved and made serviceable at the new location. All damage to fence and gates due to moving operations shall be repaired by the Contractor. All posts and gates not in serviceable condition shall be replaced with posts and gates of serviceable materials. The cost of such replacements shall be included in the price bid for Fence Reset and no direct payment will be made for such replacements.
The Contractor will not be required to furnish any additional material, except posts and gates, as above provided, and such materials as may be necessary to replace any and all parts of the fence and gates unnecessarily damaged in removing and handling and resetting. Should the owners or the lessees of the abutting property desire to improve any fence or portion thereof which is designated to be reset, and the said owners or lessees agree to furnish the Contractor, at the site of the work, the necessary material similar in character to that in the original fence, the Contractor will be required to rebuild and reset such fence using the material furnished by the owners or lessees in lieu of the original material. The Contractor will be responsible for such materials delivered on the site until incorporated in the fence. The original material so replaced may be recovered by the owners or lessees.

637.04 Method of Measurement.

The quantity of fence reset shall be the accepted net length, including gates, of completed fence removed and reset at the new location, measured along the top of the post line in linear feet to the nearest foot. No measurement or direct payment will be made for fence removed only and not reset. The quantity of fence reset includes cattle chutes, stiles, and related fences.

637.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted footage of fence reset will be paid for at the contract unit price bid per linear foot for Fence Reset, which shall be payment in full for furnishing all labor, material, equipment, tools, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Fence Reset—per Linear Foot
The Contractor, at his expense, shall locate and repair defective joints, sections, or valves until the leakage is within the noted allowances. All observed leaks shall be repaired whether or not the leakage test results are within the requirements specified above. After the Contractor has made the necessary corrections, the main shall be retested as described above until the line passes the necessary requirements. All tests, and retests, shall be at the Contractor’s expense.

b. Service Lines.
These lines shall be checked under normal operating pressures for at least six (6) hours and the line completely inspected for visible leaks unless checked along with the mains as noted in Item a above. The Contractor, at his expense, shall locate and repair or replace any connection or joint until leakage has been stopped.

(d) STERILIZATION.
Pipe lines and appurtenances, both existing and new, which are the responsibility of the Contractor by reason of and within the overall limits of construction, shall be sterilized before being placed in service. The sterilization process shall be performed after all pressure tests have been completed.

The sterilization process shall, at a minimum, be that required by the governmental regulatory body having jurisdiction over the utility. The Contractor shall contact the utility owner or regulatory body to determine the acceptable sterilization treatment. The cost for this work shall be included in the unit price bid for the water pipe.

641.04 Method of Measurement.

The length of water pipe and water main relaid and new water pipe and water main laid will be the overall length measured, along the top of the pipe in linear feet, complete in place, which shall include all valves, connections (Y’s, T’s, etc.) and fittings.

641.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted footage of water pipe and water main laid will be paid for at the contract unit price per linear foot, complete in place, which shall be payment in full for furnishing and installing pipe; including all valves, connections, fittings, and joint materials, making necessary pipe connections, excavating, backfilling, and for all materials, tools, labor, equipment and incidentals necessary to complete the work.

2. The accepted footage of water pipe and water main relaid will be paid for at the contract unit price per linear foot, complete in place which shall be payment in full for removing, cleaning, excavating, relaying, making necessary pipe connections, furnishing new joint material, backfilling and for all materials, tools, labor, equipment and incidentals necessary to complete the work.

3. Final acceptance of this work will be subject to approval by the Utility Company involved, therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner’s written approval that the work performed complies with the local codes and requirements of the Utility Company.

(b) PAYMENT WILL BE MADE UNDER:

" Kind Water Pipe/Main Laid—per Linear Foot
" Kind Water Pipe/Main Relaid—per Linear Foot
SECTION 643
FIRE HYDRANTS RESET

643.01 Description.

This Section shall cover the work of resetting existing fire hydrants together with any connections, valves and pipe or main necessary to be moved in resetting the hydrant.

643.02 Materials.

All materials shall conform to the appropriate requirements of Division III, Materials, or shall be approved equivalent in kind and quality to that replaced.

643.03 Construction Requirements.

All work shall be done in a workmanlike manner, by competent workmen in accordance with the requirements of local codes and ordinances. Any materials lost or rendered unfit for re-use on account of negligence or improper handling by the Contractor shall be replaced by him without additional compensation.

Hydrants may be reset under pressure without removing joints where the situation permits; otherwise, hydrant and necessary pipe shall be taken up and then reset at the designated elevation and location.

Attention is directed to the requirements of Section 641.03 for relaying water pipe and mains.

643.04 Method of Measurement.

The number of fire hydrants reset will be the number actually reset as directed and accepted.

643.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of fire hydrants reset, measured as above provided, will be paid for at the contract unit price each which shall be payment in full for all excavation, backfilling, resetting fire hydrants and all necessary connections, valves, and pipe, and for all equipment, tools, materials, and labor necessary to complete the work.

Final acceptance of this work will be subject to approval by the Utility Company involved, therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner's written approval that the work performed complies with the local codes and requirements of the Utility Company.

(b) PAYMENT WILL BE MADE UNDER:

Fire Hydrant Reset—per Each
SECTION 645
WATER METERS AND VALVE BOXES RESET

645.01 Description.

This Section shall cover the work of removing existing water meters and valve boxes as shown on the plans or designated, and resetting them at the locations and at the elevations designated.

The term "water meter" shall include the water meter, the meter box, and cover, the adjacent water cutoff, all connections, and pipe necessary to be moved in resetting the meter. The term "valve box" shall include all sections of the box or casing over the valve, extending from the water or gas main to the surface, and the cover for same.

645.02 Materials.

All new materials furnished for use shall conform to the appropriate requirements of Division III, Materials, or shall be approved equivalent in kind and quality to the materials used in the original construction.

645.03 Construction Requirements.

All work shall be completed in a workmanlike manner, by competent workmen. The upper section of the valve box shall be adjusted carefully to the designated elevations. The valve box shall not be removed during grading operations without permission of the Engineer and shall be carefully protected from damage. The Contractor shall accurately reference the location of each box which he is permitted to remove, in order to make correct replacement. Backfill shall be tamped around each box located in the pavement area to the required density of the adjacent material.

Any meter, valve box, or accessories lost or rendered unfit for re-use due to negligence or improper handling by the Contractor shall be replaced by him without additional compensation.

645.04 Method of Measurement.

The number of water meters and valve boxes reset will be the number of each, reset complete in place and accepted.

645.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of water meters and valve boxes reset, measured as provided above will be paid for at the contract unit price each, which shall be payment in full for all excavating, backfilling, resetting the meter or valve box and all necessary connections, and for all equipment, tools, materials and labor necessary to complete the work.

Final acceptance of this work will be subject to approval by the Utility Company involved, therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner's written approval that the work performed complies with the local codes and requirements of the Utility Company.

(b) PAYMENT WILL BE MADE UNDER:

Water Meters Reset—per Each
Valve Boxes Reset—per Each

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SECTION 647
SANITARY SEWERS

647.01 Description.

This Section shall cover the work of furnishing and installing new sanitary sewers and the removal and relaying of existing sanitary sewers at the locations and to the established lines and grades shown on the plans or designated. This work shall also include the furnishing and construction of joints, cutting and connection to other pipes as may be required by the plans or directed to provide an acceptable facility.

647.02 Materials.

Materials furnished for use shall conform to the requirements of Section 854 and other appropriate sections of Division III, Materials. The type and size of pipe will be shown on the plans or in the proposal. The pipe strength shall be in accordance with the requirements of Section 854 unless otherwise provided by plan details or the existing system to which the lines are a part require a stronger grade or actual laying conditions require the use of stronger wall pipe.

647.03 Construction Requirements.

(a) GENERAL.
Pipe shall not be laid or relaid except in the presence of the Engineer or Inspector and shall not be covered until approved. Pipe designated to be relaid that is damaged or rendered unfit for use through negligence or improper handling shall be replaced by the Contractor without additional compensation.

In general, sanitary sewers shall not be less than thirty-six inches (36") deep (finished grade to top of pipe) under right-of-ways, and no less than thirty (30") deep in non-traffic (unpaved) areas. All sewers shall follow accurately the grade and alignment shown on the plans.

All work performed shall be under a qualified experienced supervisor for this type work. The Contractor shall be required to unload, haul and distribute all pipe, and materials, perform all excavation, including sheeting, bracing and supporting the adjoining ground or structures where necessary; handle all dewatering; provide barricades, guards and warning lights; lay and test the pipe, and fittings, backfill trench to finished grade, and remove surplus excavated material; clean the site of the work; and construct the final surface cover over the trenches as specified.

When installing non-metallic sewer pipe, the Contractor shall install a metallic tape on the pipe or provide other suitable means whereby the installation can be relocated by electronic detection devices. Work required by the plans which require interruption of service shall be accomplished in such a manner that will limit interruption a minimum period of time. Construction of the sanitary sewer shall not be considered complete until all test have passed, and the finished grade surface has been completed and accepted by the City of Huntsville.

No pipes shall be connected to the City of Huntsville Sanitary Sewer System without the approval of the City Engineer and/or a permit is secured from the City Engineering Dept.
(b) HANDLING AND STORAGE

Pipe and fittings shall be inspected upon arrival at the job site and handled in such a manner so as to protect them from damage due to impact, shock, and free fall. Pipe and fittings shall not be dragged along the ground and shall be stored so as to protect the joints and pipe from damage.

(c) CONSTRUCTION SEQUENCE

Construction of sewers shall begin at the low point of the line and continue in orderly succession throughout the project. Any deviation from this procedure shall be made only with the specific approval of the Engineer, only after the right-of-way has been cleared, the entire project has been staked, and all elevations carefully checked by the Engineer of Record.

Appurtenances shall be constructed as the work progresses.

(d) CLEARING

Clearing shall be accomplished in accordance with Section 101 of these specifications.

(e) TRENCH EXCAVATION

All excavation shall be accomplished in accordance with all federal, state, and local regulations. The trench shall be excavated so that the pipe can be laid to the alignment and depth required, and it shall be excavated only so far in advance of pipe laying as set out elsewhere in these Specifications. The trench shall be so braced and drained that the workmen may work therein safely and efficiently. It is essential that the discharge of any trench dewatering pumps be conducted to natural drainage channels, drains or storm sewers.

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part.

Rock excavation may be required in some instances. If provisions are made in the bid for rock excavation, rock excavation shall be paid for. Otherwise, all excavation of any nature shall be unclassified and payment for same shall be included in the unit price of other items of work.

1. Trench Depth and Pipe Bedding

The trench shall be excavated to a minimum of six (6) inches below the bottom of the pipe when laid at the required grade. Bell holes shall be excavated in accord with the applicable specification for installation of the type pipe being installed. Pipe shall be bedded in pipe bedding material, as specified elsewhere in these Specifications for the full width of the excavated trench from a point six (6) inches below the bottom of the pipe barrel to the springline of the pipe with crushed stone base (AHD #78). The remaining trench shall be backfilled as specified elsewhere in this specification. All over excavation shall be backfilled with bedding material at the Contractor's expense. Material required to backfill over excavation shall be placed in six (6) inch lifts and thoroughly tamped with mechanical compaction equipment to reach the required established grade. All pipe bedding shall be tamped so as to provide a uniform and continuous bearing support for the pipe at every point along the pipe barrel.
2. Width of Trench:
   Should the excavated polyvinyl chloride sewer line trench width exceed the width as detailed on the Plans at any point from the trench bottom to a point 12 inches above the top of the pipe barrel, the Contractor shall, at his expense, provide additional pipe bedding material or concrete as necessary to prevent crushing of the sewer pipe due to excessive earth loads. All additional bedding material or concrete required shall be furnished at the Contractor's expense.

3. Length
   The Engineer may limit the trench excavated in advance of installation of sewers. No excavation in advance of installation of sewer pipe shall exceed 300 feet, or that length in which installation may reasonably be completed during the workday. Trench excavated to grade in advance of installation of sewers shall not exceed 150 feet, or that length in which installation may reasonably be completed during the workday.

   Every trench in rock shall be fully opened at least 50 feet in advance of the place where pipe is being laid or from where cash-in-place concrete operations are in progress.

   Material excavated in open non-roadway areas is to be laid compactly on the side of the trench and kept trimmed up until reused as backfill material. Material which is unsuitable for backfill shall be removed and disposed of by the Contractor without any additional compensation.

   When installation of the sanitary sewer system is in the roadway area and where necessitated by traffic conditions, all excavated material shall be loaded on trucks and removed or transferred for use as backfill so that neither the materials excavated nor those used for construction will be stored upon the street. All streets, sidewalks, crossings, fire hydrants, water valves, fire-alarm boxes, and other similar public utilities are to be kept open or accessible for their intended use. If excavated materials are allowed to be stored on the street, and if at any time public traffic cannot be maintained because of the materials, so much materials as necessary are to be removed from the street as directed by the City Engineer, and the suitable material returned to be used as backfill.

5. Excavation In Poor Soil and Refilling To Grade:
   Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, all types of refuse, vegetable or other organic materials, or large pieces of fragments of inorganic material which in the judgment of the Engineer should be removed, the Contractor shall excavate and remove such unsuitable material to the width and depth ordered by the Engineer. Before the pipe is laid, the subgrade shall be made by backfilling with crushed stone (AHD #5 or larger) trench backfill as specified elsewhere in these Specifications, in six (6) inch uncompacted layers. The layers shall be hand or machine tamped so as to provide a uniform and continuous bearing and support for the pipe at all points along the pipe length. Extra payment will be made for the additional trench backfill required as crushed stone base (AHD #5 or larger) in accordance with the Methods of Measurement and Payment section of these Specifications. However, no additional compensation will be made to the Contractor for the additional excavation.

6. Bracing And Shoring:
   The sides of any excavation, when deemed necessary, shall be properly supported with bracing, shoring, or sheeting as the need may be. Such bracing and shoring shall be withdrawn as the work progresses. In case the excavation is close enough to buildings or other foundations as to endanger their

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stability by the removing of such bracings, then they shall be made secure and left in place, and the sewer trench backfilled and thoroughly tamped with the bracing in place. **Note:** The Contractor will not be paid for such bracing, sheeting or shoring whether it is withdrawn or left in the trench.

7. Removal of Water And Muck:
The Contractor shall provide sufficient pumps and other necessary equipment to keep the trench free of water which may accumulate. If the bottom of the trench becomes soft and muddy, the Contractor shall remove all such soft material and replace it with crushed stone base (AHD #5 or larger) trench backfill. Under no conditions will sewer pipe be laid in a trench that has not been properly dewatered. No additional compensation will be made to the Contractor for dewatering or removal of muck. However, payment will be made for the additional bedding material paid for as "Extra Bedding."

8. Rock Excavation:
In the event rock is encountered, the Contractor shall excavate rock to a depth of 12 inches below the bottom of the barrel of the pipe. **No extra payment** shall be made for rock excavation; however, payment will be made for the additional bedding material paid for as "Extra Bedding."

Any underwater excavation required will be preformed in accordance with the plan details.

Blasting operations will be carried out in accordance with the City of Huntsville regulations, and ordinances, and all state laws, and Section 9 of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, Inc. All explosives shall be stored in conformity with said ordinances, laws and safety regulations. No blasting shall be done within 5 feet of any water main. Any damage incurred as a result of blasting is the responsibility of the Contractor and shall promptly and satisfactorily be repaired by him.

Excavation and backfill shall be considered as an incidental part of the work and no separate payment therefore will be made except as specified in other sections of these specifications.

(f) **PIPE BEDDING.**
Pipe bedding shall comply to the details in the construction plans and to these specifications. Pipe shall be laid on a firm bed in perfect conformity with the lines and grades shown in the plans. The foundation for the pipe shall be shaped and prepared to conform to the pipe so that the entire load of the backfill on top of the pipe will be carried on the barrel of the pipe; and where bell and spigot end pipe are utilized, none of the backfill load will be carried on the bells. Supporting pipe with blocks, or bricks, or other materials will not be permitted.

Whenever wet, unstable or yielding conditions exist, the subgrade shall be stabilized by removing all of the wet, unstable material below the ordinary trench depth so as to prepare a proper bed for the pipe. The trench shall be backfilled with AHD #78 crushed stone to the proper grade elevation for supporting the pipe.
(g) INSTALLATION OF PIPE

Installation of sewer pipe shall commence at the lowest point so that the spigot or tongue end points in the direction of flow. Before the sewer pipe is installed in position in the trench, the bottom and sides of the trench shall be carefully prepared and the necessary bracing and sheeting installed.

The Contractor shall be responsible for maintaining grade and alignment as shown on the construction plans. Any variances found shall be corrected by the Contractor without additional payment.

Before each section of pipe is lowered into the trench, its interior shall be inspected to insure that all dirt, rags or foreign matter is removed. The outside of the spigot or tongue end and the interior portion of the bell end shall be wiped clean of all dirt and moisture prior to jointing so as to insure a clean dry joint. Each pipe shall be lowered into the trench separately. No defective pipe or fittings will be allowed in the sewer system. Defective pipe and materials shall be removed and replaced with satisfactory pipe. If a section of pipe is cut to fit, it shall be made such that the cut leaves a smooth end at right angles to the longitudinal axis of the pipe. At no time will pipe be cut by chipping or cold chiseling.

Pipe sections shall be fitted such that a smooth and uniform invert is formed. Adjustment to the bottom of the trench to bring each section of pipe to grade/alignment shall be made by scraping or filling, as necessary, with AHD #78 crushed stone. At no time shall trenching equipment be allowed to force pipe section to a lower grade.

Fittings, wyes, tees, branches, and service connections shall be installed in accordance with the manufacturer's recommendations and at the locations as shown on the plans.

When pipe laying stops for any reason, the exposed end shall be closed with a plywood plug fitted into the bell end, so as to protect it from intrusion of foreign material. The Contractor shall take all precautions to prevent intrusion of any foreign material into the pipe system. Precautions must also be taken to prevent flotation of pipe caused by flooding of the trench from surface water or ground water.

Jointing shall be accomplished in accordance with the pipe manufacturer's recommendations.

(h) HOUSE AND BUILDING SERVICE LINES.

The City shall approve the location of the points of the collector line where sewer wyes are to be installed for service connections. The Contractor shall install the service connection line from this point to the property line or easement line. Service connection lines shall be shown on the "Record" drawings and located by actual field measurements indicating the depth of the connection line at its end, the distance from the collection line to the end and the distance from the tee to the nearest downstream manhole. All service lines, unless otherwise specified or directed, shall be four or six-inch schedule 40 PVC or ductile iron pipe as hereinbefore specified and as indicated on the drawings. Trenching, pipe installations, joints and backfilling shall conform to the requirements as set out herein. All open ends shall be sealed with standard plugs to the satisfaction of the Engineer.

For shallow sewers six feet of depth or less in rock or earth trenches wyes shall be encased entirely with crushed stone and fully compacted. Service connection pipe shall be of the material specified hereinbefore in this article and shall be placed from the wye branch to customer property line, except for sewer line construction in new subdivision, in which case the house connection pipe shall be extended ten feet inside the property line. The pipe shall be laid on a uniform grade from the wye branch to meet the probable building sewer grade at the street right-
of-ways line so that no bends will be needed for the final connection. For sewers greater that six feet in earth trenches, wyes shall be encased entirely with crushed stone and fully compacted. Service connection pipe shall be placed from the wye branch to customer property line. In new subdivisions, sewer services shall be extended ten feet inside the property line. The pipe shall be laid on a 45 degree angle from the collector line until the probable building sewer grade is met.

For sewers greater than six feet in depth in rock, laterals, wyes, fittings, etc. shall be Class 50 ductile iron. The service line shall be extended to the property line, or ten feet inside the property line. (in the case of installation in a new subdivision.) Sewer connection pipe shall be laid on a slope of not less than one foot per 100 feet (approximately 1/8 inch per foot).

Unless otherwise approved by the Engineer, service connections may not be tapped into manholes. If connection to a manhole is necessary, the invert of the service connection shall not be higher than a point three inches above the top of the bench so as to prevent accumulation of solids on the bench. If necessary, a standard drop connection shall be provided for a service connection tapped into a manhole. Installation of service connections shall follow immediately or be concurrent with the construction of the main sewer.

(i) CONNECTIONS
Connections shall be made to existing sewer lines as shown on the plans. Connections shall be made by installing a wye or tee saddle on the existing pipe in the upper quadrants. Tapping shall be preformed by cutting a round hole in the existing pipe using a power saw or tapping machine. The sewer service pipe shall be connected to the wye or tee as recommended by the pipe manufacturer to form a water tight seal. Upon completion of the service connection, the work shall be inspected by the Engineer before backfilling begins. After approval by the Engineer the connection and main shall be encased in concrete as shown in the plans.

Connections to existing manholes shall be made by cutting a neat hole with a saw in the wall of the manhole, inserting a joint of pipe into the hole, filling around the pipe with concrete or non-shrink grout and troweling the inside and outside surfaces of the joint to a neat finish.

(j) BACKFILLING.
All backfilling shall be accomplished in accordance with the details shown on the plans and the following:

1. Method "A" Backfilling in Non-Traffic Areas
   a) In all cases, the lower portion of the trench from the bedding to the springline of the pipe shall be backfilled with AHD #78 crushed stone. Care should be taken to insure stone bedding is worked under the "haunches" of the pipe so as to fill any voids.
   b) When ductile iron pipe is used, that portion of the trench from the springline of the pipe to a point twelve inches above the pipe shall be backfilled with acceptable material.
   c) When Polyvinyl Chloride or flexible pipe is used, the portion of the trench from the springline to a point six (6) inches above the pipe shall be backfilled with AHD #78 crushed stone.
   d) The upper portion of the trench above the crushed stone backfill shall be backfilled with material which is free from large rock. Any rock incorporated in the backfill with a volume exceeding one-half cubic feet shall not be placed in the trench. The method of backfilling this portion of the trench shall be
accomplished by compacting the material from excavation in maximum twelve (12) inch layers. Density requirements shall be in accordance with Section 206. Any variances in the method of placement or choice of materials for the portion of backfill between the springline of the pipe and the level twelve inches above the pipe shall be approved in writing by the City Engineer.

2. Method "B" Backfill in Traffic Areas
   a) The entire trench shall be backfilled to a point twelve inches below the bottom of the pavement surface with AHD #78 crushed stone.
   b) The upper portion of the trench, from the point twelve inches below the bottom of the pavement surface or up to grade shall be backfilled with dense graded aggregate, or an approved traffic mixture.

(k) TESTING
   Testing shall be performed on all new sanitary sewer lines by one of the following methods unless otherwise indicated by plan details. In general, infiltration shall not exceed 200 gallons per day per mile of pipe per inch of pipe diameter.

(1) EXFILTRATION TESTS.
   An exfiltration test shall be conducted on each section of sewer between manholes. Exfiltration tests shall be conducted by blocking of all manhole openings, except those connecting with the section being tested, filling the line, and measuring the water required to maintain a constant level in the manholes. Each manhole shall be subjected to at least one exfiltration test.
   During the exfiltration test, the average water depth above the pipe invert shall be eight (8) feet, unless manhole depths are such that this is impossible. The exfiltration tests shall be maintained on each section for at least two hours and such additional time as necessary, to locate all leaks.
   The Contractor shall provide, at his own expense, all necessary piping between the section to be tested and the source of water supply, together with equipment and materials required for the tests.
   If infiltration or leakage exceeds this amount, the Contractor shall make such repairs as are necessary to bring infiltration or leakage within specified limits. The Contractor shall test the line by blocking off the various sections of pipe, filling the line with water and measuring the leakage.

(2) AIR TESTING
   Sanitary sewer pipe sewer lines shall be air tested as specified elsewhere in Section 673, of these specifications.

(3) MANDREL TESTING.
   Flexible sewer pipes shall be Mandrelled with a rigid device sized to pass five (5) percent or less deflection (or deformation) of the pipe.
   The Mandrel (go/no-go) device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with less arms (in odd or even numbers, respectively) will be rejected as not sufficiently accurate. The contact length of the Mandrel's arms shall equal or exceed the nominal diameter of the sewer to be inspected. Critical Mandrel dimensions shall carry a tolerance of ± 0.01 inch.
   Pipe dimensions as contained in ASTM 2680, latest revision, shall be used to compute the Mandrel dimensions. Allowances for pipe wall thickness tolerances or ovality (from shipment, heat, shipping loads, poor production, etc.) shall not be deducted from the base ASTM data, but shall be counted as a part of the
five (5) percent or lesser deflection allowance.

The Mandrel shall be hand-pulled by the Contractor through all sewer lines. Any sections of sewer not passing the Mandrel shall be uncovered and the Contractor shall repair or replace the sewer. These repaired sections shall be retested.

The inspection shall be conducted no earlier than 30 days after reaching final trench backfill grade, provided that sufficient water densification or rainfall has occurred to thoroughly settle the soil throughout the entire trench depth. If this cannot be achieved in the time after installation prior to the project completion date, then the Mandrel size shall be increased to measure one-third less of a deflection allowance.

Drawings of the Mandrel with complete dimensioning shall be furnished by the Contractor to the Engineer for his approval for each diameter and specification of pipe.

(4) TVI

In general, before acceptance of a sewer main, the City of Huntsville shall television investigated (TVI) to identify any deflections or deformations in the line.

(i) LOCATION NEAR WATER LINES

When sewer lines must cross under water mains, the sewer will be laid on such a grade that the top (crown) of the sewer is 24 inches below the bottom of the water main. Should conditions not permit the above separation, the water main shall be relocated to provide this separation, or the sewer line shall be reconstructed with slip-joint or mechanical joint approved pressure pipe for a distance of ten feet on each side of the water line and shall be pressure tested, in place without leakage, prior to backfill. The crossing shall be designed so that the joints of the sewer line will be equidistant and as far as possible from the joints of the water main.

(m) MANHOLES

Manholes shall be constructed to the sizes, shapes, and dimensions and at the locations shown on the plans and as specified Section 623.

647.04 Method of Measurement.

The actual accepted length of sanitary sewer laid as directed will be measured in linear feet along the center of the line, with deductions for manholes, complete in place. Excavation, foundation preparation and backfilling for sanitary sewers will not be measured for direct payment but shall be considered incidental for the necessary completion of the work and shall be included in the unit bid for the sanitary sewer pipe, unless otherwise indicated on the plans or in the proposal.

647.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted length of sanitary sewer laid complete in place measured as noted above will be paid for at the respective contract unit prices for the kinds, depth, and sizes specified in the proposal including the excavation and backfilling, which shall be payment in full for furnishing, hauling, excavating, foundation preparation, laying or, backfilling, compacting, clean-up and for all materials, equipment, tools, labor, and incidentals necessary to complete the work except manholes, junction boxes, or like connecting masonry.
(b) PAYMENT WILL BE MADE UNDER:

"**Type** Sanitary Sewer Pipe, Class *—per Linear Foot.

Types:
- Reinforced Concrete (R.C.)
- Ductile Iron (D.I.)
- PVC (P.V.C.)

* Denote Class of Pipe
SECTION 648
ENCASEMENT PIPE FOR UTILITIES

648.01  Description.

This Section shall cover the work of furnishing and installing an encasement pipe for water or sewer type utility. The installation shall include placement of the pipe at the location shown on the plans or directed and in conformity with the lines and grades established by the plan details. The location of the encasement pipe within the construction limits of a project will determine the method of installation. The installation requirements are as follows:

Type 1, installation—installed by open trench method complying with requirements for installation with bedding as specified in Section 527.

Type 2, installation—installed by an approved jacking, boring, or tunneling procedure.

648.02  Materials.

Materials furnished for use shall comply with the appropriate provisions of Division III, Materials, with specific reference to Section 865.

648.03  Construction Requirements.

(a) GENERAL.

The two types of installations are for use as follows:

Type 1- Designated for use under roadways where construction permits open cut method. Type 2 - Designated for use where open cut method is not permissible. The Contractor may, at his option, substitute this installation method for Type 1 installation provided no additional cost to the City is involved. This type installation is basically for use under existing facilities and where traffic is not to be disturbed.

The type of pipe joints used will be at the Contractor's option provided the joint produces a smooth surface on the inside of the pipe suitable for installation of the carrier or line pipe. In order to prevent earth, debris, rodents, etc. from entering the encasement, the ends of the pipe shall be sealed by grouting or other suitable means.

(b) OPEN CUT METHOD.

The procedure for excavating and backfilling of pipe by the open cut method shall be as prescribed in Section 527 for a Type 1 installation.

(c) BORING, JACKING OR TUNNELING METHOD.

When a Type 2 installation is required, the method selected by the Contractor must be approved in writing by the Engineer. The Contractor shall submit to the Engineer details of the procedure he proposes to use along with a description of the equipment available for use. The results of said procedure shall produce a neatly installed encasement pipe without damage to the existing facility and without excessive voids in the earth surrounding the encasement pipe. If there are indications that voids exist around the encasement, the Engineer shall have cause to order the Contractor to pump under pressure a concrete grout to seal the voids. Any damage to the facility (roadbed, slopes, etc.) caused by the installation operation shall be restored by the Contractor without cost to the City.
(d) **SEATING OF CARRIER PIPE.**
Tracks, guides or other types of supports acceptable to the utility company involved shall be provided for conveying the carrier pipe through the encasement.

(e) **END TREATMENT OF ENCASEMENT PIPES.**
Provisions shall be made at the ends of all encasement pipes to prevent water and other foreign matter from entering the casing. Sealing of the ends of the encasement pipe may be accomplished by products manufactured specifically for this purpose or may be constructed of rubble masonry or concrete mortar.

648.04 **Method of Measurement.**

The accepted amount of encasement pipe of the type installation required shall be measured by the linear foot, to the nearest foot.

648.05 **Basis of Payment.**

(a) **UNIT PRICE COVERAGE.**
The accepted encasement pipe measured as noted above will be paid for at the contract unit price bid for the type installation involved. Said unit price bid shall be full compensation for the furnishing and installation of the pipe, for all excavation and backfill, except as provided in Section 527 for Type 1 installation, sealing ends of encasement, disposal of excess material and for all labor, tools, equipment and incidentals necessary to complete the work.

(b) **PAYMENT WILL BE MADE UNDER:**
   
   " Encasement Pipe, Type 1, 2 Installation — per Linear Foot"
SECTION 649
TOPSOIL

649.01 Description.

This Section shall cover the work of furnishing an approved topsoil material, and the incorporation of the topsoil material into the work as designated on the plans.

The use of the Item of "Topsoil" requires that the Contractor provide the material from sources he has obtained.

Basic work consists of loading, hauling, spreading, manipulating and compacting the topsoil material, all in accordance with these Specifications to the lines, grades and cross section indicated on the plans.

649.02 Materials.

(a) DEFINITION.

Topsoil is defined as a natural, workable, friable, loamy soil or a satisfactory type of humus, without admixture of subsoil, refuse, or foreign materials, reasonably free from hard lumps, stiff clay, hardpan, gravel, noxious weeds, brush, or other undesirable material, and suitable for growing grasses, legumes, or other vegetative ground cover.

(b) REQUIREMENTS.

Acceptable topsoil shall have demonstrated by the occurrence upon it of healthy vegetative growth that it is well drained, and that it does not contain toxic amounts of either acid or alkaline elements. The areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed in quantity, the product will be homogeneous in nature and of acceptable quality.

(c) SOURCES OF MATERIAL.

TOPSOIL FURNISHED BY CONTRACTOR.

Where the plans specify the Item of Topsoil, the Contractor shall furnish the topsoil material and shall obtain it from areas, arranged for and furnished by him.

649.03 Construction Requirements.

(a) SOURCE AREA OPERATIONS.

All areas from which topsoil is to be stripped shall be cleaned of all refuse which will hinder or prevent growth. In securing topsoil from approved areas, should unforeseen strata or seams of material occur which do not meet the requirements for topsoil, such material shall be removed from the topsoil and disposed of as set forth in Section 105.

(b) HAULING TOPSOIL.

Topsoil shall be hauled in vehicles suitable for the purpose, scrapers of a reasonable capacity will be considered as acceptable. However, spillage will not be tolerated and loads shall be controlled to prevent such. Topsoil spilled on subgrade or other base or pavement structure layers shall be removed immediately.
(c) CONDITIONING OF AREA TO RECEIVE TOPSOIL.
Before depositing topsoil upon any area all shaping and dressing of such area shall have been completed and approved.

(d) APPLICATION AND GROUND PREPARATION.
Areas shall receive standard ground preparation, as described in Section 651.

After the application of the topsoil to such a depth as indicated, the area shall be harrowed and disked entirely through the layer of topsoil and into the subsoil to a depth of at least two (2) inches in order to secure proper bond of the topsoil with the subsoil. At this stage all large lumps, large rocks, roots, or other objectionable matter shall be gathered up and disposed of. On such areas where the application of topsoil involves primarily the backfilling of rills or small washes, ground preparation, if directed, may be delayed until after the application of the topsoil and just before the application of fertilizer and grassing operations. Fertilizer, limestone, or other additives, when required, shall be incorporated during the harrowing and disking of the topsoil.

(e) COMPACTION.
It is intended that the grassing operation shall follow immediately after the placing of topsoil in which case such grassing operation would require satisfactory compaction in order to prevent erosion. In the event that grassing operations are delayed, the layer of topsoil shall be compacted until satisfactory.

(f) MAINTENANCE.
The Contractor shall maintain the topsoil that has been placed, without extra compensation, in connection with any seeding, sodding, planting, or other work, until final completion of the project. Maintenance shall consist of preserving, protecting, and such other work as may be necessary to keep the work in a satisfactory condition.

649.04 Method of Measurement.
This accepted topsoil material furnished by the Contractor complete in place will be measured in cubic yards, loose measure in the delivery vehicle at the point of delivery on the project. When the item of Topsoil is to be paid by square yard, measurement will be made by the number of square yards placed at the specified thickness as shown on the plans or indicated in the proposal.

649.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
The yardage for the Item of Topsoil measured as provided above will be paid for at the contract unit price per cubic yard, unless otherwise provided in the proposal, which price shall be full payment for cleaning and removing refuse from the topsoil; for ground preparation for furnishing the material including royalty and related costs, handling, hauling spreading, shaping and compacting in its final position; for incorporating fertilizer or other additives (if required); for satisfactory disposal of surplus material; and for furnishing all equipment, tools, labor and incidentals necessary to complete the work. The yardage for the Item of Topsoil from Stockpiles, measured as provided above, will be paid for at the contract unit price per cubic yard, which price shall be full payment for ground preparation; for cleaning and removing debris from the topsoil, for all handling, hauling, spreading, shaping and compacting in its final position; for incorporating fertilizer or other additives (if
required); and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:
   Topsoil—per Cubic Yard In Place
   Topsoil—per Square Yard In Place
SECTION 651
GROUND PREPARATION AND FERTILIZERS
FOR EROSION CONTROL

651.01 Description.

This Section shall cover the work consisting of the preparation of the areas designated on the plans or directed for the ground covers specified in Sections 653, 654, 655, 657, 659 and other applicable Sections of these Specifications. It is the intent that erosion control features be constructed concurrently with other work at the earliest time deemed practical by the Engineer, therefore, whenever any section of the road is substantially complete and there is a high potential for erosion and subsequent water pollution to occur, the Engineer may direct, even to the exclusion of other operations, that the Contractor promptly accomplish the ground preparation described hereinafter and place the erosion control items provided in the contract.

Ground preparation shall, in general, consist of plowing, discing and harrowing of the areas to receive a ground cover in accordance with other Sections of these Specifications.

Fertilizers, whether provided as a separate item of work or included as a part of a specified ground cover, shall include the furnishing and incorporating into the soil, to the depth of preparation specified, fertilizers of the types provided on the plans or in applicable sections of these specifications.

The cost of water necessary for ground preparation, planting and establishment of an early stand of all erosion control items and the maintenance of these items for the duration of the contract shall be included in the unit price bid for the respective item of work involved.

651.02 Materials.

(a) GENERAL.

All materials shall conform to the provisions of Division III, Materials. Specific reference is made to Section 863.12, Fertilizer.

(b) SUBSTITUTION.

Additional grades of manufactured fertilizers will be accepted on the basis of nominal content of each of the three provided fertilizing ingredients. Standard commercial grades other than those provided as shown in Section 863.12(c), or a combination of such grades, may be used without extra compensation provided the rate of their use is adjusted to supply at least as much of each fertilizing ingredient as supplied by the required grade when used at the rate provided for the items of work involved. When and as provided on the plans, basic slag may be substituted for agricultural limestone on the basis of approximately the same neutralizing power together with appropriate adjustment being made for phosphate content in the basis slag. Example: If Basic Slag contains 6% Phosphoric Acid, then one (1) ton of Basic Slag will provide 120 pounds of available phosphoric acid. For the purpose of these specifications, agricultural limestone and basic slag shall be considered as manufactured fertilizer except that they shall contain no insecticide.
651.03 Construction Requirements.

(a) EQUIPMENT.
All equipment necessary for properly handling, storing, placing and incorporating the fertilizer into the prepared ground and for ground preparation shall be at hand, proved to be in good condition and available when required, and shall have been approved before work will be permitted to begin.

(b) GROUND PREPARATION.
Ground preparation shall consist of cultivation to loose depth of approximately four (4) inches (minimum) except on slopes steeper than 2 1/2 to 1, where the depth shall be at least two (2) inches. The plowing, harrowing, cultivating, and all other operations shall be performed with proper equipment and in such a manner as to break up all clods, lumps, or earth balls, and remove all boulders, stumps, large roots, or other particles which will interfere with the work and which will result in a smooth, uniform, loose, well broken, and fine grained soil; thus providing a suitable bed for seed grass or plants. The ground shall be plowed to the required depth then cultivated with a rotary tiller and/or disc harrow, in both directions if feasible, until approved. In small or inaccessible areas use of hand tools will be permitted. After removal of all large particles which cannot be broken, the surface shall then be harrowed and tilled. The Contractor shall add sufficient water to wet the soil in order to prepare the ground.

(c) APPLYING FERTILIZER.
Fertilizers shall be applied uniformly into the areas to be planted or improved in such amount and to such depth and according to the methods indicated in the Specifications for the various ground covers. The fertilizer shall be well pulverized and free of lumps when applied. In no case shall full strength fertilizer be permitted in direct contact with roots. When fertilizers are applied hydraulically they must be diluted sufficiently as directed so that no damage is done to either seed or established grasses and legumes. Agricultural limestone and basic slag shall be applied separately but may be incorporated into the soil with fertilizers in one operation.

651.04 Method of Measurement.

(a) GROUND PREPARATION.
No measurement or direct payment will be made for ground preparation unless a specific pay item is set up in the contract. In such case it shall be measured in acres parallel to the surface.

(b) FERTILIZERS.
Fertilizers incorporated in or on the soil as directed and accepted will be measured in tons of 2000 pounds when there is a specific pay item in the contract for fertilizer; and then only for the extra quantity specified and applied as directed over and above the rate of application specified in the respective ground cover sections.

661.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
1. When separate payment is provided for ground preparation measured as provided above, it will be paid for at the contract unit price per acre for ground preparation, which shall be payment in full for all equipment, tools, labor and incidentals necessary to complete the work.
2. The quantity of fertilizer measured as provided above will be paid for at
the contract unit price per ton complete in place which shall be payment in full for
furnishing and incorporating fertilizer, and for all equipment, tools, labor, and
incidentals necessary to complete the work. Payment for the amount of fertilizer
applied at the specific rate provided in the various ground cover sections of these
specifications shall be included in the contract unit price of the appropriate ground
cover pay items.

(b) PAYMENT WILL BE MADE UNDER:
Ground Preparation—per Acre
Commercial Fertilizer—per Ton
SECTION 653
SEEDING

653.01 Description.

(a) GENERAL.
This Section shall cover the work of furnishing, sowing and establishing an acceptable growth of grass from seeds of the specified seed mixes designated for use, for protection of the project. Basic work consists of ground preparation in accordance with the provisions of Section 661; the furnishing and incorporation of fertilizer in the amounts specified in Section 653.03(a); the furnishing, inoculation, sowing of seeds during the designated sowing season, the covering, compacting and maintaining of the seeded areas.

Seeds may be sown by mechanical seeders. Mowing, when directed, will not be paid for as a separate pay item. Mulch, if required, will be applied and paid for separately under Section 657. Topsoil, if required, will be applied and paid for separately under Section 649. Water necessary to satisfactorily prepare, and establish an early stand of grass, and maintenance of all seeding shall be classified as a part of the seeding items. The amount of water and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

(b) SEEDING DATES.
Planting dates for various seeds of a mixture are provided in the mixed seeding tables of Section 863.01.

653.02 Materials.

All materials furnished for use shall comply with the requirements of Division III, Materials, with specific reference made to Section 863.

653.03 Construction Requirements.

(a) GENERAL.
Seeding operations shall be performed as provided hereinafter in these Specifications or as shown on the plans so that the various seed species noted for the seed mixture designated for use are sown during the proper sowing dates specified for the seed involved. In order to accomplish such sowing it will be necessary to sow some of the species by overseeding as noted in Section 653.03(d).

When during any part of the specified sowing season, weather or ground conditions are such that satisfactory results are not likely to be obtained, the Engineer shall not permit the work to proceed.

1. INSPECTION.
   a. The Contractor shall notify the Engineer at least twenty-four (24) hours in advance of the time he intends to start inoculating and mixing seed or begin sowing seed and shall not proceed with such work until permission to do so has been given.

   b. All ground preparation, incorporation of fertilizer, inoculation of seed, seed mixing, and other work preparatory to planting as well as the operation of sowing, covering, and rolling shall be done in the presence of the Inspector.
2. CONDITIONING OF THE AREA TO BE SEEDED.

Before sowing any seed upon any area, all shaping and dressing of such areas shall have been completed unless otherwise directed.

3. GROUND PREPARATION AND FERTILIZER.

a. Ground Preparation.

Except where the plans provide for seed to be sowed in a previously developed stubble, all areas to be seeded shall receive standard ground preparation as provided in Section 651.03(b).

b. Fertilizer Requirements.

Fertilizer shall be applied as specified in Section 651.03(c) and mixed to the depth of preparation as soon as applied. It shall be applied mechanically or by approved hydraulic equipment. Fertilizer and agricultural limestone or basic slag shall be applied separately but may be incorporated together. The seed bed for all mixed seedings shall be fertilized initially with two (2) tons of agricultural limestone, or basic slag when permitted, and 1500 pounds of grade 8-8-8 fertilizer per acre or a sufficient quantity of any other acceptable grade or grades of commercial fertilizer that will provide at least 120 pounds of nitrogen, 120 pounds of available phosphoric acid and 120 pounds of total potash per acre, as computed from the nominal contents of fertilizing ingredients. When quantities vary as a result of soil tests from those shown herein or on the plans, any increase will be paid for under Section 651. For any decrease below quantities shown herein or on the plans, deduction will be made at the unit prices. After the grass has shown growth (usually approximately 40 days) and while the soil surface is moist, a second application of fertilizer shall be made as a top dressing of nitrate of soda sulfate of ammonia, ammonium nitrate or other approved high nitrate fertilizer used at a rate to provide at least 67 pounds of nitrogen per acre; for example, approximately 200 pounds of 33.5% ammonium nitrate.

c. Fertilizing Rocky Slopes.

(1) If slopes to be seeded are determined by the Engineer to be too rocky for performing standard ground preparation but sufficiently soft or shaly to permit some form of treatment, the following method shall be used:

Apply one-half the required limestone or slag and fertilizer to the raw slope, and scarify.

Cover the slope with approximately four (4) inches of topsoil or granular soil. Apply the remaining one-half of the required limestone or slag and fertilizer.

Mix the fertilizer with the layer of soil.

Proceed with seeding.

(2) With written permission of the Engineer of Public Works the following procedure may be used on slopes steeper than 2:1:

One-half the specified limestone and fertilizers shall be applied in separate operations hydraulically on the slope areas.

The specified seed mixes shall then be applied as per specification requirements for hydro-seeding.

Mulching materials shall be applied in accordance with the provisions of Section 863.03(b).

After approximately six (6) weeks, the remaining one-half of the specified limestone and fertilizer shall be applied in separate operations hydraulically on the slope area.

Four (4) weeks from the application date of the second fertilization, an approved high nitrate fertilizer which will provide 67 pounds of nitrogen per acre shall be applied, but not by hydraulic methods.
Subsequent applications of fertilizers are required at six (6) month intervals during construction consisting of 500 pounds per acre of 8-8-8 or equivalent which may be applied by mechanical or hydraulic methods.

(b) INOCULATION OF LEGUME SEEDS.
Preparatory to sowing, the seed accepted for use shall be inoculated as provided herein. Each kind of seed shall be inoculated separately with the appropriate commercial culture according to instructions of the manufacturer of the material accepted for use, then allowed to surface dry to a free flowing state before mixing or sowing. In general, no greater quantity of seed shall be inoculated at one time that can be sowed by the end of the following work day. All inoculated seed shall be protected from the sun and direct contact with commercial fertilizers.

(c) MIXING SEED.
Following inoculation, seed of approximately the same size may be mixed together. Just prior to planting, all seed to be sown together shall be mixed by approved means until uniform in detail.

(d) SOWING.
1. GENERAL.
Sowing of seed shall, in general, follow promptly after incorporation of fertilizer in a uniform manner at the rates specified for each seed specie. Sowing shall be accomplished by one of the methods noted hereinafter.

2. STANDARD METHOD.
This method is designed for use on cleared areas where no existing growth is retained and consists of sowing and covering of the seeds.
Sowing shall be done by approved mechanical seeders. Without prejudice to power equipment or seeders of other types and makes hand operated cyclone sowers, in sufficient number, will be considered mechanical seeders. No sowing shall be done during windy weather, when the prepared surface is crusted, or when the ground is frozen, wet or otherwise in a non-tillable condition.
Care shall be exercised during covering operations to preserve the line, grade and cross-section of the seeded areas and to see that areas adjacent to pavement, walks, etc., are not left higher than the paved surface. After the seed has been sown the seed bed shall be compacted immediately by means of a cultipacker, light roller or approved drag. The weight of the roller or drag needed, will be determined according to the type and physical condition of the soil involved. Rolling or covering of seed may be omitted when seeding is done hydraulically and mulched.

3. SEEDING IN STUBBLE METHOD.
This method is designed for use in rejuvenating existing ground cover areas whereby the existing turf is to be retained.
This procedure requires that any required fertilizer shall be spread as previously provided and if spread mechanically, worked into the soil by rotary hoe, spiking or other methods that will not uproot the existing plant cover. After sowing the seed in the same manner noted in Item 2 above, they shall be covered by a second spiking followed by rolling or an approved sod seeder may be used as a one-step planter. Hoeing, spiking, and rolling may be omitted where seed is spread by hydraulic equipment, provided existing growth is mowed to approximately three to six inches in height as required by the specific seed mix.
4. OVERSEEDING METHOD.
This method is designed for use in adding a required seed to a previously
seeded area which could not be planted at the time of original planting because of
seasonal limitations.
This procedure requires that the existing growth be mowed to a specific
height with raking to remove excess cuttings and sowing of the seed as noted in Item
(d)3 above.

(e) MULCHING.
Where mulching, Section 657, is provided in the contract, the areas seeded
as provided in Section 653.03(d), which are designated to be mulched shall be covered
within 48 hours after the area has been seeded. Such mulching will be measured and
paid for separately under Section 657.

(f) CARE DURING CONSTRUCTION.
All work shall be pursued in accordance with contract erosion control
requirements.
The Contractor shall water, fill washes, and otherwise protect and maintain
the seeded areas including any mulch or cover used until the contract is accepted or
grassing bond is released.
Damage by either pedestrian, vehicular traffic, or other causes shall be
repaired by the Contractor. It shall be the responsibility of the Contractor to
establish and maintain a satisfactory stand of grass until final acceptance of the
project.
All of the above work shall be performed without additional compensation.
Mowing of excess growth shall be performed when the height of grass is in
excess of twelve inches. The vegetation shall be cut to approximately four inches in
height.

(g) BASIS OF ACCEPTANCE.
The acceptance of designated seeded areas will be based on verification of a
satisfactory stand of grass and legumes in the season for each seed specie required by
the mix designated for use. If a satisfactory stand of grass is not established, the area
shall be re-seeded without additional cost to the Department. A satisfactory stand is
defined as a cover of living plants, after true leaves are formed, of the seed species
required by the mix designated for use in which gaps larger than five (5) inches
square do not occur.

653.04 Method of Measurement.

(a) SEEDING.
1. The completed and accepted seeding will be measured in acres parallel to
the seeded surface.
2. Extra seed, ordered in writing, in addition to the types and rates provided
by the specifications, shall be measured in pounds of the ordered seed actually
placed.

(b) SUPPLEMENTARY ITEMS.
1. No measurement for payment will be made for fertilizers used as
provided by Section 653.03(a)3.
2. Topsoil, where provided in the contract and required over barren areas
will be measured and paid for as provided in Section 649.
3. Water used in mixing, applying, and maintaining seed and/or mulch will
not be measured or paid for as a separate pay item.

4. Mulching, where provided separately in the contract and required, will be measured as provided in Section 657.

**662.05 Basis of Payment.**

(a) **UNIT PRICE COVERAGE.**
Completed and accepted seeding will be paid for at the contract unit price per acre for Seeding (of the kind or mix provided) which price shall be full compensation for all fertilizing and ground preparation, furnishing and preparing all fertilizers, seeds and inoculants, including water needed in mixing, planting and maintaining of the seeded areas until final acceptance, and for all materials, equipment, tools, and labor necessary to complete the work, and for any of the foregoing material operation, et. cetera, necessary and incidental to seeding as provided hereinbefore.

Mowing will not be paid for, and will be considered incidental to the work.

(b) **EXTRA SEED.**
Extra seed, ordered in writing sown on any designated area of seeding measured as provided in Section 653.04(a), will be paid for at the verified cost of the seed plus 20 cents per pound. Verified cost shall be the lowest price submitted from at least two (2) wholesale dealers or distributors of seed.

(c) **SUPPLEMENTARY ITEMS.**
Topsoil, mulching and fertilizer used in addition to the amount provided herein will be paid for under their respective Sections.

(d) **SUBSTITUTION.**
For the purpose of substituting seeding for other planting items that may be rendered unseasonable by job conditions, a nominal quantity of a suitable seeding at a limited unit price may be shown on the plans and/or included in the proposal.

(e) **ADJUSTMENT IN FERTILIZER RATES.**
Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Section 653.03(a)3b.

(f) **PAYMENT WILL BE MADE UNDER:**
Seeding (Kind/Mix)—per Acre

309
SECTION 654
SPRIGGING

654.01 Description.

This Section shall cover the work of furnishing and planting of approved live grass sprigs or plugs and the establishment of an acceptable growth from such planting on slopes and areas of the project as may be designated by the plans.

Basic work consists of ground preparation in accordance with provisions of Section 651; the furnishing and incorporating of fertilizers in the amount noted hereinafter in this Section; the furnishing, planting, covering, compacting, and watering as necessary to establish and maintain the sprigs in a live and growing condition throughout the life of the contract. The amount of water and when it is to be applied shall be the responsibility of the Contractor until acceptance of the project.

654.02 Materials.

All materials shall conform to requirements of Division III, Materials, with particular attention directed to Section 863.

Sprigs shall comply with requirements of Section 863.02. They may be from local harvest or imported. Sprigs hauled such distance that they cannot be planted the same day harvested will be classified as imported. Except as hereinafter provided, imported sprigs shall be iced or watered during transit and planted not later than two (2) days after digging.

654.03 Construction Requirements.

(a) GENERAL.

1. PREPARATION OF SPRIGGING SITE.

Whenever any section of the road is deemed to be substantially complete, the Contractor, even to the exclusion of all other operations, shall, on that section, promptly fill major washes, dress all earthwork in accordance with plans, place loamy topsoil as required, accomplish ground preparation as provided by Section 651.03 and plant the sprigs along embankment slopes, on front slopes, shoulders, and other areas as directed, together with solid sodding and other ditch and slope protection provided in the contract. In connection with ground preparation, agricultural limestone or basic slag at a rate of 4000 pounds per acre and commercial fertilizer 8-8-8 at a rate of 1500 pounds per acre, shall be broadcast separately and mixed into the ground to the depths specified in Section 651.03. In lieu of 8-8-8 fertilizer, any other acceptable grades of commercial fertilizer will be accepted that will provide at least 120 pounds of nitrogen, 120 pounds of available phosphoric acid and 120 pounds of total potash per acre as computed from the nominal content of fertilizer ingredients.

2. FURROWS.

Following completion of ground preparation and fertilizing, furrows shall be plowed on lines parallel to the roadway and spaced twelve (12) inches apart unless otherwise indicated on the plans. The furrow may be made with a small straight shovel, opener plow, turning plow, or other appropriate tool, but must be not less than two (2) inches deep and reasonably true to line.
3. PLANTING OF SPRIGS.
   a. General.

   Unless otherwise provided by the plans or proposal, sprigs shall be placed in continuous lines in the furrows (equivalent of a minimum of 200 square yards per acre). Care shall be exercised to place the roots downward. The sprigs shall be set promptly after being taken from the bags. If the soil is not moist when the sprigs are being set, additional watering in the open furrows may be required. Immediately after being placed in the furrows, the sprigs shall be covered with 1 to 2 inches of pulverized soil. Clods or hard particles shall not be placed over the sprigs.

   Grass plugs may be used in lieu of sprigs, size of plug shall not be less than 2" x 2" planted 10 to 12 inches on center (the equivalent of a minimum of 200 square yards per acre) otherwise the same requirements for planting sprigs shall apply.

   Sprigs and grass plugs may also be planted and covered by planting machines of an approved type. On steep slopes of embankments and inaccessible areas, they may be planted by means of hand tools. In all cases, the earthwork and shoulders shall be restored to the required shape and surface condition after planting has been completed.

   b. Broadcast Planting.

   When permission is granted in writing by the Engineer of Public Works, broadcasting of sprigs or stolons may be performed if immediately covered by disc harrowing or coulters (straight disc planter) followed by rolling or cultipacking. Machinery and method for this operation must be approved. This method requires a minimum of the equivalent of 200 square yards of sod per acre. The sprigs must be covered to a minimum depth of one-half inch for centipede, hybrid bermuda and zoysia species with one inch required for common bermuda grass.

4. COMPACTION.

   After planting of the sprigs has been completed, the entire areas shall then be compacted. Rollers, cultipackers, or other approved equipment may be used for this purpose. The rolling shall be continued until all clods are broken and until the dirt is recompacted so as to prevent washing the grass out during normal rains.

5. WATERING.

   After compaction of the sprigged areas has been accomplished, the areas shall be watered by the use of spray or sprinkler which will apply the water without erosive force and in sufficient quantity to saturate the area.

(b) SEASON FOR SPRIGGING.

   No seasonal limitation shall be applicable to the planting of sprigs. It shall be the Contractor's responsibility to control his operations so that the planting will be accomplished during the most favorable time of the year. In any event, the Contractor shall be solely responsible for obtaining a satisfactory stand of grass.

(c) CARE DURING CONSTRUCTION.

1. GENERAL.

   The Contractor shall water, fill washes, and otherwise care for all sprigged areas in a satisfactory condition until final acceptance of the entire contract. The Contractor shall be responsible for establishment and maintenance of a satisfactory stand of grass from the normal growing cycle after planting until final acceptance. This care shall be performed without additional compensation.
2. WATERING.
Watering of the sprigged areas, shall be applied in the form of a spray or sprinkle, without erosive force in sufficient amounts that will keep the sprigs in a living and growing condition.

3. DAMAGED AREAS.
Any sprigged areas that are damaged shall be resprigged by the Contractor without additional compensation.

4. ADDITIONAL FERTILIZER.
After the sprigs have developed a green growth above the ground surface, the Contractor, without additional compensation, shall broadcast a surface application of nitrate of soda, ammonium nitrate, or other approved high nitrogen fertilizer at a rate sufficient to provide at least 67 pounds of nitrogen per acre (for example - 200 pounds of 33.5 percent ammonium nitrate applied per acre will provide the 67 pounds of nitrogen per acre.)

(d) SUBSTITUTION OF SEEDING.
After the Contractor has exerted all reasonable effort to obtain satisfactory sprig growth, or during extreme weather periods, the Engineer may consider the substitution of seeding as specified in Section 653 or 659 for certain portions of the project as may be deemed necessary; however, such must be requested and approved in writing, but in no event will consideration be given to the substitution of other than seed of a mix compatible with the type of grass required by the plans or proposal.

In areas where it is considered desirable to protect completed sprigging or seeding against early erosion or other damage, such sprigging or seeding may be supplemented by sowing seeds as ordered, over the previous planting. Such seeding or overseeding, when ordered in writing, will be paid for as provided in Section 654.05(b).

(e) BASIS OF ACCEPTANCE.
The acceptance of areas designated to be sprigged will be based on the Engineer's determination that the proper ground preparation, planting, etc. has been accomplished and the establishment of a satisfactory stand of grass has been established. If a satisfactory stand of grass is not established, the area shall be resprigged without additional cost.

A satisfactory stand of grass is defined as a living and growing grass of not less than nine (9) live and health plants per square yard, uniformly spaced above the ground surface. This may be deemed to include grass that is dormant during a cold or dry season but has roots which have taken hold in the soil and show sprouts that are capable of growing after the unfavorable period has passed.

654.04 Method of Measurement.

(a) SPRIGGING.
The completed and accepted sprigging will be computed in square yards from measurements made parallel to the planted surface.

(b) SUPPLEMENTARY ITEMS.
No measurement or payment will be made for fertilizer used as provided by Section 654.03(a) and Section 654.03(c). Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Section 653.03(a)3b.
654.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
Completed and accepted sprigging measured as provided above will be paid for at the contract unit price bid per square yard for sprigging, which price shall be full compensation for all ground preparation fertilizing as provided in Section 654.03(a)1, furnishing and preparing all fertilizers, sprigs, planting, replanting, and maintaining of the sprigged areas until final acceptance and for all materials, equipment, tools, and labor necessary to complete the work. Payment or deduction for additional or reduced amount of fertilizer shall be made as provided in Section 653.03(a)3b.

(b) SUPPLEMENTARY ITEMS.
Topsoil, mulching, seeding, and fertilizer or seeds used in addition to the amount provided herein will be paid for under their respective sections. Overseeding as specified in Section 654.03(d) when ordered in writing will be paid for as specified in Section 653.05(b), which shall be full compensation for furnishing seed and overseeding as directed.

(c) PAYMENT WILL BE MADE UNDER:
Sprigging — per Square Yard
SECTION 655
SOLID SODDING

655.01 Description.

This Section shall cover the work of furnishing, planting or otherwise re-establishing solid grass sodding in various locations throughout the construction limits of the work. This Section shall also cover the work of salvaging and replanting of solid sodding.

Basic work consists of furnishing sod, or in the case of salvaging sod, the salvaging thereof, ground preparation under the provisions of Section 651, the furnishing and application of fertilizer at the rates noted hereinafter in this Section, the furnishing and applying of all water necessary to establish and maintain the sod and the maintenance of the established sod throughout the life of the contract. The amount of water required and when it is to be applied shall be the Contractor's responsibility.

655.02 Materials.

All materials shall conform to the appropriate requirements of Division III, Materials. Specific reference is made to Section 863.

655.03 Construction Requirements.

(a) PREPARATION OF PLANTING SITE.

Areas which are to be planted with sod shall have all shaping and dressing performed prior to commencing planting operations.

The surface of the area designated for sodding shall receive ground preparation, as described in Section 651. The Engineer may authorize elimination of ground preparation on shoulders and fill slopes, or other areas where the soil is sufficiently loose or pulverized. Fertilizer must be incorporated into planting areas by approved means to a depth of at least two (2) inches. If the soil is not moist, it shall be watered until it is in a workable condition.

Areas to be sodded shall be fertilized initially with two (2) tons of agricultural limestone or basic slag and 1600 pounds of grade 8-8-8 fertilizer per acre; or in lieu of grade 8-8-8 or a sufficient quantity of any other approved grade or grades of commercial fertilizer that will provide at least 120 pounds of nitrogen, 120 pounds of available phosphoric acid and 120 pounds of total potash per acre as computed from the nominal content of fertilizing ingredients. Variations in quantity of fertilizer from those shown above or on the plans shall be adjusted as specified in Section 653.03(a)3b. Following this, the sod shall be placed immediately.

(b) PLANTING SOD.

1. PLACING.

The sod shall be placed on the prepared surface with the edges in close contact, cracks between blocks of sod shall be closed with small pieces of sod, and acceptable loamy top soil shall be used to fill joints. The entire sodded area shall then be tamped in place in a satisfactory manner and watered as necessary.

2. CLASS "A" EROSION CONTROL NETTING.

On slopes of approximately 2:1 or steeper when directed, Class A Erosion Control Netting may be used to anchor the sod, the Class "A" Erosion Control Netting used as directed shall be paid for as specified in Section 661.
(c) SALVAGE AND REPLANTING SOLID SOD.

At the locations shown on the plans or designated, the existing solid sod shall be salvaged, stored, and replaced after the area has been regraded. Salvaging and handling of the sod shall be performed as specified in Section 863.05, except that the time limit for replanting will not apply. However, preparation of the area for replanting shall be excavated to avoid delay. Any sod rendered unsuitable for reuse due to the Contractor's negligence in storing, watering, or promptly preparing sites for replanting shall be replaced in kind by the Contractor without additional compensation.

The Contractor may at his option elect to furnish sod of the identical species from another site, in lieu of salvaging, etc. of existing sod. Preparation of replanting sites, fertilizing, and replanting shall be the same as specified in Section 655.03(a) and (b).

(d) CARE DURING CONSTRUCTION.

1. GENERAL.

The Contractor shall preserve, protect, water, apply additional fertilizer, and perform such other work as may be necessary to keep the work in a satisfactory condition. The Contractor shall be responsible for satisfactory growth of the grass until the time of final acceptance.

2. WATERING.

Watering of the sodded areas, shall be applied in the form of a spray or sprinkle, without erosive force in sufficient amounts that will keep the sod in a living and growing condition.

3. DAMAGED AREAS.

Any sodded areas that are damaged shall be resodded by the Contractor without additional compensation.

4. ADDITIONAL FERTILIZER.

After the sod has shown growth (usually approximately 40 days) and while the soil surface is moist, a second application of fertilizer shall be made as a top dressing of nitrate of soda, sulfate of ammonia, ammonium nitrate, or other approved high nitrogen analysis fertilizer used at a rate to provide at least 67 pounds of nitrogen per acre (for example, 200 pounds of 33.5 percent ammonium nitrate applied per acre will provide 67 pounds of nitrogen per acre).

(e) BASIS OF ACCEPTANCE.

Acceptance of sodded areas will be based on verification of the establishment of a well knitted, living, growing sod covering the areas designated to be sodded. If an acceptable stand of living and growing sod is not obtained, the area shall be resodded without additional cost. A "living and growing sod" shall be interpreted to include sod that is seasonally dormant during the cold or dry season with roots that have taken hold on the sod and capable of growing off after the dormant period.

655.04 Method of Measurement.

The completed and accepted sodding placed or salvaged and replaced, as shown on the plans or as directed, will be computed in square yards from measurements made parallel to the surface of the actual area sodded.
655.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted yardage of Solid Sodding for slopes, ditch checks, outlets and flumes, and other areas will be paid for at the contract unit price for Solid Sodding which price shall be full compensation for furnishing all materials, ground preparation, planting, fertilizing, rolling, watering, top dressing, and maintaining the sod until acceptance of the contract, and for all materials equipment, tools, and labor necessary to complete the work.

The accepted yardage of salvaged and replaced solid sod will be paid for at the contract unit price for the Item of Salvaging and Replacing Solid Sod which shall be payment in full for all work listed above in this Article except for the furnishing of the solid sod.

Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Section 653.03(a)3b.

(b) PAYMENT WILL BE MADE UNDER:

Solid Sodding ___—per Square Yard
Salvaging & Replacing Solid Sod ___—per Square Yard
SECTION 657
MULCHING

657.01 Description.

This Section shall cover the work of furnishing and placing of mulching materials (covering with hay or other suitable material) on areas indicated on the plans or directed, in accordance with these Specifications.

Mulch placed under this Section shall consist of two types: Class A Type 1 shall be mulch not requiring an asphalt adhesive, consisting of hay or straw placed on 3:1 or flatter slopes by using a crimper, wood fiber or excelsior; Class A, Type 2 shall be hay or straw mulch that does require an asphalt adhesive.

Water necessary to satisfactorily prepare, establish and maintain mulching placed under this Section shall be classified as a part of the mulching item involved. The amount of water and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

657.02 Materials.

Materials used in this work shall conform to the requirements of Division III, Materials. Specific reference is made to Section 863.

657.03 Construction Requirements.

(a) GENERAL.

Mulching material shall be applied in accordance with the rate specified in Section 863.03 for the particular type mulch being used.

(b) EQUIPMENT.

Straw and hay mulch shall be applied with a mechanical mulch spreader designed to break up balls or clusters of mulch and apply it evenly over the surface so as to provide adequate shading from direct sunlight. If an asphalt adhesive is used on the mulch, the mulch spreader shall be equipped and so designed to apply effectively the asphalt adhesive to the mulch and form a uniform, porous and stable mulch blanket held in place by the adhesive over the designated area.

On slopes 3:1 or flatter, a mulch crimper shall be used instead of the asphalt adhesive. The crimper shall be a roller-type device equipped with flat, uncupped, dull edged disks. The disks shall have a minimum width of 1/4 inch and shall be placed a maximum of 8 inches apart along the axle or shaft. The crimper shall be specially designed so that by adding weight or using hydraulic force from the tractor the mulch will be imbedded a minimum of 2 inches into the ground, prepared as specified in Section 651.03. The diameter of the disks shall be large enough to prevent the axle or shaft from dragging or in any way disturbing the mulch or soil.

Under no circumstances shall a disc harrow be used to perform this crimping operation.

Wood fiber mulch will not require asphalt adhesive but shall be applied only by satisfactory hydraulic equipment.

Excelsior (wood) will not require asphalt adhesive, however, it must be applied evenly with mechanical mulch spreaders or other approved equipment.

(c) MULCHING OPERATIONS.

Immediately after the area to be mulched has received ground preparation and the specified plantings, the mulch shall be applied at the rates specified for the type mulch used. Hay or straw mulch material which contains an excessive quantity
of matured seeds or noxious weeds or a species which would constitute a menace to the planted species and to surrounding farm land, will not be acceptable. Mulch which is too fresh, or excessively brittle, or so decomposed as to retard growth of grass will not be acceptable.

Mulch shall not be applied during periods of high winds or other unfavorable conditions. Care shall be exercised to protect the public, adjacent property, bridges, curbs, sidewalks, and the like from discoloration especially by an asphalt adhesive. The Contractor shall be responsible for any such damage to public or private property. Any damage or discoloration to bridges or other parts of the roadway shall be repaired without delay at the Contractor's expense.

During crimping operations, care shall be taken to follow as closely as possible to the contours of the mulched ground's surface.

(d) CARE DURING CONSTRUCTION.
This shall consist of caring for the mulch in a satisfactory condition without additional compensation until acceptance of the project and shall include replacement of any portions damaged by erosion, fire, wind or other causes.

657.04 Method of Measurement.
The completed and accepted area of mulch, applied as directed will be measured in acres, computed from surface measurements of the area ordered treated.

657.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
The accepted mulched area measured as provided above will be paid for at the contract unit price for mulching which shall be payment in full for furnishing of all the materials, handling, placing, and for all equipment, labor, tools, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:
Mulching, Class A, Type __ —per Acre.
SECTION 659
HYDRO-SEEDING AND MULCHING

659.01 Description.

This Section shall cover the work of furnishing, sowing and establishing an acceptable growth of grass from specified seeds on designated project areas by hydraulically sowing of the seeds and mulching of the seeded areas.

Basic work consists of ground preparation in accordance with the provisions of Section 651; furnishing and incorporation of fertilizer in the amount specified hereinafter in this Section; the furnishing, inoculation, sowing of the seeds during the designated sowing season; the furnishing and application of mulching material; the furnishing and application of water as necessary to establish and maintain the grass during the period of the contract.

The amount of water and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

659.02 Materials.

Materials furnished for use shall comply with the appropriate requirements of Division III, Materials. Specific reference is made to Section 863.

659.03 Construction Requirements.

(a) GENERAL.

General requirements of Section 653.03(a), (b) and (c) are applicable to hydro-seeding. Special attention is directed to the requirements for ground preparation and fertilizing both before and after sowing of the seed. Lime, if required, shall be applied before the hydro-seeding operation.

Fertilizer may be applied either before the hydro-seeding or incorporated in and applied with the water-seed-inoculant mixture. Wood cellulose or natural wood fiber mulch shall be applied either as a part of the hydro-seeding mixture or as a separate operation following the hydro-seeding.

Straw or hay mulch shall be applied after the hydro-seeding operation.

(b) EQUIPMENT.

Equipment for applying seed by the hydro-seeding method shall be designed for this purpose and be capable of pumping a water-seed-inoculant mixture uniformly over the area to be seeded. Power driven agitators shall be provided to keep the mixture uniform during the application. When wood cellulose or natural wood fiber mulch is used, the equipment shall be so designed as to satisfactorily handle the material. For hay or straw mulch, equipment shall be as specified in Section 657.03(b).

(c) PREPARATION OF SEED.

The seed mixture meeting the appropriate requirements of Section 863.01 shall be the seed inoculated, using four (4) times the manufacturer's recommended rate of inoculant culture. The seed shall be placed in culture solution and the mixture shall be mixed by mechanical agitator in the hydraulic seeder.
(d) APPLICATION OF THE SEED.
After completion of ground preparation, including fertilizing, and the seed preparation, the seed mixture shall be applied by approved equipment in such a manner that the seed will be dispersed at the rates specified for each particular specie in the seed mixture used.

(e) APPLICATION OF MULCHING.
Immediately after application of the seed as provided above, the seeded area shall be mulched using one of the approved Class A mulches provided in Section 863.03. The rate of application of the mulch shall be as specified in Section 863.03 for the kind of mulch being used.

(f) CARE DURING CONSTRUCTION.
The Contractor shall water, fill washes, and otherwise protect and maintain the seeded areas until the contract is accepted or the grassing bond is released. Damage by either pedestrian, vehicular traffic, or other causes shall be repaired by the Contractor. It shall be the responsibility of the Contractor to establish and maintain a satisfactory stand of grass until final acceptance of the project. All of the above work shall be done by the Contractor without additional compensation.

(g) BASIS OF ACCEPTANCE.
The acceptance of designated areas to be seeded will be based on verification of a satisfactory stand of grass and legumes in the season for each seed specie required by the mix designated for use. If a satisfactory stand of grass is not established, the area shall be re-seeded without additional compensation.

A satisfactory stand of grass shall be defined as a cover of living grass after true leaves are formed (limited to the species of seed that are expected to germinate in the current season) in which gaps larger than five (5) inches square do not occur.

659.04 Method of Measurement.

(a) HYDRO-SEEDING TREATMENT.
1. The completed and accepted hydro-seeded areas will be measured in acres parallel to the treated surface.
2. Extra seed, ordered in writing in addition to the types and rates provided by the Specifications, plans, or proposal, shall be measured in pounds of the ordered seed actually placed.

(b) SUPPLEMENTARY ITEMS.
1. No measurement for payment will be made for fertilizers used as provided by Section 653.03(a)3.
2. Topsoil, where provided in the contract and required over barren areas will be measured and paid for as provided in Section 649.
3. Water used in mixing, applying, and maintaining seed and/or mulch will not be measured or paid for as a separate pay item.

659.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
Completed and accepted seeding will be paid for at the contract unit price per acre for hydro-seeding(of the kind of mix provided) which price shall be full compensation for all fertilizing and ground preparation, furnishing and preparing all fertilizers, seeds and inoculants, including water needed in mixing and sowing.
furnishing and preparation of mulching materials, application of mulch (including adhesive) and the maintaining of the seeded areas until final acceptance, and for all materials, equipment, tools, and labor necessary to complete the work, and for any of the foregoing material, operation, etc., necessary and incidental to seeding as provided hereinbefore.

(b) EXTRA SEED.
Extra seed, ordered in writing sowed on any designated area of seeding measured as provided in Section 659.04(a)2, will be paid for at the verified cost of the seed plus 20 cents per pound. Verified cost shall be the lowest price submitted from at least two (2) wholesale dealers or distributors of seed.

(c) SUPPLEMENTARY ITEMS.
Topsoil and fertilizer used in addition to the amount provided herein will be paid for under their respective Sections.

(d) ADJUSTMENT IN FERTILIZER RATES.
Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Section 653.03(a)3b.

(e) PAYMENT WILL BE MADE UNDER:
Hydro-Seeding & Mulching (Seed Mix & Type of Mulch)— per Acre
SECTION 661
EROSION CONTROL NETTING

661.01 Description.

This Section shall cover the work of furnishing, laying, and maintaining an approved protective netting material over seeded, sprigged or sodded areas in accordance with these Specifications and in conformity with details shown on the plans or directed. Areas to be covered by erosion control netting will be shown on the plans or designated. The Contractor may select one of the types of materials permitted for class of netting specified unless a specific type is designated by the plans or proposal.

Erosion Control Netting will be divided into two (2) basic classes of use as follows:

Class A
A type of anchor system designated for use with solid sod and mulch (normally an open weave netting).

Class B
A type of anchor system designated for use over a prepared ground which has been seeded or sprigged and mulch is not used (normally an open weave netting with a filler material).

661.02 Materials.

Materials furnished for use shall comply with the appropriate requirements of Division III, Materials, with specific reference made to Section 863.11.

661.03 Construction Requirements.

(a) PRELIMINARY PREPARATION.
Prior to placement of the erosion control netting, the area shall have been prepared in accordance with the ground preparation, fertilizing, and seeding, sprigging or solid sod (may or may not include mulch covering) as provided on the plans or directed, all in accordance with the applicable portion of these Specifications.

(b) PLACING NETTING.
Netting shall be placed immediately after completion of the required operation for placing the item of work which the netting is to control.

Erosion control netting strips shall be rolled out flat, parallel to the direction of flow, in flumes and ditches, perpendicular to the direction of flow on backslopes. When two or more strips are required to cover an area, they shall overlap three (3) inches (minimum); however, excelsior blankets will not require lapping but are to be butted together and staples placed with 1/2 of each staple located in each of the adjoining blankets. Ends of strips shall overlap six (6) inches, minimum, with the upgrade section on top. The upslope end (anchor slot) of each strip shall be buried in six (6) inch vertical slots, and soil tamped firmly against it. When conditions warrant, any other edge exposed to excessive flow shall be buried similarly.
(c) CHECK SLOTS.

These shall consist of 24-inch minimum width separate strips of netting placed at right angles to the direction of water flow immediately prior to placing the general covering of netting, and shall be made by burying a tight fold of netting vertically in the soil a minimum of six (6) inches deep, and tamping and stapling in place. Check slots shall be placed so that one check slot, junction slot, or anchor slot of the netting occurs every 50 feet of slope.

The netting shall be spread evenly and smoothly, and in contact with the soil at all points. It shall be pressed into the soil by use of a light lawn roller, or other approved method, and portions of the netting not so pressed into soil shall be hand tamped or stapled to assure close contact with the earth.

Each strip shall be stapled in three (3) rows; each edge and the center spaced at not more than three (3) feet longitudinally. Check slots and ends of strips shall be stapled at nine (9) inch intervals across their width.

661.04 Care During Construction.

This shall consist of protection and of repairs made necessary by erosion, wind, fire, and/or other causes. Repairs shall be such as to re-establish the condition and grade of soil as existed prior to application of netting, including stability, restoring damaged ground preparation, re-fertilization and replanting of damaged areas, without additional compensation. The period of care shall continue until acceptance of the contract or release of the grassing bond. Care shall be performed without additional compensation.

661.05 Method of Measurement.

Accepted erosion control netting placed in accordance with the plans and these specifications will be measured by the square yard, based on the finished surface dimensions of the area covered. Separate measurement will not be made for folds, laps, check slots, anchor slots, junction slots, etc.

661.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Erosion Control Netting measured as provided above will be paid for at the contract unit price per square yard, complete in place, which shall be full compensation for the construction of the item, including all materials, equipment, tools, labor and incidentals required to complete the item.

(b) PAYMENT WILL BE MADE UNDER:

Erosion Control Netting, Class ___—per Square Yard
SECTION 663
VINES, SHRUBS AND TREE PLANTING

663.01 Description.

This Section shall cover the work of furnishing, planting, and establishing healthy, live, growing trees, shrubs, seedlings, vines or other designated plants at designated locations on the project. The specie, size, etc. of vines, shrubs, seedlings and trees will be as indicated on the plans or proposal.

Basic work consists of furnishing or harvesting of plants and transporting thereof; preparation of plant site or beds including furnishing and preparation of soil, fertilizer, mulch and other miscellaneous items incidental to the planting procedure; the planting of the plants in a workmanlike manner in accordance with accepted horticultural practices along with the water necessary to establish and maintain the plants in a live, growing condition throughout the life of the project. The amount of water to be used and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

663.02 Materials.

All materials shall conform to the requirements of Division III, Materials. Specific reference is made to Roadside Improvement Materials, Section 863.

663.03 Construction Requirements.

(a) GENERAL.

The normal growing period for vines, shrubs, and trees is defined as that time period between April 1 and September 30. All vines shrubs and trees shall be planted so as to provide the maximum growing time allowable under the contract time. All plantings shall be scheduled to provide a minimum of one growing season except as noted in Section 860.06(b).

Pine seedlings shall be planted in between December 1 and March 15. Planting will not be permitted during periods of drought or when the ground is frozen. These seasonal limits may be changed only on written orders from the Engineer.

Any rock or underground obstructions shall be removed to the depth necessary to permit planting according to the plans and Specifications unless other locations for the planting are approved. Explosives may be used only where and as expressly approved.

(b) PLANTING OPERATIONS FOR VINES, SHRUBS AND TREES.

1. ROW PLANTING.

a. Furrows or trenches shall be opened in the locations designated to a depth at least six (6) inches greater than the depth of the roots or ball when extended in their normal position, and in no case less than 12 inches for vines and shrubs. The width of furrows or trenches shall be at least 12 inches greater than the spread of the roots when extended in their normal position, and in no case less than 12 inches for vines and 18 inches for shrubs.

b. The furrows or trenches shall then be partially filled with prepared plant topsoil and the vines or shrubs placed so that the crown, bud or base of the tops, as the case may be, is at or slightly below the previous growing level and the roots are in a natural spread. After the roots have been completely covered with plant topsoil, the commercial fertilizer 8-8-8 shall be evenly scattered over the surface of the plant topsoil at the rate of approximately 0.1 pound per linear foot, followed by a
satisfactory watering. After the water has soaked in and the plant topsoil is no longer muddy, additional plant topsoil shall be added and firmly compacted. Compaction shall stop when the compacted plant topsoil is two (2) inches below the finished grade. The balance of the furrow or trench shall then be filled with loose plant topsoil until it is slightly lower than the finished grade.

2. SPOT PLANTING.

    Planting operations shall be in accordance with the specifications for row planting as far as applicable. Commercial fertilizer, 8-8-8, shall be applied at a rate of 0.1 pound per square yard. Pits for trees and shrubs shall not be less than 18 inches deep and 3 feet in diameter unless otherwise shown on the plans. If the trees to be planted are larger than two (2) inches in caliper or 10 feet in height, the size of the pits shall be increased in proportion to the increase in size of the trees. For shrubs the pit shall be 12 inches greater than the ball diameter or root spread. The bottom of all planting pits for trees shall have the soil loosened at least six (6) inches deeper than excavated. The side walls of all planting pits shall be vertical and the bottoms flat. Sloping walls of pits or crowding of root systems will be cause for rejection of the planting.

3. DRAINAGE.

    Tile or pipe underdrain for subsoil drainage shall be installed as provided by the plans and these Specifications. Such tile pipe shall meet the requirements of Section 851. Trenches shall be not less than 18 inches deep below finished grades. Drain tile shall be connected with a suitable outlet.

4. DISPOSAL OF EXCESS SOIL.

    Excess soil shall be disposed in accordance with Section 105.

5. PLANT TOPSOIL.

    Unless otherwise provided by the plans, plant topsoil shall be used in preparation and in the backfill of plant pits in connection with row planting and spot planting.

6. SETTING PLANTS.

    a. All plants shall be set plumb at such a level that after settlement they bear the same relation to the level of the surrounding ground as they bore to the ground from which they were dug. All plants shall be planted in plant topsoil which shall be settled by watering when required and by tamping. For spring planting, a shallow saucer capable of holding water shall be formed about each plant by placing a mound of soil around the edge of each pit. Care shall be taken in setting plants to protect adjacent planting from damage.

    b. Ball and burlapped plants or balled platform plants (BB, BP) are to be planted with plant topsoil carefully tamped around and under the base of each ball to fill voids. Platforms shall be removed. All cloth, ropes, et cetera, shall be removed from the tops of balls, but no cloth shall be pulled out from under the balls. c. Roots or bare-root (BR) plants shall be properly spread out in a natural position and plant topsoil shall be carefully worked in among them. All broken and frayed roots shall be cleanly cut off.

(c) PLANTING OPERATIONS FOR SEEDLINGS.

1. GENERAL.

    The pine seedlings shall be transported to the planting area in a manner that will protect the roots from the wind and sun and guard against skinning or otherwise damaging the plant or root system. The roots shall be kept moist at all times. The recommended method of hand planting is shown in detail on the plans. Seedlings shall be placed in the hole to an approximate depth of 1/4 inch deeper than the depth the plant grew in the nursery. Care shall be taken not to bend or fold the
roots due to a small shallow hole. Planting by use of a soil auger will be acceptable, if care is taken to remove the air pockets by packing to ground level.

2. FERTILIZER.

No extra fertilizer will be required on areas that have been previously fertilized, fertilizer will be applied, if required, and payments made for extra fertilizer quantities provided on the plans.

3. SPACING.

The seedlings shall be spaced approximately six (6) feet on centers, or as shown on the plans, planting in an irregular pattern as outlined by the Engineer.

(d) PRUNING.

All pruning shall be done on the site before planting in accordance with the schematic drawings provided in the plans and as directed. Pruning shall follow modern horticultural practices (American Standard for Nursery Stock) and shall be done with approved tools designed for the purpose intended. Lopping, topping or shearing of trees or shrubs will be grounds for rejecting the plants as unsuitable and not meeting the requirements. Damaged, scarred frayed, split, or skinned branches, limbs or roots shall be pruned back to live wood nearest to the next sound outside lateral bud, branch, limb or root. The terminal leader or bud in all trees or shrubs shall be left intact and not removed unless damaged. The top growth of all vines shall be cut back approximately one-third unless otherwise directed.

(e) GUYING, STAKING AND WRAPPING OF TREES.

1. GUYING AND STAKING.

All trees shall be staked or guyed unless otherwise directed. Unless otherwise directed, all trees up to two (2) inches in caliper, or up to 10 feet in height, shall be supported by a single 8-foot (above ground line) stake; all trees from 2-inch caliper to 3-1/2 inch caliper, or from 10 to 14 feet in height, shall be supported by two 10-foot (above ground line) stakes. All trees from 4 to 6 inch caliper shall be supported by 4 stakes at least 12 feet (above ground line) long. All stakes shall be at least 2 feet in the ground. All trees larger than 5-inch caliper, or other trees with heavy crowns shall be supported by anchored wires and guyed 3 ways with double No. 10 wire. Stakes shall not injure plant balls. No. 12 wire and rubber hose, or approved substitutes, shall be used to secure the tree to stakes without chafing or injury. Wires used for guying shall be secured to the tree by passing through a rubber hose, by using wood stakes protected from the bark by heavy cloth padding, or by similar means to prevent chafing and injury at a point approximately 2/5 of the height of the tree. Guy wires shall be anchored in the ground to stakes or deadmen at a distance from the trunk of about 3/4 of the height of fastening. Guy wires shall be tightened by driving the stakes, leaving subsequent tightening to be done by maintenance forces by twisting the wires.

2. WRAPPING.

Trees shall have their bark protected from transpiration using Method A, B, or C.

a. Method A.

All trunks and branches shall be sprayed with "Dowax" or similar approved wax compound immediately before or after digging. The material shall be applied as directed by the manufacturer.

b. Method B.

The trunks of all trees, from the ground line to the height of the second branches, or to the height directed, shall be wrapped not later than four (4) days after planting. Trees over four (4) inches in caliper shall also have their larger
branches wrapped. A single layer of burlap bandage shall be wound spirally starting from the base and overlapping one and 1/2 inches. The burlap shall be securely tied in place with binder twine at about 6-inch intervals.

c. Method C.
The trunks of all trees from the ground line to the height of the first branches shall be wrapped in not later than four (4) days after planting with an approved wrapper, overlapping as noted hereinabove in Method B.

(f) MULCHING.
All plants shall be mulched, within two (2) days after planting. Mulching shall be Class B in accordance with the provisions of Section 863.03(c), unless otherwise shown by plan details. Thickness shall be as shown on the plans. When the vines or shrubs are set closer than 2-1/2 feet of each other, the mulch shall be spread over the entire area thus planted. When the planting distance is 2-1/2 feet or more, the layer of mulch shall cover the backfilled plant hole only, unless otherwise shown on the plans. Mulching will not be required for pine seedlings unless so specified on the plans.

(g) WATERING.
The vine, shrub and tree plantings shall be given one watering during the course of the planting operations and additional waterings as needed. Sufficient water shall be applied to wet thoroughly the adjacent area down through the root system. Water shall be applied in such a manner that will prevent erosion of the finished surface.

(h) CARE DURING CONSTRUCTION.
The Contractor shall properly care for all vine, shrub and tree planted areas in a satisfactory condition until the work has been completed, and until final acceptance as defined in Section 50.16 and other requirements contained in provisions included in the proposal. Care shall consist of providing protection of the planting beds and seedling areas by the use of clearly visible stakes or markers to prevent damage by City maintenance vehicles and/or others. Weeding and repairing of all planted areas or pits, including an area three (3) feet outside of the normal perimeter of the beds, pits or bedding areas, shall be required with particular attention directed to the following specific times:

1. At the inspection of all planted areas to be made prior to placement of the plants.

2. At the time of Final Inspection. In addition to the above, any damage to the adjacent areas mentioned above caused by the work involved in the preparing of or by the existence of the beds shall be repaired by the Contractor without cost to the City.

(i) BASIS OF ACCEPTANCE AND REPLACEMENTS.
The Engineer shall make periodic inspections of the work to determine the condition of the plantings. On these inspections, especially those noted hereinbefore in this Section, all plants which the Engineer determines are not in a healthy growing condition shall be rejected. All plants rejected shall be immediately replaced by the Contractor with the same kind and sizes and in the same manner as originally provided except that plantings out of season shall comply with the requirements for out of season plantings noted in Section 863.06.

Prior to the completion date of the project, an inspection of the plantings shall be made by the Engineer, at which time all defective, dead or missing plants shall be replaced as prescribed for out of season plantings.
Based on the findings of the above noted inspection, the Engineer shall direct the Contractor to replace dead, defective or missing plants; such replacements shall be replaced in the same manner as noted for rejected plants in the paragraph next above.

All replacements, etc., for plants prior to final acceptance shall be considered incidental to the work and no additional compensation other than the unit prices bid will be allowed.

At the final inspection of the project, all dead, defective or missing plants shall be rejected and deleted from the contract and no compensation for rejected plants will be allowed.

663.04 Method of Measurement.

(a) PLANT TOPSOIL.
If included in the proposal, the accepted quantity of this material used as ordered will be measured in cubic yards (loose measurement) in the vehicle at point of dumping. No measurement will be made for overhaul of this material.

(b) VINES, SHRUBS, AND TREES.
The quantity of vines, seedlings, shrubs and/or trees to be paid for under this item will be the actual number ordered, planted and accepted. Only vines, seedlings, shrubs and trees in a living, healthy condition will be accepted.

663.05 Basis of Payment.

(a) PLANT TOPSOIL.
If included in the proposal, this material will be paid for at the contract unit price bid per cubic yard which price and payment will be full compensation for furnishing, excavating, loading, hauling (including overhaul), unloading, furnishing, and mixing all component materials and for all labor, equipment, tools, and incidentals necessary to complete the work. When not specifically included in the proposal, the cost of this item shall be absorbed in other appropriate items of work.

(b) VINES, SEEDLINGS, SHRUBS, AND TREES.
Vines, Seedlings, Shrubs, and Trees ordered, planted and accepted will be paid for at the contract unit price for each. Such price and payment shall be full compensation for furnishing plants, plant test or certification service, planting, pruning, guying and staking, wrapping, mulching, furnishing and applying fertilizer (including all fertilizers covered by Section 860.12 and/or provided by the plans), and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(c) WATERING.
No direct payment will be made for water used in the placement and care of planting during the construction. All water necessary shall be considered as a part of the unit price bid for items provided by this Section.

(d) PAYMENT WILL BE MADE UNDER:

- Plant Topsoil—per Cubic Yard * If included
- Vines, Type—per Each
- Shrubs Type—per Each
- Trees, Type—per Each
- Seedling Type—per Each
SECTION 665
TRANSPLANTING TREES, SHRUBS AND VINES

665.01 Description.

This Section shall cover the work transplanting specified trees, shrubs and vines and the reestablishing of them in positions shown on the plans or designated. Basic work consists of digging plants, preparing them for transplanting and transporting thereof; preparing of plant sites or beds, furnishing and preparing of soil fertilizer, mulch and other miscellaneous incidentals necessary to planting procedure; the planting of plants in a workmanlike manner in accordance with accepted horticultural practices along with the water necessary to establish and maintain the plants in a live, growing condition throughout the life of the project. The amount of water to be used and when it is to be applied shall be the Contractor's responsibility until acceptance of the project.

665.02 Materials.

All materials shall conform with the requirements set forth in Division III, Materials, with specific reference made to Section 863.

665.03 Construction Requirements.

(a) GENERAL.
The requirements provided for Vines, Shrubs and Tree Planting Section 663, and Roadside Improvement Materials, Section 863, shall apply in all respects to transplanting trees and shrubs, except where otherwise indicated by specific requirements given below.

Trees, shrubs and vines to be transplanted will be identified clearly on the plans as to existing and proposed location, species, and size. Planting holes of the size shown on the plans for the particular specie of plant material shall be dug and approved prior to moving existing plants. Material to be transplanted shall be dug with the size ball for collected plants recommended in the American Standard for Nursery Stock, current edition, unless otherwise shown by plan details.

(b) WATERING.
The vine, shrub and tree plantings shall be watered once during the course of the planting operations and additional watering as needed. Sufficient water shall be applied to wet thoroughly the adjacent area down through the root system. Water shall be applied in such a manner that will prevent erosion of the finished surface.

(c) CARE DURING CONSTRUCTION.
Care during construction shall be the same as specified in Section 663.03(h).

(d) BASIS OF ACCEPTANCE AND REPLACEMENT.
The basis of acceptance and replacement shall be the same as specified in Section 663.03(i).
665.04 Method of Measurement.

(a) PLANT TOPSOIL.
   If included in the proposal, this material will be paid for at the contract unit price bid per cubic yard which price and payment will be full compensation for furnishing, excavating, loading, hauling (including overhaul), unloading, furnishing, and mixing all component materials and for all labor, equipment, tools, and incidentals necessary to complete the work. When not specifically included in the proposal, the cost of this item shall be absorbed in other appropriate items of work.

(b) VINES, SHRUBS AND TREES.
   The quantity of transplanted vines, seedlings, shrubs and/or trees to be paid for under this item will be the actual number ordered planted and accepted. Only vines, seedlings, shrubs and trees in a living, healthy condition will be accepted.

665.05 Basis of Payment.

(a) PLANT TOPSOIL.
   If provided in the proposal, this material will be paid for at the contract unit price bid per cubic yard which price and payment will be full compensation for furnishing, excavating, loading, hauling (including overhaul), unloading, furnishing, and mixing all component materials and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) VINES, SEEDLINGS, SHRUBS, AND TREES.
   Transplanted vines, seedlings, shrubs, and trees ordered, planted and accepted will be paid for at the contract unit price for each. Such price and payment shall be full compensation for furnishing plants, plant test or certification service, planting, pruning, guying and staking, wrapping, mulching, furnishing and applying fertilizer, and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(c) WATERING.
   No direct payment will be made for water used in the placement and care of planting during the construction. All water necessary shall be considered as a part of the unit price bid for items provided by this Section.

(d) PAYMENT WILL BE MADE UNDER:
   Transplanting Vines, Kind—per Each
   Transplanting Shrubs, Kind—per Each
   Transplanting Trees, Kind—per Each
SECTION 667
TREE WELLS AND TREE ROOT PROTECTION

667.01 Description.
This Section shall cover the work of (1) protecting selected trees, shrubs or other woody plants by the use of tree wells constructed so as to protect the root system and/or (2) placing a porous tree root protection material, mulch or other approved material to such depth around the roots as may be provided by plan details.
Tree wells shall be constructed of concrete, rubble masonry, or brick masonry as may be provided on the plans. Such construction shall be performed in accordance with the design and details indicated on the plans.

667.02 Materials.
All materials furnished for use shall comply with the appropriate requirements of Division III, Materials, with specific reference to the following:

- Tree Well Masonry Concrete, Section 501
- Rubble Masonry, Section 609
- Brick or Concrete Block Masonry, Section 611
- Tree Root Protection Material, Section 863

667.03 Construction Requirements.

(a) EXCAVATION AND DRAINAGE.
All excavation incidental to and necessary for constructing the work in the area of the trees to be protected shall be conducted so as to avoid injuring the root system. No backfill of any nature shall be placed by the Contractor above the root spread of a tree or plant designated to be preserved until a porous material not less than 3 inches in depth or the depth directed has first been placed above the roots.
Adequate drainage of tree wells, etc. shall be provided by means of weep holes, drain tile, etc., as may be indicated on the plans.

(b) TREE WELLS.
Tree wells shall be constructed in accordance with the dimensions and arrangements shown on the plans. They shall be made of masonry as shown on the plans, provided; however, that mortar will be omitted in any portion of the tree well extending below the level of the top of the contiguous broken stone root protection.

(c) TREE ROOT PROTECTION.
1. Where tree root protection is ordered, the porous material shall be placed to a depth ranging from 3 to 12 inches (or to such other depths indicated on the plans) over the root spread of the tree or trees selected, about each of which a tree well is to be constructed, or other trees within or without the fill area, not to be welled but designated for tree root protection.
2. The area for tree root protection shall be first cleaned of all vegetation and porous material shall be then spread loosely over the required area.
3. Following the spreading of the porous material for tree root protection, a minimum of from 4 to 5 inches of topsoil shall be spread above the porous fill to bring the area to the finished-grade lines designated. Such topsoil shall be transported, handled and paid for under the item of Topsoil, Section 649.
4. Sufficient care shall be taken so that trees or shrubs which are to be preserved in place are not scarred or damaged by the operations under this item. The
root area to be protected shall be the area of ground surface lying within the periphery of the limb spread of the tree.

667.04 Method of Measurement.

(a) TREE WELLS.
The yardage of masonry to be paid for shall be the number of cubic yards of masonry measured complete in place and accepted.

(b) TREE ROOT PROTECTION.
The yardage of tree root protection to be paid for shall be the number of cubic yards of stone, gravel, slag, or other approved material placed in tree root protection, measured loose in vehicle at point of delivery, and accepted.

667.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
The yardage of masonry, determined as provided above, shall be paid for at the contract unit price per cubic yard bid for Tree Well Masonry. The yardage of porous material tree root protection, measured as provided above, shall be paid for at the contract unit price per cubic yard for Tree Root Protection Material, which price and payment shall be full compensation for excavating and cleaning the ground surface, for placing the porous fill, for procuring and delivering all materials and for all labor, equipment, tools and incidentals necessary to complete the item. No direct payment will be made for excavation, including its backfill and disposal, incidental and necessary to tree wells and tree root protection work.

(b) PAYMENT WILL BE MADE UNDER:
Tree Well Masonry—per Cubic Yard
Tree Root Protection Material—per Cubic Yard
SECTION 669
ROOT PRUNING

669.01 DESCRIPTION.
This section shall cover the work of (a) cutting tree roots so as to protect adjacent structures from damage and (b) installation of an approved root barrier and backfilling the affected area.

669.02 MATERIALS.
All materials shall conform to the appropriate requirements of Division III, Materials, or shall be approved equivalent in kind and quality to that replaced.

669.03 CONSTRUCTION REQUIREMENTS.

(a) TRENCH EXCAVATION.
The trench shall be cleanly cut to a depth of twelve inches below the proposed finished grade, unless otherwise provided on the plans or proposal. Roots shall not be cut closer than two feet from the tree without approval from the Engineer. Root pruning shall be performed prior to base and subgrade excavations. Tree roots shall not be torn or ripped. All final root pruning cuts shall be a clean cut. A typical root prune will extend fifteen feet in length per tree. Roots under the proposed structure shall be removed a minimum of twelve inches below the proposed finished grade.

(b) ROOT BARRIER INSTALLATION.
The trench shall be cut to sufficient width to properly install the root barrier. All cut roots shall be removed from the trench along with other obstructions to allow the root barrier to be installed vertically without deflections prior to backfill. The root barrier shall extend from finished grade downward without protruding above the soil line.

669.04 METHOD OF MEASUREMENT.
The accepted quantity of root pruning shall be measured to the nearest foot along the finished graded, regardless of depth for the entire installed length. The accepted root pruning will be payment in full for all necessary excavation, tools, equipment, labor, material to complete the item of work.

669.05 BASIS OF PAYMENT.
The accepted quantity of root pruning will be paid for per linear feet of root barrier as measured above, complete in place.

Payment Will Be Made Under:

Root Pruning - per Lin. Ft.
SECTION 671
TEMPORARY EROSION CONTROL

671.01 Description.

(a) GENERAL.
This Section shall cover the work of providing, establishing, and maintaining temporary erosion control work items which consist of measures shown on the plans, determined by the Contractor and approved by the Engineer, in accordance with these specifications, during the life of the contract to control erosion both on and beyond the project right of way and or easement. Temporary water erosion control provisions as defined herein will not be incorporated into the project without prior approval of the Engineer after he determines that it is impractical to utilize permanent erosion control methods. All erosion control features installed by the Contractor shall be effectively maintained by the Contractor. Any features not designated by the Engineer as permanent fixtures shall remain the property of the Contractor and be removed prior to final acceptance; any salvage value shall be reflected in the original unit price bid.

The provisions of this Section are in no way intended to relieve the Contractor of responsibilities covered under other sections of the Specifications. In addition, all temporary erosion control measures will be in accordance with the City of Huntsville Storm Water Management Manual. The pollution control provisions contained herein shall be coordinated with the permanent erosion control features to assure effective continuous erosion control throughout the life of the project.

(b) REQUIREMENTS.

1. Prior to the pre-construction conference, the Contractor shall submit to the Engineer, in writing, a detailed plan for the accomplishment of acceptable erosion control on the project. This plan shall include both temporary and permanent measures for the project as well as for haul roads, material pits, storage sites, plant sites, or other areas that he may utilize. The time sequence proposed for placing all erosion control features will be in the plan; however, if job-site conditions should make it necessary to modify the time sequence, the Contractor shall submit a revised plan. These plans must be approved in writing by the Engineer before the work will be permitted to commence.

2. The Contractor shall not expose more than 5 acres of erodible material for any separate major operation within the project limits or beyond the right of way without prior approval of the Engineer. Consideration for increasing the specified limits noted above will be given upon written request and presentation of an acceptable justification. Such justification should include operation plan, men and equipment to be utilized and any necessary modifications to previously accepted erosion control plan). Additional temporary erosion control items required as a result of this increased acreage which would not normally be required in the course of the 5 acre limited area, will be provided at no cost to the City. Temporary erosion control work may involve the construction of temporary berms, dikes, sediment basins, drains, fences, dams, etc. with the use of temporary seeding, mulching, erosion control netting, hay bales, sand bags, check dams, rip-rap, etc..

3. The Contractor will be required to incorporate all permanent erosion control features into each 5 acre increment of the project immediately upon completion of the grading of that section. Once work has begun on a section it shall be pursued continuously until completion. Temporary erosion control measures shall be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent erosion control features; or that are needed temporarily to control erosion that develops.
during normal construction and prior to substantially completing cuts and fills.

In the event the Contractor fails to comply with the requirements of his plan, the Engineer will order the Contractor to discontinue all operations except the work involved in erosion control until such time as these requirements are met. In case of failure on the part of the Contractor to comply fully, provisions of Section 80 will be applied to the fullest extent. Except as modified hereinafter in this Section, all requirements of the following Sections shall apply:

- **Rip-Rap**
- **Ground Preparation and Fertilizers**
  - for Erosion Control
- **Seeding**
- **Sprigging**
- **Solid Sodding**
- **Mulching**
- **Hydro-Seeding and Mulching**
- **Erosion Control Netting**

### 671.02 Materials

Materials furnished for use in work under this Section shall comply with the requirements of the appropriate sections of these specifications unless otherwise noted hereinafter or detailed by the plans. All materials will be accepted on the Engineer's visual inspection and verification of the supplier's identification tags or certifications; no test reports will be required unless ordered by the Engineer. Authorization by the Engineer to use certain materials under this Section will in no way relieve the Contractor of the responsibility of providing quality materials capable of lasting the expected life span of the temporary structure. Any temporary structure failure, due to the lack of performance of the manufactured items, shall require the structure to be replaced or repaired without additional compensation.

**TEMPORARY PIPE** Temporary pipe may be constructed of any type material which will adequately carry the water.

**TEMPORARY WIRE FENCE (INCLUDING POSTS).** Temporary fence and post material may be of any type fencing and post material that will adequately serve the intended purpose.

**POLYETHYLENE.** Polyethylene sheets may be of any size or color capable of serving the purpose intended provided it is of at least four (4) mil in thickness.

**HAY BALEs.** Bales may be either hay or straw containing five (5) cubic feet of material and weighing not less than 36 pounds.

**SAND BAGS.** Bags may be cotton, burlap, or other approved material which will adequately confine the sand. Bags shall have a volume of approximately one cubic foot.

**TEMPORARY RIP-RAP.** Rip-rap shall be suitable for the purpose intended and shall be one of the classes noted in Section 821.01. The rip-rap shall be Class 2 unless otherwise designated on the plans.

**SILT FENCE.** Silt fences consist of a woven wire fabric, mounted on posts with a geo-textile filter fabric attached to the fence fabric, or a geo-textile filter fabric attached to posts by means of adjustable belts or loops or other means that will securely hold the fabric in an upright position. All materials used in the silt fence shall comply with the requirements shown by plan details or noted hereinafter in this Item. Filter fabric shall be a polymeric fabric formed from a plastic yarn of at least 85% by weight of propylene.
ethylene, amide, ester or vinylenechloride and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure for at least six months. After forming, the fabric shall be processed so that the filaments retain their relative positions with respect to each other. The fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties shown in the following table. Type A and Type B geo-textile fabrics shall retain at least 80% of the minimum specified Grab Strength at the end of the six month test noted in the preceding paragraph.

### REQUIREMENTS FOR FILTER FABRIC

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Requirement Type A</th>
<th>Requirement Type B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Strength</td>
<td>ASTM D-1682 Grab Test</td>
<td>Min. 90 Lbs.</td>
<td>Min. 175 Lbs</td>
</tr>
<tr>
<td>warp</td>
<td>Method using 1 square inch jaws and a travel rate of 12&quot; per minute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grab Elongation</td>
<td>ASTM D-1682 Grab Test</td>
<td>Min. 15%</td>
<td>Min. 15%</td>
</tr>
<tr>
<td></td>
<td>Method using 1 square inch jaws and a travel rate of 12&quot; per minute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permeability</td>
<td>AHD Permeability for Filter Fabric</td>
<td>2x10^-2 cm/sec Min.</td>
<td>2x10^-2 cm/sec Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3x10^-1 cm/sec Max.</td>
<td>3x10^-1 cm/sec Max.</td>
</tr>
</tbody>
</table>

A competent laboratory must be maintained by the producer of the fabric at the point of manufacture to insure quality control. During all periods of shipment and storage, the fabric shall be maintained, wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140°F, mud, dirt, dust and debris. The vendor shall provide a certified test report with each shipment of material attesting that the material meets the requirements of this Section.

### 671.03 Construction Requirements.

(a) **GENERAL.**

Construction details shall be in accordance with the appropriate section of the Specifications for the type work performed unless otherwise noted hereinafter in this Section.

(b) **TEMPORARY SEEDING.**

Ground preparation as required in Section 651 is hereby waived. Areas to be temporary seeded shall be left in a rough graded condition and all water pockets eliminated. Slopes that are smooth or hard shall be lightly scarified with scarifying teeth or some other acceptable method, running perpendicular to the direction of water flow. The intent of this scarifying is to obtain a rough area to hold the seed and prevent them from washing away before germination. Application of 1,000 pounds of 8-8-8 fertilizer per acre shall be applied by either hydraulic or conventional methods. Seeding shall then be applied hydraulically or by approved mechanical seeders using the appropriate seed mix shown below:
September through December

Abruzzi Rye ............................................................... 70 Lbs. per acre
Kentucky 31 Fescue ........................................................ 50 Lbs. per acre
Weeping Lovegrass ...................................................... 5 Lbs. per acre

January through April 15

Kentucky 31 Fescue ........................................................ 50 Lbs. per acre
Reseeding Crimson Clover ............................................. 30 Lbs. per acre
Weeping Lovegrass ...................................................... 5 Lbs. per acre

April through August

Brown Top Millet** ..................................................... 30 Lbs. per acre
Weeping Lovegrass ...................................................... 5 Lbs. per acre
*Kentucky 31 Fescue .................................................... 50 Lbs. per acre.

*Overseeded in September or October
**Brown Top Millet (Panicum Ramosum) - 97% Min. Purety-80% Min. Germinable.

All seeded areas shall be immediately and periodically watered until a minimum growth of three (3) inches above the ground surface is evident. Necessary measures to provide and maintain a quick and satisfactory growth will be required. No payment shall be made for temporary seed until a satisfactory growth has been established to a minimum of two (2) inches above ground. Payment may be withdrawn for any temporary seeding growth not adequately maintained. All temporary seeded areas shall be top dressed when true leaves are formed with 60 pounds of elemental nitrogen per acre, at no additional cost. After six months top dress with 400 pounds per acre of 15-0-16 if grass stand is still required for protection.

(c) TEMPORARY MULCHING.
When mulching is required for temporary seeded areas, the mulch shall be limited to cereal grain straw (oats, wheat, or rye). If cereal grain straw is not available, other type mulches provided in Section 863.03 may be used provided the Contractor at no extra cost will increase the required quantity of annual grasses or legumes (Abruzzi Rye, Crimson Clover and Brown Top Millet) by 50%.

(d) TEMPORARY PIPE.
Temporary Pipe shall be of the size designated on the plans or approved by the Engineer. The length shall be as determined by the Engineer. Bedding requirements are waived.

(e) TEMPORARY WIRE FENCE.
Construction methods shall produce an acceptable fence with the fabric securely attached to posts. Within each installation site the fence fabric and posts shall be of the same type.

(f) POLYETHYLENE.
Polyethylene sheets shall be placed only in areas where water flow and silt must be contained. Installation shall be as described for erosion control netting.

(c) TEMPORARY MULCHING.
When mulching is required for temporary seeded areas, the mulch shall be limited to cereal grain straw (oats, wheat, or rye). If cereal grain straw is not available, other type mulches provided in Section 863.03 may be used provided the Contractor at no extra cost will increase the required quantity of annual grasses or legumes (Abruzzi Rye, Crimson Clover and Brown Top Millet) by 50%.
(g) **SAND BAGS.**
Bags shall contain approximately one (1) cubic foot of sand and be securely fastened. When placed, the bags should have a thickness of approximately six (6) inches.

(h) **HAY BALES.**
Bales shall be securely anchored by the use of stakes and wire or other approved methods.

(i) **EROSION CONTROL CHECK DAMS.**
Check dams shall be of the type shown on the plans or approved by the Engineer. The check dams shall be constructed at the locations shown on the plans.

(j) **TEMPORARY RIP RAP.**
Temporary rip rap shall be placed in accordance with Section 605 except that foundation preparation will not be required. The location of the rip rap shall be as shown on the plans.

(k) **SILT FENCE.**
Silt fences shall be constructed at locations approved by the Engineer in accordance with plan details. Silt fences should be in place before the major construction in an area is begun. Due to the fact that various lengths and widths of sheets may be required, sheets of fabric may be sewn together with thread of a material meeting the chemical requirements given for the plastic yarn to form fabric widths and lengths as required. In lieu of sewing the fabric, field splices can be made by overlapping the fabric a minimum of three (3) feet and securely fastening the fabric to the wire fence (Type A) or to additional posts (Type B). Once installed, the silt fence shall be maintained until its capacity has been reached or erosion activity in the area has stabilized; said maintenance being considered incidental to the work. When a silt fence has reached its capacity to function properly and the need for a backup fence becomes evident, the Engineer will authorize the construction of an additional line of silt fence. Failure to maintain a silt fence shall not be cause for the Contractor to claim additional compensation for construction of a new line of fence. Repair of a damaged silt fence shall be accomplished by methods approved by the Engineer utilizing the same type materials used in the original construction. Existing wire fabric may be utilized by splicing in new sections of fabric that provide at least 12 inches of overlap on each side of a break. Filter fabric may utilize an additional layer of fabric firmly affixed to the original fabric by an approved method providing at least a three (3) foot overlay onto unruptured material. After the stabilization of the erosion activity in an area has been reached, the removal or demolition of the silt fence and the dressing up of the area shall be accomplished in an acceptable manner.

(l) **DRAINAGE SUMPS.**
Temporary drainage sumps or sediment basins shall be constructed near the ends of drainage structures or ditches where needed to control silting. The size, shape and location of these sumps shall be as shown by the plan details. Construction of the sumps shall be accomplished by methods and equipment suitable for the purpose. The sump may be supplemented by the use of pipe, polyethylene, hay bales or other temporary items in this Section and/or indicated by the plans. The sumps shall be cleaned periodically by the removal and disposal of the silt collected in the sumps as deemed necessary to keep the unit functional. When the sump is deemed of no further use, the sump shall be closed, backfilled with suitable material and compacted as directed, and the area dressed and shaped to blend with the adjacent area.
natural ground. The above work will be covered under Drainage Sump Excavation; however, if the proposal does not contain such an item, payment for the work noted above will be made under the Item of Unclassified Excavation.

671.04 Method of Measurement.

Temporary seeding and temporary mulching will be measured in acres computed from surface measurements taken parallel to the treated surface. Computations will be to the nearest tenth of an acre. Temporary pipe will be measured in linear feet to the nearest foot with measurements taken along the center line of the pipe. Temporary wire fence will be measured in linear feet to the nearest foot with measurements taken along the top line of the fence. Temporary polyethylene will be measured in square yards computed from surface measurements of the area treated. Computations will be to the nearest tenth of a yard. Hale bales, sand bags, and erosion control check dams will be measured in individual units of the type item actually used in the treatment. Temporary Rip-Rap will be measured on acceptable scales in one (1) ton units of 2,000 pounds each of the material actually used. Temporary silt fence will be measured in linear feet to the nearest foot with measurements taken along the top line of the fence. Drainage sump excavation will be measured in cubic yards computed from dimensions of the sump size and depth. No measurements will be made of material removed during sump cleaning operations or backfilling when the sump is closed.

671.05 Basis of Payment.

(a) GENERAL.

The basis of payment for all temporary erosion control items provided under this Section shall include the maintenance of the items throughout the duration of their need. If work is deemed necessary that is not included in the contract, the Contractor may submit his plan along with any new items and costs thereof for approval by the Engineer. If approved, the work may be performed at an agreed unit price as per Section 40.03 or the work may be performed on a Force Account basis. The Engineer may at any time order work not included in the contract to be performed by Change Order or Force Account basis. In the event that temporary erosion control measures are necessary due to negligence or failure on the part of the Contractor in installing the permanent measures, such temporary work shall be performed at the Contractor's expense. Payment for any temporary erosion control measures deemed necessary by the Engineer on areas outside the right of way or easements will be included in other items of work and no direct payment will be made. Such areas shall include material pits, haul roads, plant or storage sites, or any area used for the Contractor's convenience. The unit price coverage for items listed hereinafter measured as noted in Section 671.04, shall be full compensation for furnishing all materials, the construction and/or installation of the materials into complete erosion control measures, and shall include all equipment, tools, labor, and incidentals necessary to complete the work, to maintain all work in an acceptable condition, and to remove all items as directed.

(b) PAYMENT WILL BE MADE UNDER:

Temporary Seeding—per Acre
Temporary Mulching—per Acre
Temporary Pipe—per Linear Foot
Temporary Wire Fence (Including Posts)—per Linear Foot
Polyethylene—per Square Yard
Hay Bales—per Each 665-G Sand Bags—per Each
Erosion Control Check Dams, Type —per Each
Temporary Rip-rap, Class —per Ton
Silk Fence, Type —per Linear Foot.
Drainage Sump Excavation—per Cubic Yard.
SECTION 673
LOW PRESSURE AIR TESTING FOR SEWER LINES

673.01 DESCRIPTION

The work to be included under this section of the Specifications shall consist of providing all labor, equipment, tools, supplies, and incidentals necessary for low pressure air testing of all sewer lines.

673.02 MATERIALS

No permanent materials are required for this section. All supplies furnished by the Contractor shall be at his discretion, however all test shall strictly conform the the requirements of these Specifications.

673.03 CONSTRUCTION REQUIREMENTS

After the sewer line has been installed and manholes constructed, the Contractor shall proceed to air test all sewer lines to determine if sewers are free of breaks or other defects which would permit excessive infiltration or exfiltration. The test shall be performed according to the provisions of ASTM C828, latest revision, and these Specifications.

On all gravity flow sewers, the Contractor shall conduct low pressure air tests of the various sections of pipe by use of equipment manufactured for this purpose. The equipment shall include a regulator to avoid overpressurizing and possibly damaging an otherwise acceptable line. The equipment used shall be identical or equal to the Air-Loc system as manufactured by Cherne Industrial, Inc., Hopkins, Minnesota.

The low pressure air test shall be conducted by plugging each opening in the reach of pipe to be testing. All plugs shall be braced against slippage due to internal pressure, and no one shall be allowed in the manhole during the testing procedure. One of the plugs provided must have an inlet tap or other provision for connecting an air hose. After connecting the air control equipment to the air hose, the air pressure shall be monitored so that the internal pressure does not exceed 5.0 psig. After reaching 4.0 psig, the air supply shall be throttled to maintain between 4.0 and 3.5 psig for at lest two (2) minutes in order to allow equilibrium between air temperatures and the pipe walls. If plugs are found to leak, the Contractor shall bleed off the air, tighten the plugs, and again begin supplying air. After the temperature has stabilized, the pressure will be allowed to decrease to 3.5 psig. At 3.5 psig, the Contractor shall begin timing to determine the time required for the pressure to drop to 2.5 psig. The pipe shall be presumed free of defects if the time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown in the table below.
If by use of the above procedure, defective sections(s) of line is found, the line segment shall be tested at 20 foot intervals to determine the exact location of the defect(s). Repairs shall be made in defective section(s), and the entire line segment shall then be retested.

673.04 Method Of Measurement

No measurement will be made for this item. The cost of this work shall be absorbed in other appropriate items of work.

673.05 Basis of Payment

No payment will be made for this item of work and the cost absorbed in other related items of work.
SECTION 677
MANHOLE FRAMES AND COVERS

677.01 Description

This section shall include the installation, construction, or adjustment of manhole frames and covers for sanitary and storm sewers in accordance with the plans and these specifications.

677.02 Materials

All materials shall conform to the appropriate requirements of Division III, Materials, and the following:

Concrete and steel for cast-in-place units and for precast units or parts of units not covered by other requirements shall conform to the requirements of Sections 620 and 503.

Precast concrete units or portions of units shall conform to the appropriate requirements of ASTM C-478 unless otherwise provided by plan details.

Masonry materials shall conform to the requirements of Section 613 utilizing brick or block meeting the following requirements:
- Clay or Shale - ASTM C-32 Grade SS, MS or MM.
- Concrete brick - ASTM C-55, Type I, Grade N.
- Concrete block - ASTM C-90, Type I or II, Grade N.

Castings shall conform to the requirements of Section 839 with attention directed to Section 839.04, 839.05, 839.06 and 839.07. They shall be sound, smooth, clean, and free from blisters and other defects and where necessary planed to provide flat true surfaces.

Welded grates, grate seats, etc. shall be fabricated from ASTM A-36 material unless otherwise denoted by plan details.

Inlet and outlet pipe shall conform to the appropriate requirements of the section of the specifications covering the kind of pipe to which they are to connect.

Galvanization of grates, grate seats, nuts, bolts and miscellaneous metal hardware, when specified on the plans, shall be hot-dipped galvanized after fabrication by one of the following methods:
- Casting, grates and seats fabricated from rolled, pressed or forged steel shapes - ASTM A-123. Nuts, bolts and miscellaneous hardware - ASTM A-153.

677.03 Construction Requirements

(a) SETTING MANHOLE FRAMES AND COVERS

Manhole frames shall be set with the tops conforming to the required elevations set by plan details to the nearest 1/2 inch. Frames shall be set concentric with the top of the brick or precast concrete masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom of the flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the masonry shall be placed all around and on the top of the bottom flange. The mortar shall be smoothly finished and have a slight slope to shed water away from the frame.
(b) ADJUSTING MANHOLE FRAMES AND COVERS TO GRADE

Except where shown on the drawings, the top of the pre-cast concrete eccentric cone of a standard manhole or the top of a flat slab of a shallow manhole shall terminate 4 inches below existing grade in an unpaved non-traffic area and 13 inches in a traffic area. The remainder of the manhole shall be adjusted to the required grade as described in section (a) above.

When a manhole is located in a paved traffic area, the frame and cover shall be adjusted the required grade by pre-cast concrete rings or brick courses as shown on the plans. The adjusted cover shall conform to the required elevation and slope.

677.04 Method of Measurement.

(a) MANHOLE FRAMES AND COVERS.

Manhole frames and covers that are to be installed on new manholes will not be measured for directly, and the cost shall be absorbed other appropriate items of work.

(b) ADJUSTMENT OF FRAMES AND COVERS.

Manhole frames and covers that are to be adjusted will be measured as an individual unit including risers, frames, covers, lids, gratings, etc. of the type, size and shape shown on the plans.

677.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted number of manhole frames and covers adjusted measured as provided above will be paid for at the respective contract unit prices for each which shall be payment in full for furnishing all materials including risers, gratings, covers, and other fittings and for all form work, disposal of surplus material, and for all labor, equipment, tools and incidentals necessary to complete the work hereinabove specified.

(b) EXCAVATION AND BACKFILL.

Excavation and backfill will be considered incidental to the cost of the structures, and shall be absorbed in the appropriate items of work.

(c) PAYMENT WILL BE MADE UNDER:

Manhole Frame and Cover Adjustment, Type —per Each.
SECTION 679
GRINDER PUMP STATIONS

679.01 Description
This Section shall cover the work of furnishing and installing grinder pump stations complete with the necessary pump, basin, control panels, and pipe at the required locations shown on the plans for sanitary sewer service. The grinder pumps shall be Simplex units or an equivalent unit, containing one grinder pump and all necessary parts and equipment. Units shall be installed in fiberglass reinforced polyester tanks for outside installation and all equipment shall be factory installed, except for externally mounted control panel and gravity sewer inlet hubs which are to be installed in the field.

Each pre-assembled grinder pump station shall include the basin, basin cover, grinder pump and motor, quick disconnect rail system, check value, junction box, start-stop level controls, motor high temperature shutoff, motor seal leak alarm, all internal wiring terminating into the junction box, shutoff valve and discharge pipe and fittings. In addition, an external alarm pump control panel is to be provided by plan details.

All units required for a project shall be of the same brand and be identical in all respects per horsepower ratings. The Contractor shall supply the City of Huntsville with equipment specifications, manufacturer's literature, along with the pump.

679.02 Materials
All materials shall conform to the requirements of Division III, Materials and plan details and the following:

(a) PUMP
Each grinder pump shall be Myers WG 20 or an approved equivalent. The pump shall have an integrally built in grinder unit and submersible type motor.

(b) MOTOR
The pump motor shall be of the submersible type rated for 2 horsepower at 3450 RPM. Motors shall be single phase, 230 volt, 60 hertz. Single phase motors shall be of the capacitor start-capacitor run type for high starting torque. The stator winding shall be the open type with class A insulation. A heat sensor thermostat shall be attached to the top end of the motor windings and shall be connected in series with a holding relay in the control box to stop the motor if the motor windings temperature reached 200 F.

(c) POWER CORDS
Motor power cords shall be No. 14-4 Type SOW/SOW-A, four conductor, while the motor control cord shall be No. 18-5 Type SO, five conductor.

(d) SEAL CHAMBER
The motor shall be protected by two rotary shaft seals mounted in tandem with an oil filled chamber separating the seals. The seals shall have carbon and ceramic seal faces diamond lapped to a tolerance of one light band. Metal parts and springs for seals shall be stainless steel. An electrical sensing probe shall be mounted in the seal chamber to detect any water leakage past the power seal.
(e) PUMP IMPELLER
The pump impeller shall be of the recessed type to provide an open unobstructed passage through the volute for the ground solids. The impeller shall be constructed of bronze and shall have pump out vanes on the back side of the impeller to keep solids from the lower seal and reduce pressure at the seal faces. Impellers shall be threaded onto the stainless steel shaft.

(f) CONTROL PANEL
A Nema 3R control panel shall be furnished with each pumping unit to be installed as shown on the plans. This panel shall include a two-pole, 20 amp, main disconnect breaker, seal failure alarm light, pump hand-off auto switch, pump run light, fused relay motor manual reset overload, terminal block, contractor, switch holding relay, ground bar and all necessary wiring and brackets.

(e) PIPING
All piping shall be schedule 80 PVC

679.03 Construction Requirements
(a) GENERAL
Grinder pump units shall be placed to allow gravity flow from the house to the unit. Basins can either be placed in front or sides yards in front of the rear wall provided it is accessible for maintenance. In all cases the tops of all grinder pump units must be exposed and the surrounding area graded to minimized the amount of dirt and grit entering basin. Also, the control panel must be positioned in order that the alarm light is clearly visible from street view and is accessible for maintenance. Wiring from the cabinet to the isolation switch and basin shall be installed in 3/4 inch (minimum) PVC schedule 80 conduit. If pump discharge lines or service laterals are to cross under driveways, concrete patios, walkways, etc., the pipe shall be encased in a steel pipe with 1/8" wall thickness. Service laterals shall be protected during construction any any damage promptly repaired or replaced by the Contractor.

Each grinder pump unit shall have one anti-syphon hose bibb and one ground fault interrupter receptacle both located within ten feet of the basin. At least one inside alarm light shall be required in a location that is viewed daily, such as inside a garage next to a doorway.

All units shall be inspected and tested as outline in this Section by the City of Huntsville City Engineer and Building Inspection Department before a certificate of occupancy is given for the structure.

(b) BASIN
The basin shall be 24" diameter and depth as shown on the plans and be anchored to the concrete foundation as detailed on the plans. The basin shall be molded of fiberglass reinforced polyester resin manufactured by the lay-up and spray technique or filament wound fiberglass. The interior surface is to be smooth and resin rich. The cover shall be 3/16" steel coated with high temperature baked on green epoxy paint. The cover shall be bolted to the basin with stainless steel cap screws. Cadmium plated nuts for the screws shall be imbedded in the fiberglass to prevent turning and for corrosion resistance.

A basin inlet flange for 4" SCH 40 plastic pipe shall be included, but not mounted on the basin. The flange shall be mounted in the field at an inlet height required by the installation, or as shown on the drawing. The flange shall be furnished with a gasket to seal between the basin and flange and also include mounting bolts.
A rubber transition type gasket shall be supplied to seal 4" SCH 40 PVC pipe into the basin hub.
The inlet hub shall be a one piece cast iron mounted to the basin by four stainless steel bolts, and gasket.
All pipe lines and the basin unit shall be bedded and backfilled with a minimum of 6" inches of AHD # 78 crushed stone.

(c) PUMP
The pump shall be suspended in the basin by two (2) 1" galvanized guide rails and quick disconnect lift out mounting assembly. Solids shall be fed in an up-flow direction to the grinder mechanism with no obstructions below the grinder unit.
The grinder assembly shall consist of a rotating radial cutter and a stationary shredding ring and shall be mounted directly below the volute passage. The rotating cutter shall be threaded onto the stainless steel shaft and shall be locked with a screw and washer. The stationary shredding ring shall be pressed onto an iron holding flange for easy removal. The flange shall be provided with tapped back-off holes so that screws can be used to push the shredding ring from the housing. Both the radial cutter and shredding ring shall be removable from the outside without dismantling pump. The manufacturers grinder assembly shall be of such construction that no clearance adjustments are required when assembling in the field. All grinding of solids shall be from the action of the radial cutter against the shredding ring. The radial cutter and shredding ring shall be of No. 440 stainless steel.
All iron casting shall be of high tensile cast iron and shall be properly cleaned, pre-treated with chromic rinse with a high quality enamel paint. All pump components that are not cast iron or stainless steel shall be galvanized or painted with baked on epoxy. All fasteners shall be stainless steel.
Sufficient cord length shall be used so that the pump may be removed without disconnecting power and control wires from junction box. Cord lengths shall be such that no splices will be required between the pump and junction box at top of basin.
In order to prevent possible wicking of moisture into the motor as a result of damaged cables, all leads from the the power and control cords to be potted into the motor end cap using a polyurethane type resin. Power and control leads are to be non-wicking wire inside the motor cap and connected to the pump cables by a compression type connector. The pump lead and control wires shall also be held captive into the motor housing by a gromet and flange type compression fitting. The pump and control cords shall be able to withstand a minimum of 200 lbs. pull without sacrificing the seal into the motor. The end cap shall have female thread tapping for 1-1/2 inch conduit.
A lifting chain shall be securely fastened to the top of the pump and to the top of the basin to facilitate removal of the pump. The chain shall be minimum of 1/4" welded link type or of adequate strength, required to effectively support the weight of the pump assembly while removing and installing.
(d) MOTOR
The motor winding housing shall be filled with clean dielectric oil that will lubricate bearings, seals and transfer heat from the windings to the outer shell. The motor stator is to be pressed into the motor housing for optimum concentricity and alignment, and maximum heat transfer. The motor shall be capable of operating over full range of performance curve without overloading motor an causing any objectionable noise or vibration. A heat sensor thermostat shall be attached to the top end of the motor windings and shall be connected in series with a holding relay in
the control box to stop the motor if the motor windings temperature reached 200 F. The high temperature shutoff will cause the pump to cease operation, should a control failure cause the pump to run in a dry wet well. The thermostat shall reset automatically when the motor cools to a safe operating temperature. The common motor, pump and grinder shaft shall be of stainless steel.

(e) SHUTOFF VALVE
A PVC true union ball type shutoff valve with Teflon seats shall be furnished and installed in the discharge piping as shown on the plans. If the discharge depth is more than 2 feet from the surface, a "tee" handle extension shall be supplied (1 handle for the first station and 1 for each additional 20 stations).

(f) PIPING
Schedule 80 PVC discharge piping shall connect to the stationary discharging base lift assembly and terminate at a 1 1/4 " NPT discharge flange mounted on the basin at the height shown on the drawing.

(g) RAIL ASSEMBLY
A lift out guide rail assembly shall permit easy removal and installation of the pump and lower check valve without the necessity of personnel entering the basin. Cast iron guide brackets with guide yokes of sufficient bearing strength to prevent binding shall bolt to the pump. The pump shall be suspended in the basin by two (2) 1" galvanized guide rails and quick disconnect lift out mounting assembly. The mounting assembly shall be at least one inch below the top rail to prevent the motor from any vertical movement. Solids shall be fed into an up-flow direction to the grinder mechanism with no obstructions below the grinder inlet. The yokes shall mate over guide rails of a minimum of 1" galvanized pipe running between an upper rail support casting. A lower discharge nozzle, downstream from the check valve, shall be guided into a chamfered cavity in the discharge casing. A shoulder on the nozzle shall bottom on the discharge casing when the pump is properly located and shims shall not be required to insure alignment for a leak tight seal. Dual "O" rings shall effect a hydraulic seal around the nozzle when it is in its operating position. A mounting assembly, easily removable from the top of the basin shall be provided to lock the parts together, preventing line surges from breaking the seal and allowing leakage. The discharge case shall have a tapped discharge opening with piping to a coupling through the basin wall.

The discharge case shall be securely bolted to the basin floor and arranged in such a way that slight deflection caused by the discharge pipe will not cause the quick-connect pump flange to leak.

(h) CHECK VALVE
A heavy duty spring loaded all rubber flapper type check valve with cast iron body shall be an integral part of the discharge seal assembly and shall lift out with the pump assembly. The valve design shall be such to allow for operation when negative heads, of up to 5 feet, are encountered. The valve shall be designed to operate at all pressures in the sewer system created by the grinder pumps.

A flat set stainless steel spring, integrally molded into the Buna N rubber flapper, shall be furnished in order to prevent collection of debris in the check valve. All fasteners shall be stainless steel. The valves, when open, shall provide a full pipe opening and create a friction loss no greater than 7 feet at 40 GPM and 4 feet at 20 GPM.

(i) CONTROL PANEL
A Nema 3R control panel or equivalent shall be furnished with each
pumping unit to be installed as shown on the plans.

This panel shall include a two-pole, 20 amp, main disconnect breaker, seal failure alarm light, pump hand-off auto switch, pump run light, fused relay motor manual reset overload, terminal block, contactor, switch holding relay, ground bar and all necessary wiring and brackets.

The control panel shall be housed in a full gasket NEMA 3R enclosure with a hinged door. The enclosure shall be a minimum of 16 gauge for 12x12x6 or smaller, and 14 gauge for up to 20x20x6 enclosures. The enclosure shall be gray enamel paint over treated steel and shall have exterior mounting feet on the top and bottom of the enclosure. Each enclosure shall have combination closing latch and locking hasp. The back panel shall be painted 14 gauge steel held in place by four (4) No. 10 screws which will mate to four (4) threaded standoffs which are welded to the back of the enclosure.

The control enclosure shall be fitted with a red lexan (polycarbonate) alarm light. The light shall be approximately 3" high by 3-1/2" diameter. The globe shall be mounted on top of the enclosure with a neoprene gasket. The lens cannot be removed from the exterior of the enclosure. The lens may be removed by entering the interior of the enclosure and removing four (4) No. 8 screws. The bulb shall be easily replaced by removing a thumb screw from the support bracket on the interior of the panel.

The alarm shall have bright glow and flash during high water conditions. The alarm light will go out when the water level drops.

All internal wiring shall be neat and color coded or numbered. All incoming wires shall terminate into a box clamp type terminal block, except incoming power.

A schematic diagram (showing wire color or number where practical) shall be permanently fastened to the inside of the enclosure.

The control panel shall be properly grounded as per the manufacturer's recommendation and local and national electrical code.

(j) LEVEL CONTROL AND ALARM SWITCHES
Pump on, off, and high levels shall be controlled by three (3) mercury tube float type switches.

The mercury switches shall be sealed in a solid polyurethane float ball. The support wire shall be 16-2 SJOW (neoprene jacket) and weight shall be attached to the cord above the float to hold the switch in place in the pump.

The high water alarm switch shall be the same as the level control switch, except a built in stabilization weight shall be supplied instead of an external weight. The floats shall be labeled on the float bracket as to their function.

The level controls shall be supported in the pump by a bracket and cord snubber which will give positive support to the controls and allow flexibility in the set levels.

Float switches shall be located such that the influent does not flow onto the switches. Switches are fragile and shall not be subjected to rough treatment. The plumber shall verify the location of float switches. The off float switch shall be positioned to allow the remaining sewage to be 1/2 inch above the pump impeller. The on float switch in general shall be located one inch below the top of the motor to prevent solids from collecting on the motor. The high water alarm to be located just below the sewer lateral inlet.

(k) ALARM LIGHTS
The control enclosure shall be fitted with 2 lexan (polycarbonate) alarm lights. The lights shall be approximately 3" high by 3-1/2" diameter; one shall be red, one shall be amber. The globe shall be mounted on top of the enclosure with a
neoprene gasket. The lens cannot be removed from the exterior of the enclosure. The lens may be removed by entering the interior of the enclosure and removing 4 No. 8 screws. The bulb shall be 40 watt minimum high intensity, medium base type. The bulb shall be easily replaced by removing a thumb screw from the support bracket on the interior of the panel.

The alarm shall flash during high water conditions and shall be activated by a separate tilt type mercury switch within a solid urethane ball mounted in the wet wall.

(I) JUNCTION BOX

The junction box shall be constructed of fiberglass or PVC for corrosion resistance, stability and mechanical strength. The enclosure shall be of adequate thickness and properly reinforced to provide good mechanical strength. The junction box shall have a full gasket cover that is held in place by four (4) captive stainless steel screws that can not be removed from the cover with heads totally encapsulated in PVC so that no metal parts are exposed. The screw heads shall be of adequate size so that they may easily be installed and removed without the use of special tools. The cover shall be fastened to the main body of the junction box by means of a totally corrosion resistant cord, to prevent dropping the cover into the basin during service.

An adequate number of sealing type cord grips shall be supplied for incoming pump and switch cords. The cord grips shall be made of non-corrosive material, such as PVC or nylon, and shall make an effective seal around the wire jacket. The cord grip shall also seal to the junction box wall with an "O" ring gasket or other effective means.

The junction box shall have a PVC solvent weld socket type conduit hub mounted in the bottom of the enclosure. The hub shall be of a corrosion resistant material and shall be of adequate size to accommodate the number of wires required to operate the pump.

A method for sealing the incoming wires shall be supplied so that condensation from the conduit or ground water will not enter the enclosure. The sealing method shall be offered as a kit containing all necessary mixing, measuring, stirring and potting material required for an effective in field seal. The interior of the enclosure shall be of adequate size to accommodate the wires and connections required to operate the pump.

The wires running between the control panel and the junction box shall be color coded and fastened to the pump and switch controls by means of adequate sized and insulated twist lock or crimp connectors.

The junction box shall be designed to NEMA 6 standards for occasional submergence.

(m) STORAGE AND SPARE PARTS

1. Storage

All grinder pumps shall be stored at a location designated by the City of Huntsville Sewer Superintendent. Deliveries shall be scheduled normal working weekdays between the hours of 1:00 p.m. and 3:00 p.m.. All pumps and control boxes shall be clearly marked on the outside of the cartons with the names of the subdivision, lot, block and developer.

2. Spare Parts

The Contractor shall be required before actual installation begins, an inventory of replacement parts in an amount equal to ten percent of the total number of grinder pump units to be installed and shall consist of the following:
Attention is directed to the requirements of Ordinance 87-167.

(n) INSPECTION

The Contractor shall notify the City Engineer and the Building Inspector when the grinder pump is complete and ready to be inspected and tested. A meeting time will be arranged by the builder for representatives of the Inspection Department and the City Engineering Department. The City Engineering Department shall be responsible for inspecting the control panel and the pump station beginning at the holding station to the force main. The Inspection Department shall be responsible for inspecting the plumbing between the house and the basin including the connection at the basin, and the electrical work from the control panel back to the house.

The general inspection sequence shall be as follows:

Electrical Inspection
City Engineering Inspection
Plumbing Inspection

After the City Engineer has inspected and passed the grinder pump installation, only then can the house lateral be connected to the basin. The pipe lateral shall extend inside the basin wall 1/2 inch to 1" inch.

The builder shall provide temporary power to the grinder pump through the control panel for the testing pump operation.

679.04 Method of Measurement.

(a) GRINDER PUMP STATIONS.

The accepted individual grinder pump units will be measure as complete separate stations and shall consist of the basin, pumps, wiring, PVC pipe, electrical receptacles, control cabinet, conduit, street valve boxes, alarm lights, and all the necessary incidentals necessary to provide functioning grinder pump units. No
separate payment will be made for excavation and backfill necessary for the proper installation of the units and pipe.

(b) SEWER MAINS.
Sewer pressure mains will be paid for as specified according to Section 681.

679.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.
The accepted number of grinder pump stations as provided above will be paid for at the respective contract unit prices for each which shall be payment in full for furnishing all materials including basins, pumps, wiring, PVC pipe, electrical receptacles, control cabinets, conduit, street valve boxes, alarm lights, and all the necessary incidentals necessary to complete the work hereinabove specified.

(b) EXCAVATION AND BACKFILL.
Excavation and backfill will be considered incidental to the cost of the units, and shall be absorbed in the appropriate items of work.

(c) PAYMENT WILL BE MADE UNDER:
Grinder Pump Stations, —per Each.
SECTION 681
PRESSURE SANITARY SEWER SYSTEM

681.01 Description
The work under this section shall consist of furnishing all materials, equipment, tools, labor, and services necessary for the construction of the complete pressure sanitary sewer system as shown on the plans including all piping, fittings, valves, and appurtenances and testing as described hereinafter.

681.02 Materials
(a) PIPING
All pressure pipe from 1-1/2" through 4" shall be class 200. All plastic pipe shall be made from Class 12454-B polyvinyl chloride plastic (PVC 1120) as defined by ASTM D1784. All Class 200 pipe shall have NSF approval and be manufactured in accordance with ASTM D2241. The following tests shall be run for each machine on each size and type of pipe being produced, as specified:

- Flatting Test: One test per shift in accordance with ASTM D2412. Upon completion of the tests, the specimen shall not be split, cracked, or broken.
- Acetone Test (Extrusion Quality Test): One test per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking, or visible deteriorated on the inside or outside surface after completion of the tests.
- Quick Burst Test: One test per 24 hours in accordance with ASTM 5199.

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<th>Minimum Bursting</th>
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<tr>
<td>21</td>
<td>200</td>
<td>800 psi</td>
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Impact test: One test for pipe 4" and smaller each 2 hours in accordance with ASTM D2444.
Wall Thickness and Outside Dimensions Test: One test per hour in accordance with ASTM D3139

If any specimen fails to meet any of the above mentioned tests, all pipe of that size and type manufactured between the tests periods must be scrapped and a full set of tests re-run.

The Contractor shall furnish a notarized certificate from the manufacturer stating that they are fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these specifications and further stating that he has manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturers equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also the manufacturer shall certify that the pipe furnished for the project meets all requirements of these specifications.

All pipe shall be manufactured in the United States of America and for any one project shall be made by the same manufacturer.
The pipe may be furnished in the manufacturers standard laying lengths of 20', 38', or 40'. The Contractors methods of storing and handling the pipe shall be approved by the Engineer in accordance with these specifications. All pipe shall be supported within 5' feet of each end; in between the end supports, there shall be additional supports at least 15'. The pipe shall be stored away from heat or...
direct sunlight. Stringing pipes out along the proposed sewer line routes will not be allowed.

Certain information shall be applied to each piece of pipe. At the least, this shall consist of:

Nominal size
Type of material
SDR or Class
Manufacturer
NSF Seal of Approval

Pipe that fails to comply with the required set forth in these specifications shall be rejected.

Joint shall be of the solvent welded type for 2-1/2" and smaller and solvent welded or compression for 3" and larger and shall be designed to withstand the same pressures as required for the pipe. Fittings shall be fabricated by the same manufacturer of the pipe used and manufactured shall be capable of supplying fittings with any combination of spigot (plain) end and socket (ball).

All pipe for any one project shall be from the same manufacturer and shall be manufactured in the United States of America.

Service Pipe shall be 1-1/4 Class 200 PVC pressure pipe made from Type, Grade 1 Polyvinyl chloride plastic as defined in ASTM D1784, "Specifications for project Polyvinyl Chloride Compounds. The joints shall be of the solvent type and suitable for the pressure required if the pipe.

(B) VALVES

1. Ball valve

The valve on the service line at the connection to the main shall be a PVC ball valve of true union design with permanently lubricated Teflon seats and elastomer "O"-ring seals. The valves shall open and close with a quarter of a turn. Working pressure at 70 F shall be 150 pounds per square inch.

2. Redundant Check Valve

Each service line shall include a check valve for installation in the discharge line between the grinder pump and the sewer force main to ensure maximum protection against backflow in the event of sewer service line break.

The valve shall be 1-1/4 and of the gravity-operated flapper type or of the ball type. The flapper-type check valve will provide a full ported passage way when open and shall introduce a friction loss of less than 6" at maximum rated flow. Working parts will be made of 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability and fatigue strength. A non-metallic hinge shall be an integral part of the flapper assembly providing maximum degrees of freedom for assured seating at a very low back pressure. The ball type will be so designed that the ball check will be completely out of the sewage flow at rated flow and will drop back on the seat to prevent reversing of flow when flow stops.

The valve body shall be a high gloss, injection molded part made of PVC with hub and socket compatible with 1-1/4 PVC solvent weld system shall be in accordance with Commercial Standards C5-272-65.

3. Valve Boxes

Valve boxes shall be a standard plastic meter box with a nominal size of 16" x 10-3/4" x 12" and a 6" extension. The meter box shall be injection molded meeting ASTM D2853-70. Class 1212. It shall be a rigid combination of polyolefin with
inorganic component reinforcing, and UV stabilizer additive to assure resistance to material degradation from ultraviolet light.

The cover shall be molded of the same material and designed with no molded protrusions for latching. A 2-1/2" diameter 16 gauge steel reflector with dichromate coating shall be applied to the underside of the plastic cover for electronic detection. The cover shall be green with the words "Control Valve" imprinted on the top.

681.03 Construction Requirements
(a) GENERAL
The Contractor shall furnish all materials and equipment and install the service pipe and connections to the sewage force main at the locations shown on the drawings or as directed.

The Contractor shall be responsible for safely storing materials needed for the work that have been accepted by him until they have been incorporated into the completed project. The interiors of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

(b) FORCE MAIN INSTALLATION
The force main shall be laid at the lines and grades required by the drawings. All fittings shall be at the required locations, and spigots well centered in the bells. Unless otherwise indicated by the drawings, all force mains shall have at least 24" of cover.

1. Excavation
Details of trenching and bedding shall be shown on the plans. Excavation shall be accomplished in accordance with Section 107. The bottom of the trench shall be carefully graded so that each pipe barrel will rest on a solid foundation for its entire length. Should unsuitable material be encountered at the trench floor, the material shall be removed entirely and replaced with AHD #78 foundation backfill. All trenches shall be dewatered before the placement of the sewage force main is allowed.

Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions or plumb stems, or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer. Thrust blocks shall be placed at locations shown on the plans at main changes direction (e.g., at tees and bends), at dead ends. Thrust blocks shall be in place for a minimum of three days prior to a pressure test.

2. Placing Pipe
The Contractor shall provide and use tools and facilities that will allow the work to be accomplished in a safe convenient manner. All pipe shall be carefully lower so that neither it nor any protective coating or lining will be damaged. Under no circumstances, shall the materials be dropped or dumped into the trench. Bell ends of the pipe shall be placed facing upstream unless otherwise shown on the plans.

Every precaution shall be taken to keep foreign materials from getting into the pipe while it is being placed into the line. All pipes must be swabbed to remove any mud, debris, etc. that may have accumulated on them before and after the pipe has been lowered. In addition, the spigot end and the inside of it's bell shall be brushed and wiped clean to ensure that the pipe is dry and oil-free. If conditions are such that the pipe cannot be installed without allowing debris getting inside, the Contractor shall place a heavy, tightly woven canvas bag of suitable size over each end of the pipe until the adjacent pipe is to be installed. No debris, tools, clothing, or
other materials will be allowed in the pipe at any time during laying operations.

After a length of pipe has been placed in the trench, the spigot end shall be centered in the bell of the adjacent pipe, and then inserted to the depth specified by the manufacturer and brought to the correct line and grade. All joints, whether standard mechanical or push-on joints, shall be installed in conformance with the recommendations of the joint manufacturer as approved by plan details. The pipe shall then be backfilled by compacting an approved backfill for the required depth as indicated by plan details. Whenever pipe laying is not in progress, the open ends of the pipe in the trench must be closed with a water tight plug or by other means.

The cutting of pipe so that fittings or closure pieces can be inserted shall be done in a neat and workmanlike manner and without any damage to the pipe. The Contractor shall follow the manufacturer's recommendations concerning how to cut and finish the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis. The flame cutting of the pipe by means of an oxyacetylene torch will not be allowed.

(c) SERVICE LINE, VALVE, AND FITTING INSTALLATION

All service lines shall have a minimum of 24" cover. The service lines shall be installed in accordance with the manufacturer's recommendation and the specifications in close conformity to the location as shown on the construction plans.

Valve boxes shall be installed so that no shock or stress is transmitted to the valve, and the box is centered and the plumb over the wrench nut of the valve. The box cover of the valve box shall be set 1/2" above the ground surface or such other level. Valve depth shall be a maximum of 16" below finish grade at the valve box location. The valve box shall be of sufficient size to house the curb stop valve, redundant check valve, an testing tee including couplings as shown on the detail drawings. The curb stop is to be PVC and of the ball type situated first in line from the sewer main. A 1-1/4" galvanized test tee with 12" x 1" galvanized nipple with cap is to be situated second in line from the sewer main. The check valve shall be PVC of the ball type and situated third in line from the sewer main. Pipe unions shall be installed on both sides of curb stops and check valves.

(d) TESTING REQUIREMENTS

1. Hydrostatic Tests
   a. Pressure Test

   After all the pipe has been laid and backfilled as specified above, the pipe shall be subjected to a pressure test. All services are to be laid prior to testing the main and tested as part of the system. For the required test, the Contractor shall furnish all necessary equipment tools and labor including clear water at all test points. The Contractor shall also furnish a water pressure gauge graduated in one PSIG in increments, a water flow meter capable of measuring the volume of water to the nearest hundredth of a gallon, and a pump capable of pressurizing the test section to the required test pressure.

   The duration of each pressure test shall be approximately four hours and shall be performed in the following manner:

   1. Test section backfilled to a minimum of two feet over pipe.
   2. All service connections and valves to be installed.
   3. Thrust blocks in place a minimum of five days.
   4. Public Works Department to be notified of flushing procedures and disposal arrangements for flushing water.
   5. Section to be flushed at a minimum velocity of two and one half feet per second until clear water is observed exiting cleanout.
6. Test section is to be slowly filled with clear water and all air expelled.
7. After water stands in pipe twenty-four hours, it shall be filled again and all air expelled.
8. All valves in the test section are to be closed.
9. Test section to be pressurized sixty (60) psi gauge minimum at all points along the test section; or one and one half times the working pressure.
10. Pressure gauge is checked after thirty minutes and pressure recorded. If pressure has dropped more than two PSIG, pressurize again to sixty (60) PSIG and record volume of water in gallons required to restore test pressure.
11. Repeat step ten at thirty minute intervals for three hours, then total the volume of water used to maintain the test pressure which shall be defined as leakage.

Conditions Constituting Section Test Failure:
Any of the following conditions shall constitute failure for the test section involved during pressure testing:

1. Any leakage visually observed
2. Drop in test pressure of five PSIG or more
3. Leakage in excess of ten gallons per inch pipe diameter per mile per twenty-four hour period.

On a four-hour test:

Allowable Leakage (Gal) = \(10 \times \text{Pipe Size (in)} \times \frac{\text{Section length (ft)}}{5280}\)

6. All cost of finding and repairing leaks shall be borne by the Contractor.

(e) CLEANUP
After completing each section of force main, all debris construction materials, and equipment shall be removed from the work site. The finished grade over the pressure lines shall be leveled and contoured to leave a neat and pleasant appearance for the disturbed area. The entire area shall be clean and left in a condition satisfactory to the Engineer.

681.04 Method of Measurement.
The actual accepted length of pressure sanitary sewer laid will be measured in linear feet along the center of the line, with deductions for valves, complete in place. Excavation, foundation preparation and backfilling for sanitary sewers will not be measured for direct payment but shall be considered incidental for the necessary completion of the work and shall be included in the unit bid for the sanitary sewer pipe, unless otherwise indicated on the plans or in the proposal.

681.05 Basis of Payment.
(a) UNIT PRICE COVERAGE.
The accepted length of pressure sanitary sewer laid complete in place measured as noted above will be paid for at the respective contract unit prices for the kinds, depth, and sizes specified in the proposal including the excavation and backfilling, which shall be payment in full for furnishing, hauling, excavating, foundation preparation, laying or, backfilling, compacting, clean-up and for all
materials, equipment, tools, labor, and incidentals necessary to complete the work except manholes, junction boxes, or like connecting masonry.

(b) PAYMENT WILL BE MADE UNDER:

Pressure Sanitary Sewer Valve Box - ___ per Each

___" Type Sanitary Sewer Pipe, Class *—per Linear Foot.

Types:
Reinforced Concrete (R.C.)
Ductile Iron (D.I.)
PVC (P.V.C.)

* Denote Class of Pipe
SECTION 685
WASTEWATER LIFT STATIONS

685.01 Description
This section shall cover the work of constructing wastewater lift stations as indicated on the plans, and the the established lines and grades.

685.02 Materials
All materials and all appurtenant equipment shall be new, and shall conform to Division III, Materials. Reference is made to the following Section:

- Concrete Block: Section 808
- Lumber: Section 833
- Cement: Section 823
- Ductile Iron: Section 854

Suction lift pumps shall be self priming and manufactured by Gorman Rupp or an equivalent.
Submersible pumps shall be manufactured Flygt Inc. or equivalent.
Pump controls shall be capable of high wet well level alarm manufactured by Polysonics or equivalent.
Alarm system shall be an Intrac-2000 as manufactured by Motorola or equivalent with eight alarm points.

685.03 Construction Requirements

(a) SITE REQUIREMENTS
The wastewater lift station shall be constructed at the exact location as indicated on the plans. In general the lift station shall remain fully operational during the one hundred year storm event within dedicated easements.
The lift station site shall be protected by a six feet high chain link fence with 3 strand barbed wire above. One three foot walk through gate and one ten foot drive through gate will be constructed in accordance with Section 633.
The single lane access road shall be built by plan details and in accordance with these specification. If curb and gutter is required for the access road, it shall be placed as specified in Section 625.
Slopes shall be graded to less than 20% grade, and all disturbed ground seeded for grass as specified in Section 653.

(b) LIFT STATION BUILDING
The lift station building shall be built in accordance with plan details and the Southern Building Code as adopted by the City of Huntsville along with any special construction specification required by the City Engineer for the station involved. Each door lockset shall be keyed different, and the Contractor shall deliver four master keys to the City of Huntsville for each door lockset prior to final acceptance. All keys shall match the existing City of Huntsville master key system and all keying must be performed at the lock factory.

(c) WET WELLS, PUMPS AND CONTROLS
For wet wells, the Contractor will be required to seal all penetration through the slab to prevent sewer gas leaks. Any leakage shall be promptly corrected by the Contractor.
Suction lift pumps shall be installed as per the manufacturers
recommendation and shall be installed for automatic restart after power restoration. Hour meters for each pump shall be installed according to plan details on the motor control pump. All pumps shall be capable of passing a 3 Inch or larger sphere.

(d) ELECTRICAL
All electrical service shall be 460 or 220 volt 3 phase, and the control voltage shall be 110 volts. Phase conversion equipment will not be allowed for lift station operation. All electrical equipment shall be installed to the NECA 1987 Edition.

The required radio alarm system shall be installed according to the manufacturers requirements and wired with 8 alarm points and labelled as follows:

1. Power Failure
2. High wet-well
3. Low wet-well
4. Pump High temperature shutdown
5. Illegal entry
6. Lift station main
7. Repair crew
8. Low Battery

It should be noted that the cost of the FCC licence shall be absorbed in the appropriate items of work and that a six month delivery time for the alarm should be assumed.

(e) FORCE MAIN
Unless otherwise shown on the plans, the force main shall be of ductile iron and installed at a minimum depth of 3'-0" feet. All cut-off valve gates shall be installed on the force main at the locations indicated on the plans.

(d) START-UP
Upon completion of the lift station, the equipment shall be checked by performed by an authorized service technician from the original equipment manufacturer.

The Contractor shall notify the Water Pollution Control Office forty-eight hours prior to to start and a WPC representative shall be present of during the period of start-up. A copy of the technician report showing all field data shall be furnished to the WPC representative. The Contractor shall be responsible for sufficient water for the start-up and equipment check.

685.04 Method of Measurement.
The completed and accepted waste water lift station item will measured as a complete facility which shall be considered a lump sum item. Excavation, foundation preparation and backfilling for lift stations will not be measured for direct payment but shall be considered incidental for the necessary completion of the work and shall be included in the lump sum bid for the waste water lift stations, unless otherwise indicated on the plans or in the proposal.
685.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted waste water lift station shall be paid for at the contract lump sum unit price which shall be payment in full for all materials, equipment, tools, labor, and incidentals necessary to complete the work. When partial payments are to be made they will be based on the complete percentage of the total waste water lift station contract unit price bid as determined by the Engineer.

(b) PAYMENT WILL BE MADE UNDER:

Waste Water Lift Station - ____ Lump Sum
SECTION 701
TRAFFIC STRIPE

701.01 Description

This Section shall cover the work of furnishing all materials and the application of the materials to form either a permanent or temporary traffic stripe in substantial conformity with plan details and these specifications at the location shown on the plans.

Dimensions, color, type of material and reflectability of the stripe will be designated on the plans or in the proposal. The type of material will be designated by "Class" with Class 1 designating paint and Class 2 designating plastic material. Reflectivity will be designated by "Type" with Type A designating reflective and Type B designating non-reflective.

For the purpose of these specifications two (2) kinds of traffic stripe are designated: 1) standard or permanent traffic stripe and 2) temporary traffic stripe. Standard or permanent stripe shall be used at all times unless otherwise provided by the plans or proposal. Temporary stripe is a safety item designated to be used by the Engineer as deemed necessary for protection of the traveling public, on a short term basis. No section of road shall be opened to traffic without either a temporary or permanent (as appropriate) traffic stripe having been placed.

In addition this Section shall cover the removal of existing or temporary traffic stripe when such is provided by the plans or proposal.

701.02 Materials

Materials furnished for use shall comply with the appropriate provisions of Division III, Materials, with special reference to Sections 861 and 862.

Temporary traffic striping material may be either of the following:

a. Reflectorized traffic paint complying with the provisions of Sections 861 or 862.

b. An approved reflectorized pressure sensitive traffic marking tape with the following characteristics:
   (1) Capable of molding itself to the pavement contours and maintaining its position, shape, color and reflectivity under normal traffic conditions.
   (2) Provide highly visible markings of the appropriate color during both daylight hours and hours of darkness.

If the marking tape will be required to be removed, it shall be capable of being removed intact or in large pieces either manually or with a recommended roll up device when its function is no longer required. A moderate amount of heat may be used in the removal of the tape as long as it does not scar, disfigure or in any way harm the pavement.

Failure to satisfactorily adhere to the pavement or to be satisfactorily removable shall be reason for disallowing the use of a particular type of traffic marking tape.
701.03 Construction Requirements

(a) EQUIPMENT

1. GENERAL

Selection of the proper equipment to produce satisfactory results within the basic requirements noted hereinafter shall be the responsibility of the Contractor.

Basic requirements are as follows:

a. A type that will permit traffic to pass safely within the limits of the roadway surface and shoulder while the unit is operating.

b. Designed for placement of both solid and broken line stripes of the spacing shown on the plans with square neat stripe ends.

c. Provide for application of "drop-on" glass spheres when reflectorized strip is required.

d. Provide for application of striping material in accordance with the following:

   (1) Application of Paint Stripe
   The spray machine shall have an attachment that will permit accurate regulation of the rate of application and a tachometer or other approved device to insure uniform paint application at the designated rate.
   It shall be adjustable for applying one or two adjacent lines simultaneously along the centerline as may be required. The operation of the unit shall be such that paint will not be spattered or blown on another stripe. The unit shall be so designed that the paint will be properly agitated while in operation.

   (2) Application of Thermoplastic Stripe
   The application equipment shall be especially designed for placing the plastic material in a hot molten state on the pavement, utilizing either an extrusion or spray method. Equipment shall have the capability of providing continuous mixing and agitation of the material while maintaining the material at the proper placement temperature in a continuous stripe of uniform thickness and width. The use of direct flame heat will not be allowed in any heating operation.

2. TEMPORARY STRIPING EQUIPMENT

Equipment for applying temporary striping shall be suitable for placing of the stripe in accordance with requirements noted elsewhere in this Section.

(b) CLEANING PAVEMENT

All pavement areas to be striped shall be thoroughly cleaned using whatever equipment is necessary to clean the pavement thoroughly without damaging the surface taking particular care to remove all vegetation, loose soil and the like from areas where edge striping is to be applied. Where necessary, the surface shall be wet with a water jet and scrubbed to dislodge all foreign material. After washing, the surface shall be allowed to dry thoroughly and any film of dried mud apparent after surface drying shall be removed before application of paint. Striping shall follow as closely as practicable after the surface has been cleaned and dried, but no striping shall be done until the surface has been inspected and permission given to proceed. Compensation for cleaning the surface shall be included in the contract unit prices of the striping pay items.

(c) REMOVING STRIPE

Where so shown on the plans, the existing or directed temporary traffic line stripe shall be removed by sand blast, approved grinding equipment, approved chemical process, or similar approved methods that will not damage the surface.
Burning or painting over the old stripe will not be permitted. Removal of existing or temporary stripe will be paid for as a separate item of work.

Where unsatisfactory striping performed by the Contractor must be removed and replaced in compliance with these specifications, the Contractor shall use one of the removal methods described above. No payment will be made for removal or replacement of the Contractor's unsatisfactory striping.

(d) WEATHER CONDITIONS

No permanent striping will be permitted when (1) there is any moisture on the pavement surface or the air is misty, (2) the surface temperature of the pavement to be striped is below 40°F for paint or 60°F for thermoplastic, unless special disposition is authorized in writing, (3) wind or other conditions cause a film of dust to be deposited on the surface after cleaning and before striping can be placed, or (4) other conditions that in the opinion of the Engineer, would displace, damage or affect the bonding of the striping material to the pavement surface. Any striping placed in violation of the above conditions or damaged due to water or rain within 16 minutes after application, shall be removed and replaced without additional compensation.

For temporary striping the weather conditions noted above may be waived to obtain a traffic stripe before allowing traffic to traverse the roadway.

Striping shall be accomplished during daylight hours, except with written permission of the Engineer. Lighting arrangements will be required for night time operations and shall conform to A.M.U.T.C.D.

(e) APPLICATION

1. GENERAL

The Contractor shall provide all engineering services necessary for pre-marking of all proposed stripe within the limits of the designated work. The Contractor shall submit for approval to the Engineer three (3) copies of a written report which clearly indicates the limits of no-passing zones (odometer survey of the route is acceptable), two weeks prior to the date proposed striping is to begin on the route covered by the survey. All no-passing zones shall be located by painting a mark on the pavement and referencing these points to some identifiable point off the pavement surface. Upon acceptance and approval of the survey date, the Engineer may waive the two (2) weeks time period noted above. Note is made of the fact that obtaining approval of the survey data is considered incidental to the work and no time extension or time delay will be considered due to failure to obtain approval.

All striping and pavement markings shall be placed in accordance with the requirements of these Specifications, the detailed plans and Section "J" of the Current A.M.U.T.C.D.

Where no previous striping exists, the location of no-passing zones shall be established by the Contractor using criteria set forth in Section "J" of the current A.M.U.T.C.D., and details shown on the plans.

The Contractor may be required to paint over some existing stripe, as necessary. This may require adjusting the operation of the sprayers to match the previous lengths of stripes and skips.

No striping material shall be applied over a guide cord; only longitudinal joints, existing stripes or other approved type guides will be permitted.

In the absence of a longitudinal joint or existing stripe, the Contractor shall mark the points necessary for the placing of the proposed stripe. Edge striping shall be adjusted as necessary so that the edge stripe will be parallel to the centerline and not run off the edge of the pavement.

If a reflectorized stripe is required and a material conforming to Section
861 with "premixed" glass spheres is used, it shall be treated with a top dressing of glass spheres as noted hereinafter to provide instant reflectivity. Application of this top dressing shall be timed so that the spheres will be firmly attached to the material before final set has occurred and accomplished in such a manner as to provide uniform coverage of the full width of stripe being placed. The minimum rate of application of this treatment shall be 44 pounds per mile of four inch wide solid paint stripe placed and 88 pounds per mile of four inch wide solid thermoplastic stripe placed. Appropriate adjustments shall be made for broken stripe.

If a reflectorized stripe is required and paint conforming to Section 862 is used, the glass spheres shall be applied at the same time but in a separate operation. The minimum rate of application of this treatment shall be 117 pounds per mile of four inch wide solid paint stripe placed. Appropriate adjustments shall be made for broken stripe. The glass spheres shall be applied to the paint before final set has occurred and accomplished in such a manner as to provide uniform coverage for the full width of the stripe.

The operation of applying the drop-on glass spheres shall be such that will insure adequate embedment and uniform coverage of the glass spheres in the amounts noted for the type striping material used. A periodic check (at least every mile) which does not indicate uniform coverage and/or adequate embedment of spheres shall be cause for ordering the effected section to be reworked without additional cost to the City.

Failure of the striping material to adhere to the pavement surface during the life of the contract shall be prima facie evidence that the materials even though complying with these specifications, or the application thereof, was inconsistent with the intent of the requirements for the work under this Section and shall be cause of ordering corrective action or replacement of the stripe all without additional cost to the City.

Placement of permanent traffic marking material on freshly placed pavements, especially bituminous pavements, can be detrimental to the life expectancy of the marking material; hence, every effort should be made to allow the pavement to cure for approximately 14 days before placing of the marking material.

2. PAINT STRIPES.

a. Preparation of Paint.

Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned unless approval is given to correct consistency.

b. Rate of Application.

For a 4 inch solid stripe, paint shall be applied at the rate of 18 gallons per mile for a smooth textured pavement surface (concrete or bituminous plant mix), or 22 gallons per mile for a rough textured pavement surface (bituminous surface treatment or an open graded plant mix) with appropriate adjustment made for broken lines or other width traffic lines. The application rate shall not vary from the designated rate by more than five (5) percent in any mile. At any point where a check indicates a variation in excess of five (5) percent, the work shall be stopped and the equipment adjusted or replaced. This tolerance is for providing leeway in equipment adjustment only; a consistent and uncorrected underrun, even within the five (5) percent tolerance will not be acceptable; the Contractor will be required to approach closely the designated rate.

The paint machine shall be so designed that its operation will be at a uniform speed on a grade as well as level ground. The operating speed of the equipment shall be approved by the Engineer consistent with the characteristics of the equipment's capabilities to produce an acceptable stripe within the tolerances noted in other portions of this Section at the rate noted in paragraph one of this item.
3. THERMOPLASTIC STRIPES.
      The thermoplastic material shall be prepared in accordance with the 
      recommendations of the manufacturer of the thermoplastic material. Special care 
      shall be exercised in obtaining the proper molten state temperature and retaining 
      said temperature during the application operation.
   b. Rate of Application.
      Unless provided otherwise by the proposal, and shown on the plans, 
      the rate of application of the thermoplastic striping shall be such as to produce a 
      minimum average film thickness of 0.090 inch on lane striping and 0.060 inch in 
      edge striping.
      The thickness of the material shall be verified periodically (at least 
      every 1/2 mile) and thickness more than 5% under the designated thickness shall be 
      reworked. A consistent, uncorrected underrun, even within 5%, will not be accepted 
      and the Contractor will be required to approach closely the specified thickness.
      The pavement surface shall be treated with an approved primer-sealer just prior to application of the thermoplastic to facilitate bonding of the 
      striping material to the pavement surface. The rate of application of the primer-sealer shall be as recommended by the producer of the material.

4. TEMPORARY STRIPE
   a. General
      Temporary striping has been designed for use when it is necessary to 
      provide temporary pavement markings for traffic control during construction of a 
      project. Said striping patterns and colors shall be consistent with the requirements 
      of the A.M.U.T.C.D., the plan details, and the following:
      Centerline and lane lines shall be broken line stripes unless the Traffic 
      Control Plan in the plans specifies the use of a solid line stripe to control vehicular 
      passing. Edge lines will not be required unless provided for on the plans.
      Unless specified otherwise by the plans, a broken line stripe shall 
      consist of four inch wide by 8 foot long markings placed on 40 foot centers. A solid 
      line shall be a continuous four inch wide stripe.
      Special attention is directed to the requirement that no section of road 
      shall be opened to traffic without a traffic stripe. When traffic is to be maintained 
      through the work, appropriate lane lines shall be maintained at all times. Existing 
      lane lines covered by paving operations shall be replaced with temporary stripe.
      In general the removal of the temporary striping prior to placement of 
      a subsequent paving layer or permanent stripe will not be required except as follows:
      (1) A solid line stripe of marking tape used on an underlying 
          pavement layer, or any type stripe of marking tape used on a wearing surface.
      (2) A solid line stripe of paint used on a wearing surface which is not 
          to be replaced with a Class 1 permanent stripe that will completely cover the 
          temporary stripe.
      The removal of any temporary stripe shall be by such methods that will 
      not damage nor disfigure the pavement surface of a wearing layer.
   b. Temporary Traffic Marking Tape
      In general, the application of traffic marking tape shall be in 
      accordance with the recommendations of the manufacturer of the material; however, 
      minor changes will be allowed if such is shown to produce an equal or better 
      application.
      Note is made to the fact that approval for the use of this type material is 
      subject to satisfactory performance under traffic. Any failure for whatever reason, 
      during the time frame the material is scheduled to perform shall be repaired 
      immediately. Continued failure of a material to perform shall be cause for disallowing 
      further use of that particular manufacturer's material.
c. Temporary Traffic Marking Paint.

The paint and beads shall be placed at the same rate as specified for permanent stripe in Sections 701.03(e)1 and 701.03(e)2. Appropriate adjustments shall be made for broken stripe.

Equipment for placing the stripe shall be suitable for the purpose intended, capable of placing at least one stripe complete with beads.

(f) TOLERANCES
1. STANDARD STRIPING

A tolerance of 1/2 inch over or 1/8 inch under the specified 4-inch width will be allowed, provided the variation is gradual and does not detract from the general appearance. Segments of broken line may vary up to one foot from the specified length. Segments shall square off at each end without mist or drip. Variations from the control guide up to one inch will be allowed provided the variation does not increase or decrease at a rate of more than 1/2 inch in 2~ feet. Lines that do not meet these tolerances shall be removed and replaced, without additional compensation. Establishment of tolerances does not relieve the Contractor of responsibility to construct as closely as practicable to exact plan dimensions.

2. TEMPORARY STRIPE.

The width of the temporary stripe shall not exceed the specified 4 inches, but shall have a 1/2 inch under tolerance. Traffic marking tape shall have a nominal 4 inch width. The tolerance for the lengths of the temporary broken stripe sections shall be one foot under and one foot over the length specified in Section 701.03(e)4a. Strict compliance to alignment on underlying surfaces will not be required provided a reasonable straight line of markings is obtained. The tolerances for placement on a wearing surface shall be such that will not distort the alignment, etc. of the permanent stripe.

(g) PROTECTION OF TRAFFIC STRIPE

Immediately following the application of the striping in areas under public traffic, traffic cones (Min. 7" high), red flags supported by springs or heavy wire on pedestals, or other approved devices, shall be placed alongside or over the line at intervals not exceeding 50 feet to remain in place until the stripe has dried to such an extent that it will not be picked up by the tires of vehicles. All flags and supports shall be furnished and placed by the Contractor. It is essential that traffic be prevented from crossing a wet traffic stripe and should at any time the above provisions not be sufficient to prevent such, the Contractor shall use a sufficient number of flagmen, proper boards, or other protection for the wet stripe, particularly at crossings, to prevent traffic from crossing the wet stripe, or he shall reduce the amount of wet line by slowing down the striping operation. Sections of traffic stripe which have been marred or picked up by traffic crossing them before they have dried shall be repaired by the Contractor and the pavement cleaned outside the stripe without extra compensation.

(h) PROTECTION OF TRAFFIC

The Contractor shall furnish and place without extra compensation all warning and directional signs required to direct, control and protect the traveling public while marking and striping operations are in progress. Temporary barricades of the design shown in the plans or as otherwise designated together with the signs shown for use therewith, shall be placed as shown with reference to the pavement edges at the beginning and end of the section which the Contractor proposes to stripe in one operation. As soon as the striping material has dried sufficiently in any one section to permit traffic to cross the traffic line, the temporary barricades shall be moved ahead to the next section. No protectors or barricades shall be left in place
overnight. The striping equipment shall be so operated that it will be unnecessary for the traffic to cross the newly placed traffic stripe behind the equipment in order to safely pass the striping machine, and traffic shall be allowed to keep moving at all times.

All protective and traffic warning devices shall be in accordance with Section "G" of the current Alabama MUTCD.

(i) MAINTENANCE

All sections of traffic striping, including temporary striping, which has been placed in accordance with the plans, specifications will be considered satisfactory, and the Contractor relieved of responsibility for ordinary maintenance on such sections after they are opened to public traffic, pending completion and acceptance of the contract. The Engineer reserves the right to order the Contractor to replace any traffic striping so placed with payment made under the appropriate Pay Item.

701.04 Method of Measurement

Solid or broken traffic stripe will be measured along the centerline of each stripe either by direct measurement and computation to the nearest thousandth of a mile or by odometer to the nearest thousandth of a mile. Dotted traffic stripe item will be measured along the centerline of the stripe to the nearest foot.

The mileage of broken traffic stripe complete in place and accepted and the linear footage of dotted traffic stripe complete in place and accepted will include the gaps shown on the plans as a part of the traffic line design but will not include the length of any other gap or section omitted by the Engineer.

Each 4-inch wide traffic stripe will be measured separately for payment. Each traffic stripe wider than 4 inches will be measured as multiple 4 inch stripes.

Any traffic stripe, either existing or temporary stripe, of any width removed as directed will be measured in the same manner noted for placement of the type stripe involved.

701.05 Basis of Payment

(a) UNIT PRICE COVERAGE

The mileage of Solid or Broken Traffic Stripe, measured as noted above, will be paid for at the respective contract unit prices bid and shall be full compensation for the stripe complete in place which includes the cleaning of the pavement, the furnishing and applying of the striping material and for all equipment, tools, labor and incidentals necessary to complete the item of work.

The footage of Dotted Traffic Stripe, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for furnishing all materials of the appropriate color consistent with the use of the stripe in accordance with the plan details, the preparation of the pavement, the application of the striping material and for all equipment, tools, labor and incidentals necessary to complete this item of work.

The mileage of Solid or Broken Temporary Traffic Stripe, measured as noted above, will be paid for at the respective contract unit prices bid which shall be full compensation for the furnishing of all materials, of the appropriate color consistent with the use of the stripe in accordance with the requirements of the plan details and the A.M.U.T.C.D., the preparation of the surface, the placing of the material, the maintenance of the traffic stripe, the removal of stripe (if necessary) and for all equipment, miscellaneous materials, tools, labor and incidentals necessary to
complete the item of work.

The mileage of existing or temporary Solid or Broken Traffic Stripe Removed, measured as provided above, will be paid for at the contract unit price which shall be payment in full for all materials, equipment, tools, and labor necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Solid/Broken Color, Class _Type _Traffic Stripe (*) —per Mile
Dotted Class _Type _Traffic Stripe (*)—per L.F.
Solid/Broken Temporary Traffic Stripe—per Mile
Solid/Broken Traffic Stripe Removed—per Mile

*If Class 2 Stripe, specify thickness in inches
SECTION 703
TRAFFIC CONTROL MARKINGS AND LEGENDS

703.01 Description

This Section shall cover the application, including furnishing of all materials, of traffic control markings and/or legends in substantial conformity with the plan details and these specifications at the locations designated on the plans or directed. This Section shall also include the application, including furnishing of all materials, of temporary traffic control markings and legends in accordance with the plan details and these specifications at the locations designated on the plans or directed.

Dimensions, color, material, etc. shall be designated in the same manner as noted in paragraph 2 of Section 701.01 for Traffic Stripe.

In addition, this Section shall cover the work of removal of existing traffic control markings and legends when such is provided by the plans and/or proposal.

703.02 Materials

Materials shall conform to the requirements of Division III, Materials, with special attention directed to Sections 861 and 862 and, in the case of temporary marking tape, to the requirements specified in Section 701.02.

All materials must be approved by the Engineer before installation and only materials of a recognized, reputable manufacturer will be considered.

703.03 Construction Requirements

(a) GENERAL
The application of traffic control markings and legends will not normally lend itself to the use of large automatic type machinery; however, selection of a method of placing the markings to produce a uniform satisfactory finished product consistent with the plan details shall be the responsibility of the Contractor.

Cleaning of the pavement surface prior to the placement of any traffic marking material will be required. This may be accomplished by either an attachment to the applying unit or a separate operation.

Applying units used with reflectorized markings shall be equipped with an attachment that will apply a top dressing of "drop-on" glass spheres to the marking material when such is required.

(b) CLEANING PAVEMENT
All pavement areas to be treated shall be thoroughly cleaned. Cleaning shall be accomplished in the same manner as specified in Section 701.03(b).

(c) REMOVING EXISTING MARKINGS
Where so shown on the plans or directed, the existing or directed temporary pavement markings shall be removed by the same methods set forth in Section 701.03(c). Removal of existing markings shall be paid for as a separate item.

Where unsatisfactory traffic control markings are placed by the Contractor and must be removed and replaced to comply with these specifications, the Contractor shall use the removal methods described above. No payment will be made for removal or replacement of the Contractor's unsatisfactory traffic markings.

(d) WEATHER CONDITIONS
Weather conditions provided in Section 701.03(d) shall apply.
(e) APPLICATION

1. GENERAL

The general location of the Traffic Control Markings and Legends will be indicated on the plans. The Contractor shall supply all engineering services necessary to pre-mark and lay out the traffic control markings and legends in accordance with the provisions of Section "J" of the current Alabama MUTCD and details shown on the plans. The Contractor shall submit to the Engineer for approval three (3) copies of a report of survey which clearly indicates the proposed legends and marking to be used and their locations. Said report shall be submitted at least two (2) weeks prior to beginning the marking of a route. All legends and markings shall be referenced by painting a mark on the pavement. Upon acceptance and approval of the survey data, the Engineer may waive the two (2) week time period noted above. Note is made of the fact that obtaining approval of the survey data is considered incidental to the work and no time extension or time delay will be considered due to failure to obtain approval.

If reflectorized markings or legends are required, they shall be treated with a top dressing of glass spheres as noted hereinafter to provide instant reflectivity. Application of this top dressing shall be timed so that the spheres will be firmly attached to the material before final set has occurred and accomplished in such a manner as to provide uniform coverage of the entire marking or legend being placed. The minimum rate of application of this treatment shall be 0.025 pounds per square foot for paint conforming to Section 861, 0.050 pounds per square foot for hot thermoplastic, and 0.066 pounds per square foot for paint conforming to Section 862.

2. PAINT

a. Preparation of Paint

Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned unless approval is given to correct consistency.

b. Rate of Application.

The application rate shall not be less than 0.015 gallon per square foot including the volume of glass spheres in the mixture. The rate should not vary below that specified above by more than 6 percent; any work below this amount shall be repainted without cost to the City.

3. THERMOPLASTIC PAINT

a. Preparation of Paint

Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned unless approval is given to correct consistency.

b. Rate of Application

Application rate shall be applied at a wet film thickness of 15 mils. The rate shall not vary more than plus or minus 1 mil. Any work below this amount shall be repainted without additional cost to the City.

4. Thermoplastic

a. Preparation of Materials

The thermoplastic material shall be prepared in the same manner prescribed in Section 701.03(e)3a.
b. Rate of Application shall be such as to produce a minimum average film thickness of 0.125 inch on all markings and legends. The thickness shall be verified periodically and thickness more than 6% under the designated thickness shall be reworked. Consistent underruns, even within 5% will not be accepted and the Contractor will be required to approach closely the specified thickness. The pavement surface shall be treated with an approved primer-sealer (a type recommended by the thermoplastic material producer) just prior to application of the markings and legends to facilitate bonding of the thermoplastic to the pavement surface.

5. TEMPORARY
   a. General

Temporary markings and legends have been designed for use when it is necessary to provide additional temporary traffic control during construction of a project. The markings and legends shall be consistent with the requirements of the A.M.U.T.C.D., the plan details, and the following requirements.

After placement of any temporary markings and/or legends, the Contractor shall maintain them in such a manner as to provide (1) the placement of a subsequent paving layer or (2) in case of a wearing layer, the placement of the permanent markings and legends or (3) in case of a detour road, until traffic is removed from the detour.

Temporary paint markings and legends will not be required to be removed unless they are on a wearing surface and will not be completely covered by permanent markings and legends.

Temporary tape markings and legends will always be required to be removed whether on a wearing surface or an underlying pavement layer.

Any removal of temporary markings and legends will be considered incidental work and shall be removed by the Contractor prior to the placement of the overlying pavement layer or permanent markings and legends.

b. Temporary Traffic Marking Tape.

In general, the application of traffic marking tape shall be in accordance with the recommendations of the manufacturer of the material; however, minor changes will be allowed if such is shown to produce an equal or better application.

Note is made of the fact that approval for the use of this type material is subject to satisfactory performance under traffic. Any failure for whatever reason during the time frame the material is scheduled to perform shall be repaired immediately. Continued failure of a material to perform shall be cause for disallowing further use of that particular manufacturer's material.

c. Temporary Traffic Marking Paint.

Paint for temporary markings and legends shall meet the same requirements as for permanent markings and legends. The paint shall be prepared and applied as specified in Section 703.03(e)2.

(f) TOLERANCES

A tolerance of 1/2 inch over or 1/8 inch under the specified width will be allowed, provided the variation does not detract from the general appearance. Areas treated shall have neat squared-off edges, painted areas shall have edges without mist or drip. Markings that do not meet these tolerances shall be removed and replaced without additional compensation. Establishment of tolerances does not relieve the Contractor of responsibility to construct as closely as practicable to exact plan dimensions.
(g) PROTECTION OF MARKED AREAS

Protection of the markings shall be accomplished in the same manner set forth for striping in Section 701.03(g).

(h) PROTECTION OF TRAFFIC

Traffic protection shall be accomplished in the same manner set forth in Section 701.03(h). All protective and traffic warning and control devices shall be in accordance with Section "G" of the current Alabama MUTCD.

(i) MAINTENANCE

All treated areas which have been placed in accordance with the plans and specifications, will be considered satisfactory, and the Contractor will be relieved of responsibility for ordinary maintenance on such areas, pending completion and acceptance of the contract.

703.04 Method of Measurement

The square footage of Traffic Control Markings or Legends complete in place and accepted will be surface measured to the nearest 1/10 of a square foot of the area actually treated.

The removal of existing markings or legends shall be measured in the same manner as prescribed above except that it shall cover only the area from which the markings were actually removed.

The square footage of Temporary Traffic Control Markings or Legends, complete in place and accepted, will be surface measured to the nearest 1/10 of a square foot of the area actually treated. No measurement for payment will be made for the removal of temporary markings or legends, the removal of such being classified as incidental to the Items of Temporary Traffic Control Markings and Temporary Traffic Control Legends.

703.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted square feet of Traffic Control Markings or Legends, measured as provided above, will be paid for at the contract unit price bid which shall be full compensation for the item complete in place and includes the cleaning of the pavement, furnishing and applying the markings or legends, and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

The accepted square feet of Traffic Control Markings or Legends Removed, measured as provided above, will be paid for at the contract unit price bid which shall be full compensation for the item complete and includes all necessary materials, equipment, tools, labor and incidentals necessary to complete the work.

The accepted square feet of Temporary Traffic Control Markings or Legends, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the item complete in place and includes the cleaning of the pavement, furnishing and applying the markings or legends, the satisfactory removal, and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Traffic Control Markings, Class ___ Type ___ — per Sq Ft
Traffic Control Legends, Class ___ Type ___ — per Sq Ft
Removal of Existing Traffic Control Markings or Legends — per Sq Ft
Temporary Traffic Control Markings — per Sq Ft.
Temporary Traffic Control Legends — per Sq Ft.
SECTION 705
PERMANENT BARRICADE

705.01 Description

This Section shall cover the work of furnishing and installing a complete permanent barricade system at the location shown on the plans or designated and in conformity with plan requirements and these specifications.

705.02 Materials

Materials furnished for use shall be new, complying with the requirements specified on the plans and with the appropriate sections of Division III Materials.

705.03 Construction Requirements

(a) GENERAL

All the work performed in the installation of the permanent barricade system shall be performed in a competent, workmanlike manner.

(b) ERECTING POSTS

Unless otherwise provided by the plans or proposal, the Contractor may use one of the optional type posts shown on the plans; however, once selected, the same type shall be used through the contract. Posts shall be erected in such a manner that they shall be vertical with their top inside edges within 1/4 inch of their correct position for both vertical and horizontal line. The posts shall be erected to the dimensions shown on the plans and compacted by tamping, puddling, or as directed, to obtain a rigid installation. Where posts are driven, the tops shall be protected by a suitable driving cap and the adjacent area compacted. If raising or other movement of the post is required, the earth shall be compacted to fill any voids caused by such movement. All posts damaged in any way during erection shall be removed and replaced without additional compensation.

(c) ATTACHING PANELS AND HAZARD MARKERS

Panels and hazard markers for the barricade shall be fastened to the rails in the manner shown on the plans. The reflectorized Type "III B" sheeting may be affixed to the panels either before or after the panels have been fastened to the rails.

705.04 Method of Measurement

Permanent Barricades installed as directed and accepted will be measured in linear feet to the nearest 1/10 foot from end to end of each continuous installation. No separate payment will be made for any item or part of the barricade system.

705.06 Basis of Payment

(a) UNIT PRICE COVERAGE

Accepted permanent barricade installed, measured as provided above, will be paid for at the contract bid price per linear foot for permanent barricade which shall be payment in full for the furnishing and installing of the barricade complete in place, including posts, rails, hardware, panels, reflectorized sheeting, and hazard markers and all equipment, tools, labor, and incidentals necessary to complete the work.
(b) PAYMENT WILL BE MADE UNDER:
Permanent Barricades—per Lin. Ft.
SECTION 707
PORTABLE CONCRETE SAFETY BARRIERS
AND IMPACT ATTENUATORS

707.01 Description

This Section shall cover the work of furnishing and installing a portable concrete safety barrier and impact attenuators at the locations shown on the plans, designated in the proposal or directed, along with the satisfactory removal thereof, if so directed.

Portable Safety Barriers shall be classified as to "Type" which will designate the size, shape, height, etc., all in accordance with details shown in the plans. Unless specified otherwise, the type shall be optional, but once a type is selected it shall be used throughout the contract. Portable Impact Attenuators shall be in accordance with details shown in the plans.

707.02 Materials

All materials furnished for use shall conform to the appropriate requirements of Division III, Materials, the details shown on the plans and the following:

Concrete, unless otherwise provided by plan details, shall meet the requirements for Class A, Type 1 of Section 501.

Steel Reinforcement shall meet the requirements of Section 503.

707.03 Construction Requirements

(a) GENERAL

The Construction of barrier units shall be in accordance with the appropriate provisions of Section 501, unless otherwise noted on the plans or proposal.

The finished concrete shall be within reasonably close conformity to the lines, grades and dimensions shown on the plans. The barrier unit shall present a smooth uniform appearance free of objectionable cavities or projections. Where a ten (10) foot straightedge is placed horizontally on the exposed faces of the unit, the surface shall not vary more than 0.02 feet from the edge of the straightedge.

The exposed concrete surfaces shall be finished in accordance with the provisions of Section 501.03(1) for a Class 2 finish on exposed surfaces, unless otherwise specified by plan details.

Portable Impact Attenuators shall be constructed in accordance with plan details.

(b) HANDLING, STORAGE, TRANSPORTING AND INSTALLATION

The Contractor shall be responsible for the proper handling, transporting and installation of the barrier units and impact attenuators, complete in place, at the designated locations.

The units shall be lifted and supported at the points shown on the plans.

Damage to any unit caused by improper handling, transporting or installation on the part of the Contractor shall be cause for the Engineer to order it to be repaired or replaced at no additional cost to the City.
707.04 Method of Measurement

The Portable Concrete Safety Barriers of the type designated will be measured in linear feet to the nearest 1/10 foot along the top surface of the barrier.

The Portable Impact Attenuators will be measured per each in accordance with the plan details for one complete attenuator and its accessories.

707.05 Basis of Payment

(a) UNIT PRICE COVERAGE

1. Portable Concrete Safety Barriers.

The ordered and accepted Portable Concrete Safety Barrier of the designated type, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the fabrication and furnishing of the complete barrier unit and its exclusive use for the duration of the contract, all handling, hauling, installation, relocation, maintenance, removal and satisfactory disposal of the units when deemed of no further use on the project by the Engineer includes all tools, equipment, labor and incidentals necessary to complete the work.


The ordered and accepted Portable Impact Attenuators of the designated design, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the fabrication and furnishing of the complete impact attenuator unit and its exclusive use for the duration of the contract, all handling, hauling, installation, relocation, maintenance, removal and satisfactory disposal of the units when deemed of no further use on the project by the Engineer and includes all tools, equipment, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Portable Concrete Safety Barriers Type *; per L.F.
Portable Impact Attenuator—per Each.

* Show specific type, if required.
SECTION 709
TRAFFIC CONTROL DEVICES FOR CONSTRUCTION WORK ZONES

709.01 Description

This Section shall cover the work of furnishing, erecting, lighting as directed, handling and maintaining all construction signs (warning, regulatory and guide), barricades and other traffic control devices installed at locations specified by plan details for the purpose of handling traffic safely through construction work zones.

The traffic control devices covered by this Section shall meet the requirements specified in the A.M.U.T.C.D. and as detailed on the plans. In case of conflict or discrepancy, the plans shall govern over the A.M.U.T.C.D.

709.02 Materials

All signs, barricades, markers, lights and other warning devices shall be previously approved for use in highway construction.

Materials used in the fabrication, construction and installation of the construction signs barricades and other devices shall conform to the requirements of Section 40.04, plan details, the A.M.U.T.C.D. and the details noted hereinafter:

Sign panels may be fabricated from one of the types of material shown below:

<table>
<thead>
<tr>
<th>Material</th>
<th>Min. Panel Thickness</th>
<th>*Sign Face Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Flat Sheets</td>
<td>0.080 in.</td>
<td>All sizes</td>
</tr>
<tr>
<td>Steel Flat Sheets</td>
<td>0.075 in.</td>
<td>All sizes</td>
</tr>
<tr>
<td>Plastic Flat Sheets</td>
<td>0.250 in.</td>
<td>All sizes</td>
</tr>
<tr>
<td>Exterior Plywood Sheets,</td>
<td>0.50 in.</td>
<td>Up to 16 sq. ft.</td>
</tr>
<tr>
<td>Grade A-C</td>
<td>0.75 in.</td>
<td>Over 16 sq. ft.</td>
</tr>
</tbody>
</table>

*NOTE: Any sign panel installation using Standard Mounting procedures, which does not provide a reasonably rigid sign installation, shall be strengthened by the use of additional supports and/or backing stringers.

Sign backgrounds and messages shall be formed using materials noted for such in Sections 880.02 and 880.03.

When no pre-requirements are specified for units, they shall comply with the manufacturer's specifications.

Items are not required to be new. Used items may be acceptable provided the following conditions are met:

1. Units are in good repair, clean and structurally sound.
2. Reflective sheeting on any unit is clean and in good repair.
3. All legends and messages are sharp, clean and legible.
4. Reflectivity of said units during the hours of darkness shall provide acceptable, clear and uniform delineation without deadspots.
No test reports are required, but the Engineer shall visually inspect all units and accessories for compliance with the various dimensional and material stipulations noted before approving their use in the work. The approval of any unit for use is subject to satisfactory field performance and does not preclude the Engineer ordering replacements of units; said replacements for these previously approved units shall be without additional compensation.

709.03 Construction Requirements

(a) GENERAL

The Contractor shall designate or otherwise provide personnel to furnish continuous surveillance over his traffic control operations. This designee will also be available at night to respond to calls involving damage to barricades lights, signs, etc., either through vandalism or traffic accident. The Contractor shall make known the name of the person providing the surveillance both at the pre-construction conference and to local police establishments.

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 road under traffic, the necessary signs shall be moved concurrently with advancing operation.

All construction signs shall be erected in a workmanlike manner such that all supports are vertical, sign panels generally perpendicular to the travelway and legends horizontal so that they effectively convey the intended message. These signs shall be mounted on stationary or temporary supports depending on the type work being performed. In general work being performed at spot locations and of short duration will necessitate the use of temporary supports properly weighted for stability. If the construction signs are not to be lighted, the supports shall not extend above the top edge of the sign panel.

The location, legends, sheeting, dimensions, spacing of supports and horizontal and vertical placement with respect to the pavement of warning signs barricades and other traffic control devices shall be as required by plan details, A.M.U.T.C.D.. The Contractor must advise and have the approval of the Engineer prior to installing or removing traffic control devices from the project.

During periods of non-use, construction signs and other devices shall be removed from the work area, covered with specified material or otherwise positioned so they do not convey their message to the traveling public. If covered the covering material shall be one-half inch exterior plywood cut to fit the shape of the sign panel. The covering material shall be installed in accordance with the plan details and in such manner that no damage will occur to the sign panel during installation. Covering material shall be maintained in a neat and workmanlike manner during its use.

All construction signs, barricades and other devices which require lighting, as designated by plan details, shall be provided with warning lights or electric incandescent or fluorescent lighting. It will be the Contractor's responsibility to install electric lighting in a safe workmanlike manner and in accordance with the latest edition of the National Electrical Code, National Electrical Safety Code and/or all local codes. The Contractor will be responsible for investigating, procuring and bearing the expense of a continuous power source whether by battery, generator or commercial A.C. supply.

Flagmen with proper attire and flags shall be provided when ordered by the Engineer or when the Contractor deems flagmen necessary to safely handle traffic through the construction zone. Flagmen are considered a general requirement of all traffic control schemes and no direct payment will be made for such.
If at any time the Engineer determines that proper provisions for safe traffic control are not being provided or maintained in accordance with these specifications, he may order suspension of the work until the proper level is achieved. In cases of serious or willful disregard for safety of the public or his employees by the Contractor, the Engineer may proceed forthwith to replace the traffic control measures in proper condition and deduct the cost thereof from monies due or becoming due the Contractor.

(b) SUPPLEMENTARY ITEMS

1. AREA LIGHTING

Area lighting is designated for use at locations where standard delineation devices are not considered sufficient to properly guide the traveling public through the construction work nor advise them of the hazardous conditions which exist. The primary use will be in the areas of crossovers and intersections which are not clearly distinguishable during hours of darkness. Area lighting may consist of one or more area lights.

An area light shall consist of a 250 watt mercury vapor light or equivalent, mounted on a 12 foot mast arm attached to a class 7 wood pole of sufficient length to provide a 30 foot luminaire mounting height above the elevation of the outside edge of paving, unless otherwise shown by plan details. These lights will be placed at locations designated by the Engineer. If possible, the locations should be such that the lights will adequately light the area, but not present a hazard to the traveling public. Bracing or guying of poles which is unsightly or presents a hazard will not be allowed. It will be the Contractor's responsibility to investigate, procure and bear the expense of the power source for these lights whether by commercial A.C. current or generator and to insure that these light sources are installed in a safe workmanlike manner and in accordance with the latest editions of the National Electrical Code, National Electrical Safety Code and/or all local codes.

2. SPECIAL CONSTRUCTION SIGNS.

Special construction signs shall consist of signs which require special fabricated sign panels or special mounting requirements; such signs will be designated as "Special" on the construction plans.

(c) MAINTENANCE

The Contractor shall assume full responsibility for the continuous and expeditious maintenance of all construction warning signs, barricades and other traffic control devices. Maintenance shall include but shall not be limited to replacement of sign panels, barricades and other devices which are damaged or deteriorated beyond effective use, replacement of broken supports, plumbing of leaning signs, cleaning of dirty signs, barricades and other devices, repair of defaced signs, replacement of stolen items, etc.

All items used for traffic control shall be generally maintained in its original placement condition and such maintenance will be considered a part of the original installation cost. Failure to maintain all traffic control devices in such manner as to provide adequate continuous safety to the public will be cause for action by the Engineer as noted in the last paragraph of Section 709.03(a).

(d) LIABILITY

Reference is made to Section 70 of the Specifications which covers the legal responsibilities of the Contractor to the traveling public. Although the City will be designating and directing the placement of certain traffic control devices, the Contractor is not relieved of his responsibility to continuously review and maintain all traffic handling measures and insure himself that adequate provisions have been made for the safety of the public and workmen.
Construction signs and other traffic control devices specified by plan details are considered the minimum requirements for satisfactory traffic control and does not prohibit the Contractor from furnishing additional items to protect his contract liability. These additional traffic control devices will be considered as an overall part of the Contractor's obligation under Section 70 and no direct payment will be made for such additional devices.

709.04 Method of Measurement

The various items used in the handling of traffic through construction zones will be not be measured directly for payment and will be considered incidental to the work.

709.05 Basis of Payment.

No direct payment will be made for the traffic control and the cost shall be absorbed in other appropriate items of work.
SECTION 711
PORTABLE SEQUENTIAL ARROW
AND CHEVRON SIGN UNIT

711.01 Description

This Section shall cover the work of furnishing Portable Sequential Arrow and Chevron Sign Units and all services and operational supplies necessary to provide a functional sign unit during the life of the contract.

711.02 Materials

All sign units furnished for use under this Item may be new or reconditioned units which were designed and manufactured specifically for use in traffic control which provide at least the following:

1. A minimum 4' x 8' message board of an appropriate design capable of producing a left or right hand mode for a sequential chevron (min. of 3 chevrons), flashing arrow, sequential arrow or sequential stem arrow using 5" diameter sealed beam lamps.

2. Electronic controls for operating messages at 30-50 FPM with dimming of lamp intensity for day and/or night operation capability.

3. Power source shall be capable of providing an adequate continuous power supply for at least 24 hours without refueling.

4. A trailer of substantial design for transporting the sign unit from one location to another and to provide a stable setup at location of use.

711.03 Construction Requirements

(a) GENERAL

The portable sign unit furnished or provided under this Section is to be used in conjunction with the handling of traffic through the work. The use thereof is shown on the plan details for traffic handling.

(b) MAINTENANCE

All sign units shall be maintained in such a manner as to provide continuous service during their use on the project. Units which become non-operational during use will require the Contractor to provide flagmen or other approved traffic handling methods until the units can be repaired or replaced.

711.04 Method of Measurement

This item if used in the handling of traffic through construction zones will be not be measured directly for payment and will be considered incidental to the work.

711.05 Basis of Payment.

No direct payment will be made for the traffic control and the cost shall be absorbed in other appropriate items of work.
SECTION 713
ELECTRICAL CONDUITS UNDER ROADWAYS

713.01 Description

This Section shall cover the work of furnishing and installing electrical conduits as detailed by the plans and these specifications. The installation shall include placement of the conduit at the location shown on the plans.

All electrical conduits installed under this Section shall be encased, with the kind of encasement depending on the type of installation as follows:

Type 1 installation—conduit installed by open trench method and having a concrete encasement.

Type 2 installation—conduit installed by an approved jacking or boring procedure and having a steel pipe encasement.

713.02 Materials

Materials shall meet the appropriate requirements of Division III, Materials, and the requirements noted hereinafter in this Section.

Conduit shall meet the requirements of the plan details and proposal.

Metal encasement pipe shall meet the requirements of the plan details and proposal.

Concrete used to encase conduit in a Type 1 installation shall be Class A concrete meeting the requirements of Section 501.

All electrical equipment shall conform to the standards of the National Electrical Manufacturers' Association (N.E.M.A.), or Underwriters Laboratory, whichever is applicable. Workmanship and materials shall conform to the requirements of the National Electrical Codes, National Electrical Safety Code and with any local codes or ordinances governing electrical installations. All materials and equipment shall be new, except where the plans specifically provide for re-using existing equipment.

Within 30 days after execution of the Contract, the Contractor shall submit to the Engineer a list of materials which he proposes to use. The list shall show the name of the manufacturer, size, name and identifying catalog number of each item.

If requested by the Engineer, the Contractor shall submit for inspection and approval samples of the proposed substitute item and bear any extra costs of evaluating the quality of the materials. All lists shall be submitted in quintuplicate for checking and approval. The City will not be liable for any materials purchased or work done or any delay incurred prior to such approval. Failure of the Engineer to note unsatisfactory material as received will not relieve the Contractor from responsibility.

Omissions from the drawings and specifications, or the mis-description of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omissions and details of work, but they shall be performed as if fully and correctly set forth and described in the drawings and specifications. In any case of discrepancy in figures, catalog numbers, descriptions in the drawings or in the specifications, the matter shall be promptly submitted to the Engineer who shall promptly make a determination in writing. Any adjustment by the Contractor shall be at the Contractor's own risk and expense.

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713.03 Construction Requirements

(a) GENERAL

All construction and installation of electrical conduits shall be done under direction of specially qualified supervisors. All workmanship shall be in accordance with the latest accepted standard of the industry.

Upon completion of the contract, the Contractor shall deliver to the Engineer a corrected plan showing in detail the actual location and depth of conduits.

Improvements, such as sidewalks, curbs, gutters, portland cement concrete and asphaltic concrete pavement, bituminous surfacing, base material, and any other improvements broken or damaged by the Contractor, shall be replaced or reconstructed with the same kind of materials as found on the work, or with materials of equal quality. The new work shall be left in a serviceable condition.

Whenever a part of a square or slab of existing concrete sidewalk or driveway is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed as above specified.

The outline of all areas to be removed in portland cement concrete sidewalks and pavements shall be cut to a minimum depth of 1 1/2 inches with a saw, prior to removing the sidewalk and pavement materials. Cut for remainder of the required depth may be made by a satisfactory method. Cuts shall be neat and true with no shatter outside the removal area.

(b) OPEN TRENCH METHOD

The excavations required for the installation of conduits shall be performed in such a manner as to cause the least possible injury to the street, sidewalks, and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavating shall not be performed until immediately before installation of conduit and other appliances. The material from the excavation shall be placed in a position where the least damage and obstruction to vehicular and pedestrian traffic, and the least interference with the surface will occur.

All surplus excavated material shall be removed and disposed of by the Contractor.

Excavations after backfilling shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made.

At the end of each day's work and at all other times when construction operations are suspended, all equipment and other obstructions shall be removed from that portion of the roadway open for public travel.

Coordination of this type work with regular roadway or bridge work will be of prime importance to prevent undue damage to completed items of work or existing facilities. Any damage to existing facilities caused by the installation of the ducts shall be repaired by the Contractor at no additional cost to the City.

(c) JACKING OR BORING METHOD

All conduits installed under paved areas shall be encased in steel pipe. Installation of the casing shall be made prior to placement of the pavement or it shall be jacked or bored through the roadbed under the pavement providing a minimum cover of 30 inches.

The jacking or boring procedure and equipment shall be such that placement of the casement shall be accomplished without producing an unsupported opening through the roadbed between the established ends of the required length of casing. In no event should casing lengths be less than the distance between shoulder limits of a roadway.

The accepted amount of electrical conduit of the type installation required shall be measured by the linear foot to the nearest foot.
713.05 Basis of Payment

(a) UNIT PRICE COVERAGE

The accepted electrical conduit, measured as noted above, will be paid at the contract unit price bid for the type installation involved. Said unit price bid shall be full compensation for the furnishing and installation of the electrical conduit, for the steel pipe or concrete encasement, for all excavation and backfill jacking or boring, disposal of excess material, and for all labor, tools, equipment, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER:

Electrical Conduit, *Lines, Type **Installation —per L.F.

*Specify number of lines in installation
** Specify type of installation
DIVISION III

SECTION 800
MATERIALS

800.01 General

All materials used in the work shall be new, unused material that will meet the requirements described in this Division unless the same are altered by specific requirements of any Section of these Specifications, Supplemental Specifications, Special Provisions, or by modifying Notes on the plans. All materials shall also meet the requirements of applicable portions of Section 60 which will supplement the requirements of this Section. All tests shall be performed as noted within these Specifications.

800.02 Inspection Arrangements.

(a) CONTRACTORS' NOTIFICATION.

It shall be the duty of the Contractor to notify the Engineer of Public Works of the source of the various materials required for each project. This notice shall be received sufficiently in advance of any shipment of materials so that inspection may be arranged at the producing plant if the Engineer so elects.

(b) PLANT INSPECTION.

Whenever the quantity of materials warrants such an arrangement or it is economically advantageous to the City, the inspection of materials at the original or immediate source of supply will be made. However the Department is under no obligation to the Contractor to inspect materials until it arrives at the site of the work. In general, all aggregates, soil, brick, reinforcing and structural steel, bituminous materials, timber, lumber, piling, and posts which are to become a part of the completed work will be inspected at the point of production.

(c) GENERAL DETAILS.

1. For lumber and timber products the producer shall have sorted his stock and shall have separated a sufficient quantity of material to insure that all of each item for inspection is available before the Inspector is called. In the event that part of the shipment is rejected because of failure to meet the specification requirements, the producer shall furnish other stock to replace the rejected items.

2. Should the quantity of any material rejected for failure to meet specification requirements amount to 20 percent or more of the material inspected and tested at that time, the inspection operation will be suspended until the producer shall have regraded his stock or revised his production methods to produce material uniformly conforming with the specifications. When sampling stockpiles of aggregates, base materials, etc., the average of all samples must be within the gradation band required for the size aggregate specified. In no case will stockpiles be acceptable if more than 20% of the total samples fall outside the gradation band, in addition any failing sample must be within 20% of the range specified for any designated sieve.

3. Where a Contractor's producer or jobber requests inspection of material for warehouse stock or for use in plants where stocks of materials inspected and accepted for use in street construction or maintenance cannot be kept separated from materials which are to be used on other work, the cost of inspection of those materials shall be the responsibility of such producer or jobber.
materials which have been approved for construction projects, but are later diverted to other uses not connected with the City's construction or maintenance, will be charged to the Contractor who requested such inspections.

800.03 Testing, General.

Where maximum and minimum specification limits are given, it is intended and expected that materials having approximately mean values will be furnished under the respective specifications. The established allowances for variations in the determination of these values are considered in establishing the limits and no tolerances in excess of the established variation allowances will be permitted unless so specifically stated in the proposal or on the plans.

Where material is fabricated of or treated with another material or any combination of materials is assembled to form a product, any or all of which are covered by these specifications, the failure of any of the components of the product to comply with the designated specifications shall be deemed sufficient cause for the rejection of the whole.

The sieves used for testing materials shall be woven wire cloth conforming to AASHTO Specifications M-92.

800.04 Tests for Concrete Materials.

Preliminary samples of fine aggregate, water, and cement shall be subject to both 7 and 28 day tests or their equivalent and acceptance based thereon. During the progress of the work, these materials may be accepted on the basis of the 7 day test, except that Type III cement may be accepted on the basis of the 3 day test.

800.05 Bituminous Mixture Stability and Density Test.

These tests shall conform to the current methods as described in ASTM Designation D 1559 or D 1138, depending on the maximum aggregate size.

800.06 Measurement of Liquid Bituminous Materials.

(a) MEASUREMENT.
Actual measurement shall be in accordance with the provisions of Section 90.02(a) and/or (b).

800.07 Soil Analysis Test.

(a) MECHANICAL ANALYSIS.
This test shall be performed in accordance with AASHTO Test Method T-88.

(b) ELUTRIATION TEST FOR CLAY.
This test shall be performed in conformity with the current Alabama State Highway Department method of elutriation tests, Test No. AHD 50.

(c) CALIFORNIA BEARING TEST.
The California Bearing Test shall be performed in conformity with AASHTO Designation T-193 modified as required by the Engineer of Public Works.

(d) LIQUID LIMIT.
This test shall be performed in accordance with AHD Test Method 232.
800.08 Field Performance Test.

In addition to specifications and tests specified, it may be necessary to have certain material undergo field performance testing for a prescribed period. The materials involved and the specified field performance testing will be determined by the Department's Project Engineer or authorized representative. The project Engineer or representative will determine which type of material will require this field performance testing and the duration thereof. In general, this will include materials such as Pavement Markers, Concrete Joint Fillers and Sealants, Concrete Patching Materials, Epoxies, Reflective Material for Object Safety Markings, Membranes for Waterproofing Joints, and certain pavement marking materials.
SECTION 801
COARSE AGGREGATE

801.01 Description.

Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, or crushed slag, having hard, strong, durable pieces, free from adherent coatings and conforming to the requirements provided hereinafter in this Section.

801.02 Deleterious Substances.

The amount of deleterious substances in coarse aggregates shall not exceed the following limits:

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>TABLE II</th>
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</thead>
<tbody>
<tr>
<td>Bituminous Surface Treatments and Concrete Types 1, 5, 6 &amp; 7</td>
<td>All Other Uses</td>
</tr>
<tr>
<td>(a) Soft particles (AHD No. 345)</td>
<td>5.0%</td>
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<tr>
<td>(b) Coal and Lignite</td>
<td>0.25%</td>
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<tr>
<td>(c) Clay Lumps</td>
<td>0.25%</td>
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<tr>
<td>(d) Material Passing the No. 200 Sieve</td>
<td>1.0%</td>
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<tr>
<td>(e) Thin or elongated pieces (length greater than 5 times average thickness)</td>
<td>10.0%</td>
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<tr>
<td>(f) Other local deleterious substances (Shale, Mica, Marcasite, etc.)</td>
<td>2.0%</td>
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<tr>
<td>(g) Total Sec. 801.02(a), (b), (c), (d), and (f)</td>
<td>6.0%</td>
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<tr>
<td>(h) Silica (in limestone used in Portland Cement Concrete Pavement)</td>
<td>8.0%</td>
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<tr>
<td>(i) Absorption</td>
<td></td>
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</tbody>
</table>

*Crushed gravel for use in bituminous plant mixes shall have a total sample absorption not greater than 5 percent on the material passing the 3/4 inch sieve and retained on the No. 4 sieve.

Material suspected of containing deleterious substances will be examined in the laboratory and will be rejected if the amount is considered objectionable.

Coarse aggregate for portland cement concrete and cover aggregate for bituminous treatment shall be washed and shall be free from adherent coatings. Coating on crushed stone shall be dust of fracture as determined by washing the material passing the #200 sieve in accordance with AASHTO-T 11 or visual inspection using a petrographic microscope. Adherent coating will be checked by washing in a large container without scrubbing or applying water pressure. The aggregate will then be checked for adherent coating by visual inspection. Aggregate that has an adherent coating will not be acceptable.
801.03 Crushed Stone, Gravel, and Crushed Gravel.

(a) GENERAL.
Crushed stone shall be from approved ledges or working strata within an approved source and shall consist of clean, tough, durable fragments, reasonably free of shale, conforming to requirements for the type use noted in Section 801.03(b) and the gradation specified. Gravel shall consist of natural rounded or crushed fragments of clean, tough, durable stone free from coatings of any character and conforming to the gradation specified. Crushed gravel shall consist of crushed fragments of gravel, conforming to the requirements of Sections (a) and (b) of this Section. At least 80 percent by weight of the material retained on the No. 4 mesh screen shall have at least 2 fully fractured faces, one of which shall have a dimension as large as the diameter of the particle inspected.

(b) PHYSICAL TESTS.
Crushed stone, gravel, and crushed gravel shall meet the following requirements for the respective physical tests:

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Conforming Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Percent Wear Los Angeles Test (AASHTO T-96)</td>
<td>Cement Concrete 50 Max.</td>
</tr>
<tr>
<td>2. Percent Sound, Soundness Test (AASHTO T-104 using Sodium Sulphate and 5 Cycles)</td>
<td>Cement Concrete 90 Min.</td>
</tr>
</tbody>
</table>

801.04 Blank

801.05 Crushed Slag.

(a) GENERAL.
Slag is defined as a stone-like siliceous material with porous faces produced as a by-product of various manufacturing processes. Crushed slag produced from processing slag obtained from sources approved by Engineer shall consist of clean, tough, durable pieces, reasonably uniform in density and quality without thin or elongated pieces, free from deleterious substances and conforming to the specified gradation.

(b) PHYSICAL TESTS.
Physical tests for crushed slag shall be the same as provided by Section 801.03(b) for the type of construction specified, i.e., soil type, or bituminous.

801.06 Coarse Aggregate for White Concrete.

This coarse aggregate shall be white or very light colored gravel, limestone, marble, or granite, subject to the approval of the Engineer for color and otherwise conforming to the specifications of this section for coarse aggregate. The size number will be shown on the plans and/or proposal.
801.07 Coarse Aggregate for Mastic (For Water Proofing Concrete Surfaces).

Coarse aggregate for mastic shall be a well crushed stone, slag, or washed gravel that will pass a 3/8 inch screen and be retained on a No. 8 screen. It shall be free from soft particles and organic matter.

801.08 Gradation.

Coarse aggregate shall be graded between the limits specified and the size or sizes designated shall conform to the limits shown in the following Coarse Aggregate Gradation Table provided in Section 801.11(d).

801.09 Aggregates for Base.

Aggregates for base layers shall consist of gravel, crushed gravel, crushed slag or crushed stone as specified for the type of base designated; however, sand and gravel from local roadside pits will only be required to comply with the applicable portion of Section 826.

801.10 Aggregates for Bituminous Work.

Aggregate for bituminous work shall be one or a combination of the aggregates specified for the type of bituminous work involved. It shall be uniformly graded so as to meet the gradation requirements for the size designated to be used. The aggregate shall be of such nature that, when once thoroughly dried and coated with the bituminous material proposed for construction, the coating will not strip off upon contact with water.

801.11 Use, Care, and Handling: Gradation Table and Explanation.

(a) CARE AND HANDLING.

Care and handling shall be as provided by Section 60.05.

(b) STORAGE.

1. Attention is directed to the requirements of Section 60.05 and the following:
   1. The Contractor shall prepare the storage area as needed—any stockpiled material that cannot be removed without including dirt or other foreign matter shall be rejected.
   2. Stockpiling shall be as provided by AHD Method 175.
   3. Different sizes of aggregate and aggregate from different sources shall be stored in separate stockpiles sufficiently separated from each other so that the material will not become intermixed. Any material which segregates so that the grading no longer conforms to that specified shall be rejected for use.

(c) USE.

1. At the time of their use, the aggregates shall be free from all foreign materials.
   2. When more than one size of aggregate is required, the various sizes shall be combined in proper proportions at the mixer or plant.
   3. Aggregates stored in proportioning bins shall be protected from rain by waterproof coverings.

(d) COARSE AGGREGATE GRADATION TABLE.
### TABLE OF COARSE AGGREGATE SIZES *

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<td>60-85</td>
<td>40-70</td>
<td>10-25</td>
<td>1-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>100</td>
<td>85-100</td>
<td>10-40</td>
<td>0-10</td>
<td>0-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>100</td>
<td>85-100</td>
<td></td>
<td></td>
<td>10-30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Explanation of Table**

1. Tabulated figures are percentages by weight of material finer than each laboratory sieve.
2. Exclusive of light weight aggregates, the minimum dry rodded weight per cubic foot shall be 65 pounds for Sizes 1, 3 and 4, and 70 pounds for other sizes. See Section 801.12 for weights of light weight aggregates.

The following coarse aggregate (gravel only) gradation may be substituted for use in concrete types 2, 3 and 4 for those coarse aggregate size Nos. designated in the Master Proportion Table:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- 1/2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>80 - 100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>70 - 100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>25 - 80</td>
</tr>
<tr>
<td># 4</td>
<td>0 - 15</td>
</tr>
<tr>
<td># 8</td>
<td>0 - 10</td>
</tr>
</tbody>
</table>

801.12 Lightweight Aggregates for Bituminous Work.

Lightweight Aggregates of expanded clays or shales produced by the Rotary Kiln Method shall meet the requirements noted herein in this Section except the dry rodded weight shall be 35 to 55 pounds per cubic foot and the L.A. Abrasion Test (AASHTO-T-96) shall be modified to compensate for lightweight aggregate by the use of the following method.

Modification to AASHTO-T-96 for Lightweight Aggregate:
To avoid the excessive volume of material in the testing machine which will occur when the lightweight aggregate sample is prepared according to AASHTO-T-96, it is necessary to reduce the weight proportionately to obtain an equal volume of lightweight aggregate comparable to that normally obtained with a conventional aggregate sample.

The abrasive charge must also be reduced in a similar manner.

1. Determine the unit weight \((U_L)\) of the lightweight aggregate by AASHTO-T-19.
2. Assume an average unit weight of conventional aggregate to be 97.0 pounds per cubic foot.
3. Reduce the lightweight aggregate sample.

\[
U_L = \frac{X}{97}
\]

\[
X = (C) \times U_L
\]

\[
X = \frac{\text{(C)} \times (U_L)}{97.0}
\]

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Where:

\[ U_L = \text{Unit weight of lightweight aggregate sample (Lbs. per cu. ft.)} \]
\[ C = \text{Weight of Conventional aggregate required for grading in AASHTO T-96.} \]
\[ X = \text{Reduced lightweight aggregate sample charge.} \]

4. Reduce the abrasive charge:

\[ U_L = X \times \frac{97.0}{C} \]
\[ X_1 = (C_L)97(U_L) \]

Where:

\[ U_L = \text{Unit weight of lightweight aggregate (lzs. per cu. ft.)} \]
\[ C_L = \text{Weight of abrasive charge required for grading in AASHTO T-96.} \]
\[ X_1 = \text{Reduced abrasive charge for lightweight aggregate.} \]

5. Remainder of procedure as set forth in AASHTO-T-96.

NOTE: It is sometimes impossible to obtain the exact abrasive charge with the steel balls available. In this case, obtain the closest abrasive charge possible to the reduced value and then adjust the weight of the sample in proportion to the new abrasive charge.
SECTION 805
FINE AGGREGATES

805.01 Description.

Fine aggregate shall consist of natural or manufactured sand having hard, clean, durable, uncoated particles and conforming to the requirements provided hereinafter in this Section.

805.02 Concrete Sand.

(a) DESCRIPTION.
Concrete sand shall consist of natural sand, blends of natural sand, blends of natural and manufactured sand, or manufactured sand. The use of manufactured sand shall be limited to the conditions noted in Section 805.06.
Blended sand shall be mixed and tested for gradation after blending has been completed.
The sand shall be washed and have strong, hard, clean, durable particles meeting the physical requirements noted below and the gradation requirements of AHD Size #100. There will be no F.M. or mortar strength requirements for concrete sand used in bituminous pavements.

(b) DELETERIOUS SUBSTANCES.
1. The maximum weight of deleterious substances shall not exceed the following requirements:
   Materials passing the #200 Sieve removed by decantation shall be subject to approval or rejection based on the following:
   a. If any sample has more than 2.5% material passing the No. 200 mesh sieve by decantation, the stockpile will be rejected.
   b. An average will be made of the samples tested by decantation through the No. 200 mesh sieve. If the average is greater than 2.0%, the stockpile will be rejected. If the average is 2.0% or less, the stockpile will be accepted.
   c. If smaller quantities of the fine aggregate are being tested where only one sample would be required, this sample will be required to comply with a 2.0% maximum removed by decantation, not to exceed the following percentages:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shale</td>
<td>1.0%</td>
</tr>
<tr>
<td>Coal and/or Lignite</td>
<td>0.5%</td>
</tr>
<tr>
<td>Clay Lumps</td>
<td>0.5%</td>
</tr>
<tr>
<td>Cinders and Clinkers</td>
<td>0.5%</td>
</tr>
<tr>
<td>Other local deleterious substances (such as alkali, mica, coated grains, soft and flaky particles)</td>
<td>1.0%</td>
</tr>
<tr>
<td>Total shale, coal, and/or lignite, clay lumps, cinders and clinkers, and other local deleterious substances</td>
<td>3.0% Maximum</td>
</tr>
</tbody>
</table>

Concrete sand to be used in Concrete Type 2, 3 and 4 shall comply with the above except that not more than 3.0 percent shall pass the No. 200 mesh sieve by decantation.

2. The percentage of clay lumps shall be determined by examining the various fractions which remain after the test for grading. An indication of clay lumps shall require testing in accordance with AASHTO T-1 12 to determine the amount of clay lumps.
3. The diameter of deleterious substances shall not exceed the maximum size of aggregate.

(c) ORGANIC IMPURITIES.
All fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colorimetric test for organic impurities and producing a color darker than the standard shall be rejected unless they pass the mortar strength or concrete strength tests as outlined in Section 805.02(e) and (f).

(d) SOUNDNESS.
When subjected to five cycles of the soundness test of fine aggregate by the use of sodium sulphate the weighted percentage of loss shall not be more than 10 percent by weight when tested by AASHTO T-104. In lieu of the soundness test, satisfactory evidence may be provided that the fine aggregate has been exposed to natural weathering, either directly or in concrete for a period of at least 5 years without appreciable disintegration.

(e) MORTAR STRENGTH.
When tested in accordance with AASHTO T-71, fine aggregate shall have compressive strength not less than 95% of treated sand as prescribed in AASHTO T-71 at 3 days and 14 days with the use of Type III portland cement or at 7 days and 28 days with Type I or Type II portland cement.

(f) CONCRETE STRENGTH.
Fine aggregate failing to meet the requirements herein provided for mortar strength may be used if (1) when tested in combination with the cement and coarse aggregate to be used in the work, the crushing or tensile strength of the concrete at the end of 7 (3 days with Type III cement used) and 28 days is at least equal to the strength obtained from specimens made with sand meeting the requirements for the class of concrete in which the material is to be used, or (2) when the past performance record of the aggregate with the particular cement has been satisfactory.

(g) GRADATION UNIFORMITY.
The gradation of AHD size 100 fine aggregate from any one source shall be reasonably uniform. For the purpose of determining the degree of uniformity, a fineness modulus determination shall be made upon representative samples from the source in accordance with the provisions of AASHTO M-6 for fineness modulus determination.

The following schedule will apply to AHD size 100 fine aggregate for various kinds of concrete.

Portland Cement Concrete Pavement, Bridge Superstructure Concrete and Prestressed Concrete.

<table>
<thead>
<tr>
<th>FM</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.30</td>
<td>3.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Establish Working F.M. (W.F.M.)
Tolerance from W.F.M. is plus or minus 0.20

Structure Concrete (Other Than Bridge Superstructure Concrete).

<table>
<thead>
<tr>
<th>FM</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.30</td>
<td>3.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Working F.M. not required, however, if the F.M. exceeds 2.80 the Contractor will be required to increase the designated cement volume by 1/4 sack per yard without additional cost to the City.*

*If requested in writing by the Contractor, consideration will be given to using fly ash in the mix to increase the fines. There will be no F.M. requirements on concrete sand used in Concrete Types 2, 3 and 4.
805.03 Mortar Sand.

Sand for mortar, AHD size 101, shall consist of washed, hard, strong, durable, uncoated mineral or rock particles, reasonably free from injurious amounts of organic, or other deleterious substances and meeting applicable requirements of Section 805.02.

805.04 Bituminous Pavement Fine Aggregate.

Fine aggregates for bituminous pavements shall be defined as material passing the 3/4 inch sieve. The aggregate may be natural sand, manufactured sand (produced by crushing aggregates approved by the Engineer of Public Works), or a blend of natural and manufactured sand. However, if, in the opinion of the Engineer of Public Works, the manufactured sand contains an excessive amount of fines as outlined in the gradation table contained in these specifications, the material will be rejected unless supplemented by blending with washed coarse sand in an amount approved by the Engineer.

Mineral filler (including agricultural limestone or limestone screenings, all of which shall pass the 3/8 inch sieve) may be used when additional fines are needed; however, if used in the actual wearing surface, the amount of mineral filler shall not exceed 20 percent by weight of the total mineral aggregate. The total fine aggregate after drying shall be free from lumps or balls of clay and sand.

805.05 Blank.

805.06 Manufactured Sand for Portland Cement Concrete

Manufactured sand produced from crushing gravel or granite shall be used either as a blend with natural sand or as one hundred percent (100%) weight of the total fine aggregate.

Manufactured sand produced from crushing limestone shall be used in a blend with natural sand and shall not exceed twenty percent (20%) weight of the total fine aggregate. One hundred percent (100%) manufactured limestone sand may be used in prestressed or precast concrete, or cast in place concrete if approved by the Engineer, which will not be exposed to vehicular traffic.

Manufactured sand shall meet all of the requirements for AHD #100 concrete sand, Section 805.02, except the requirement of Section 805.02(b)1a may be increased to five percent (5%) if the material is "Dust of Fracture.”

805.07 Fine Aggregate for White Concrete.

Fine aggregate for white concrete shall be a natural white washed sand and/or an artificial sand made from white quartz, crushed white limestone, white marble, or white granite and shall contain no discoloring material, clay loam or other foreign matter. It shall be secured from sources previously tested and approved by the Department for whiteness and light reflecting qualities or by visual comparison shall be, in the opinion of the Engineer, at least as white as the approved standard sample on file in the Engineer's office. Other requirements for this fine aggregate shall conform to Section 805.02, with the gradation requirements in accordance with size No. 106.

805.08 Blank.

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805.09 Gradation.

Fine aggregate shall be well graded between the limits specified and the size or sizes designated shall conform to the limits shown in the Fine Aggregate Gradation Table.

### TABLE OF FINE AGGREGATE SIZES

<table>
<thead>
<tr>
<th>AGG SIZE NO.</th>
<th>DESCRIPTION</th>
<th>3/8&quot;</th>
<th>No. 4</th>
<th>No.8</th>
<th>No.16</th>
<th>No.50</th>
<th>No 100</th>
<th>No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Concrete Sand</td>
<td>100</td>
<td>95-100</td>
<td>80-100</td>
<td>50-90</td>
<td>5-30</td>
<td>0-10</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Mortar Sand</td>
<td></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Plant Mix Sand</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-12</td>
</tr>
<tr>
<td>105</td>
<td>Manuf. Sand</td>
<td>100</td>
<td>95-100</td>
<td></td>
<td>50-80</td>
<td>20-50</td>
<td>10-25</td>
<td>5-12</td>
</tr>
<tr>
<td>106</td>
<td>White Concrete</td>
<td>100</td>
<td>95-100</td>
<td>75-100</td>
<td>50-90</td>
<td>10-35</td>
<td>5-15</td>
<td>0-5</td>
</tr>
</tbody>
</table>

NOTES: (1) Figures are percentages by weight of material finer than each sieve.
(2) The F.M. for size 100 when used in Portland Cement Concrete Pavement shall be 2.30 minimum, 3.00 maximum.
(3) See Sections No. 805.02 to 805.07 for descriptions.

Concrete sand for Concrete Types 2, 3 and 4 shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>95 - 100</td>
</tr>
<tr>
<td>#4</td>
<td>85 - 100</td>
</tr>
<tr>
<td>#8</td>
<td>75 - 100</td>
</tr>
<tr>
<td>#16</td>
<td>30 - 80</td>
</tr>
<tr>
<td>#30</td>
<td>5 - 45</td>
</tr>
<tr>
<td>#50</td>
<td>0 - 10</td>
</tr>
<tr>
<td>#100</td>
<td></td>
</tr>
</tbody>
</table>
805.10 Aggregate for Bituminous Work.

The provisions of Section 801.10 are applicable to all Fine Aggregate used in bituminous work.

805.11 Use, Care, and Handling; Gradation Table.

Use, care, and handling of fine aggregate shall be in accordance with the provisions of Section 801.11, modified with respect to fine aggregate where necessary.
SECTION 807
BITUMINOUS MATERIALS

807.01 General.

The bituminous materials furnished shall be of approved quality and shall meet the requirements shown under its respective type in the following tables for the kind of material furnished. For any contract, the material furnished shall show a uniform test. Where more than one grade of material is permitted for any item of work, the Engineer shall specify the grade desired. In all cases, the Engineer will specify the consistency limits for the grade of material shown on the plans and/or proposal form designated. The Contractor may without extra compensation, supply bituminous material containing approved additives for producing non-stripping characteristics. For such materials an adjustment in the total bitumen requirements of this subdivision will be made as deemed necessary by the Engineer.

Sampling of tank cars, tank trucks, distributor trucks or recirculating storage tanks shall be by the use of a sampling valve as prescribed in Figure 3 of AASHTO Designation T-40 installed in the tanks.

807.02 Asphalt Cement.

The material supplied under this Section shall be asphalt prepared by the refining of asphaltic petroleum of the six (6) basic Viscosity grades of asphalt cement used in pavement construction. The refined asphalt cement shall be homogeneous, free of water, shall not foam when heated at 347°F. (175°C.), and shall conform to the requirements shown in Bituminous Table No. 1.

Shipping temperature of the asphalt from the refinery shall not exceed 360°F. At the time of use, the asphalt temperature shall comply with the requirements of Item 401.03(d)2 or Section 410.02(b) whichever is applicable.

807.03 Cutback Asphalt.

The materials supplied under this Section shall be made from asphalt cement base and naphtha solvent, so proportioned and mixed that the finished product shall be homogeneous and conform to the requirements of AASHTO Designation M-81 for rapid curing cutback and AASHTO M-82 for medium curing cutback.

807.04 Emulsified Asphalt.

The materials supplied under this Section shall be homogeneous emulsification of asphalt and shall show no separation of asphalt or objectionable change in viscosity within 3 months after delivery. Separation at any time caused by freezing or contamination shall be cause for rejection. Emulsified asphalt shall conform to the requirements as shown in Bituminous Table No. 2.

807.05 Tar.

The materials supplied under this Section shall be produced from suitable gas-house, coke-oven, and/or water-gas tars. The grades of tar specified shall conform to the requirements as shown in Bituminous Table No. 3.

807.06 Tables of Bituminous Materials.

(See following pages)
**BITUMINOUS TABLE NO. 1**

**SPECIFICATIONS FOR ASPHALT CEMENTS**

<table>
<thead>
<tr>
<th>Tests</th>
<th>Viscosity Grade</th>
<th>Tests on Residue from Thin-film Oven Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AC-2.5</td>
<td>AC-5</td>
</tr>
<tr>
<td>Viscosity, 140 Deg. F. (60 Deg. C.). poises</td>
<td>250 + 50</td>
<td>500 + 100</td>
</tr>
<tr>
<td>Viscosity, 275 Deg. F. (135 Deg. C.). Cs</td>
<td>125</td>
<td>175</td>
</tr>
<tr>
<td>Penetration, 77 Deg. F. (25 Deg. C.), IOOg</td>
<td>220</td>
<td>140</td>
</tr>
<tr>
<td>Flash Point, COC. F.</td>
<td>325</td>
<td>350</td>
</tr>
<tr>
<td>Solubility in trichloroethylene. %</td>
<td>99.0</td>
<td>99.0</td>
</tr>
<tr>
<td>T-179</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, 140 Deg. F. (60 Deg. C.), poises, 5 cm per min, cm</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Ductility, 77 Deg. F. (25 Deg. C.), 5 cm per min, cm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# BITUMINOUS TABLE NO. 2—SPECIFICATION FOR EMULSIFIED ASPHALT

<table>
<thead>
<tr>
<th>TEST</th>
<th>GRADE</th>
<th>AE-P</th>
<th>MP</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO M-1 4 0</td>
<td>Meet</td>
<td>-</td>
<td>-</td>
<td>AASHTO T-59</td>
</tr>
<tr>
<td>AASHTO M-208</td>
<td>-</td>
<td>Meet</td>
<td>-</td>
<td>AASHTO T-59</td>
</tr>
<tr>
<td>Viscosity, Saybolt-Furol:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 77°F., Sec</td>
<td>-</td>
<td>-</td>
<td>10 Min.</td>
<td>AASHTO T-59</td>
</tr>
<tr>
<td>@ 122°F., Sec</td>
<td>-</td>
<td>-</td>
<td>50 Max.</td>
<td>AASHTO T-59</td>
</tr>
<tr>
<td>Settlement, 5 days, %</td>
<td>-</td>
<td>-</td>
<td>5 Max.</td>
<td>5 Max.</td>
</tr>
<tr>
<td>Sieve, %</td>
<td></td>
<td>-</td>
<td>0.1 Max</td>
<td>-</td>
</tr>
<tr>
<td>Distillation to 500°F. (260°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Distillate, % by Weight</td>
<td>-</td>
<td>-</td>
<td>55 Max</td>
<td>30 Max</td>
</tr>
<tr>
<td>Oil Distillate, by Volume of Emulsion</td>
<td>-</td>
<td>-</td>
<td>12 Max</td>
<td>6 Max</td>
</tr>
<tr>
<td>Residue by Distillation, %</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stone Coating Test, % Coated</td>
<td></td>
<td>-</td>
<td>-</td>
<td>90 Min</td>
</tr>
<tr>
<td>Modified Sand Coating</td>
<td></td>
<td>-</td>
<td>-</td>
<td>Meet</td>
</tr>
<tr>
<td>Tests on Residue from Distillation:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Float Test @ 140°F., Sec.</td>
<td>-</td>
<td>-</td>
<td>20 Min.</td>
<td>1200 Min.</td>
</tr>
<tr>
<td>Solubility in CLCH:CCl2, %</td>
<td>-</td>
<td>-</td>
<td>97.5 Min</td>
<td>97 Min.</td>
</tr>
<tr>
<td>Ductility @ 77°F., cm.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40 Min.</td>
</tr>
<tr>
<td>Ash, % by Wt.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.0 Max</td>
</tr>
<tr>
<td>Specific Gravity, 77°F/77°F.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
NOTES TO BITUMINOUS TABLE NO. 2

NOTE #1. Stone Coating Test.
Use AASHTO T-59, Coating Test, except the mixture of stone and asphalt emulsion shall be mixed vigorously for 5 minutes and then immediately drenched with approximately twice its own volume of tap water at room temperature after which the aggregate shall be at least 90 percent coated with an asphalt film.

NOTE #2. Modified Sand Coating Test.
Use AASHTO T-59, Coating Test, except a mixture of air-dry test aggregate and asphalt emulsion shall be mixed thoroughly for 5 minutes then allowed to stand for 5 hours, after which the mixture shall be capable of being mixed for an additional 5 minutes. The mixture shall then be drenched with approximately twice its own volume of tap water at room temperature without showing more than 10 percent loss of bituminous film. The test aggregate for use in this test shall be a combination of 90 percent concrete sand and 10 percent Portland cement. The amount of asphalt emulsion used shall be 10 percent by weight of the aggregate.

NOTE #3. Float Test.
Use AASHTO T-50, with the exception that the residue shall be allowed to cool to room temperature and re-melted at lowest possible temperature that will bring it to a sufficiently fluid condition for easy pouring. Then pour into the collar for completion of the float test.

NOTE #4. Cement Mixing Test.
The Cement Mixing Test is waived for SS-1 and SS-lh except when used in slurry seal.
## BITUMINOUS TABLE NO. 3—SPECIFICATIONS FOR TAR

<table>
<thead>
<tr>
<th>TEST</th>
<th>RT-1</th>
<th>RT-2</th>
<th>RT-3</th>
<th>RT-4</th>
<th>RT-5</th>
<th>RT-6</th>
<th>RT-7</th>
<th>RT-8</th>
<th>RT-9</th>
<th>RT-10</th>
<th>RT-11</th>
<th>RT-12</th>
<th>RTCB-5</th>
<th>RTCB-6</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engler Sp Visc. at 40° C. (104° F.)</td>
<td>5.8</td>
<td>8.13</td>
<td>13.22</td>
<td>22.35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>AASHTO T-54</td>
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<tr>
<td>Engler Sp Visc. at 50° C. (122° F.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.26</td>
<td>26.40</td>
<td></td>
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<td>Float Test at 32° C. (89.6° F.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td>120</td>
<td>50-80</td>
<td>80-120</td>
<td>120-200</td>
<td></td>
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<td></td>
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<td>Float Test at 50° C. (122° F.)</td>
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<td></td>
<td></td>
<td>75-100</td>
<td>100-150</td>
<td>150-220</td>
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<tr>
<td>Sp. Gr. at 25°C/25°C. (77°F/77°F.)</td>
<td>1.08+</td>
<td>1.08+</td>
<td>1.09+</td>
<td>1.10+</td>
<td>1.10+</td>
<td>1.12+</td>
<td>1.14+</td>
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<td>1.16+</td>
<td>1.09+</td>
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<td>Total Bitumen, percent by wt.</td>
<td>88+</td>
<td>88+</td>
<td>88+</td>
<td>83+</td>
<td>83+</td>
<td>78+</td>
<td>78+</td>
<td>78+</td>
<td>75+</td>
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<td>75+</td>
<td>80+</td>
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<td>Water pct. by vol.</td>
<td>2.0-</td>
<td>2.0-</td>
<td>2.0-</td>
<td>2.0-</td>
<td>1.5-</td>
<td>1.5-</td>
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<td>1.0-</td>
<td>1.0-</td>
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<tr>
<td>Distillation, pct. by wt.</td>
<td></td>
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<td></td>
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<td>AASHTO T-52</td>
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<tr>
<td>To 170°C. (338°F.)</td>
<td>7.0</td>
<td>7.0</td>
<td>7.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>3.0</td>
<td>1.0</td>
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<td>1.0</td>
<td>1.0</td>
<td>2.0-</td>
<td>2.0-</td>
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<tr>
<td>To 200°C. (392°F.)</td>
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<td></td>
<td></td>
<td>5.0+</td>
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<tr>
<td>To 235°C. (455°F.)</td>
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<td>8.0-18.0</td>
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<td>To 270°C. (518°F.)</td>
<td>35.0</td>
<td>35.0</td>
<td>30.0</td>
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<td>25.0</td>
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<td>20</td>
<td>15.0</td>
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<tr>
<td>To 300°C. (572°F.)</td>
<td>45.0</td>
<td>45.0</td>
<td>40.0</td>
<td>40.0</td>
<td>35.0</td>
<td>35.0</td>
<td>30.0</td>
<td>25</td>
<td>25.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>35.0-</td>
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<td>Softening point of distillation Residue - degrees C.</td>
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<td>30.60</td>
<td>35.65</td>
<td>35.65</td>
<td>35.70</td>
<td>35.70</td>
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<td>40.70</td>
<td>40.70</td>
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<tr>
<td>Sulfonation index (when Specified) on distillate</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
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<tr>
<td>To 300°C. (572°F.)</td>
<td>1.5-</td>
<td>1.5-</td>
<td>1.5-</td>
<td>1.5-</td>
<td>1.5-</td>
<td>1.5-</td>
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<tr>
<td>300°C. to 355°C. (572° F.- 671° F.)</td>
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</table>

**AASHTO** T-54, T-55, T-52, T-108
SECTION 808
MINERAL FILLER, HYDRATED LIME,
CALCIUM CHLORIDE, BRICK AND BLOCKS

808.01 Mineral Filler, Hydrated Lime,
Calcium Chloride, Brick and Blocks.

These minerals shall meet the following requirements:

- Mineral Filler: AASHTO Designation M-17
- Hydrated Lime: ASTM Designation C-207, Type N.
- Calcium Chloride: AASHTO Designation M-144, Type I or I1
- Sewer Brick: AASHTO Designation M-91, Grade S.M. or M.M.
- Building Brick (Clay or Shale): AASHTO Designation M-114, Grade S.W. or M.W.
- Concrete Brick (Manholes, etc.): ASTM Designation C-55, Type 11, Grade S
- Concrete Brick (Buildings): ASTM Designation C-55, Type 1
- Concrete Block (Hollow Load Bearing): ASTM Designation C-90, Grade N, Type I or II

SECTION 809
FLY ASH

809.01 Fly Ash.

Fly ash shall consist of the finely divided residue or ash that remains after burning finely pulverized coal at high temperatures and shall meet the requirements of AASHTO M-295.
SECTION 811
WATER

811.01 Water for Cement Concrete.

(a) Water used in cement concrete shall be fresh, free from oil and shall not contain impurities in excess of the following limits:

Acidity or alkalinity calculated in terms of calcium carbonate 500 mg/l AASHTO-T26
Total organic solids 500 mg/l AASHTO-T26
Total inorganic solids 500 mg/l AASHTO-T26
Chloride Ion Concentration 250 mg/l AASHTO-T26
Sulfate Ion Concentration 250 mg/l AASHTO-T26
PH Min. 6.0, Max. 8.0—ASTM D-1293

(b) A comparison of the given water with distilled water can be obtained by making standard soundness, time of setting, and mortar strength tests with standard Ottawa sand, using the same cement of standard quality with each water. Any indication of unsoundness, marked change in time of setting, or a variation of more than 10 percent in strength from results obtained with mixtures containing the distilled water shall be sufficient cause for rejection of the water under test.

(c) Water from city water supplies may be accepted without being tested.

(d) Water used in curing cement concrete or mortar shall be free from salt or other substance which may be injurious to concrete.

811.02 Water for General Purposes.

This water shall be suitable for the purpose intended and free from substances harmful to the particular work involved.

811.03 Water for Lime Stabilization Work.

Water shall be from an approved source, free from any substance which might be harmful to the work, and the total inorganic solids shall not exceed 0.20 percent.
SECTION 813
AIR ENTRAINING ADDITIVES

813.01 Air Entraining Additives.

Air entraining additives as specified in Section 501.02(c)4 for Portland Concrete shall be non-agglomerating type containing a dispersive agent. Air entraining agents already approved for use may not be required to meet performance tests; however, new agents not already approved, will be required to meet the comparative strength and non-bleeding provisions of AASHTO M-154 modified to require only 3, 7 and 28 day flexural and compressive tests. The additive in concrete shall not give a sticky or gummy mix or any harmful effects even when placed with a slump of 2" or less.

SECTION 815
RETARDERS AND REDUCERS

815.01 Retarders.

Retarders shall comply with the requirements of AASHTO M-194 within the following limitations: Retardant admixtures shall be limited to calcium, sodium, potassium or ammonium lignosulfonate or hydroxylated carboxylic acid compounds. These compounds shall not contain calcium chloride or sugars. Carboxylic compounds shall be limited to dosages of 2 to 4 ounces per sack of cement. The precise amount of this type additive will be included in the concrete design mix approved by the Engineer of Public Works. The Contractor shall submit without additional compensation the following:

1. The Manufacturer's written certification of the product's conformance to the Specifications.
2. Submit actual test data from an approved laboratory substantiating that this material when mixed with the concrete will produce the specification results.

815.02 Reducers

Reducers shall comply with the requirements of AASHTO M-194 within the following limitations: Reducing admixtures shall be sulfonated melamine formaldehyde, sulfonated naphthalene formaldehyde or the same basic compounds noted in Section 815.01 for retarders and shall not contain calcium chlorides or sugars. The approximate amount of this type additive will be included in the concrete design mix submitted for approval to the Office of the Engineer of Public Works. The Contractor shall furnish without additional compensation, the same data noted in paragraph 2 of Section 815.01.
SECTION 817
GEOTEXTILES

817.01 Filter Fabrics.

Filter fabrics shall meet the requirements of AASHTO M-288 and the requirements specified hereinafter in this Section.

The fabric shall be a polymeric fabric formed from a plastic yarn of a long-chain synthetic polymer composed of at least 85% by weight of propylene, ethylene, amide, ester or vinlyledenechloride and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. After forming, the fabric shall be processed so that the filaments retain their relative positions with respect to each other. The fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties.

The filter fabric shall be formed in widths of not less than six (6) feet. Sheets of fabric may be sewn together with thread of a material meeting the chemical requirements given for the plastic yarn to form fabric widths as required. The sheets of filter fabric shall be sewn together at the point of manufacture or another approved location.

SECTION 819
MASONRY STONE

819.01 Masonry Stone.

(a) TYPE I MASONRY STONE.

Stone for coursed and uncoursed rubble masonry shall be of approved quality, sound, durable, and free from segregations, seams, cracks, and other structural defects or imperfections tending to destroy its resistance to stresses and the weather. It shall be free from rounded, worn, or weathered surfaces. All weathered stone shall be rejected. It shall be kept free from dirt, oil, or any other injurious material which may prevent the proper adhesion of the mortar. Unless otherwise provided herein or shown on the plans, individual stones shall have a thickness of not less than six (6) inches. No stone having a horizontal dimension less than 12 inches or less than its thickness shall be used except for filling the interior of the wall.

(b) TYPE II MASONRY STONE.

This stone shall meet the requirements of Type I Masonry Stone above, except that the dimensions of the individual stones shall be 4 to 6 inches in depth and shall have a reasonably flat top surface of a width not less than 2 inches and length not less than the depth. All stones shall be inspected before and after laying and all rejected material shall be removed immediately from the work.

(c) TYPE III MASONRY STONE.

Stone for rustic masonry shall be rough quarried or field stone of varying sizes and shapes, suitable for the purpose intended and with no attempt made toward squaring or dressing.
SECTION 821
RIPRAP MATERIALS.

821.01 Stone.

(a) GENERAL.
All stone for riprap shall consist of field stone or rough unhewn quarry stone as nearly rectangular in section as is practicable. When tested as specified in AASHTO T-104, the stone shall show a soundness of not less than 85 percent for 5 cycles, using sodium sulphate, and shall be suitable in all other respects for the purpose intended. It shall have a percentage wear not over 60 percent by the Los Angeles Test, AASHTO T-96, and shall meet the requirements of Section 801.02 for deleterious substances; however, the requirements for deleterious substances may be modified by the Engineer when conditions require such. Sound pieces of broken concrete of proper size from pavement or structures will be acceptable as stone for riprap, but only one type of riprap may be used at one structure.

Control of the gradation of the various classes of riprap will be by visual inspection either at the source or the project site at the Engineer's option. Any difference of opinion between the Engineer and the Contractor shall be resolved by checking 2 random truck loads (or equivalent size sample) in accordance with the method provided in AHD 239 with all the equipment, labor and sorting site for this check being provided by the Contractor at his expense.

(b) CLASS 1 RIPRAP.
Stone for this class riprap shall consist of graded stones ranging from 10 to 100 pounds with not more than 10% weighing over 100 pounds and at least 50% weighing over 50 pounds and not over 10% weighing under 10 pounds.

(c) CLASS 2 RIPRAP.
Stone for this class riprap shall consist of graded stones ranging from 10 pounds to 200 pounds with not over 10% weighing over 200 pounds and at least 50% weighing over 80 pounds and not over 10% weighing under 10 pounds.

(d) CLASS 3 RIPRAP.
Stone for this class riprap shall consist of reasonably well graded stones ranging from 25 pounds to 500 pounds with not over 10% weighing over 500 pounds, at least 50% weighing over 200 pounds and not more than 15% weighing under 25 pounds.

(e) CLASS 4 RIPRAP.
Stone for this class riprap shall consist of reasonably well graded stones ranging from 50 pounds to 1000 pounds with not over 25% weighing over 1000 pounds, at least 50% weighing over 500 pounds and not more than 25% weighing under 50 pounds.

(f) CLASS 5 RIPRAP.
Stone for this class riprap shall consist of reasonably well graded stones ranging from 2000 pounds and down with not over 10% weighing over 2000 pounds, at least 50% weighing over 1000 pounds and not more than 25% weighing under 200 pounds.
821.02 Concrete Sacked Riprap.

(a) SACKS.
Sacks shall be new, unused, manufactured from jute, cotton, burlap, reinforced paper or other materials capable of holding the cement mixture without significant leakage when handled. The sacks shall be of uniform size and dimension with a capacity of approximately one (1) cubic foot.

(b) AGGREGATE.
Local sand, gravel or other designated aggregates shall be from sources capable of producing suitable materials for the purpose intended.

(c) CEMENT.
Cement shall meet the requirements of Section 823.

(d) WATER.
Water shall meet the requirements of Section 811.

(e) MIXING.
The aggregate and cement shall be formulated by volumetric measure in the proportions of one part cement to four (4) parts sand and five (5) parts gravel or nine (9) parts of bank run gravel, or to designated proportions of other materials, then damp mixed in a concrete mixer using sufficient water to provide for a crumbly consistency.

(f) PREPACKAGED CONCRETE SACKED RIPRAP.
Prepackaged sack riprap which utilizes approved bagging material and a dry mixture of pre-dried sand-cement material may be substituted for the concrete sacked riprap noted hereinbefore in this Section provided (1) the source or prepackaging operation has been approved by the Engineer, (2) the packing material is permeable and absorptive enough to permit passage of sufficient water to provide for hydration of the cement, (3) the sand and cement materials are from sources acceptable to the Engineer, (4) the sand and cement are dry mixed in the proportions of five (5) cubic feet of sand to one bag of cement until uniform in color, (6) packaging, handling and storage shall be such as to prevent damage to the prepackaged material, especially from collecting excess moisture until placed.

821.03 Filter Blanket.

(a) GENERAL.
Filter blanket material shall consist of a blanket of aggregate or fabric placed under a riprap material.

(b) AGGREGATE BLANKET.
An aggregate blanket may be either gravel or crushed stone AHD Size 467 Aggregate, unless otherwise shown on the plans, reasonably free from flat or elongated pieces and from organic or soft friable particles in objectionable quantities.

(c) FABRIC BLANKET.
A fabric blanket shall be a polymeric fabric formed from a plastic yarn of a long-chain synthetic polymer composed of at least 85% by weight of propylene ethylene, amide, ester or vinlylendenechloride and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. After forming, the fabric shall be processed so that the filaments retain their relative positions with respect to each other. The fabric shall be free of defects or flaws which significantly affect its physical and/or
filtering properties.

The filter fabric shall be formed in widths of not less than six (6) feet. Sheets of fabric may be sewn together with thread of a material meeting the chemical requirements given for the plastic yarn to form fabric widths as required. The sheets of filter fabric shall be sewn together at the point of manufacture or another approved location.

A competent laboratory must be maintained by the producer of the fabric at the point of manufacture to insure quality control. During all periods of shipment and storage, the fabric shall be maintained, wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140°F., mud, dirt, dust, and debris.

The vendor shall furnish certified test reports with each shipment of material attesting that the fabric meets the requirements of this Specification. A sample of five (5) square yards of the fabric shall be furnished the City from each shipment for verification testing.

The fabric shall meet the requirements noted in the following Table and provide an "EOS" (equivalent opening size) and a "percent open area" determined by the Engineer after an on-site investigation of the soil to be protected, based on the following criteria:

If the soils to be protected have 85% (D85) by weight passing the No. 200 Sieve (US Std.), a fabric filter blanket will not be permitted.

If the soil to be protected contains 50% or less by weight of fines (minus No. 200 Material) the following will govern:

\[
\text{85\% Size of Soil (D85)} > 1
\]

\[
\text{Opening Size of EOS* Sieve} =
\]

If the soil to be protected contains more than 50% by weight of fines (minus No. 200 material), the following will govern:

EOS* no larger than the opening in the US Std. Sieve #70 (0.0083 inch) nor smaller than US Std. Sieve #100 (0.0059 inch).

DEFINITIONS: The "equivalent opening size" (EOS) is defined as the number of US Standard Sieve having openings closest in size to the filter fabric openings. The "percent open area" is defined as the summation of the open area divided by the total area of the filter fabric.

* NOTE: No fabric with an EOS smaller than a Size No. 100 Sieve (US Std.) will be allowed.

**Requirements for Fabric Filter Blanket**

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Requirements</th>
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<tbody>
<tr>
<td>Tensile Strength</td>
<td>ASTM D-1682 Grab Test Method using square inch jaws and a travel rate of 12 inches per minute.</td>
<td>120Lbs.Min. in any principle direction.</td>
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<td>*(unaged cloth)</td>
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<tr>
<td>Bursting Strength</td>
<td>ASTM D-751 Diaphragm Bursting Tester.</td>
<td>500 psi Min.</td>
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<td>*(unaged cloth)</td>
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<tr>
<td>ASTM D-751 Diaphragm Bursting Tester.</td>
<td>500 psi Min.</td>
<td></td>
</tr>
<tr>
<td>*(unaged cloth)</td>
<td>Ring Clamp; steel ball replaced with a 5/16</td>
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</tbody>
</table>
Puncture Strength *(unaged cloth)

ASTM D-751 Tension Testing Machine with Rng Clamp; Steel ball replaced with 5/16 inch diameter solid steel cylinder centered with the ring clamp. 120 lbs. Min.

Abrasions Resistance

ASTM D-1682 as above, after abraded as in ASTM D-1175 Rotary Platform, Double Head Method; rubber-base abrasive wheels equal to CS-17 "Calibrase" by Taber Instrument Co.; 1 kilogram load per wheel; 1000 revolutions. 500 lbs. min. in any direction

Seam Breaking Strength

ASTM D-1683, 1" square jaws, constant rate of traverse 12" per minute. 180 lbs. min.

Permeability

AHD Permeability Test for Filter Fabric. 2x10^-2 cm/sec Min. 3x10^-1 cm/sec Max

* Unaged cloth is defined as cloth in the condition received from the manufacturer or distributor.

(d) SECURING PINS.

Securing pins for anchoring filter fabric shall be 3/16 inch steel bars, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of not less than 1.5 inches. The length of the pin shall not be less than 18 inches.
823.01 Type I Portland Cement.

Type I Portland Cement shall meet the requirements of AASHTO Designation M-85.

823.02 Type II Portland Cement.

Type II Portland Cement shall meet the requirements of AASHTO Designation M-85.

823.03 Type III Portland Cement (High Early Strength).

Type III Portland Cement shall meet the requirements of AASHTO Designation M-85.

823.04 Type IS Portland Blast Furnace Cement.

Type IS Portland Blast Furnace Cement (for use in soil-cement stabilization) shall meet the requirements of AASHTO Designation M-240.

823.05 Type IP Portland—Pozzolan Cement.

Type IP Portland Pozzolan Cement shall meet the requirements of ASTM C-595 with the following modifications:
1. The fly ash content shall be limited to a maximum of 20% by weight.
2. The Pozzolan shall be limited to fly ash meeting the requirements of Section 809, Fly Ash.
3. Attention is directed to the fact that the final blend of the IP Cement must comply with Section 823.07.

823.06 Masonry Cement.

Masonry cement shall meet the requirements of AASHTO Designation M-150 and ASTM Designation C-91 for masonry cement.

823.07 Chemical Properties.

The Specifications for all cements as covered by Sections 823.01 to 823.06, inclusive; are amended to the effect that the total alkali content of any cement used, calculated as the percentage of sodium oxide (Na2O) plus the product of 0.658 times the percentage of potassium oxide (K2O) shall not exceed 0.60 percent.

823.08 Testing of Cement.

All cement shall be from an approved source or tested before use.

823.09 Flash Set And False Set.

Flash set and false set as determined by ASTM C-451 shall be cause for rejection of the cement.
823.10 Unusual Appearance.
Unusual appearance as to color, etc. shall be sufficient grounds for rejection of the cement.

823.11 Use, Care, And Handling.

(a) USE.
1. Bulk cement will be permitted provided the bulk cement is handled as follows:
   a. Portland cement shall be measured by weight, considering that one sack of cement is equivalent to 94 pounds net of cement.
   b. The weighing and handling equipment shall be inspected by the Engineer prior to use. Cement shall be fully protected from contamination or damage during handling.
   c. Bulk cement shall be batched by weight, and scales may be of either the beam or springless dial type and shall be the product of a reputable manufacturer. Scales shall be accurate to within a tolerance of 5 pounds per 1,000 pounds net load in the hopper. The value of the minimum gradation of any scale shall not be greater than 0.1 percent of the scale capacity.
   d. Provisions shall be made to indicate to the operator that the required load in the hopper or container is being approached, such as a springless dial indicator or tare beam. Such device shall indicate at least the last 50 pounds of load.
   e. After cement is weighed, it shall be protected from loss in handling or in transit.

2. Only cement of the same "Type" shall be used in the construction of any structure or unit (substructure or superstructure) except as permitted in writing. All cement in any container having lumps of cement or caked cement, or cement which for any reason has become damaged or partially set, shall be rejected. Cement salvaged from discarded or used sacks shall not be used. Cement shall not be used while its temperature is more than 150°F. NOTE: Brands of cement are interchangeable but cement types are not.

3. The Contractor shall keep accurate records of the deliveries of cement and its use in the work including that from ready-mix plants. Copies of these records shall be furnished the Engineer at the close of each day's work or 8 hour run, in such form as he may require, showing the quantity used during the day or run at each part of the work.

(b) CARE AND HANDLING.
1. The Contractor shall provide suitable means for storing and protecting the cement against dampness. Cement not for immediate use shall be stored in suitable weather proof buildings. Buildings shall be placed in approved locations. Provisions for storage shall be ample and the shipment of cement as received shall be separately stored in such a manner as to provide easy access for identification and inspection of each shipment. On small structures, storage in the open may be permitted by authorization, in which case a raised platform and ample waterproof covering shall be provided. Stored cement shall meet the test requirements at any time after storage when a retest is ordered.

2. Cement of different types even if tested and approved, shall be stored separately and shall not be mixed.
SECTION 825
SELECTED MATERIALS FOR BASES

825.01 Description.

Selected materials for the purpose of these specifications shall be of the kind and general character of sand-clay, chert, clay-gravel, sand, local stone, stone screenings, etc., or combinations thereof, with or without commercial aggregate meeting the requirements noted hereinafter in this Section.

825.02 General Requirements.

(a) GENERAL.

The material shall meet the general requirements for the respective material noted hereinafter in this Section and the special and specific requirements noted in Section 825.03.

The following terms are defined for general use:

Artificial Mixture. The term "Artificial Mixture" is defined as a mixture, resulting from combining as indicated on the plans 2 or more base course materials, including binder soils suitable for the purpose intended and sands of the same or different kind generally from separate sources.

Coarse Aggregate and Binder Soil (Binder). The coarse aggregate for base courses shall be all material retained on the No. 8 mesh sieve; binder shall be all materials passing the No. 8 mesh sieve.

Blends. Blends shall be an artificial mixture of (1) two or more materials of the kind and/or character described in this Section or similar materials; (2) one or more soils plus stabilizer aggregate or either local stone, commercial coarse aggregate meeting the provisions of Section 801 with size number designated on the plans.

(b) SAND CLAY.

Sand clay shall be a natural material or artificial mixture, consisting largely of a mixture of sand and clay in proper proportions, that occurs in natural deposits of varying depths or a blended mixture of sand and clay.

(c) CHERT.

Chert shall be a metamorphic, fragmentary, flint or silica formation interspersed with varying quantity and quality of clay binder. Chert in its natural formation may require blasting to facilitate loading and manipulation.

(d) CLAY GRAVEL.

Clay gravel shall be composed of gravel and sand with clay binder. The coarse aggregate (gravel) shall be clean, hard, tough, durable and reasonably free from thin, elongated, soft or laminated pieces. The binder, consisting of material passing the No. 8 sieve, shall be a good grade of sand clay or other approved material. Clay gravel in its natural formation may require blasting to facilitate loading and manipulation.

(e) LOCAL SAND.

Local sand shall consist of grains of hard, sound material, predominantly quartz or other hard, durable rock, including friable, loosely bound deposits of sandstone conglomerate normally found in natural deposits in the project vicinity.

(f) LOCAL SAND-GRAVEL.

Local sand-gravel shall be hard, sound, durable rock, including friable, loosely bound sand-stone conglomerate, with varying amounts of coarse aggregate and sand normally found in natural deposits in the project vicinity. The coarse
aggregate and the sand shall be free from a coating of injurious material, lumps of clay, loam, organic matter, or other foreign material. If necessary, gradation and/or other requirements will be provided in the plans and/or proposal form.

(g) LOCAL STONE.
Approved local source-run stone, shall consist of tough, durable fragments and sand, clay, or other binder type materials. If necessary, gradation and/or other requirements will be provided in the plans or proposal.

(h) COMMERCIAL AGGREGATES.
Commercial aggregates shall meet the appropriate requirements of Sections 801 and 805.

(i) STONE SCREENINGS.
Stone screenings shall consist of crushed stone fragments, all passing the No. 4 sieve with the fines down to and including dust, but not more than 30 percent by weight passing the No. 100 sieve. The stone shall meet the general requirements of Section 801.

(j) POND ASH.
Pond ash shall consist of a combination of bottom ash and fly ash produced as a by-product of burning coal.

825.03 Specific Requirements.

GENERAL COMPOSITION

<table>
<thead>
<tr>
<th>Sieve Requirements</th>
<th>A</th>
<th>A-1</th>
<th>B</th>
<th>B-1</th>
<th>C*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No. 8</td>
<td>60-100</td>
<td>42-100</td>
<td>22-75</td>
<td>20-70</td>
<td>20-50</td>
</tr>
</tbody>
</table>

Material Passing No. 8

<table>
<thead>
<tr>
<th>Sieve (Binder)</th>
<th>Type</th>
<th>A</th>
<th>A-1</th>
<th>B</th>
<th>B-1</th>
<th>C*</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 200</td>
<td></td>
<td>12-45</td>
<td>12-45</td>
<td>12-50</td>
<td>15-65</td>
<td>15-75</td>
</tr>
<tr>
<td>Liquid Limit (LL)</td>
<td></td>
<td>28 Max.</td>
<td>35 Max.</td>
<td>28 Max.</td>
<td>35 Max.</td>
<td>45 Max.</td>
</tr>
<tr>
<td>Plasticity Index (PI)</td>
<td></td>
<td>8 Max.</td>
<td>15 Max.</td>
<td>8 Max.</td>
<td>15 Max.</td>
<td>20 Max.</td>
</tr>
</tbody>
</table>

* CBR of 40 + with swell of less than 5%

Material placed on the road found not meeting the above requirements may in lieu of removal and replacement be stabilized with approved materials in such proportions that the finished layer will meet the above specified requirements.
SECTION 826
CRUSHED AGGREGATE BASE MATERIALS

826.01 Description.

Crushed Aggregate Base for the purpose of these Specifications shall consist of 100 percent crushed aggregates conforming to the requirements noted hereinafter in this Section.

826.02 General Requirements.

The aggregate furnished for use shall conform to the general requirements of Section 801, and the specific requirements noted in Section 826.03. Gradation analysis will be performed in accordance with AHD Test Method 50. Gradation may be obtained by the proper mixing of certain regular AHD size aggregates as noted below; however, no specific gradation will be required prior to mixing operations.

Type A—Approximately 75% AHD No. 610 with approximately 25% AHD No. 8910.

Type B—Approximately 60% AHD 410 with approximately 60% AHD 810.

826.03 Specific Requirements.

<table>
<thead>
<tr>
<th>Sieve Requirements</th>
<th>Type A*</th>
<th>Type B**</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>90-100</td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>75.98</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>60-85</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>60-85</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>26-55</td>
<td>40-65</td>
</tr>
<tr>
<td>No. 8</td>
<td>15-41</td>
<td>28-54</td>
</tr>
<tr>
<td>No. 16</td>
<td>19-42</td>
<td></td>
</tr>
<tr>
<td>No. 50</td>
<td>9-27</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td>4-18</td>
<td></td>
</tr>
</tbody>
</table>

*The fraction passing the No. 40 sieve shall not have a liquid limit in excess of 25.
**The fraction passing the No. 40 sieve shall not have a P.I. in excess of 6 nor a L.L. in excess of 25, and contain not more than 2/3 by weight passing the No. 200 sieve.
SECTION 827
LOCAL SAND AND SAND-GRAVEL
FOR
MISCELLANEOUS CONSTRUCTION USE

827.01 Description.

Local materials, for the purpose of these Specifications, shall be of the kind and character of local sand and local sand-gravel or blends thereof.

827.02 General Requirements.

(a) GENERAL.
The kind of material shall meet the general requirements for the respective classification of material as noted hereinafter in this Section.
Blends shall consist of any combinations of local sand or sands or local sand-gravel or sand-gravels. All blends shall be of the material proportions or ratio provided by the plans and/or proposal.
When used in bituminous pavements, local source material shall be non-plastic.

(b) LOCAL SAND.
Local sand shall be pit-run sand suitable for the purpose intended. In general, all local sand shall consist of grains of hard, sound material, predominantly quartz or other hard, durable rock, including friable, loosely bound deposits of sandstone conglomerate. The sand shall be free from a coating of injurious material, lumps of clay, loam, organic matter or other foreign material. If necessary, gradation or other requirements will be provided in the plans or proposal form.

(c) LOCAL SAND-GRAVEL.
Local sand-gravel shall be pit-run sand-gravel, suitable for the purpose intended. In general, the sand-gravel shall be hard, sound durable rock, including friable, loosely bound sandstone conglomerate, with varying amounts of coarse aggregate and sand. The coarse aggregate and the sand shall be free from a coating of injurious material, lumps of clay, loam, organic matter, or other foreign material. If necessary, gradation and/or other requirements will be provided in the plans or proposal form.
SECTION 829
CONCRETE CURING MATERIAL

829.01 Burlap Cloth and Waterproof Covering Material.

(a) GENERAL.
Burlap cloth and waterproof covering material shall be of sufficient length and width to extend beyond the edge of the concrete a distance of at least twice the thickness of the slab. Sections of covering material shall be lapped at least 18 inches. The surface and both sides of a concrete slab shall be completely covered. The covering shall be so placed and weighted as to cause it to remain in intimate contact with the exposed surface. Burlap cloth shall be saturated with water before being placed and shall be kept wet while in position. The covering shall remain in position for 6 days after the concrete has been placed unless otherwise specified herein.

(b) TYPES OF COVERING MATERIAL.
1. Burlap cloth shall conform to the requirements of AASHTO M-182 for Class 4 burlap.
2. White Waterproof Paper shall conform to the requirements of AASHTO M-171.
3. Polyethylene sheeting (film) shall be white opaque conforming to the requirements of AASHTO M-171 modified to omit the elongation requirements when the sheeting is internally reinforced with a cord net having a cord spacing of 1/4 to 1/2 inch. (Net may be nylon or other approved material.)
4. White Burlap Polyethylene sheet shall conform to the requirements of AASHTO M-171.

829.02 Impervious Membrane.

Impervious membrane compounds shall meet the requirements of AASHTO M-148, Class A. Type 2, white pigmented, shall be used on concrete pavement and bridge decks. Other types may be used on other concrete.

Membrane liquid shall be applied under pressure with spray nozzles in such a manner as to cover the area being treated with a uniform film. For concrete pavement the rate of application shall be one gallon to not more than 135 square feet, applied in two applications. For concrete bridge wearing surfaces and sidewalks the rate of application shall be one gallon to not more than 200 square feet.

829.03 Wetted Earth Or Sand.

When this type of curing is used, the pavement shall be cured initially with burlap cloth, polyethylene sheets or waterproof paper, as specified in Section 829.01, until after final set of the concrete or, in any case, for 12 hours after placing the concrete. As soon as the covering material is removed, the surfaces and sides of the pavement shall be covered with a blanket of earth or sand not less than 2 inches thick. If the earth or sand covering becomes displaced during the curing period, it shall be replaced to the original depth and saturated with water for 3 days and thoroughly wetted down during the morning of the fourth day; the cover shall remain in place until the concrete has attained the required strength. When permission is given to open the pavement to traffic, the covering material shall be removed and the pavement cleaned and swept.

Earth or sand used in this method of curing shall be free of sticks, stones, or other matter which might injure the surface of the concrete nor shall the material contain ingredients which would be detrimental to the concrete or discolor the surface finish.
829.04 Straw.

Straw used as a supplement to the curing materials noted in Section 829.01 and 829.02 for cold weather protection shall be suitable for the purpose intended and approved each time it is used.
SECTION 831
CONCRETE JOINT FILLERS,
SEALERS AND WATERSTOP MATERIAL

831.01 Preformed Joint Filler

(a) GENERAL.
Preformed joint filler units shall be furnished in one piece of the length, thickness and depth shown on the plans for a complete joint. When the use of more than one piece is authorized, the abutting ends shall be fastened securely and held accurately in place to correct shape by stapling or other satisfactory means.

When a preformed filler is used with dowels or other protruding items which must pass through the filler, clean cut holes, accurately spaced and not more than 1/8 inch larger than the protruding item shall be provided.

Damaged filler units shall be rejected.

Joint fillers used in conjunction with expansion joints will require the use of a joint sealer in order to provide a functional joint. Sealers shall be one of the appropriate types specified in Section 831.02 or Section 831.03(a), unless a specific type is specified by the plans.

(b) FILLER FOR CONSTRUCTION JOINTS IN BRIDGE, CULVERT AND DRAINAGE STRUCTURES.
Preformed bituminous joint filler for general use in bridge, culvert and drainage structure work shall meet the requirements for one of the following "Types" unless a specific "Type" is required by the detailed plans:

Type 1- AASHTO M-33
Type 2 - AASHTO M-213 modified to allow a maximum of 25% water absorption.

(c) EXPANSION JOINT FILLER.
Expansion joint filler for concrete pavement, curb, gutter, combination curb and gutter, flumes, slope paving, and other miscellaneous concrete structures shall be one of the materials provided by AASHTO M-153 or AASHTO M-213 with the latter being modified to allow a maximum of 25% water absorption.

831.02 Poured Joint Sealers.

(a) GENERAL.
Poured sealers may be used for sealing both expansion joints and construction joints in concrete units other than bridges within the following limitations:

Type 1 and Type 3 poured sealers may be used in all joints located in all concrete units unless a specific type is specified by plan details.

Type 2 and Type 3 poured sealers may be used for sealing joints in concrete units not under normal traffic usage, such as curbs, gutters, combination curb and gutter, flumes, slope paving, etc.

Vertical joints in concrete units such as curbs, etc. will require the use of a non-sag compound.

Construction joints 1" inch or less in width will not require sealing unless specified by plan details.

The shape factor of joint sealer is most important, the joint configuration shown by the plan details may require the use of a backer rod or strip to insure proper shape. When a backer rod or strip is necessary, it shall be compatible with the sealant and no bond or reaction between the sealant and the backer rod or strip. A bond breaking tape may be used to insure no bond occurs between the two materials.
Requirements for poured sealers are noted in the following Subsections; however, the Contractor may substitute an approved preformed elastomeric seal meeting the requirements of Section 831.03(a) in lieu of a poured sealer provided such is furnished at no additional cost to the City.

A certified test report showing actual test results shall be furnished with each lot of joint sealer furnished to each project. Each lot of sealant shall be delivered in containers plainly marked with manufacturer's name or trade mark, type of sealant, lot number and date of manufacture. The City may run any or all tests deemed necessary to verify the accuracy of the "certified test report."

(b) TYPE 1—HOT-POURED JOINT SEALER.
This type sealer shall conform to the requirements of AASHTO Designation M-173, modified as follows:

The joint sealant shall be free from all foreign matter. When heated the material shall be free of lumps. The composition of the material shall be a mixture of virgin synthetic rubber, reclaimed rubber or a combination of the two with asphalt, plasticizers and tackifiers. Under no circumstances shall ground cured rubber scrap be used in place of virgin or reclaimed rubber.

Flow test at 140°F shall not exceed 1.0 Cm.
Ductility test at 77°F. (ASTM D-113) 40 Cm. minimum.

(c) TYPE 2—COLD Poured JOINT SEALER.
This type sealer shall be a resilient adhesive compound capable of effectively sealing joints from infiltration of incompressible materials and water throughout repeated contraction and expansion cycles.

The sealer shall be capable of being prepared on the job site and may be placed by machine, pressure gun or by hand. The compound, when used in other than horizontal joints, shall be capable of conforming to the slope face without sagging.

Sealer material may be a homogeneous blend of asphalt, rubber, and inert filling meeting the requirements of ASTM D-1850, or a two compound polymer meeting the requirements of FS-SS-S-156.

(d) TYPE 3 — LOW MODULUS SILICONE COLD POURED JOINT SEALANT.
This type sealer shall be a resilient adhesive compound capable of effectively sealing joints from infiltration of incompressible materials and water throughout repeated contraction and expansion cycles.

The sealant, when delivered, shall be capable of being used on the job site and may be placed by machine, pressure gun, or by hand. The compound, when used in other than horizontal joints, shall be capable of conforming to the slope face
without sagging. A list of qualified materials for low modulus silicone joint sealers has been established. Refer to AHD Procedure 355 concerning this list. The sealant shall be a homogeneous blend of materials, which may or may not require a primer, and shall meet the following requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>0.3 inches maximum</td>
<td>ASTM C-639</td>
</tr>
<tr>
<td>Tack free time @ 77°F. ±3° and 45-50% R.H.</td>
<td>100% @ 75 minutes</td>
<td>ASTM C-679</td>
</tr>
<tr>
<td>Durometer hardness cured 7 days @ 77°F. ± 3° and 45-55% R.H.</td>
<td>10-25</td>
<td>ASTM D-2240</td>
</tr>
<tr>
<td>Tensile stress @ 150% elongation (7-day cure @ 77°F. ± 3° and 45-50% R.H.)</td>
<td>75 psi maximum</td>
<td>ASTM D-412</td>
</tr>
<tr>
<td>Elongation (7-day cure @ 77°F. ±3° and 45-55% R.H.)</td>
<td>500% minimum</td>
<td>ASTM D-412</td>
</tr>
<tr>
<td>Bond (using mortar blocks)</td>
<td>1/4 inch Max. as per Item 3.3 of ASTM D-1850</td>
<td>ASTM D-1851</td>
</tr>
<tr>
<td>Accelerated weathering test</td>
<td>No chalking, cracking, or bond loss after 5,000 hour minimum</td>
<td>ASTM C-793</td>
</tr>
</tbody>
</table>

PRIMER SPECIFICATIONS
(When required by silicone mfgr. and must be approved by mfgr.)

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Solids</td>
<td>46-50%</td>
</tr>
<tr>
<td>Viscosity @23°C.</td>
<td>60-100 CPS</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.035-1.085</td>
</tr>
</tbody>
</table>

Certification: The manufacturer of the joint sealant, and primer if required, shall furnish certified test results of each lot of the material furnished to each project. Each lot of material shall be delivered in containers plainly marked with the manufacturer's name or trade mark, lot number, and date of manufacture.

831.03 Preformed Elastomeric Joint Seals.

(a) COMPRESSION SEALS.
1. GENERAL.
Compression type elastomeric seals shall consist of an approved seal shape formed from elastomeric material, designed to be installed and function in a compressed state. Installation of this type seal requires the use of a lubricant adhesive. This type seal when used on bridge decks will not require the use of a joint filler material unless such is specified by plan details.

2. MATERIALS.
a. Materials used in fabricating the preformed elastomeric seals shall conform to the requirements of ASTM D-2628 and be of the basic shape dimension, etc. shown by the plan details. No factory or field splicing of seals in transverse joints 50 feet or shorter in length will be allowed. On transverse joints over 50 feet in length, one field splice will be considered for approval by the Engineer pending
written request from the Contractor. This request shall specify the materials and details of performing the splice. Since the intent is to have one continuous seal meeting the above requirements, absolutely no patching of torn or damaged spots in the seal shall be permitted.

In addition to the above, seals for bridge joints (including the joint between the bridge end and the bridge end slab) shall comply with the following:

Provide a depth to width ratio of not less than 1 ($D > 1$)

Be capable of generating the following pressure when tested in accordance with AHD Procedure 288:

<table>
<thead>
<tr>
<th>Seal Size (width)</th>
<th>Minimum Generated Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>11&quot; inch through 2 inches</td>
<td>3 psi</td>
</tr>
<tr>
<td>Over 2 inches through 6 inches</td>
<td>4 psi</td>
</tr>
</tbody>
</table>

b. The lubricant adhesive used in installing the compression seals in joints shall meet one of the following requirements based on the classification of the seal and the constructed joint width in accordance with the following criteria:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Type A</th>
<th>Type B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Seals &amp; Joint Widths Measuring &gt; 1 inch</td>
<td>8 lbs. ± 10%</td>
<td>7.75 lbs. ± 10%</td>
</tr>
<tr>
<td>Roadway Seal &amp; Joint Widths Measuring &lt; inch</td>
<td>65% Min.</td>
<td>22% - 28%</td>
</tr>
<tr>
<td>a. Average weight per gallon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Solids Content % by weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Film Strength (ASTM D-412)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Tensile Strength*</td>
<td>2000 psi Min.</td>
<td>2000 psi Min.</td>
</tr>
<tr>
<td>(2) Elongation*</td>
<td>250 - 300%</td>
<td></td>
</tr>
<tr>
<td>d. The Lubricant-adhesive shall have a viscosity such that it will perform suitably, with installation equipment, remaining fluid from 5°F. to 120°F.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* For cast films of the adhesive solids.

NOTE: A certified test report showing actual test results shall be furnished with each lot of lubricant adhesive furnished to each project. Each lot of lubricant adhesive shall be delivered in containers plainly marked with manufacturer's name or trade mark, type of lubricant adhesive, lot number and date of manufacture. The Department may run any or all tests deemed necessary to verify the accuracy of the "certified test report."

3. CONSTRUCTION METHOD. The installation of the seal shall be in accordance with the manufacturer's recommendation, plan details, approved shop drawings and the following:

a. Sand blast and clean all surfaces of the joint with steel areas cleaned to a "Near White" classification.

b. Prepare joint lubricant adhesive compound and apply to joint.

c. Place sealer without stretching beyond a maximum of 5% elongation.

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(b) DIAPHRAGM TYPE SEALS.

1. FLEXIBLE, UNREINFORCED ELASTOMERIC TYPE SEAL
   a. General.
   This type seal shall consist of an approved seal shape formed from elastomeric material without metal reinforcement, anchored by mechanical or other acceptable methods to anchor plates cast into or affixed to the joint edges.
   b. Materials.
   The elastomeric material shall conform to the requirements of ASTM D-2628 modified to omit the 14°F, - 20°F. and the 212°F. recovery tests, with or without fiber or other types of acceptable non-metallic reinforcement. The seal shall be of the basic shape and dimensions shown by plan details.
   Metal anchor plates shall conform to the requirements of ASTM A-36 or equivalent.
   Any sealant or lubricant shall conform to the requirements for lubricant adhesive noted in Section 831.03(a) or an approved equivalent.
   c. Construction Methods.
   The installation of the seal shall be in accordance with the manufacturer's recommendations, the plan details and the approved shop drawings.

2. FLEXIBLE, REINFORCED ELASTOMERIC TYPE SEAL.
   a. General.
   This type seal shall consist of an approved shape formed from elastomeric material reinforced internally with metal strips with the seal affixed to the bridge deck by the method indicated in the plan details.
   b. Materials.
   The elastomeric material used in the seal shall conform to the following:

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness, Durometer A</td>
<td>ASTM D-2240</td>
<td>45±5</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D-412</td>
<td>1800 psi, Min.</td>
</tr>
<tr>
<td>Elongation @ break</td>
<td></td>
<td>400% Min.</td>
</tr>
<tr>
<td>Compression Set, 22 hrs. @ 158°F</td>
<td>ASTM D-395</td>
<td>20% Max.</td>
</tr>
<tr>
<td>Low Temperature</td>
<td></td>
<td>Not Brittle @-40°F.</td>
</tr>
<tr>
<td>Ozone Resistance Exposure to 100 PPM</td>
<td>ASTM D-746</td>
<td></td>
</tr>
<tr>
<td>Ozone for 70 hrs. @ 100°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample under 20% Strain</td>
<td>ASTM D-1149</td>
<td>No Cracks</td>
</tr>
<tr>
<td>Oil Deteriorization Volume increase after immersion in ASTM Oil #3</td>
<td>ASTM D-471</td>
<td>120% Max.</td>
</tr>
<tr>
<td>Flame Resistance</td>
<td>ASTM C-542</td>
<td>Will Not propagate flame</td>
</tr>
<tr>
<td>Reinforcement</td>
<td>ASTM A-36 or equivalent</td>
<td></td>
</tr>
</tbody>
</table>

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Sealant shall conform to lubricant adhesive in Subsection (a).

c. Construction Method.

Installation of the seal shall be in accordance with the manufacturer's recommendations in the plan details and the approved shop drawings.

831.04 Blank.

831.05 Waterstop Materials.

(a) DESCRIPTION.

Waterstops shall be of the size and shape shown by the plan details. The material may be either neoprene or polyvinylchloride meeting the requirements noted hereinafter in this Section.

(b) NEOPRENE.

Physical Requirements.
2. Elongation—300% Min., ASTM D-412.
3. Type A Shore Durometer Hardness—70 ± 5, ASTM D-2240.
4. Change in Type A Durometer Hardness, 70 hrs. heat aged @ 212°F. + 15 points Max.
5. Ozone aging when subjected to an exposure of 100 hours at an atmosphere containing 100 parts of ozone per 100,000,000 in an ozone chamber —Show no checking or cracking.

(c) POLYVINYLCHLORIDE.

Physical Requirements.
2. Elongation—300% Min., ASTM D-412.
3. Type A Shore Durometer Hardness 70 ± 5 ASTM D-2240.
4. Change in Type A Durometer Hardness, 70 hrs. heat aged @ 212°F. + 15 points Max.
5. Ozone aging when subjected to an exposure of 100 hours at an atmosphere containing 100 parts of ozone per 100,000,000 in an ozone chamber —Show no checking or cracking.
6. Specific Gravity, 1.38 Max., ASTM D-792.

831.06 Drainage Trough Material for Open Type Expansion Dam Units.

Drainage trough material furnished for use shall be a high grade neoprene reinforced with at least two layers of flexible polyester or nylon cord fabric meeting the following requirements.

1. Fabric reinforcement shall be a close woven material providing equal strength in both warp and fill directions.
2. The finished product shall be of the shape, size and thickness shown by the plan details meeting the following physical and chemical tests:
   a. Ozone Aging - Show no cracking or checking when subjected to an exposure of 70 hours in an atmosphere containing 100 parts of ozone per 100,000,000 in an ozone chamber @ 104°F. - ASTM D-3041.
   b. Oil Deterioration - Maximum weight change of 55% after immersion in ASTM Oil No. 3 for 70 hours at 212°F. - ASTM D-471.
3. Only minimum splicing across the width of the required material will be allowed. Any splice allowed must be performed using materials and in a manner recommended by the producer of the material so as to provide a waterproof, full strength (same as original material) joint through the splice.

If necessary, samples (12"x 12"minimum) of the material along with the material data sheet of the producer of the material shall be submitted to the Engineer of Public Works for approval.
833.01 Lumber and Timber.

(a) GENERAL.

The words "lumber" and "timber" in these specifications are used interchangeably and whenever either is used, it shall include the other. Grading and terminology shall be as specified in AASHTO M-168. The requirements provided hereinafter are basically for bridge and miscellaneous roadway materials whenever lumber or timbers are to be used in buildings (houses or similar type structures) the treatments shall be with one of the type preservatives noted by the plan details, applied in accordance with current AWPA procedure for such treatment.

(b) SPECIES OF WOODS.

The species of wood used shall be Southern Yellow Pine unless otherwise indicated on the plans. Southern Yellow Pine shall be of at least medium grade.

(c) GRADES OF TIMBER.

Lumber ordered in multiple lengths shall be graded after having been cut to length. When so specified on the plans or in the proposal, lumber for permanent use in structures shall be grade marked by a recognized acceptable agency. The grades recognized by these specifications together with the extreme allowable fiber stresses in bending for each stress grade are as follows:

1. YARD LUMBER.

   C Finish—A choice quality grade for finish purposes, reasonably clear, and without defects or blemishes which detract from a finish appearance, especially when painted.

   No. 1—Sound and tight knotted stock. Size of defects and blemishes limited.

   No. 2—Allows somewhat (approximately 50 percent) larger and coarser defects than No. 1. May be considered grain tight lumber.

2. STRUCTURAL TIMBER.

   Allowable Unit Stress—Visually Graded in Accordance with current Grading Rules of SP1B.

<table>
<thead>
<tr>
<th>Thickness</th>
<th>2&quot; to 4&quot;</th>
<th>5&quot; &amp; Up</th>
<th>2&quot; to 4&quot;</th>
<th>5&quot; &amp; Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dense Structural 86</td>
<td>1850 Fₜ</td>
<td>1450 Fₜ</td>
<td>2050 Fₖ</td>
<td>1350 Fₖ</td>
</tr>
<tr>
<td>Dense Structural 72</td>
<td>1500 Fₜ</td>
<td>1250 Fₜ</td>
<td>1700 Fₖ</td>
<td>1150 Fₖ</td>
</tr>
<tr>
<td>Dense Structural (D.S. 65)</td>
<td>1400 Fₜ</td>
<td>1100 Fₜ</td>
<td>1650 Fₖ</td>
<td>1000 Fₖ</td>
</tr>
<tr>
<td>No. 1 Dense SR</td>
<td>1200 Fₜ</td>
<td>1000 Fₜ</td>
<td>1450 Fₖ</td>
<td>1050 Fₖ</td>
</tr>
<tr>
<td>No. 1 SR</td>
<td>1000 Fₜ</td>
<td>850 Fₜ</td>
<td>1250 Fₖ</td>
<td>925 Fₖ</td>
</tr>
<tr>
<td>No. 2 Dense SR</td>
<td>975 Fₜ</td>
<td>850 Fₜ</td>
<td>1050 Fₖ</td>
<td>775 Fₖ</td>
</tr>
</tbody>
</table>

NOTE: Fₜ = Allowable fiber stress in psi in tension parallel to grain.
Fₖ = Allowable fiber stress in psi in compression parallel to grain.
SR = Stress Rated.
The above structural grades are further divided on the basis of use, size and defects, into the following subgrades:

- Joist and Plank
- Beam Stringer
- Post and Timber

833.02 Stress Grades For Structural Purposes.

Where the specifications and/or plans call for standard stress grades for the various structural purposes, material of the grades provided for the various uses in Table II shall be furnished and it shall be the understanding that in the design, unit stresses corresponding to Table II have been assumed, and that where choices appear in Table II, the choice shall be as noted on the plans.

833.03 Untreated And Treated Timber.

(a) TREATED TIMBER.

Treated timber shall be interpreted to mean timber of the species called for treated by a pressure method to retain the minimum quantity per cubic foot of the provided preservative stipulated in Table I, unless otherwise provided in the proposal or on the plans. The preservatives used shall meet the requirements for the particular type provided as specified on the plans.

For timber that is to be pressure treated there shall be no heartwood requirement or sapwood limitation.

(b) UNTREATED TIMBER, HEART REQUIREMENTS.

All timber to be used without preservative treatment shall show not less than the following amounts of heartwood:

- Stringers, floorbeams and flooring, 80 percent of heart of any girth.
- Caps, sills and posts, 75 percent of heart on each of the four sides measured across the side.
- Bracing, struts, rails, etc., 80 percent of heart on both sides measured across the side.
<table>
<thead>
<tr>
<th></th>
<th>CREOSOTE OIL</th>
<th>WATER BORNE PRESERVATIVE</th>
<th>PENTACHLOROPHENOL TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Empty Cell</td>
<td>Full Cell</td>
<td>ACA</td>
</tr>
<tr>
<td>General Bridge Construction</td>
<td>12</td>
<td>-</td>
<td>0.6</td>
</tr>
<tr>
<td>Timber, Marine Use</td>
<td>16</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Piling for Gen. Use</td>
<td>16</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Piling for Marine Use</td>
<td>20</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>or Refusal</td>
<td>8</td>
<td>0.6</td>
<td>8</td>
</tr>
<tr>
<td>Posts</td>
<td></td>
<td></td>
<td>3/4</td>
</tr>
<tr>
<td>Lumber to be Painted</td>
<td></td>
<td></td>
<td>3/4</td>
</tr>
<tr>
<td>or for Dry Use</td>
<td></td>
<td></td>
<td>3/4</td>
</tr>
<tr>
<td>General Building Construction</td>
<td></td>
<td></td>
<td>3/4</td>
</tr>
<tr>
<td>Lumber to be Painted</td>
<td></td>
<td></td>
<td>3/4</td>
</tr>
<tr>
<td>or for Dry Use</td>
<td></td>
<td></td>
<td>3/4</td>
</tr>
<tr>
<td>Fence Posts &amp; Braces</td>
<td>10*</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Guard Rail Posts &amp; Block Out</td>
<td>12**</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Signal Poles</td>
<td></td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Light Poles</td>
<td></td>
<td>0.6</td>
<td>Note 1</td>
</tr>
</tbody>
</table>

Note 1. AWPA P9-72. 8 Lb. of 7.5% penta. Solution/Cu. Ft. = 0.60 Lb. dry penta/Cu. Ft. 0.60 Lb. Penta = is the same as 12 Lbs. ~1 Creosote Oil Treatment.

*An alternate treatment will be 8 pounds of No. 1 Creosote Oil with 2% by weight of Pentachlorophenol, empty cell treatment.

*An alternate treatment will be 10 pounds of No. 1 Creosote Oil with 2% by weight of Pentachlorophenol, empty cell treatment.
<table>
<thead>
<tr>
<th>STRUCTURE PURPOSE</th>
<th>SIZE OF MEMBER</th>
<th>STANDARD STRESS GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(a) Truss members, tension</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor beams</td>
<td>5&quot; and thicker</td>
<td>1450 Ft, 1250 Ft, or 1100 Ft</td>
</tr>
<tr>
<td>Stringers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other floor members</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(b) Caps and Posts, bridge and guardrail,</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sills and Mud Sills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nailing strips</td>
<td>5&quot; x 5&quot; and larger</td>
<td>1350 Fc, 1150 Fc or 1000 Fc</td>
</tr>
<tr>
<td>Truss members, compression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timbers (culvert)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(c) Joists</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decking, wearing</td>
<td>2&quot; to 4&quot; thick</td>
<td>1860 Ft, 1500 Ft, 1400 Ft, or 1200 Ft</td>
</tr>
<tr>
<td>Other floor members</td>
<td>4&quot; and wider</td>
<td></td>
</tr>
<tr>
<td>Rails and Rail posts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nailing Strips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truss members, compression and tension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guardrail</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(d) Wheel and felloe</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guards</td>
<td>5&quot; x 5&quot; and larger</td>
<td>1050 Fc</td>
</tr>
<tr>
<td><strong>(e) Sub-decking, flat and laminated</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bracing, Sway, sash and longitudinal</td>
<td>4 &quot; and wider</td>
<td>1400 Ft or 1200 Ft</td>
</tr>
<tr>
<td>Bulkhead Plank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scupper blocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleats and Grillage</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(f) Cross Bridging</strong></td>
<td>2&quot; and 3&quot; thick</td>
<td>(Yard lumber grade)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>No. 1</td>
<td></td>
</tr>
<tr>
<td><strong>(g) Truss housing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inside sheathing</td>
<td>1&quot; and 1&quot;&quot; thick</td>
<td>C Finish</td>
</tr>
<tr>
<td><strong>(h) For temporary structures which are for use only during erection or for</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>emergency use,</strong> the grades of 1200 Ft or 1000 Fc may be substituted for**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1850 Ft, 1500 Ft or 1400 Ft, or 1150 1-c, where provided above.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
833.04 Preparation For Oil Timber Treatment.

(a) INSPECTION.

Inspection at the treating plant shall cover the material and treatment, the storing and handling and the loading of the material after treatment. All timber to be treated shall be free from dirt, grease, or other foreign material which will in any way hinder the full penetration of the preservative. Round timber or timber with wane shall have the rough bark and inner bark removed. No piece of material will be accepted for use which does not bear the Inspector's stamp, nor will delivery of material be accepted unless the Inspector certified that he has personally inspected the material as loaded. Reasonable care will be exercised to prevent delivery of defective material but it is expressly understood that mill or plant inspection will not be a bar to subsequent rejection of material found undersized, broken, split, rotten or otherwise clearly defective.

(b) CONDITIONING.

1. AIR CONDITIONING.

Material to be treated preferably shall be air-conditioned until the moisture remaining in the wood will not prevent the injection and proper distribution of the specified amount of preservative. For air conditioning, the materials shall be sorted as follows: Lumber shall be segregated according to the size, and each layer in the pile shall be separated by at least 2-inch thick strips for lumber 6 inches thick or less, and 4-inch strips for lumber over 6 inches thick, with an air space between each two pieces of lumber in any layer equal to the width of the timber. Alleys at least 3 feet wide shall be left between rows of stacks and the material shall be at least 12 inches off the ground on concrete or treated timber sills. Piles shall be stored in like manner, placing as nearly as practical only one length in a stack, using at least 4-inch strips or saplings of equal size between each layer and reversing all sticks in every other layer in order to keep the stack level. The space under and between the rows of stacks shall be kept free at all times of rotting wood, weeds or rubbish. The yard shall be so drained that no water can stand under the stacks or in their immediate vicinity. Air conditioned timber shall be steamed before treatment for a minimum of 6 hours in accordance with methods set out under steam seasoning.

2. STEAM CONDITIONING FOR SOUTHERN YELLOW PINE.

Southern Yellow Pine may be steam-conditioned until the moisture remaining in the wood will not prevent the injection and proper distribution of the specified amount of preservative. The material shall be steamed in the cylinder at not more than 245°F., approximately 13 pounds pressure per square inch for not more than 15 hours for sawed timber and not more than 20 hours for piles; the maximum pressure shall be reached in not less than 2 hours. The duration of the steaming shall be based on consideration of the shape, cross-sectional area and moisture content of the material. The cylinder shall be provided with bents to relieve it of air and insure proper circulation of steam. After steaming is completed, a minimum vacuum of 24 inches shall be maintained for not less than 60 minutes, or until the wood is as dry and free from moisture as practicable. The cylinder shall be relieved continuously or frequently enough to prevent condensate from accumulating in sufficient quantities to reach the wood.

Before the preservative is introduced the cylinder shall be drained of condensate.
(c) PREPARATION FOR TREATMENT.
Each cylinder charge shall consist of pieces of the same species approximately equal in size and moisture and sapwood content, into which approximately equal quantities of preservatives can be injected. Each piece shall have all surfaces free from contact with surrounding pieces for its entire length to insure contact of steam and preservatives with all surfaces.

(d) MANNER OF TREATMENT.
Following the conditioning period, and unless otherwise specified herein, the timber or piles shall be treated with creosote oil by an empty cell process, except that the full cell process may be used only when the maximum net retention is desired, and where pressure is held to refusal, or when stipulated retention is greater than can be obtained by the use of an empty cell process. The ranges of pressure, temperature and time duration shall be controlled so as to obtain the maximum penetration by the quantity of preservative injected.

833.05 Plant Equipment.
Treating plants shall be equipped with the thermometers and gauges necessary to indicate and record accurately the conditions at all stages of treatment, and all equipment shall be maintained in condition satisfactory to the Engineer. The apparatus and chemicals necessary for making the analyses and tests required shall also be provided by plant operators and kept in condition for use at all times.

833.06 Penetration Of Treatments.

(a) PRESSURE.
1. The range of pressure, temperature, and time duration shall be controlled so as to result in a maximum penetration by the quantity of preservatives injected. The vacuum requirements stipulated are in inches of mercury at sea level, and necessary corrections shall be made for altitude. 2. In Southern Yellow Pine, the preservative shall permeate all of the sapwood and as much of the heartwood as practicable.

(b) PENETRATION.
1. The penetration of creosote oil shall be based on black or dark oil and in no case will light discoloration of the wood due to treatment be taken into consideration in measuring the depth of penetration.
2. Tests for penetration shall be made by taking borings with an increment borer. All holes so bored shall be immediately plugged by the vendor or Contractor with tight fitting treated plugs.
3. As many penetration tests of lumber and piling shall be made as is considered necessary. At least one boring shall be taken in each pile, the holes being bored midway between the ends. Every fourth stick of timber and the lumber in the charge may be bored.
4. In gauging the depth penetrated by preservatives other than creosote oil the method used shall be such as will enable the Engineer to determine, to his satisfaction, the actual depth penetrated.
5. The penetration of pentachlorophenol preservatives shall be determined by either method 5 or 6, as required, of the AWPA Standard A-3.
833.07 Pressure Oil Treatments Of Southern Pine.

Either the full cell or empty cell process as specified shall be used for treatment of Southern Yellow Pine with creosote oil or any type of pentachlorophenol petroleum oil solution. Treatment shall be in accordance with Section 2, "Treatment" of AWPA Standard C-1.

833.08 Blank.

833.09 Water Borne Preservative Treatments.

Treatment with water borne preservatives shall be by the "full cell process" in accordance with the provisions of Section 2, TREATMENT of AWPA Standard C-1 and the following:

1. In general, the material to be treated shall have been seasoned by air drying, or kiln drying or a combination of them until the moisture content in the treatable areas of the wood has been reduced to not more than 20 percent of the oven-dry weight of the wood. When it is necessary to treat lumber or timber with a greater moisture content than 20 percent, such material shall be artificially seasoned in the cylinder by alternate steam bath and vacuum of such intensity and duration and such number of cycles as will prepare the material for a minimum absorption of solution to provide the stipulated net preservative retention. In no case shall the steam pressure be such as to exceed a maximum temperature in the cylinder of 240°F., and the maximum pressure shall be not more than 20 pounds per square inch and the steaming period shall not exceed 6 hours, which pressure and temperature maxima shall not be reached in less than 2 hours. The cylinder shall be relieved of condensate and wood extracts continuously during both the steaming and the vacuum periods, and after the final vacuum the treating solution shall not be admitted to the cylinder until all such condensate and wood extracts have been evacuated.

2. The concentration of preservative in the solution shall be so adjusted that the injected quantity of solution, after the carrier water has dried out, shall leave not less than 90 percent nor more than 110 percent of the stipulated preservative retention in any one charge.

833.10 Blank.

833.11 Pentachlorophenol—Petroleum Oil Treatments.

The provisions of Section 833.04(d) are applicable to the manner of treatment using pentachlorophenol petroleum oil in the same respect that they are applicable to creosote oil.

833.12 Retreatment.

(a) GENERAL.

Timber or piles not conforming to the stipulated minimum requirements may be retreated and may be re-offered for acceptance, but retreatment should be avoided so far as practicable. If retreatment is necessary, it shall be as set forth below.

(b) STEAM TEMPERATURE.

The maximum limits for temperature of steam or preservative and the maximum limit for preservative pressure that apply to original treatment shall not be exceeded during retreatment.
(c) PRESERVATIVE RETAINED.
   1. When a charge to be retreated is made up entirely of nonconforming or
      rejected materials, the amount of preservative retained in the retreatment shall be at
      the discretion of the treating plant, provided the total net retention does not fall
      below the minimum requirements.
   2. In the computation of the required minimum net retention in any
      charge containing both black and white timber or piles, all materials in the charge
      shall be considered as untreated.

833.13 Storage And Handling Of Lumber And Timber.

(a) STORAGE.
   1. Lumber and timber on the site of the work shall be stored in piles. Untreated material shall be open
      stacked at least 12 inches above the ground surface and piled to shed water and prevent warping. It shall be protected
      from the weather by suitable covering. Creosoted timber and piling shall be closed stacked, piled to
      prevent warping, and the tops of the stacks shall be covered with a 2-inch layer of earth. The ground underneath and in
      vicinity of all material shall be cleared of weeds and rubbish.
   2. Lumber and timber that is to be painted should be exposed to the weather, either by sticker piling or after the lumber is in
      place, for at least 60 days. The stacks of lumber shall be piled so as to prevent warping and allow drainage.

(b) HANDLING.
   1. In general all cutting, framing, and boring of treated timber shall be done before treatment. The timbers shall be handled carefully
      without dropping or breaking of outer fibers, bruising or penetrating the surface with tools. It shall be handled with suitable
      slings or by hand. Cant dogs, peavyes, hooks or pike poles shall not be used. In water infested by marine borers, cutting below
      high water shall be avoided.
   2. All precautions in regard to painting on damp surfaces and in wet weather should be followed. The weathered lumber shall be painted
      with a prime coat followed by a finish coat. Then another coat of primer and the final finish coat shall be applied.

(c) CUTS AND HOLES.
   1. All cuts in treated timbers, and all abrasions after having been carefully
      trimmed, shall be coated with two applications of the treatment mixture, creosote
      treatments shall have an application of 60 percent creosote oil and 40 percent
      roofing pitch, or brush coated with at least two applications of hot creosote oil and
      covered with hot roofing pitch.
   2. All holes bored after treatment shall be impregnated with preservatives
      by means of an approved bolt hole treater prior to plugging or driving of bolts. Any
      unfilled holes, after being treated, shall be plugged with treated plugs.

(d) SALVAGED TIMBER.
   1. Any salvaged treated timber furnished by the City will be made available
      to the Contractor as provided herein. He shall transport it to the site prepare it for
      use and erect it complete in the structure under the same provisions and
      requirements as specified for new treated timber, except that field framing and
      boring will be permitted. All cuts and holes shall be treated as specified in Subsection
      (c) above.
2. Timber cutoffs of size and length as directed, and timber carried to the site and not used, shall be cared for by the Contractor and stacked at a point convenient for loading on trucks for recovery by the City.

833.14 Identification.

The Contractor's or vendor's treating plant shall brand or place some approved permanent markers on each pile so that the year treated and the company responsible for the treatment may be determined at any time while the timber is in service.
835.01 Concrete Piles.

(a) GENERAL.

All concrete materials and their preparation and placing shall be in accordance with the requirements of Section 501 unless otherwise specified hereinafter in this Section.

Reinforcement shall conform to the requirements of Section 503 and dimensions shall be as shown on the plans.

(b) PRECAST CONCRETE PILES.

The manufacture of precast concrete piles shall conform to the requirements for precast units provided in Section 501.03(m). Concrete shall be Class A unless otherwise specified by plan details or in the proposal.

(c) PRECAST PRETENSION-PRESTRESSED CONCRETE PILING.

1. GENERAL.

The term precast prestressed concrete as used herein shall refer to concrete in which the prestressing strands or wire are tensioned prior to placing the concrete and released after the concrete has gained sufficient strength to retain the prestressing force by bond.

The definition of all other terms pertaining to prestressed concrete shall conform to the latest report of the AASHTO Committee on Bridges and Structures and Prestressed Concrete Institute Joint Committee.

2. MATERIALS.

Materials shall be the same as specified in Section 507.02 for pretensioned-prestressed girders.

3. MANUFACTURE OF UNITS.

The manufacture of pretensioned-prestressed piling shall conform to the requirements of Sections 507.03(a) through 507.03(g), and the following:

a. Anchorage of the prestressed concrete pile to the cap shall be in accordance with the plan requirements.

b. No piling shall be transported or driven until 5000 psi concrete is obtained and verified by test cylinders.

c. Any pile damaged during driving shall be repaired or removed and replaced, all at the expense of the Contractor.

d. The outside of all pile shall receive an ordinary surface finish as specified in Section 501.03(1). All exposed surfaces of the pile shall receive a Class I or a coated finish, with the finish the same as used on the bridge structure.

In the case of a Class I finish, the first rub shall be applied at the fabrication yard and the second after installation. For a coated finish the coating shall be applied after installation.

(d) CAST IN PLACE CONCRETE PILES.

1. SHELL.

a. Cast in place concrete piles shall be reinforced and cast in strong metal shells which shall remain permanently in place. However, other types of cast in place concrete piles, plain or reinforced, cased or uncased, may be used if the soil conditions permit their use.

b. The metal shell shall be of sufficient thickness and shall be reinforced so that it will hold its original form and show no signs of distortion after the core has been withdrawn. The design of the shell shall be approved before any
driving is done but it shall be Contractor's responsibility to select an adequate shell thickness that will permit driving without damage. Pipe steel shell meeting requirements of ASTM Designation A-252 may be driven without use of a driving core or mandrel.

c. After the shell has been driven and the core withdrawn, the shell shall be inspected and approved before any concrete is placed. Any improperly driven, broken, or otherwise defective shell shall be removed and replaced.

2. CONCRETE.
   a. Class A concrete with one inch (1") maximum size aggregate shall be used.
   b. No concrete shall be placed until all driving within a radius of 15 feet has been completed, nor until all the shells for any one bent have been completely driven. If this cannot be done, all driving within the above limits shall be discontinued until the concrete in the last pile cast has set at least seven (7) days.
   c. Concrete shall be placed as provided in Section 501.03(m) except that the forms shall not be vibrated. Accumulations of water in the shells shall be removed before the concrete is placed.

3. REINFORCEMENT.
   Reinforcement for cast in place piles shall be of the unit type, (fastened together rigidly) and shall be lowered into the shell before concrete is placed. No loose bars will be permitted. The reinforcement shall be secured in such a manner as to insure its proper location in the finished pile.

835.02 Blank.
835.03 Blank.
835.04 Blank.
835.05 Steel Bearing Piles.

The material in rolled steel piles and splices shall conform to requirements of Section 839 and ASTM A-36 unless otherwise specified by plan details. All piles shall be rolled steel sections of the section number, size and weight per linear foot indicated on the plans and shall be fabricated in conformity with the requirements of Section 839. A minimum copper content of 0.2 percent will be required, if so specified on the plans.

835.06 Steel Sheet Piles.

Steel sheet piles shall be of the type called for on the plans and shall conform to the requirements of ASTM Designation A-328 and its supplementary requirement, S1.

835.07 Storage And Handling.

(a) PRECAST, AND PRECAST Prestressed Concrete Piles.

The method of storing and handling shall be such as to eliminate the possibility of undue bending stresses, cracking, spalling or other injury in curing or transporting the piles from the forms and into the leads. Concrete piles shall be lifted
by means of a suitable bridle or sling attached to the pile at pickup points designated on the plans. Piles cracked or otherwise injured during handling or driving will be rejected and shall be immediately removed and replaced at no cost to the Department.

(b) STEEL PILING.
When placed in the leads, the pile shall conform to camber and sweep permitted by allowable mill tolerance. The method of storing and handling shall be such as to avoid undue bending stresses or other injury. Piles bent, cracked, or otherwise injured will be rejected.
SECTION 837
STEEL REINFORCEMENT

837.01 General.

All reinforcing steel shall be Grade 40 or Grade 60 billet steel, unless otherwise stipulated in these Specifications or specifically designated by plan details. All reinforcing bars over 1/4 inch in diameter shall have deformations as prescribed in ASTM A 615. Rail steel concrete reinforcement bars in sizes not greater than No. 6 will be permitted for all culverts and other concrete structures except bridges. In bridges their use shall be limited to curbs and handrail and to floor slabs with a clear span of less than 10 feet measured parallel to the main bar reinforcement.

837.02 Reinforcing Bars.

(a) BILLET STEEL REINFORCEMENT BARS.
Billet steel reinforcement bars over 1/4 inch in diameter shall meet the requirements of AASHTO M-31 or ASTM A-615 modified to require the pin diameter for the bend test to be as follows:

<table>
<thead>
<tr>
<th>Bar Size</th>
<th>Grade 40</th>
<th>Grade 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4, 5</td>
<td>4d</td>
<td>4d</td>
</tr>
<tr>
<td>6</td>
<td>4d</td>
<td>5d</td>
</tr>
<tr>
<td>7, 8</td>
<td>5d</td>
<td>5d</td>
</tr>
<tr>
<td>9, 10, 11</td>
<td>5d</td>
<td>7d</td>
</tr>
</tbody>
</table>

Bars less than 1/4 inch in diameter shall meet the requirements of AASHTO M-32 or ASTM A-82.

(b) RAIL STEEL REINFORCEMENT BARS.
Rail steel reinforcement bars shall meet the requirements of AASHTO M-42, Grade 50 or Grade 60. Rail steel shall not be used for tie bars that are to be bent and restraightened. See restrictions noted in Section 837.01.

837.03 Reinforcing Mesh or Mats.

WIRE FOR MESH REINFORCEMENT.—Wire for mesh reinforcement shall meet the requirements of AASHTO M-32 (ASTM A-82).

WELDED STEEL WIRE REINFORCEMENT.—Welded steel wire reinforcement shall meet the requirements of AASHTO M-55 (ASTM A-185).

FABRICATED BAR OR ROD MAT.—Fabricated bar or rod mat shall meet the requirements of AASHTO M-54 (ASTM A-184).

837.04 Spiral Reinforcement.
Spiral reinforcement may be plain or deformed bars or may be cold drawn wire. Plain reinforcing bars shall conform (except for deformations) to AASHTO M-31 (ASTM A-615), Grade 40 or Grade 60. Deformed bars shall conform to Section 837.02. Cold drawn wire shall conform to AASHTO M-32 (ASTM A-82).
837.05 Dowel and Tie Bars for Concrete Pavement.

(a) DOWEL BARS.

Dowel bars shall be smooth round bars of the size shown by plan details. The bars shall be fabricated from steel conforming to AASHTO M-31, M-42, M-53, or M-227 of a grade which will provide a tensile strength of 70,000 psi or higher. The bars shall have a corrosion resistant coating conforming to the requirements of AASHTO M-254 for a Type A or Type B coating. One end of each dowel used in an expansion assembly shall be provided with an approved tight fitting non-collapsible expansion cap.

(b) TIE BARS.

Standard tie bars shall be of the size shown by plan details, fabricated from deformed bars meeting the requirements of AASHTO M-31, M-42 or M-53, Grade 40, 50 or 60 steel, unless a specific grade is designated by plan requirements, except that rail steel (M-42) or axle steel (M-53) shall not be used for bars which are required to be bent and restraightened.

Sectional tie bars shall be of the size shown by plan details fabricated from deformed bars meeting the requirements of AASHTO M-31, M-42, or M-53 for Grade 60 steel.

837.06 Prestressing Steel.

(a) STRESSING CABLE.

Unless otherwise shown by plan details, stressing cables shall meet the requirements of ASTM A-416 for the appropriate design strength. Designs using other strands may be submitted for consideration by the Engineer of Public Works.

(b) STRESSING BARS.

Stressing bars, when allowed by plan details, shall meet the requirements of ASTM A-722 for Type 1 with supplemental requirements S2 and S4 unless other requirements are provided by the plans or proposal.

837.07 Use, Care, And Handling.

All reinforcement received on the project shall be placed in approved storage and shall be maintained clean, intact, and free from distortion. Reinforcement shall be free from loose or thick rust, which would impair bond of the steel with the concrete. Rust that produces only discoloration without reducing the cross section of the steel will not be considered objectionable. Only such reinforcement shall be distributed along the construction as needed for immediate use.
839.01 General.

(a) MARKING OF STEELS.
Steels, when received from the mill shall be identified in accordance with ASTM A-6.
Certified mill test reports or certified reports of tests made by other agencies shall be furnished for each project containing steel in order to verifying that the material meets the requirements of the type and grade specified. The Department reserves the right to make its own test of any material, and the material may be rejected if these tests prove the material does not meet the requirements.

For identification purposes mill heat numbers shall be stamped in the flanges and webs of welded members and in the webs of rolled members. The numbers shall be located adjacent to piece marks.

All steel which is required to have a yield point greater than 36,000 psi shall, at all times in the fabricator's plant, be marked to identify its ASTM or special specification.

(b) GENERAL REQUIREMENTS.
1. Structural steel shall conform to the requirements of ASTM A-36 unless otherwise noted hereinafter in this Section or shown on the plans.

Materials for minor secondary members or details may be taken from stock as approved by the Engineer provided the fabricator makes an affidavit to the effect that the material will conform to the required specifications.

Special attention is directed to the following mandatory material requirements for member components when designated by the contract drawings.

The material supplied shall meet the longitudinal Charpy V-notch test noted below. Sampling and testing shall be in accordance with ASTM A-673 with the frequency of heat testing used. Test reports are required and shall be furnished in the same number of copies as mill test reports. All members requiring CVN testing shall have heat numbers legibly marked during fabrication.

<table>
<thead>
<tr>
<th>Steel</th>
<th>Thickness</th>
<th>Test Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-36</td>
<td>Up to 4&quot;</td>
<td>15 ft. LB@ 70°F. (Min. Ser. Temp. 0°F. and above)</td>
</tr>
<tr>
<td>A-440</td>
<td>Up to 4&quot;</td>
<td>15 ft. LB@ 70°F. (Min. Ser. Temp. 0°F. and above)</td>
</tr>
<tr>
<td>A-441</td>
<td>Up to 4&quot;</td>
<td>15 ft. LB@ 70°F. (Min. Ser. Temp. 0°F. and above)</td>
</tr>
<tr>
<td>A-572</td>
<td>Up to 4&quot; Mech. Fastened</td>
<td>15 ft. LB@ 40°F. (Min. Ser. Temp. -1°F to -30°F.)</td>
</tr>
<tr>
<td></td>
<td>Up to 2&quot; Welded</td>
<td></td>
</tr>
<tr>
<td>A-588</td>
<td>Up to 4&quot; Mech. Fastened</td>
<td>15 ft. LB@ 40°F. (Min. Ser. Temp. -1°F to -30°F.)</td>
</tr>
<tr>
<td></td>
<td>Up to 2&quot; Welded</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 2&quot; to 4&quot; Welded</td>
<td>20 ft. LB@ 40°F. (Min. Ser. Temp. -1°F to -30°F.)</td>
</tr>
</tbody>
</table>

* If the yield point of the material exceeds 65 ksi, the temperature of the CVN value for acceptability shall be reduced by 15°F. for each increment of 10 ksi above 65 ksi.
When designated on the plans, the Contractor (Fabricator) shall furnish one (1) main load carrying member 18 inches overlength in order to provide an 18 inch sample for testing.

Unless otherwise shown on the plans, steel plates for main members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses.

2. Fasteners, pins and rollers shall conform to the requirements of Sections 839.30, 839.32, 839.33 and 839.42 and the following:

Rivets .................................................................ASTM A-502
Unfinished bolts ....................................................ASTM A-307
High Strength bolts ...............................................ASTM A-325
Pins and Rollers ..................................................ASTM A-108 and A-668

Threads for all bolts and pins for structural steel construction shall conform to the American National Standard for Unified Screw Threads, ANSI Bl.1, Class 2 A for external threads and Class 2 B for internal threads, except that pin ends having a diameter of 1-3/8 inches or more shall be threaded six (6) threads to the inch.

All bolt heads and nuts shall be hexagonal shaped with dimensions conforming to the requirements for Hexagon Structural Bolts and Heavy Semi-Finished Hexagon Nuts of ANSI Standard B18.2.1 and B18.2.2.

3. All cast and built-up bearings shall be shop assembled, checked for fit, securely packaged and shipped as a unit. The method of securing the bearing unit for shipment shall be as shown by the plan details.
   The diameter of pins used in cast and built-up bearing shall be within 1/16 inch of the diameter specified by the plans with pin holes not in excess of the pin diameter by more than 1/16 inch.

4. Copper bearing structural steel, used for structural steel piling, shall conform to the requirements of Section 839.01, except that it shall contain not less than 0.20 percent of copper. Copper bearing steels for other structural uses shall be as specified.

5. High strength and alloy steel shall be in accordance with the following.
   a. Special alloy steels to meet definite corrosion requirements shall be as specified on the plans.
   b. High strength structural steel for riveted and bolted construction shall conform to ASTM A-440, A-572* or A-588. If a specific grade of these steels is required, such will be designated on the plans.
   c. High strength structural steel for welded construction shall conform to ASTM A-441, A-572* or A-588; if a specific grade of these steels is required, such will be designated on the plans.

*ASTM A-572 steel shall be limited to Grades 42, 45, and 50 and to structural shapes in groups 1, 2 and 3 or ASTM A-6 and to plates and bars in thicknesses through 1-1/2 inches (38.1 mm). Plates and bars over 3/4 inch (19.0 mm) through 1-1/2 inches (38.1 mm) in thickness shall be "killed-fine grain practice."

6. Corrosion-resistant iron chromium and iron chromium-nickel castings for general application shall conform to the requirements of ASTM A-296 of the grade specified on the plans.

7. Anchor bolts, unless otherwise specified by plan details, shall be fabricated of a grade steel equal to or better than ASTM A-36 steel (maximum tensile strength is waived), threaded in accordance with ASTM A-307 and galvanized with
zinc in accordance with ASTM A-153 Class C or AASHTO M-276 Class 50 except that galvanization of the bolt below three (3) inches from the top of the embedment line will not be required. Nuts shall be hex nuts meeting the requirements of ASTM A-307, hot-dipped galvanized in accordance with ASTM A-153. Washers shall be plain hardened washers meeting the requirements of ASTM F-436 galvanized in accordance with the provisions noted above for the anchor bolts.

(c) FULL SIZE TESTING OF MEMBERS.
When full size tests of structural members are required the methods and procedures shall be provided in the plans and specifications.

839.02 Steel Forging.
Carbon steel forgings shall, unless otherwise specified by plan details, conform to the requirements of ASTM A-668 for Class C material. All forgings shall be annealed prior to being machined to form finished parts. A record of the annealing charges shall be furnished the Engineer by the manufacturer showing the forgings in each charge, the melt or melts from which they were secured, and the treatment they received.

839.04 Steel Castings.
Steel castings shall conform to the requirements of ASTM A-27 Grade 70-36, unless otherwise specified on the plans, and the following:

(a) The dimensions of fillets shall not be less than the thickness of the thinnest adjoining section or member nor less than 1/2 inch.
(b) All steel castings shall be annealed, unless otherwise provided on the plans, in accordance with ASTM A-27. Certification of annealing process shall be furnished by the manufacturer.
(c) Steel castings shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. No finished casting shall have visible blow holes so located that a straight line laid in any direction will cut a total length of cavity greater than one inch in any one foot, nor shall any single blow hole exceed one inch in any dimension or have an area greater than 1/2 square inch. Blow holes shall not have a depth injuriously affecting the strength of the casting. Minor defects which do not impair the strength may be welded by the electric process. The defects shall be removed to solid metal by chipping, drilling or other satisfactory methods and, after welding, the castings shall be annealed, if required. No cracks, flaws or other defects shall appear after such treatment. No sharp unfilleted angles or corners will be allowed. Castings that have been welded without the Engineer's permission shall be rejected.
(d) All castings shall be blast cleaned of scale and sand so as to present a smooth, clean and uniform surface.
(e) Castings shall be checked for soundness by comparing computed weight against actual weight (actual weight less than 95% of computed weight shall cause for rejection of casting) and/or by suspending the casting and hammering it all over, comparing soundness of the ring.
839.05 Gray Iron Castings.

(a) GENERAL.
Gray iron castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. They shall be true to pattern in form and dimensions. Castings will be classified under one of the following grades:
1. Grade "A".
   Grade "A" Castings shall conform to the requirements of Class No. 30 A for Gray Iron Castings, ASTM A-48.
2. Grade "B".
   Grade "B" Castings shall conform to the requirements of Class No. 20 A for Gray Iron Castings, ASTM A-48. All castings shall be of the Grade "A" classification unless otherwise noted.

(b) CLEANING.
All castings shall be blast cleaned of scale and sand so as to present a smooth, clean and uniform surface.

(c) PAINTING.
The finished castings shall, after being thoroughly cleaned and before rusting begins, be coated immediately after heating to 300°F., with approved coal tar pitch varnish.

(d) WEIGHTS.
Any casting weighing less than 95% of the weight computed from its dimensions shall be rejected.

839.06 Malleable Iron Castings.

Malleable iron castings shall conform to the requirements of ASTM A-47, Grade No. 35018. Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. The dimensions of fillets shall not be less than provided in Section 839.04. The surfaces shall have a workmanlike finish. Malleable castings shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Cleaning shall be as provided in Section 839.05(b). Soundness shall be checked as provided in Section 839.04(e).

839.07 Ductile Iron Castings.

Ductile iron castings shall conform to the requirements of ASTM A-536, Grade 60-40-18. Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. The dimensions of fillets shall not be less than provided in Section 839.04. The surfaces shall have a workmanlike finish. Malleable castings shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Cleaning shall be as provided in Section 839.04(d). Soundness shall be checked as provided in Section 839.04(e).

839.08 Self-Lubricating Bronze Or PTFE Bearing Plates.

(a) SELF-LUBRICATING BRONZE BEARING PLATES.
These bearing plates shall be an article of standard production by an established manufacturer of such equipment. They shall be provided with trepanned or drilled recesses (not grooves) which shall be filled with a lubricating compound capable of withstanding the atmospheric elements and consisting of graphite and
metallic substances with a lubricating binder. Such compound shall be pressed into
the recesses by hydraulic presses so as to form dense non-plastic lubricating inserts.
The lubricating area shall comprise not less than 25 percent of the total area. The
manufacturer shall furnish additional lubrication and just prior to assembling, the
entire sliding surfaces of members in contact with plates shall be thoroughly
lubricated with the approved lubricant. The bearing plates shall be made of bronze
conforming to the requirements for Bronze Castings for Bridges and Turntables,
ASTM B-22, Alloy D, Copper Alloy #905, except that a maximum of 2-1/2 percent lead
will be permitted. This will modify minimum on copper to 84.5 percent, minimum on
tin to 8.5 percent and maximum on zinc to 3.75 percent.

The coefficient of friction shall not exceed one-tenth.

(b) PTFE BEARING PLATES.
1. STRUCTURAL STEEL.
The structural steel portion of the bearing plate shall meet the
requirements of ASTM A-36 unless otherwise noted by plan details.
2. PTFE MATERIAL.
The Polytetrafluoroethylene (PTFE) polymer shall be composed of 100%
virgin (unfilled) PTFE. The virgin (unfilled) PTFE shall have a thickness of not less
than 1/16" with properties conforming to the requirements set forth in Section
843.02(b)2 for the PTFE material.
3. BONDING OF PTFE TO STEEL PLATE.
Bonding of the PTFE to the surfaces required by the plans shall be
accomplished with an adhesive approved by the manufacturer of the PTFE. The
application and curing shall be in accordance with the producing manufacturer's
recommendations.
4. COEFFICIENT OF FRICTION.
The coefficient of friction shall not exceed one-tenth.

839.09 Grounding Materials For Steel Bridges.

Standard stranded copper grounding conductor shall be bare annealed
Class B stranded electric conductor.
Extra flexible grounding conductor shall be Class G bare annealed stranded
electric conductor.
Grounding rods shall be 5/8" x 8 feet, minimum size, copperclad steel
grounding rods as manufactured by A.B. Chance, McGraw-Edison, Joslyn
Manufacturing and Supply Company, or approved equal.
Exothermic welding shall be by the Cadwell process or an approved
equivalent method. All materials shall conform to the National Electrical
Manufacturers' Association (NEMA) or the Underwriter's Laboratories, Inc.
standards.

839.10 Lead Plates, Etc.
Lead used for plates, pipes, etc., shall conform to the requirements of ASTM
B-29 for common desilverized lead.

839.11 Shop And Working Drawings.
The plans furnished the Contractor by the Department are not intended for
use as shop or working drawings. Shop drawings and working drawings will be
required as specified in Section 50.02.
Shop drawings shall include camber and sweep diagrams covering steel portions of all structures.

Fabricators shall furnish verification certificates of the actual measurements of the camber placed in each beam, girder or truss.

839.12 Mill Orders And Shipping Statements.

The Contractor shall furnish the Engineer with as many copies of mill orders and shipping statements as may be necessary. The weights of the individual members shall be shown.

839.13 Notice And Facilities For Inspection.

The Contractor shall give ample notice to the Engineer of the beginning of work at the mill and of shipping so that inspection may be provided. The term mill means any rolling mill or foundry where material for the work is to be manufactured.

No material shall be fabricated before the Department has been notified where the fabrication order has been placed.

The Contractor shall provide adequate, suitable facilities and equipment when required for the inspection of materials and workmanship in the mill and fabrication shop.

Unless otherwise provided for in the proposal, the Contractor shall furnish, without extra compensation, test specimens as provided herein. Fabrication shops shall have a master tape calibrated by the U.S. National Bureau of Standards. All tapes used in the fabrication measurements shall be calibrated with the master tape before used on a project. Any master tape found damaged or with a certification over two (2) years old shall be replaced or recalibrated. The quality control program for any fabrication work performed for the City of Huntsville will be subject to the approval of the Engineer.

839.14 Handling, Storage And Transporting Of Materials.

The loading, unloading, handling and storing of materials shall be so conducted that the metal will not be injured or damaged. Structural material delivered at the bridge shop receiving yard shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected from corrosion. It shall be kept free from accumulations of dirt, grease or foreign matter.

During and after fabrication, proper lifting equipment with the capacity to handle members carefully at all times so that no member or part thereof will be bent, excessively stressed, deformed or otherwise damaged shall not be used. Handling of members shall require the use of suitable clamps, plate hooks or other approved devices. Chains or chokers will not be allowed without the use of a protective shield between the chain and the member. Members longer than 50 feet shall utilize a two or more point pickup method. Members shall be transported in such a manner that they will not be excessively stressed, deformed or otherwise damaged. For exceptionally deep girders, girders and beams shall be stored and transported in a "workway position" as used in the structure with appropriate shoring and blocking methods. Chain tie downs shall be provided with protection shields. Any suspected damage from handling, storage or hauling shall be cause for the Engineer to order verification of design camber and/or repair of the beam or girder.

Material that has become pitted due to exposure or other causes shall not be used for fillers or for any member or part of a structure. The above shall also apply to fabricated material stored prior to shipment and to material delivered at the bridge.
Attention is called to Section 60.05(b). Preparation and shipment of fabricated pieces shall conform to the following:

**Loose Members.**
1. Parts not completely assembled in the shop shall be secured, insofar as practicable, to prevent damage in shipping or handling.
2. Projecting parts likely to be damaged during shipment shall be blocked with wood or otherwise protected. Members weighing more than 3 tons shall have the weight marked thereon.

**Packages.**
1. Pins, small parts and small packages of bolts, rivets, washers, and nuts shall be shipped in boxes, crates, kegs, or barrels. A list and description of the contained material shall be plainly marked on the outside of each shipped container.
2. Fasteners of one length and diameter and loose nuts or washers of each size, shall be packed separately.
3. Anchor bolts, washers, and other anchorage or grillage materials, shall be shipped in time to suit the requirements of the masonry construction.

**839.15 Straightening Material.**
Rolled material, before it is marked, laid off, punched or otherwise worked in the shop must be straight or cambered as shown on the plans. Material with sharp kinks or bends may be rejected. If straightening is necessary, it shall be done by methods that will not injure the metal. Heat straightening will be permitted provided the metal is not heated above 1100°F. (controlled by the use of heat crayons furnished by the Fabricator or other approved means). After heating, the metal shall not be artificially cooled until after naturally cooling to 600°F. (315.2°C.) or less. The method of artificial cooling is subject to the approval of the Engineer. After straightening, the surface of the metal shall be carefully inspected for evidence of fracture.

**839.16 Workmanship And Finish.**
(a) GENERAL.
Workmanship and finish shall be first class in every respect. Materials at the shop shall be kept clean and protected from the weather insofar as practical. Shearing, burning, chipping and grinding shall be neatly and accurately done in a workmanlike manner.

Damage incurred to members or the surfaces of members for any reason shall be cause for the Engineer to order the damage repaired or to reject the member in accordance with the following:
1. Except as noted in paragraph 2 below, damage to surfaces of plates that does not reduce the plate thickness below the permissible minimum thickness allowed by ASTM A-6 or the thickness of structural shapes in excess of 1/32 inch for material less than 3/8 inch in thickness, 1/16 inch for materials 3/8 inch to 2 inches inclusive in thickness or 1/8 in for material over 2 inches thick are considered repairable. Damage in excess of the limits noted hereinbefore will be evaluated by the Engineer as to whether to reject the member due to an unacceptable quality of the member.

2. Surface indentation of members caused by lifting devices shall be evaluated by the Engineer to determine if the damage is repairable and if repairable, the repairs necessary for acceptance. Continued use of lifting devices that cause damage, especially that which reduces the specified thickness by more than 1/16 inch, will be cause for the rejection of all such members so damaged.
Horizontal curving of built-up girders shall be accomplished by cutting flange plates to the radii shown by the plan details from wider plates, unless the heat up-set method is allowed by the plans or proposal. When the heat up-set method is allowed, such will require a written procedure approved by the Engineer. Said procedure shall utilize minimum temperatures not to exceed 1100°F. as evidenced by heat crayons (furnished by the Contractor).

After heating of metals as noted hereinbefore, the metal shall not be artificially cooled until after naturally cooling to 600°F. or less. The method of artificial cooling must be accomplished in a manner not to reduce the strength of the member.

Any material that is heated above the temperature limit noted hereinbefore will be rejected until tests and investigations reveal the material is suitable for use. The Contractor shall be solely responsible for providing any test data or other information deemed necessary by the Engineer to evaluate the acceptability of the material at no cost to the City.

839.17 Flame Cutting.

Steel may be flame cut, provided a smooth surface is secured by the use of a mechanical guide. Flame cutting by hand shall be done only when approved, and the surface shall be made smooth by planing, chipping or grinding. Re-entrant cuts shall be filleted to a radius of not less than $\frac{3}{4}$ inch.

In all oxygen cutting, the cutting flame shall be so adjusted and manipulated as to avoid cutting beyond (inside) the prescribed lines. Roughness of oxygen cut surfaces shall not be greater than that defined in ANSI B-46. 1 for a surface roughness value of 1,000 for materials up to four (4) inches thick and 2,000 for materials four (4) inches to eight (8) inches thick, except that the ends of members not subject to calculated stress at the ends shall meet the surface roughness value for 2,000. Roughness exceeding these values and occasional notches or gouges not more than $\frac{3}{16}$" deep, on otherwise satisfactory surfaces, shall be removed by machining or grinding. Cut surfaces and edges shall be left free of slag. Correction of defects shall be faired to the oxygen cut surfaces with a slope not exceeding 1 in 10. Defects in oxygen cut edges shall not be repaired by welding except with approval of the Engineer for occasional notches or gouges less than $\frac{7}{16}$" deep for material up to 4" thick and less than $\frac{5}{8}$" for material over 4" thick. Such weld repairs shall be made by suitably preparing the defect, welding with low hydrogen electrodes not exceeding $\frac{5}{32}$" in diameter, grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

Other methods of cutting steel may be approved for use provided the method will produce cut surfaces within the tolerances noted hereinbefore for oxygen cut surfaces.

839.18 Substitutions.

Substitutions of sections having different dimensions than those shown on the plans shall be made only when approved in writing. The Contractor must submit certified test data that indicates that the member equals or exceeds the structural requirements of the section to be substituted.
3. In general, when allowed, repair work will consist of welding and/or grinding of the surfaces; however, other methods may be approved. The Engineer shall be the sole judge as to the acceptability of the repair work, and unacceptable work shall be cause for rejection of a member.

(b) DETAILS.

1. Bends and crimps shall conform to wood or metal templates. All bending or crimping shall be done to the bend lines shown on the plans by a mechanically operated press without avoidable or unnecessary decrease in section.

2. All material shall be bent cold when practical. Cold bending of rolled steel plates shall conform to the following:
   a. They shall be so taken from the stock plates that the bending line will be at right angles to the direction of rolling.
   b. The radius of bends, measured to the concave face of the metal, shall not be less, and preferably shall be greater, than shown in the following table in which "T" is the thickness of the plate:

<table>
<thead>
<tr>
<th>Angle through which Plate is Bent</th>
<th>Minimum Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>61 degrees to 90 degrees</td>
<td>1.0 T</td>
</tr>
<tr>
<td>91 degrees to 120 degrees</td>
<td>1.5 T</td>
</tr>
<tr>
<td>121 degrees to 150 degrees</td>
<td>2.0 T</td>
</tr>
</tbody>
</table>

If a shorter radius is essential, the plates shall be bent hot. Hot-bent plates shall conform to requirement Item 1 above.

c. Before bending, the corners of the plate shall be rounded to a radius of 1/16 inch throughout that portion of the plate at which the bending is to occur.

3. When hot bending is necessary, the metal shall be carefully heated to a temperature not to exceed 1100°F. as evidenced by heat crayons or other approved means. Material that has been heated shall be slowly cooled after the bending has been completed.

4. Material that is overheated, fractured, or otherwise injured or damaged shall be rejected.

5. All corners of oxygen cut or sheared edges, all edges of bottom flanges of beams and girders along with splice material and other sharp edges on structure members designated to be painted shall be slightly rounded. Said rounding shall be accomplished by light grinding to produce a satisfactory surface for painting (approximately 1/16 inch radius). The grinding shall be performed in such a manner as to produce a neat workmanship like product without nicks or notches in the metal.

(c) CAMBER OR CURVING OF BEAMS AND GIRDERS.

Camber in rolled beams shall be accomplished by the heat up-set method utilizing the lowest possible temperature not to exceed 1100°F. as evidenced by heat crayons (furnished by the Contractor). The application of heat shall be carefully supervised using a method which will not damage the member or camber.

Camber for built-up girders shall be accomplished by cutting the web to the prescribed camber with suitable allowance for shrinkage due to cutting and welding. However, moderate variation from the prescribed camber tolerance may be corrected by a carefully supervised application of heat not to exceed 1100°F. as evidenced by heat crayons (furnished by the Contractor).

Horizontal curving of rolled beams shall be accomplished by the heat up-set method which will require a written procedure approved by the Engineer. Said procedure shall utilize the lowest temperature possible but not in excess of 1100°F. as evidenced by heat crayons (furnished by the Contractor).
Fastener Holes.

(a) GENERAL.
All fastener holes shall be either punched or drilled.
Holes for connections in material forming a part of the section for main members shall be (1) sub-drilled and while assembled, reamed or drilled to full size, or (2) shall be drilled full size from the solid while assembled.
Holes may be punched with a die or drilled full size in material used for lateral, longitudinal, and sway bracing and for lacing plates, stay plates, and diaphragms not forming a part of the section of main members, provided each thickness of material is not greater than the nominal diameter of the fastener nor greater than 3/4 inch for carbon steel, 5/8 inch for high strength steel, 1/2 inch for quenched and tempered alloy steel. The diameter of the die shall not exceed the diameter of the punch by more than 1/16 inch. Holes shall be clean cut and without torn or ragged edges. If the thickness of the material is greater than the nominal diameter of the fastener or greater than the thickness shown above, the holes shall be drilled.
Completed holes, whether drilled or punched, shall be 1/16 inch larger than the nominal diameter of the fastener. Burrs on the metal surfaces shall be removed. Members drilled while assembled shall be securely held in correct position while being drilled.

(b) PUNCH WORK.
1. If the Engineer finds that the punched work does not comply with requirements hereinafter provided, it may be required that any or all holes be (1) subpunched (or subdrilled) and either reamed or drilled to full size or (2) drilled full size from the solid. All sub-punched holes shall be 3/16 inch smaller than the nominal diameter of the fastener. There shall be no drifting in the shop or field to enlarge mismatched holes. If any holes must be enlarged to admit the fastener, they shall be reamed.
2. The punching of holes shall be accurately done, that after assembling the component parts of a member and before any reaming is done, a cylindrical pin or rod 1/8 inch smaller than the nominal diameter of the punched hole may be passed through at least 75 of any group of 100 contiguous holes in the same surface or in like proportion for any group of holes. If this requirement is not fulfilled, the badly punched pieces may be rejected. If any group of holes will not pass a pin 3/16 inch smaller than the nominal diameter of the punched hole, the mispunched pieces may be rejected.

(c) SHOP ASSEMBLY.
Riveted or bolted trusses, arches, continuous beam spans and plate girders shall be assembled in the shop either in an upright position or on their side, the parts adjusted to line and fit with the proper camber and while so assembled and the members have been rigidly drift pinned and fastened together, the holes for field connections shall be reamed or drilled. Holes for floorbeam connections and stringer splices shall be reamed or drilled with the connecting parts assembled or else reamed or drilled to a steel template of not less than one inch in thickness.
After assembling, sub-punched or sub-drilled holes shall be reamed to a diameter 1/16 inch larger than the nominal diameter of the fastener. Reaming shall be done after all the pieces to be connected are assembled and firmly fastened together. Reaming of fastener holes shall be done with twist drills or with short taper reamers. Where practicable, reamers shall be directed by mechanical means. Burrs resulting from reaming or drilling shall be removed.
(d) ACCURACY OF REAMED OR DRILLED HOLES.

Reamed or drilled holes shall be cylindrical and perpendicular to the member and their accuracy shall be the same as provided for punched holes except that, after reaming or drilling, 85 of any group of 100 contiguous holes in the same surface, or in like proportion for any group of holes, shall not show an offset greater than 1/32 inch between adjacent thickness of metal. The minimum distance from the center of any fastener to a sheared or flame cut edge shall be:

- 1" Fastener: 1-3/4"
- 7/8" Fastener: 1-1/2"
- 3/4" Fastener: 1-1/4"
- 5/8" Fastener: 1-1/8"

The minimum distance from the center of any fastener to a rolled or planed edge, except in flanges of beams and channels, shall be:

- 1" Fastener: 1-1/2"
- 7/8" Fastener: 1-1/4"
- 3/4" Fastener: 1-1/8"
- 5/8" Fastener: 1"

In the flanges of beams and channels the minimum distance from the center of the fastener to a edge shall be:

- 1" Fastener: 1-1/4"
- 7/8" Fastener: 1-1/8"
- 3/4" Fastener: 1"
- 5/8" Fastener: 7/8"

839.20 Through 839.26 Blank.

839.27 Shop Assembling.

(a) GENERAL.

All surfaces of metal that will be in contact when assembled shall be cleaned before assembly but shall not be painted unless otherwise specified by plan details.

No temporary welds for fitting aids or for other purposes will be allowed unless shown on the approved drawings.

All welding (including stiffeners) shall be completed on beams or girders before they are put into laydown and/or assembled.

(b) ASSEMBLING.

1. Before the reaming or drilling of any holes in a splice for continuous beam spans, continuous plate girder spans and stringer beams, is done, a "laydown", consisting of at least three contiguous shop sections or all members in at least three contiguous panels but not less than the number of panels associated with three contiguous chord lengths (lengths between field splices) and not less than 160 feet in the case of structures longer than 150 feet, shall be required. Shop assembly may proceed so long as one (1) section of the minimum size "lay down" has been satisfactorily assembled in a preceding "lay down."

All trusses shall be assembled in the shop.

For structures having curved girders, girders with integral steel caps, extreme skews in combination with severe grade or camber, or other complex characteristics, the plans may direct that the entire structure, including the floor
system, be assembled in the shop. The assembly, including camber, alignment, accuracy and fit of joints, shall be approved by the Engineer before reaming or drilling is commenced.

2. The parts of a member shall be assembled properly aligned with drift pins and firmly drawn together with bolts before reaming or shop fastening is commenced. Assembled pieces shall be taken apart, if necessary, for the removal of burrs and shavings produced by reaming or drilling operation. The member shall be free from twists, bends and other deformations.

3. Preparatory to the shop fastening of full-sized punched material the fastener holes, if necessary, shall be spear-reamed for the admission of the fastener. The reamed or drilled holes shall not be more than 1/16 inch larger than the nominal diameter of the fastener.

4. End connection angles, stiffener angles, and similar parts shall be carefully adjusted to correct positions and bolted, clamped, or otherwise firmly held in place until fastened.

5. Parts not completely assembled in the shop shall be secured by bolts, insofar as practicable, to prevent damage in shipment and handling.

839.28 Drifting Holes.

The drifting done during assembling shall be only such as to bring the parts into position, and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the fasteners, they shall be reamed.

839.29 Match-Marking.

Connecting parts assembled in the shop for the purpose of reaming or drilling holes in field connections shall be match-marked with a steel die using figures and letters at least $\frac{1}{8}$ inch high, and a diagram showing such marks shall be furnished to the Engineer. Reamed parts shall not be interchanged.

839.30 Rivets and Riveting.

(a) GENERAL.

1. Rivets shall be of the diameter provided before heating. Rivet heads before driving shall be of approved shape, concentric with the shanks, true to size, full, neatly formed, free from furnace scale on their shanks and free from fins and collars on the underside of the machine-formed heads. Sufficient field rivets of each diameter and length shall be furnished in excess of the actual number to be driven to provide for losses due to misuse, improper driving or other contingencies.

2. Structural rivet steel shall conform to ASTM A-502, Grade 1; high strength structural rivet steel shall conform to ASTM A-502, Grade 2.

3. Rivets shall be heated uniformly to a "light cherry red color" and shall be driven while hot. Any rivet whose point is heated more than the remainder shall not be driven. When a rivet is ready for driving, it shall be free from slag, scale and other adhering matter. Any rivet which does not meet the requirements of this section shall be rejected.

4. All rivets that are loose, burned, badly formed, or otherwise defective, shall be removed and replaced with satisfactory rivets. Any rivet whose head is driven off center will be considered defective and shall be removed. Stitch rivets that are loosened by driving of adjacent rivets shall be removed and replaced with satisfactory rivets. Caulking, recupping or double gunning of rivet heads will not be permitted.
5. Countersinking shall be neatly done and countersunk rivets shall completely fill the holes.

(b) REMOVING.
In removing rivets, care shall be taken not to injure the adjacent metal, and, if necessary, they shall be drilled out.

(c) DRIVING.
1. Shop rivets shall be driven by direct-acting rivet machines when practicable. Approved beveled rivet sets shall be used for forming rivet heads on sloping surfaces. When the use of direct-acting rivet machine is not practicable, pneumatic hammers of approved size shall be used. Pneumatic bucking tools will be required when the size and length of the rivets warrant their use.
2. Rivets may be driven cold provided their diameter is not over 3/8 inch.

839.31 Blank.

839.32 Bolts, And Bolted Connections.

(a) GENERAL.
1. This Section does not pertain to the use of high strength bolts.
2. Unfinished and turned bolts and nuts shall conform to the requirements for Grade "A" bolts of ASTM A-307 unless otherwise specified on the plans.
3. The holes shall be truly cylindrical. Holes shall be at right angles to the surface of the metal so that both head and nut will bear squarely against the metal.
4. The heads and nuts shall be drawn tight against the work with a suitable wrench. Where bolts are to be used in beveled surfaces, beveled washers shall be provided to give full bearing to the head or nut. All bolts shall have cut threads neatly and accurately finished.
5. Permanent unfinished or turned bolts shall have single self-locking nuts or double nuts, unless otherwise shown on the plans.

(b) UNFINISHED BOLTS.
Bolts transmitting shear shall be threaded to such a length that not more than one thread will be within the grip of the metal. The bolts shall be of such length that they will extend entirely through their nuts, but not more than 1/4 inch beyond them.

(c) TURNED BOLTS.
1. Holes for turned bolts shall be carefully reamed and the bolts turned to a light driving fit with the threads entirely outside of the holes and under the washer, and a washer shall be used. The heads and nuts shall be hexagonal.
2. The surface of the body of turned bolts shall meet the ANSI roughness rating value of 125.
3. Bolts shall be driven accurately into the holes without damaging the thread. A snap shall be used to prevent damaging the threads.

839.33 High Strength Fasteners And High Strength Fastener Connections.

(a) GENERAL.
High strength fasteners, unless otherwise specified, shall conform to the current requirements of ASTM A-325.
Nuts shall meet the requirements of ASTM A-563 or A-194 suitable for use with the type bolting material being used.
Washers, unless otherwise specified on the plans, shall conform to the requirements of ASTM F-436, suitable for use with the type fastener material with which they are used.

Galvanization, where required, shall utilize zinc in accordance with the provisions of ASTM A-153 Class C or AASHTO M-276 Class 50.

Sampling and testing of the bolts, nuts and washers will be based on the "Production Lot Method" and each lot of material shall be manufactured tested and packaged for shipment accordingly. It shall be the Contractor's responsibility to insure that lots are not mixed after they have been packaged and marked with lot identification numbers. Mixed lots will be rejected.

(b) BOLTS AND NUTS.

Unless otherwise noted by plan details, A-325 Type 1 bolts shall be used for standard construction and Type 3 bolts with weathering steel with both utilizing heavy hex heads.

Nuts shall be heavy hex suitable for the type bolt material being used.

(c) LOCK-PIN AND COLLAR FASTENERS.

The shank and head of the "high strength steel lock-pin and collar fasteners" shall meet the chemical composition and mechanical property requirements of ASTM A-325. Each fastener shall provide a solid shank body of sufficient diameter to provide tensile and shear strength equivalent to or greater than the bolt or rivet specified, having a cold forged head on one end, of type and dimension shown on the plans, a shank length suitable for material thickness fastened, locking grooves, breakneck groove and pull grooves (all annular grooves) on the opposite end. Each fastener shall provide a steel locking collar, of proper size for shank diameter used, which by means of suitable installation tools is cold swaged into the locking grooves, forming a head for the grooved end of the fastener after the pull groove section has been removed.

839.34 Sheared Edges.

Sheared edges of plates more than 5/8 inch in thickness shall be planed to a depth of 1/4 inch. Plates 5/8 inch and less in thickness shall be ground to remove sharp corners and burrs.

Re-entrants corners shall be filleted to a minimum radius of 3/4 inch before cutting.

839.35 Facing Of Bearing Surfaces.

The top and bottom surfaces of steel slabs and base plates and cap plates of columns and pedestals shall be planed, or else the plates or slabs hot-straightened. Parts of members in contact with them shall be faced and shall have full contact when assembled.

Sole plates of beams and girders shall have contact for at least 75% of the area with the flange, with no greater separation than 1/32 of an inch for the remainder of the area. The contact area shall include full contact on the surface beneath the web and its fillets. Sole plate and masonry plate corrections may be made by planing or hot-straightening. In planing the surface of expansion bearings, the cut of the tool shall be in the direction of expansion.

Cast pedestals shall be planed on surfaces to be in contact with steel, and the surface to be in contact with masonry rough finished. The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with
each other or with concrete shall meet the ANSI surface roughness requirements as defined in ANSI B46.1, Surface Roughness, Waviness and Lay, Part I unless otherwise specified on the plans.

Steel slab in contact with Masonry ....................................................... ANSI 2000
Steel slabs ......................................................................................... ANSI 2000
Heavy plates in contact in shoes to be welded................................... ANSI 1000
Milled ends of compression members, milled or ground ends of stiffeners and fillers .......................................................... ANSI 500
Bridge rollers and rockers ................................................................. ANSI 250
Pins and pin holes .............................................................................. ANSI 125
Sliding bearings ................................................................................ ANSI 125

Surfaces of bronze bearing plates intended for sliding contact shall be carefully milled and polish finished.

839.36 Abutting Joints.

Abutting joints in compression members, where so specified on the drawings, shall be faced and brought to an even bearing. No milling shall be done until members are completely shop assembled, unless otherwise provided on the plans. Where joints are not faced, the opening shall not exceed 3/8 inch.

839.37 Blank.

839.38 Finished Members.

These shall be true to line and free from twists, bends, and other defects.

839.39 Lacing Bars.

The ends of lacing bars shall be neatly rounded unless otherwise indicated on the plans.

839.40 Plate Girders.

(a) WEB PLATE.

1. RIVETED CONNECTIONS.

a. In girders having no cover plates and not to be encased in concrete, the top edge of the web plate shall not extend above the backs of the flange angles and shall not be more than 1/4 inch below at any point. Any portion of the plate extending beyond the angles shall be chipped or ground flush with the backs of the angles. Web plates of girders having cover plates may be 1/2 inch less in depth than the distance back to back of flange angles. Web splices shall be located as shown on the plans.

b. At web splices, the clearance between the ends of the web plates shall not exceed 3/8 inch. The clearance at the top and bottom of web splice plates and fillers shall not exceed 1/4 inch. Splices in webs of girders without cover plates shall be sealed on the top by welding.

2. WELDED CONNECTIONS.

Welded connections shall be as required in Section 839.46.
(b) FIT OF STIFFENERS

1. RIVETED CONNECTIONS.
   a. End stiffeners of girders and stiffeners intended as supports for concentrated loads shall be milled or ground to secure an even bearing against the flange. Where a tight fit is specified on intermediate stiffeners, at least 50% of stiffener shall bear against the flange and the remainder shall not have a gap in excess of 1/16 inch. Fillers under stiffeners shall fit within 1/4 inch at each end.
   b. Welding to compression flanges will be permitted in lieu of milling or grinding. No welding of stiffeners or other attachments will be permitted across the width of the tension flanges of beams and girders. Welding shall be in accordance with the requirements of Section 839.46.

2. WELDED CONNECTIONS.
   Welded connections shall be as required in Section 839.46.

839.41 Stress Relieving.

Members such as bridge shoes or pedestals which are built-up by welding sections of plates together shall be stress relieved in accordance with the provisions of paragraph 3.9 of AWS-D1.1-75.

839.42 Pins And Rollers.

(a) GENERAL.
   Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth, and free from flaws. Pins and rollers more than 9 inches in diameter shall be forged and annealed, pins and rollers 9 inches or less in diameter may be either forged and annealed or cold finished carbon steel shafting. Pins and roller material shall conform to one of the following unless a specific Grade or Class is specified by plan details:
   - 4" in Diameter or less ASTM A-108*, Grade 1016 to 1030, Inclusive
   - 0" to 20" in diameter. ASTM A-668, Class C, Class D or Class G**
   - 0" to 10" in diameter..................................ASTM A-668, Class F

* This material shall provide the following minimum values: Yield - 36,000 psi Stress in extreme Fiber - 29,000 psi Shear -14,000 psi Bearing on Pins not subject to rotation 29,000 psi Bearing on Pins subject to rotation 14,000 psi

** Rolled material with the same properties may be substituted for this class.

In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling, and before being annealed.

Two pilot nuts and two driving nuts shall be furnished for each size pin, unless otherwise provided by plans.

The diameter of pins and rollers shall not exceed 1/16 inch plus or minus from the diameter specified by the plans.

(b) BORING PIN HOLES.
   Pin holes shall be bored true to gauge, smooth and straight, at right angles with the axis of the member and parallel with each other unless otherwise shown on the plans. Pins shall be parallel to each other unless otherwise shown on the plans.
The final surface shall be obtained by a finishing cut. Boring of holes in built up members shall be done during the final lay down operation.

(c) PIN CLEARANCE.
The diameter of the pin holes except as noted in Section 839.01(b)3 shall not exceed that of the pin by more than 1/50 inch for pins 5 inches or less in diameter or 1/32 inch for larger pins.

839.43 through 839.45 Blank.

839.46 Welds.

(a) GENERAL.
1. All welding shall be in accordance with the American Welding Society Structural Welding Code D1.1-80 modified in accordance with the provisions of AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges, dated 1981 and any applicable special provision.
2. All welding shall be subject to the inspection and approval of the Engineer or his representative.

(b) SHOP WELDING.
1. The Contractor or his representative will furnish to the Department a written report which shall cover the welding procedure for each type of shop welding that is to be used in the fabrication work.
2. All shop welds shall be properly identified so that it can be determined by the Engineer which welder performed the work.

(c) FIELD WELDING.
Only authorized welding shall be done in the field. Unauthorized indiscriminate welding shall not be done to attach temporary construction details such as rails, beams, girders, or other main members without approval of the Engineer.

(d) NON DESTRUCTIVE TESTING.
All non destructive testing required by these Specifications shall be performed by the Contractor at his expense.

839.47 & 839.48 Blank.

839.49 Painting.

Shop painting shall meet applicable requirements of Section 520.
839.50 Protection Of Machine Finished Surfaces.

Machine-finished surfaces in general shall be shop painted except for the following: Driven pins and pin holes; surfaces in sliding contact; bronze, and steel surfaces opposing bronze in sliding contact; other surfaces as noted on the plans. Machine surfaces of steel not requiring paint should receive a heavy shop coat of Petrolatum meeting the requirements of ASTM D-217, NLGI Grade 2 or 3 or Military Specification C-16173D, Grade 1. Other approved coating may be used. Surfaces opposing bronze in sliding contact, if shipped assembled with bronze, shall be coated and assembled with the lubricant supplied by the bronze manufacturer. If not shipped assembled with bronze, such surfaces shall receive a shop coating, which shall be removed before field assembly. The lubricant furnished by the bronze manufacturer shall then be applied. No paint or protective coating shall be applied to bronze.
SECTION 841
ELASTOMERIC BEARING PADS.

841.01 Description.

Elastomeric bearings shall be classified by Type in accordance with the following:

Type 1—A plain bearing pad consisting of an elastomer only.
Type 2—A laminated bearing pad consisting of layers of elastomer restrained at their interfaces by bonded non-elastic laminates.
Type 3—A plain bearing pad (Type 1) vulcanized to a structural steel bearing plate.
Type 4—A laminated bearing pad (Type 2) vulcanized to a structural steel bearing plate.

The elastomer portion of the elastomeric compound shall be 100% virgin chloroprene (neoprene) meeting the physical requirements specified hereinafter in this Section. Natural rubber, vulcanized rubber (natural or synthetic) or other synthetic rubber-like materials will not be acceptable. Physical properties tests shall be performed in accordance with the following ASTM Specifications, latest edition, for rubber and rubber-like materials.

Where applicable, test specimens are to be prepared in accordance with ASTM D-15, Part B.

841.02 Required Physical Properties.

(a) ELASTOMER BEARINGS.

1. TYPE 1 (ELASTOMER GRADE 60).
   a. Tensile Strength, ASTM D-412 - Min. 2500 psi
   b. Elongation, ASTM D-412 - Min. 350%
   c. Compression Set, ASTM D-395 Method B, 22 hours @ 212°F. Max. 35%
   d. Durometer Hardness, ASTM D-2240 - 60 ± 5
   e. Change in Durometer Hardness 70 Hours Heat Aged @ 212°F. Max. + 15 points.
   f. Samples cut from finished pads shall show no cracking when subjected to an exposure of 100 hours in an atmosphere containing 100 parts of ozone per 100,000,000 in a test otherwise conforming to ASTM D-1149.

NOTE: When test specimens are cut from the finished product, an additional 10% variation will be allowed on the physical requirements specified in Sub-items a. through e. noted above.

2. TYPE 2 (ELASTOMER GRADE 60).
   a. Elastomer shall meet all of the requirements noted in Section 841.02(a).
   b. Non-elastic laminates, unless otherwise shown on the plans, shall be 14 gage rolled steel sheets conforming to ASTM A-570, Grade 30 or equal.
3. TYPE 3 (ELASTOMER GRADE 60).
   a. Elastomer shall meet all the requirements noted in Section 841.02(a)1.
   b. Bearing plates shall, unless otherwise noted by plan details, meet the requirements of ASTM A-36.
   c. The elastomer bonding to the bearing plate (sole plate) shall be by vulcanization. The bonding surface of the bearing plate shall be cleaned to "white metal" immediately prior to bonding of the elastomeric material to the plate.

4. TYPE 4 (ELASTOMER GRADE 60).
   a. Elastomer and non-elastic laminates shall meet all the requirements of Section 841.02(a)2.
   b. All other requirements are as noted in Sub-sections 841.02(a)3b and c.

(b) MANUFACTURING REQUIREMENTS.
   The preparation of elastomer compound prior to placement in the mold shall be such as to result in a homogeneous finished bearing pad free of voids, blisters, cracks, folds, cuts, nonfills and any appearance of layers or ply separation on the surface or within the pad. Plain bearings may either be individually molded or cut from larger sheets which have been molded to a specific thickness. No pads shall be formed from the laminating of previously cured sheets or slabs.

   All components of a laminated bearing shall be molded together into an integral unit. All edges of the nonelastic laminations shall be covered by a minimum of 1/8 inch of elastomer. Unless otherwise shown on the plans, all laminates shall be parallel with the bottom surface of the bearing. Adhesion requirements for laminated bearings shall be such that all bond failures will occur within the elastomer rather than at an interface.

(c) APPEARANCE AND TOLERANCES.
   Flash tolerance, finish and appearance shall meet the requirements of the latest edition of the Rubber Handbook as published by the Rubber Manufacturers Associations, Inc.

   For plain and laminated bearings, the permissible variation from the dimensions required by the plans and these specifications shall be as follows:
   1. Length .......................................................... ± 1/4 inch
   2. Width .......................................................... ±1/8 inch
   3. Thickness .................................................... ±1/16 inch
   4. Thickness of individual layers of
      Elastomer (Laminated bearings) . . . ±1/16 inch
   5. Edge cover of laminates ...................................-0; + 1/8 inch
   6. Thickness of nonelastic Laminates . . -0; + 1/16 inch

   Cut edges shall be at least as smooth as ANSI 250 finish.

841.03 Marking, Sampling and Testing.
   The lot number shall be legibly stenciled on each bearing by the manufacturer.

   All bearings shall be shipped to the project along with certified test reports for each lot of bearings. Certified test reports shall show actual test results of tests noted in Section 841.02(a). The certified test report shall be forwarded to the Engineer.
SECTION 843
PREFORMED FABRIC BEARINGS

843.01 Description.

Preformed fabric bearings shall be classified by type in accordance with the following:

Type 1—A plain preformed fabric bearing pad.
Type 2—An expansion bearing assembly consisting of a plain pad treated with a special surface material and a bearing plate (sole plate) with a stainless steel face.

843.02 Physical Requirements.

(a) TYPE 1, PLAIN FABRIC PAD.

Plain fabric pads shall be composed of multiple layers of 8 ounce cotton duck meeting the requirements of AASHTO M-166 impregnated with high quality rubber or equivalent and equally suitable materials compressed into resilient pads of uniform thickness and vulcanized. The number of plies shall be such as to produce the specified thickness after compression and vulcanization. The finish pads shall withstand loads perpendicular to the plane of the laminations of not less than 10,000 psi without detrimental reduction in thickness or extension. The completed pad shall have a Shore Durometer, Type A, hardness of 90 ± 5 in accordance with ASTM D-2240.

(b) TYPE 2, EXPANSION BEARING ASSEMBLY.

1. GENERAL.

A preformed fabric expansion bearing assembly shall consist of (1) a lower unit consisting of a fabric pad meeting the requirements of Section 843.02(a) and with a PTFE surface layer and confining substrate; (2) an upper unit consisting of a stainless steel sheet bonded to a bearing or sole plate.

2. POLYTETRAFLUOROETHYLENE (PTFE) LAYER.

PTFE self-lubricating bearing elements shall be composed of 100 percent virgin (unfilled) Polytetrafluoroethylene polymer and bonded to a rigid confining substrate. The substrate shall limit the flow (elongation) of the confined PTFE to not more than .009" under load of 2,000 psi for 15 minutes at 78°F for a 2" x 3" test sample. The virgin (unfilled) PTFE shall have a thickness of not less than 1/32". The properties of the PTFE shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shore Durometer Hardness at 78°F., Type D</td>
<td>ASTM D-2240</td>
<td>60 ± 5</td>
</tr>
<tr>
<td>Tensile Strength, p.s.i.</td>
<td>ASTM D-1457</td>
<td>2800 (Min. Avg.)</td>
</tr>
<tr>
<td>Elongation, %</td>
<td>ASTM D-1457</td>
<td>200 (Min. Avg.)</td>
</tr>
<tr>
<td>Deformation Under Load - % 78°F - 2,000 p.s.i. (1/2 x 1/2 x 1/32)</td>
<td>ASTM D-621</td>
<td>4 (Max.)</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>ASTM D-792</td>
<td>2.14 to 2.21</td>
</tr>
</tbody>
</table>
3. STAINLESS STEEL SHEET.

The Stainless Steel Sheet shall be 0.0359 inches thick, minimum, meeting AISI Type #304 Specifications and have a 2B finish on the side in contact with the PTFE. The reverse side shall be prepared for bonding to the sole plate. The stainless steel sheet and the sole plate shall be bonded together with a high temperature resistant epoxy meeting the following requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>ASTM D638</td>
<td>32,000</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>ASTM D790</td>
<td>2 x 104</td>
</tr>
<tr>
<td>Safe Operating Temp.</td>
<td></td>
<td>-60 to 145°C</td>
</tr>
<tr>
<td>Linear Expansion Coefficient</td>
<td>ASTM D696</td>
<td>4.8 x 10</td>
</tr>
<tr>
<td>Bond Strength (Tensile Shear 77°F)</td>
<td>ASTM D1002</td>
<td>1000 psi</td>
</tr>
</tbody>
</table>

The Coefficient of Friction between the self-lubricating bearing element (PTFE) and the stainless steel shall be not more than .06 at 800 psi compressive loading.

4. STRUCTURAL STEEL BEARING OR SOLE PLATE.

The steel bearing or sole plate shall meet the requirements of ASTM A-36 unless otherwise noted by plan details.

5. ANCHOR BOLTS, NUTS AND WASHERS.

Anchor bolts, nuts and washers for the bearing or sole plate shall meet the requirements of Section 839.01(b)7.

843.03 Marking, Sampling and Testing.

Each bearing shall be marked (permanent ink or paint) with the manufacturer's name or trade mark, lot number and date of manufacture. All markings shall be legible.

All bearings shall be shipped to the project along with certified test reports for each lot of bearings. Certified test reports shall show actual test results of tests noted in Section 843.02. The certified test report shall be forwarded to the Engineer.
SECTION 845
ROUND AND ARCH CORRUGATED
STEEL ROADWAY AND SIDEDRAIN PIPE

845.01 Description.
Corrugated steel pipe used in the construction of roadway and sidedrain culverts shall meet the requirements of AASHTO M-36, for Type 1 and 2 culverts, the requirements noted hereinafter in this Section, and the details shown in the plans.
The pitch and depth of corrugation allowed by the AASHTO Specifications but not covered by plan details must be approved by the Department before use. Acceptance of pipe will be based on job site inspection for workmanship and compliance with fabrication requirements.
A certificate of compliance for each shipment as per AASHTO M-36 will not be required; however, a copy of the manufacturer's analysis of the sheets used in the manufacture of the pipe will be furnished.
Corrugated steel roadway pipe shall have a protective coating and in most cases requires a paved invert. For side drains, certain streets may use plain galvanized steel pipe if specifically designated by plan details.

NOTE: The use of any round or arch corrugated metal pipe must first be approved in writing by the Engineer of Public Works.

845.02 Fabrication.
All pipes furnished under this Section shall be fabricated with circumferential corrugations and a riveted lap joint or with helical corrugations and a continuous lock seam or welded seam extending from end to end of each length of pipe.
In addition, helical corrugated pipe shall comply with the following:
1. Lock joints or seams shall produce a continuous water-tight seam parallel to the corrugations and as near as practical to the neutral axis of the corrugations, for all sizes without perforations. The seam shall be so designed and fabricated as to develop strength and serviceability equal to that of riveted pipe of the same gauge.
2. Welded seams shall produce a continuous water-tight seam parallel to the corrugations and as near as practical to the neutral axis of the corrugations. The welding process shall be so controlled that the combined width of the weld and the adjacent spelter coat burned by the welding operation shall not exceed three (3) times the thickness of the metal being joined. If the spelter is damaged outside the above specified width, the weld and the damaged area adjacent to the weld shall be cleaned and treated as required by the appropriate Section of AASHTO M-36. A coating of rust on the base metal portions of the weld is not considered a defect. The welding process shall be such that the welded seam strength shall not be less than 70 percent of the base metal.
The manufacturer of welded seam pipe shall submit a certified test report of his production testing that shows the production will meet the above noted weld strength requirements. One test will be reported for each day's production run with the test performed on the final joint produced for that day.
3. All ends of helical corrugated pipe which are to be joined to other pipe with coupling bands shall be reformed to provide a minimum of two standard size circumferential corrugations.
For correlation of specified thickness of corrugated metal sheets and pipe gauges shown in the detailed plans, the following shall apply:
Pipe Specified Culvert Sheet Thickness, Table 4
Gauge AASHTO M-218
(Includes Zinc Coating)

<table>
<thead>
<tr>
<th>Pipe Gauge</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>0.064&quot;</td>
</tr>
<tr>
<td>14</td>
<td>0.079&quot;</td>
</tr>
<tr>
<td>12</td>
<td>0.109&quot;</td>
</tr>
<tr>
<td>10</td>
<td>0.138&quot;</td>
</tr>
<tr>
<td>8</td>
<td>0.168&quot;</td>
</tr>
</tbody>
</table>

Note: Tolerances for specified sheet thickness noted in Table 4 of AASHTO M-218 shall apply.

Arch pipe will be accepted on either the old sizes as shown on Departmental drawing or the new AASHTO sizes. The following table is provided for correlation of the two sizes.

<table>
<thead>
<tr>
<th>New Sizes</th>
<th>Old Sizes</th>
<th>Equiv. Circular Dia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-2/3&quot; x 1/2&quot; Corrugations</td>
<td>Span - Rise</td>
<td>Span - Rise</td>
</tr>
<tr>
<td>17 x 13</td>
<td>18 x 11</td>
<td>15</td>
</tr>
<tr>
<td>21 x 15</td>
<td>22 x 13</td>
<td>18</td>
</tr>
<tr>
<td>28 x 20</td>
<td>29 x 18</td>
<td>24</td>
</tr>
<tr>
<td>35 x 24</td>
<td>36 x 22</td>
<td>30</td>
</tr>
<tr>
<td>42 x 29</td>
<td>43 x 27</td>
<td>36</td>
</tr>
<tr>
<td>49 x 33</td>
<td>50 x 31</td>
<td>42</td>
</tr>
<tr>
<td>57 x 38</td>
<td>58 x 36</td>
<td>48</td>
</tr>
<tr>
<td>64 x 43</td>
<td>65 x 40</td>
<td>54</td>
</tr>
<tr>
<td>71 x 47</td>
<td>72 x 44</td>
<td>60</td>
</tr>
<tr>
<td>77 x 52</td>
<td>79 x 49</td>
<td>66</td>
</tr>
<tr>
<td>83 x 57</td>
<td>85 x 54</td>
<td>72</td>
</tr>
</tbody>
</table>

NOTE: A tolerance of plus or minus 1 inch or 2% of the equivalent circular diameter, whichever is greater, will be allowed on the size designations the Contractor elects to furnish.

845.03 Protective Coatings, Linings, and Paved Inverts.

(a) GENERAL.
Proctive coating for corrugated metal round and arch pipe shall meet one of the requirements noted hereinafter in this Section.
Concrete linings for corrugated steel round pipe shall meet the requirements specified in Subsection (d) of this Section.
Paved inverts shall be formed by the addition of a smooth pavement in the invert of the pipe filling the corrugations for at least 25% of the circumference for a round pipe and 40% for an arch pipe. The pavement shall have a minimum thickness of 1/8 inch above the crest of the corrugations, except where the upper edges intersect the corrugations.
In addition the following will be required for the manufacturer of each section of pipe shipped to a project:

1. Each length of protective coated corrugated metal pipe will be marked for identification by two (2) metal tags.

2. The metal tags shall be die imprinted to show the company name or brand, gauge of metal and heat number. This shall include each heat number used in the length of pipe.

3. One metal tag shall be attached to each end of the pipe length with one tag having the protective coating and one without the coating. The coated tag shall be processed in the same manner as the pipe at the same time the coating is applied.

4. Pipe that is not properly marked shall not be placed on a project until it has been sampled and tested if required from the Engineer of Public Works.

(b) COATING.
Bituminous coating shall meet the requirements of AASHTO M-190 for Type "A" Pipe. Polymeric coatings on precoated metal sheets meeting the requirements of AASHTO M-246 for Type B sheets may be used provided the pipe is fabricated so that the heavier coating is located on the inside of the pipe.

(c) PAVED INVERTS.
Paved inverts for bituminous coated pipe shall conform to the requirements of AASHTO M-190 for Type "C" Pipe. Paved inverts for pipe formed from precoated metal sheets shall be compatible with the coating material, capable of providing an acceptable bond with coating material and otherwise meeting the same basic test requirements of Section 5 of AASHTO M-190.

(d) CONCRETE LINING.
Concrete lined pipe shall be bituminous coated on the outside as outlined in Subsection (b) above. Although not required, bituminous coating of the inside of the pipe will be permitted.
Concrete for the lining shall be composed of cement, fine aggregate, and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregated lining. The cement shall be Portland Cement, Type II, conforming to AASHTO M-85. Aggregate shall conform to the requirements of AASHTO M-6 except the sections on gradation and uniformity of gradation. 100% of the aggregate shall pass the No. 4 sieve with not more than 10% passing the No. 200 sieve. The concrete used as lining shall have a minimum 28 day compressive strength of 5,000 psi when tested in accordance with AASHTO T-22.
The concrete lining shall be applied in one or more courses by a machine traveling through the pipe and discharging the concrete over stationary pipe sections. The rate of travel of the machine and the rate of concrete discharge shall be regulated so as to produce a homogeneous, non-segregated lining throughout.
The lining machine shall be equipped with attachments for mechanically troweling the concrete lining. The trowel attachment shall be such that the pressure applied to the lining will be uniform and shall produce a lining that has a uniform thickness and a smooth surface. The concrete lining thickness shall be 3/8" ± 1/8" over the inside crests of the corrugations. The manufacturer shall submit certifications stating the gage of the pipe and that the cement, aggregate, and the lining itself all comply with the above specifications. Random samples of the cement, aggregate, and cylinders made from the lining mixture shall be submitted on request of the City. If cylinders are required, they shall be made from the last batch mix of the day's operation. Either standard rodded cylinders or cylinders compacted and
cured in the same manner as the pipe lining will be acceptable. The minimum average 28 day compressive strength of cylinders tested from any one batch shall be 5,000 psi.

845.04 Connecting Bands.

Connecting bands shall be made of material conforming to AASHTO M-218 or to AASHTO M-274 depending on the type of metallic coat on the pipe. All bands shall have a minimum of two circumferential corrugations which shall effectively engage the second, as a minimum, circumferential corrugated valley from the end of each pipe. Connecting bands shall be no more than three nominal sheet thicknesses lighter than the thickness of the pipe to be connected but in no case lighter than 17 gage.

Bolts and nuts for connecting bands, furnished in sufficient sizes and numbers to adequately perform the intended function, shall conform to the requirements of ASTM A-307. Band connection hardware consisting of bolts nuts, bars, and rivets shall be galvanized in accordance with the requirements of AASHTO M-III or be coated by the electroplating process as provided in ASTM A-164 Type RS or A-165 Type TS.

Protective coatings for connecting bands shall be the same as used on the pipes which are being connected and shall meet the appropriate requirements for such noted in Section 845.03.

845.05 Blank.

845.06 Hauling and Storage.

Pipe shall be handled, transported, delivered, and stored by methods that will not damage the pipe or bituminous coating, and with the paved invert at the bottom of the pipe. Any pipe damaged or bent will be rejected even though previously inspected and found satisfactory, and shall be replaced or repaired at the Engineer's option, without additional compensation. Damaged coating or paving shall be repaired by the Contractor in a manner recommended by the manufacturer and satisfactory to the Engineer.
847.01 Rigid Pipes.

(a) GENERAL.

The manufacturer's design and production tolerance for the annular space within the manufactured joint will determine the type of joint which will be required for sealing of the joints. When the annular space within the pipe joints (algebraic difference in diameters measured between the exterior edges of the pipe at the spigot end and the interior faces of the hub at the shoulder of the joint) falls within the following ranges, the type sealer noted thereafter will be used.

<table>
<thead>
<tr>
<th>Total Annular Space</th>
<th>Type Sealer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 inch or Less</td>
<td>Bituminous Plastic Cement</td>
</tr>
<tr>
<td>1/4 inch to 1/2 inch</td>
<td>Mortar or Bituminous Plastic Cement</td>
</tr>
<tr>
<td></td>
<td>as elected by the Contractor</td>
</tr>
<tr>
<td>1/2 inch or More</td>
<td>Mortar</td>
</tr>
</tbody>
</table>

NOTE: When rubber or other approved types of gaskets are used or required, the joints shall conform to the requirements of Section (d) below.

(b) MORTAR.

Mortar, meeting the requirements of Section 607 shall be used on joints whose design or manufacturing process produces an annular space within the limits noted in Subsection (a) above.

(c) BITUMINOUS PLASTIC CEMENT.

Bituminous Plastic Cement meeting the Specifications noted hereinafter, or other kinds of mastic joint sealer that have been approved by the City Engineer, shall be used on joints whose design or manufacturing process produces an annular space within the limits noted in Subsection (a) above.

The Specification noted hereinafter covers a bituminous joint sealing compound which may be applied cold for sealing the joints of bell and spigot or tongue and groove or culvert pipe. Material furnished shall be composed of either a steam-refined petroleum asphalt or a refined coal tar, dissolved in a suitable solvent and stiffened with a mineral filler consisting of short fiber asbestos.

Properties: The Bituminous Plastic Cement shall be a smooth uniform mixture, not thickened or livered, and it shall show no separation which cannot be easily overcome by stirring. The material shall be of such consistency and properties that it can be readily applied with a trowel, putty knife, or caulking compound gun without pulling or drawing. When applied to the joint surfaces, it shall exhibit good adhesive and cohesive properties. The material shall meet the following requirements:
1. When applied in a layer 1/16 to 1/8 inch thick on a tinned metal panel and cured at room temperature for 24 hours, the Bituminous Plastic Cement shall set to a tough, plastic coating, free from blisters.

<table>
<thead>
<tr>
<th>Tests</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grease Cone Penetration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight, pounds per Gal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Volatile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash, by ignition, by weights</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tests: Methods of tests shall be in accordance with the following:

- Grease Cone Penetration: AASHTO T-187
- Non-Volatile: ASTM D-1010
- Ash: ASTM D-128

(d) RUBBER GASKETS.

Rubber gaskets, meeting the requirements of AASHTO M-198, shall be used only on joints specifically designed for the use with this type gasket. Special conditions, when noted on the plans, may require the use of this type gasket exclusively, under this condition pipe joints shall comply with the requirements of AASHTO M-198 except that for pipe to be used in culvert construction the exfiltration or infiltration test will not be required.

When rubber type gaskets are used, the pipe and/or gasket manufacturer shall furnish the Engineer with a certification showing the physical properties of the gasket and results of hydrostatic tests of the gasket and pipe to be used in the work.

(e) OTHER TYPES OF JOINT SEALERS.

Other types of joint sealers or gaskets with proven satisfactory performance records may be considered by the Department for use on individual contracts on a trial basis.

847.02 Flexible Pipe Sealers.

(a) GENERAL.

Connecting bands complying with the appropriate provisions of the type pipe being used may be considered as a satisfactory sealer provided the installation method provides a water tight joint for the full circumference of the joint, unless otherwise directed. Where a satisfactory joint seal cannot be obtained using only the connecting band, the joint shall be sealed by the use of gaskets designed for this purpose, mastic or other material that provides a watertight seal. The producer of the sealant used in the joints shall furnish the Engineer with a certification showing the physical properties of the material and hydrostatic tests of joints sealed with his material.

(b) SPECIAL JOINTS.

If special joints or sealers are required, such will be designated by plan details.
SECTION 849
CIRCULAR AND ARCH CONCRETE ROADWAY
PIPE

849.01 General.

Circular concrete pipe shall comply with the requirements of AASHTO M-170, except that elliptical steel reinforcement will not be permitted unless such is permitted for special design pipe by details provided in the plans. Concrete arch pipe shall comply with the requirements of AASHTO M-206.

849.02 Special Design.

When so permitted by the plans or in the proposal, pipe of designs other than those shown in the standard plans may be permitted; however, such pipe must meet performance and test requirements specified, for AASHTO M-170 and shall be installed under the same specifications as circular pipe.

849.03 Classes of Pipe.

(a) ROADWAY PIPE.
Circular pipe and arch pipe shall be of the following classes, corresponding to AASHTO M-170 or AASHTO M-206 classes as tabulated herein.

<table>
<thead>
<tr>
<th>AASHTO CLASS</th>
<th>CITY OF HUNTSVILLE CLASS</th>
<th>ABBREVIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class II</td>
<td>Class 2 Reinf. Conc. Pipe</td>
<td>Cl. 2 R. C. Pipe</td>
</tr>
<tr>
<td>Class III</td>
<td>Class 3 Reinf. Conc. Pipe</td>
<td>Cl. 3 R. C. Pipe</td>
</tr>
<tr>
<td>Class IV</td>
<td>Class 4 Reinf. Conc. Pipe</td>
<td>Cl. 4 R. C. Pipe</td>
</tr>
<tr>
<td>Class V</td>
<td>Class 5 Reinf. Conc. Pipe</td>
<td>Cl. 5 R. C. Pipe</td>
</tr>
<tr>
<td>Class II</td>
<td>Class 2 Reinf. Conc. Arch Pipe</td>
<td>Cl. 2 R. C. Arch Pipe</td>
</tr>
<tr>
<td>Class III</td>
<td>Class 3 Reinf. Conc. Arch Pipe</td>
<td>Cl. 3 R. C. Arch Pipe</td>
</tr>
<tr>
<td>Class IV</td>
<td>Class 4 Reinf. Conc. Arch Pipe</td>
<td>Cl. 4 R. C. Arch Pipe</td>
</tr>
</tbody>
</table>

(b) REINFORCED CONCRETE PIPE.
Circular pipe shall meet the requirements of AASHTO M-170 for the class of pipe designated by the plans.
Arch pipe shall meet the requirements of AASHTO M-206 for the class of pipe designated by the plans.
Elliptical pipe shall meet the requirements of AASHTO M-207 for the class of pipe designated by the plans.

849.04 Materials.

Coarse aggregate, fine aggregate, cement, steel reinforcement, and water shall meet the requirements of AASHTO M-170 or M-206, whichever is applicable except as modified in applicable Sections of Division III, Materials.
849.05 Tests.

Testing shall be in accordance with applicable AASHTO Specifications listed above, with the following additional requirements:

1. For every lot of pipe, at least one joint, or a maximum of one percent of the joints of each size in the lot up to the size limits indicated in the tables, shall be tested and broken by methods set forth in AASHTO Designation T-33. One edge of each absorption specimen shall be freshly broken so as to cut squarely across the circumferential steel reinforcement. For pipe sizes required to be broken, the strength test results shall not be less than the minimum loadings indicated.

2. One joint, or a maximum of 5 percent of the joints, of each size in every lot of reinforced pipe shall be tested by cutting one or more sound whole radial cores from the pipe wall and examining the steel reinforcement encountered for area and location. The cores taken shall include the line, or lines, of reinforcement required and be of the diameter specified by the Engineer. Cores from pipe having a required wall thickness of 4 inches or more shall be tested in compression as provided in AASHTO Designation T-24. Cores from pipe may be used for absorption tests.

3. In sizes affected, both the three-edge bearing and the coring methods of test shall be used.

4. The manufacturer shall furnish equipment for both the loading and the core tests, as provided in Paragraphs 1 and 2 above, and also all labor, materials, and incidentals required to conduct the tests.

5. Joints of pipe that have been cored and found to meet requirements may be accepted for use if the core holes have been sealed with mortar in an acceptable manner.

In addition to inspection and testing prior to shipment, pipe will be inspected at the site of the work. Any that fail to meet Specifications or that have been cracked or otherwise damaged to the extent that serviceability is impaired, will be rejected and shall not be used in the work.

849.06 Handling and Storage.

Pipe shall be handled, transported, delivered and stored in a manner that will not injure or damage the pipe. Pipe shall not be shipped before it has been inspected and approved. Pipe that is damaged during shipment or handling will be rejected even though satisfactory before shipment. Pipe dropped from platforms or vehicles or in the pipe trench will be rejected.
SECTION 853
PIPE UNDERDRAIN

853.01 Vitrified Clay Pipe.

This pipe shall meet requirements for standard strength, either plain or perforated pipe of AASHTO M-65 or ASTM C-700.

853.02 Concrete Pipe.

This pipe shall meet the requirements of AASHTO M-86, Class 1 for plain pipe; for perforated pipe AASHTO M-86, Class 1 and AASHTO M-175 Type 1 or 2; for porous concrete pipe, AASHTO M-176, extra strength class.

853.03 Corrugated Iron or Steel Pipe.

This pipe shall meet the requirements of AASHTO M-36 for Type I, II, or III Pipe, fabricated from a specified sheet thickness of 0.064 inches and may be perforated or non-perforated as required.

853.04 Coated Corrugated Iron or Steel Pipe.

This pipe shall meet the requirements of Section 853.03 coated as specified in Sections 845.03(a) and (b).

853.05 Corrugated Aluminum Pipe.

This pipe shall meet requirements of AASHTO M-196 for Type III Class I, II, or III, pipe fabricated from a specified sheet thickness of 0.060 inches and may be perforated or non-perforated as required.

853.06 Coated Corrugated Aluminum Pipe.

This pipe shall meet requirements of Section 853.05 coated as specified in Sections 845.03(a) and (b).

853.07 Bituminized Fiber Pipe.

This pipe shall meet requirements of AASHTO M-177 unless otherwise specified on the plans and may be perforated or non-perforated as required.

853.08 Asbestos Cement Pipe.

This pipe shall meet requirements of AASHTO M-189 for Type I, II, or III pipe unless otherwise specified on the plans and may be perforated or non-perforated as required.
853.09 Filter Material.

(a) TYPE A-COARSE FILTER MATERIAL.
The coarse filter material may be slag, gravel, or crushed stone, meeting gradation of AHD sizes 710, 67 or 78, at the Contractor's option, provided he gives the engineer written notice of his choice in advance. Soundness and Los Angeles Abrasion tests will not be required.

(b) TYPE B-FINE FILTER MATERIAL.
Fine filter material shall be reasonably clean, natural sand or manufactured sand produced from the crushing of quartzite gravel, sandstone or sandstone conglomerates meeting the following requirements:
Permeability - at least 0.05 cm/sec when measured by the constant head method of AASHTO T-215.
Gradation limits when tested in accordance with AASHTO T-27.

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>96 - 100</td>
</tr>
<tr>
<td>#200</td>
<td>0 - 7</td>
</tr>
</tbody>
</table>

853.10 Poly (Vinyl Chloride) Pipe.

This pipe shall meet the requirements of either ASTM D-3033 or ASTM D-3034. Pipe having a nominal diameter of 4 inches shall have a standard dimension ratio (SDR) of 36; pipe having a nominal diameter of 6 inches or more shall have a standard dimension ratio of either 36 or 41. Perforations, if required, shall be in accordance with the perforation requirements of AASHTO M-176 for either Type 1 or Type 2.

Pipe meeting the requirements of ASTM F-768, Type PS 28 or Type PS 46, may be used in lieu of the above designated pipe.

853.11 Acrylonitrile Butadiene Styrene Pipe.

This pipe shall meet the requirements of ASTM D-2761 for SDR 41 or SDR 35 pipe. Perforations, if required, shall be in accordance with the perforation requirements of AASHTO M-175 for either Type 1 or Type 2.

853.12 Handling And Storage.

Pipe shall be handled, transported, delivered and stored by methods that will not damage the pipe or coating. Any pipe damaged or bent will be rejected, even though previously inspected and found satisfactory, and shall be replaced or repaired at the Engineer's option, without additional compensation. Bituminous coating scratched or damaged shall be neatly repaired in a satisfactory manner with bituminous material.
SECTION 854
SEWER PIPE

854.01 Vitrified Clay (Sanitary) Sewer Pipe.

This pipe shall meet the requirements of AASHTO Designation M-65 or ASTM C-700 with standard strength permitted on diameters 15 inches and under, and extra strength required on diameters over 15 inches.

854.02 Concrete (Storm) Sewer Pipe.

REINFORCED CONCRETE PIPE.
Circular pipe shall meet the requirements of AASHTO M-170 for Class II unless another class is designated by the plans or proposal. Arch pipe shall meet the requirements of AASHTO M-206 for Class A-II unless another class is designated by the plans or proposal.

854.03 Ductile Iron (Sanitary) Sewer Pipe.

This pipe shall meet the requirements of FSS-WW-P-421c and the following unless otherwise specified by plan details:

Grade of Pipe  —Grade C.
Fittings  —Type I, II or III, Class 100
Pressure Class  —50 psi Minimum
Wall Thickness  —Wall thickness shall be in accordance with ANSI Standard A-21.1 for five feet of cover unless a greater depth is required for installation, Laying Condition "B".
Pipe Coating  —Pipes and fittings shall have an outside coating of bituminous material in accordance with ANSI Standards A-21.1, A-21.8 and A-21.51.

854.04 Coated, Smoothlined Corrugated Metal (Storm Sewer) Pipe

This pipe shall meet the requirements of AASHTO M-36 or AASHTO M-196 for Type IA pipe and the following: Coating requirements - all surfaces of the pipe walls shall have a protective coating of either bitumen in accordance with AASHTO M-190 for Type A treatment or the pipe fabricated using precoated sheets complying with AASHTO M-246 using Type B sheets. When using precoated sheets, the pipe shall be so fabricated that the heavier coating is on the exposed surface of the corrugated shell and the exposed inside surface of the liner. For correlation purposes the following table provides acceptable shell and liner plate thickness which may be used to equate with C.M. Pipe gauges.

<table>
<thead>
<tr>
<th>Class</th>
<th>Equivalent Single Steel Sheet</th>
<th>S.L. Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe</td>
<td>Gauge</td>
<td>Sheet Thickness</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>.064</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>.079</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>.109</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>.168</td>
</tr>
</tbody>
</table>
NOTE: For aluminum all thicknesses may be reduced by 0.004" to compensate for zinc coating.

Connecting bands shall conform to the appropriate provisions of AASHTO M-36 or M-196 for the type material used and shall have the same type coating as used on the pipe. Appropriate designed waterproof gaskets shall be used in conjunction with connecting bands to form a watertight joint. Gasket material shall be neoprene or other approved material. Damage to coatings shall be repaired in accordance with the appropriate provisions of AASHTO M-245 for a polymeric coating and approved asphalt mastic as noted in AASHTO M-243.

854.05 Handling And Storage.

Pipe shall be handled, transported, delivered and stored by methods that will not damage the pipe, coatings, or linings. Any pipe damaged or bent will be rejected even though previously inspected and found satisfactory, and shall be replaced or repaired at the Engineer's option, without additional compensation. Coating or linings scratched shall be repaired in a satisfactory manner with appropriate material.

854.06 Joint Materials.

Joint material shall provide a suitable waterproof joint capable of withstanding internal pressure of the system involved and be of the type as specified on the plans or proposal. Basic requirements are as follows; however, other types may be considered if appropriate backup data is available.

STORM SEWERS Joint material for storm sewers shall be the same as specified in Section 527 for Storm Sewers, or those specified for Sanitary Sewers in Section 645.

SANITARY SEWERS PVC pipe shall use a bell and spigot joining system that conforms to ASTM D3212 and/or Uni-Bell UNI-B-1. Gaskets shall be in accordance with ASTM F477. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket which is positively retained. Wall thickness of this bell at any point shall not be less than the required minimum for the pipe barrel. No solvent cement joints will be permitted in field construction except as specifically authorized by the Engineer.

V.C. pipe may be bell and spigot using rubber gaskets meeting AASHTO M-198 or plain ends using couplings specified in ASTM C-594. Wiped joints for bell and spigot pipe shall consist of jute, oakum Ol-hemp packing with lead or metallic joint compound as per FSS-QQ-C40.

854.07 PVC (Sanitary) Sewer Pipe And Fittings.

Pipe and fittings for pressure flow applications shall meet the requirements of ASTM D-2665. Pipe and fittings for gravity flow applications shall meet the requirements of ASTM D-2665, ASTM 3034, SDR 35, or ASTM F-789. Service connection pipe shall be schedule 40 PVC pipe or ductile iron pipe as outlined above in Section 854.03.
854.08 Coated Smooth Flow Corrugated Metal (Storm Sewer) Pipe

This pipe shall meet the applicable requirements of Section 845.01 and the following: All pipes shall have a protective coating in accordance with the applicable provisions of Section 845.03. In addition, the inside of the pipe shall have a paved lining for the entire inside periphery which will fill the valleys to the extent that the thickness above the top of the crest of the corrugations will not be less than 1/8 inch. The lining shall be smooth and uniform and its surface shall be parallel to a line projected along the crest parallel to the centerline. Bituminous coating and pavement lining shall conform to the requirements of AASHTO M-246 for Type B sheets with the pavement lining formed from material compatible with the coating material and otherwise meeting the same basic requirements of Section 5 of AASHTO M-190. Connecting bands shall meet the requirements of Section 845.04 and have appropriate waterproof seals in accordance with Section 847.02. Damage to coating and pavement linings shall be repaired in accordance with the appropriate provisions of AASHTO M-245 for polymeric material and approved asphalt mastic as noted in AASHTO M-245.

854.09 Concrete Lined Corrugated Metal Pipe.

This type pipe shall meet the requirements of Section 845 with the lining as specified in Section 845.03(d).
859.01 Scope.

This Section covers the specifications of the above mentioned materials and their components. It describes and/or designates the procedure for sampling, methods of testing and other details relative to inspection, manufacture, packaging, storage, and shipping of these materials.

859.02 General Information.

(a) Specifications and methods referred to in other standard specifications are listed below, with the abbreviation used throughout this Section. The latest specification and method of these will govern except as herein modified.

Federal Specifications and Standards (Standard No. 141)...FSS
Military Specifications..........................................................MIL

(b) Calculation of test results shall be made according to ASTM-E-29 using the so called "Rounding Off" method.

(c) No mixed or unmixed material will be accepted if it does not meet all the requirements of these specifications.

(d) All percentages are by weight unless otherwise stated.

(e) A gallon shall be a volume of 231 cubic inches.

(f) Brand names and trade names are not accepted as evidence as to the quality of any material.

(g) No blanket approval will be made for any product(s).

(h) The acceptance of a lot of material has no bearing on a future lot.

859.03 Inspection.

(a) A representative of the Engineer (hereinafter called the Inspector) may inspect the operation required of these specifications, in the manufacturer of these materials.

(b) Where distance and the time involved make the above impossible the right is reserved to appoint another Inspector to represent the Engineer.

859.04 Samples And Sampling.

(a) Components that do not meet the specifications shall be rejected, removed, and replaced by ones that are acceptable within 30 days after the first rejection.

(b) Before offering any components or materials for tests the producer shall be reasonably certain that they meet their respective specifications.

859.05 Manufacture.

(a) All operations of manufacture may be witnessed by the Inspector.

(b) The producer shall give free, unhindered and safe access to the Inspector into all areas of the plant where his presence is required.

(c) The producer shall be responsible for correctness of the formulation, accuracy of all metering devices and the performance of all equipment.

(d) Pigments shall be proportioned by weight and liquids by weight or volume.
(e) The producer shall furnish the Inspector with a current copy of formulation showing the weights and/or measure of all components used therein and the yield of the batch in gallons.

859.06 Packaging And Containers.

(a) All materials shall be packaged in clean, sturdy containers fitted with tight lids to prevent leakage and the entry of air. All containers shall be filled to capacity leaving a minimum of air space. Unless otherwise specified, all containers shall have a capacity of at least five (5) gallons.

(b) All containers shall be clearly and legibly identified showing the following information:
   1. Manufacturer's name and address.
   2. Name of material.
   3. Batch Number.
   4. City of Huntsville Project No. unless it is for pretested stock.

(c) Containers with illegible identification marks or those that leak or show evidence of leakage may be rejected and, if rejected, shall be removed from storage stock or job site.

859.07 Storage.

(a) All materials and their components shall be amply protected from all forms of damage at all times.

(b) Storage space for all materials shall be the responsibility of the Contractor. Improper storage conditions may cause the rejection of the material stored therein.

859.08 Resampling And Retesting.

(a) The right is reserved to inspect, resample and retest any previously approved material at any time when it is deemed expedient by the Engineer.

(b) All materials shall be retested 12 months after date of manufacture.

(c) Retested material will be accepted or rejected as determined by the retest.

(d) The holder of any old material shall request in writing the resampling and retesting of old material not less than 6 weeks before the expiration date.

859.09 Stock Of Pretested Material.

(a) A producer, Contractor, jobber, or vendor can on written approval of the Engineer of Public Works accumulate and distribute a supply or stock of pretested and approved material, provided he issues a satisfactory report or "shipping notice" on each and every shipment.

(b) This "shipping notice" shall be on the firm's letterhead and in affidavit form signed by a responsible person. This shipping notice shall give the following information:
   1. Name of material.
   2. Consignee and destination.
   3. City of Huntsville Project No. and County.
   4. Name of producer and address.
   5. Batch number
   6. Quantity shipped.
   7. Quantity remaining on hand.
Sections 859.07 and 859.08, Storage, resampling, and retesting respectively, apply to all materials held in stock.

859.10 Test And Analysis.

All components and mixed or finished materials will be tested or analyzed according to the latest methods and procedures indicated in the latest product specification.

859.11 Requirements Applicable To Materials.

Contractors, jobbers, vendors, and other buyers of materials intended for highway construction or maintenance are held responsible for notifying the producer or manufacturer of these materials, that the requirements of Section 859 are mandatory for such materials.

859.12 Finished Materials And Their Components.

(a) GENERAL.

In addition to meeting the individual production specifications listed below, all materials must meet the requirements of all provisions of Section 859. The specifications listed apply to the chemical and physical properties of the components and finished materials and to the methods of tests.

(b) PIGMENTS AND PASTES.

1. Aluminum Paste
2. Blank
3. Chrome Green
4. Chrome Yellow
5. Iron Blue
6. Iron Oxide
7. Lamp Black
8. Ochre
9. White Lead:
   Basic Carbonate
10. White Lead:
    Basic Sulphate
11. Zinc Oxide
12. Zinc Oxide Leaded
13. Zinc Sulphide Pigments
14. Red Lead
   (97% grade)
15. Titanium Dioxide
16. Pigment-in-Oil
    Tinting Color
17. Prussian Blue
    (Iron Blue)
18. Aluminum Stearate
19. Zinc Chromate
20. Red Iron Oxide

of calcium sulfate, containing not less than 86% Fe20s.

<table>
<thead>
<tr>
<th>Pigment/Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Paste</td>
<td>FSS TT-P-320a, Type II, Class B</td>
</tr>
<tr>
<td>Blank</td>
<td></td>
</tr>
<tr>
<td>Chrome Green</td>
<td>ASTM-D-212</td>
</tr>
<tr>
<td>Chrome Yellow</td>
<td>FSS TT-P-3466</td>
</tr>
<tr>
<td>Iron Blue</td>
<td>FSS TT-P-385</td>
</tr>
<tr>
<td>Iron Oxide</td>
<td>ASTM-D-84</td>
</tr>
<tr>
<td>Lamp Black</td>
<td>FSS TT-P-350a</td>
</tr>
<tr>
<td>Ochre</td>
<td>FSS TT-P-420a</td>
</tr>
<tr>
<td>White Lead:</td>
<td></td>
</tr>
<tr>
<td>Basic Carbonate</td>
<td>FSS TT-W-251e</td>
</tr>
<tr>
<td>White Lead:</td>
<td></td>
</tr>
<tr>
<td>Basic Sulphate</td>
<td>FSS TT-W-261c</td>
</tr>
<tr>
<td>Zinc Oxide</td>
<td>FSS TT-P-463a</td>
</tr>
<tr>
<td>Zinc Oxide Leaded</td>
<td>FSS TT-P-462a</td>
</tr>
<tr>
<td>Zinc Sulphide Pigments</td>
<td>ASTM-D-477</td>
</tr>
<tr>
<td>Red Lead</td>
<td>FSS TT-R-191b(1)</td>
</tr>
<tr>
<td>Titanium Dioxide</td>
<td>FSS TT-P-422</td>
</tr>
<tr>
<td>Pigment-in-Oil</td>
<td>FSS TT-P-381c(2)</td>
</tr>
<tr>
<td>Tinting Color</td>
<td></td>
</tr>
<tr>
<td>Prussian Blue</td>
<td>FSS TT-P-386</td>
</tr>
<tr>
<td>(Iron Blue)</td>
<td>MIL-A-16206</td>
</tr>
<tr>
<td>Aluminum Stearate</td>
<td>ASTM-D-478, Type 1.</td>
</tr>
<tr>
<td>Zinc Chromate</td>
<td>Siliceous type of red iron oxide, free</td>
</tr>
</tbody>
</table>
21-26 Blank.

26. Graphite—The pigment in both semi-paste and ready-mixed paint shall consist of finely ground graphitic carbon and insoluble siliceous material. The graphitic carbon may be derived from either natural or artificial graphite and the insoluble impurities of the graphite or added insoluble siliceous matter. The pigment shall show the following analysis:

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphitic Carbon, percent</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Insoluble Silicic Matter, percent</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Sum of graphitic carbon and insoluble siliceous matter, percent</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Calcium and magnesium carbonate and sulphates, percent</td>
<td>—</td>
<td>5</td>
</tr>
</tbody>
</table>

The pigment shall be ground so that 100 percent will pass the Number 200 sieve.

(c) EXTENDERS.

These shall meet the following specifications:
1. Aluminum Silicate ASTM-D-603
2. Barium Sulphate ASTM-D-602
3. Diatomaceous Silica ASTM-D-604, Type A
4. Magnesium Silicate ASTM-D-605
5. Mica ASTM-D-607

(d) VEHICLES AND THINNERS.

These shall meet the following specifications:
1. Raw Linseed Oil FSS TT-L-215a
2. Boiled Linseed Oil FSS TT-L-190b
3. Turpentine FSS TT-801a, Type I
4. Mineral Spirits ASTM D-235
5. Drier, Paint Liquid FSS TT-D-651c(1)
6. Lacquer Thinner FSS TT-T-266b
7. Drier, Naphthenate FSS TT-D-643b
8. Alkyd Resin FSS TT-R-266a, Type III
9-15. Blank
16. Bodied Linseed Oil—Bodied Linseed oil shall be a heat boiled or blown oil and shall have the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodine Value</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>Saponification Number</td>
<td>189</td>
<td>230</td>
</tr>
<tr>
<td>Specific Gravity 15.5°C/15.5°C</td>
<td>0.950</td>
<td>1.000</td>
</tr>
<tr>
<td>Acid Number</td>
<td>—</td>
<td>10</td>
</tr>
<tr>
<td>Color (Gardner)</td>
<td>—</td>
<td>11</td>
</tr>
<tr>
<td>Viscosity (in poises at 25°C)</td>
<td>80</td>
<td>120</td>
</tr>
</tbody>
</table>

859.13 Finished Materials.

(a) PAINTS.

All paints shall be delivered to the project completely mixed and ready for use without the addition of oils or thinner. Paints shall be well ground, shall not settle or cake badly in the container, and shall be readily broken up to a smooth,
uniform paint of good brushing consistency. When brushed or sprayed on a smooth, vertical surface, the paint shall dry hard and elastic without running, streaking, sagging, or spotting. For the purpose of identification, the first coat of paint applied in the shop or in the field to uncoated structural steel or wood shall be called "Primer coat". The paint covering the "primer coat" shall be called the "second coat", and the paint covering the "second coat" shall be called the "third coat". The "primer coat" and "second coat" materials shall be of the same basic ingredients unless otherwise directed in writing.

(b) COMPONENTS.
For finished materials these shall meet the specifications as indicated in Section 859.12 unless otherwise specified in the production specification.

(c) WEIGHT PER GALLON, DRYING TIMES, AND OTHER TESTS.
These shall be made according to FTM Methods.

859.14 Primers.
(a) RED LEAD PRIMER.
This primer shall meet the requirements of AASHTO M-72, Type II, modified to require a "Fineness of Grind" (Hegman Scale) of not less than 4.

(b) ZINC CHROMATE-IRON OXIDE PRIMER.
1. GENERAL.
This specification covers single type and grade of semiquick drying zinc chromate-iron oxide ready mixed paint intended for use as a primer, shop coat or for any maintenance coats which are placed on bridges, similar structural steel and other ferrous metal surfaces.
The paint shall be well-ground, shall not settle or cake badly in the container and shall be readily broken up with a paddle to a smooth uniform paint of good brushing consistency. The paint, when brushed on a smooth vertical metal surface, shall dry hard and elastic within the specified period without running, streaking or sagging.

2. MATERIALS.
The materials used in the manufacture of the paint shall conform to the requirements of Section 859.13 and the following:

Driers ASTM D-600, Class B

3. PIGMENT.
The pigment composition shall be as follows:

<p>| % by Weight |</p>
<table>
<thead>
<tr>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc Chromate</td>
<td>40</td>
</tr>
<tr>
<td>Red Iron Oxide (85% Fe203)</td>
<td>30</td>
</tr>
<tr>
<td>Magnesium Silicate</td>
<td>—</td>
</tr>
<tr>
<td>Aluminum Stearate</td>
<td>0.3</td>
</tr>
</tbody>
</table>
4. VEHICLE.
The vehicle shall consist of raw linseed oil blended with a glyceryl phthalate varnish composed of a linseed oil modified resin together with the necessary driers and volatile thinners. It shall be free from resin and resin derivatives.
The vehicle composition shall be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Linseed Oil</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Alkyd resin solids</td>
<td>28</td>
<td>44</td>
</tr>
<tr>
<td>Volatile thinner &amp; drier</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. PAINT COMPOSITION.
The composition of the paint shall meet the following limits:

<table>
<thead>
<tr>
<th>Component</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment, % by Wt.</td>
<td>48</td>
<td>51</td>
</tr>
<tr>
<td>Vehicle, % by Wt.</td>
<td>49</td>
<td>52</td>
</tr>
<tr>
<td>Moisture, % by Wt.</td>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Coarse particles, skins and other foreign matter (residue retained on #325 sieve based on pigment), &amp; by wt.</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Fineness of Grind (Hegman Scale)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Wt. per gallon; pounds</td>
<td>11.5</td>
<td></td>
</tr>
</tbody>
</table>

6. DRYING TIME.
The paint shall set to touch in not more than four (4) hours and dry hard and tough in not more than 16 hours.

7. METHOD OF ANALYSIS.

(c) BASIC LEAD SILICON CHROMATE PRIMER.
This primer shall meet AASHTO M-229, Type I, modified to require a "Fineness of Grind" (Hegman Scale) of not less than 4.

859.15 Second Coats.

(a) RED LEAD PRIMER FOR SECOND COAT
This primer shall meet the requirements of AASHTO M-72, Type II modified to require a "Fineness of Grind" (Hegman Scale) of not less than 4 and require the addition of one ounce of I.D. Lampblack or IE Black Iron Oxide (FSS-TT-P-381E) to each five (5) gallons of paint.

(b) RED LEAD, (VARNISH TYPE) PRIMER FOR SECOND COAT.
For special shop coat and touching up coat in the field this shall meet AASHTO M-72, Type III, modified to require a "Fineness of Grind" (Hegman Scale) of not less than 4.
(c) ZINC CHROMATE-IRON OXIDE PRIMER FOR SECOND COAT.
This paint shall meet the requirements noted in Section 859.14(b) modified to require the addition of one ounce of IC Carbon Black or ID Lampblack (FSS-TT-P-381e) to each five (5) gallons of paint.

(d) BASIC LEAD SILICO CHROMATE PRIMER FOR SECOND COAT.
This primer shall meet AASHTO M-229, Type I, amended by adding the following:
1. Fineness of Grind, Hegman Scale 4 Min. 2. Addition of one ounce of IC Carbon Black or ID Lampblack (FSS-TT-P-381E) to each five (5) gallons of paint.

859.16 Third Coat.
(a) BLACK PAINT FOR THIRD COAT.
The paint shall meet the requirements of AASHTO M-68.

(b) BLANK.

(c) ALUMINUM PAINT FOR THIRD COAT.
This paint shall meet the requirements of AASHTO M-69, Type I.

(e) GREEN BRIDGE PAINT, THIRD COAT.
1. GENERAL REQUIREMENTS.
This paint is to be used as the third or finish coat only. The color of the dried film shall match a standard established by the Alabama State Highway Department. When the paint is brush or spray applied, it shall dry to a smooth film and exhibit no running, streaking, sagging, or other undesirable film defects. The hiding power shall be sufficient to obtain complete hiding when applied at a normal spreading rate of 500 square feet per gallon. Under normal drying conditions, the paint shall set to touch within two hours and dry for handling in not more than twelve hours. The paint shall be well ground, shall not settle badly, or cake in the container. It shall be readily broken up with a paddle to a uniform condition of good brushing consistency as tested in Method 3011 of Federal Test Method Standard 141. If unusually cool atmospheric conditions prevail at time of application, the paint may be thinned by adding one pint of mineral spirits or turpentine per one gallon of paint. In the event referee tests are required, the methods described in Federal Standard 141 shall be used, along with any other methods which may be required to establish conformity to this specification.

2. SPECIFICATIONS.
a. The following specifications shall govern the various components of the paint:
FSS TT-R-266 Type I, Class A Resin, Alkyd; Solution.
FSS TT-P-442 Type III, Gr. A Pigment, Titanium Dioxide.
FSS TT-D-643 Drier, Paint Naphthenate, Liquid Concentrated.
FSS TT-T-291 Thinner, Paint, Volatile Mineral Spirits.
FSS-TT-P-347 Pigment, Chromium Oxide Green, Dry.
FSS TT-L-215 Linseed Oil, Raw.
ASTM D-1648 —Basic Led Silico Chromate.
b. The composition of the paint shall meet the following limits:

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment, % by weight</td>
<td>31.0</td>
<td></td>
</tr>
<tr>
<td>Vehicle, % by weight</td>
<td></td>
<td>68.0</td>
</tr>
<tr>
<td>Weight/gallon, pounds</td>
<td>10.1</td>
<td></td>
</tr>
<tr>
<td>Water, %</td>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Coarse Particles and Skins (total residue retained on 325 sieve based on paint), %</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Fineness of Grind (North Standard)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Viscosity: Stormer-Krebs Units</td>
<td>74</td>
<td>84</td>
</tr>
<tr>
<td>Grams Stormer</td>
<td>160</td>
<td>215</td>
</tr>
<tr>
<td>Color — Shall match standard color chip in State Highway Department Laboratory.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c. The composition of the pigment shall be as specified below:

<table>
<thead>
<tr>
<th></th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Lead Silico Chromate</td>
<td>Min.  29.0</td>
</tr>
<tr>
<td>Titanium Dioxide, Rutile Non-Chalking</td>
<td>28.0</td>
</tr>
<tr>
<td>C.P. Chromium Oxide Green</td>
<td>30.0</td>
</tr>
<tr>
<td>Organo Montmorillonite*</td>
<td>Min.  1.1</td>
</tr>
<tr>
<td>Light fast toning colors (phthalocyanine green, lampblack, etc., no iron blue allowed)</td>
<td>Balance</td>
</tr>
</tbody>
</table>

*Note: Bentone 38—National Lead Company or approved equal Pre-dampen with 35% Methyl Alcohol: Water—95.5

Care shall be taken to properly process the Organo Montmorillonite to obtain its maximum efficiency as a suspending, thixotropic, and bodying agent.

d. The liquid portion of the paint shall consist of a mixture of long oil alkyd resin, raw linseed oil, driers and thinners. Small quantities of antiskinning agents, grinding, wetting aids, and antiflooding and antifloating aids may be used if desired.

<table>
<thead>
<tr>
<th></th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkyd Resin Solids</td>
<td>Min.  50.0</td>
</tr>
<tr>
<td>Raw Linseed Oil</td>
<td>5.0</td>
</tr>
<tr>
<td>Thinners, Driers, etc.</td>
<td>40.0</td>
</tr>
<tr>
<td>Phthalic Anhydride in the Nonvolatile Vehicle</td>
<td>20.2</td>
</tr>
</tbody>
</table>
859.17 Dowel Bar And Wood Paint.

(a) DOWEL BAR DIPPING PAINT.
This shall be well ground, homogeneous throughout and mixed according to the following proportions:

- **Red Lead**
  - Pigment: 59.0 to 61.0 percent
  - Red Lead: 64.0 to 66.0 percent
  - Magnesium Silicate: 34.0 to 36.0 percent
  - Vehicle: 39.0 to 41.0 percent
  - Raw Linseed Oil: 59.0 to 61.0 percent
  - Bodied Linseed Oil: 39.0 to 41.0 percent

(b) TIMBER AND WOOD PAINTS.
The following primer, second and third coat paints shall meet the production specification indicated below. Unpainted wood and old painted surfaces in poor condition shall be painted with one coat of primer FSS TT-P-25a. These paints have different uses according to the area in which they are used and whether they are to be tested or not.

859.18 Primer (Wood).

- FSS TT-P-25a.

859.19 Outside White.

- FSS TT-P-103. This paint contains titanium dioxide, zinc oxide and oil. It is fume resistant and it not to be tinted. This paint is designed for localities where hydrogen sulphide is present in the air in sufficient quantities to discolor paint containing lead compounds. It can be used on either wood or steel. This paint is sometimes called "Industrial Outside White".

859.20 Outside White.

- FSS TT-P-102 in 2 classes.
  - Class A—for use as white paint only.
  - Class B—for use as paint of light color but not as white paint.
  - This paint contains titanium, lead, zinc, and oil. Neither class should be used where hydrogen sulphide is present in the air.

859.21 Blank.
859.22 Outside Yellow.
   FSS TT-P-53c. Intended as top or finished coat on previously primed wood or metal.

859.23 Outside Black.
   FSS TT-P-61d. Intended for the top or finish coat on previously primed wood or metal.

859.24 Blank.

859.25 Paint For Concrete And Masonry.
   FSS TT-P-24a.
   Type I—White only.
   Type II—Tint-base-white for tinting. Primarily intended to be used as a primer and finish coat on outside surfaces. It can be used inside over suitable primed concrete, brick, stucco and similar surfaces except floors. The dried coat is an eggshell color.

859.26 Paint For Masonry.
   FSS TT-P-0019a.
   Acrylic Emulsion Type, for exterior use.

859.27 Olive-Drab (Exterior).
   FSS TT-P-81d(2).
   This specification covers medium shades of a lead-zinc based paint. Olive-drab is Color No. 1405-FSS TT-C-595.

859.28 Green Exterior Paint.
   FSS TT-P-71d.

859.29 Enamel (Exterior).
   FSS TT-E-489c.
   Class A—Air-drying.
   Class B—Baking.
   This enamel gives a high-gloss finish to be used over previously primed smooth wood or metal surfaces. Color selection is wide. It is suitable for signs and automotive equipment.

859.29 A Paint (Interior) Oil, Flat, White And Tints.
   FSS TT-P51c.

859.30 Primer For Steel.
   FSS Mil-P-26915A Zinc Dust Pigmented.
859.31 Galvanizing Repair Paint.
   FSS Mil-P-21035

859.32 Asphalt Varnish.
   FSS TT-V-51c.

859.33 Shellac Varnish.
   FSS TT-S-300.

859.34 Spar Varnish.
   FSS TT-V-121c.
SECTION 861
TRAFFIC MARKING MATERIALS

861.01 General.

This Section shall cover the materials used for traffic markings, these materials will be divided into Classes, with Class 1 designating paints and Class 2 designating plastics. These Classes will be further designated as to reflectorization or non-reflectorization with Type A designating reflectorized and Type B designating non-reflectorized.

Reflectorization (Type A) shall be accomplished by the use of glass spheres (beads) premixed into the base compounds (paint or plastic) and the application of additional beads by a separate operation but at the same time to produce instant reflectivity. This requires the use of beads of different gradation, see Section 861.04, of glass spheres (beads) by a separate operation but at the same time, in such a manner that portions of the bead application produces imbedded beads providing instant reflectivity along with bead exposure when base material wears down.

All traffic marking materials shall be from pretested stocks. Attention is directed to the requirements for pretesting stocks of paints noted in Section 861.05(a) and plastic noted in Section 861.05(b).

861.02 Paints.

(a) GENERAL.

The supplier shall submit his formulation and the materials used in the formulation shall meet the requirements of the ingredients noted in Section 859 and this Section.

Colors shall be white and yellow designated TW (Traffic White) and TY (Traffic Yellow).

(b) DETAILED REQUIREMENTS.

1. GENERAL REQUIREMENTS.

Table I below lists the characteristics, their required tolerance limits and references that control these paints. Paragraphs referred to give detail information regarding test methods, procedures and other data that are part of these specifications. The explanatory paragraphs in Item 2 of this Section have the same number as the characteristics (Item No.) listed below.
### TABLE I

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>2</td>
<td>Color and Daylight Reflectance</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>TW—Relative to Magnesium Oxide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TY—Federal Yellow</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Dry Opacity</td>
<td>.88</td>
</tr>
<tr>
<td></td>
<td>TW—Contrast Ratio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TY—Contract Ratio</td>
<td>.94</td>
</tr>
<tr>
<td>3</td>
<td>Weight per Gallon</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Premixed</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td>TW pounds 77°F.</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td>TY pounds 77°F.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Binder Only</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>TW pounds 77°F.</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>TY pounds 77°F.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Spheres per gal, Premixed TW&amp;TY</td>
<td>4.20</td>
</tr>
<tr>
<td>5</td>
<td>Consistency at 77°F.</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Krebs Units, Premixed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Without Glass Spheres</td>
<td>70</td>
</tr>
<tr>
<td>6</td>
<td>Stability, Increase in consistency,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Item 5 above), after test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Krebs Units</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Total Solids Content (pigment, non-volatile vehicle) Percent by Weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Premixed</td>
<td>75.5</td>
</tr>
<tr>
<td></td>
<td>Without Glass Spheres</td>
<td>70.0</td>
</tr>
<tr>
<td>8</td>
<td>Dry Solids &amp; Pigment, Percent by Weight</td>
<td>61.0</td>
</tr>
<tr>
<td></td>
<td>Premixed</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>Without Glass Spheres</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Nonvolatile Matter in the Vehicle Percent by Weight</td>
<td>35.0</td>
</tr>
<tr>
<td>10</td>
<td>Drying Time: Minutes</td>
<td>45</td>
</tr>
<tr>
<td>11</td>
<td>Water Content in Compound Percent by Weight</td>
<td>0.5</td>
</tr>
<tr>
<td>Item No.</td>
<td>Characteristics</td>
<td>Min.</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>12</td>
<td>Degree of Settling Rating</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Pigment Content: (Percent by Weight binder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>White—Titanium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yellow—Chrome Yellow</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Bleeding Resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TW Contract Ratio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TY Contract Ratio</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Flexibility—The binder shall show no</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cracking when prepared, bent and examined</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as specified in Par. 15.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Abrasion Resistance (Par. #16)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>When subjected to the Falling Sand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abrasion Resistance Test, the amount of sand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>required to completely abrade the binder film</td>
<td></td>
</tr>
<tr>
<td></td>
<td>from an area 4 mm in diameter on the panel shall be</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as follows:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>White</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liters</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Water Resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The binder film shall show good adhesion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>to the glass panel, and shall show no</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wrinkling, blistering, or other forms of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>deterioration when tested according to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Par. 17.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Accelerated Weathering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Compound shall not blister, peel, crack,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>show excessive chalking or loss of spheres.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There shall be no appreciable change in color</td>
<td></td>
</tr>
<tr>
<td></td>
<td>when tested as specified in Par. 18.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Fineness of Grind, Hegman Scale</td>
<td></td>
</tr>
</tbody>
</table>

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2. EXPLANATION OF TABLE 1.

Characteristics & Test Method

Color and Daylight Reflectance. Films of TW and TY shall be applied to glass plates and processed as follows:
(1) Wet Film Thickness 0.015" (Bird Applicator)
(2) Dry (horizontally) for 24 hours at laboratory conditions.
(3) Determine Daylight Reflectance according to FSS Method 6121. TW—shall not be less than 80 percent relative to magnesium oxide. TY—shall match the standard shade within the red and green balances when compared with Color Chip 33538 of Fed. Standard No. 595.

Dry Opacity. This shall be determined on the binder(s) films according to the sections of FSS Method 4121 listed below:
Section 2-1 and 2-2—Apparatus
Section 2-3-2—Film Applicator—Wet Film thickness of 0.0025 inches.
Section 3-2-3—Application of the film.
Section 3-1-4—Drying the film.
Section 3-2-5-1—Calculation of contrast ratio.

Weight per gallon. This shall be determined from not less than 8 fluid ounces of the material. A straight-walled cylindrical glass jar 2 inches in diameter and 5-3/4 inches tall contains a little over 8 fluid ounces. The jar is used as a pycnometer to determine the specific gravity of the compound(s).
Accurately calibrate the jar by weight using distilled water at 25°C, 77°F. Fill the jar level with the top edge—avoid over filling by using a glass plate cover.
Determine the specific gravity of the compound(s) by carefully filling the jar to the proper calibrated level with the well-mixed material. Remove all entrapped air by tapping the jar on a mat. Recently shaken material will contain air and should stand a while but be well stirred before filling the jar.
Calculate the weight per gallon by the following equation:

Weight per gallon = Net weight of the paint \times 8 \frac{33}{100} \text{ Net weight of water}

Spheres per gallon. See Section 861.02(c)

Consistency of the Compound(s). This shall be determined according to FSS-4281 at 77°F. 25°C.
Stability. This is consistency determination made on the compound(s) according to FSS Method 4281 after the material has been processed as specified below.
Fill the test cup as described in Sec. 1.2 and Sec. 2.1 Close the lid tightly and shake for 5 minutes on a mechanical shaker. Place cup (still closed) in an oven at 60°C ± 2°C for 18 hours. Then remove, and after cooling to laboratory temperature, open the container and examine for any form of deterioration. There shall be no livering or excessive skin formation. Determine the consistency as specified in Sec. of the method FSS 4281. The increase in consistency shall not be more than 3 Krebs Unit above the reported Consistency Item No. 5.

Total Solids Content of the Compound. This includes pigment, spheres if premixed, and the nonvolatile matter of the vehicle and shall be determined according to FSS Method 4041.

Dry Solid Content of the Compound(s). This includes pigment and spheres if premixed, and shall be determined according to FSS Method 4021.

Nonvolatile Matter in the Vehicle. This shall be determined according to FSS Methods 4041 and 4053. Determination shall be made on the binder and/or compound.

Drying Time. This shall be determined on the compound(s) according to ASTM D-711.

Water Content of the Compound. This shall be determined according to FSS Method 4081.

Degree of Settling. This shall be determined on the compound according to ASTM 869 with regard to apparatus, procedure, examination and evaluation. The aging period shall be 24 hours at laboratory conditions.

The Titanium Dioxide and Chrome Yellow Content in the Pigments. This shall be determined by a recognized analytical method.

Bleeding Resistance. This test is made on films prepared, examined, and evaluated as follows: (A) Bleeding Resistance is expressed as a "contract ratio". The ratio being between the Daylight Reflectance of the film over a standard bleeding surface and that of the film over a non-bleeding surface. Daylight Reflectance (abbr.—D.R.) is determined according to FSS Method 6121. Contract ratio is expressed as

\[
\text{Contract Ratio} = \frac{\text{D. R. of the Bleeding Area}}{\text{D. R. of the Non-Bleeding Area}}
\]

(B) Panel and Film Preparation. Apparatus and Materials Required. Suction Box or Vacuum Plate Film Applicator (Bird) producing a film not less than 31/2 inches wide and a wet film thickness of approximately 0.015 inches (gate clearance of 0.030 in.) Transparent cellulose acetate adhesive tape (1/2 in. wide) used to provide the non-bleeding surface.
(C) Standard Bleeding Surface is a 6 in. x 10 in. panel of standard 15 pound asphalt-saturated felt. (D) Provide a non-bleeding surface on the 6 in. x 10 in. panel by affixing a strip of the tape to the entire length of the panel about one in. from the edge and parallel to it. Apply the tape with firm pressure so that it is in contact with the panel throughout, with no air bubbles between tape or panel. (E) With the tape side up hold the panel flat and smooth on the suction plate. Apply the binder with the above described applicator in such a manner that the entire width of the tape is covered leaving the rest of the film to the right in direct contact with the panel. The position of the tape with reference to the applicator must be such that it is near to but not under the foot of the applicator. (F) Allow the film to dry, in a horizontal position, for 24 hours in a dark, well ventilated cabinet at laboratory conditions. (G) Measure the Daylight Reflectance (FSS Method 6121) by taking pairs of readings at one inch intervals over the film in direct contact with the panel and one over the film over the tape. Average the readings respectively and calculate the contrast ratio as directed above.

Flexibility. This test is conducted according to the following FSS Methods: Panels, Method 2013, Sec. 1.2; 2.1; 2.2 (Size 3 by 5 in.) Application, Method 2161 Procedure, Method 6221, with the following supplementary information and changes. The binder shall be applied to the panel to a wet film thickness of approximately 0.002 inch with a Bird film applicator. The panel shall be dried in a horizontal position for 18 hours at laboratory conditions. It shall then be baked for 5 hours at 105°C to 110°C. Cool to laboratory conditions. Bend the panel through an arc of 180° over a 1/2 inch rod. Examine as directed (Method 6221).

Abrasion Resistance (By the Falling Sand Method). This test is made on the binder film. The apparatus, standard sand used, standardization and maintenance of the apparatus shall be according to ASTM 968, paragraphs 1 to 5a inclusive. Fresh, new, unused sand shall be used for each panel to be tested. Glass panels shall not be less than 8 inches long or less than 4 inches wide, cut from smooth flat glass. Use a Bird film applicator that produces a wet film thickness of 0.006 in. Apply the binder, without reduction, to not less than 3 panels using the film applicator. Dry in a horizontal position for 24 hours under laboratory conditions. Bake the panel in an oven for 3 hours at a temperature of 105°C. to 110°C.

Charge the apparatus with 17.5 pounds of the specified sand, this weight being considered as 5 liters. Secure the panel to the apparatus tightly so that the middle third of panel will be subjected to the abrasion of the falling sand. Return the sand to the hopper after each run until the minimum quantity of sand
has fallen on the panel.
Remove the panel and measure the diameter of the abraded area.
The abraded area or spot shall be less than 4 mm in diameter.
Fragment of binder film within the spot will not be considered.

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Water Resistance. This is determined on film of the binder
drawn down by a 0.005 inch film applicator, on a clean glass
panel 8 to 10 inches long. Allow the panel to dry for 72 hours in a
horizontal position at laboratory conditions. Immerse the panel
(top down) in distilled water to a depth of 4 to 5 inches. Leave it
immersed for 24 hours at laboratory conditions. Allow to dry for 2
hours after removal and then examine.

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Accelerated Weathering. Apply one coat of the compound
(wet film thickness of 0.014 to 0.016 inches) to a smooth, glass
panel of suitable dimensions. Air dry for 24 hours at laboratory
conditions. Expose the panel for 168 hours according to FSS
Method 6152. This test shall be performed for all prequalification
testing and for verification testing.

3. INGREDIENTS NOT COVERED BY SECTION 859.12.
This material shall be chlorinated natural rubber supplied as a 30 to 40 percent
solution by weight in toluene of 10 or 20 centipoise type chlorinated rubber. Two
percent by weight of propylene oxide or Pichlorohydrin based on rubber solids, shall
be added as stabilizer. The chlorinated rubber shall have the following properties:

Chlorine, percent by wt. of rubber solids..........................................................66-69
(FSS-TT-P-115c Paragraph 4.3.6)
Color, Gardner (20 percent by wt. in toluene) .................................................4 Max.
Viscosity, (20 percent by wt. in toluene), centipoise) .......................................9-25
(ASTM Method D 115)

b. Chlorinated Paraffin.
This material shall be a viscous liquid chlorinated paraffin having the
following properties:

Chlorine, percent (FSS-TT-P-115c, Par. 4.3.6) .................................................40 ± 2
Color (Gardner) .................................................................................................2
Viscosity, 25°C. (Gardner Tube), poises .........................................................20 - 32
Index of refraction .......................................................................................1.50 ± .05
Specific gravity, (25°/25°C) ........................................................................1.15 ± .05

c. GLASS SPHERE (BEADS) REQUIREMENTS.
1. REFLECTORIZED PAINTS.
a. Spheres per gal. - pounds 4.20 Min. - 4.90 Max.
   Type 1 (Section 861.04) spheres.
b. Spheres, add on - 0.025 # per Square Foot of Stripe Min. Type 2 (Section
   861.04) spheres.
Spheres per gallon.
This shall be determined by reclaiming the spheres from a known weight of the well-mixed compound(s).
The spheres can be reclaimed by elutriation using a suitable solvent or thinner. The weighed compound is transformed to a conical breaker and the thinner added. Thoroughly mix by stirring. Allow the spheres to settle then pour the supernatant liquid on a #325 sieve. Refill the graduate and continue the elutriation until the supernatant liquid is clear. Return any spheres collected on the sieve to the graduate. Wash the reclaimed sphere 3 times with acetone. Transfer the spheres, using acetone, to a clean tared evaporating dish or beaker. Evaporate the acetone and dry the beaker and spheres at 220° to 230°F., 105° to 110°C. to constant weight.
Calculate the percent by weight of spheres in the compound.
Spheres per gallon = wt. per gallon x percent of spheres. (in pounds).
A slight error can exist as a small amount of spheres may pass the #325 sieve. This error or loss is offset by another - a gain in weight of spheres due to adhering pigment.
The Engineer reserves the right to calculate spheres per gallon using data obtained by other tests.
The reclaimed spheres shall be retained for gradation which should be reasonably close to the gradation of the clean spheres in Section 861.04(b).
Gradation of the Clean and Reclaimed Spheres.
This procedure shall be in accordance with ASTM D-1214 on a representative sample of 50 to 100 grams. Gradation requirements are noted in Section 861.04.

2. NON-REFLECTORIZED PAINT.
None.

861.03 Plastic.

(a) HOT APPLIED (TRAFFIC STRIPE AND MARKING AND LEGENDS).
1. GENERAL.
This type material shall comply with the requirements of AASHTO M-249 and the requirements noted hereinafter in this Section.
2. COMPOSITION.
The composition of the thermoplastic shall be in accordance with the provisions of AASHTO M-249 except that no filler may be used which will interfere with the analysis of the premix glass spheres as outlined in AASHTO T-250.
3. GLASS SPHERES (BEADS).
The premix bead requirements of AASHTO M-249 shall be amended to require the beads to conform to the requirements for Class 3 Glass Spheres of Section 861.04.
In addition to the premix beads a top dressing of Class 2 spheres of Section 861.04 shall be automatically applied to the surface of the freshly applied material while it is in a molten state at a rate of not less than 0.05 pounds per square foot of marking material.
4. PRIMER-SEALER.
On all pavements a primer-sealer, meeting the requirements of the manufacturer of the thermoplastic material and approved by the Department, shall be applied just prior to actual application of the thermoplastic to insure optimum adhesion to the surface.

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5. PACKING AND MARKING.

The thermoplastic material shall be packaged in either block or granular form utilizing suitable containers to which the material will not adhere during storage or handling. Each container shall weigh approximately 50 pounds, labeled with the manufacturer's name, color, batch number, date of manufacture and application temperature.

(b) COLD APPLIED (TEMPORARY STRIPE ONLY).

This type material shall be formed from the same basic material noted in Section (a) above, preformed to size and shape required and capable of being affixed to the pavement by means of a precoated adhesive.

In addition to the above, the following requirements are applicable:

1. The applied stripe shall be capable of molding itself to the pavement contours, faults, etc., and maintain its original dimensions and placement under normal traffic conditions.

2. Thickness of the plastic stripe shall be not less than 0.05 inches, without the pre-coated adhesive. All edges shall be clean cut and true.

3. The adhesive furnished for pre-coated adhesive applied plastic shall be capable of firmly affixing the stripe to the pavement surface so as not to be loosened or displaced by traffic; however, the product shall be demonstrated to produce the desired results before permission to install this type marking will be given.

4. Drop on spheres are not required with this type material.

861.04 Glass Spheres (Beads).

(a) GENERAL.

Glass spheres are divided into three (3) classes based on their use in accordance with the following:

Class 1 - Spheres used in premixed paints.
Class 2 - Spheres used with Fast-dry traffic paints and for drop-on application with premixed paints and premixed plastics.
Class 3 - Spheres used in premixed plastics.

(b) DETAILED REQUIREMENTS.

1. GENERAL REQUIREMENTS.

The glass spheres shall be free-flowing, free from dust and dirt, colorless, transparent, free from milkiness and excessive air bubbles.

The glass spheres shall have a minimum of 75 percent true spheres when tested in accordance with ASTM D-1155.

The glass spheres shall have an index of refraction of not less than 1.50 nor more than 1.60 as determined by the immersion method.

The Silica (SiO2) content of the spheres shall be not less than 60 percent when determined according to FSS Method 7251, Sec. 4.1 Silica.

The water content of the spheres shall not exceed 0.05 percent by weight when tested in accordance with the following:

This test shall be made on the sample before it is prepared for any other test. The portion for this test shall be taken as a "grab-sample" and not the result of sampling by riffling. The grab-sample is weighed at once, then dried to a constant weight of 105° to 110°C. Loss in weight is reported in percent as water by weight.
2. GRADATION.

The gradation requirements for the various classes of glass spheres using the test methods of ASTM D-1214 are as follows:

**Gradation Table for Glass Spheres**

<table>
<thead>
<tr>
<th>% Passing by Wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>200</td>
</tr>
</tbody>
</table>

861.05 Inspection And Sampling.

(a) PAINT.

1. MANUFACTURE.

The manufacturer shall use sufficient capacity of his plant to produce an average of 2,500 gallons of paint per day. The vendor for the paint shall notify the Department of his intention to manufacture the paint at least ten (10) days before the beginning of production. (May be waived by mutual agreement.) The manufacturer of the paint shall make available to the Engineer or his authorized representative the batch formula (genetic rather than trade names and in weight proportions and total gallons per batch) 30 days prior to manufacture. This formula shall be sent to the Engineer of Public Works. The manufacturer shall furnish information as to the source, type and trade designation of all raw material used in the paint making.

2. SAMPLES, SAMPLING AND INSPECTION.

If requested, the supplier shall submit samples in accordance with the following schedule for each batch of 5,000 gallons or less.

- Non-Reflective Paint - Not less than 4 quarts.
- Reflective Paint - Binder - Not less than 2 quarts Premixed
  Compound - Not less than 2 quarts Spheres - Not less than 1 quart of each type to be used.

All paint delivered must conform to the Specifications and any material not conforming shall be rejected and removed at once by the Contractor at his expense. Samples upon which acceptance or rejection of the material is based may be taken by a representative of the Department. All materials proposed to be used may be inspected, sampled and tested at any time and at any place during their preparation, storage, or use. All materials used in the manufacture of the paint may be subject to test by the Department.

In sampling paint products at the plant, the vendor shall furnish the representative of the Department free access to all parts of the plant, and furnish every reasonable facility for sampling and for sealing the container of both the paint and raw materials before and during the process of manufacture. Samples adequate for test shall be furnished free of charge by the vendor.
The representative of the Department may observe the weighing of raw material going into batches as well as the finished paint. The vendor will be allowed to manufacture paint only when the authorized Department inspector is present, or when the Department waives its right. No batch of traffic paint will be considered for tests unless represented by a full set of samples as described above.

3. CONTAINERS.

Containers shall be of at least five (5) gallon capacity, clean, sturdy and capable of being closed tightly to prevent the entry of air and leakage.

For City purchase orders for traffic paint, containers shall, unless otherwise specified on the purchase order, be open-end drums of 30 to 55 gallon capacity (size to be specified) meeting current Specification requirements of the U.S. Department of Transportation for transporting flammable liquids. No secondhand containers shall be used. The drums shall be sealed with a reusable multiseal sponge gasket of a type which will prevent the entry of air and leakage.

All containers shall be filled to capacity, leaving a minimum of air space above the material. All containers shall be clearly and legibly identified showing the following information:

a. Name of material.
b. Specification and Section number.
c. Batch number. d. Inspector's number (if any).
e. Project number or purchase order number is available. Pretested material held as stock for future distribution - see Section 861.05(a)5.

4. STORAGE.

The following applies to paint producers, jobbers, contractors and anyone who keeps a supply or stock of pretested paints intended for street use. All materials and their components shall be amply protected from all forms of damage at all times.

Storage space for all materials shall be the responsibility of the Contractor. Improper storage conditions may be cause for rejection of the material stored therein.

5. PRETESTED STOCKS OF TRAFFIC PAINT.

These shall comply with Section 861.09 and the following requirements:

a. The Engineer reserves the right to cancel the approval to maintain stocks of paint if the paint fails to meet the requirements of this section.

b. All paints are subject to being re-sampled at the job site or in the warehouse. Tests made on these re-samples shall meet the requirements of these Specifications. Materials not meeting the requirements shall be rejected and removed. Excessive rejections of a batch of paint shall condemn the batch as a whole.

c. Traffic Paints that are over 9 months old shall be retested on such tests that apply to the compounds. Material one year old must meet the requirements of these Specifications and be approved before its use can be continued.

d. The producer, jobber, or contractor shall be held responsible for the expiration dates of the batches of paint in this stock. Request for inspection, resampling and retesting shall be made not less than 6 weeks before the expiration date of the material.

e. In the case of unsatisfactory results, and for minor adjustments to the finished compound, the material in question shall be completed to approval or rejection in not more than 60 days after the first unsatisfactory report. f. Calculations of all results shall be controlled by ASTM E-29 "Practice for Indicating Which Places of Figures Are to be Considered Significant in Specified Limiting Values."
(b) PLASTIC.

The manufacturer of the thermoplastic shall have capacity of furnishing batches or production lots of not less than 3000 pounds, unless the total order is less than this amount.

A prerequisite for sampling and testing of any thermoplastic material will be a test report from the producer of the material certifying to the actual test results on each requirement of these specifications for the batch of material involved (see form provided in AHD Procedure No. 322).

Note is made of the fact that no thermoplastic material will be accepted for use in the work under a "Materials Guarantee." The Engineer must have either a passing test report or a pretested batch report in hand or certified test report by the manufacture before allowing the material to be placed in the work.
SECTION 862
FAST-DRY TRAFFIC PAINT

862.01 General.

This Section shall cover the Fast-Dry Traffic Paints used for Class 1 Traffic Markings, in colors White and Yellow designated TW (Traffic White) and TY (Traffic Yellow). This Class marking material will be further designated as to reflectorization or non-reflectorization with Type A designating reflectorized and Type B designating non-reflectorized.

Reflectorization (Type A) shall be accomplished by the use of glass spheres (beads) which meet the requirements of Section 861.04 for Class 2 Spheres applied as noted in Section 701.03(e)1 and the Field Test Procedure of Section 862.04(b) in such a manner as to provide embedded spheres which produce both instant reflectivity along with reflectivity (sphere exposure) as the paint wears down.

All paint and glass spheres shall be from pretested stocks.

862.02 Formulation and Manufacture.

The formulation, manufacture, the composition of pigments and the composition of the pigmented binders shall be at the option of the producer, provided such is formulated and manufactured from first grade materials free from defects and imperfections that might adversely affect the serviceability of the finished product.

862.03 General Requirements.

The pigmented binder shall be capable of being applied with specialized traffic striping equipment without damaging such equipment.

The pigmented binder shall have the capability of being preheated and applied, in a heated state at temperatures between 140°F. and 160°F. without damaging the formulation or serviceability of the product. Said binder shall not be damaged or deteriorated under re-heating or if held under heated conditions for four (4) to six (6) hours.

The pigmented binder shall provide proper anchorage and refraction for glass spheres (beads) when both are applied at the rates specified in Sections 862.04 and 862.05. Glass spheres shall be applied by specialized pressurized bead guns.

The pigmented binder shall show no evidence of excessive settling, gelling, spoilage, or livering upon storage in sealed containers within a six (6) month period.

The pigmented binder shall show no evidence of skinning in the delivered sealed containers.

862.04 Specific Requirements For Solvent Based Paints.

(a) COMPOSITION OF FORMULATION.

1. PERCENT PIGMENT.

The percent pigment shall not be less than 50% nor more than 64% by weight when determined by Federal Test Standard No. 141a, Method 4021 -use extraction mixture "A" (by volume) 9 parts, dichloromethane (methylene chloride) 1 part.

500
2. VOLUMETRIC WEIGHT.
The volumetric weight of the pigmented binder shall not be less than 13.5 pounds/gal. nor shall the weight of the production batches vary more than ± 0.3 pounds/gal. from the weight of the qualification samples. Testing shall be in accordance with Federal Test Standard No. 141a, Method 4184.

3. VEHICLE SOLIDS PERCENT ON VEHICLE.
The vehicle solids percent on the total vehicles shall not be less than 40% by weight nor shall the production batches vary more than ± 2% from the percent of the original sample. Testing shall be in accordance with Federal Test Standard No. 141a, Method 4053.

4. TOTAL NON-VOLATILE.
The white and yellow pigmented binders shall have not less than 70% by weight total non-volatiles when tested in accordance with Federal Standard No. 141a, Method 4041.1.

5. EXTENDERS.
The use of amorphous or crystalline silica will not be permitted.

(b) NO-TRACKING TIME.
The pigmented binders upon actual application to the pavement surface shall dry to a no-tracking condition in a minimum of 20 seconds and a maximum of 60 seconds.

Laboratory Test.
A wet film thickness of 0.015 inch ± 0.0005 inch of the pigmented binder, without glass spheres, shall dry to a no-pickup condition in not more than six (6) minutes (360 seconds) when tested in accordance with ASTM D-711 at a temperature of 77°F. ± 2°F.

Field Tests.
Under actual field conditions the pigmented binder combined with 6# ± 1# of Class 2 glass spheres per gallon of binder shall be applied to the pavement and shall dry to a no-tracking condition in a minimum of 20 seconds and a maximum of 60 seconds when tested as follows:
The material shall be applied with specialized equipment operated so as to have the pigmented binder at a temperature of between 140°F. to 170°F. at the spray orifice and adjusted so as to provide a wet film thickness of binder and bead equal to 15 mils ± 1 mil.
The no-tracking condition shall be determined by passing over the paint line placed as noted above on dry pavement when the air temperature is between 35°F. and 140°F. under all humidity conditions with a passenger car traveling @ 35 MPH. A line showing no disposition of the paint surface when viewed from a distance of 50 feet shall be considered as showing no-tracking and complying with this field drying requirement.

(c) VISCOSITY.
The consistency of the pigmented binder shall not be less than 85 nor more than 100 Krebs Units at 77°F., when tested in accordance with Method 4281 of Federal Standard No. 141a. The pigmented binder shall have good spraying characteristics when its temperature is elevated to the required working temperatures (150°F. - 170°F.) in the specialized striping equipment.

(d) FLEXIBILITY.
The paint shall show no cracking, flaking or loss of adhesion when tested in accordance with TT-P-115D, with the exception that magnification shall be used for examination.
(e) DRY OPACITY.
The pigmented binder shall have a minimum contrast ratio of 0.96 when applied at a wet film thickness of 0.005 inch and tested in accordance with Federal Test Method Standard No. 141a, Method 4121, Section 4.2, Procedure B (except the use of a suction box is to be omitted).

(f) COLOR AND DAYLIGHT REFLECTANCE.
The daylight reflectance of the pigmented binder, without glass spheres, shall not be less than 82% for the white and not less than 52% for yellow relative to magnesium oxide when tested in accordance with Federal Standard No. 141a, Method 6121.

(g) FINENESS OF GRIND.
Both the white and yellow pigmented binders shall be ground to a clean 4 when tested on a Hegman Grind Gauge in accordance with ASTM D-1210.

(h) FILM SHRINKAGE.
The cured film of pigmented binder shall not be less than 60% of the thickness of a cast film of the binder as supplied. This value shall be determined as follows: A film of the pigmented binder shall be cast with a film applicator having a clearance of 0.03 inches on a smooth glass plate. A wet film thickness shall be taken within three seconds of the completion of the drawdown. This film thickness shall be between 0.018 inch to 0.020 inch. Panels outside this range shall be rejected. The films shall be air-dried for 24 hours at 77°F. plus or minus 2°F. and a relative humidity of 52% plus or minus 2%, and then baked for three hours at a temperature of 225°F. ± 5°F. The thickness of the glass plate shall be determined with a suitable micrometer before the film is cast. A measurement shall be again taken in the same area after the film is applied and cured as described below. The dry film thickness will be the difference between these two readings. The film shrinkage value shall be the average of the dry thickness to wet thickness ratios of three panels, expressed as percentages.

(i) GLASS BEAD ADHESION.
Both white and yellow pigmented binders, with glass beads meeting the required specification, applied at the rate of 6 pounds per gallon of pigmented binder, shall require not less than 150 liters of sand for removal of the binder film. The test for bead adhesion shall be conducted in accordance with TT-P-85d, Section 4.3.6. Test for Abrasion Resistance, except that 4.3.6.2 does not apply. The glass spheres shall be applied by gravity flow. The application of the glass spheres is to be a separate operation but applied at the same time as the pigmented binder.

(j) BLEEDING.
The white and yellow pigmented binders shall have a minimum bleeding ratio of 0.97 when tested in accordance with Federal Specifications TT-P-85E. The asphalt saturated felt shall conform to Federal Specification HH-R-590.

(k) ACCELERATED WEATHERING.
The pigmented binder shall not blister, peel, crack, show excessive chalking, loss of spheres or appreciable change in color when subject to 160 hours accelerated weathering in accordance with FSS Method 6152 using an Atlas Twin Arc Weathering machine. Test samples shall have a wet film thickness of 0.014 to 0.016 inch placed on a smooth glass panel of suitable dimension and air dried for 24 hours before testing.
862.05 Specific Requirements For Acrylic Water Based Paints.

(a) COMPOSITION OF FORMULATION.

The composition of the paint shall be left to the discretion of the manufacturer as long as the finished product is composed of a 100% acrylic emulsion and meets the requirements of this specification and of any applicable Federal, State or local regulations for products of this type.

1. PERCENT PIGMENT. The percent pigment by weight shall be not less than 45% nor more than 55%.

2. TOTAL NON-VOLATILE.
The paint shall have not less than 73% total non-volatiles by weight.

3. NON-VOLATILE VEHICLE.
The non-volatile vehicle of the paint shall be not less than 48% by weight.

4. ORGANIC MATTER.
The volatile content of the paint shall contain less than 150 grams of volatile organic matter per liter of total non-volatile paint material.

5. SOLIDS.
The volume of solids shall be not less than 58%.

6. VOLUMETRIC WEIGHT.
The paint shall weigh a minimum of 12.0 pounds/gallon and the weight of the production batches shall not vary more than ± 0.2 pounds/gallon from the weight of the qualification samples.

(b) NO-TRACKING TIME.
The paint shall dry to a no-tracking condition under traffic in one minute maximum when applied at 15 ± 1 mil wet film thickness and 140-170°F. and from three to ten minutes when applied at ambient temperatures, with 6 pounds/gallon of Class 2 glass spheres.

(c) VISCOSITY.
The consistency of the paint shall be not less than 70 nor more than 90 Krebs Units at 77°F. when tested in accordance with Federal Test Method Standard No. 141b.

(d) FLEXIBILITY.
The paint shall show no cracking or flaking when tested in accordance with Federal Specification TT-P-1952b.

(e) DRY OPACITY.
The minimum contrast ratio shall be 0.97 when drawn with a 0.005 Bird applicator.

(f) DAYLIGHT REFLECTANCE.
The daylight directional reflectance of the white paint shall not be less than 85% and not less than 54% for yellow (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141b.
(g) ABRASION RESISTANCE.
No less than 210 liters of sand shall be required for removal of the paint film when tested in accordance with TT-P-1952b, Section 4.3.8.

(h) GLASS BEAD ADHESION.
The paint with Class 2 drop-on glass spheres, applied at 6 pounds/gallon shall require not less than 550 liters of sand for removal of the beaded film. The test for bead adhesion shall be conducted in accordance with the Abrasion Resistance Test above modified to require glass beads at the rate of 6 pounds/gallon to be uniformly applied by gravity flow. The application of the glass spheres is to be a separate operation, but applied at the same time as the paint.

(i) BLEEDING.
The paint shall have a minimum bleeding ratio of 0.97 when tested in accordance with Federal Specification TT-P-1952b, Section 4.3.11. The asphalt saturated felt shall conform to Federal Specification HH-R-590.

(j) SCRUB RESISTANCE.
The paint shall pass 300 cycles minimum when tested in accordance with ASTM D-2486.

(k) FREEZE-THAW STABILITY.
The paint shall show no coagulation or change in consistency greater than 5 Kreb Units, or a decrease in scrub resistance of greater than 10% when tested in accordance with TT-P-1952b, Section 4.3.11.

(l) DILUTION TEST.
The paint shall be capable of dilution with water at all levels without curdling or precipitation such that the wet paint can be readily cleaned up with water only.

(m) STORAGE STABILITY.
After 30 days storage in a three-quarters filled, closed container, the paint shall show no caking that cannot be readily remixed to a smooth, homogeneous state, no skinning, livering, curdling, or hard settling. The viscosity shall not change more than 5 Kreb Units from the viscosity of the original sample.

(n) CERTIFICATION.
The bidder shall be required to furnish a copy of a laboratory test report with certification that the material meets these specifications, including any samples that may be requested and for materials furnished under contract.
Furnishing this certification will not relieve the vendor of the responsibility to furnish paint in full compliance with this Specification. In the event the contract material does not meet these specifications, the vendor shall be required to replace all such material at his own expense, including handling and transportation charges, with material that does comply.

862.06 Containers.
All containers used to ship the pigmented binder shall be identified in accordance with ICC Regulations.
Containers shall be of at least five (5) gallons capacity, clean, sturdy, and capable of being closed tightly to prevent the entry of air and leakage. Drums of 30 to 55 gallons capacity meeting current Specification requirements of the U.S.
Department of Transportation for transporting flammable liquids may be used, however no second-hand containers shall be used. Drums shall be sealed with a re-usable multi-seal sponge gasket of a type which will prevent the entry of air and leakage. Other types of containers may be used if they meet the requirements stated above.

Each container shall show the name of material, color, tare weight, equivalent net gallons, name and address of manufacturer, and batch number. Volume measurements shall be based on 77°F. All containers shall be filled to capacity, leaving a minimum of air space above the material.

862.07 Solvents.

The producer shall furnish the name and number of the appropriate solvents, if any, for the pigmented binder, and sources thereof.

862.08 Inspection and Sampling.

(a) MANUFACTURE.
The manufacturer shall use sufficient capacity of his plant to produce a minimum average of 2400 gallons of paint per batch. The vendor for the paint shall notify the Department of his intention to manufacture the paint at least ten (10) days before the beginning of production. (May be waived by mutual agreement).

The manufacturer shall furnish information as to the source, type and trade designation of all raw material used in the paint making.

(b) SAMPLES, SAMPLING AND INSPECTION.
The producer shall submit samples upon written request by the Engineer of Public Works in accordance with the following schedule for each batch of 5,000 gallons or less.

Binder—Not less than 4 quarts.
Spheres—Not less than 1 quart of the type to be used. (Note: Sampling method must provide uniform samples, otherwise it is recommended that a full bag be provided.) All paint delivered must conform to the Specifications and any material not conforming shall be rejected and removed at once by the Contractor at his expense. Samples upon which acceptance or rejection of the material is based may be taken by a representative of the Department. All materials proposed to be used may be inspected, sampled and tested at any time and at any place during their storage, or use.

In sampling paint products at the plant, the producer shall furnish the representative of the Department free access to all parts of the plant, and furnish every reasonable facility for sampling and for sealing the containers of the paint. Samples adequate for test shall be furnished free of charge by the producer.

The representative of the City may observe the manufacture of the batches as well as the finished paint. The producer will be allowed to manufacture paint only when the authorized Department inspector is present, or when the Department waives its right. No batch of traffic paint will be considered for tests unless represented by a full set of samples as described above.

(c) CONTAINERS.
All sample containers shall be clearly and legibly identified showing the following information.

a. Name of material.
b. Specification and Section number.
c. Batch number.
d. Inspector's number (if any).
c. Project number or purchase order number if available. Pretested material held as stock for future distribution - See Section 862.08(e).

(d) STORAGE.
The following applies to paint producers, jobbers, contractors and anyone who keeps a supply or stock of pretested paints intended for street use. All materials and their components shall be amply protected from all forms of damage at all times. Storage space for all materials shall be the responsibility of the Contractor. Improper storage conditions may cause the rejection of the material stored therein.

(e) PRETESTED STOCKS OF TRAFFIC PAINT.
These shall comply with Section 861.09 and the following requirements:
1. Approval shall cover laboratory tests of the paint only. Field testing will be performed on the job site. Failure to meet field testing requirements shall be cause for rejection of the paint batch.
2. The Engineer reserves the right to cancel the approval to maintain stocks of paint if the paint fails to meet the requirement so this section.
3. All paints are subject to being re-sampled at the job site or in the warehouse. Tests made on these re-samples shall meet the requirements of these Specifications. Materials not meeting the requirements shall be rejected and removed. Excessive rejections of a batch of paint shall condemn the batch as a whole.
4. Traffic Paints that are nine (9) months old shall be retested. Material one year old must meet the requirements of these Specifications and be re-approved before its use can be continued.
5. The producer, jobber, or contractor shall be held responsible for the expiration dates of the batches of paint in this stock. Request for inspection, resampling and retesting shall be made not less than 6 weeks before the expiration date of the material.
6. In the case of unsatisfactory results, and for minor adjustments to the finished compound, the material in question shall be completed to approval or rejection in not more than 60 days after the first unsatisfactory report.
7. Calculations of all results shall be controlled by ASTM E-29 "Designating Significant Places in Specified Limiting Valves".

862.09 Thermoplastic Paint

(a) GENERAL
This Specification covers White & Yellow Thermoplastic Paint for use as a binding material for glass spheres to produce a reflective pavement marking or as a delineation stripe for crosswalks, stop bar, etc.

(b) SPECIFIC REQUIREMENTS
1. APPLICATION:
Thermoplastic paint shall be applied at a wet film thickness of 15 + Mils.

2. FORMULATION AND MANUFACTURE:
The Thermoplastic Paint shall be formulated and processed specifically for service as a delineation stripe for use of traffic carrying pavements, such as concrete, brick and bituminous.
The Thermoplastic Paint shall dry to an elastic adherent finish that will not show appreciable discoloration with age.
3. COMPOSITION:

I Pigment 35 to 40%

<table>
<thead>
<tr>
<th>Pigment</th>
<th>White</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutile Titanium Dioxide</td>
<td>40% Minimum</td>
<td>N/A</td>
</tr>
<tr>
<td>Medium Chrome Yellow</td>
<td>N/A</td>
<td>40% Minimum</td>
</tr>
<tr>
<td>Siliceous Extenders</td>
<td>20% Minimum</td>
<td>20% Minimum</td>
</tr>
<tr>
<td>Calcium Carbonate</td>
<td>37% Maximum</td>
<td>37% Maximum</td>
</tr>
<tr>
<td>Organo Montmorillonite</td>
<td>8% Minimum</td>
<td>3% Minimum</td>
</tr>
</tbody>
</table>

II Vehicle 60 to 65%

<table>
<thead>
<tr>
<th>Component</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermoplastic Copolymer Solids</td>
<td>37%</td>
<td>37%</td>
</tr>
<tr>
<td>Plasticizer</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Aromatic Hydrocarbons</td>
<td>50%</td>
<td>60%</td>
</tr>
</tbody>
</table>

4. WEIGHT PER GALLON:

The Thermoplastic Paint shall weigh between 10.60 and 11.00 pounds per gallon at 25 C. The above shall be determined in accordance with Method 4184.1 of Federal Test Method Standard No. 141a.

5. VISCOSITY:

The consistency of the thermoplastic paint shall be not less than 75 nor more than 80 Krebs Units at 25 C, when tested in accordance with Method 4281 Standard No. 141A.

6. DRYING TIME:

The Thermoplastic Paint shall dry to no pick-up in 10 minutes or less when tested in accordance with ASTM D-711-67.

7. HIDING POWER:

The Thermoplastic Paint when applied at the rate of 5 mils wet film thickness, using a suitable doctor blade (Bird Film Applicator or equivalent) shall complete hiding over Morest Black and White Hiding Power Chart 03-B or equivalent. If there should be an occasion where there is a question of complete hiding the reflectance of the black and white areas are determined according to Federal Test Method Standard No. 141a, Method 6121. The reflectance value obtained on the black portion of the chart. A minimum contract ratio of 0.98 shall represent complete hiding.

8. FLEXIBILITY:

Apply a wet film thickness of five mils with a Bird Film Applicator or equivalent to 3" x 6" panel, previously cleaned with toluol and lightly buffed with steel wool. The panels used in the above shall meet the requirements for panels described in Federal Test Method Standard 141a, Method 2012.1 for flexibility tests. The prepared panels shall be dried in a horizontal position for eighteen (18) hours.
and shall then be baked for five (5) hours at 105 C to 100 C. and bent over a one-half inch mandrel.

9. WATER RESISTANCE:

The Thermoplastic Paint shall be applied to glass panels which have been previously cleaned with toluol. A fifteen mil wet film shall be applied using a Bird Film Applicator, or a similar blade to apply the pigmented binder to glass panels. Application shall be started within approximately one inch from the top of the panel. The coated glass panels shall be allowed to air dry at room temperature (20 to 30 C.) for ninety (90) hours. The panel shall then be immersed top down, where application was started as indicated above, to a depth of four (4) inches in distilled water. After eighteen (18) hours, remove panels and allow to dry for two (20 hours and examine.

The immersed film shall show adhesion to the glass panel and shall show no wrinkling, blistering, or other forms of deterioration.

10. BLEEDING RATIO:

A fifteen mil wet film thickness shall be applied to an asphalt saturated felt test panel. One-half of the asphalt test panel shall be covered with a clean transparent tape. The reflectance shall be determined on each half of the panel according to Federal Test Method Standard 141a, Method 6121. The Bleeding ratio is calculated by dividing the reflectance value obtained on the unmasked half of the panel by the reflectance obtained on the masked half of the asphalt saturated panel. A value of plus 0.92 is acceptable.

11. DIRECTIONAL REFLECTANCE:

The daylight reflectance of the white thermoplastic paint (without glass) shall not be less that 84% relative to magnesium oxide when tested in accordance with Federal Test Method Standard 141a, Method 6121 for white binders. Yellow Thermoplastic Paint shall be an approximate visual match of Federal Test Method Standard No 595, Color No. 33538 By Federal Test Method Standard 141a, Method 425.

12. LABORATORY EQUIPMENT:

The Contractor shall have available for testing purposes laboratory equipment required to perform all the foregoing tests, and shall furnish certification to the purchaser that the furnished material meets or exceeds all tests and specifications.
863.01 Seed.

(a) PURE SEEDLINGS.

1. All seed used shall meet the requirements of these Specifications and comply with the Alabama Seed Law, Act No. 424, General Acts, 1963, Vol. 2 Page 931, and rules and regulations promulgated thereunder, and any revisions of the Act. They shall be tested within nine (9) months prior to use, in accordance with "Rules for Seed Testing" approved by the Association of Official Seed Analysts in July, 1960, and as subsequently amended. Each kind of seed for use either pure, or as a part of mixed seedings, shall be separately packed and delivered to the project in standard seed-tight shipping bags, all prominently identified. Each bag shall bear a tag or label certifying to contents, tests and analysis. A seed deficient in purity or germination will be accepted for use, provided the impure and imperfect fraction consists substantially of seeds of plants that can be tolerated consistently along the roadside and provided the Contractor elects to cover the deficiency in either purity or germination by a proportionate increase in the rate of sowing. Seed furnished shall be hulled and scarified where indicated by the letter symbols "H" and "S", respectively. All seeds of legumes, as indicated by letter symbol "N" shall be inoculated just before use, with the appropriate commercial culture manufactured by a reputable concern. Such material shall be used according to the manufacturer's instructions. The following tables specify the quantity by weight of the different seeds required when sown alone or in mixtures, their purity, germination and the months of opening and closing their sowing seasons.
2. TABLE OF PURE SEEDINGS, GRASSES

<table>
<thead>
<tr>
<th>Common and Scientific (International) Names</th>
<th>Seed Req'd. Lbs. per Acre</th>
<th>Min. Purity %</th>
<th>Min. % Germ.</th>
<th>Opening and Closing Months of Sowing Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abruzzi Rye (Secale-cereale)</td>
<td>70</td>
<td>98</td>
<td>80</td>
<td>August-November</td>
</tr>
<tr>
<td>Dallasgrass (Paspalum dilatatum)</td>
<td>30</td>
<td>60</td>
<td>60</td>
<td>March-May</td>
</tr>
<tr>
<td>Bermudagrass (Cynodon dactylon)</td>
<td>30 Unhulled</td>
<td>98</td>
<td>80</td>
<td>March-June</td>
</tr>
<tr>
<td>Bermudagrass (Cynodon dactylon)</td>
<td>20 (HS)</td>
<td>98</td>
<td>85</td>
<td>April-July</td>
</tr>
<tr>
<td>Pensacola Bahiagrass (Paspalum notatum Var Pensacola)</td>
<td>40</td>
<td>90</td>
<td>85</td>
<td>April-July</td>
</tr>
<tr>
<td>Kentucky 31 Fescue (Festuca elatior Var Arundinacea)</td>
<td>30</td>
<td>98</td>
<td>85</td>
<td>February-May September-November</td>
</tr>
<tr>
<td>Alta Fescue (Festuca elatior Var Arundinacea)</td>
<td>30</td>
<td>98</td>
<td>85</td>
<td>February-May September-November</td>
</tr>
<tr>
<td>Kentucky Blue Grass (Poa pratensis)</td>
<td>40</td>
<td>85</td>
<td>75</td>
<td>September-April</td>
</tr>
<tr>
<td>Sudan Grass (Sorghum vulgare var Sudanense)</td>
<td>50</td>
<td>98</td>
<td>85</td>
<td>July-August</td>
</tr>
<tr>
<td>Lovegrass (Weeping) (Eragrostis curvula)</td>
<td>5</td>
<td>97</td>
<td>80</td>
<td>March-November</td>
</tr>
<tr>
<td>Brown Top Millet (Panicum fasciculatum va nosum)</td>
<td>30</td>
<td>97</td>
<td>80</td>
<td>May-August</td>
</tr>
<tr>
<td>Centinede (Eremochola Ophiuroides)</td>
<td>10</td>
<td>98</td>
<td>80</td>
<td>March-April</td>
</tr>
</tbody>
</table>

NOTE: Pure seedings dates will not in all cases agree with mixed seedings dates.

**Method for Correcting Seed Deficient in Purity or Germination.**

Multiply the % Minimum Purity times the % Minimum Germinable. This should be done for the minimum percentages shown in the Specifications and that shown on the seed analysis tag. The answer obtained will be the percent of pure live seed. When the pure live seed figure calculated from the percentages shown on the seed analysis tag is less than the pure live seed obtained from the Specifications, a proportionate increase should be made in the seed required.
### 3. TABLE OF PURE SEEDINGS, LEGUMES

<table>
<thead>
<tr>
<th>Common and Scientific Names</th>
<th>Seed Req'd.</th>
<th>Min. Purity</th>
<th>Min. Germ.</th>
<th>Opening and Closing Months of Sowing Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lbs. per Acre</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Sericea Lespedeza (Lespedeza cuneata ** or Variety Serala, Sericea or Interstate)</td>
<td>50 HS</td>
<td>98</td>
<td>85</td>
<td>March-June (Slopes)</td>
</tr>
<tr>
<td>Annual Lespedeza (Lesp. striata Var Kobe)</td>
<td>60 HN</td>
<td>95</td>
<td>80</td>
<td>March-June</td>
</tr>
<tr>
<td>Caley Pea (Rough Pea) (Lathyrus Hirsutus)</td>
<td>70 HN</td>
<td>98</td>
<td>85</td>
<td>August-March</td>
</tr>
<tr>
<td>White Sweet Clover (Melilotus alba)</td>
<td>30 HSN</td>
<td>95</td>
<td>80</td>
<td>March-May (Slopes)</td>
</tr>
<tr>
<td>Yellow Sweet Clover (Melilotus Officinalis)</td>
<td>30 HSN</td>
<td>95</td>
<td>80</td>
<td>March-May (Slopes)</td>
</tr>
<tr>
<td>Showy Partridge Pea (Chamaecrista Fasciculata)</td>
<td>40 HSN</td>
<td>90</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Reseeding *Crimson Clover (Trifolium Incarnatum)</td>
<td>30 HN</td>
<td>99</td>
<td>85</td>
<td>August-November</td>
</tr>
<tr>
<td>White Clover (La. Strain) (Trifolium repens)</td>
<td>10 HN</td>
<td>98</td>
<td>85</td>
<td>August-March</td>
</tr>
<tr>
<td>Ladino Clover (Adapted) (Trifolium repens)</td>
<td>5 HN</td>
<td>98</td>
<td>85</td>
<td>September-November</td>
</tr>
<tr>
<td>** Regal Ladino Strain</td>
<td>6 HN</td>
<td>98</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Hairy Vetch (N) (Vicia villosa)</td>
<td>50 HSN</td>
<td>95</td>
<td>80</td>
<td>September-November (Slopes)</td>
</tr>
<tr>
<td>Crown Vetch (Coronilla varia (Certified) (VarEmerald,Cheung, or Penngrift)</td>
<td>15 HSN</td>
<td>95</td>
<td>80</td>
<td>Any Month</td>
</tr>
<tr>
<td>Bicolor Lespedeza (Lespedeza bicolor)</td>
<td>15 HSN</td>
<td>95</td>
<td>80</td>
<td>March-April</td>
</tr>
</tbody>
</table>

* Certified or Affidavit Grown  
**When Specified  

**NOTE:** Where calcareous soils exist White Dutch Clover La Strain or Regal Ladino Strain shall be used in lieu of Crimson Clover. Soil tests taken prior to planting will indicate when these substitutions are necessary.

SEE METHOD OF CORRECTING SEED DEFICIENCIES, "PURE SEEDING GRASSES" TABLE.
(b) MIXED SEEDINGS.
Each of the kinds of seeds specified for use by it common name in the mixed
seedings designated below shall be of the same quality as provided for seed of that
kind in the tabulation for pure seedings.

<table>
<thead>
<tr>
<th>Seeding Mixture</th>
<th>Backslopes and Frontslopes Steeper than 3:1</th>
</tr>
</thead>
</table>
| April thru June - Mix 1B | Bermudagrass (Hulled) 20 lbs. per acre
|                     | Kentucky 31 or Alta Fescue 50 lbs. per acre
|                     | Sericea Lespedeza 30 lbs. per acre |
| July and August - Mix 2B | Bermudagrass (Hulled) 25 lbs. per acre
|                             | Pensacola Bahiagrass 30 lbs. per acre
|                             | Sericea Lespedeza 35 lbs. per acre |
| September thru March - Mix 3B | Kentucky 31 or Alta Fescue 55 lbs. per acre
|                                     | Sericea Lespedeza 35 lbs. per acre
|                                     | Reseeding Crimson Clover 30 lbs. per acre |

<table>
<thead>
<tr>
<th>Medians and Slopse Flatter than 3:1</th>
</tr>
</thead>
</table>
| April thru June - Mix 4B | Bermudagrass (Hulled) 20 lbs. per acre
|                        | Kentucky 31 or Alta Fescue 50 lbs. per acre
|                        | Kobe Lespedeza 30 lbs. per acre |
| July and August - Mix 5B | Bermudagrass (Hulled) 25 lbs. per acre
|                        | Pensacola Bahiagrass 30 lbs. per acre
|                        | Reseeding Crimson Clover 35 lbs. per acre |
September thru March - Mix 6B

Kentucky 31 or Alta Fescue
Reseeding Crimson Clover
Bermudagrass (Unhulled)
Annual Ryegrass

55 lbs. per acre
30 lbs. per acre
30 lbs. per acre
25 lbs. per acre

Special Crown Vetch Mixes
To be used on Rocky Backslopes Steeper than 3:1.

April thru June - Mix B

Weeping Lovegrass
Pensacola Bahiagrass
Kentucky 31 Fescue
Crown Vetch Corinilla Varia*

5 lbs. per acre
30 lbs. per acre
50 lbs. per acre
8 lbs. per acre

July thru August - Mix 8B

Weeping Lovegrass
Pensacola Bahiagrass
Annual Lespedeza (Kobe)
Reseeding Crimson Clover
Crown Vetch Corinilla Varia*

5 lbs. per acre
20 lbs. per acre
20 lbs. per acre
20 lbs. per acre
8 lbs. per acre

September thru March - Mix 9B

Weeping Lovegrass
Reseeding Crimson Clover
Kentucky 31 Fescue
Pensacola Bahiagrass
Crown Vetch Corinilla Varia*

5 lbs. per acre
30 lbs. per acre
50 lbs. per acre
20 lbs. per acre
8 lbs. per acre

*Variety - Emerald or Chemung.

Special Urban Seed Mixes
Median and Areas Adjacent to the Roadway in Urban Area.

45 lbs. per acre

Special Urban Mix
March thru July
Bermudagrass (Hulled)
Kobe Lespedeza

20 lbs. per acre
45 lbs. per acre
August thru February

Bermudagrass (Unhulled) 30 lbs. per acre
White Clover 15 lbs. per acre
Kentucky Blue Grass 30 lbs. per acre

WARNING! Treatment of young grasses with herbicides may kill even the most tolerant varieties. It is recommended that maintenance herbicide programs not be initiated until 18 months (minimum) from time of planting. This will allow time for the grasses to establish good root growth and become tough.

863.02 Grass Sprigs.

(a) GENERAL.
This Section is based on the use of sprigs; however, should the Contractor elect to use plugs of sod, the same basic requirements are applicable except that harvesting shall be in accordance with the provisions of Section 863.05 for solid sod, which in turn shall be cut to proper size (at least 2 inches by 2 inches) by an acceptable procedure before use.

Grass sprigs or plugs of sod turfs shall be common or Tiflawn Bermudagrass, Centipede, Myers Zoysia, Zoysia Matrella, or other perennial running grasses that may be indicated by the plans. All grass shall be native or adaptable to the locality of the work and shall be live, fresh, vigorous, and uninjured at the time of planting and until completion and acceptance of the work. The sprigs shall have well formed and developed root systems and shall be in clusters or tufts at least one inch in diameter unless otherwise directed. Sprigs containing Johnsongrass, Bahiagrass, Dallasgrass or other objectionable grasses or weeds will not be accepted.

(b) PROCURING AND HANDLING SPRIGS.
Unless the grass area has been grazed closely, it shall be mowed to height of three (3) inches maximum before harvesting. The sprigs shall be harvested with a sod-cutter, turning plow, or other approved implements in such a manner that at least two (2) inches of the root system will be lifted intact. Raking and otherwise harvesting sprigs that remain on the surface after digging and have been allowed to dry out, will not be permitted. Solid sod specified in Section 863.05 may be pulled apart and used as sprigs.

The properly harvested sprigs shall be loaded within one hour after they are dug then transported to the place where they are to be planted. They shall be kept cool, moist and shaded at all times after digging, while being transported to the sprigging site, after being unloaded, and until planted. Small quantities of sprigs left over at the end of the work day or at time of heavy rains may be stacked in thin covered piles and may be used the next day or not over three (3) days later, provided sprigs in the pile are still acceptable.

When large pieces of sprigs are to be broken down into smaller pieces for sprigging, this operation shall be done by hand or by such other means that will avoid severing the roots from the tops of the sprigs. After unloading, accepted sprigs shall be carried to the planting site in moist cloth or burlap bags and kept therein until ready to be dropped into the furrows.
863.03 Mulching Material.

(a) GENERAL.
Mulch shall be any of the following materials. Mulch material which contains matured seed of species which would volunteer and be detrimental to the proposed planting or to adjacent farm land will not be acceptable. Mulching materials will be broken into two basic classes suitable for use as follows:
Class A. For use with regular erosion control items that produce grasses such as seeding, sprigging, etc.
Class B. For use with shrubs, vines, trees, or other plants.

(b) CLASS A. MULCH.
1. GENERAL.
Class A mulch will, in general, require the use of some type of adhesive, a krimper or erosion control netting to hold the mulch in place.

2. HAY.
Hay shall be applied at the rate of not less than two (2) tons per acre, and may be native hay or Sudan grass, broom straw, coastal bermudagrass or any other material compatible with the planted species. Low grade, musty, spoiled, partially rotted hay unfit for animal consumption is acceptable. Hay or straw shall be applied with a moisture content not more than 15 percent or if the moisture content exceeds 15 percent, a proportionate increase shall be made in the rate of application.

3. STRAW.
Straw shall be threshed straw of oats, wheat, or rye, applied at the rate of not less than 1-3/4 tons per acre with a moisture content of not more than 15 percent, or if the moisture content exceeds 15 percent, proportionate increase shall be made in the rate of application.

4. EXCELSIOR (WOOD).
This shall be manufactured from freshly cut wood stock, coarse grade, six (6) inches to ten (10) inches long and 1/16 to 1/8 inch wide applied at the rate of not less than two (2) tons per acre with a moisture content of not more than 35 percent, or if the moisture content exceeds 35 percent, a proportionate increase shall be made in rate of application.

5. WOOD CELLULOSE FIBER OR NATURAL WOOD FIBER.
A mulch for use with the hydraulic application of grass seed shall consist of specially prepared wood cellulose or a natural wood fiber containing clean whole cut chips. It shall be processed in such a manner that it will contain no growth or germination inhibiting factors and shall be dyed an appropriate color to facilitate a uniform spread of the slope by visual inspection. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with fertilizers, grass seeds, water, and other additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry- and that when hydraulically sprayed on the ground, the material will form a blotterlike ground cover impregnated uniformly with grass seed; and which after application will allow the absorption of moisture and allow rainfall or mechanical watering to percolate to the underlying soil. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished, and that it meets all the foregoing requirements based upon such testing.

The mulch material described above shall be supplied in packages having a gross weight not in excess of 100 pounds. Weight specifications of this material from suppliers, and for all applications, shall refer only to air dry weight of the fiber.
material. Absolute air dry weight is based on the normal weight standard of the
Technical Association of the Pulp and Paper Industry for wood cellulose and natural
wood fiber is considered equivalent to $12 \pm 3$ percent moisture. Each package of the
fiber shall be marked by the manufacturer to show the air dry weight content. The
fiber shall be applied at the rate of at least 2000 pounds per acre with a moisture
content not over $12 \pm 3$ percent, or if the moisture content exceeds $12 \pm 3$ percent, a
proportionate increase shall be made in the rate of application.

6. MOISTURE CONTENT.
Should the Engineer denote excessive moisture in the mulching material,
he may order the moisture content checked in accordance with the following, with
excessive moisture being cause for rejection of material.

Hay Or Straw.
Run sample at $100^\circ$C. to $110^\circ$C. until constant weight is obtained, using
the following formula, compute the moisture content:

\[
\text{Moisture content} = \frac{(A-C)/(A-B)}{100} 
\]
A = Sample and pan weight
B = Tare weight pan
C = Dry weight, sample and pan
A-B = Sample weight
A-C = Moisture loss

Excelsior.
ASTM D-1348 Federal Specifications on Excelsior PPP-E91 1C.

Wood Cellulose Fiber Or Natural Wood Fiber.
See paragraph 2 of Item 863.03(b)5.

7. ADHESIVE OR EROSION CONTROL NETTING FOR USE WITH MULCH.
a. General.
Straw or hay, not requiring the krimper operation, will require the use
of either the asphalt adhesive or the erosion control netting noted hereinafter in
this Section. Excelsior (wood) or wood fiber does not normally require the use of a
krimper, an adhesive or netting.
b. Asphalt Adhesive.
Asphalt used in the mulching operations shall be suitable for mulching
and shall contain no petroleum solvents or other diluents toxic to plant growth. It
shall be a homogeneous emulsification of refined asphalt of the SS-1, SS-lh, or RS-2
Type as provided in the Emulsified Asphalt Tables of Section 807 and suitable for
spray application with or without dilution by additional water applied at a rate of not
less than 150 gallons per acre of undiluted emulsified asphalt. In addition to the
emulsified asphalts noted above, Type SS-2 meeting the following requirements may
be used as an asphalt adhesive.
**TEST**

1. Residue by Distillation (%) (AASHTO T-59)
2. Viscosity, Saybolt Furol @ 77°F., Sec. (AASHTO T-59)
3. Settlement, 5 days, % by Wt. (AASHTO T-59)
4. Sieve Test, % (AASHTO T-59)
5. Penetration @ 77°F., 100 gms. 5 Sec. (AASHTO T-49)
6. Solubility in Trichloroethylene, % (AASHTO T-44)
7. Ductility @ 77°F., cm (AASHTO T-51)

<table>
<thead>
<tr>
<th>REQUIREMENTS</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Residue by Distillation (%) (AASHTO T-59)</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>2. Viscosity, Saybolt Furol @ 77°F., Sec. (AASHTO T-59)</td>
<td>40</td>
<td>400</td>
</tr>
<tr>
<td>3. Settlement, 5 days, % by Wt. (AASHTO T-59)</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>4. Sieve Test, % (AASHTO T-59)</td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>5. Penetration @ 77°F., 100 gms. 5 Sec. (AASHTO T-49)</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>6. Solubility in Trichloroethylene, % (AASHTO T-44)</td>
<td></td>
<td>97</td>
</tr>
<tr>
<td>7. Ductility @ 77°F., cm (AASHTO T-51)</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

On areas where erosion is likely, the quantity of asphalt adhesive may be increased.

c. Erosion Control Netting.
Erosion control netting shall be of the Class A Type complying with the requirements of Section 661.

8. GLASS FIBER WITH ASPHALT ADHESIVE.

Glass fiber material used for mulching shall consist of continuous fibers drawn from molten glass, coated with a chrome-complex sizing compound collected into strands and lightly bound together with the use of clay, starch or like deleterious substances. The glass fibers shall be formed or wound into a cylindrical package in such a manner that the glass fibers can be continuously fed through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

The glass fibers shall conform to the following specific requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Limits</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber Diameter</td>
<td>0.00035 to 0.00053 in.</td>
<td>ASTM D-578</td>
</tr>
<tr>
<td>Yds./lbs. of fibers</td>
<td>170 - 300</td>
<td>ASTM D-578</td>
</tr>
<tr>
<td>Organic content</td>
<td>1.65% Max.</td>
<td>ASTM D-578</td>
</tr>
<tr>
<td>Pkg. weight</td>
<td>30 - 45 lbs.</td>
<td>ASTM D-578</td>
</tr>
</tbody>
</table>

The glass fibers shall be spread on the area at the approximate rate of 0.25 to 0.35 pound per square yard. An asphalt adhesive meeting the requirements noted in Subsection 863.03(b)7b shall be applied at the rate of approximately 0.15 to 0.20 gallons per square yard.
(c) CLASS B MULCH.
1. GENERAL.
Class B mulch, in general, is suitable only for use with vines, shrubs and other types of planting.
2. FOREST LITTER.
Forest litter shall be the surface layer of semi-decayed leaves, twigs, needles, and small branches from local woods, and shall be removed in such a way as to avoid injury to the existing trees.
3. HULLS.
Hulls may be the hulls of cotton seed, cotton bolls, peanuts, or ground corn cobs.
4. MANURE.
Manure shall be partially decomposed stable manure. It shall contain no more than 25% shavings, sawdust, and be free from noxious weeds and harmful chemicals, and at least three (3) months old.
5. SPHAGNUM MOSS PEAT.
Peat under this requirement shall be partially decomposed material and shall contain not more than 25% ash by dry weight and meet the requirements of Section 4.11 of ASTM D-2607.
6. SAWDUST.
Sawdust shall be in a decomposition stage.
7. PINE BARK, REDWOOD OR OTHER APPROVED WOODBARK MULCH.
Pine bark, Redwood or other approved wood bark mulch for use as a mulching material or as an organic additive for prepared plant topsoil when specified on the plans or proposal. All bark materials shall be clean and free of noxious weed seed, harmful material and basically without decomposition.
Materials shall be graded as follows:
- Bark Fines (passes through 1/4" screen)
- Bark Flakes (retained on 1/4" screen)
- Chunks (retained on 3/4" screen) maximum chunk 2"
- Cambium and Bark (shredded combination Bark and Cambium)

863.04 Blank

863.05 Solid Sod.
(a) GENERAL.
Solid sod shall be obtained from sources of the Contractor's selection. The Contractor shall furnish such material and construct and maintain hauling roads necessary for obtaining the material.
The sod shall be of common Tiflawn Bermudagrass, Fescue, Centipede, Myers Zoysia, Zoysia Matrella, or other types of native or adaptable grasses, suitable for growing in the locality of the work.

(b) PROCURING AND HANDLING SOD.
1. GENERAL.
All sod shall be procured from areas where the soil is fertile and contains a high percentage of loamy topsoil and where the grass is well rooted and full grown and from areas that have been grazed or mowed sufficiently to form a dense turf. (Approximately two (2) inches in height at the time of lifting). The soil shall be free from obnoxious weeds or other grasses and shall not contain any matter deleterious to its growth. The sod shall be live, fresh growing grass at the time of harvesting as well as at the time of placement.

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2. HARVESTING.

Mechanical devices, such as sod cutters, may be used for cutting the sod into strips, blocks or rolls at least twelve (12) inches wide, except when sod strips are specified, then they shall be at least three (3) inches wide. Depth of sod cutting shall be such that approximately 3/4 inch of soil is removed with the turf. Care shall be exercised at all times to retain the native soil on the roots of the sod during the process of excavating, hauling and planting.

3. HANDLING.

Sections of sod shall be cut away below the root line and shall be lifted and loaded in such a manner that no tearing or breaking will occur, and unloaded by hand or approved mechanical method. Dumping from vehicles will not be permitted. All broken or dried sod shall be rejected and removed from the job.

4. CONTROL.

The sod shall, in general, be transplanted within three (3) days from the time it is harvested. However, if held in temporary storage, the sod shall be spread in a shady location with the grass side up. The sod shall be sprinkled with water often enough to prevent sod from drying out and to keep sod green. If condition are present which will dry out the sod, it shall be covered with moist burlap, or straw. Any sod permitted by the Contractor to dry out may be rejected whenever its survival, after placing, shall have been rendered doubtful.

In no event shall more than 10 days elapse between the cutting and planting of the sod.

863.06 Vines, Shrubs And Trees.

(a) GENERAL.

1. The scientific and common names of plants shall be in conformity with the approved names in "Standardized Plant Names" (current edition) prepared by the American Joint Committee on Horticultural Nomenclature.

2. Plants shall be in accordance with the American Standards for Nursery Stock (current edition), except as provided on the plans. All plants shall have normal habit of growth and shall be typically characteristic of the particular variety and species. All plants shall conform to the measurements provided which are the minimum acceptable sizes. They shall be measured before pruning with branches in normal position. When a minimum and maximum size is provided, an average size is required. Deciduous trees shall be measured by approved calipers. Plants which have been cut back from larger grades to meet these Specifications will not be acceptable.

Plants shall be nursery grown and shall bear evidence of proper top and root pruning. No old storage plants will be accepted. Plants shall have been growing for a period of at least one year under the same climate conditions as exist at the location to be planted. Where the Specifications or plans permit planting stock which has been collected, such stock shall be clean, sound stock free from decayed or decaying stumps and from fire injury.

3. The Contractor shall be responsible for all certificates of inspection of plant materials that may be required by Federal, State or other authority to accompany shipments of plants. Plants may be inspected where growing, but approval at place of growth shall not preclude the right of subsequent rejection of plants not fully meeting the requirements of the Specifications. The removal and replacement of rejected plants shall be effected by the Contractor in compliance with the Specifications.

4. Plants and plant qualities other than those named in the Specifications will be accepted only and meeting the landscape requirements shown on the plans.

5. Legible labels shall be attached to all separate plants or boxes, bundles,
bales or other containers, indicating the name, size, age or other necessary detailed information and the quantity contained in the individual bundles, boxes or bales.

(b) PLANTING LIMITATIONS.

Normal planting season for vines, shrubs and trees is between December 1 and February 15 and the Contractor shall make every effort to accomplish the planting during this period. Under conditions that require or if the Contractor elects to place the plants out of the normal planting season, all plants shall be container grown or pre-cured and planted in accordance with the following:

**Container Grown:**

Container grown plants shall have been grown in its container for a minimum of eight (8) months. After plants are moved to their permanent location, they shall be watered in as specified, mulched, etc. Syringing down of the leaf areas shall be performed as necessary to prevent wilting, dehydration and excessive shedding of new or old growth. This will require a period of thirty (30) days or longer to assure that a given plant has been successfully transplanted.

**Pre-Cured.**

Pre-curing of plants is a technique that allows the planting of balled in burlap plant materials during period other than in the dormant period of planting season specified. The following procedure shall generally be followed to precure or hardening off a plant.

1. Specified plants shall be dug and placed unpruned in a lath or greenhouse.
2. The ball shall be covered with well rotted sawdust.
3. Humidity shall be maintained to such a degree that wilting or dehydration does not occur.
4. Spray nozzles shall be of mist type, connected to suitable interrupter devices if necessary, so that water logging of the plant balls does not occur.
5. After root hairs have formed, as evidenced by their emergence through the burlap, and with new and old top growth in a health, turgid condition, the plants shall be transplanted to their permanent location.
6. This pre-curing period shall be a minimum of thirty (30) days.
7. Leaf drop or defoliation shall be limited to one-fourth the total leaves.
8. After plants are moved to their permanent location, they shall be watered, mulched, etc. Syringing down of the leaf areas shall be performed as necessary to prevent wilting, dehydration and excessive shedding of new or old growth. This will require a period of thirty (30) days or longer to assure that a given plant has been successfully transplanted.

Any plantings accomplished outside of the normal planting season shall be inspected regularly and any plant found defective shall be removed and immediately replaced with the same size and kind in the same manner as originally provided.

Planting will not be permitted during periods when the ground is frozen.

(c) DIGGING AND TRANSPORTATION.

1. All plants shall be dug with reasonable care and skill immediately before shipping, avoiding all possible injury to, or loss of roots. Plants shall be of the size, and with balls or roots spread, as shown on the plans. After plants are dug, their roots shall not be permitted to dry out, and they shall not be exposed to artificial heat or freezing temperatures.
2. During transportation, all plants shall be packed or protected in such a manner as to insure adequate protection from sun, wind and climatic or seasonal injuries. All bare-root plants shall have their roots carefully protected by wet straw, moss, or other suitable material. Tarpaulins or other covers shall be placed over
plants when transported by truck or in an open freight car. Shipments made in box cars shall be adequately ventilated to prevent sweating. The head of each tree shall be tied in carefully to prevent fracturing or cracking the branches.

3. Previous to shipment and after delivery to the project, all plants shall be properly protected. Bare-root plants shall be heeled-in in trenches with the bundles opened and the plants spaced separately and all roots covered. Balled and burlapped, and balled and platformed plants, shall have their earth balls protected by earth or wet cloth or straw. Where possible all plants shall be stored in a well-ventilated and shaded place and protected from wind and sun.

(d) TREES.

1. Trees shall be of the size and kind designated by the plans, have a straight trunk with a well-branched, symmetrical top and with leader intact. Trees shall have no fresh cuts of limbs over 3/4 inch which have not completely calloused over, no cut back trees and no abrasions of the bark. Trees must be free from insect and disease injury. Trees injured in transit or delivered in an unsatisfactory manner will be rejected. Trees must have good fibrous root systems. All root cuts must be cleanly cut.

2. At the time of digging, bare-root trees (B.R.) must be puddled in a clay solution of proper consistency to coat and adhere to all parts of the root system. Any tree may be supplied balled and burlapped instead of bare-root at the unit price bid.

3. Balled and burlapped trees (B & B) shall be adequately balled with firm, natural balls of sufficient size to insure the growth of the plants or cut to size shown on the plans. Balls shall be firmly wrapped with burlap and firmly tied with rope or other satisfactory material. No balled plant will be acceptable if cracked or broken before or during the process of planting, and no plant will be acceptable which is handled by the plant itself and not by the ball. All fibrous and pliable roots encountered in trenching around the ball shall be cut off flush with the outer side of the trench, the ground in the trench loosened with spading fork, and the flexible roots are to be immediately wrapped in burlap, moss or straw and bound against the side of the ball. Only stiff roots may be cut off flush with the ball. The ball of earth for each tree shall be of sufficient depth to include all lateral roots.

4. Balled and platformed trees (B & P) shall be balled as provided for balled and burlapped trees. Platforms shall be square or octagonal shaped in a size slightly larger than the diameter of the bottom of the soil mass, inserted under each ball and securely lashed to the ball by means of ties from the platform corners to the rope collar on top of the ball.

(e) SHRUBS.

Shrubs shall be of the size and kind designated. Bare-root shrubs shall have good fibrous root systems. Balled and burlapped shrubs shall be vigorous, well furnished plants of uniform quality and must have fibrous root systems. Plants provided as sods or clumps shall be collected from good soil which has produced a fibrous root system typical of the nature of the plant. The sods shall be dug with earth and incidental vegetation adhering to the roots. If the soil or habit of the root growth is such that the roots are not adequately protected, the sods shall be wrapped in burlap or other suitable material.

(f) VINES AND PERENNIALS.

Vines and perennials shall be of the size and kind designated by the plans. Bare-root vines shall be vigorous, well furnished plants with good vigorous root systems, puddled before delivery or otherwise protected by an acceptable method. Pot-grown plants (P.G.) shall be vigorous well-developed plants, well established in pots with sufficient roots to hold the earth together intact after removal from containers and at the same time not to be root-bound. The Contractor may furnish
and plant potted plants of the kinds of vines designated as bare-root provided the
potted plants are at least one year old, the pots 2-1/2 inch minimum diameter, and 2
plants for the one ordered are furnished and planted in the same pocket holes or
beds. Balled and burlapped vines shall be vigorous, well-developed plants. Perennials
shall be field grown.

(g) PINE SEEDLINGS.
Pine seedlings shall be Loblolly Pine unless otherwise shown on the plans.
Seedlings shall be approximately one year old and 6 to 12 inches high, except that
any longleaf seedlings are to be root pruned and needle clipped.
Pine seedlings that are shipped in bales shall be protected from the sun,
wind, and freezing weather at all times before planting. The bales shall be stacked
loosely to permit free circulation of air and not more than two (2) bales high. They
shall be watered on arrival and every two (2) days thereafter, or more frequently if
required to keep the plants alive. Seedlings from damaged or broken bales shall be
"heeled in" by cutting V-bottom trenches approximately six (6) inches deep,
spreading the pines along the trench with the roots down. Roots shall be covered
with fine soil, leaving the tops exposed. Seedlings shall be watered frequently
enough to keep the soil moist.

863.07 Seed Inoculating Material.
Inoculating materials for coating certain legume seed immediately before
sowing shall be a commercial culture manufactured by a reputable concern and of
the culture group appropriate for the kind of seed to be treated. The material as
received on the work shall be fresh stock designated for the current season,
packaged and sealed to protect bacteria and insure against moisture loss.

863.08 Plant Topsoil (Topsoil For Backfilling Plant Pits).
Plant topsoil shall be composed of four (4) parts of soil containing not more
than 35% clay and not less than 15% nor more than 75% sand, one part mulching
material (as defined in Subsection 863.03(c), eight (8) pounds of 8-8-8 Commercial
Fertilizer, and five (5) pounds of agriculture limestone per cubic yard (mineral
additive may be adjusted to fit soil test results).

863.09 Tree Root Protection Material
The material for root protection shall be an aggregate suitably graded from
3/8 to 5 inches in size. The material may be any suitable aggregate broken to suitable
size, or may be gravel, crushed stone, slag or broken concrete.

863.10 Miscellaneous Materials For General Planting Operations.
(a) BRACING AND ANCHOR STAKES.
Bracing stakes shall be of southern yellow pine sized in accordance with
plan requirements. Stakes shall have a minimum allowable deflection of ten percent.
All stakes shall be free from insects and fungi. Anchor stakes or deadmen shall be of
the quality and sizes required for the operations calling for their use.
(b) WIRE AND BRACING MATERIALS.
Wire shall be galvanized steel or aluminum, No. 9, No. 10, or No. 12, A.S. & W.
gauge. The size and quality of cables, turnbuckles, thimbles, lag hooks, eye bolts,
rods, washers and nuts shall be as required to assure adequate bracing.
(c) PAPER AND TWINE.
Wrapping paper for trees shall be krinkle-kraft or equal, waterproof paper, 30-30-30, in four (4) inch strips. The tying material to be used in wrapping trees shall be Jute twine not less than two (2) ply for trees three (3) inches or less in diameter, and three (3) ply for trees over three (3) inches in diameter.

(d) TREE PAINT.
Paint used for tree wounds shall be approved antiseptic, waterproof, adhesive and elastic, such as asphaltum water emulsion, gutta percha, and certain oils with a fungicide and which remains tacky for four (4) hours and retains elasticity after setting when tested under the heat of the hand. It shall not contain kerosene, coal tar, creosote, or other material harmful to cambium or living tissue.

(e) WIRE PROTECTIVE HOSE.
Hose shall be 1/2, 5/8, or 3/4 inch in diameter, suitable for the purpose intended (hose may be second-handed).

(f) BURLAP.
Burlap shall weigh at least eight (8) ounces per square yard.

(g) DRAIN TILE PIPE.
Drain tile pipe shall meet the requirements of Section 853.

863.11 Erosion Control Netting.

(a) GENERAL.
Netting material furnished for use shall be of sufficient strength to hold the processed ground and/or any cover material (mulch, sod, etc.) in place until a growth of natural or planted material is established. The following materials have been found acceptable for the class designated.

(b) CLASS A NETTING.
Class A netting shall be a jute netting woven from undyed and unbleached plain, single jute yarn, loosely twisted with approximately uniform diameter yarn in both length and width directions. The finished cloth physical requirements are as follows:

- Width—Nominal 48"
- Length—Convenient lengths; 50 yard minimum
- Weight—1.05 pounds - 1.70 pounds per linear yard of 48" wide material
- Openings—Approximately 1/2" - 1" in width and length

Jute netting may be used with a certification by the producer that the material meets the above requirements.

(c) CLASS B NETTING.
1. CLOSED COTTON, RAYON, POLYESTER YARN, OR PLASTIC NETTING.
This type netting shall consist of a uniform open weave fabric having 1/2 to 1 inch rectangular or square openings woven from undyed and unbleached yarn or extruded polypropylene material. This fabric shall then be firmly affixed to a sheet(s) or intrawoven with strips of heavy or medium weight cellulose tissue. This type netting shall be furnished in rolls meeting the following requirements:

- Width—48 inches, minimum
- Length—Convenient lengths, 50 yard minimum
- Weight—0.165 pounds per square yard, minimum average

2. EXCELSIOR, OR BOTANICAL FIBER, BLANKET AND NETTING.
The excelsior blanket and netting shall consist of a machine produced mat of curled wood excelsior formed from 80% 6 inch or longer fibers so formed as to provide a reasonably uniform blanket of the same thickness which shall be covered on at least one side (top) with a netting material.

The botanical fiber blanket and netting shall consist of a mat of sufficiently long botanical fibers or straw so formed as to provide a reasonably uniform blanket of the same thickness which shall be covered on at least one side (top) with a netting material.

Nutting for either blanket shall be one of the following:

1. Twisted kraft paper with a high wet strength or a cotton, rayon, or polyester fabric forming a mesh having 1/4 to 1 inch rectangular or square openings.

2. Biodegradable extruded polypropylene or other acceptable plastic material forming a mesh having 1/4 to 1 inch rectangular or square openings. The excelsior, or botanical fiber, blanket and netting shall be furnished in rolls meeting the following requirements:

   Width—48 inches, minimum
   Length—Convenient lengths, 20 yard minimum
   Weight—0.75 pounds per square yard, minimum average

(d) STAPLES.

Staples used to fasten the erosion control netting to the soil surface shall be made of steel, U-shaped and shall be approximately six (6) inches long and one inch wide. Machine made staples shall be of No. 11 gauge or heavier steel wire. Hand made staples shall be made from 13 inch lengths of No. 9 gauge or heavier steel wire.

863.12 Fertilizer.

(a) GENERAL.

The fertilizer or fertilizers used shall be of the type and grade provided herein or on the plans and shall comply with Alabama Fertilizer Laws, Title 2, Sections 282-300, Alabama Code of 1940, as amended.
(b) MANUFACTURED FERTILIZERS.

1. Manufactured fertilizer shall be standard commercial products and shall contain not less than the percentages by weight of the ingredients set out in the following table:

<table>
<thead>
<tr>
<th>Type</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0-15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>13-13-13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>10-10-10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>8-8-8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>0-14-14</td>
<td>0</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>4-12-12</td>
<td>4</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>4-16-08</td>
<td>4</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Cottonseed Meal</td>
<td>6.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super Phosphate</td>
<td></td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Ammonium Nitrate</td>
<td>33.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonium Sulphate</td>
<td>20.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate of Soda</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muriate of Potash</td>
<td></td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

2. An allowance of 5 percent variation or tolerance of the above proportions will be permitted based on relative commercial value.

3. Nitrogen may be derived from any nitrogen-carrying material approved by the State Commissioner of Agriculture and Industries.

4. Cottonseed meal shall contain 41 percent protein or 6.56 percent nitrogen.

5. All fertilizers shall be transported in containers which will insure proper protection, handling, and which are commonly used with such fertilizers.

6. Fertilizers containing pesticide materials produced by a recognized, responsible manufacturer and prequalified for use by the State Department of Agriculture and Industries or the U.S. Department of Agriculture may be used.

(d) AGRICULTURAL LIMESTONE.

All limestone for agricultural liming purposes shall be crushed or ground to such a degree of fineness that 90 percent of the material will pass through a 10 mesh screen and not less than 50 percent of the material will pass through a 60 mesh screen. All such limestone shall also have a neutralizing value of 90 percent calcium carbonate or better.

(e) BASIC SLAG.

Basic slag shall be ground open hearth basic slag containing not less than the percentage by weight of the following ingredients.

<table>
<thead>
<tr>
<th>P₂O₅ (Available)</th>
<th>Iron Oxide</th>
<th>Magnesium Oxide</th>
<th>Calcium Oxide</th>
<th>Manganese Oxide</th>
<th>Neutralizing Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>20.0</td>
<td>6.0</td>
<td>18.0</td>
<td>2.0</td>
<td>55.0</td>
</tr>
</tbody>
</table>

At least 80 percent shall pass through a 100 mesh screen and at least 90 percent shall pass a 50 mesh screen.
When basic slag is substituted for limestone in seeding, sprigging and/or solid sod planting operations, the amount applied shall be adjusted to equal the neutralizing effect of the specified amount of limestone as defined in Subsection 863.12(d). Blends of basic slag and other elements, such as 0-6-6, 0-5-6 + .05B and 0-4-12 + .05, may be used and the added elements credited to the total element requirements for plant food.

863.13 Water.

Water free from substances harmful to the growth of plantings will be suitable for use with roadway improvement materials.

863.14 Blank.
865.01 **General.**

Utility encasement pipe shall comply with the appropriate requirements for the size shown in the following table:

<table>
<thead>
<tr>
<th>Pipe Diameter Inches</th>
<th>Minimum Wall Thickness* Inches</th>
<th>Pipe Requirements* **</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Sch. 40</td>
<td>ASTM A-120, Sch. 40</td>
</tr>
<tr>
<td>4 - 6</td>
<td>.083</td>
<td>ASTM A-139, Grade B</td>
</tr>
<tr>
<td>8 - 12</td>
<td>.104</td>
<td>ASTM A-139, Grade B</td>
</tr>
<tr>
<td>14 - 20</td>
<td>.134</td>
<td>ASTM A-139, Grade B</td>
</tr>
<tr>
<td>22 - 24</td>
<td>.164</td>
<td>ASTM A-139, Grade B</td>
</tr>
<tr>
<td>26 - 36</td>
<td>.164</td>
<td>ASTM A-139, Grade B</td>
</tr>
<tr>
<td>38 - 42</td>
<td>.188</td>
<td>ASTM A-139, Grade B</td>
</tr>
<tr>
<td>44 - 48</td>
<td>.219</td>
<td>ASTM A-283, Grade B</td>
</tr>
<tr>
<td>50 - 60</td>
<td>.250</td>
<td>ASTM A-283, Grade B</td>
</tr>
</tbody>
</table>

* Minimum requirements unless local codes or ordinances are more stringent.

** All pipe shall be coated inside and out with at least one shop coat of an approved primer paint. In addition the external surface shall be treated with one (1) coat of asphaltum paint.

° Does not require hydrostatic pressure test.

865.02 **Joints.**

The type of joints used shall be the Contractor's option provided the joint produces a smooth surface on the inside of the pipe suitable for installation of the carrier pipe and is consistent with the installation requirements of the pipe.
SECTION 867
WATER PIPE

867.01 Cast Iron Water Pipe Mains.

Pipes, joints and fittings shall conform to the requirements of WW-P421c and the following unless otherwise specified by plan details:

Grade of Pipe. Grade B (21,000 psi bursting strength/45,000 psi modulus of rupture).
Fittings. Type II or III, (Push-on or Mechanical), Class 250.
Pressure Class. 150 psi minimum.
Wall Thickness. Wall thickness shall be in accordance with the requirements of ANSI Standard A-21.1 for five (5) feet of cover, laying condition "B".
Pipe Lining. Pipes and fittings shall be cement lined in accordance with ANSI Standard A-21.4.
Pipe Coating. Pipes and fittings shall have an outside coating of bituminous material in accordance with ANSI Standard A-21.6, A-21.8 and A-21.51.

867.02 Ductile Iron Water Pipe Mains.

Pipes, joints and fittings shall conform to the requirements of WW-P421c and the following, unless otherwise specified by plan details:
Grade of Pipe. Grade C (60,000 psi tensile strength - 42,000 psi yield strength - 10 percent elongation).
Fittings. Type II or III (Push-on or Mechanical), Class 250.
Pressure Class. 150 psi minimum.
Wall Thickness. Wall thickness shall be in accordance with ANSI Standard A-21.1 for five (5) feet of cover, laying condition "B".
Pipe Lining. Pipes and fittings shall be cement lined in accordance with ANSI Standard A-21.4.
Pipe Coating. Pipes and fittings shall have an outside coating of bituminous material in accordance with ANSI Standards A-21.6, A-21.8 and A-21.51.

867.03 Copper Water Pipe.

Pipes and fittings shall meet the requirements of ASTM B-88 and FSS-WW-T-799, and shall be Type K, L or M as specified by plan details.

867.04 Omitted.

867.05 Galvanized Steel Water Pipe.

Pipes and fittings shall meet the requirements of ASTM A-120 Schedule 40, unless otherwise specified by plan details.

867.06 Poly (Vinyl Chloride) (PVC) Plastic Pipe.

Pipe and fittings shall be made of PVC 1120, PVC 1220, or PVC 2120 meeting the requirements of ASTM D-1785 or ASTM D-2241. If D-2241 pipe is used, it shall be SDR 26, 21, 17, or 13.5. If D-1785 pipe is used, it may be Schedule 40, 80, or 120 for pipe eight inches in diameter or smaller, but shall be limited to Schedule 80 or 120 for
pipe larger than eight inches in diameter. Joints and gasket material shall be as recommended by the pipe manufacturer except that solvent welding of field joints will not be allowed for pipe greater than 1 1/2 inches in diameter.

867.07 Omitted.

867.08 Incidental Materials.

Such joint and other materials as are necessary for a proper and watertight installation at the greatest operating pressure of water shall be suitable for the purpose intended and of an approved type.
SECTION 869
GUARDRAIL AND BARRIER RAIL MATERIALS

869.01 Rail Elements.
(a) BEAM PLATE GUARDRAIL.
1. STEEL.
Steel rail elements and accessories shall conform to the requirements of AASHTO M-180 modified as follows:
Type 1 shall be zinc coated, 2.00 ounces per square foot, minimum triple spot test as noted in Table II.
Type 2 shall be zinc coated, 4.00 ounces per square foot, minimum triple spot test as noted in Table II.
Chemical composition for Type 4 beams shall conform to one of the following based on ladle analysis.

CHEMICAL COMPOSITION TYPE 4 BEAMS

<table>
<thead>
<tr>
<th>Blend</th>
<th>C</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
<th>Si</th>
<th>Cu</th>
<th>Cr</th>
<th>Ni</th>
<th>Zr</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>0.12</td>
<td>0.2</td>
<td>0.07</td>
<td>0.05</td>
<td>0.25</td>
<td>0.25</td>
<td>0.3</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>to</td>
<td>Max.</td>
<td>to</td>
<td>to</td>
<td>to</td>
<td>to</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>0.15</td>
<td>0.75</td>
<td>0.55</td>
<td>1.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition, for Type 4 beams after fabrication, all steel shall be blast cleaned or pickled to remove all mill scale. Blast cleaning shall conform to Steel Structures Painting Council Surface Preparation Specification "No. 10 Near-White Metal Blast Cleaning (SSPC-SP10). All pickling acid shall be thoroughly rinsed off. All fabricated steel parts shall be handled with care to avoid gouges, scratches and dents. The steel shall be kept clean of all foreign material, such as paint, grease, oil, chalk marks, crayon marks, concrete spatter, or other deleterious substances. Natural oxidation of the steel will not be considered foreign material. Storage in transit, in open cars and trucks, for an extended period will not be permitted. Steel parts stored outside in yards or at job-sites shall be positioned to allow free drainage and air circulation.

2. ALUMINUM.
Aluminum alloy rain element shall be aluminum alloy 2023 T-3 conforming to the requirements of ASTM B 209. The rail shall be of such thickness as will meet strength requirements of AASHTO M-180 for the strength class designated, however, in no case will the tensile strength of the full size beam (including a splice at the center) be less than 80,000 pounds for Class A or 100,000 pounds for Class B. The shape shall meet AASHTO M-180 requirements.
(b) BARRIER RAIL.

The barrier rail elements, including all accessories, shall conform to the material requirements shown on the plans for the type material of which the barrier rail is to be constructed.

869.02 Posts.

(a) TREATED TIMBER POSTS.

Timber posts shall be sawed to within plus or minus one (1) inch of the length and plus or minus 3/8 inch of the full end dimensions shown on the plans. Timber block-outs shall be sawed to within 1/4 inch of the length and plus or minus 3/8 inch of the full end dimensions shown on the plans. Holes shall be drilled slightly smaller than the designated bolt size so as to provide a driving fit.

All timber shall be Southern Yellow pine, Grade No. 1SR or better, in accordance with the Southern Yellow Pine Inspection Bureau's grading system. Post treatment shall be in accordance with AWPA-C-14 as applicable to guardrail posts. The preservative shall be one recommended under AWPA-C-14. All timber posts should be fabricated and holes drilled before treatment, but where field modifications of necessity are made after treatment, the new surfaces shall be given a preservative treatment in accordance with the provisions of AWPA-M-4.

(b) METAL POSTS.

Steel posts, including block-outs for guardrail, shall comply with the requirements of ASTM A-36, modified to waive the maximum tensile strength. All material shall be new and of the size, shape, etc. noted by the plan details, hot-dip galvanized after fabrication.

Metal posts for barrier rails shall be steel meeting the requirements noted in paragraph one above or when aluminum barrier rail is used, aluminum posts conforming to the requirements of ASTM B-221, Alloy 6351-T4 or 6061-T4 of the size, shape, etc. noted by plan details.

Concrete for anchors shall be constructed of Class "A" Concrete in conformity with the detailed requirements of Section 501 with attention directed to Section 501.03(k)2. All surfaces shall be given a Class 1 finish with all exposed surface given a Class 2 surface finish.

Metal parts used in anchors shall comply with the appropriate requirements for metals noted elsewhere in this Section or other portions of these Specifications.

Wire rope (cable) for anchors shall be 3/4 inch nominal diameter meeting the requirements of AASHTO M-30, Type II, having a Class A galvanization coating.

869.04 Galvanization.

All metal required by the plans or specifications to be galvanized shall be galvanized after fabrication in accordance with AASHTO M-III amended to cover the weight of zinc coating specified in Section 869.01. Shop fabrication shall be considered to include all work necessary to prepare the unit for immediate and complete installation. No punching, cutting, burning or welding will be permitted in the field.
SECTION 871
FENCING MATERIALS

871.01 Chain Link Fabric.

All chain link fence fabric shall consist of woven wire in the form of approximately 2 inch uniform square mesh, having parallel sides with horizontal and vertical diagonals of approximately uniform dimensions in accordance with the provisions of ASTM A-392. The wire shall not be less than 9 gauge (coated), unless otherwise specified by plan details, meeting the following requirements.

Zinc-Coated Steel Fabric.
The base metal of the fabric shall be a good commercial quality of steel wire coated with prime western spelter or equal (AASHTO M-120) in accordance with the provisions of ASTM A-392 for a Class 2 coating weight. The zinc coating shall be applied after weaving. The wire after treatment shall have a minimum breaking load of 1290 pounds.

Vinyl (PVC) Coated Steel Fabric.
The base metal of the fabric shall be a good commercial grade of steel wire coated with a vinyl (PVC) material thermally bonded to the steel core. The coating material shall be compounded from virgin PVC resins, plasticizers and stabilizers which when combined and bonded to the wire core, shall meet the following physical requirements:

The coating shall provide a dense, impervious covering free of void with a smooth lustrous finish.

The strength of the bond to the steel core shall be equal to or greater than the cohesive strength of the PVC coating material.

The coating shall be dimensionally stable showing no shrinkage or expansion from the exposed ends after a sample is held at a temperature of 212°F. for 24 hours.

The coating shall be self-extinguishing and shall not support combustion when tested by ASTM D-470, Horizontal Flame Test. The coating before and after 2000 hours accelerated weatherometer testing shall be flexible, shall not rupture, split or separate from the wire when bent around a mandrel with a diameter of 10 times the diameter of the wire being tested above -25°F.

The PVC coating shall have a specific gravity greater than 1.35.

The PVC coating shall show no deleterious effect after a six month immersion test of samples of the coating material in the following chemicals:

- Ammonium Chloride*
- Calcium Chloride*
- Ammonium Nitrate*
- Copper Sulfate*
- Copper Chloride*
- Potassium Chloride*
- Sodium Hydroxide**
- Calcium Hydroxide**
- Ammonium Hydroxide**
- Sulfuric Acid**
- Hydrochloric Acid**
- Citric Acid**
- Ethanol
- Gasoline
- Kerosene
- Mineral Oil
- Petroleum Oil
- Synthetic Urine (DuPont Formula)

*Saturated Solutions
**10% Solutions
The vinyl thickness shall be 0.007 in. ± 0.001 in.
The wire used in the fabric shall have a minimum breaking strength of 1200 pounds.
The color of the coating shall be uniform grey or green.

871.02 Woven Wire Fabric.

The woven wire fabric shall be No. 9 Farm Fence, design 1047-6-9, having either a Class 2 Zinc Coating conforming to the requirements of ASTM A-116 or a Class II Aluminum Coating conforming to the requirements of ASTM A-584.

871.03 Barbed Wire.

Barbed wire shall be composed of two (2) strands of not less than 12 1/2 gauge wire with 4-point barbs wrapped around both strands of the wire and spaced not more than 5 inches apart. The barbed wire shall conform to the requirements of Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad R.O.W. Wire Fence, ASTM Designation A-121, with galvanization conforming to the requirements for Class 3 Coating.

Unless specified otherwise on the plans, the Contractor may, at his option, provide a high tensile strength barbed wire in lieu of the above. The barbed wire shall conform to ASTM Designation A-121 for 15 1/2 gage steel wire having 4-point round barbs and a Class 3 galvanized coating.

Unless specified otherwise by the plans, the Contractor may, at his option, furnish barbed wire having an aluminum coating meeting the requirements of ASTM A-585 in lieu of the galvanized coating specified above.

871.04 Miscellaneous Wire.

Wire used for bracing or as tension wires shall be No. 9 gage minimum or as shown on the plans. Wire used for tying and other purposes shall be No. 11 gage minimum. The wires may be steel or aluminum of not less than 25,000 psi tensile strength. All miscellaneous steel wire shall have one of the following coatings: 0.7 oz. zinc per square foot or uncoated wire, 0.3 oz. aluminum per square foot of uncoated wire, or a vinyl coating the same as noted for the fabric.

871.05 Fence Supports.

(a) CHAIN LINK.

1. GENERAL.

The frame, including posts, rails, braces, fittings and the like, shall include an acceptable expansion joint. Fittings and connections may, in general, be of the fabricator's design provided they comply with plan details and the following: Post caps, tops, etc. shall be of the heavy duty cast metal design of either malleable steel or aluminum consistent with other parts of the material; line post caps shall be of such design that the addition of barbed wire arms can be accomplished at a later date by a standard arm which is capable of being set at either a vertical position or at 45° from the vertical on either side of the fence, all of which can be accomplished without dismantling or removing the post cap, straps, bands or similar type connections,
unless otherwise noted, shall be fabricated from material of not less than 0.125 inches thick.

2. STEEL.
   a. General.
   All steel elements used as Fence Supports shall be classified as either Type A or Type B according to the following requirements. Unless specified on the plans, the Contractor shall have the option to use either type.

   (I) Type A.
   All steel elements used in the frame work shall be of a good commercial grade steel, hot-dipped, galvanized in accordance with the following:

   Tubular posts, braces, etc. - ASTM A-120; Shaped posts, braces, etc. - ASTM A-123; Castings and Miscellaneous hardware - ASTM A-153. Minimum sizes and weights of posts, rails and framing shall be as follows:

   **Steel Fence Supports & Framing**

   **Use**

   **Shape, Size, Etc.**

   **Line Post**
   3-6 ft. high fence
   1.90" O.D. Pipe @ 2.72 #/ft.
   1.875" x 1.625" x .121" "C" Section @ 2.28 #/ft.
   1.875" x 1.625" x .113" "H" Section @ 2.70 #/ft.
   7-12 ft. high fence
   2.375" O.D. Pipe @ 3.65 #/ft.
   2.25" x 1.70" x .121" "C" Section @ 2.64 #/ft.
   2.25" x 1.93" x .143" "H" Section @ 4.10 #/ft.

   **Corner & Pull Posts**
   3-6 ft. high fence
   2.375" O.D. Pipe @ 3.65 #/ft.
   2.5" x 2.5" Sq. Tubing @ 5.70 #/ft.
   7-12 ft. high fence
   2.875" O.D. Pipe @ 5.79 #/ft.
   3" x 3" Sq. Tubing @ 9.10 #/ft.

   **Gate Post**
   **Gate Leaf Width**
   6 ft. and less
   2.875" O.D. Pipe @ 5.79 #/ft.
   2.5" x 2.5" Sq. Tubing @ 5.70 #/ft.
   Over 6 ft. to 13 ft.
   4.0" O.D. Pipe @ 9.10 #/ft.
   Over 13 ft. to 18 ft.
   6.625" O.D. Pipe @ 18.97 #/ft.
   **Top & Middle Rail**
   1.625" O.D. Pipe @ 2.27 #/ft.
   **Gate Frames**
   1.625" O.D. Pipe @ 2.27 #/ft.
   2" x 2" Sq. Tubing @ 3.85 #/ft.
### Tolerances for Steel Tubing and Shapes

<table>
<thead>
<tr>
<th>Shape and Size</th>
<th>Dimension</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubular, to and incl. 1 1/2&quot;</td>
<td>+ 1/64&quot;, -1/32&quot;</td>
<td>± 5%</td>
</tr>
<tr>
<td>Tubular, 2&quot; &amp; larger</td>
<td>± 1%</td>
<td>± 5%</td>
</tr>
<tr>
<td>&quot;C&quot; Section, to and incl. 2.25&quot; x 1.70&quot;</td>
<td>±0.0625</td>
<td>± 5%</td>
</tr>
<tr>
<td>&quot;H&quot; Section, to and incl. 1.875&quot; x 1.625&quot;</td>
<td>± 0.0625</td>
<td>± 5%</td>
</tr>
<tr>
<td>&quot;H&quot; Section, 2.25&quot; x 1.93&quot; &amp; larger</td>
<td>±0.0937</td>
<td>± 5%</td>
</tr>
</tbody>
</table>

(2) **Type B.**

All steel elements of this type shall be produced from a lightweight, high tensile/high yield strength steel. The steel shall possess a minimum yield strength which when multiplied by the section modulus of a particular pipe size shall equal or exceed the minimum elastic bending moment of the same outside diameter Type A, above, steel pipe. Type B pipe shall meet either, or both, of the following bending tests with a maximum permanent deflection of not more than 0.25 in.:

<table>
<thead>
<tr>
<th>Fence Industry O.D. Pipe</th>
<th>Actual Min. Loading Bearing Capacity (Ibs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10' Free Supported 4' Cantilever</td>
<td></td>
</tr>
<tr>
<td>1 3/8&quot;</td>
<td>185</td>
</tr>
<tr>
<td>1 5/8&quot;</td>
<td>327</td>
</tr>
<tr>
<td>2&quot;</td>
<td>468</td>
</tr>
<tr>
<td>2 1/2&quot;</td>
<td>814</td>
</tr>
<tr>
<td>3&quot;</td>
<td>1463</td>
</tr>
</tbody>
</table>

The exterior surface of the pipe shall have a hot-dipped galvanized coating, minimum 0.9 oz/SF, followed by a chromate conversion coating. The interior surface of the pipe shall have either these same coatings or a zinc rich based coating having a minimum zinc powder content of 80% by weight. These coatings shall be capable of withstanding the following tests:

<table>
<thead>
<tr>
<th>Exposure Test</th>
<th>ASTM Designation</th>
<th>Exposure Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathering</td>
<td>A 623</td>
<td>250 Hours</td>
</tr>
<tr>
<td>Salt Spray</td>
<td>B 117</td>
<td>350 Hours</td>
</tr>
<tr>
<td>Humidity</td>
<td>D 1735</td>
<td>500 Hours</td>
</tr>
<tr>
<td>Salt Spray</td>
<td>B 117</td>
<td>250 Hours</td>
</tr>
<tr>
<td>(interior surface)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In lieu of the galvanized coatings specified elsewhere in this subsection, the coating specified herein may be used. The coating on all surfaces of the fence supports and framing shall be a hot-dipped aluminized coating. The minimum weight of coating shall be 0.75 ounces per square foot, triple spot test, 0.70 ounces per square foot, single spot test, as measured in accordance with ASTM A-428.
The external and internal aluminum coating surface shall have a chromate chemical treatment and a thin resin film to minimize galling and provide wet storage stain resistance during storage and shipment.

b. Miscellaneous steel fittings and hardware shall be of a good grade commercial steel, meeting the general requirements noted in Section 871.05(a)1, hot-dipped galvanized after fabrication in accordance with ASTM A-153 or hot-dipped aluminized in accordance with the requirements noted in subsection 871.05(a)2a.

3. ALUMINUM.
   a. All aluminum elements used in the frame work shall be in accordance with the following:

   ALUMINUM FENCE SUPPORTS & FRAMING

   Use                     Shape, Size, etc.
   Line Post               _2.375" O.D. pipe @1.25 #/ft.
   3 - 6 ft. high fence    2.25" x 1.95" "H" Section @1.25 #/ft.
                           _2.875" O.D. Pipe @ 2.00 #/ft.
   7-12 ft. high fence     _2.5" x 2.5" Sq. Tubing @1.25 #/ft.

   Corner and Pull Posts
   3 - 6 ft. high fence    _3.0" O.D. Pipe @ 2.62 #/ft.
   7 -12 ft. high fence    _3.0" O.D. Pipe @ 3.00 #/ft.

   Gate Post
   Gate Leaf Width
   6 ft. and less          _3.0" O.D. Pipe @ 2.62 #/ft.
                           _3.0" x 3.0" Sq. Tubing @ 2.0 #/ft.
   Over 6 ft. to 13 ft.    _4.0" O.D. Pipe @ 3.0 #/ft.
   Over 13 ft. to 18 ft.   _6.626" O.D. Pipe @ 7.0 #/ft.

   Top & Middle Rail
   _1.660" O.D. Pipe @ 0.786 #/ft.

   Gate Frames
   _1.660" O.D. Pipe @ 0.786 #/ft.
   _1.5" x 1.5" Sq. Tubing @ 0.684 #/ft.

   Materials and tolerances for tubing and shapes shall be in accordance with the following:
   Pipe ASTM B-245 Alloy 6063T6
   Tubing ASTM B-221 Alloy 6063T6
   H Section ASTM B-221 Alloy 6063T6

   b. Miscellaneous aluminum alloy fittings and hardware shall be wrought or cast aluminum alloy conforming to the minimum requirements set forth in the following table:
PHYSICAL PROPERTIES OF ALUMINUM FITTINGS

<table>
<thead>
<tr>
<th>Fittings or Product</th>
<th>Tensile Strength psi, Min.</th>
<th>Yield Strength PSI Min. (0.2% offset)</th>
<th>Elongation in 2 inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Ends and brace ends</td>
<td>30000</td>
<td>20000</td>
<td>3</td>
</tr>
<tr>
<td>Stretcher bars and bands</td>
<td>30000</td>
<td>25000</td>
<td>10</td>
</tr>
<tr>
<td>Flat band ties</td>
<td>20000</td>
<td>17000</td>
<td>5</td>
</tr>
<tr>
<td>Truss or Brace Rods</td>
<td>42000</td>
<td>35000</td>
<td>10</td>
</tr>
<tr>
<td>Turnbuckles</td>
<td>30000</td>
<td>20000</td>
<td>3</td>
</tr>
<tr>
<td>Post Tops</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Bolts</td>
<td>62000</td>
<td>40000</td>
<td>14</td>
</tr>
<tr>
<td>Nuts</td>
<td>42000</td>
<td>35000</td>
<td>10</td>
</tr>
<tr>
<td>Gate hinges, barbed wire extension arms and other fittings.</td>
<td>30000</td>
<td>20000</td>
<td>3</td>
</tr>
</tbody>
</table>

*Aluminum Association Alloys 356-F or 360 are acceptable.

(b) WOVEN WIRE.

1. All steel elements used as fence supports shall be classified as either Type A or Type B according to the following requirements. All post and brace caps, straps and other fittings shall be as noted in Section 871.05(a). All tubular posts and braces shall be provided with a heavy duty cast cap. Unless specified on the plans, the Contractor shall have the option to use either Type A or Type B elements.

(a) Type A.

All steel elements of this type shall meet the test requirements specified for Type A steel elements in Subsection 871.05(a). Minimum sizes and weights of posts, braces and framing shall be as follows:

**Steel Fence Supports & Framing**

**Shape, Size, Etc.**

**Use**

**Line Posts**

1.90" O.D. Pipe @ 2.72 #/ft.
1.875" x 1.625" x .113" "H" Section @ 2.70 #/ft.
1.875" x 1.625" x .121" "C" Section @ 2.28 #/ft.
Studded "T" Post with Spade Plate @ 11.3 #/posts

**Corner, End & Pull Posts**

2.375" O.D. Pipe @ 3.65 #/ft.

**Brace Posts**

1.625" O.D. Pipe @ 2.27 #/ft.

**Gate Posts**

**Hinge Side**

4.0" O.D. Pipe @ 9.10 #/ft.

**Latch Side**

2.375" O.D. Pipe @ 3.65 #/ft.

**Gate Frame**

1.90" O.D. Pipe @ 2.72 #/ft.
Tolerances in dimensions and weight shall be the same as specified in Section 871.05(a)2. Weight tolerance for "T" posts shall be ± 5%.

(b) **Type B.**

All steel elements of this type shall meet the standards and test requirements specified for Type B steel elements in Subsection 871.05(a)2a. Type B elements may be used in lieu of the same outside dimensioned Type A elements. 2. Wood posts and braces shall conform to the requirements noted herein, except as modified by details shown on the plans. Posts shall be sound and free from decay, other defects, or loose knots. Posts may be round or square sawed meeting applicable requirements of Section 833. The slope of the grain in sawed posts shall not exceed one (1) in ten (10). All posts shall be reasonably straight. Round posts shall be free of multiple crooks and in no case will posts, where the geometric center lies more than one (1) inch outside of a straight line drawn from the center of the post at the butt end, less the burying depth to the center of the tip end, be acceptable. Square sawn posts shall not have crooks in excess of one (1) inch in five (5) feet. The length and sizes of wood posts shall be as detailed on the plans within the following tolerances.

**Round Posts.** The furnished posts may include posts from the minimum diameter specified up to, but not to include, those one (1) inch larger than the minimum diameter designated. When tapered posts are furnished, the diameter at the butt end should not be more than one and one-half (1-1/2) inches larger than the diameter measured at the tip end.

**Sawed Posts.** The furnished posts shall be of the dimensions shown on the plans, plus one-half (1/2) inch or minus one-quarter (1/4) inch.

**Lengths.** The furnished posts shall not measure over one (1) inch less than that specified on the plans. Lengths greater than those shown on the plans may be acceptable, if not detrimental to the appearance of the fence. All posts shall be pressure treated in accordance with the provisions of Section 833. All job cuts shall be painted with three (3) coats of hot preservative composed of 60 percent Creosote Oil and 40 percent refined tar. The Contractor shall have the choice of selecting one of the two types of Treated Timber Posts shown on the plans. Once a choice is made and erection begun, the Contractor will not be permitted to change to another type. Fasteners for attaching fencing fabric and wire to wooden posts shall be staples formed from #9 gage (0.148" dia.) wire, approximately 1 1/2 inches long, galvanized with at least 0.6 ounce of zinc per square foot when tested in accordance with ASTM A-90.

(c) **BARBED WIRE.**

Posts shall be wood conforming to the requirements of Section 871.05(b)2.

871.06 Gates.

Gates, where required, shall be swing-gates as detailed or specified on the plans. The gate frames shall be the height of the top of the posts and, covered with the same wire and fabric used on the fence. The frames shall be formed from the tubular shapes noted in Section 871.05 complying with plan details, with all joints welded, or otherwise constructed, to form a rigid unit. Gates for woven wire fencing, however, of another acceptable design may be permitted provided it is so constructed that the unit will not sag. All gates shall be furnished complete with approved (tamper-proof) hinges, latches, auxiliary braces, and all other necessary fittings, including heavy padlock with two keys and one master key for each gate furnished.
Concrete for bedding posts, etc., shall be Class A type complying with applicable portions of Section 501, with the following modifications.

The concrete may be dry batched at a central mixing plant and delivered to the project. Before the concrete is placed water shall be added. This may be done in small amounts as needed and mixed on a mixing board or mortar box. After water is added, the mix shall be used within sixty (60) minutes. Posts braces and brace struts shall be held in proper position until the concrete hardens. The concrete for all corner, brace and line posts shall have cured for 72 hours before any strain is placed on them.
SECTION 880
SIGN MATERIALS

880.01 Sign Panels.

(a) ALUMINUM SIGN MATERIALS.

1. GENERAL.
Aluminum sign materials shall conform to the details and thicknesses shown on the plans and the following: The materials used, unless otherwise noted by plan details, shall meet the requirements noted below and, in addition, the material used shall be free from corrosion, white rust, water stains, dirt and grease with the panels processed as noted in Item 2 below.

<table>
<thead>
<tr>
<th>Use</th>
<th>Alloy &amp; Temper Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign Panels</td>
<td>ASTM B-209 Alloy 6061-T6</td>
</tr>
<tr>
<td>Angles (including Stiffeners)</td>
<td>ASTM B-308 Alloy 6061-T6</td>
</tr>
<tr>
<td>*Bolts</td>
<td>ASTM B-211 Alloy 2024-T4</td>
</tr>
<tr>
<td>*Spring Lock Washers</td>
<td>ASTM B-211 Alloy 7075-T6</td>
</tr>
<tr>
<td>*Hex. Nuts (Plain)</td>
<td>ASTM B-211 Alloy 6262-T9</td>
</tr>
<tr>
<td>*Hex. Lock Nuts</td>
<td>ASTM B-211 Alloy 2017-T4</td>
</tr>
</tbody>
</table>

* Unless otherwise specified.

Aluminum bolts, nuts, and washers shall have an anodic coating of at least 0.0002 inch in thickness and shall be chromate sealed. Galvanized bolts, nuts, and washers as specified under Galvanized Signs, or stainless steel hardware meeting the requirements of ASTM F-593, will be acceptable in lieu of the above.

2. SPECIAL TREATMENT OF ALUMINUM SIGN MATERIAL.
Each panel shall receive a chemical conversion treatment that will produce an acceptable etched surface suitable for either porcelainizing or attachment of reflectorized or non-reflectorized sheeting.

3. TESTS AND SAMPLES.
The Contractor shall furnish certified test reports confirming compliance with the requirements noted.

(b) GALVANIZED STEEL SIGN MATERIAL.

1. GENERAL.
Galvanized steel sign sheets shall conform to the details and thickness designated on the plans and the following: The materials used for Galvanized Steel Signs, unless otherwise noted by plan details, shall meet the following specifications:

<table>
<thead>
<tr>
<th>Use</th>
<th>ASTM For Metal</th>
<th>ASTM For Galvanizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign Panels</td>
<td>A446 Grade A</td>
<td>A-123</td>
</tr>
<tr>
<td>Angles (including Stiffeners)</td>
<td>A-36</td>
<td>A-123</td>
</tr>
<tr>
<td>Bolts, Nuts and Washers,</td>
<td>A-307*</td>
<td>A-153</td>
</tr>
</tbody>
</table>

*Aluminum bolts, nuts, and washers as specified under Aluminum Signs, or stainless steel hardware meeting the requirements of ASTM F-593, will be acceptable.
Galvanized steel sheets and parts other than bolts, nuts and washers shall be mill galvanized with a two (2) ounce per square foot coating in accordance with ASTM A-446, Grade A. The galvanizing shall be a continuous coat, extra smooth, minimum spangle process. After galvanizing, the sheets are to be given a light, tight, crystalline phosphate coating. No galvanizing of any steel part may be done until all welding, cutting, milling, punching, and drilling of the part has been completed. This includes all holes necessary for attaching demountable copy.

2. TESTS AND SAMPLES.
The Contractor shall furnish certified test reports confirming compliance with the requirements noted.

(c) ALUMINUM LAMINATED PANELS.
1. GENERAL.
Panels shall consist of sheet aluminum laminated to a honeycomb core, sealed completely around the perimeter with an extruded aluminum frame to form a surface of the length, width and depth required. These panels may be used either with sign face sheathing meeting the requirements of Section 880.02 or a porcelain enameled face sheet. These laminated panels shall be fabricated in accordance with these Specifications and to sizes and shapes as shown on the plans. The minimum number of panels shall be used for each sign. Panels shall be mounted horizontally on all signs having widths up to and including 24 feet, 0 inches; panels may be mounted vertically on signs having widths exceeding 24 feet, 0 inches. The span between supports on one (1) inch thick panel shall not exceed 9 feet, 0 inches with overhang not in excess of 3 feet, 0 inches. The span for a two and one-half (2 1/2) inch thick panel shall not exceed 14 feet, 6 inches with overhang not in excess of 4 feet and 9 inches. All metal materials shall meet the requirements of Subsection 880.01(a) unless otherwise specified hereinafter in this Subsection.

2. PANEL FACE AND BACKING.
The face sheet shall be fabricated in one piece from a sheet meeting the following requirements: For porcelainized panels the face sheet shall comply with the requirements of Section 880.01(d)3. For panels to be covered with sign sheathing the face sheet shall meet the requirements specified for the back sheet. The back sheet shall be fabricated in one piece from a sheet of 3003 alloy, tempered to provide a minimum tensile strength of 18,000 psi and a minimum yield strength of 12,000 psi and otherwise meeting the requirements of ASTM B-209. Sheets shall not be less than 0.04 inches thick and free from all soil or corrosion prior to lamination.

3. PERIMETER FRAME.
Each panel section shall be provided with a perimeter frame. Frames shall be fabricated of extruded shapes of #6063-T6 Aluminum, with all joints mitered, and firmly affixed together with the exterior framing sealed against moisture penetration. The horizontal top and bottom frame members shall have an integral retainer track for affixing mounting bolts with an additional slot milled in the frame for field insertion of post clip bolts. If the horizontal finished dimension of the sign exceeds 24' and vertical panels are used, the vertical frame members shall have an integral retainer track for mounting bolts. On the perimeter of the finished sign, a 1/8" tolerance from flush between the sheets and frame will be allowed and all edges shall be straight within 1/8" from a straight plane. All sharp edges that would present a hazard in handling shall be smoothed.

4. CORE MATERIAL.
Core material shall be of the appropriate thickness, as required, and shall be phenolic impregnated paper honeycomb. Thickness of core materials shall be held within a tolerance of plus or minus .010 inch. Core material shall meet Specification MIL-D-5272 for resistance to fungus. Cell size, approximately 1/2 inch;
weight of paper, 80#; impregnation, 18 percent by weight minimum.

a. Laminating Adhesive.
The laminating adhesive shall be a thermoplastic neoprene rubber base solvent type or a thermo-setting type exhibiting a permanent oil and water resistant bond.

b. Tensile Strength.
The tensile strength of the honeycomb type laminated construction shall have a minimum of 20 psi when tested in accordance with ASTM Designation C-297 and aged in accordance with ASTM Designation C-481, Cycle

5. FLATNESS.
All adhesively bonded panels shall have an exterior face of such flatness that when measured at normal room temperature of 70° to 80°F, the maximum wave slope of the surface at any point, measured from the nominal plane of the surface, shall not exceed 1% for panel to which sign face sheeting is to be attached or 1.5% for panels which have porcelainized face sheets. [Wave slope shall be computed in the following manner: Measure the distance between high points (Dimension A). Place a straight edge across the points and measure the depth of slope (Dimension B). Divide one half of A into B to determine percentage of wave slope.]

6. SEAM CLOSURE.
Where multiple panels adjoin, the face and edges shall be milled to a tolerance of plus or minus 1/32" from a straight plane, so that when adjoining panels are assembled, no gap over 1/16" shall be visible between panels. Panels may be milled up to 1/4" on each side in order to achieve edge uniformity. Seam closure extrusion between panels shall be as provided by the manufacturer of Type 6063-T6 aluminum. Seam closure extrusion may be set in 3" from edge of panels for clearance of rivets and frame.

7. RIVETS.
Rivets appearing on the face side of the panel shall be anodized a color similar to that required for the face of the panel. Rivets for mounting letters shall be as specified.

8. WEEP HOLES.
Weep holes of approximately 1/8 inch in diameter shall be drilled in the perimeter frame at the bottom of each panel. Holes are to be spaced approximately 3 inches in from either end and in the center of each panel.

9. FABRICATION OF LAMINATED SIGNS.
Each completed sign face shall comply with the requirements noted hereinbefore with the legend and border laid out on the sign face in accordance with the approved shop drawing, signs that do not meet these requirements shall be corrected or removed and replaced so as to comply with the requirements noted hereinabove.

10. TESTS AND SAMPLES.
The Contractor shall furnish certified test reports confirming compliance with the requirements noted in this Section in addition to samples of materials used in the manufacturing of the signs.

(d) PORCELAIN ENAMEL SIGNS.

1. GENERAL.
Porcelainized signs may be fabricated from flat aluminum or steel sheets or Aluminum Laminated panels. Materials shall meet the requirements of Subsections 880.01(a), (b), or (c), unless otherwise modified hereinafter in this Subsection. Porcelain enamel surfaces shall be in accordance with the following requirements. These requirements are basic manufacturing quality controls, and certified test reports will be accepted in lieu of samples. However, samples of each color to be used and for each separate production run shall be furnished for verification of tests of
requirements as required by current testing schedule.

a. Coating. Porcelain enameled signs shall have a base or ground coat, designed to develop minimum adherence, applied to all surfaces which are to be porcelainized. At least one separately fired cover coat, in addition to the base or ground coat, shall be applied to all surfaces being porcelainized. All porcelain enamel shall conform to the Porcelain Enamel Institute’s Specification ALS 105. The thickness of the enamel coating shall not be less than 0.002 inches.

b. Color. The finish color shall be uniform colors, matching the Alabama Green Chip and the standard interstate colors within the Hue, Value and Chroma I ranges of the color Tolerance Charts published by the Federal Highway I Administration.

c. Gloss. The porcelain enamel shall have a gloss reading of 50 to 70 units at an angle of 45° when measured on a photovolt meter, or a meter capable of giving equal results. (Reference Federal Test Method 6101, and current ASTM Standard Method C-346.) Panels shall be checked for gloss every 1,000 square feet of production run.

d. Adherence. Adherence shall be checked by accelerated spall test in accordance with Porcelain Enamel Institute Process Bulletin C-486 AL-la, (Section 6, Spall Test to Determine Retention of Adherence.)

This test conforms with current ASTM Designation C-486 "Method of Test for Spalling Resistance of Porcelain Enameled Aluminum." Tests shall be performed on process evaluation test specimens, 3 inch x 12 inch, processed with the production run. Test samples shall be processed at a minimum rate of one set of samples per every 1,000 square feet of the production cycle or total order, whichever occurs first, and marked with the date and time of the production run. Extra process evaluation test specimens shall be processed to check any change in processing such as cleaning, enamel formulation, firing, etc. The number of specimens constituting one set of samples shall be three.

Failure of any process evaluation test specimen to satisfactorily pass the spall test shall be cause for holding and retesting the 1,000 square feet of the production cycle the specimen represents. For the purpose of retesting, process evaluation test specimens shall be taken from production pieces of the production cycle being held.

e. Acid Resistance.

The porcelain enamel shall have a weight loss of less than 20 mg/square inch in the boiling 6% citric acid test. Reference test is described in ASTM Standard C-283-54 "Standard Method of Test for Resistance of Porcelain Enamels to Boiling Acid."

Tests shall be performed on process evaluation test specimens, 3 inch x 12 inch, processed with the production run. Test samples shall be processed at a minimum rate of one set of samples per every 1,000 square feet of the production cycle or total order, whichever occurs first, and marked with the date and time of the production run. Extra process evaluation test specimens shall be processed without any change in processing such as frits, mill formula, fineness of grind, firing, etc. The number of specimens constituting one set of samples shall be three.

Failure of any process evaluation test specimen to satisfactorily pass the acid resistance test shall be cause for holding and retesting the 1,000 square feet of the production cycle the specimen represents. For the purpose of retesting, process evaluation test specimens shall be taken from production pieces of the production cycle being held.
2. ALUMINUM OR STEEL FLAT OR MULTIPLE FLAT PANELS.

a. Metals. All materials shall meet the requirements of Subsections 880.01(a) or (b) unless otherwise specified hereinafter in this Section.

Aluminum panel sheets shall be an aluminum-alloy or aluminum clad alloy (6061-Core) especially designed for enameling and capable of being porcelain enameled to meet the Specifications noted herein. The aluminum sheets, after enameling, shall have a minimum ultimate strength of 18,000 psi, a minimum yield strength of 12,000 psi and an elongation of not less than 4%. If the porcelain enameling process materially alters the temper of the aluminum sheets such that the minimum yield point of the material is below 12,000 psi, they shall be artificially aged or processed to raise the yield point of the panels to the required minimum stress.

Steel Sheets and Backing Strips shall meet the requirements of ASTM Designation A-424 Type 11, and be capable of being porcelain enameled to meet the Specifications noted herein. All steel sheets and backing strips shall be shaped and formed before porcelainization. The exposed surfaces shall be provided with a protective coating of either porcelain or galvanization.

b. Porcelain Coverage.

In addition to the requirements of Section 880.01(d)1, the following shall apply. The base or ground coat may be applied to the entire exposed surface area of the sheets, including face and back. If both sides are covered, the coating thicknesses shall be equal and rack marks will be allowed on the back of panels. The face and back shall be of the same color.

c. Flatness.

Each completed sign face, after erection, shall not vary more than 1/8 inch in any 4 foot length with the maximum variation of 1/4 inch from a flat surface in any 8 foot length.

3. PORCELAINIZED ALUMINUM LAMINATED PANELS.

All materials shall meet the requirements of Subsection 880.01(c) except as noted hereinafter. Porcelainization of the face sheet shall be as specified in Section 880.01(d)1.

Aluminum Face Sheets shall be an aluminum alloy or aluminum clad alloy (6061-Core) especially designed for enameling and capable of being porcelain enameled to meet the Specifications noted hereinbefore. The aluminum sheets, after enameling, shall have a minimum ultimate strength of 18,000 psi, a minimum yield strength of 12,000 psi and an elongation of not less than 4%. If the porcelain enameling process materially alters the temper of the aluminum sheets such that the minimum yield point of the material is below 12,000 psi, they shall be artificially aged or processed to raise the yield point of the panels to the required minimum stress. Face sheets shall not be less than 0.063 inches thick after porcelainization.

4. FABRICATION OF PORCELAIN ENAMELED SIGNS.

Each completed sign face shall comply with the surface flatness requirements noted hereinbefore, with the legend and border laid out on the sign face in accordance with the approved shop drawings; signs that do not meet these requirements shall be corrected or removed and replaced so as to comply with these requirements without additional cost to the City.

5. TESTS AND SAMPLES.

The Contractor shall furnish certified test reports confirming compliance with the requirements noted in this Section and in addition, samples of materials used in manufacturing of the signs, if requested by the Engineer of Public Works, but in no case less than one (1) 3 inch x 12 inch sample of each color used shall be furnished for each separate production run of the porcelain enameled panels.

Verification of the porcelain colors by comparison with the Alabama Green Chip and the Color Tolerance Charts published by the FHWA shall be made on all
samples. Noticeable variation of color in a production run shall be cause of ordering inspection of all sign faces and the rejection of any sign face outside of the tolerances provided by the Color Charts.

880.02 Reflective And Non-Reflective Sheeting.

(a) GENERAL.
Sheeting used in the fabrication of sign faces will be classified by type in accordance with the following:

Type A - Reflective sheeting utilizing "enclosed" lens consisting of spherical lens elements imbedded beneath the surface of a smooth transparent flexible plastic, resulting in a nonexposed lens, optical reflecting system.
Type B - Reflective sheeting utilizing "encapsulated" lens consisting of spherical lens elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface.
Type C - Non-reflective sheeting consisting of a smooth, flat durable gloss plastic film.
All sheeting shall be weather resistant and have a precoated adhesive backing protected by a removable liner.
To permit visual verification of proper use, Type A sheeting shall display the international worker symbol in a repeat pattern and Type B sheeting shall display the international worker symbol in a circle in a repeat pattern.
All reflective sheeting shall be of the Type A Classification unless otherwise required by plan details.

(b) MATERIAL REQUIREMENTS.
1. GENERAL.
Sheeting shall meet the requirements for Type 1, Class 1 or 2 of Federal Specifications LS-300 C, dated March 20,1974, modified as noted hereinafter in this Subsection.

2. COLOR (PARA. 3.5).
The chromaticity limits of the colors shown by Tables 1A and 1B shall be modified to conform to the requirements of the FHWA Color Tolerance Charts for the colors covered by the Color Charts.

3. RETROREFLECTIVE REQUIREMENTS (PARA. 3.6.4).
The SIA values for sheeting shall be in accordance with the following: Type A—Not less than the values shown in Table II Type B—Not less than the values shown in Table III Type C—No reflective values, the colors shall have a gloss reading between 50 to 70 units at an angle of 45° when measured with a photovoltaimeter or a meter capable of giving the same results. On divergence angles of 0.2°, 0.5° and 2.0° will be applicable.

4. ACCELERATED WEATHERING (PARA. 3.6.5).
Item 3.6.5(c) shall be amended to read as follows: "The reflective values after the weathering test shall not be less than 80% of the values noted in Table II for Type A sheeting or Table III for Type B sheeting."

5. FLEXIBILITY (PARA. 4.4.5).
Type B sheeting shall not require the use of a backing sheet.

6. TESTS AND SAMPLES.
The Contractor shall furnish certified test reports confirming compliance with the requirements noted hereinbefore in this Section. In addition at least one set of three (3)12 inch by 12 inch samples of each color for each 1,000 square yards of production run or total order if required. Verification of color by comparison of samples with Color Tolerance Charts published by the FHWA shall be made on all
samples. Noticeable variation of color in the production run shall be cause for ordering inspection of all sign faces and the rejection of any sign face outside of the tolerances provided by the Color Tolerance Charts.

(c) APPLICATION OF SHEETING.
Application of sheeting shall be in accordance with the manufacturer's recommendations; splicing of the sheeting will be allowed on sign faces provided such splices have a minimum overlap of 1/2 inch and are held to a minimum. More than one splice per 48 square feet of panel is considered excessive. On signs which consist of only one panel, the sheeting shall extend to the edge of the sign panel, except where otherwise indicated in the plans. On all signs which are of sufficient size to require two or more panels, sheeting shall be applied separately to each panel. No attempt shall be made to extend the sheeting from one panel to adjacent panels. Sheetig shall be applied in strict conformity with the recommendations of the manufacturer.

880.03 Sign Copy.

(a) APPLIED COPY.
1. GENERAL.
Applied copy is classified as copy applied directly to the sign background as distinguished from demountable copy which is affixed to the sign background by approved fasteners. All standard Class 3 and 4 signs shall have the sign copy applied by either the direct or reverse screening (silk screen) method as noted in Items 2 and 3 below. All standard signs requiring reflective white copy and colored background shall use the reverse-screening process for application of the sign copy. Special Class 3 and 4 signs may utilize cut-out copy as noted in Item 4 below is so noted by the plans or on the approved shop drawings.

2. DIRECT SCREENING PROCESS.
This method is used for applying a non-reflective copy to a sign background.

3. REVERSE SCREENING PROCESS.
This method is used for applying white reflectorized copy to a reflectorized colored background by utilizing a transparent color stencil paste applied to a white reflectorized background. When this method is used with Type III B sheeting, it will require a clear coating be placed over the processed sign face.

4. SCREENING MATERIAL AND APPLICATION.
Material for application by the silk screen method shall be a top quality exterior baking screen enamel or stencil paste manufactured especially for use on roadway signs and compatible with the type sign background material being used. Application of screened copy and curing thereof shall be in strict compliance with the manufacturer's recommendations of the background material. Colors shall be durable, and consistent with the requirements of the FHWA Standards Colors Charts for Signs. The color shall be uniform unacceptable hue when viewed in daylight and under normal headlights at night.

5. SUBSTITUTION OF CUT-OUT COPY FOR SCREEN COPY.
Certain signs for which standardization is impractical, such as destination signs, may be authorized to use cut-out copy. Said cut-out copy shall be fabricated from the appropriate class sheeting by individually cutting of the borders, legends, numerals, and symbols, and applying them to the required background in strict compliance with the sheeting manufacturer's recommendation. When cut-out copy is authorized, borders, legends, symbols or numerals shall be either screened or cut-out copy; mixing of the two to form a border, a legend, a symbol or numerals will not be permitted except when authorized on construction.
warning signs. White copy shall be formed from Type II or II A sheeting; non-reflective copy shall be formed from Type I sheeting.

(b) DEMOUNTABLE COPY.

1. GENERAL DESIGN.

Letter design shall meet the Federal Standard Alphabet Series digits, arrows, borders and other accessories shall be all in accordance with the details shown on the plans. All Items shall be fabricated from sheet aluminum of alloy 3003 B-209 or equal, of not less than 0.032 inch in thickness. Mounting holes shall be provided within the frames, in accordance with the manufacturer's directions, to permit the use of rivets or other acceptable fasteners. The demountable copy shall be fastened to sign panels either by aluminum rivets or galvanized self-tapping sheet metal screws with heads of the same color as the copy. The number of rivets or screws with heads shall be as recommended by the manufacturer of the demountable copy. Border sections shall be full standard length, except where it is necessary to use less than a standard length to fit a sign dimension. Border units shall fit snugly together without visible gaps. All Items shall be reflectorized, unless otherwise specified by plan details, by one of the following methods: (1) Prismatic reflectors installed in the copy frame as noted in Item 2 below, or (2) Encapsulated lens reflective sheeting mounted on the copy frame as noted in Item 3 below. Non-reflectorized demountable copy, when specified, shall be finished in the same manner as provided in Subsection 880.03(b)2b meeting the same requirements except that the finished color shall be black or white porcelain enamel as required. The type of reflectorization for the demountable copy will be at the option of the Contractor except when (1) a specific type is designated by plan details or (2) when repairing or adding to an existing sign the new copy shall be consistent with that retained. The type of reflectorization, once selected, should be consistent throughout the project.

2. PRISMATIC REFLECTORIZATION.

a. General.

Prismatic reflectors shall be supported by embossed frames with reflectors installed so as to be an integral part of the character, or otherwise securely affixed to prevent displacement by handling or servicing; the use of tape to hold reflectors in place is not acceptable. The size and spacing of the reflectors shall be such as will provide maximum night legibility and visibility of the unfinished cutout figure.

b. Finishing of Frame.

After the metal fabrication has been completed, the finishing process shall be as follows: Preparation: Aluminum frames shall be degreased, etched, neutralized, and treated as specified in Section 880.01(a)2. Enameling: After treating, frames shall be finished in white porcelain enamel unless otherwise specified by plan details. The porcelain finish shall be in accordance with the Porcelain Enamel Institute Specification ALS105. When subject to Porcelain Enamel Gloss Test T-18, the enamel shall have a gloss reading at 45° of 50 to 70 units.

c. Prismatic Reflectors.

(1) General.

The reflectors shall consist of a transparent acrylic plastic face, hereafter referred to as the lens, and an opaque back hermetically sealed to form a unit permanently sealed against dust, water, and water vapor. The reflector lens shall be crystal or as designated on the plans. The lens shall consist of a smooth front surface free from projections or indentations other than for identification or orientation of the reflector and a rear surface bearing a prismatic configuration such that will effect total internal reflection of light. The manufacturer's trademark shall be molded legibly into the face or back of the unit. The reflector lens shall be methyl methacrylate meeting the requirements of Federal Specification L-M-500a,
Type 1, Class 3. The backing shall be a heat-sealable plastic or metallic foil fused to the lens under heat and pressure around the entire perimeter of the lens to form a unit permanently sealed against dust, water and vapor.

(2) Reflecting Requirements.

The specific intensity of each reflector shall be equal to or exceed the following minimum values with measurements made with the reflectors spinning. Failure to meet the specific intensity minimum shall constitute failure of the reflector being tested.

<table>
<thead>
<tr>
<th>Observation $\theta_i$ Angle</th>
<th>Entrance $\theta$ Angle</th>
<th>Specific Intensity $\theta_{ii}$ Candle power/square In/Foot Candle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1°</td>
<td>0°</td>
<td>14</td>
</tr>
<tr>
<td>0.1°</td>
<td>20°</td>
<td>5.6</td>
</tr>
</tbody>
</table>

$\theta$ Entrance angle shall mean the angle at the reflector between the direction of light incident to it and the direction of the reflector axis.

$\theta_i$ Observation angle shall mean the angle at the reflector between the observer's line of sight and the axis of the incident light beam on the reflector.

$\theta_{ii}$ Specific intensity shall mean the candlepower returned by the reflector at the chosen divergence angle per square inch of reflecting surface for each foot-candle of illumination at the reflector.

(3) Optical Testing.

(3a) Procedure.

The reflex reflector to be tested shall be located at a distance of 10 feet from a single light source having an effective diameter of 0.2 inch; the light source shall be operated at approximately normal efficiency. The return light from the reflector shall be measured by means of a photoelectric photometer having a minimum sensitivity of 1 x 10^-7 foot-candle per mm scale division. The photometer shall have a receiver aperture 0.05-inch diameter, shielded to eliminate stray light. The distance from light source center up to aperture center shall be 0.21 inch for 0.1° observation angle. During testing, the reflectors shall be spun so as to average the orientation effect.

(3b) Tests.

All samples shall be tested at normal ambient temperature for compliance with the requirements noted in Item 2 above. In addition, 3 samples shall be heated for four hours in a circulating air oven at 140°F plus or minus 5°F, removed from the oven and permitted to cool to room temperature and retested for specific intensity. Failure of any sample to retain the minimum specific intensity noted in Item 2 above shall be cause for classifying the unit as defective.

(4) Seal Test.

The following test shall be used to determine if a reflector is adequately sealed against dust and water. Submerge all samples in water bath at room temperature. Subject the submerged samples to a vacuum of five (5) inches gauge for five (5) minutes. Restore atmospheric pressure and leave sample submerged for five (5) minutes, then examine the sample for water intake. Evidence of water or moisture within the unit will be considered as failure of the unit.

(5) Heat Resistance Test.

This test shall be divided into 2 parts; the first part being a test for
deformation or shape at a possible temperature obtainable on the job (140°F.) and second part, a heat test to help evaluate the grade of plastic contained in the unit.

Part 1: Three reflectors shall be heated for four hours in a circulating air oven at 140°F. plus or minus 5°, with the specimen placed in a horizontal position on a grid or perforated shelf which will permit free air circulation. At the end of the heating period the samples shall be removed from the oven, permitted to cool to room temperature and examined. Deformation or a significant change in shape shall be cause for classifying the unit as defective. (Samples used in the optical test noted in paragraph 2 of Item 2b may be used for this test.)

Part 2: This part of the heat test is for evaluation of the material only; therefore, any unit constructed so that an air pocket exists between the face of the reflector lens and backing surface shall be vented. The test shall be the same as noted for Part 1 above except the temperature used shall be 175°F. plus or minus 5°. Deformation or a significant change in shape shall be cause for classifying the unit as defective.

(6) Sampling Procedure and Test Requirements.
The State of Alabama Highway Department has established a Qualified Traffic Control Devices and Materials list for reflectors. Refer to Subsection 106.01(f) of the AHD Standard Specifications (1989) and AHD Procedure 355 concerning this list. Approval of reflectors shall be based on the evaluation of a submission from the manufacturer of 50 samples, accompanied by certified test reports confirming compliance of lens material used in the manufacture of the reflectors to the Federal Specification L-M-500A.

Failure of the samples on any specific tests noted hereinbefore in this Item of more than four percent, but not in excess of 10 percent, shall be cause for requiring resubmission of samples by the supplier. Failure of more than 10 percent shall be cause for disapproval of the particular model being tested.

A resubmittal qualification submission will be rejected if the retesting produces failures in excess of four percent. Only two resubmissions of a particular model will be accepted.

Job acceptance of reflector units will be based on the receipt of a certification from the manufacturer that the reflectors furnished to the job were made from the same material and by the same manufacturing process as were the qualification samples and verification tests of the qualification tests by the testing of samples by the following procedure.

Each shipment of reflector units shall be divided into approximately equal lots not to exceed 3,000 units per lot and sampled as follows:

Samples shall be selected from lots by random number by selecting 1% of the lot, however, in no event shall the number of samples selected be less than three (3).

Failure on any specified test of more than 5% but not in excess of 12% will be cause for resampling. Failure of more than 12% shall be cause for rejection of the sampled lot. Resampling shall be accomplished in such a manner as to produce twice the number of samples as required for the original sampling. A resampled lot shall be rejected if the retesting produces failures in excess of 5% of the number of reflectors tested.

NOTE: In determination of samples involved in the above noted requirements, any fractional product produced shall be rounded off to the next whole number.

Where reflectors are presealed into the copy furnished the project, the manufacturer of the copy shall furnish extra reflectors along with the completed copy, such samples being taken from the material used to manufacture the copy. The
number of samples furnished shall be as noted above; if resampling is necessary due to failures the resampling shall be taken from the copy furnished the project, and the copy shall be repaired by the Contractor.

3. ENCAPSULATED LENS REFLECTORIZATION.
Encapsulated lens sheeting used for demountable copy shall be of a white or silver-white color mounted on an aluminum frame as noted in Item 1 above. The reflective sheeting shall meet all the requirements for Type III B reflective sheeting. Fabrication of the cut-out character shall be such that the entire exposed surface of the character will be covered by the reflective sheeting.

880.04 Sign Supports.

(a) GROUND MOUNTED SIGN SUPPORTS.
1. GENERAL.
Ground mounted supports shall fall into two categories, a lightweight or bendaway post and a standard or rigid post.
The lightweight or bendaway posts are normally single "U" channels (aluminum or steel) and tubular shapes (round, square, etc.) of such size and design that when hit by a moving vehicle, will easily bendaway from the vehicle without seriously damaging it.
The standard or rigid posts shall be of various designs (shapes, tubular, etc.) which by size and design will not easily bendaway when hit by a moving vehicle. This type post, unless otherwise noted by plan details, will require a "breakaway" feature to be incorporated with the post. The material and design of the breakaway features for the various shapes of standard posts shall be shown by the plan details.
Breakaway features constructed of steel shall have all elements galvanized unless otherwise provided by the plan details. Damage to galvanization or any bare spots developed during construction shall be treated with two coats of approved galvanizing paint (Article 859.31) or approved zinc spelter paint. Aluminum elements will require no special treatment unless so specified by plan details.
All materials furnished for use shall be new unless otherwise specified by plan details.
All tubular post shapes whose design will have a tendency to collect water shall be provided with an approved type of tight fitting post cap fabricated of material compatible with that of the post.
2. STEEL POSTS.
a. Tubular Type (Std.)
This type of post shall be fabricated from standard steel shapes of the size and weight shown by plan details. Round shapes shall conform to the requirements of ASTM A-53, Grade B, Schedule 40 or better (no pressure test required). Other shapes and materials shall be as noted by plan details.
b. Beam Type (Std.)
This type of post shall be fabricated from standard beam shapes of the size, shape and weight shown on the plans. The material shall conform to the requirements of either ASTM A-441, A-588 or A-572, Grade 50, unless otherwise noted by plan details.
c. Lightweight or Bendaway Type.
This type post shall be fabricated to acceptable shape and design to provide the Moment and Inertia and Section Modulus for the requirements of the designated post size shown by the plan details. The posts shall be made of rerolled rail steel meeting the requirements of ASTM A-499, Grade 60, or a comparable new billet steel. The steel in the posts shall meet the chemical requirements of ASTM A-1 for rails having a nominal weight of 91 pounds per yard or greater, modified to require
the carbon content to be between 0.67 and 0.89 percent. Shapes and tubular sections shall be provided with 3/8 inch diameter holes placed on one inch centers starting one inch from the top of the post and extending the full length of the post (holes in tubular sections shall extend through the opposite walls).

d. Post Finish.
All standard posts shall be hot dipped zinc galvanized after fabrication in accordance with ASTM A-123 for beam shape and ASTM A-120 for tubular shape. Lightweight or bendaway posts shall be zinc galvanized in accordance with the following: "U" Channel Section - ASTM A-123 after fabrication Tubular Section - ASTM A-525 Grade G90 or better.

3. ALUMINUM POSTS.
   a. Tubular Type (Std.)
This type of post shall be fabricated from extruded tubing to the size, shape and wall thickness shown on the plans and shall conform to the Aluminum Association, Alloy 6061-T6 (ASTM B-221).
   b. Beam Type (Std.)
This type of aluminum support shall be fabricated from extruded shapes of the size, shape and weight shown on the plans and shall conform to the Aluminum Association, Alloy 6061-T6 (ASTM B-308).
   c. Lightweight or Bendaway Type.
This type of aluminum support shall be fabricated from acceptable extruded shapes meeting the design requirements (Moment of Inertia and Section Modulus) for the designated post size shown in the plan details. Materials shall conform to the requirements of Alloy 6061-T6 of ASTM B-221. Holes 9/32 inch in diameter shall be placed on one inch centers starting one inch from the post top and extending the full length of the post or within 8 feet or less of the bottom of the post (holes in tubular sections shall extend through the opposite walls).
   d. Finish. Aluminum supports shall be provided with a smooth non-glare finish.

4. BOLTS, NUTS, WASHERS AND MISCELLANEOUS HARDWARE.
High strength bolts, nuts and washers shall meet the requirements of Section 839.33. Bolts, nuts and washers other than high-strength shall meet the requirements of ASTM A-307 for bolts and the appropriate requirements noted in Subsection 839.33(a) for nuts and washers. All bolts, nuts and washers shall be galvanized utilizing zinc in accordance with the provisions of ASTM A-153 Class C or AASHTO M-232, Class C. Other miscellaneous hardware shall be galvanized in accordance with ASTM A-153 Class B.

(b) OVERHEAD SIGN SUPPORTS.
1. GENERAL.
The Contractor shall furnish five (5) certified copies of mill tests reports covering steel and aluminum. These reports shall include chemical determinations and physical characteristics. When physical characteristics are enhanced by "cold working", the Contractor shall also furnish test reports from a recognized independent laboratory showing yield strengths through the welded area not less than the guaranteed minimum yield strength.
All steel welding shall be in accordance with the provisions of Section 839; aluminum welding shall be in accordance with the provisions of Section 10 of the AASHTO "Specifications for Design and Construction of Structural Supports for Highway Signs."
Fabrication of the structure shall be in accordance with dimensions shown on plans and approved shop drawings. All work shall be done in a workmanlike manner.
All structures shall be fabricated in a plant owned and operated by the
Contractor or a fabricator sufficiently experienced to manufacture structures in accordance with these provisions.

All horizontal units shall be shop assembled to check fabrication.
The structure shall be free from (a) sharp edges and irregularities (b) any misfits or structural deficiencies, and (c) all members must fit and make for an easy and quick erection.

The structure must be protected on all surfaces during shipment so that no injury or defacement takes place during transit to the point of use.
Upright supports and horizontal structure members shall not be delivered to the erection site until such date as the complete structure (less sign faces) can be erected.

2. STEEL STRUCTURES.
Material for steel structures shall be of structural carbon steel or structural low alloy steel meeting the requirements of Division 1, Sections 10.2 and 10.7 of the "AASHTO Specifications for Highway Bridges," latest edition. Steel pipe shall be in accordance with ASTM A-53, Grade B, Schedule 40 or better. Nuts, bolts, and washers shall be in accordance with ASTM A-307 or A-325 as required to meet the strength required to the structure design.

All components of the structure assembly shall be hot-dipped galvanized after fabrication in accordance with ASTM A-153 for fasteners and ASTM A-123 for other steel portions. Hollow sections shall be galvanized on both exterior and interior surfaces, closed hollow sections shall have appropriate sized galvanizing vent holes at each end of a member. Damage to galvanization or any bare areas developed during erection shall be painted with two (2) coats of approved galvanizing paint, Section 859.31.

The Contractor shall furnish five (5) certified copies of zinc coating tests and three metal coupons which have been processed with the structure members. One coupon shall be forwarded with the reports and the other attached to the structure.

3. ALUMINUM STRUCTURES.
Material for aluminum structures shall comply with the following:

<table>
<thead>
<tr>
<th>Shapes, etc.</th>
<th>Alloy &amp; Temper Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extruded tubing</td>
<td>ASTM B-221 6061-T6</td>
</tr>
<tr>
<td>Structural shapes</td>
<td>ASTM B-308 6061-T6</td>
</tr>
<tr>
<td>Pipe</td>
<td>ASTM B-241 6061-T6</td>
</tr>
<tr>
<td>Casting</td>
<td>ASTM B-26 SG-70-A-T6</td>
</tr>
<tr>
<td>Bolts 6061-T6</td>
<td>ASTM B-211 2024-T4* or</td>
</tr>
<tr>
<td>Nuts, 1/4&quot; Tap and Under</td>
<td>ASTM B-211 2024-T4* or</td>
</tr>
<tr>
<td>Nuts, 5/16&quot; Tap and Over</td>
<td>ASTM B-211 6160-T6 or</td>
</tr>
<tr>
<td>Washers</td>
<td>ASTM B-211 Alclad 2024-T4</td>
</tr>
</tbody>
</table>

*In this application the alloy shall have an anodic coating of .0002" minimum thickness with dichromate or boiling water seal.
4. ANCHOR BOLTS.

Anchor bolts shall be of grade of steel capable of transferring the loads safely from the structure base plates to the foundation. Transfer of loads from anchor bolts to the concrete foundation shall be accomplished by providing a right angle bend on the embedment end of anchor bolt. The exposed end of the anchor bolt shall be threaded (rolled or cut type) and provided with appropriate nuts, flat washers, and lock washers. The anchor bolts, nuts, and washers shall be hot-dipped galvanized in accordance with ASTM A-153, however, galvanization of the bolt below six (6) inches from the top of the embedment line will not be required.

880.05 Protection Of Sign Material.

All sign panels shall be protected by packaging after fabrication and during shipment and storage. Packaging and packing shall be adequate to prevent damage to any part of the sign panel, legends, copy or borders. Before packaging all paint shall be thoroughly dry and all signs free of moisture. Adhesive tapes shall not be used on any sign face. All packaged signs shall be kept entirely dry.

All assembled or partially assembled signs, other than flat sheet signs, shall have sufficient braces securely attached to prevent buckling or warping at all times from after assembly has begun until the signs have been attached to their permanent supports.

880.06 Sampling and Testing of Sign Materials.

All hardware such as nuts, bolts, washers, angles, channels, etc., sign panels along with the samples of the materials used in the panels and any certified test reports required and sign supports shall be shipped to the project site. Inasmuch as certain tests require actual inspection of all sign panels, the Contractor shall supply at the time of inspection the necessary personnel for uncrating and movement of the panels.

Until test reports are issued on the sign materials, the Contractor will not be permitted to install the sign materials.

Should any material samples fail or any question arise concerning submitted samples being representative of those on the project, additional samples shall be selected from those on hand at the job site. Failure of resamples shall be cause for rejection of all items of the type involved.

Verification of color by comparison with Color Tolerance Charts published by the FHWA shall be made. Noticeable variation in color shall be cause of ordering inspection of all sign faces and the rejection of any sign face outside the tolerances provided by the Color Charts.

All signs shall be inspected for faulty application, blemishes or other faults that might impair the serviceability of the sign or any noticeable color mismatching when viewed from a distance of 25 feet under both daylight and nighttime conditions shall be cause for rejection of the sign face.
SECTION 881
DELINEATORS AND HAZARD MARKERS

881.01 Standard Delineators.

(a) GENERAL.
A delineator shall consist of one or more colorless or colored reflector units mounted as shown on the plans. A reflector unit shall consist of a hermetically sealed acrylic plastic prismatic reflex reflector housed in an embossed aluminum housing.

(b) REFLECTOR UNITS.
1. REFLECTOR LENS.
The reflector lens shall be methyl methacrylate meeting the requirements of Federal Specifications L-M 500a Type 1, Class 3, and shall be of clear transparent plastic, with a minimum seven (7) square inches of reflective area. The lens shall have a smooth front surface, free from projection or indentation other than a central mounting hole and identification, and a rear surface bearing a prismatic configuration, such as will effect essentially total internal reflection of light. The manufacturers trademark shall be molded legibly on the face or back of the reflector unit. The backing shall be a heat-sealable plastic or metallic foil fused to the lens under heat and pressure around the entire perimeter of the lens and the central mounting hole to form a unit permanently sealed against dust, water and vapor.

2. REFLECTOR HOUSING.
The housing shall be 0.020 inch, aluminum alloy 1100-T0, 5052-T0 conforming to ASTM B-209, formed as shown on the plans to retain the acrylic reflector. The housing shall be marked with name and part number of the manufacturer. An aluminum grommet having a 3/16 inch inside diameter shall be expanded within the reflector mounting hole.

3. REFLECTING REQUIREMENTS.
The specific intensity of each reflector shall be equal to or exceed the following minimum values with measurements made with the reflectors spinning. Failure to meet the specific intensity minimum shall constitute failure of the reflector being tested.

<table>
<thead>
<tr>
<th>Observation Angle</th>
<th>Entrance Angle</th>
<th>Specific Intensity ( \phi_{ii} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.1^\circ )</td>
<td>( 0^\circ )</td>
<td>Crystal: 17.0; Amber: 10.0; Red: 4.0; Green: 4.0</td>
</tr>
<tr>
<td>( 0.1^\circ )</td>
<td>( 20^\circ )</td>
<td>Crystal: 6.5; Amber: 4.0; Red: 1.5; Green: 1.5</td>
</tr>
</tbody>
</table>

\( \phi \) Entrance angle shall mean the angle at the reflector between the direction of light incident on it and the direction of the reflector axis.

\( \phi_i \) Divergence angle shall mean the angle at the reflector between the observer's line of sight and the axis of the incident light beam.

\( \phi_{ii} \) Specific intensity shall mean the candlepower returned by the reflector at the chosen divergence angle per square inch of reflecting surface for each footcandle of illumination at the reflector.
4. OPTICAL TESTING.
   a. Procedure.
   The reflex reflector to be tested shall be located at a distance of 10 feet from a single light source having an effective diameter of 0.2 inch; the light source shall be operated at approximately normal efficiency. The return light from the reflector shall be measured by means of a photoelectric photometer having a minimum sensitivity of 1x10^-7 foot-candle per mm scale division. The photometer shall have a receiver aperture 0.05 inch diameter, shielded to eliminate stray light. The distance from light source center up to aperture center shall be 0.21 inch for 0.1° observation angle. During testing, the reflectors shall be spun so as to average the orientation effect.
   b. Tests.
   All samples shall be tested at normal ambient temperature for compliance with the requirements noted in Item 3 above. In addition, three (3) samples shall be heated for four (4) hours in a circulating air oven at 140°F. plus or minus 5°, removed from the oven and permitted to cool to room temperature and retested for specific intensity. Failure of any sample to retain the minimum specific intensity noted in Item 2 above shall be cause for classifying the unit as defective.

5. SEAL TEST.
   The following test shall be used to determine if a reflector is adequately sealed against dust and water. Submerge all samples in water bath at room temperature. Subject the submerged samples to a vacuum of five (5) inches gauge for five (5) minutes. Restore atmospheric pressure and leave sample submerged for five (5) minutes, then examine the sample of water intake. Evidence of water or moisture within the unit will be considered as failure of the unit.

6. HEAT RESISTANCE TEST.
   This test shall be divided into two parts; the first part being a test for deformation of shape at a possible temperature obtainable on the job (140°F.) and the second part a heat test to help evaluate the grade of plastic contained in the unit. Part 1: Three reflectors shall be heated for four (4) hours in a circulating air oven at 140°F. plus or minus 5°, with the specimen placed in a horizontal position on a grid or perforated shelf which will permit free air circulation. At the end of the heating period the samples shall be removed from the oven, permitted to cool to room temperature and examined. Deformation or a significant change in shape shall be cause for classifying the unit as defective. (Samples used in the optical test noted in Paragraph 2 of Item 4b may be used for this test.) Part 2: This part of the heat test is for evaluation of the material only, therefore, any unit constructed so that an air pocket exists between the face of the reflector lens and the backing surface shall be vented. The test shall be the same as noted for part 1 above, except the temperature used shall be 175°F. plus or minus 5°. Deformation or a significant change in shape shall be cause for classifying the unit as defective.

7. SAMPLING PROCEDURE AND TEST REQUIREMENTS.
   The State of Alabama Highway Department has established a Qualified Traffic Control Devices and Materials list for reflectors. Refer to Subsection 106.01(f) of the AHD Standard Specifications (1989) and AHD Procedure 355 concerning this list. Approval of the reflectors shall be based on the testing of 50 samples submitted by the manufacturer for compliance with the specific tests noted hereinbefore in this Section, a certification that the lens material used in the manufacture of the reflector units conform to the Federal Specifications as noted in Item 1 above and the
following: Failure on any specified test of more than four percent but not in excess of 10 percent shall be cause for requiring resubmission of samples by the supplier. A resubmitted qualification submission will be rejected if the retesting produces failures in excess of four percent of the number of samples tested. Failure of more than 10 percent will be cause for disapproval of the particular model being tested.

8. PACKAGING.
The reflectors shall be supplied in suitable containers which will protect the units from damage during shipment and storage. Containers shall be legibly marked with the name, type, etc. of the contents.

9. JOB CONTROL AND JOB ACCEPTANCE.
Job acceptance of reflector units will be based on the receipt of a certification from the manufacturer that the reflectors furnished to the job were made from the same material and by the same manufacturing process as were qualification samples and verification tests of the qualification test by the testing of samples selected by the following procedures:

Each shipment of reflector units shall be divided into approximate equal lots not to exceed 3,000 units per load and sampled as follows:

Samples shall be selected from lots by random number by selecting 1% of the lot; however, in no event shall the number of samples selected be less than three (3). Failure on any specified test of more than 5% but not in excess of 12% will be cause for resampling. Failure of more than 12% shall be cause for rejection of the sampled lot. Resampling shall be accomplished in such a manner as to produce twice the number of samples as required for the original sampling. A resampled lot shall be rejected if the retesting produces failures in excess of 5% of the number tested.

NOTE: In determination of the number of samples involved in the above noted requirements, any fractional product produced shall be rounded off to the next whole number. Multiple Reflector Units shall consist of 2 or more reflectors mounted on a panel to form a single unit. Acceptance of Multiple Unit Reflectors shall be made by selecting one unit of each type and color for each 200 or less units required for the project. Samples shall be selected by random number. Failure of any reflector per each 200 unit sample shall be cause for resampling of that particular 200 sample unit resampling shall require selection of 2 units for retesting. Failure of any reflector on resample tests shall be cause for rejection of the entire 200 sample unit. All job selected samples used in performing the tests noted above that are not destroyed or made unusable by the tests shall be returned to the project.

(c) POSTS.
The posts shall be of the design and weight as shown on the plans. Posts shall be straight with no bending, warping, splits or other defects. Mounting holes shall be punched or drilled on the centerline of the web, as shown on the plans. Steel posts shall be manufactured from rerolled rail steel meeting the requirements of ASTM A-499, Grade 60, or a comparable new billet steel. The steel in the posts shall meet the chemical requirements of ASTM A-1 for rails having a nominal weight of 91 pounds per yard or greater, modified to require the carbon content to be between 0.67 and 0.89 percent. The posts shall be hot-dipped galvanized after forming, cutting, punching or drilling has been completed. Galvanization shall be in accordance with ASTM A-123. Aluminum posts shall be manufactured from aluminum alloy 6063-T6.

881.02 Reflective Hazard Markers.

(a) GENERAL.
A hazard marker may be either a series of reflector units (three or more)
mounted on special backup plate or a designated standard or special reflectorized sign panel.

(b) REFLECTORS.
The reflectors shall comply with the requirements for delineator type reflectors noted in Subsection 881.01(b), except the metal housing and metal center grommet will not be required.

(c) BACKUP PLATES.
The backup plates for the hazard markers shall be at least 0.064 inch thick embossed aluminum sheets. The surface of the marker facing traffic shall be treated with a coating of baked on yellow enamel (Highway yellow). Attachment of the reflectors to the backup plate and of the backup plate to the post or mounting surface shall be in accordance with the details shown on the plans.

(d) POSTS.
Posts used for mounting hazard markers shall be in accordance with the details shown on the plans and the requirements of Subsection 881.01(c).

(e) MOUNTING.
Mountings other than on posts shall be in accordance with plan details.

(f) SAMPLING AND TESTING.
Sampling and Testing of the reflector units shall be as prescribed in Subsection 881.02(b).

(g) STANDARD OR SPECIAL SIGN PANELS.
The panel shall comply with the requirements of Section 880 for signs with the legend or marking as required by plan details. Sign panels shall be sampled and tested as prescribed in Section 880.
SECTION 882
PAVEMENT MARKERS

882.01 General.

(a) SAMPLING PROCEDURE AND TEST REQUIREMENTS.

The State of Alabama Highway Department has established a Qualified Traffic Control Devices and Materials list for reflectors. Refer to Subsection 106.01(f) of the AHD Standard Specifications (1989) and AHD Procedure 355 concerning this list. Approval of the markers shall be based on the testing of 50 samples submitted by the manufacturer for compliance with the specific tests noted hereinafter in this Section. Failure on any specified test of more than four percent, but not in excess of 10 percent will be cause for requiring resubmission of samples by the supplier. A resubmitted qualification submission will be rejected if the retesting produces failures in excess of four percent of the number of samples tested. Failure of more than 10 percent will be cause for disapproval of the particular model being tested.

(b) JOB CONTROL AND JOB ACCEPTANCE.

Job acceptance of markers will be based on the receipt of a certification from the manufacturer that the markers furnished on the job were made from the same material and by the same manufacturing process as were the qualification samples and verification tests of the qualification tests by the testing of samples selected by the following procedure.

Each shipment of marker units shall be divided into approximate equal lots not to exceed 3,000 units per lot and sampled. Samples shall be selected from lots by random number by selecting one percent of the lot; however, in no event shall the number of samples selected be less than three (3). Failure on any specified test of more than five percent but not in excess of 12 percent will be cause for resampling. Failure of more than 12 percent shall be cause for rejection of the sampled lot. Resampling shall be accomplished in such a manner as to produce twice the number of samples as required for the original sampling. A resampled lot shall be rejected if the retesting produces failures in excess of five percent of the number tested. NOTE: In determination of the number of samples involved in the above requirements, any fractional product produced shall be rounded off to the next whole number.

(c) RETURN OF JOB SAMPLES.

All job selected samples used in performing the tests noted above that are not destroyed or made unusable by the tests shall be returned to the project.

(d) PACKAGING.

The markers shall be supplied in suitable containers which will protect the units from damage during shipment and storage. Containers shall be legibly marked with the name and type, etc. of the contents.

882.02 Class A Markers (Reflective).

(a) GENERAL.

Class A pavement markers shall consist of one or two prismatic type reflectors as may be required enclosed in a high impact plastic shell, filled with a suitable inert thermosetting compound filler, so constructed as to form a solid, sealed, water tight unit. The markers shall be of the general size and shape shown on the plans and provide a minimum of 2.6 square inches of reflective surface for each reflective face. The base of the marker shall be flat (deviation from a flat surface
shall not exceed 0.05 inch) rough textures (comparable to at least that of a fine grade of sand paper) and free from gloss or substances which may reduce the markers bond to the adhesive. The markers shall be so designed that they can be firmly affixed to the pavement by an epoxy adhesive in such a manner that they will not be loosened or displaced by traffic. The adhesive shall in general be that recommended by the manufacturer of the item, however, the adhesive shall conform to the appropriate requirements of Section 870 of the AHD Standard Specifications for attachment of pavement markers to a pavement and shall be demonstrated to produce the desired results before permission to install the markers will be given.

(b) REFLECTIVE REQUIREMENTS.

The specific intensity of each reflecting surface shall be equal to or exceed the following minimum values. Failure to meet the specific intensity minimum constitutes failure of the reflector being tested.

<table>
<thead>
<tr>
<th>Observation Angle</th>
<th>Entrance Angle</th>
<th>Specific Intensity</th>
<th>Crystal</th>
<th>Red</th>
<th>Ambe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2°</td>
<td>0°</td>
<td>0.85</td>
<td>0.22</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>0.2°</td>
<td>20°</td>
<td>0.35</td>
<td>0.08</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

φ Entrance angle shall mean the angle at the reflector between the direction of light incident on it and the direction of the reflector axis.

φi Divergence angle shall mean the angle at the reflector between the observer's line of sight and the axis of the incident light beam.

φii Specific Intensity. This shall mean the candlepower returned by the reflector at the chosen divergence angle per square inch of reflecting surface for each footcandle of illumination at the reflector.

(c) OPTICAL TESTING.

1. PROCEDURE.

The markers to be tested shall be located with the center of the reflecting face at a distance of five (5) feet from a uniformly bright light source having an effective diameter of 0.2 inches. The photocell width shall be 0.05 inch. It shall be shielded to eliminate stray light. The distance from light source center to the photocell shall be 0.21 inches. If a test distance of other than five (5) feet is used, the source and receiver dimensions and the distance between source and receiver shall be modified in the same proportion as the test distance.

2. TESTS.

All samples shall be tested at normal ambient temperatures for compliance with the requirements noted in Item 1 above. In addition, three (3) markers shall be heated for four (4) hours in a circulating air oven at 140°F, plus or minus 5°F., removed from the oven and permitted to cool to room temperature and retested for Specific Intensity. Failure of any marker to retain the minimum reflective requirements noted in Item 1 above shall be cause for rejection of the lot.

(d) SEAL TEST.

The following test shall be used to determine if a reflector is adequately sealed against dust and water. Submerge all samples in water bath at room temperature. Subject the submerged samples to a vacuum of five (5) inches gauge for five (5) minutes. Restore atmospheric pressure and leave sample submerged for five (5) minutes, then examine the sample for water intake. Evidence of water or moisture within the unit will be considered as failure of the unit.
HEAT RESISTANCE TEST.
This test is as test for deformation of shape at a possible temperature obtainable on the job (140°F.) and to help evaluate the grade of plastic contained in the unit. Three markers shall be heated for four (4) hours in a circulating air oven at 140°F. plus or minus 5°, with the specimen placed in a horizontal position on a grid or perforated shelf which will permit free air circulation. At the end of the heating period the samples shall be removed from the oven, permitted to cool to room temperature and examined. Deformation or a significant change in shape shall be cause for classifying the unit as defective. (Samples used in the optical test noted in Subsection 882.02(c) may be used for this test.)

STRENGTH REQUIREMENTS FOR MARKERS.
Markers shall be capable of supporting a load of 2,000 pounds applied in the following manner:
A marker shall be centered over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be at least one (1) inch high, with an internal diameter of approximately three (3) inches, and with a minimum thickness of 1/4 inch. Loading shall be slowly applied to the top of the marker through a one (1) inch diameter by one (1) inch high metal plug centered on top of the marker. Failure shall constitute either breakage or significant deformation of the marker at any load of less than 2,000 pounds.

MARKER HOUSING COLOR.
The marker housing shall be of a color, except for the reflective surface, that will be compatible with the traffic stripe color being supplemented, and consistent with the requirements noted in Section 705.01 of the AHD Standard Specifications (1989).

ADHESIVE BOND STRENGTH.
The adhesive tensile bond strength to the bottom of the marker approved for use on the project and the epoxy adhesive approved for use on the project shall be not less than 475 psi.

882.03 Class "B" Marker (Non-Reflective).

GENERAL.
Class B pavement markers shall be formed of heat fixed ceramic base material constructed in such a manner as to form a solid, watertight unit. The markers shall be of the general size and shape shown on the plans with smooth rounded corners. Any change in the curvature shall be gradual. The top and sides of the marker shall be smooth and free from mold marks, pits, indentations, air bubbles, or other objectionable marks or discolorations. The base of the marker shall be flat (deviation from a flat surface shall not exceed 0.05 inch) rough textures (comparable to at least that of a fine grade sand paper) and free from gloss or substances which may reduce the markers bond to the adhesive.

MATERIALS.
Ceramic - Heat fired, vitreous, ceramic base and a heat fired, opaque, glazed top surface. The bottom surface shall be unglazed, suitable for cementing to the road surface. The marker may be produced from any suitable combination of intimately mixed clays, shales, talcs or other inorganic material. The marker shall be thoroughly and evenly matured and free from defects which will affect the appearance and serviceability.
(c) TESTS.

1. Color.
   White - Brightness relative to Magnesium Oxide - 80% Minimum. Yellow - Brightness relative to Magnesium Oxide - 40% Minimum and match the standard shade within the red and green balances when compared with Color Chip 33538 of Federal Standard No. 595.

2. Water absorption - 2% Max. (ASTM C-373)

3. Hardness-
   Moh Hardness - 6 Min.

4. Autoclave Test -- shall not craze, spall or peel when subjected to one cycle at 250 psi -ASTM C-424.

5. Glaze Thickness - 0.005 in. Min.

6. Strength - 1,500 lb. Min. -
   Using the equipment noted in Subsection 882.02(f), an average compressive strength of three (3) markers shall be obtained; however, any individual marker which fails under a compressive load of less than 1,200 pounds shall be cause for rejection of the marker lot being tested.

7. Adhesive Bond Strength -
   The adhesive tensile bond strength to the bottom of the marker accepted for use on the project and the epoxy adhesive accepted for use on the project shall be not less than 1,500 psi.