Section 1

Lines, Grades and Construction Stakes

When Construction Layout Staking is not included as a pay item in the proposal, the Engineer or his representative shall set all line and grade stakes, and will establish base lines and bench marks needed to complete the work. The Contractor shall provide proper facilities and assistance for clearing and grading where required to complete the field survey. Survey stakes and points will be placed at the location and at the distance from the line of construction as requested by the Contractor. The Contractor shall notify the Engineer one full working day (twenty-four (24) hours minimum) in advance for any additional need for services in staking for the construction work.

The Contractor shall carefully preserve all bench marks, reference points and stakes which have been set by the Engineer, and in case of willful or careless destruction of the same by the Contractor, he shall be charged with the resulting expense of resetting and shall be responsible for any mistakes which may be caused by the loss or disturbance of such bench marks, reference points and stakes.

All parts of the completed work shall conform to the lines and grades set by the Engineer.

Section 2

Clearing, Grubbing and Removal of Trees, Stumps and Shrubs

Clearing, grubbing and removal of trees, stumps and shrubs shall be performed in accordance with the General Specifications of the Southwest Ohio Engineers Association (as modified by the City of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications except as supplemented below. The following directives have precedence over the other specifications referenced in all cases where the requirements conflict.

The Engineer shall control all clearing and grubbing. The Engineer, together with the City Horticulturist, shall specifically identify and mark all trees, stumps and shrubs to be removed. The Contractor will only remove such trees, stumps and shrubs marked by the Engineer.

The Contractor will exercise extreme caution not to damage any trees, stumps, shrubs or other vegetation not marked for removal. The Contractor will, at no cost to the city, replace trees, shrubs and other vegetation in accordance with the Engineer's direction when such items were not marked for removal and were damaged or removed by the Contractor.

Sidewalks, driveways, curbs/gutters and roadway damaged by stump removal shall be repaired at the completion of all stump removal operations. The Contractor will be paid for restoration costs in all cases except where the Engineer determines that an excessive amount of damage resulted from the Contractor's carelessness.

Section 3

Excavation, Backfill and Embankment

Excavation, backfill and embankment shall be performed in accordance with the General Specifications of the Southwest Ohio Engineers Association (as modified by the City of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications except as supplemented below. The following directives have precedence over the other specifications referenced in all cases where the requirements conflict. All top soil removed shall be stockpiled for future covering of the excavated or otherwise disturbed areas.

The Contractor shall exercise caution not to damage roots (any more than is necessary to complete the work) encountered during excavation unless roots are part of a tree designated for removal.

The Contractor shall use bracing, sheeting, pilling or other approved means to support excavated areas as needed and shall keep excavated areas dewatered using suitable pumping equipment. The Contractor is responsible for protecting excavated areas from saturation and/or other damage and will repair such damage as it occurs at no cost to the City. “Soft” subgrade caused by inundation shall be dewatered and satisfactorily corrected with “french” drains or tile to satisfaction of the Engineer, or the “soft” material will be removed to satisfactory bearing material and backfilled with Class “C” concrete or other suitable material approved by the Engineer.

Where unsuitable bearing materials are encountered at finish grade, the Engineer will direct the Contractor to either excavate further and backfill with suitable bearing material, or take other appropriate action to correct the situation. The Contractor will receive full payment in accordance with the contract price or as extra work for all such additional work performed except when the unsuitable bearing material resulted from carelessness by the Contractor as discussed in the preceding paragraph.

Backfill and embankment will be placed to minimize subsequent settling. The Engineer will examine surplus excavated material prior to removing it from the site and determine whether it shall be stockpiled for future use or otherwise disposed. Subgrade compaction shall normally be performed using a 5 ton minimum roller, either 3 wheel or vibratory. Smaller areas requiring compaction may, upon approval of the Engineer, be compacted using a hand held vibrating plate type compactor. Where the subgrade exceeds moisture contents suitable for compaction, the Contractor shall aerate the subbase by plowing or disking until the moisture content is reduced to an acceptable level. The cost of such aeration is to be included in the bid price for Subgrade Compaction.

Where topsoil placement is required, the Contractor shall backfill and embank to within 4” of final grade, making reasonable allowance for settlement; topsoil shall then be placed to meet final grade.

Section 4

Excavating Brick Roads/Salvage of Brick

The Contractor shall excavate brick roads and salvage bricks as follows:

When excavation of brick roads or gutters is called for in the plans, the Contractor shall carefully remove the bricks to avoid breakage and use the same bricks to restore the excavated area to its original condition. When additional bricks are needed to complete restoration, the Contractor may only use bricks approved by the Engineer.

If bricks are encounted under asphalt or concrete streets or during any other excavation, the Contractor shall do the following:

1. Carefully remove the bricks to avoid breakage, hand digging and handling where necessary.

2. Clean, deliver and stack bricks at the City maintenance yard at 210 Shafor Boulevard.

Section 5

Asphalt Pavement, Roadways, Parking Areas and Walks

Asphalt pavement, roadways, parking areas and walks shall be constructed in accordance with the General Specifications of the Southwest Ohio Engineers Association (as modified by the City of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications referenced in all cases where the requirements conflict.

No base material, leveling, intermediate or surface courses shall be placed until the subgrade has been properly shaped and compacted. Roadways shall be compacted to 90% of maximum density as determined by AASHO T 99 or other approved method except that the soil for a depth of 11 inches below pavement subgrade shall be compacted to not less than 95%. Where soft subgrade is encountered and satisfactory compaction cannot be secured, the Engineer shall direct the Contractor to aerate the subgrade by moisture control and compaction. If in the opinion of the Engineer the base is suitable, he may direct that the unstable material be removed and replaced with either #2 stone or surplus excavation or borrow of suitable quality and then compacted as specified above. All loose or foreign material shall be removed and the subgrade shall be free of ruts or standing water when compaction begins or the base material is placed.

5-1 STANDARD ASPHALT PAVEMENT

Unless otherwise shown on the plans, all roadway and parking areas shall consist, in general, of the following:

Base shall consist of the following:

STREETS WITH EXISTING AGGREGATE BASE:

Base shall consist of a 10 inch course of compacted aggregate applied as two courses, each course 5 inches in depth when compacted, and 1 inch screenings. Material and method of construction shall meet the requirements of ODOT Item #304, Aggregate Base, except for course thickness. If an asphalt base ODOT Item #301 is approved for use, the baes must be a minimum of 20% recycled material in the mix.

STREETS WITH EXISTING CONCRETE OR BRICK BASE:

Base shall consist of a 10 inch course of concrete tamp mix, 3000 psi, placed in 2 compacted lifts. Surface of tamp mix shall be wetted with water prior to compacting to aid in obtaining maximum compaction.

Prime cost shall meet all the requirements of ODOT 702.02, RT-2, RT-3, MC-70, MC-30 or MC-250 and applied according to Item 408, Prime Cost, at the rate of 0.50 gallons per square yard.

Intermediate course – The Contractor shall apply a 1-1/2” (minimum) thickness asphalt course meeting the specifications of ODOT Item 402 with a minimum of 6% liquid asphalt and a maximum of 20% recycled material in the mix.

Wearing Surface – The wearing surface shall be an asphalt concrete surface meeting all the requirements of ODOT Item 404, Surface Course, 1 inch minimum thickness with a minimum of 6% liquid asphalt and no recycled material allowed.

Where the new pavement meets the existing pavement, a butt joint shall be made, and the edges of the existing pavement shall be saw cut in a straight line and round or cracked material shall be removed. The junction of the two shall be smooth and flush.

5-2 ASPHALT WITH GILSONITE MODIFIER

The bituminous material shall be 92% asphalt cement and 8% Gilsonite asphalt modifier. Gilsonite is available from the American Gilsonite Company, 131 East Temple Street, Salt Lake City, UT 84111. The Contractor shall finish the manufacturer's certification that the Gilsonite meets the following specification requirements:

Granular Solid	300-350F
Softening Point, ASTM E28-51T	1,045 +/-0.015
Specific Gravity	0
Penetration @77F, 100gm, 5sec.	
Color	Black
Flash Point, COC	550F min.

The Gilsonite shall be added to the asphalt concrete using one of the following methods:

1. Blended into the liquid asphalt cement in an agitated tank heated to a minimum temperature of 345F.
2. Added to the batch plant pug mill during the dry cycle and increasing the mix time by 15 to 20 seconds per batch.
3. Added to a dryer drum plant through the recycle ring or dry mineral feeder.

5-3 EDGE SEALING

All edges between new and old asphalt work shall be sealed with asphalt sealant. Edges between new asphalt pavement and concrete curbs, aprons and street pavement shall be likewise sealed. Along curb line joints, the Contractor shall apply 2 coats of AC 20 asphalt sealant; one coat prior to laying the final course and one coat after laying the final course. Wherever possible, this application shall be done using a distribution truck. No additional payment shall be made for this sealant.

The Contractor shall apply this sealant in a careful manner to avoid covering the curb face with the sealant. Where, in the opinion of the Engineer, excessive sealant is applied to the curb, the Contractor shall, at no additional cost to the City, remove the sealant and restore the curb to its original condition.

5-4 SPECIAL WALKS

Walks shall be as specified above unless otherwise shown for roadway and parking areas except that a 4 inch aggregate base shall be used, sloped away from structures and center crowned in open areas.

5-5 TEMPORARY ROAD WIDENING

Temporary roads shall consist of 19 inches of compacted #304 with a seal coat or 6 inches of #301 bituminous aggregate base.

5-6 COLD PLANING

The Contractor shall uniformly cold plane pavement areas shown on the plans, or as specified by the Engineer, to the depth shown on the plans or in the Proposal. This work shall include furnishing of all equipment, trucking and labor to complete the cold planing operation, including clean-up as specified herein.

The cold planing operation shall be performed with a rotary drum-type machine with randomly spaced teeth to produce a textured surface which varies no more than 1/4 inch from the datum elevation. The machine shall not exert more than 6,000 p.s.f. loading on the milled surface and shall convey the planed material directly to trucks. All cold planing work shall be performed with a full width automatic milling machine (Caterpillar, C.M.I., Barber=Greene or other approved equipment) unless otherwise authorized by the Engineer.

The Contractor shall strip all asphalt material from the concrete gutter plates and sweep this area for inspection prior to beginning cold planing operations. After the Engineer has inspected the work, he may direct the Contractor to 1) proceed with cold planing and have an exposed gutter finished pavement section; 2) replace certain curb and gutter sections; 3) replace poor curb and gutter sections with barrier curb and grind down and pave over the remaining gutter sections. Payment for gutter plate cleaning shall be included in cold planing.

The Contractor shall make every effort to machine plane all areas of the work; however, irregular or inaccessible sections of pavement must be removed by hand, if stipulated by the Engineer. The area to be planed is generally asphalt material, however, concrete, stone or brick material may be encountered in some locations. No extra will be paid by the City of Oakwood for removal of this other material to the depths specified. In most cases, the stripped material shall become the property of the Contractor, and shall be promptly removed from the work site; however, the City reserves the right to retain a portion of the millings.

Hauling vehicles shall not be loaded with more than 10 tons of planed material and shall be operated on designated haul routes only (See Division 1, Section 77). Fully loaded equipment will not be driven over the stripped area.

After planing, the stripped surface shall be swept clean and tree lawns, sidewalks, etc., shall be carefully cleared of all asphalt or other stripped material. The Engineer will inspect the area and mark those areas which, if necessary, require further excavation, base replacement and compaction.

All air quality and noise suppression regulations of the City of Oakwood, E.P.A. and/or R.A.P.C. must be adhered to by the Contractor during the planing operation.

5-7 PAVEMENT FABRIC

The Contractor shall apply and install non-woven reinforced waterproof membrane pavement fabric material when shown on the plans.

All street cleaning, leveling, filling, tack coat and material laydown work as described herein shall be included in the unit price for pavement fabric.

The fabric shall be a needle-punched, nonwoven, fused on one side, polypropylene or polyester pavement reinforcing fabric meeting the following specifications:

Test Method	Test Method	Polypropylene Typical	Absolute Minimum Polyester Typical	(Any Principle Direction)
Weight, oz/sq.yd.	ASTM D1910	4.3	4.2	3.8
Tensile Strength	ASTM D1682	115 lbs	150/115 lbs	90 lbs
Elongation-at-Break	ASTM D1682	65%	75/85%	50%
Mullen Burst Strength	ASTM D3786	235 psi	225 psi	210 psi
Asphalt Retention, gals./sq.yd.		---	---	0.20

The Contractor shall submit samples and certification letter from suppliers and receive written approval from the Engineer prior to any fabric being brought to the job site.

Asphaltic Sealant: The asphalt sealant shall meet the requirements of AASHTO M-20/AASHTP M-226 (Penetration or Viscosity grade to be determined by the Engineer). No other material other than AC-20 will be accepted as a sealant by the City of Oakwood. The asphalt cement used shall be uncut and not contain oil distillates, kerosene or other spirits.

Aggregate: Although not always required, small quantities of hot mix spread over the fabric will serve to facilitate movement of construction equipment over the fabric during overlay.

Asphalt Distributor: The distributor must be suitably metered and capable of spraying the asphalt sealant at a prescribed uniform application use. No drilling or skipping shall be permitted. The Engineer may require satisfactory test application at an off-site area to insure proper equipment performance. The distributor should be equipped with a hand spray with single nozzle and positive shut-off valve.

Fabric Handling Equipment: Mechanical equipment shall be used to lay fabric. This equipment shall be capable of handling full rolls and laying the fabric smoothly without excessive wrinkles and/or folds. Fabric handling equipment shall be approved by the Engineer prior to the start of the work.

Miscellaneous Equipment: Stiff bristle brooms to smooth fabric and scissors (or blades) to cut the fabric shall be provided by the Contractor.

Surface Preparation: The surface on which the fabric is to be placed shall be swept free of dirt, water and vegetation. If no leveling course is specified prior to placing the fabric, all cracks or holes shall be repaired with slurry, cold or hot mix.

Application of Sealant: The asphaltic sealant and binder must be uniformly spray applied at the specified rate.

Application of the sealant will be by distributing equipment whenever possible, with hand spraying kept to a minimum. Temperature of the asphalt sealant must be sufficiently high to permit a uniform spray pattern and provide adhesion. For AC-20 asphalt cement, the minimum recommended temperature is 290 degrees F. To avoid damage to the fabric, distributor tank temperatures should not exceed 330 degrees F.

The target width of asphalt application will be fabric width plus 2 to 6 inches. The Contractor shall maintain tack arms free of traffic.

Asphalt spills must be cleaned from the road surface to avoid leeching to the surface and possible fabric movement at these asphalt-rich areas.

Fabric Placement: The fabric shall be placed into the asphaltic sealant with a minimum of wrinkles or folds. The fabric shall be placed as soon as possible after the application of the tack coat while the tack coat is still hot and in a semi-fluid state. No fabric shall be placed on asphalt cement which, in the opinion of the Inspector, has cooled and lost tackiness. The fabric shall be unrolled so that the bearded (fuzzy) side is unwound into the sealant. Wrinkles severe enough to cause folds shall be slit and layered flat. Maximum fabric contact with the pavement surface shall be achieved through brooming.

To maximize the bond between the fabric and existing surface, the Contractor shall pneumatically roll the fabric prior to the placement of the surface treatment if the outside ambient temperature is less than 55 degrees F. No work shall be performed when the ambient temperature is less than 50 degrees F.

Wind conditions should be such that, in the Engineer's opinion, satisfactory placement of fabric can be achieved.

Overlap of fabric joints should be a minimum 6 inches to insure full closure of the joint. Transverse joints shall be lapped in the direction of paving to prevent edge pick-up by the paver. The distributor shall apply an overspray of asphalt cement under the longitudinal joint so a satisfactory fabric lap can be formed. Fabric shall be placed in all turnouts. On curved streets, fabric may be applied in half roll widths. General traffic shall not be allowed on the uncovered fabric.

Removal and replacement of fabric that is damaged after placement is the responsibility of the Contractor.

Fabric Overlay: Placement of the hot mix overlay should closely follow fabric laydown. **No more fabric than can be overlayed that working day shall be placed.** In the event that the sealant bleeds through the fabric before the hot mix is placed, it may be necessary to blot the sealant by spreading hot mix over the affected areas. This will prevent any tendency for construction equipment to pick up the fabric when driving over it. Turning operations of the paver and other vehicles over the uncovered fabric must be gradual and kept to a minimum to avoid movement or damage to the membrane. Care shall be exercised to insure that no rips or tears occur in the fabric during placement of the surface course. Temperature of the overlay asphalt mix shall not exceed 325 degrees F.

Manufacturer's Representative. The Contractor shall notify the fabric representative as early as possible prior to construction so that he may be on the project to provide whatever technical assistance is required to aid satisfactory placement. The individual or company shall have a minimum of three construction years' experience in the placement of the fabric.

Joint Fabric: The Contractor shall furnish and install either an asphalt polypropylene type pavement joint fabric or a weaver fiberglass type pavement joint fabric at all rigid pavement joints or major cracks as shown on the plans or specified by the Engineer.

The polypropylene material shall consist of outer layers of needle punched, nonwoven polypropylene and a center core of asphalt mastic and shall have a minimum weight of 12 oz. per square foot with an asphalt content of .8 gal. per square yard of material.

The joint area shall be cleaned and leveled and all areas spanning openings greater than 1-1/4 inch shall be filled with asphalt. A fogging tack coat of .15 gal. per square yard concentration will be applied using an uncut asphalt cement (AC-20). The polypropylene fabric will be placed with a minimum number of joints and with a 4-inch lap at each joint.

The woven fiberglass material shall have a minimum weight of 24 oz. per square yard and a minimum, tensile strength of 1250 lbs. per inch. The joint area shall be cleaned and a specifically formulated polymer having high adhesion shall be placed in the joint or crack or squeegeed or spread to the approximate width of the fiberglass material. The fiberglass shall be immediately placed over the polymer without folds or wrinkles and a second coating of polymer shall be applied to the fiberglass material and spread to a thin consistency. The entire pavement shall next have a tack coat of .2 gal. per square yard applied in preparation for the 402 leveling course.

5-8 PAVEMENT COMPACTION

Pavement compaction shall be completed in accordance with ODOT specifications except that finish rolling shall not be completed using a pneumatic-tire roller.

Section 6

Stress Absorbing Membrane

Guideline for Materials and Placement

DESCRIPTION – The stress absorbing membrane (SAMI) system shall consist of furnishing, preparing, and systematically applying a polymerized emulsion, or polymerized asphalt cement and cover materials to pavement surfaces as described. The applied materials shall completely seal the entire surface and provide a uniform textured surface for hot mix paving.

SELECTION OF (SAM) BINDER –

1. SAM-CE, emulsion shall be used for all construction except when temperatures fall below specified range, or when construction requirements dictate immediate application of hot mix paving.

2. SAM-AC, hot applied binder shall be used for construction, when temperature requirements dictate, or when the hot mix paving is to be performed immediately.

SAM-CE	MIN.	MAX.
ASTM D244 Viscosity, SSF, 122 F	-	400
ASTM D244 Storage Stability, 24 hours	-	1
ASTM D244 Sieve Test, 20 mesh. o/-	-	0.1
ASTM D244 Distillation or Evaporation	65%	-
**ASTM D113 Force Ductility of Residue @ 39 F., 40 cm. – 70 cm.	13lbs/sq. in.	

SAM-AC	MIN.	MAX.
ASTM D5 Penetration, 77 F., 100 grams, 5 sec.	60	120
*ATSM D113, % Recovery, 39 F	60%	-
ASTM D2398 Softening Point, Ring & Ball	100 F	-
**ASTM D113 Force Ductility at 39 F., 40 cm. – 70 cm.	13 bs/sq. in.	-

*This test is an extension of the routine ductility test. When the specimen is extended 10 cm. the distressed area is severed in the middle by a pair of shears. After 1 hour at the test temperature the severed distressed ends are returned to contact and the ductilometer reading is read again. The sample must recover at least 60% of the 10 cm. distance or to a reading of 4 or less.

**ASTM D113 as modified by the addition of a load cell to the standard ductility test apparatus. The load cell records pounds per square centimeter. Readings are multiplied by 6.45 to yield pounds per square inch force required to extend the test specimen.

The asphalt modifier shall be of a SBS type polymer. Styrene-Butadiene-Styrene. The modifier shall be added to the asphalt cement prior to the emulsification process.

BINDER APPLICATION RATE (GALLON PER SQ. YD.) -

BINDER	TACK COAT	TYPE I	TYPE II
SAM – CE	0.25 - 0.40	0.45 - 0.55	1.55 – 1.75
SAM – AC	0.17 – 0.25	0.32 – 0.40	0.40 – 0.60

The supplier of (SAM) binder is to design the application rate of the cover material and binder in relation to the surface. This rate shall be approved by the Engineer prior to use.

APPLICATION TEMPERATURE OF BINDER –

SAM – CE	160 F. – 190 F.
SAM – AC	250 F. – 340 F.

AGGREGATE - The aggregate shall be slag, gravel, or limestones, one hundred percent crushed, and shall conform to section 703.05 of the Ohio Construction and Material Specifications.

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.

STOCKPILES – Stockpiling and loading methods shall be such as to permit ready identification of the material and to minimize segregation. Sites for stockpiles shall be clean prior to storing materials. Material shall not be removed from stockpiles within one foot of the ground until final cleanup of the work.

Materials shall be handled in such a manner that the moisture content will be reasonably uniform for each days run.

SPECIFIED GRADATION BY APPLICATION TYPE - PERCENT BY WEIGHT			
Sieve Size	SAM Tack Coat	SAM Type I	SAM Type II
1 ½”	100		100
1”	100	100	95-100
¾”	100	100	-
½”	100	100	25-60
3/8”	95-100	85-100	-
#4	85-100	0-30	0-10
#8	0-15	0-10	0-5
#16	0-5	0-5	-
Application Rate			
Lbs./Sq. Yd.	12-16	25-32	45-60

CONSTRUCTION –

WEATHER LIMITATIONS – No SAM-CE emulsion shall be applied unless the atmospheric temperature is 50°F. and rising nor when the temperature has been below 40°F. in the preceding 12 hours. For applications using the SAM-AC the air temperature must be 35°F. and rising, provided the cover material is heated, (min. 100°F.) or the cover material has been pre-dried, and covered from moisture. No bituminous material shall be applied while the surface is wet nor impending weather conditions are such that proper curing may not be obtained.

PREPARATION OF SURFACE – The surface shall be thoroughly clean and dry when the bituminous material is applied. Material cleaned from the surface shall be removed and disposed of as directed by the Engineer. Removal of mud, clay, and other fine silts shall be accomplished by high pressure water, min. 6,000 PSI..

APPLYING BITUMINOUS MATERIAL – The bituminous material, heated to a temperature within the specified range, shall be applied by means of a pressure distributor. The material shall be applied with uniformity to prevent ridging or streaking in the completed surface. The application shall be considered satisfactory when the actual rate is within plus or minus five (5) percent of the required rate.

COMPACTION – Immediately following the application of cover material, the freshly treated surface shall be rolled using a minimum of two rollers. At no time shall the rollers lag more that 500' behind aggregate spreader. The entire treated surface shall receive a minimum of two passes.

Rollers shall be of the pneumatic tire type, meeting the minimum requirements. All ballasting shall conform to manufacturer's specifications.

Minimum requirements –

- Tire size – 7.50x15
- Wheel load – 2,000 lbs.
- Average tire contact pressure (55 lbs. per sq. inch)

SPECIAL NOTE – When the SAM-CE emulsion is curing slowly due to cool temperature or high humidity, the roller lag distance shall be increased, such that compaction is occurring at the same time of emulsion break. No traffic shall be permitted until compaction is complete.

SPREADING COVER MATERIAL – Material spreader shall be self-propelled and shall be equipped with hoppers, revolving cylinders and adjustments necessary to produce a uniform distribution of particles at the specified rate. Immediately following the application of the bituminous material, cover material shall be applied uniformly without ridges or laps at the specified rate adjusted as directed by the Engineer to produce a minimum of excess loose particles. Spreading shall be accomplished in such manner that the tires of the truck or spreader at no time contact the uncovered and newly applied bituminous material. Deficiencies in the application of cover material shall be corrected prior to rolling.

PROTECTION OF EXISTING CASTING – Prior to any material placement and after the surface is prepared, all manholes, water valve boxes, storm sewer casting, etc., shall be covered using plastic or other protection. All covers shall be removed prior to sweeping operation.

TRAFFIC CONTROL – Prior to starting application, Contractor shall notify the proper agency at least 24 hours in advance. Contractor shall erect all necessary "No Parking" signs on streets intended for treatment. The signs shall be maintained until the initial sweeping is completed. Traffic shall be controlled throughout the

construction phase. This shall be accomplished using barricades, lights, signs, and flagmen. The Contractor is responsible to maintain traffic at or below 25 MPH. on the uncured surface.

FINAL CLEAN-UP – Sweeping shall be completed within six hours of material application. Initial sweeping shall remove all loose or unbounded material. All debris shall be removed from job site. A second sweeping shall be accomplished immediately prior to asphalt paving.

INSPECTION – The Contactor shall complete one street at a time which shall be inspected and accepted by the Engineer. This provision shall not include sweeping. Should the Engineer determine that any section of work is unsatisfactory, the contractor shall immediately take steps to ensure that proper repairs are made.

VERIFICATION OF QUANTITIES – Scale tickets on liquid binder shall be provided to inspection personnel on a daily basis.

Scale tickets shall include –

1. Date and time of loading
2. List streets where material will be placed

METHOD OF MEASUREMENT – The method of measurement shall be the actual number of square yards of pavement treated in accordance with specifications and as accepted by the Engineer.

TIME SCHEDULE FOR PERIOD BETWEEN SAM APPLICATION AND HOT MIX ASPHALT SURFACE PLACEMENT

CONDITIONS FOR USE BY TRAFFIC DURING CONSTRUCTION

The safety of construction personnel and the public is a major concern of companies during periods of construction. Damage that traffic inflicts on newly constructed applications is also a problem. The following table of recommendations are presented for consideration.

Type of Treatment	Traffic Volume Categories		
	0-2000 ADT	2000-10,000 ADT	10,000 ADT PLUS
SAM TACK COAT	10 DAYS	5 DAYS	3 DAYS
SAME TYPE I	7 DAYS	5 DAYS	3 DAYS
SAME TYPE II	5 DAYS	* 3 DAYS	*3 DAYS

*TRAFFIC SPEED NOT TO EXCEED 35 MPH.

NOTE – Conditions such as heavy, turning traffic may require alteration of the recommendation.

Section 7

Latex Modified and Fiber Reinforced Latex Modified Asphalt Emulsion Slurry Seal

Part A. Latex Modified Asphalt Emulsion Slurry Seal

1. Scope

The work covered by this specification consists of furnishing all plant, labor, equipment, and materials in performing all operations necessary in connection with the application of a latex modified emulsified asphalt slurry seal surface upon the designated surface, in complete and strict accordance with the specifications.

This work shall consist of a POLYMAC Pavement Surface System or an approved equal to provide a wearing course or fill ruts for existing pavements in reasonably close conformity with the lines shown on the plans or established by the Engineer. The paving mixture shall be composed of a non-biodegradable latex modified CQT-1H Emulsified Asphalt, 100 percent crushed aggregate, mineral filler and other additives as required.

It is the express intent of the owner to consider only those bidders who are well equipped and have demonstrated their ability to successfully perform the class of work described herein.

2. Applicable Specifications

Current editions of the following specifications and methods form a part of this specification:

AASHTO – American Association of State Highway & Transportation Officials
ASTM – American Society for Testing and Materials
ISSA – International Slurry Seal Association
ODOT – Ohio Department of Transportation

3. Materials shall be:

a. Co-emulsified Latex Modified Emulsified Asphalt. The 100 percent latex modifier, emulsifier, adhesion, and stabilizing agents shall be co-milled into the CQT-1H, emulsified asphalt, 720.04, and shall show no separation after mixing. The blended asphalt mixture shall conform to the requirements of The Polymac Corporation,556 North Valley Road, P.O. Box 127, Alpha, Ohio 45301 for co-emulsified latex modified emulsified asphalt.

b. Other Additives. Additional additives shall be used to regulate the setting time of the modified CSS-1h. This material shall be furnished by the Contractor at no additional cost to the Owner.

c. Aggregate. The aggregate shall be crushed limestone, crushed air-cooled blast furnace slag, or crushed gravel meeting the gradation limits for the aggregate-mineral filler blend and the physical properties of ODOT Sec. 703.05 except the percent of fractured pieces shall be 100. Compatibility of the job aggregate with the modified CQT-1h shall be certified by the emulsified asphalt manufacturer in accordance with ODOT Sec. 101.061.

d. Mineral Filler. Portland cement, type 1, ODOT Sec. 701.04.

e. Water. ODOT Sec. 499.02.

f. Stockpiling of Aggregate. Stockpiling at areas other than the quarry site will not be permitted. Segregation of the aggregate will not be permitted.

g. Storage. The Contractor shall provide suitable storage facilities for the asphalt emulsion. The container shall be equipped to prevent water from entering the emulsion. Suitable heat shall be provided if necessary to prevent freezing.

h. Sampling. Samples of materials and of the finished slurry surface shall be furnished by the Contractor as directed by the Engineer during the progress of the work. Test reports may be requested from the Contractor as additional materials arrive.

Precautions shall be taken to ensure that aggregate stockpiles do not become contaminated. Oversize pieces and/or foreign materials shall be screened from the aggregate prior to delivery to the mixer. Aggregate acceptance shall be determined prior to incorporation to the mixture based on samples taken from the stockpiles. The gradation analysis of the mineral filler shall be completed with the gradation analysis of the aggregate in accordance with proportions of the JMF for determining acceptance.

4. Proportioning and Job Mix Formula

The manufacturer of the modified CQT-1h shall develop the Job Mix Formula (JMF) for the paving mixture and shall present certified test results, as per sec. 101.061, for the Engineer's approval. The JMF shall have a minimum Marshall Stability of 2000 pounds and a flow of 5 to 16 units when tested according to ASTM 01559 procedures modified to permit air drying of the mixture for three days before reheating and placing the material in the test molds. After an initial 30 minutes of compaction, the TRRL#50 Wheel Tracking Rate at 45°C shall be no greater than 2.0mm/hour for a 20mm specimen.

The Engineer shall approve the JMF prior to use. Proportions for the JMF shall be within the following limits:

Gradation Limits for Aggregate-Mineral Filler Blend:

Total Percent Passing

Sieve	**Type 2-0/6**
1/2"	100
3/8"	100
5/16"	100
#4	90-98
#8	65-90
#16	45-55
#30	30-50
#50	18-30
#100	10-22
#200	5-15

Nominal Minimum Thickness	1/4"
Mineral Aggregate lbs/SY	13-18
Latex Modified Asphalt Residue, % of cured total	6.5-0.5%

ADDITIONAL MIX TYPES

Type S	Used to seal cracks and fill voids or provide rich elastomer inner layer and tack prior to overlay.
Type A	Used to seal cracks, fill voids and shallow ruts and provide wearing surface where ADT is less than 20,000.
Type B	Used to fill moderate ruts and give a heavier wearing surface where ADT is 10,000 or greater.
Type RF	Used to fill deep ruts up to 2" in single pass.

Surface	**Type S**	**Type A**	**Type B**	**Type RF**
Minimum Thickness inches	n/a	1/4"	1/2"	3/4"
Mineral Aggregate lbs/sy dry wt.	10-20	15-50	25-50	37-50
Latex Emulsified Asphalt Residue by Wt. of Aggregates	6.5-8.0%	6.0-7.5%	5.5-7.0%	5.0-6.5%
Mineral Filler	1% x 0.5% by weight of dry aggregate depending on weather conditions			
Latex Based Modifier	As required	As required	As required	As required
Mix Set Additive	As required	As required	As required	As required

It is permissible to increase content for slags and other absorptive aggregates.

TABLE A
Gradation Limits for Aggregate – Mineral Filler Blend:

Total Percent Passing

	Type S	**Type A**	**Type B**	**Type RF**
1/2"	100	100	100	100
3/8"	100	100	95-100	90-100
#4	90-100	85-100	65-85	55-70
#8	70-100	50-80	45-65	40-55
#16	45-80	40-65	28-45	25-40
#30	25-60	25-45	19-34	19-34
#50	15-40	13-25	10-20	10-20
#200	5-15	5-12	5-12	5-12

It is permissible to increase binder content when absorptive aggregate, such as blast furnace slag is used at no additional cost to the owner.

5. Equipment

All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. Descriptive information on the slurry mixing and application equipment to be used shall be submitted for approval not less than 10 days before the work starts.

Mixing Equipment. All equipment, tools and machines sued in the performance of this work shall be maintained in satisfactory working order at all times.

General. The slurry mixing equipment may be either a batch type, truck mounted unit containing reloadable material compartments or a self-contained, continuously self-loading unit. The material delivery systems shall continuously deliver precise, predetermined quantities of each material specified in the job mix design in the proper sequence to the mixing chamber.

Mixer. The mixer shall intimately and uniformly disperse all material and discharge the completed mixture without restriction, dams or gates to the material spreader. The mixer shall be longitudinal, double-shafted type containing multiple, alternately opposed, variably pitched, paddle-type blades adequately powered at sufficient speed to exert a total rotary tip exposure to the mix in excess of 50,000 feet per minute at a minimum production rate of 2 tons per minute.

Material Proportioning Control Units. Each material delivery function ((a) fines feed, (b) aggregate feed, (c) emulsion feed, (d) water feed, (e) liquid additive feed, and other required materials feeders) shall be independently operated, controlled and monitored with a digital rate of flow meter and a totalizing indicator.

Externally mounted, calibrated liquid level gauges for each liquid ((f), (g), (h)) shall be required. A digital read-out, calibrated distance measuring instrument capable of measuring the length of each run shall be optional.

All instruments, gauges and meters shall be accurate to within +5% of the operating range required. All instruments and controls shall be centrally mounted in a protected console and shall be readily accessible during operation to both the operator and the Engineer or his designated representative.

Certifications. The bidder must submit, as part of his proposal, a written certification on the forms provided in the proposal documents stating that the bidder's equipment proposed for use in the performance of this work meets the requirements of this specification.

Spreading Equipment. Attached to the existing machine shall be a mechanical spreader box equipped with flexible material in contact with the surface to prevent loss of the mix from the spreader. The spreader shall be maintained to prevent loss of the mix on varying grades and crown by adjustments to assure uniform spread. Provision for complete mix agitation is required when quick traffic CQT-1h systems are used.

There shall be a steering device and an adjustable knife edge screed-type strike-off backed by a flexible drag. The box shall be kept clean, and true. Build-up of asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other flexible drags shall be approved by the Engineer.

When rut filling is required a "V" shaped internal screed and "V" shaped agitators shall be used. The leveling runners shall have a minimum length of 10 feet. The width of spread shall be adequate to fill a single rut without marring the center or edge stripes.

Cleaning Equipment. Power brooms, power blowers, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface. High pressure water (10 gal/m at 7000 psi) shall be the only approved method for removal of mud and adhesive clays.

Auxiliary Equipment. Hand squeegees, shovels, and other equipment shall be provided as necessary to perform work.

6. Preparation of Surface

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

If the slurry is being placed over a brick or concrete surface, highly absorbent asphalt surface, or over a surface where the aggregate has become exposed and is polished and slick, a 1 part emulsion, 3 part water, tack coat of the same asphalt emulsion type and grade as specified for the slurry may be required. This mixture may be applied with the slurry machine spreader box.

The normal application rate is 0.05 to 0.10 gallons of the diluted emulsion per square yard of surface. The Engineer should give final approval.

7. Composition and Rate of Application of the Slurry Mix

The optimum Job Mix Formula as set forth in the materials section of this specification shall be translated into job control quantities by the Contractor in accordance with ISSA TB #107. The rate of speed shall be determined in accordance with ISSA TB #112 by the Contractor. The consistency of the mix shall be controlled within 2.5 and 3.5 cm. A complete load-by-load record of the quantities used as in ISSA TB #107 shall be kept by the Contractor and shall be made available to the Engineer or his representative upon request. Final payment for the work will not be made until all load tickets and inventories are verified to assure that specification quantities have been applied. In case of disputes, the Engineer's judgement shall be final.

8. Weather Limitations

Contractor shall place the mixture when the atmospheric temperature is 40F and rising or above. It is not raining, and there is no forecast of temperature below 32F within 24 hours from the time the mixture is applied.

9. Traffic Control

Suitable methods such as barricades, flagmen, pilot cars, etc., shall be used to protect the uncured slurry surface from all types of traffic. Any damage to the uncured slurry will be the responsibility of the Contractor. The Engineer shall give final approval as to the method used and shall have final say on the order and direction of the streets to be treated.

Residents affected by the work shall be notified by the Contractor, in writing and in a manner acceptable to the Engineer, the day before the work is to be done. The written notice shall include a local telephone number where the Contractor may be reached.

10. Application of the Slurry Surfaces

A. General. The surface shall be fogged with water directly preceding the spreader. The slurry mixture shall be of the desired consistency when deposited on the surface and no additional elements shall be added. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that complete coverage is obtained. No lumping, balling, or unmixed aggregate shall be permitted.

No excessive breaking of the emulsion will be allowed in the spreader box. No streaks such as caused by oversized aggregate will be left in the finished pavement.

B. Joints. No excessive build-up nor unsightly appearance shall be permitted on longitudinal or transverse joints.

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

D. Curing. Treated areas will be allowed to cure until such time as the Engineer permits their opening to traffic.

E. Structures. All structures which may become marred by the slurry, such as open grates, catch basins, manholes and valve boxes, shall be masked prior to the work with .006" plastic or equal and attached so as not to be displaced by the operations and shall be removed after the slurry has cured. Care shall be taken at intersections to achieve a clean straight line as directed by the Engineer by use of 15 pound roofing felt or equal. All masking materials shall be removed at the completion of the work.

11. Qualification of Bidders

Bidders who have not previously completed satisfactory work for this subdivision should provide evidence of adequate experience with the materials and design proposed for this work and shall submit the following:

A. All public work of this class undertaken by him in the past two years.

B. A list of equipment available for completion of this work.

C. Name and address of his principal banker or fiduciary agent.

12. Measurement and Pavement

The latex modified slurry seal (Polymac or approved equal) surface shall be measured and paid for by the square yards of work completed and accepted as designed by the Engineer for each type applied.

Part B. Fiber Reinforced, Latex Modified Asphalt, Emulsion Slurry Seal

I. SCOPE

The work shall consist of a pavement surface materials system containing heavy loadings of both latex modified coemulsified asphalt emulsion and synthetic fibers in combination with the specified aggregate and other necessary ingredients to produce a pavement surface course or interlayer which will provide combination both strain or stress relieving flexibility at low temperatures and resistance to plastic deformation at high temperatures.

II. MATERIALS

A. The specified short length polyester fiber shall have the following properties:

1.	Diameter, nominal	0.0005”
2.	Length, nominal	1/4
3.	Specific gravity	1.32 to 1.40
4.	Melt temperature	480 F min.
5.	Ignition temperature	1000 F min.
6.	Tensile Strength	70-80,000 psi
7.	Elongation at break	33 to 45%

B. The fibers shall be uniformly suspended in a homogeneous, non-air entraining, non-segregating, pumpable, aqueous suspension.

C. The fibers shall be incorporated into the mix at the rate of 1% + - .1% dry fiber weight based on the dry weight of the aggregate.

III. CONSTRUCTION PROCEDURES

A. A separate fiber dispersion tank shall be mounted on the mixing machine and contain a full sweep agitator capable of producing a uniform, smooth, pumpable fiber suspension without excessive air entrainment. No liquid separation, lumps or fiber balling will be permitted in the mixing tank, mixer or spreader.

B. An independently powered peristaltic pump, capable of delivering an accurate flow of the fiber suspension to the mixer, shall be used. The pump delivery shall be controlled and monitored with a digital rate of flow meter and totalizing water to ensure accurate delivery of the fiber suspension.

IV. JOB MIX FORMULA AND TESTING REQUIREMENTS

A. The manufacturer of the latex modified emulsion shall develop the emulsion formulation and job mix formula. In addition to meeting the requirements of the attached primary specification, cured mix specimens compacted by 1000, 125 lb loaded wheel cycles bend, low temperature (4C; 39.2F) flexural tension test without cracking in the wheel path.

B. Certified laboratory reports of the tests and the recommended job mix formula shall be presented to the Engineer for approval prior to placement.

C. Rolling with a pneumatic tired roller may be required at the direction of the Engineer.

V. MEASUREMENT AND PAYMENT

A. The Fiber Reinforced, Latex Modified stress absorbing surface or interlayer shall be paid for by the number of square yards measured and completed to the satisfaction of the Engineer.

Section 9

Asphalt Street Rejuvenation

9-1 DESCRIPTION

This work shall consist of furnishing all labor, equipment and material, and in performing all operations necessary for the rejuvenation and in-depth sealing of asphalt pavements by sweeping, flushing or otherwise cleaning the pavement, spray application of petroleum oil and resin emulsified with water, and spreading of sand when necessary to blot excess in accordance with the specifications and as directed by the Engineer.

The purpose of the surface application of "Rejuvenating Agent" is to provide an environmental seal on the surface asphalt course and to provide improved durability, thus longer service life. The function of the Rejuvenating Agent application is to replace the volatile components of the asphalt cement that are lost during the manufacture of the aggregate asphalt mixture and through the normal aging, oxidation process. The results of this Rejuvenating Agent application will be elevated asphalt penetration values for the upper 0.50 inch of the surface asphalt course and a greater resistance to further oxidation and water intrusion.

9-2 REJUVENATING AGENT

The asphalt Rejuvenating Agent shall be composed of a petroleum resin oil base uniformly emulsified with water. The Rejuvenating Agent shall consist of a cationic emulsion such as "Reclamite" produced by Witco Chemical Corporation or "A.R.A-1" produced by Dust Allayers, Inc. or approved equal. The Contractor shall specify on the Proposal, the brand of Rejuvenating Agent he intends to use.

Each bidder must submit with his bid a certified statement from the asphalt rejuvenator manufacturer showing that the asphalt rejuvenating emulsion conforms to the physical and chemical requirements in Table 27-1.

If a Rejuvenating Agent other than "Reclamite" or "A.R.A-1" is to be used, the Contractor shall obtain written approval from the Engineer prior to the bid opening date. To obtain approval the Contractor shall supply a certified statement from the manufacturer that the Rejuvenating Agent conforms to these specifications and shall supply references from at least three successful projects using the proposed Rejuvenating Agent.

The Contractor shall furnish the manufacturer's certification that the material proposed for use is in compliance with the specification requirements and include copies of supporting tests and previous use documentation when directed to do so by the Engineer.

9-3 CONTRACTOR APPROVAL

Contractors for Asphalt Street Rejuvenation work may gain approval to work in the city of Oakwood by one of two methods: 1) satisfactory work of the identical character in previous years; and 2) submission and approval of a written statement of experience showing at least three projects of identical character that have been successfully completed within the last three years using Rejuvenating Agents such that the City can seek references.

A project superintendent knowledgeable and experienced in the application of these rejuvenators must be on the job and in control of each day's work. Also, the distributor truck driver must have ample experience in driving, operating and maintaining that equipment.

The bidder shall submit, along with his statement of experience, a written experience outline of both the project superintendent and the distributor truck driver indicating expertise. The prospective contractor shall certify that these would be the individuals on this project should he be awarded the contract.

TABLE 27-1

TESTS	ASTM	AASHTO	MIN.	MAX.
Tests on Emulsion:				
Viscosity @ 25 C, SFS	D244	T-59	15	40
Residue, % W (1)	D244 (Mod)	T-59 (Mod)	60	65
Miscibility Test (2)	D244 (Mod)	T-59 (Mod)	No Coagulation	
Sieve Test, % W (3)	D244 (Mod)	T-59	-	0.1
Particle Charge Test	D244	T-59	Positive	
Tests on Residue from Distillation:				
Viscosity @ 60 C, cst	D-445	-	100	200
Asphaltenes, % W	D-2006-70	-	-	1.00
Maltene Dist. Ratio	D-2006-70	-	0.3	0.6
PC + A				

APPLICABLE SPECIFICATIONS – The following specifications and test methods form a part of this specification.

Aggregate and Mineral Filler

AASHTO T-2	Sampling Mineral Aggregates
AASHTO T-27	Sieve Analysis of Aggregates
AASHTO T-176	Sand Equivalent Value of Soilsand Fine Aggregate

Emulsified Asphalt

AASHTO T-53	Softening Point of Asphalt (Ring & Ball)
AASHTO T-40	Sampling Bituminous Materials
AASHTO T-59	Testing Emulsified Asphalt
AASHTO M-208	Specification for Cationic Emulsified Asphalt
ISSA T-102 (1)	Mixing, Setting and Water Resistance Test to Identify “Quick-Set” Emulsified Asphalts

Micro-Surface

ISSA T-100	Wet Track Abrasion of Micro Seals
ISSA T-101	Guide for Sampling Micro Mix for Extraction Test
ISSA T-106	Measurement of Micro-Seal Consistency
ISSA T-109	Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by use of a Loaded Wheel Tester and Sand Adhesion
ISSA T-113	Trial Mix Procedure for Micro-Seal Compatibility
ISSA T-114	Wet Stripping Test for Curing Micro-Seal Mixes
ISSA T-115	Determination of Micro-Seal Compatibility
ISSA T-139	Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester. Measurement of Set and Cure Characteristics

MATERIALS

LATEX OR POLYMER MODIFIED EMULSIFIED ASPHALT – The latex or polymer modifier and other emulsifiers shall be milled into the asphalt cement and shall show no separation after mixing. The latex or polymer modified emulsified asphalt shall have a minimum softening point (Ring and Ball) of 140 degrees F when combined with aggregate and mineral filler shall have the following characteristics:

(1) ISSA International Slurry Seal Association

a. Be capable of filling up to 1 1/2 inch wheel ruts in one pass.
b. Be capable of field regulation of the setting time.
c. Be suitable for nighttime placement.

The latex or polymer modified emulsified asphalt shall be accepted by certification from the manufacturer.

AGGREGATE

GENERAL – The mineral aggregate used shall be of the type and grade specified for micro-surfacing. The aggregate shall be manufactured crushed stone such as granite, slag, limestone, chat or other high quality aggregate or combination thereof.

GRADING – When tested by AASHTO T-27, ASTM C-136 and ASTM C-117, the aggregate (including mineral filler) shall meet the following gradation.

SIEVE SIZE	TYPE A PERCENT PASSING
3/8	100
No. 4	85 - 100
No. 8	50 - 80
No. 16	40 - 65
No. 30	25 - 45
No. 50	13 - 25
No. 200	5 - 15

DELETERIOUS SUBSTANCES – To limit the permissible amount of clay like fines in an aggregate, a sand equivalent value of 65 or higher is required when tested by ASTM 2419.

SOUNDNESS – The aggregate shall have a weighted loss of not more than 15% when sodium sulfate test is used or 20% when magnesium sulfate test is used.

HARDNESS – The aggregate wear, from resistance to abrasion, shall be a maximum of 35% when using AASHTO T-96 or ASTM C-131 test methods.

MINERAL FILLER – Mineral filler shall be any recognized brand of nonairentrained portland cement that is free of lumps. It may be accepted upon visual inspection. The amount of mineral filler needed shall be determined by the laboratory mix design and will be considered as a part of the material gradation requirement.

WATER – The water shall be potable and shall be free of harmful soluble salts.

MICRO SURFACING DESIGN – Prior to beginning work, the Contractor shall submit a signed original of a mix design covering the specific materials to be used on the project for verification together with representative samples of each ingredient to be used in the micro-surface mix. The samples should contain information relative to sources, type of materials and project number.

This design must have been performed by a qualified laboratory, or emulsion producer. Once the materials are approved, no substitution will be permitted unless first tested and approved by the agency preparing the mix design.

The agency report will show the results of test performed on individual materials, comparing their values to those required by this specification. Job aggregates will be used in all laboratory design test. Mixing tests must pass at the maximum expected air temperature in T-115, compatibility. The report will provide the following information on the micro-surface mixture.

Mixing Time Test, seconds @ 77 degrees F (T-102)	45 Minimum (2)
Set Time Tests: 30 minutes (T-139)	14 kg-cm minimum
Early Rolling Traffic Time: 60 minutes (T-102)	21 kg-cm minimum
Water Resistance Test: 30 minutes (T-102)	No discoloration

Wet Stripping Test, % coating (T-114)	90% minimum
System Compatibility (T-115)	Pass
Wet Track Abrasion Test, loss in grams per square foot (T-100)	75 Maximum

PROPORTIONING – For the paving mixture, the design shall verify the functioning of the set regulating additives and shall present certified test results for the Engineer's approval. The design mix shall have a minimum Marshall Stability of 1,800 pounds and a flow of 6 to 16 units when tested according the AASHTO T-245 modified to permit air drying of the mixture at 70-75 degrees F for three days before reheating and placing the material in the test molds. Aggregate in the mixture shall represent material to be used on the project.

The Engineer shall approve the design prior to use. Proportions for the design shall be within the following limits:

Modified Emulsified Asphalt Residue by Dry Wt. of Aggregates	6% - 8%
Mineral Additive by Dry Weight of Aggregate	0.5% - 3.0%
Latex or Polymer Based	As required to provide the specified properties
Mix Set Additive	As required to provide the specified properties
Water	As required to produce consistency

WEATHER LIMITATIONS – The micro-surface shall be placed only when the pavement surface temperature and the ambient air temperature are a minimum 50 degrees F and rising. Micro-surface will not be placed during foggy or rainy conditions nor when the National Weather Service forecasts temperatures of 32 degrees F or below for the 24 hour period following placement of the micro-surface.

EQUIPMENT – All equipment necessary for the satisfactory performance of this work shall be on hand and approved before the work is permitted to begin. All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working condition.
Power brooms, power blowers, air compressors, water flushing equipment and hand brooms shall be capable of thoroughly cleaning all cracks and the old surface. Hand squeegees, hand brooms, shovels and other incidental equipment shall be provided as necessary to perform work.

MIXING EQUIPMENT – The intent of this specification is to require a continuous, non-stop micro surfacing operation where the mixing machine is resupplied with all materials while in motion depositing micro mixture on the roadway. The paving mixture shall be produced in a self-propelled, front feed, continuous loading, mixing machine equipped with a positive, non-slipping aggregate delivery system and an interconnected, positive displacement water-jacketed gear pump to accurately proportion ingredients.

The mixing machine shall be equipped with an approved fines feeder that has an accurate metering device or method to introduce a predetermined amount of mineral filler into the mixer at the same time and location as the mineral dropping down to the pug mill with additive and water. The twin-shafted multi-blade pug mill shall be a continuous flow type and a minimum of fifty (50) inches long. The emulsion shall be introduced above the third point of the mixer to ensure proper premixing of the aggregate, cement, additive, and water when the modified emulsified asphalt is added. Blade size and side clearances shall beet the equipment manufacturer's recommendations.

Mixing shall be done in a manner that does not cause premature breaking of the emulsified asphalt. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients.

The mixer shall be equipped with a remote forward speed control at the back mixing platform so the back operator can control forward speed and level of mixture in paving or rut box. Contractor shall provide material control devices that are readily accessible and positioned so the amount of each material used can be determined at any time. Each material control device shall be calibrated prior to each mix application and as often thereafter as deemed necessary by the Engineer.

The mixing machine shall be equipped with a water pressure system and fog type spray bar, adequate for complete fogging of the surface preceding spreading equipment of the micro-surface mixture.

The mixing machine shall include controls for proportioning and calibrating the aggregate feed. The aggregate feed device shall be equipped with a revolution counter so that the amount of aggregate used may be determined at any time and shall have a positive locking feed gate.

The emulsion pump shall be of the positive displacement type and shall be equipped with a device so that the amount of emulsion used may be arranged to afford a means to calibrate the meter by weighing a metered volume. The pump shall deliver the emulsion to the mixer at a uniform rate which shall not vary more than two percent from the required quantity.

The water pump shall be equipped with a minimum of two valves. One valve shall establish the required water flow. The other valve shall be a quick acting valve to start and stop the water flow.

The mixing machine shall have sight gauges located at the material storage tanks for the asphalt emulsion.

The mixing machine shall be equipped with approved metering devices so that it can be accurately calibrated and the quantities of materials used during any one period can be closely estimated. In the event that the metering devices stop working properly, the mixing machine shall no longer be used until necessary repairs have been made.

Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of emulsion from the pump. Each micro mixing unit to be used in the performance of the work shall be calibrated in the presence of the Engineer prior to construction. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering devices. No machine will be allowed to work on the project until the calibration has been completed and accepted. Additional calibrations may be required during the process of the work at directed by the Engineer.

SPREADING EQUIPMENT - Attached to the machine shall be a mechanical type spreader box with a positive screed adjustment for yield control and a positive adjustment for the joint matcher. The box shall be attached to the mixer, equipped with paddles mounted on an adjustable shaft or spiral auger to continually agitate and distribute the materials throughout the box. The box shall be equipped with curb bumpers and replaceable runners with a minimum of 5 ½ feet long end runners. The box shall be equipped with a sufficient walkway to provide access to either side of the spreader box without walking through the freshly laid material. The spreader box shall be heavy duty weighing not less than 1,400 pounds at a width of 12 feet. The box must be capable of laying mix to a width of 14 feet. The equipment shall provide sufficient turbulence to prevent the mix from setting in the box or causing excessive side build-up or lumps. To prevent the loss of the mixture from the box, the Contractor shall attach flexible seal, front and rear, in contact with the road. The full width

application box shall be equipped with a secondary strike-off located approximately one to three feet behind the primary strike-off to minimize transverse corrugations. The secondary strike-off shall have elevation and width adjustments similar to the primary strike-off. It shall have a pivot point where its can be tilted for texturing or raised completely off the surface. Rut filling may require a steel strike-off on the spreading equipment or the use of a rut box. A rut box shall be used for filling ruts in excess of 3/8 inch unless otherwise specified on the plans. The Contractor shall operate the spreading equipment in such a manner to prevent the loss of the mixture on super-elevated curves. Mixture shall be spread to fill cracks and minor surface irregularities and achieve a uniform skid-resistant surface without causing skips, lumps or tears in the finished mat.

RUT FILLING – For ruts with a depth in excess of 3/8 inch a V-shaped rut box shall be used. The rut box shall spread the mixture at a width of 5 feet. The V-shaped metal screed shall be capable of feathering the edges and providing the proper crown or overfill. The overfill shall be determined by averaging the rut depth over a specific area, lane or lot. Overfill shall be accomplished at a depth of 3/16 inch overfill per inch of rut depth.

Use of burlap drags or other drags necessary to obtain the desired finish shall be approved by the Engineer. Drags having excessive build-up shall be replaced. Drags shall be kept in a completely flexible condition at all times.

PREPARATION OF EXISTING SURFACE – Immediately prior to applying the micro-surface, all dust, dirt, vegetation and other deleterious material shall be removed from the existing surface by brooming, washing with water under high pressure, blowing with compressed air or other approved methods.

APPLICATION – Prior to the placement of the micro-surface, if specified on the plans, a tack coat of CSS-1H emulsion shall be applied with an asphalt distributor. The tack coat shall consist of one part emulsion and two parts water. The application rate shall be 0.05 to 0.10 gallons of the diluted emulsion per square yard. The actual application rate shall be determined by the Engineer.

The micro-surface shall be applied based on dry aggregate weight as specified on the plans. The maximum allowable speed of the machine shall be 150 feet per minute. When rut filling, the maximum allowable speed shall be 250 feet per minute.
The final micro-surface seal shall be placed uniformly across the width of the traffic lane unless otherwise specified or directed. The action of the squeegee shall permit the mix to flow freely leaving a smooth, uniformly textured surface.

Unless otherwise directed by the Engineer, the surface shall be pre-wetted with water by fogging ahead of the spreader box. Pre-wetting shall be closely controlled to prevent accumulation of water to the point of running off or puddling.

The micro-mixture shall be of the desired consistency when deposited on the surface after which no additional elements shall be added. A sufficient amount of micro-surface will be carried in all parts of the spreader at all times so the complete coverage is obtained. No lumping, balling or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the micro mix will be removed from the pavement. The micro mixture shall have proper consistency so that excessive splattering and excessive free water is avoided. Hand tools, lutes and squeegees shall be used to spread micro mix on areas not accessible to the machine spreading equipment.

JOINTS – No excessive build-up, uncovered areas or unsightly appearance shall be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project.

EDGES – The edges of the micro-surfacing shall be uniform and neat appearing along the roadway centerline, lane lines, or curb lines. The edge shall vary no more than plus or minus two inches from the straight line along one hundred feet of edge length or from a one hundred foot arc of the design curve in a curved section.

OPENING TO TRAFFIC – The final micro-surfacing surface shall be ready to have rolling traffic applied within one hour after application, or other time period as agreed upon by the purchasing agency and contractor. Rut filling micro-surfacing shall be ready to have rolling traffic applied within two hours after application, or other time period as agreed upon by purchasing agency and contractor. The surface shall not be significantly altered by the traffic.

COMPACTION – Rolling with a pneumatic-tired roller shall be at the discretion of the Contractor. The roller shall have minimum tire size of 7.50 x 15, with a minimum tire contact pressure of 55 pounds per square inch. Roller shall be provided with the necessary accessories to prevent adhesion of the mixture. The use of excess liquid will not be permitted.

PROTECTION – Traffic shall not be allowed on the micro-surface until it has cured sufficiently to prevent pickup by vehicles tires. The Contractor shall maintain traffic control as necessary to prevent damage to the micro-surface shall be required by the Contractor at no expense to the Department.

RESPONSIBILITY – The production process of the micro-surface operation requires the Contractor to have full responsibility for the placement of acceptable micro-surface.

METHOD OF MEASUREMENT

AGGREGATE – The quantity of aggregate, including mineral filler, shall be measured by the ton (dry), based on the calibrated metering devices affixed to the micro-surface mixing machine.

LATEX OR POLYMER MODIFIED EMULSION – The quantity of latex or polymer modified emulsion used in the accepted portion of the work shall be measured by ton of material based on the calibrated metering device affixed to the micro-surface mixing machine.

BASIS OF PAYMENT

AGGREGATE – The accepted quantity of aggregate (including mineral filler) used in the micro surfacing will be paid for at the contract unit price. The unit price shown in the contract shall be full compensation for all materials, labor, tools, equipment, traffic control, and all other incidentals necessary to complete the work.

ASPHALT EMULSION FOR TACK COAT – The accepted quantity of asphalt emulsion used will be paid for at the contract unit price. The unit price shown in the contract shall be full compensation for all materials, labor, tools, equipment, traffic control, and all other incidentals necessary to complete the work.

LATEX OR POLYMER MODIFIED EMULSION – The accepted quantity of latex or polymer modified emulsion used will be paid for at the contract unit price. The unit price shown in the contract shall be full compensation for all materials, including modifiers and liquid additives necessary to complete the work.

SPREAD RATE

RUT FILL OR LEVELING COURSE – Shall be applied as specified in the plans or as required to completely fill the rutted area, such that proper profile is obtained.

SURFACE COURSE – Shall be applied at a rate of 20 lbs. plus or minus 2 lbs. per square yard.

PAYMENT WILL BE MADE FOR:

(Surface) Micro-surfacing	- Per square yard
(Rutfill or Leveling) Micro-surfacing	- Per ton of mix applied

Section 9

Asphalt Street Rejuvenation

9-1 DESCRIPTION

This work shall consist of furnishing all labor, equipment and material, and in performing all operations necessary for the rejuvenation and in-depth sealing of asphalt pavements by sweeping, flushing or otherwise cleaning the pavement, spray application of petroleum oil and resin emulsified with water, and spreading of sand when necessary to blot excess in accordance with the specifications and as directed by the Engineer.

The purpose of the surface application of "Rejuvenating Agent" is to provide an environmental seal on the surface asphalt course and to provide improved durability, thus longer service life. The function of the Rejuvenating Agent application is to replace the volatile components of the asphalt cement that are lost during the manufacture of the aggregate asphalt mixture and through the normal aging, oxidation process. The results of this Rejuvenating Agent application will be elevated asphalt penetration values for the upper 0.50 inch of the surface asphalt course and a greater resistance to further oxidation and water intrusion.

9-2 REJUVENATING AGENT

The asphalt Rejuvenating Agent shall be composed of a petroleum resin oil base uniformly emulsified with water. The Rejuvenating Agent shall consist of a cationic emulsion such as "Reclamite" produced by Witco Chemical Corporation or "A.R.A-1" produced by Dust Allayers, Inc. or approved equal. The Contractor shall specify on the Proposal, the brand of Rejuvenating Agent he intends to use.

Each bidder must submit with his bid a certified statement from the asphalt rejuvenator manufacturer showing that the asphalt rejuvenating emulsion conforms to the physical and chemical requirements in Table 27-1.

If a Rejuvenating Agent other than "Reclamite" or "A.R.A-1" is to be used, the Contractor shall obtain written approval from the Engineer prior to the bid opening date. To obtain approval the Contractor shall supply a certified statement from the manufacturer that the Rejuvenating Agent conforms to these specifications and shall supply references from at least three successful projects using the proposed Rejuvenating Agent.

The Contractor shall furnish the manufacturer's certification that the material proposed for use is in compliance with the specification requirements and include copies of supporting tests and previous use documentation when directed to do so by the Engineer.

9-3 CONTRACTOR APPROVAL

Contractors for Asphalt Street Rejuvenation work may gain approval to work in the city of Oakwood by one of two methods: 1) satisfactory work of the identical character in previous years; and 2) submission and approval of a written statement of experience showing at least three projects of identical character that have been successfully completed within the last three years using Rejuvenating Agents such that the City can seek references.

A project superintendent knowledgeable and experienced in the application of these rejuvenators must be on the job and in control of each day's work. Also, the distributor truck driver must have ample experience in driving, operating and maintaining that equipment.

The bidder shall submit, along with his statement of experience, a written experience outline of both the project superintendent and the distributor truck driver indicating expertise. The prospective contractor shall certify that these would be the individuals on this project should he be awarded the contract.

TABLE 27-1

TESTS	ASTM	AASHTO	MIN.	MAX.
Tests on Emulsion:				
Viscosity @ 25 C, SFS	D244	T-59	15	40
Residue, % W (1)	D244 (Mod)	T-59 (Mod)	60	65
Miscibility Test (2)	D244 (Mod)	T-59 (Mod)	No Coagulation	
Sieve Test, % W (3)	D244 (Mod)	T-59	-	0.1
Particle Charge Test	D244	T-59	Positive	
Tests on Residue from Distillation:				
Viscosity @ 60 C, cst	D-445	-	100	200
Asphaltenes, % W	D-2006-70	-	-	1.00
Maltene Dist. Ratio	D-2006-70	-	0.3	0.6
PC + A1 (4)				
S + A2 (4)				
PC/S Ratio	D-2006-70	-	0.5	-
Saturated Hydro – carbons, S (4)	D-2006-70	-	21	28

(1) ASTM D-244 Modified Evaporation Test for percent of residue is made by heating 50 gram sample to 149 C (300 F) until foaming ceases, then cool immediately and calculate results.
(2) Test procedure identical with ASTM D-244-60 except that .02 Normal Calcium Chloride solution shall be used in place of distilled water.
(3) Test procedure identical with ASTM D-244 except that distilled water shall be used in place of two percent sodium oleate solution.
(4) Chemical composition by ASTM Method D-2006-70:
PC = Polar Compounds A1 = First Acidaffins
A2 = Second Acidaffins S = Saturated Hydrocarbons

A contractor who has not gained approval by one of the above methods and who wishes to demonstrate his abilities may request a demonstration contract of up to 25% of the work being bid but not more than 2500 S.Y. The unit price paid for the demonstration contract shall be the same as that paid the successful bidder.

9-4 EQUIPMENT

Equipment and tools necessary for unloading, transporting and applying material and for performing and maintaining all parts of the work, satisfactory as to design, capacity and mechanical condition for the purpose intended, must be on the job before the work is started. Any equipment which is not maintained in full working order, or which as used by the contractor is proven inadequate to obtain the results prescribed, shall be repaired, improved, replaced, or supplemental to obtain the progress and workmanship contemplated by the contract.

In the event the equipment furnished and used is inadequate or unsatisfactory to obtain the progress and workmanship contemplated, operations shall be suspended until such conditions have been rectified.

The distributor shall be so designed, equipped, maintained and operated that material may be applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to

0.5 gallons per square yard, with uniform pressure under 10 p.s.i. and with an allowable variation from any specified rate not to exceed 5 percent.

The distributor for spreading the emulsion shall be self-propelled, and shall have pneumatic tires. Distributor equipment shall include full circulation spray bars, curb shield, pump, tachometer, volume measuring device and a hose attachment suitable for application of the emulsion manually to cover areas or patches inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the emulsion within the tank.

Distributors shall be equipped with a power unit for the pump and full circulation spray bar adjustable laterally and vertically. The distributor shall be so designed that the driver or operator will not have to leave their seats in order to start or stop distribution, and so that the application of material can be started instantly at all nozzles without dribbling. The distributor shall not be operated when any nozzles are clogged.

The application rate requested by the Engineer in accordance with the Specifications shall be capable of being set by the operator in the truck cab taking into consideration the spray bar width, pump speed, application rate per square yard, and truck speed in feet per minute. The distributor must be capable of delivering the requested application rate regardless of truck variations.

9-5 CONSTRUCTION

Contents in tank cars or storage tanks shall be circulated for at least 10 minutes before withdrawing any material for applications. When loading the distributor, the asphalt rejuvenating agent concentrate shall be loaded first and then the required amount of water shall be added. The water shall be introduced into the distributor with enough force to cause agitation and thorough mixing of the two materials. To prevent foaming, the discharge end of the water hose or pipe shall be kept below the surface of the material in the distributor tank.

All tools, machines and equipment used in the performance of the work shall be subject to the approval of the Engineer and shall be maintained in a safe and satisfactory working condition at all times.

Equipment used for the application of the petroleum oil and resin emulsions shall be clean of all foreign and objectionable material. An asphalt distributor which shall be used as a spreader, will be cleaned of all of its asphalt materials, washed out to the extent that no discoloration of the emulsion may be perceptible. Cleanliness of the spreading equipment shall be subject to the approval and satisfaction of the Engineer.

The Contractor shall notify in writing each resident along the proposed work by a letter acceptable to the city of Oakwood, the day preceding application, that the street will be closed for a specific period of time.

In order that all necessary delay to the traveling public may be avoided, the Contractor shall provide and station competent flagmen whose sole duties shall consist of directing the movement of public traffic either through or around the work.

Immediately before application of the emulsion, all loose material, dirt, clay, sand and other objectionable material shall be removed from the surface to be treated with power brooms or blowers, or by hand brooms, shovels, or other suitable tools. It shall be the Contractor’s responsibility to find a dump site or landfill to dispose of the swept up material and dirt. After the preparation operations and prior to application of the emulsion, an inspection of the surface to be treated will be made by the Engineer to determine its fitness to receive the emulsion application.

Before spreading, the asphalt Rejuvenating Agent shall be cut back with water at the approximate rate of two (2) parts rejuvenating agent to one (1) part water, by volume or as specified by the manufacturer. The combined mixture of asphalt rejuvenating agent and water shall be spread at the rate designated in the specifications or as approved by the Engineer.

The emulsion shall be applied only when the existing surface to be treated is thoroughly dry and when the weather is clear and is not threatening to rain. If it rains within 24 hours after applying rejuvenation, the City will make a judgment whether a significant portion of the rejuvenating agent has washed away, and if so, will require the Contractor to apply a second coat of rejuvenating agent, same mis as the first, to all affected streets; this reapplication will be completed at no cost to the City. The emulsion shall not be applied when the atmospheric temperature is below 50 degrees F.

Immediately following the surface preparation, the emulsion shall be applied by distributor at the temperature recommended by the manufacturer and at the pressure required for the proper distribution or as may be directed by the Engineer. The emulsion shall be so applied that uniform distribution is obtained at all points of the areas to be treated. Distribution shall be commenced with a running start to ensure full rate of spread over the entire area to be treated. Areas inadvertently missed and irregular area shall receive additional treatment by hand sprayer application. The distribution rate shall be 0.08 to 0.10 gallon per square yard as directed by the Engineer.

When more than one application is to be made, succeeding applications shall be made as soon as penetration of the preceding application has been completed and approval is granted for additional applications by the Engineer.

Grades or super elevations of surfaces that may cause excessive runoff, in the opinion of the Engineer shall have the required amounts applied in two or more applications as directed.

Low spots or depressions that may cause ponding or puddling of the emulsion shall be hand broomed to spread excessive accumulations of the emulsion.

A check of distributor rate and uniformity of distribution shall be made when directed by the Engineer.

In the event the rate of application varies beyond the tolerance specified above, underapplications shall be corrected and any excess bituminous materials used in over-applications will be construed to be at the cost and expense of the Contractor.

If the Contractor is unable to maintain the specified rate of application within the tolerance, operations shall be discontinued until such discrepancies can be remedied through providing more experienced operators or improved distributing equipment or both.

When the road is closed to traffic and surface width does not exceed 24 feet, materials may be applied the full surface width at one pass for each individual application. When the road is not closed to traffic, application of asphalt rejuvenating agent shall be on one-half width at a time.

When the second half of the surface is sealed, the distributor nozzle nearest the center of the road shall overlap the previous application by at least one-half the width of the nozzle spray but shall not exceed the full width.

Sanding. In the event that application is made under traffic and/or a previously closed road must be opened to traffic and slow penetration occurs and, in the opinion of the Engineer, a hazard exists to the traveling public, a light coating of dry, gritty sand shall be applied to the surface in sufficient amount to protect the traveling public.

As a general rule, the streets shall be swept clean at approximately 3 days after rejuvenation application; exact time of street sweeping will be determined by the Engineer.

Prior to acceptance of the work the streets and curb gutters must be completely clean.

The Contractor shall schedule his operation and carry out the work in a manner to cause the least disturbance and/or interference with the normal flow of traffic over the areas to be treated. The Contractor shall be responsible for the provision and maintenance of all barricades, warning lights, or other equipment necessary for safety and the control of traffic and the protection of the work from damage. Treated portions of the bituminous surfaces shall be kept closed and free from traffic until penetration, in the opinion of the Engineer, has become complete, and the area is suitable for traffic.

9-6 MEASUREMENT

Asphalt Rejuvenating Agent and sand will be measured by the square yard in place.

9-7 BASIS OF PAYMENT

The accepted quantities, measured as provided for above, will be paid for at the contract unit price for:

Rejuvenation Treatment, complete, which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Square yardage payment will be compared with actual gallons applied as determined by plant tickets.

Section 10

Brick Pavement

BASE COURSE – The base course shall be a 6 inch thick Portland cement concrete base having a minimum compressive strength of 4000 psi The concrete shall be poured on a compacted subbase. The base surface shall be broom finished.

CUSHION OR BEDDING COURSE – The cushion or bedding course shall be composed of sand, granulated slag or slag screenings as approved by the Engineer. Immediately before the cushion is to be placed, the concrete foundation shall be thoroughly cleaned and all dirt, sand and foreign matter removed. The bedding course or cushion, having a thickness of approximately one inch, shall be deposited evenly over the foundation in such quantities that after shaping and compacting, it will be of uniform density with its surface parallel to the finished surface of the pavement. The cushion shall be carefully shaped to the true cross-section and grade of the street by means of a template of approved design and construction. This template must cover at least ½ of the width of the roadway and must be so arranged as to be easily drawn over curbs or guide rails set to the proper elevation. The template shall be drawn forward and backward until the surface of the cushion conforms closely to the designated cross-section. The cushion shall then be compacted by the use of a hand roller weighing not less than 10 pounds per inch of width of roller and having a diameter of approximately 24 inches. The total width of the roller shall not be greater than 30 inches. After the cushion has been carefully rolled, the template shall again be drawn over the surface and all depressions brought to the proper grade by additional cushion material and the surface shall then again be rolled.

These processes of shaping and compacting shall be continued and repeated until a uniformly compacted cushion of specified thickness and surface is obtained. When the use of the template is for any reason impractical, the required surface may be obtained by hand luting. Care shall be observed during subsequent paving operations that the bed be disturbed as little as possible. Workmen will not be allowed to walk on the finished cushion and injury to the surface must be corrected by hand luting before the bricks are laid.

LAYING PAVING BRICK – Brick shall be carried from the side of the roadway to the droppers by hand, on pallets, or in brick clamps. They shall be arranged so that in the regular operation of laying, the better face or side will be upward. The brick shall be laid upon the prepared bedding in successive courses with the wire-cut surface upward. Alternate courses of brick must begin with ½ a brick. Each course must be completed by batting in at the end, if necessary, with fragments of brick at least 3 inches long, a portion of the next adjoining brick being broken off, if necessary to allow for the minimum 3 inch bat at the end of the course. The fractured end of cut or trimmed brick must be turned toward the center of the roadway. Every course of brick shall be laid true and even, perpendicular to the edge of the pavement.

LAYING THE BRICK AROUND CURVES – Where the curvature of the street permits, the brick shall be laid in radial courses, allowing at the outside of the curve a space between the courses not to exceed ½ inch. Where the curvature of the street exceeds the above, the brick shall be laid in radial courses transversely across the roadway and in the intervening space between the courses, the brick shall be laid longitudinally at right angles to one of the transverse courses at each successive closure.

No portion of a brick less than 3 inches in length shall be used for batting such closure and the amount of space to be batted in shall, by varying the length of the successive transverse courses, not exceed a whole brick. In no case shall brick be broken longitudinally to make a closure on a curve.

INSPECTION – Immediately after laying the brick, the surface of the roadway shall be swept and inspected. Brick not laid with the batter face or side upward must be turned and those not meeting the requirements for quality will be removed by the Contractor and replaced with acceptable brick. Those slightly chipped but otherwise acceptable may be used.

ROLLING – The surface of the roadway shall then be rolled by a power tandem roller weighing approximately 3 tons. Rolling shall begin at the edge of the pavement and continue backward and forward until the center of the pavement is reached. The roller shall then pass to the other edge and repeat the operation. The rolling may then be repeated in the opposite direction. Broken or otherwise injured brick shall be removed and replaced before final rolling. Final rolling must be parallel with the centerline of the roadway. Portions of the surface not accessible to mechanical rolling shall be hand tamped.

TESTING THE SURFACE – The completed surface of the roadway must conform to grade and cross-section as provided in the plans. Depressions exceeding a ¼ inch s tested with a 6 foot straight edge laid parallel to the centerline of the roadway must be corrected.

SAND FILLER – Brick must be clean from debris when the filler is applied. The sand shall be carefully worked into the open joints and compacted with a vibratory compactor. At the completion of work, all excess filler shall be removed from the site.

BRICK GUTTER – Brick gutters shall be constructed or reconstructed as shown on the plans. All gutter bricks either new or reworked shall be mortared in place. The cost of mortaring shall be included in the price bid for brick gutters.

Section 11

Concrete

Concrete work shall conform with the General Specifications of the Southwest Ohio Engineers Association (as modified by the City of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications for "Portland Cement" Type 1 (ASTM C150) or the Specifications for "Air Entraining Portland Cement" Type 1A (ASTM C175), unless otherwise noted.

11-1 CEMENT

All cement delivered to the job site shall be of the same brand, furnished by a manufacturer of good reputation, and shall be shipped in strong cloth or paper bags bearing the manufacturer's name and brand. The cement shall be stored in suitable buildings to fully protect it from moisture and shall be segregated by lots so as to permit easy access for inspection and sampling. Sufficient quantity of cement shall be kept on hand at all times to allow time (12 days minimum) for testing before use.

Bulk cement, if specifically authorized for use by the Engineer for site mixing, or cement used by truck mixers shall be delivered in sealed cars and should be accompanied by a certificate of the manufacturer that it complies with these specifications.

Cement which contains lumps or has partially hardened shall be rejected. All cement rejected by the Engineer shall be immediately removed from the site or from storage with other cement intended for use in the work.

11-2 FINE AGGREGATES

a) General. Fine aggregates shall be composed of clean, hard, durable uncoated particles of stone, well graded from coarse to fine, with coarse particles predominating.

b) Grading. Fine aggregates used in concrete shall conform with the following grading requirements:

Sieve Size (U.S. Standard)	Total Passing % by Weight
3.8 inch	100
No. 4	95-100
No. 16	50-75
No. 50	15-30
No. 100	3.5-10

Loss on decantation by weight no over 4%.
No individual size portion shall exceed 35%.

c) Deleterious Substances. Fine aggregate shall be free from lumps of clay, injurious amounts of organic impurities, soft or flaky particles, loam, coal or other deleterious substances.

d) Mortar Strength. Mortar specimens (1-3), when made with fine aggregate, proposed for use shall have a flexural or compressive strength at 7 days of at least 100% of similar specimens made with standard Ottawa sand.

e) Storage. Fine aggregate shall be stored separately and in such manner as to avoid the inclusion of any foreign material. Fine aggregate shall be handled in such manner that the moisture content will be

reasonably uniform for each days run. If necessary, in order to obtain uniformity of moisture content, stockpiling of all materials will be required.

11-3 COARSE AGGREGATES

a) General. Coarse aggregation shall be crushed stone, gravel or crushed slag. The maximum size of particles shall not exceed 1/8 of the narrowest dimension between forms or 2/3 of the minimum clear space between adjacent bars of reinforcing steel.

b) Grading. Coarse aggregate shall be well graded from the maximum to the minimum size which shall be that retained on a 1/4 inch screen. Gradation and quality of coarse aggregate shall be approved by the Engineer prior to use. When maximum size is greater than 1-1/2 inch, the aggregate shall be furnished and stored separately in two sizes and combined in batching to conform with the desired gradation.

c) Deleterious Materials. The maximum percentage of deleterious substances shall not exceed the following:

		PERCENT BY WEIGHT		
	Test	**Limestone**	**Gravel**	**Slag**
1.	Removed by decantation	1	1	1
2.	Shale	1	1	1
3.	Coal	1	1	1
4.	Clay lumps	¼	¼	¼
5.	Soft fragments	3	3	3
6.	Other local deleterious substances which will readily disintegrate	1	1	1
	Total of 2 to 6 inclusive not more than	5	5	5

d) Physical Properties.

1. Limestone. The broken stone shall consist of uncoated particles of clean, sound, durable, angular rock of uniform quality and free from an excess of thin, flat or shaley pieces.

2. Gravel. The gravel shall be composed of hard, durable particles of stone, thoroughly clean, and shall be free from frozen lumps, vegetable or other deleterious matter and an excess of soft, thin or elongated pieces.

3. Slag. The broken slag shall be composed of air cooled, blast furnace slag and shall be clean, sound, durable, reasonably uniform in density and free from an excess of thin or elongated pieces. Weight per cubic foot of aggregate compacted shall be not less than 70 pounds.

e) Tests. Coarse aggregate shall be subjected to the Los Angeles Abrasion Test, ASTM C131 and shall show a percentage of wear of not more than 40%.

Where concrete in finished work will be exposed to aggressive soils or waters, alternate freezing and thawing, or to other destructive agents, the coarse aggregate shall be subjected to the sodium sulfate soundness test (ASTM C88). Coarse aggregates showing a loss by weight in excess of 12% after five cycles, shall be further

investigated (by freezing and thawing concrete specimens containing the aggregate) before being approved for use.

Aggregate failing to pass any or all of these tests may be used, upon approval by the Engineer, provided that convincing evidence of their suitability for the use proposed (based upon not less than eight years of competent record of their behavior in similar structures under comparable conditions of exposure) is furnished the Engineer.

f) Storage. Coarse aggregates shall be stored separately and in such manner as to avoid inclusion of any foreign material. Stock piles of coarse aggregates shall be built up in horizontal layers not to exceed three feet in height to avoid segregation.

g) Sampling and Testing. Unless otherwise specified, all test samples of aggregates shall be furnished by the Contractor at his expense.

Aggregates shall be approved by the Engineer before purchase. The Engineer shall be given opportunity to inspect the source of aggregate material and shall be furnished with sieve analyses of the fine and coarse materials which are proposed to be furnished, these analyses to be made from samples selected under the Engineer's supervision. In addition to the above, there shall be provided analyses in the field covering: (1) color test for organic matter, (2) decantation test for silt and (3) sleve analyses or in lieu thereof, there shall be furnished equipment and facilities for making these tests in the field.

All tests shall be made at the expense of the Contractor by a qualified testing laboratory under supervision of the Engineer.

11-4 WATER

Water used in mixing concrete shall be furnished at the Contractor's expense and shall be clean and free from deleterious amounts of oil, acids, alkalis, or organic materials. One fire hydrant shall be designated for the Contractor's use.

11-5 AIR ENTRAINMENT

Air entraining cements shall conform to the Specifications for Air Entraining Portland Cement Type 1A, ASTM C175. The mixed concrete immediately prior to placing shall contain between 4.0% and 6.0% of entrained air as determined by the Volumetric Method in conformance with specifications for "Air Content of Freshly Mixed Concrete by the Volumetric Method", ASTM C173.

Additives for increasing, reducing or controlling the air content shall conform to specifications for admixtures ASTM C260 or shall receive the approval for the Engineer prior to use. Such additives shall be compatible with the cement used and shall be used in strict accordance with the manufacturer's recommendations and under the initial supervision of a representative of the manufacturer.

11-6 PLASTICITY AND WORKABILITY CONTROL

There shall be added to the batch immediately before or during its mixing, a water reducing or densifying admixture. Such admixture shall be equal to "Pozzolith Normal" as manufactured by the Master Builders Company or "Plasticrete" as manufactured by the Sika Chemical Corporation, all as approved by the Engineer.

Such admixtures shall be used in strict compliance with the manufacturer's directions and shall be compatible with the cement used.

Approved additives for controlling the rate of hardening (retarded or accelerated) will be required when, in the opinion of the Engineer, adverse working conditions, weather conditions, or special conditions will have an adverse effect on the finished structure. When used, such admixtures shall be used in strict compliance with the manufacturer's recommendations and under the initial supervision of a representative of the manufacturer.

11-7 PROPORTIONING AND MIXING

Measurement. Wherever practicable, materials shall be measured by weighing except that sacked cement need not to be weighed, and water may be measured by volume. The weight of a sack of cement shall be taken as 94 pounds and the weight of one gallon of water as 8.33 pounds.

When measurement of aggregate by volume is permitted, the method used shall be approved by the Engineer.

Water shall be measured in an approved manner such as will insure the desired quantity in successive batches. Under no circumstances shall the quality of water used in successive batches be left to the manual control of the operator, except by written approval by the Engineer. The free water contained in the fine and course aggregates shall be deducted from the permissible quantity of water to be added per bag of cement.

The accuracy of all measuring devices shall be such that all quantities can be measured to within 1 percent of the desired amount (i.e. $\pm$ 1%).

Powdered admixtures shall be measured by weight, and paste or liquid admixtures by weight and volume, within a limit of 3 percent. When admixtures are used in small quantities in proportion to the cement, as in the case of air-entraining admixtures, mechanical dispensing equipment is recommended.

11-7.01 Proportioning . In general, all concrete mixtures shall contain the minimum amount of water required by modern efficient methods of vibratory placement. Mixes shall be used that contain the largest practicable maximum size of well graded coarse aggregate, consistent with bar spacing.

Unless otherwise noted on the plans or by special specifications, all reinforced concrete or pavement concrete shall be Class "A"; all non-reinforced concrete not designated on the plans as Class "C" shall be "B"; and all non-reinforced fill concrete so designated on the plans shall be "C", all in accordance with Table No. 1-a below. Unless otherwise specified, weight of dry aggregate per bag of cement shall be as shown in Table No. 1 1-b below:

TABLE NO. 1-a

Class	Min. Bags of Cement per Cubic Yard	Max. Water Content per Bag Cement	Minimum Compressive Strength		
			7 Days	28 Days	Use
A	6.38	5.50 gals.	2900	4000	All reinforced concrete unless specifically noted otherwise on plans.
B	5.75	6.50 gals.	2400	3400	All non -reinforced concrete unless otherwise noted on plans.
C	4.00	9.75 gals.	1000	1700	Fill Concrete so noted on plans

TABLE NO. 1-b

Weight in Lbs. of surface Dry Aggregate per Bag of Cement

Class	Fine. Agg.	*Coarse Agg.	Total	Fine. Agg.	*Coarse Agg.	Total
A						
Gravel	183	263	446	187	263	450
Stone	195	254	449	199	254	453
Slag	205	211	416	209	211	420
B						
Gravel	219	290	509	224	290	514
Stone	230	282	512	235	282	517
Slag	240	236	476	245	236	481
C						
Gravel	374	382	756	382	382	764
Stone	374	386	760	382	386	768
Slag	394	318	712	402	318	720

Weights listed above will theoretically produce proper yield with 5% air entrained concrete.

*Weights based on AASHO-M-43, Size 57 coarse aggregate gradation.

Natural Sand (Fineness Modules 2.6-2.9) Limestone Sand (Fineness Modules 2.6-2.9)
The proportions of water and fine and coarse aggregate may be varied by the Engineer to produce the desired strength or workability.

The weights specified in the above table are for aggregate of the following bulk specific gravities:

Natural sand and gravel – 2.62
Limestone sand – 2.68
Limestone – 2.65
Slag – 2.30

If the specific gravities vary more than 0.02 from the above, specification adjustments shall be made by the Engineer.

11-7.02 Consistency. The quantity of water used shall be the minimum necessary to produce concrete of the strength and workability required by the Engineer. Consistency shall be measured by the slump test (ASTM C143) and in general the slump shall not exceed that indicated in Table 2 below.

TABLE NO. 2

		Maximum Slump
Class A	Reinforced walls and columns Slabs and beams (Open), streets Sidewalks, aprons and curb	4”
Class B	Non-reinforced concrete, lightly reinforced mass concrete, or as designated on the drawings.	4”
Class C	Fill concrete so noted on the drawings	4”

11-7.03 Mixing. Unless otherwise specified or called for on the plans, the Contractor has the option of accomplishing mixing by the use of modern, efficient, mechanical equipment in good condition by any of the following methods:

a) Mixing at the forms in a stationary mixer and the mixed concrete transported to the forms by concrete bucket and crane, concrete baggy, wheelbarrows or other means approved by the Engineer.

b) Mixing at a central mixing plant in a stationary mixer and the mixed concrete transported to the point of delivery in a truck agitator or truck mixer operating at agitating speed or in non-agitating equipment approved by the Engineer.

c) Mixing by transit-truck mixer.

The location, type, capacity, length of haul and condition of the plant and associated equipment shall be subject to the approval of the Engineer. All batching, mixing and agitation equipment for Ready Mixed Concrete shall meet the requirements of ASTM C94.

Mixers and agitators shall be operated within the limits of capacity and speed rotation designated by the manufacturer of the equipment.

When stationary mixer is used for complete mixing of the concrete, the mixing time for mixers having capacities of one cubic yard or less shall not be less than one minute. For mixers of larger capacities, this

minimum shall be increased 15 seconds for each cubic yard or fraction thereof additional capacity. Mixing time shall be measured from the time all cement and aggregates are in the drum. The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate, and all water shall be in the drum by the end of the first one-fourth of the specified time.

When the concrete is mixed in a truck mixer loaded to its rated capacity, the number of revolutions of the drum or blades at mixing speed shall not be less than 50 not more than 100. If the volume of the batch is greater than the rated capacity, but not greater than that guaranteed by the manufacturer, the number of revolutions of the drum or blades at mixing speed shall not be less than 70 nor more than 100. All revolutions after 100 shall be at agitating speed. When a truck mixer is used for the complete mixing of the concrete, the mixing operation shall begin within 30 minutes after the cement has been intermingled with the aggregates. Concrete batches which arrive too dry, and already contain the maximum allowable mixing water, or batches which arrive too wet, will be rejected.

11-8 TRANSPORTATION AND PLACING

Before beginning a run of concrete, the condition of mixing and handling equipment forms which are to receive concrete and the steel reinforcement shall receive the approval of the Engineer.

11-8.01 Base Preparation. Base upon which concrete is placed shall be prepared in accordance with the construction detail on the project plans.

If concrete pavement is being placed to restore a utility trench or other similar out, and existing base material has eroded away from under adjacent pavement left in place, the Contractor shall use a Controlled Low Strength Material (CLSM) in lieu of other specified base material (typically ODOT 304) to achieve optimum compaction under existing pavement. The CLSM shall be designed to flow into place and achieve 100% compaction without use of mechanical compacting equipment. Physical properties of the CLSM shall be as follows:

Compressive Strength	100-200 psi
Density	130-150 pcf
Removability	Similar to normal aggregate base

The mix shall consist of sand, cement, fly ash and water.

11-8.02 Mixing and Placing. Concrete shall be handled from mixer to the place of final deposit as rapidly as possible by methods which prevent the separation or loss of ingredients. It shall be deposited in the forms as neatly as practicable in its final position. The surface of concrete during placing shall be maintained as nearly level as practicable.

Chuting of concrete will not be permitted unless specifically authorized by the Engineer.

During and immediately after placing, concrete shall be thoroughly compacted by means of power driven vibrates, operating at a frequency of not less than 3,200 pulsations per minute, and other suitable tools to produce a concrete of maximum density. Sufficient vibrators and other suitable tools shall be provided to accomplish the proper placement of the concrete to the satisfaction of the Engineer.

Special attention is hereby directed to the number of and efficiency of puddlers or spaders. The Contractor shall provide men for this work in sufficient numbers to accomplish the proper compacting of the fresh concrete to the satisfaction of the Engineer.

The concrete shall be well compacted and thoroughly worked around the reinforcing steel and into all corners and angles of the forms and around all embedded structures. Where rodding and spading of concrete is difficult due to thin sections or inaccessible portions, the compacting shall be assisted by hammering the forms opposite the freshly deposited concrete so carried on as not to damage the form surface.

Concrete shall be deposited continuously until the unit of operation, as approved by the Engineer, is completed.

Concrete shall not be placed in water unless written approval is obtained from the Engineer.

No retempering of concrete will be permitted.

Before depositing new concrete on or against old concrete which has set, the forms shall be retightened, the surface of the set concrete shall be cleaned of all foreign matter and laitance and saturated with water. The old surface shall be flushed with neat cement grout or with a mortar composed of cement and sand in the same proportions as required for the concrete in contiguous portions of the work, deposited in a layer at least 1 inch thick and the new concrete shall be deposited thereon before the grout or mortar has reached its initial set.

Cold Weather. Cold weather concreting shall conform to all requirement of ACI 306.1, Standard Specifications for Cold Weather Concreting, published by the American Concrete Institute, Detroit Michigan, except as modified by the requirements of these Contract Documents.

11-9 JOINTS

Construction Joints. Horizontal and vertical construction joints in the concrete shall be made only where shown on the plans or where approved by the Engineer. When construction joints are not shown on the plans, the planes on which a days work is to terminate shall be approved by the Engineer before depositing of concrete begins. Such joints shall be perpendicular to the lines of principal stress and in regions of small shear and in general shall be so designed and located as least to impair the strength and appearance of the structure. Joints in columns shall be made at the under side of beams or haunches. At least 2 hours shall elapse after depositing column concrete before placing concrete in beams or slabs. Construction joints in floors shall be located near the middle of span and shall be right angles to the finished concrete surface.

Construction joints shall be placed in five (5) foot intervals for curbs and walls, unless otherwise shown on the plans or approved by the Engineer.

Horizontal joints will not be permitted in girders, beams, or slabs. Slabs acting with beams and girders shall be deposited continuously unless otherwise shown on the plans or approved by the Engineer.

In order to allow for shrinkage, concrete shall not be placed against the second side of construction joints for at least 12 hours after that on the first side has been placed.

Construction joints in water-bearing walls shall be watertight and shall be made as follows:

a) Unless otherwise specified on the plans, vertical joints shall be made with 20 oz. copper or PVC water stops of a design approved by the Engineer or as shown on the drawings.

b) On all exposed faces, the lines of horizontal or vertical construction joints shall be made truly straight. For horizontal joints, a temporary straight edge shall be tacked on the inside of the form so that its bottom edge is on the line of the joints.

c) All beams, rectangular section columns and exposed concrete corners shall be finished with beveled edges.

Expansion Joints. All expansion joints will be constructed where and as shown on the plans. In general, expansion joints will be placed as follows:

a) Parallel to all retaining and building walls
b) Parallel to catch basins, gas and water boxes, manholes and poles
c) Near trees and other plantings as may be determined by the Inspector
d) Every three hundred (300) running feet or as determined by the Engineer
e) Where a curb, sidewalk, or step form a coterminous point of contact
f) Wherever a gutter forms a coterminous point of contact with a separately poured curb or separately poured street as may be determined by the Inspector.
g) Pavement construction joints shall be sawed every seventeen (17) running feet or as directed by the Engineer. The joint shall be sawed on a 6 to 1 skew, or as shown on the plans.
h) Every 200 square feet there will be a sawed joint unless waived in writing by the City Engineer (nominal 17 x 12).

Expansion joint material shall be securely held in place during placing and finishing of the concrete.

11-10 FORMS

Construction. The form material and the design of the forms shall be adapted to the structure and to the kind of surface required. For all faces exposed to continuous view, the surfaces of the forms next to the concrete shall be of plywood or steel. The forms shall be substantially built, secure to prevent movement or deflection during concrete pouring, and tight to prevent leakage of mortar. They shall be sufficiently strong and braced to resist the pressures to which they are subjected during the placing of concrete and remain in straight, true alignment. Temporary openings shall be provided in wall, pier and column forms to permit cleaning and inspection.

Form ties shall be used of a type which will insure a tight, impervious wall, free from holes. On exposed faces, wall ties shall be of a type which break off at ¼" back of the wall surfaces when forms are stripped and which can be neatly pointed. Wire ties will not be permitted on exposed work. The design of form ties shall be approved by the Engineer.

Chamfer Strips. The contractor shall provide a wooden ¾" Chamfer strip in all corners of concrete form work where exposed edges will result when the forms are stripped.

All contraction, construction and longitudinal joints in the concrete pavement work shall be neatly filled with a mastic type joint filler to at least within ¼' of the pavement surface. Excessive spillage of mastic will be removed from the pavement by the Contractor.

Removal. Forms shall be removed in such manner as will prevent injury to the concrete and injury to the concrete and insure the complete safety of the structure. Before the removal of forms, the concrete shall be carefully inspected. No exact time for the removal of forms can be specified because of the varying character of the work and other controlling conditions, but no forms shall be struck without the consent of the Engineer. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to support safely their weight and the load thereon. Forms shall be thoroughly cleaned and oiled before being used again.

11-11 EMBEDDED ITEMS

All metal parts to be imbedded in concrete shall be accurately and securely fastened in position as indicated on the drawings or as approved by the Engineer before the concrete is placed. Such embedded items shall be thoroughly clean and free from rust, scale, oil or other foreign matter. Care shall be exercised during placing and compacting concrete that embedded items are not moved from their proper position.

11-12 FINISHING

Walls, Beams, Girders, and Columns. Concrete surfaces exposed to continuous view in the finished structure such as the inside of buildings and the outside of structures above grade, shall be poured against smooth, tight forms. If wood forms are used, they shall be either built of plywood or lined with plywood so placed as to make the fewest possible joints. Such necessary joints shall be inconspicuous, regular and shall conform with the lines of the structure. During pouring of concrete, the exposed faces shall be made smooth by thrusting a spade or suitable tool between the form and the concrete to force back the coarse aggregate from the exposed face. Face forms shall be removed as soon as practicable and all fins and projections shall be removed. Voids and damaged places shall immediately be saturated with water and filled with a mortar of the same composition as that in the concrete mixture and brought even with the surface by means of a wood float. The entire surface shall then be rubbed with a carborundum brick or other abrasive until even and smooth and of uniform appearance, as determined by the Engineer, without applying any cement or other coating. In cases where it is impracticable to remove forms before the concrete has fully hardened, the exposed faces may be brushed with a neat cement grout and immediately rubbed with the carborundum brick to a uniform appearance.

Faces not continuously exposed to view in the flushed work such as the inside of water reservoirs or the outside of structures below grade shall be treated as for exposed faces except that they need not be rubbed and forms need not be lined with plywood.

Inside faces of covered basins and clear wells, reservoirs, filters below sand lines, and open tanks below flow lines shall be classed as unexposed.

Pavement. Concrete pavement shall have a uniform transverse broomed finish approximately 3/16 inch in depth.

Slabs and Floors. Surfaces not subject to wear and not in contact with liquids shall be screeded and smoothed with a wood float.

Surfaces in contact with liquids and other top surfaces subject to wear, shall be screeded smooth and after drying, but before reaching a final set, shall be trowled to a smooth, dense finish with a steel trowel. Excess mixing water and over-troweling shall be avoided.

Floor Hardener. The surface of concrete stair treads and concrete floor slabs within buildings other than floors of liquid retaining basins, that is, all floors which shall be subject to pedestrian or vehicular traffic in normal operation, shall be treated to harden and dust-proof the surface. This may be accomplished by the use of a liquid equal to Lapidolith Liquid, Chemical Concrete Hardener, as manufactured by L. Sonneborn Sons, Inc., New York City, applied in three (3) applications in accordance with the manufacturer's directions. Use of other like materials for this purpose shall be approved by the Engineer.

Footings. That portion of the upper surface of footings on which walls are to be built shall be left rough to insure proper bond with the superimposed concrete. The balance of the footer top surface shall be screeded smooth but not floated.

11-13 CURING

All exposed concrete curb and pavement shall be cured using the curling method selected by the City of Oakwood from the following alternatives. Unless a pay item is included in the bid for concrete curing, payment for concrete curing will be included in the price bid for placing the concrete; no additional payment for concrete curing will be made regardless of which method of curing is used.

1. White pigmented curing compound per ODOT 451.10.

2. Curing the concrete by means of water curing with burlap cloth, waterproof paper or polyethylene sheeting. Curing shall be applied as soon after the finishing of operations as possible. After the concrete has attained 28-day strength, the Contractor shall apply 2 coats of a 50/50 mix of linseed oil and mineral spirits 24 hours apart at a rate of 0.02 gallons per square yard. The Contractor shall close the road to all traffic for a period of at least 4 hours for the first coat and at least 6 hours for the second cost or until penetration is complete and tackiness has disappeared. The Contractor shall notify all homeowners affected at least 48 hours in advance of this operation.

3. Curing the concrete using a white curling compound and then applying 2 coats of linseed oil as described above after a period of 60 days or earlier if so directed by the City.

4. Curing the concrete using a clear curing compound and then applying 2 coats of linseed oil as described above after a period of 60 days or earlier if so directed by the City. The Contractor shall ensure the Project Inspector is present at the job site prior to applying clear curing compound.

5. If concrete is poured during the winter months when the possibility of snow and freezing weather exists, the Contractor shall apply a white cure and anti-spall compound to protect concrete against scaling and spalling caused by deicing salts and winter freeze-thaw. White cure and anti-spall compound shall be "Safe-Cure AS" manufactured by the Spray-Cure Company, or approved equal. This white cure and anti-spall compound requirement during winter months also applies to concrete walks.

If alternative 2, 3 or 4 is selected, then the final certificate shall be issued and one year retainage shall begin for all work other than linseed oil application when said work is completed to the City's satisfaction. Payment

for linseed oil application, less 2% retainage, shall be made following satisfactory completion thereof and shall not affect the date for release of retainage.

When linseed oil is applied to concrete pavement, it shall be uniformly applied using a vehicle mounted bar sprayer covering at least one-half the pavement width.

All other concrete, unless otherwise specified, shall be completely covered with a white pigmented curing compound being placed on it after finishing, but before setting. Said compound shall be approved by the Inspector prior to commencement of work. Minimum application rate shall be one (1) gallon per 150 square feet of surface. Wind protection of the spray shall be provided.

The Contractor shall protect all freshly poured concrete against marking or defacing. The Contractor shall promptly replace any defaced or marred concrete at no expense to the City of Oakwood.

All structural concrete exposed to weathering, pavement, aprons, driveways and sidewalks shall be completely covered by spraying with an anti-spall mixture before backfilling. This mixture shall be made of 50% boiled linseed oil and 50% kerosene. The mixture shall be applied up to 30 days after the forms are stripped.

All concrete shall be thoroughly protected from too rapid drying, and adequately cured. Provisions shall be made for maintaining concrete in a moist condition for a period of at least seven (7) days after the placement of the concrete, except that for concrete made with high early strength cement, moist curing shall be provided for at least the first three (3) days.

The methods of curing used shall be approved by the Engineer and may include (a) continuous mechanical applications of water, (b) saturated cotton mats or burlap, (c) saturated straw, (d) heavy kraft paper (Sisalkraft or equal) or (e) an approved waterproof membrane.

The following additional practices will be required unless otherwise specified by the Inspector when the following weather conditions occur:

a) Straw, polyethylene cover or other acceptable means of protection shall be placed whenever there is an indication of freezing.

b) Whenever there is a possibility of rain, the Inspector may require the protection of the new concrete with polyethylene, canvas, or other acceptable material. Therefore, the Contractor shall have the protective material on the job at all times. The protection shall be maintained as directed by the Inspector. Failure to do so shall be sufficient reason to reject any concrete section. Any rejected concrete shall be corrected at the Contractor's expense.

11-14 TESTS ON CONCRETE

During the progress of the week, test applications shall be prepared by the Contractor under supervision of the Engineer. Tests shall be made in accordance with the "Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (ASTM C31). Each test shall be made on one laboratory control specimen and one field control specimen.

There shall be at least one test for each class of concrete placed on any one day and at least one test for each 250 cubic yards of concrete or fraction thereof in the job.

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

In all cases where the average strength of the laboratory control cylinders shown by these tests for any portion of the structure falls below the minimum ultimate compressive strengths called for in Table No. 1 (a), the Engineer shall have the right to order (1) a change in the mix or (2) a change in the water content or (3) additional cement at not additional cost to the Owner for the remaining portion of the structure. In cases where the average strength of the cylinders cured on the job falls below the required strength, the Engineer shall have the right to require load tests made on the portions of the structures so affected or cores drilled and tests on portions where load tests are not feasible.

The cost of making test cylinders shall be borne by the City of Oakwood. The Engineer shall be the final judge as to when the finished pavement shall be opened to traffic. Normally, this will be the 7th day after pouring; however, if, in the opinion of the Engineer, the concrete has not properly cured because of high slump, high water/cement ratio, or low concrete cylinder strength test, the pavement will remain closed to traffic for an additional period. If the Contractor wishes to have beam specimens cast at the time of pavement placement, it will be his responsibility to notify the Engineer of this need and bare the cost of such tests.

11-14.01 Concrete Alternatives for Rigid Pavement. With the City's approval, the Contractor may, at no additional cost to the City, use a special concrete mix in accordance with ODOT Supplemental Specification 905 as shown below to accelerate setting and strength development time of the pavement.

a) Class FS. This mixture is a fast setting Portland cement concrete. When used in accordance with ODOT 905, pavement may be opened to traffic after four hours provided test beams have reached a modulus of rupture of 400 psi.

b) Class MS. This mixture is a moderate setting Portland cement concrete. When used in accordance with ODOT 905, pavement may be opened to traffic after 24 hours provided test beams have reached a modulus of rupture of 400 psi.

As with the standard concrete mix, the Engineer shall be the final judge as to when the finished pavement shall be opened to traffic.

11-15 GENERAL NOTES

Concrete shall not be pigmented or painted except as shown on the plans. Unless otherwise specified, all joints in concrete work shall be saw cut to full length in sections as delineated by previous construction, contraction or expansion joints. Lights and barricades shall be placed around uncured concrete work as a safety precaution, unless otherwise specified by the Engineer.

Concrete delivery trucks and concrete laying implements shall be washed only where directed by the Engineer.

All catch basins, sanitary and storm manholes, valve boxes, and other appurtenances in the construction area or those which are involved in the completion of the work shall be kept free from construction materials or rubbish and shall be cleaned to the satisfaction of the City at the conclusion of the work.

The Contractor is responsible for ensuring that concrete delivery trucks use the City's designated haul routes as specified in Division 1, Section 77.

Section 12

Curbs, Sidewalks, Steps and Gutters

Curbs, sidewalks, steps and gutters shall be constructed in accordance with the General Specifications of the Southwest Ohio Engineers Association (as modified by the city of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications except s supplemented below. The following directives have precedence over the other specifications referenced in all cases where the requirements conflict.

All new or replacement curbs, sidewalks, steps and gutters shall be constructed using Portland Cement concrete, Class B with a 28 day strength of 3400 psi.

Where replacement concrete walk is constructed to remove bad sections, the minimum allowable replacement size shall be 1 full panel, unless otherwise approved by the City.

Curb, walks, steps and gutters shall be constructed in accordance with the construction details on the project drawings. Expansion joints shall be placed as directed by the Engineer.

Unless otherwise specified, the Contractor will replace defective curb with barrier type concrete curbing unless the entire street has exposed concrete gutter plate where a concrete curb and gutter replacement section shall be used.

Unless otherwise specified, curbs and sidewalks shall be backfilled, after removal of forms, with approved soil, compacted, and either sodded or seeded as shown on the plans. Fill slope shall not exceed 2 to 1 unless specifically approved by the Engineer.

The front face of all barrier-type curbs shall be hand troweled and finished to a depth of 12 inches below the top of the curb.

The height of the curb above street surface shall be in accordance with the design plans.

All tile to be used shall be approved by the city of Oakwood. All tile shall be installed at proper grade and shall be connected to the proper conduits according to the plans or instructions of the Inspector. At least three inches (3”) of concrete or other proper and accepted topping shall cover all such drainage tile. There shall be a minimum encasement of concrete on the side of six inches (6”) and a minimum of six inches (6”) below the flow line when said tile interposes concrete. Expansion joints shall be placed a minimum of six inches (6”) from the side of the tile (as opposed to top and bottom). The maximum distance from the side of the tile that this expansion joint shall be placed is ten inches (10”). In the case that the tile is located near the termination of a curb, the minimum encasement on the termination side shall be six inches (6”). If this specification cannot be met, then the tile shall be adjusted laterally to meet such dimensions.

Handicap Ramps: In all cases where walk is replaced at a street intersection where a handicap ramp should be installed to comply with ADA (American Disabilities Act) requirements, the Contractor shall install a ramp meeting ADA specifications.

Section 13

Driveway Aprons

Driveway apron work shall be performed in accordance with Section 5 and 11 of this specification and as follows:

The Contractor shall saw cut driveways full depth and carefully remove sections of driveway where shown on the plans or designated by the Inspector.

Driveway aprons shall be installed at grades which prevent dragging of cars entering or exiting the drive. The length of replacement sections will normally be shown on the plans, but may be specified and/or changed in the field to meet this requirement.

Concrete driveways shall have concrete replacement aprons and asphalt driveways shall have asphalt aprons unless otherwise shown on the plans or directed by the Engineer.

Both asphalt and concrete aprons shall remain barricaded until approved for traffic use by the Inspector.

13-1 ASPHALT APRONS

Where asphalt aprons are used, the Contractor shall place a 1/2” mastic joint at the juncture between curb and apron. The junction between aprons and existing drives shall be smooth and flush, and sealed with asphalt sealant. Unless otherwise specified, the apron shall consist of an 8” base of ODOT Item 304 Aggregate and 2” cover of ODOT Item 404 Asphalt Cement Concrete.

13-2 CONCRETE APRONS

Where concrete aprons are used, a 1/2” expansion joint (ODOT Item 705.03, Preformed Filler) with asphalt sealant (ODOT Item 705.04 Joint Sealer) shall be used between the curb and apron and between the apron and existing concrete drive. The junction between aprons and existing drives shall be smooth and flush. Where concrete aprons meet existing asphalt drives, asphalt sealant only shall be used to seal the joint.

Concrete aprons shall be constructed using Class A concrete as defined in Section 11, Table No. 1-a. Unless otherwise specified, the apron shall consist of a 4” base of ODOT Item 304 Aggregate and 6” cover of Class A concrete.

Section 12

Painting

GENERAL – This section is intended to cover interior and exterior coatings for metal, concrete and wood surfaces. Unless otherwise specified oil base paint and prime shall be used for all wood surfaces exposed to weathering. Concrete surfaces, above grade, shall be coated with a Tnemec waterproof paint. Metal work shall be primed with a rust inhibitive orange primer and painted with a rust inhibitive satin finish enamel.

COLORS – The Contractor shall submit color samples of chips to the city of Oakwood, for approval, prior to ordering any paint supplies.

These processes of shaping and compacting shall be continued and repeated until a uniformly compacted cushion of specified thickness and surface is obtained. When the use of the template is for any reason impractical, the required surface may be obtained by hand luting. Care shall be observed during subsequent paving operations that the bed be disturbed as little as possible. Workmen will not be allowed to walk on the finished cushion and injury to the surface must be corrected by hand luting before the bricks are laid.

EXTERIOR PAINTING – Wood members shall be sealed and primed with an oil base sealer and given one coat of oil base finish paint to match the existing white paint. Concrete shall be left unpainted, however, all exposed concrete, including walls, steps and flat work shall be sealed with 50-50 mixture of linseed oil and turpentine.

Handrails shall be primed with a rust inhibitive paint and given one coat of gloss black finish paint.

Gutters, downspouts and supports shall have a pre-applied coat of white paint and shall be touched up as necessary on the job site.

INTERIOR PAINTING – All block work shall be carefully cleaned and painted with one coat of block filler paint and two coats of exterior Tnemec paint. Wood floors shall be sealed with a clear polyurethane sealer. All metal work will be primed with a rust inhibitive fish oil base primer and painted with a satin finish enamel except for floor drains which shall be left tar black.

PAINTING OF CONCRETE WORK – Deteriorated concrete work shall be carefully wire brushed, filled and sealed, and painted with a Tnemec type paint having waterproof characteristics, as approved by the city of Oakwood.

REMOVAL OF LATEX PAINT – In preparing the exterior wooden portion of the building for repainting, the contractor shall remove all latex paint by scraping, grinding or otherwise mechanically removing this surface material.

Section 15

Steelwork and Miscellaneous Metal

DESCRIPTION – The Contractor shall furnish and install all of the steelwork and miscellaneous metal work of every description as required by the drawings and as specified herein. This section is not intended to cover such items as flashings, water stops, reinforcing steel, anchor bolts, sleeves and supports required for installation of mechanical, plumbing, heating, ventilating and electrical equipment; metal clamps, anchors, ties and dowels for stone, masonry and concrete work. Metal windows, metal doors, door bucks and trim are specified under other divisions or specifications.

GENERAL – All steel shall be either open hearth or basic oxygen process and shall meet the requirements of the Standard Specifications for Structural Steel for Bridges and Buildings, ASTM designation A-36.

All cast iron used in connection with structural work shall meet the requirements of the Standard Specifications of Gray Iron Castings of the ASTM designation A-48.

In general, all steelwork is to be fabricated to meet the requirements applicable to this work of the Standard Specifications of the American Institute of Steel Construction.

Aluminum alloys are specified herein under the different types of shapes required. All aluminum in contact with concrete or dissimilar metals shall be isolated from same by coating the contact surface with a heavy coat of alkali resistant bituminous paint.

Steel and wrought iron shall be well formed to shape and size, with sharp lines or angles. Shearing and punching shall leave clean, true lines and surfaces. Permanent connections shall be welded or bolted using high strength bolts. Do not use screw where they can be avoided; where used, heads shall be countersunk, screwed up tight and threads nicked to prevent loosening. Curved work shall be evenly sprung.

Castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arrises. Machine joints, where required, shall be milled to a close fit. Provide necessary rabbets, lugs and brackets so that work can be assembled in neat and substantial manner.

Fastenings shall be concealed where practicable. Thickness of metal, and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water. Provide holes and connections for the work of other trades.

Where no details are indicated, it is expected that the Contractor will submit details. Details shall be drawn in a workmanlike manner in accord with the spirit of the design, for approval. Measurements shall be taken on the job to insure proper fit.

All exposed miscellaneous metal work shall be primed and painted as directed by the Engineer. All castings shall be covered with one coat of bituminous material.

THE CONTRACTOR – shall conduct all operations in strict accordance with safety requirements imposed by the city of Oakwood and OSHA. Special precautions shall be taken at time of field welding and cutting to eliminate fire hazard.

FABRICATION AND ERECTION – shall be done in accordance with the standard specification and code of standard practice of the American Institute of Steel Construction. The Contractor shall verify and/or determine all required dimensions by field measure before fabricating or modifying steel.

WELDING OF ALUMINUM – shall be welded with an inert gas shielded arc or resistance welding process. No welding process that requires a welding flux shall be used. The filler metal shall be 4043 for 6061-T6 aluminum alloy as specified by the American Welding Society Specification A5.10-69.

CUTTING OF ALUMINUM – shall be sheared, sawed, cut with a router, or arc cut. All edges which have been cut by the arc process shall be planned to remove edge cracks. Oxygen cutting of aluminum alloy shall be permitted.

ALUMINUM STANDARD STRUCTURAL SHAPES – shall be 6061-T6 alloy.

ALUMINUM BOLTS – shall be made of 6061-T6 alloy.

STEEL STANDARD STRUCTURAL SHAPES – shall be ASTM-A36.

STEEL BOLTS – shall be ASTM A325N.

WELDING OF STEEL – shall use E70XX electrodes for ASTM-A36 steel.

PAINTING ALUMINUM SURFACES – to be placed in contact with steel shall be given one coat of zinc chromate primer in accordance with Federal Specification TT-T-645, or the equivalent. Zinc chromate paint shall be allowed to air dry 24 hours before assembly of the parts.

ALUMINUM SURFACES – to be embedded in concrete shall not be painted, unless corrosive components are added to the concrete.

PAINTING STEEL SURFACES – to be placed in contact with aluminum shall be painted with zinc chromate primer in accordance with Federal Specification TT-P-645, followed by one coat of paint consisting of 2 lb. of aluminum paste pigment (ASTM Specification D962-66, Type 2, Class B) per gallon of varnish meeting Federal Specification TT-V-81, Type II, or the equivalent.

PAINTING – all new structural, miscellaneous and embedded steel, except those surfaces in contact with concrete, shall be given shop coat at Rustoleum, #769 red primer, and two coats of Sherwin-Williams grey enamel. Any scarred areas shall be touched up with same point after erection. Field painting of new steel and cleaning and painting of modified structural steel shall be in accordance with the city of Oakwood's instructions. Anchor bolts shall be set with a template to insure good workmanship.

Section 16

Reinforcing Steel

Steel reinforcement shall conform to General Specifications of the Southwest Ohio Engineers Association (as modified by the city of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications except as supplemented below. The following directives have precedence over the other specifications referenced in all cases where the requirements conflict.

Detailing, fabrication, accessories and erection of reinforcing bars shall conform to the ACI "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (ACI 315).

Laps and splices shall conform with the ACI "Building Code Requirements for Reinforced Concrete" (ACI 318).

The Contractor will place reinforcement of the size and shape exactly as shown in the plans, including type and locations of splices.

The Contractor shall use No. 18 black annealed wire to secure bars to intersections and shall use galvanized chairs or spacers in all places as shown on the plans.

Wire mesh reinforcement shall be laid securely in place with spacer bars and chairs, and have minimum laps of 5 inches at splices. Slabs on ground may have chairs replaced by precast concrete blocks.

The clear space between main reinforcing bars and concrete surface, unless otherwise shown on plans, shall be as follows:

A	Beams, slabs and wall in contact with earth or water	2"
B	Walls not in contact with earth or water	1"
C	Beams not in contact with earth or water	2"
D	Slabs other than foundation slabs, top and bottom, not in contact with earth or water	1"
E	Stirrups	1-1/2"
F	Footings and foundation slabs in contact with earth	3"
G	Top of foundation slabs in contact with water	2"
H	Piers	2"
I	Columns not in contact with earth or water	1-1/2"
J	Columns in contact with earth or water	2"

Section 17

Block Masonry

DESCRIPTION – The Contractor shall furnish the necessary concrete block and other materials required to construct the concrete block masonry work shown on the drawings.

CONCRETE BLOCK – Concrete block shall be Grade A quality, thoroughly cured and of the size shown on the plans, free from imperfections and of a physical quality satisfactory to the Engineer.

Concrete blocks shall be made from Portland cement and the use of the following aggregates: Limestone sand or natural sand with gravel, crushed stone, or blast furnace slag. Blocks to be of the two or three core type, except for the first course under precast units, wall caps, and elsewhere called for on the drawings shall be solid units.

No overall dimension shall vary more than 3 percent over or under the specified dimension for any form of unit.

All units shall be sound and free from cracks or other defects that would interfere with the proper placing of the unit or impair the strength, permanence, or appearance of the structure. Corner block and fillets shall be provided as shown on the plans.

The Owner or his authorized representative shall be accorded proper facilities to inspect and sample the units at the place of manufacture from the lots ready for delivery. At least ten (10) days should be allowed for completion of the tests.

PHYSICAL REQUIREMENTS – Hollow load bearing blocks shall meet the physical requirements set forth in the following table:

TABLE 1

	Compressive Strength, Min. psi (Average Gross Area		Water Absorption Max lb, per c.f.	Moisture Content Maximum Percent
Minimum Face Shell Thickness, inches	Average of 5 Units	Individual Unit	Average of 5 Units	Average of 5 Units
1-1/4 or over:				
Grade A	1,000	800	15	40
Grade B	700	600	-	40
Under ¼ and over ¾	1,000	800	15	40

METHOD OF LAYING – All concrete block shall be laid in the best, neat and workmanlike manner with plumb, even wall surfaces. All courses shall be laid level and all joints completely filled with mortar. Exterior joints shall be tooled. Interior finish surface joints shall be struck smooth and even with the wall surface or tooled at the option of the Owner. Exposed surfaces shall be free from broken defective or warped block. All exposed surfaces shall be kept clean and free from mortar splashes and discolorations.

In warm weather, all concrete block shall be thoroughly wetted before laying. In freezing all concrete block and mortar materials shall be protected from the elements and kept dry until laid. No frozen material will be permitted in the mortar.

Block shall be mechanically tied to concrete with approved wall ties placed in the concrete as shown on the drawings.

All openings shall be accurately located in both plan and elevation. All intersecting partitions, walls or columns shall be located together with major openings for pipes or ventilators. Irregularities in line or grade shall be noted and corrected if possible. From the above, the coursing, both vertical and horizontal, shall be determined and the lead corners laid up accordingly. Masonry shall be isolated from concrete "bed" with a coat of bitumastic paint or a layer of 15 lb. unperforated felt.

Care shall be exercised during laying operations to protect the finished masonry and floors from mortar stains, drippings and chipping.

After laying, all masonry work shall be protected from freezing during cold weather for not less than 48 hours. Provisions shall be made to protect newly finished work from rain or weather elements. No masonry work shall be accomplished during inclement weather without the Engineer's approval of proposed protective methods. Any masonry damaged by elements shall be replaced at no additional cost.

Point up around all doors, windows, openings, nail holes and elsewhere as required or directed.

PRECAST CONCRETE LINTELS – Precast concrete lintels shall be furnished as and where shown on the drawings. Lintels shall be of the sizes show, and shall match adjacent block in composition and texture. Lintels shall have a full 8" bearing at each end and be reinforced as shown on the drawings.

MORTAR – The mortar for all masonry shall be composed of one part Portland cement, one part lime putty and five parts of sand. The lime putty shall be made by properly slaking a good quality quick lime. The quick lime shall be slaked at least three days before using. Waterproofing mortar shall be added to the mortar according to the manufacturer's directions. Suitable arrangements shall be made for accurate measuring and thorough mixing of ingredients to insure uniformity. Measurements shall be by volume. With the approval of the Engineer, specifically processed hydrated lime conforming to Type S for "Hydrated Lime for Masonry Purposes" may be used in lieu of lime putty.

PORTLAND CEMENT -	ASTM C-150 or C-175 for air entraining cement
LIME -	Either hydrated lime conforming to ASTM Specification C-207 and must be at least 92 percent hydrated, or quick-lime conforming to ASTM C-5. Quick-lime putty mixture shall be allowed to slake for 72 hours before using.
SAND -	Clean, natural colored sand conforming to ASTM Specifications C-144.

MASONRY REINFORCING – All masonry walls shall be reinforced every other course vertically or every 16" o.c., and every course for three (3) consecutive courses above and below openings. Reinforcing shall be truss design with 3/16" side rods and #9 gauge cross rods galvanized after fabrication.

EXPANSION JOINTS – Provide ½" polyethylene strips where shown on the drawings. Expansion strip shall be recessed ½" from the face of the block to provide a reglet for caulking.

MASONS FLASHING – Install 3 oz. protected galvanized flashing where shown on the drawings. Flashing shall be one piece and extend a minimum of 8" beyond each side of the openings.

FLUE LINE – Chimneys, when shown or called for, shall be lined from the inlet to outlet with vitrified clay flue lining of the size shown on the drawings. Flue liner shall be grouted solid with all joints tight and smooth on the inside.

WATERPROOFING – See "Waterproofing".

MASONRY INSULATION – When shown on the drawings, cavity wall shall be filled with a water repellent granular masonry fill insulation. Insulation shall be inorganic, rot proof, vermin proof, fire-resistant, light weight and non-settling. Insulation shall be capable of reducing the noise transmission through the wall by not less than 30%. Insulation shall meet federal specifications JJ-1-585B.

CLEANUP – Clean and point up at the end of each working day all exposed masonry work including nail holes. On completion of the work, all masonry must be carefully cleaned down, removing all large particles of mortar with a putty knife or chisel, and stiff brush ready and accepted for surface finish specified.

Section 18

Stone Masonry

DESCRIPTION – The Contractor shall furnish all labor, materials, equipment and incidentals required for the stone work as specified and as shown on the drawings. The Contractor shall verify all measurements and shall be responsible for dimensions and elevations.

CUT STONE – Cut stone for sills, coping, belt courses, and elsewhere shown, shall be planer finish select buff, "Indiana Oolitie" limestone of the sizes and shapes shown. All stone shall be set in a full bed of mortar by experienced and competent masons.

No damaged or broken stone shall be used. All leveling wedges shall be completely removed.

Setting and pargetting mortar shall be nonstaining. The back of all stone shall have a 3/8" parget coat. All joints of all cut stone shall be raked out to a depth of 1/2" for later caulking as specified elsewhere.

All stone shall be treated immediately upon arrival at the site with a 5 percent solution of colorless silicone waterproofing on all surfaces.

MORTAR – Mortar shall be as specified under masonry except it shall be nonstaining.

EXPANSION JOINTS – Provide expansion joints as and where shown on the drawing. Expansion joints shall be packed with 1/2" polyethylene strips recessed 1/2" from the face of the stone to provide a reglet for caulking. See "Caulking".

STONE RETAINING WALL – Where possible, stone for existing walls will be salvaged and reused. Additional stone shall match the existing as nearly as possible to the property owner's satisfaction.

Section 19

Fencing – Farm Type

DESCRIPTION – The Contractor shall furnish all labor, material, equipment and incidentals necessary to construct the farm fence as shown on the drawings and specified herein.

GENERAL – Fence shall be installed in such a manner that will provide a rigid, taut fence within 2" of the surface of the ground. Where gaps of more than 2" occur, the Contractor shall add soil and grade the site to bring fence within 2" of grade.

WOGEN STEEL WIRE FENCE – The fence shall be made of high tensile strength, rust resisting copper steel heavily and evenly galvanized.

The fencing shall also meet the following requirements:

Number of line wires	10
Height in inches	47"
Spacing of stay wires	12"
Top wire	9 gauge (steel wire gauge)
Bottom wire	9 gauge
Filler	9 gauge

The spacing of the bars in inches from bottom to top shall be approximately as follows: 3", 3-1/2", 4", 4-1/2", 5", 5-1/2", 6", 7" and 8".

Two strands of barbed wire are to be placed over the fence, spaced 4" on center. Barbed wire shall be four point pattern consisting of two strands of No. 12-1/2 gauge copper bearing hot-dipped galvanized wire with heavy barbs spaced 5" apart.

Line posts may be either "U", "L" or "T" steel sections and shall be not less than 7'-6" in length unless noted otherwise on the drawings. All posts shall be equipped with improved anchors and shall weigh not less than 1/39 pounds per lineal foot. The posts shall be notched to support each bar or clamp.

Wooden end and corner posts shall be made of Oak or other approved hard wood and shall be at least 8" in diameter. The posts shall be butt treated in accordance with the requirements of Item 710.13 of the Construction and Material Specifications, State of Ohio, Department of Highways, to within 6" above the ground line. The posts shall be set in a minimum of 3' concrete.

Section 20

Fencing – Chain Link

DESCRIPTION – The work shall consist of furnishing and erecting the chain link fence and gates in reasonably close conformance with lines, grades and locations specified on the drawings or established by the Engineer and shall conform to the provisions of Sections 607, Fence and 710.03, Chain Link Fence, of the ODOT Construction and Material Specifications.

MATERIALS –

1. Fabric. Fence fabric shall be 2" mesh of 9 gauge copper bearing, steel wire, hot-dipped galvanized with a heavy zinc coating (1.2 oz. per square foot minimum) after fabrication. Fence shall be of the height or heights as shown on the drawings.

2. Line Posts. Line posts shall be approximately 2-1/2" O.D., Type 1 @ 3.65 lbs. per foot copper bearing hot-dipped galvanized steel pipe. "H" or other approved sections may be substituted.

3. Top Rail. Top rail shall be 1-5/8" O.D. @ 2.27 lbs. per foot, copper bearing hot-dipped galvanized steel pipe.

4. Terminal Posts. Terminal posts and end, corner or pull posts shall be approximately 3" O.D. @ 5.79 lbs. per foot, copper bearing hot-dipped galvanized steel pipe. Posts shall be complete with all necessary fittings.

5. Gate. Gate posts shall be approximately 3" O.D. @ 5.79 lbs. per foot for single leaf gates up to 6 feet in length, and 4" O.D. @ 9.11 lbs. per foot for spans over 6 feet. The gate shall be of the same height and fabric as the main fence on 2" O.D. galvanized pipe @ 2.72 lbs. per foot. Gate shall be complete with necessary hinges and latches arranged for use of a padlock. Gate shall be of the size or sizes shown on the drawings.

6. Barbed Wire. Fence posts shall be fitted with adjustable barbed wire arms for carrying three lines of barbed wire at a 45 degree angle. Each barbed wire shall be four-point pattern consisting of two strands of No. 12-1/2 gauge copper bearing hot-dipped galvanized wire with heavy barbs spaced 3" apart. Barbed wire shall be included unless excluded on the drawings.

7. Concrete. Concrete required for setting of posts shall be Class B having a 28-day compressive strength of 3,400 psi.

INSTALLATION – Construction shall be accomplished in a manner that will provide a rigid, taut fence within 2" of the surface of the ground. Where gaps of more than 2" occur between the bottom of the fence and the ground, the Contractor shall add soil and grade the site to bring the fence within the 2" acceptable gap. Stretcher bars, post braces, truss rods, turnbuckles and other galvanized accessories will be required at terminal points, abrupt changes in alignment or grade and at gates.

1. Clearing and grading**.** The Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required alignment and shall provide a reasonably smooth ground profile at

the fence line. Upon completion of the installation, all debris created by the installation shall be removed from the premises and disposed of as directed by the Engineer.

2. Posts. The posts shall be placed vertically in holes of a diameter which will provide a minimum of 6" of encasement around the post and a minimum depth of 36" unless otherwise noted, securely braced and the holes filled with concrete. Forms will not be required for post encasement. Line posts shall be spaced at not more than 10' centers.

3. Fabric. The fabric shall not be erected until after 5 days from the time of setting posts in concrete. The fabric shall be fastened to the line posts with clips or banks spaced approximately 14" apart, and to the top rail with bands or tie wires at approximately 24" intervals.

4. Horizontal Deflection. Special treatment will not be required at deflection points where the fence changes alignment by 5 degrees or less. At points of deflection where the fence changes alignment by more than 5 degrees, a post brace and truss rod shall be provided in each fence panel adjacent to the post located at the angle point.

5. Post Braces. A brace and truss assembly shall support each gate, corner, pull or end post. The brace shall extend from the line post back to the gate, corner, pull or end post.

6. Grounding of Fence. The fence shall be grounded on each side of all power line crossings or when shown on the plans with one 5/8" x 8' copper-clad steel rod. The ground rod shall be connected to the fence with No. 6 solid, bare copper wire connected to the fabric and rod by bronze-clad clamp and bronze or stainless steel washers and bolts.

MEASUREMENT AND PAYMENT – Payment for fence will be paid at the contract unit price bid per lineal foot for fence, and the contract unit price each for gates of the sizes and types specified. Contract unit price shall include the cost of furnishing and installing all posts, braces and accessories. The contract unit price for gates shall include the cost of furnishing and installing the gate, posts and accessories.

Section 21

Gravity Sewers

21-1 PIPE MATERIAL

1. Pipe. All sewer pipe shall conform to American Society of Testing Materials Specifications, as set forth for the various classifications of pipe as shown on the drawings and/or in the proposal of these specifications.

   All pipes and special fittings will be inspected by the Engineer or his authorized representative immediately prior to installation and all rejected or damaged pieces must be completely removed from the project. Pipe acceptable to the Engineer shall be substituted for rejected or damaged pieces at the Contractor's expense.

   Unless otherwise approved by the Engineer, the Contractor shall use the type of pipe specified on the plan sheets. Where called for in the plans, pipe shall meet the following material specifications.

21-1.1 CLAY PIPE – Vitrified clay sewer pipe shall be furnished in accordance with ASTM "Specifications for Vitrified Clay Pipe, Extra Strength and Perforated" C-700.

Where changing from standard strength to extra strength pipe at intermediate points between manholes, a transition piece, or other transition method as approved by the Engineer shall be used.

Testing of clay sewer pipe, when required by the Engineer, shall be made in accordance with ASTM C-301. In addition to the ASTM tests, additional testing of assembled pipe joints shall be accomplished as set forth herein.

Unless otherwise permitted, all pipe shall be not less than three feet in laying strength.

21-1.2 CONCRETE PIPE – Concrete sewer pipe shall be furnished in accordance with ASTM "Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe," C-76, Wall B.

Pipe shall be bell and spigot or tongue and groove pipe and shall have a joint suitable for the type of joint material used.

Testing of concrete sewer pipe, when required by the Engineer, shall be made in accordance with ASTM on C-497. In addition to the ASTM tests, additional testing of assembled pipe joints shall be accomplished as set forth herein.

21-1.3 DUCTILE IRON PIPE – Ductile iron pipe shall conform to ASA Specifications 21.50 or 21.51.

The chemical constituents shall meet the Physical Property recommendations of ASTM A 536 to insure that the iron is suitable for satisfactory drilling and cutting.

The minimum thickness of the ductile iron pipe shall be as follows:

SIZE	
6” – 16”	Class 3
18” – 36”	Class 4

The pipe shall be provided with either mechanical or push-on joints made in accordance with ASA A21.11 (AWWA C 111).

Testing of ductile iron pipe shall be in accordance with appropriate sections of ASA A21.5 (AWWA C 151).

COATING AND LINING DUCTILE IRON PIPE – The pipe shall be coated with a bituminous coating of either coal tar or asphalt base and lined inside with cement mortar and seal coated in accordance with ASA A21.4 (AWWA C 104) in all respects.

21-1.4 ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PIPE – ABS pipe shall conform to ASTM D 2680.

21-1.5 TYPE PSM POLY VINYL CHLORIDE (PVC) PIPE – Type PSM PVC pipe shall conform to ASTM D 3034.

21-1.6 PVC PIPE – Perforated PVC pipe used for underdrains, shall conform to ASTM D 2729.

21-1.7 CORRUGATED POLYETHYLENE DRAINAGE TUBING – Corrugated polyethylene drainage tubing shall conform to ASTM F 405.

FITTINGS – Fittings shall be provided, where required, with joints of proper design to connect them to the pipes or approved adapters shall be furnished to connect the pipe to the fittings. Cost of fittings, adapters or other special joints will be included in price bid for pipe.

All couplings or joints shall be used shall be of a type recommended by the manufacturer for the pipe used and shall meet the approval of the Engineer.

21-2 PIPE JOINTS – SANITARY SEWER

GENERAL – Premium sewer pipe joints meeting the pipe and joint test included herein are specified for sanitary sewers. The Contractor shall specify whose product he proposes to use and shall furnish evidence of satisfactory performance of the joint at previous installations. Installation shall be in strict accordance with the manufacturer’s recommendations.

21-2.1 CLAY SEWER PIPE – Clay sewer pipe joints shall be compression joints conforming to the requirements of “Compression Joints for Vitrified Clay Pipe and Fittings,” ASTM C-425.

21-2.2 CONCRETE SEWER PIPE – Concrete sewer pipe joints shall have flexible watertight joints conforming to the requirements of “Standard Specifications for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets,” ASTM C-443.

21-2.3 DUCTILE IRON PIPE – Mechanical and push-on joints including accessories shall conform to ASA 21.11.

Flanged joints shall conform to ASA A21.10 or ASA B 16.1 but shall not be used in underground installations except within structures. All flanged joints shall be furnished with 1/16 inch thick red rubber gaskets. The bolts shall have American Standard Heavy Unfinished Hexagonal Head and nut dimensions all as specified in American Standard for Wrench Head Bolts and Nuts and Wrench Openings (ASA B 18.2). For bolts requirements of 1-3/4 inch diameter and larger, bolt studs with a nut on each end are recommended. Material for bolts and nuts shall conform to ASTM A 307, Grade B.

Bell and Spigot joint shall conform to ASA A21.10.

21-2.4 ABS PIPE – ABS pipe joints shall conform to ASTM 2680.

21-2.5 PVC PIPE – PVC pipe joints shall conform to ASTM 3212.

21-2.6 PIPE JOINT TESTS – The sewer pipe joints furnished shall meet the leak tests as specified in ASTM C 425 and C 443.

21.3 PIPE JOINTS – STORM SEWER

GENERAL – Pipe joints as specified for sanitary sewer or any of the following may be used on storm sewer and other drains unless a specific joint is specified.

21-3.1 BITUMINOUS FILLER JOINT – A bituminous plastic cement meeting the requirements of ODOT 706.10, or as otherwise approved by the Engineer, shall be used in sufficient quantity to fill the joint after the pipe has been placed in position. After the pipe has been set to its true alignment and grade, all surplus material shall be removed from the inside of the pipe. If bell and spigot pipe is used, a gasket of jute shall be placed in the joint and properly caulked to maintain proper alignment of the pipe.

21-3.2 RUBBER GASKET JOINTS – Joints may be sealed by use of a rubber compression gasket. The gasket shall be a continuous rubber ring which fits snugly in the annular space between the beveled surfaces of the tongue and the groove ends of the pipe to form a flexible seal. The gasket shall have smooth surfaces free from all imperfections and shall meet the physical test requirements specified in ASTM C-443.

21-3.3 CEMENT MORTAR JOINT – The following may be used for storm sewers thirty (30) inches in diameter and larger. The groove end of the pipe laid to line and grade shall be carefully washed with wet brush and the bottom half of the groove buttered with one to two Portland Cement mortar. The tongue of the next section of pipe shall be cleaned with a wet brush and a layer of one to two Portland Cement mortar shall be applied to the top half of it. The tongue end of the second pipe shall then be fitted into the groove end of the first pipe until the mortar is squeezed out onto the inner and outer surfaces. The inner surface of the pipe at the joint shall be then pointed up smooth with a long-handled brush, and the outside pointed with a head of mortar. If the joint opening on the bottom half of the pipe exceeds one-half (1/2) inch, it shall be filled with one to two Portland Cement mortar. If bell and spigot pipe is used, a gasket of jute shall be placed in the joint and properly caulked to maintain proper alignment.

21-3.4 PRECAST JOINTS – Precast joints shall be made with an approved die-cast tapered-style joint which shall be made by fitting the spigot and socket of the pipe with collars of bituminous compound. The compound shall have a melting point of 240 to 270 F., and a penetration of 4 to 7 at 77 F.

A lining or ring of this jointing material shall be die-cast into the socket of the pipe. The spigot shall be fitted with a collar of the same material die-cast around the end of the pipe, and of such size that when shoved firmly into the socket portion of the pipe a right fit between the socket and the spigot end of the pipe will be made. All pipe must be dry and clean when the lining and collar are cast, and the compound must be poured at a heat high enough to produce adhesion to the pipe. All asphalted collars shall be inspected before the pipe is laid, and no pipe shall be used if either collar shows any void or unfilled space. No jute or caulking material is necessary for this type of joint, and will not be permitted. Just before the pipe is laid, the lining and the collar shall be painted with a solvent which shall cause the surfaces to become plastic or tacky, and when the pipes are shoved firmly together the joint material shall unite, and incidental to diffusion of the solvent, congeal and become one homogeneous body.

21-4 INSTALLATION

21-4.1 SAFETY – For the security of persons in and adjacent to trenches or construction operations, the specific safety requirements of the Industrial of the Industrial Commission of Ohio Relating to Construction, latest revision, shall be followed as applicable.

21-4.2 TRENCH EXCAVATION (EARTH) – The trenches in which the sewers and appurtenances are to be constructed shall be excavated in all cases in such a manner and to such widths as will accommodate the building of the structures they are to contain. Machine excavation shall be stopped at the depths outlined under “Bottom Preparation” for the type of pipe being installed. Unauthorized excavation below grade shall be filled with granular material, at the expense of the Contractor.

21-4.3 TRENCH EXCAVATION (ROCK) – When excavation is made in rock or boulders, the trench shall be excavated to a depth of six inches below the barrel of the bell of the pipe and to a clear width of eight inches on each side of all pipes or structures unless otherwise specified on the drawings.

Under no circumstances will there be any blasting done in the city of Oakwood without written permission from the City Manager or his authorized agent.

No blasting shall be done within forty feet of the end of the sewer, water line or other structure without specific permission from the Engineer. Blasts shall be properly covered and the water line, sewer or other structures properly protected. Warning shall be given to all person in the immediate vicinity. Blasting methods and protective measures used by the Contractor shall be approved by the Engineer. The Contractor shall meet and satisfy all claims for damages resulting from blasting and shall save the Owner and the Engineer harmless from such claims.

The word “rock” wherever used as the name of an excavated material shall mean boulders and solid masonry larger than one-half cubic yard in volume, or solid ledge rock and masonry which, in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, sledging or barring, or breaking up with a power-operated hand tool. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator or shovel; no loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere; and no rock exterior to the minimum limits of measurement, which may fall into the excavation, will be measured or allowed when extra payment for rock excavation is set forth.

If extra payment for rock excavation is set forth, the volume for which payment is to be made shall be based on the width as excavated but not to exceed the outside diameter of the pipe plus 16 inches

or a total trench width of 30 inches, whichever is greater, or the outside dimensions of the structure plus 2 feet and a depth equal to the distance from the top of the unexcavated rock to a point 6" below the barrel of the pipe or structure.

21-4.4 TRENCH WIDTH – Widths of trenches shall be held to a minimum to accommodate the pipe, timbering, etc., and in no event will the trench width at the top of the pipe exceed 30 inches or the outside diameter of the pipe plus 16 inches whichever is greater, unless prior approval has been received from the Engineer. If, for any reason, excessive trench width occurs at depths which would impose critical loads on the pipe, the Contractor shall provide gravel or stone backup, extra strength pipe or concrete encasement as approved by the Engineer, at no additional cost to the Owner.

Where the sewer is located adjacent to or in pavement, the Contractor shall maintain vertical sides on all trenches using full sheeting and bracing if necessary. Maximum top width of trench permitted under such conditions shall be four (4) feet, plus the inside diameter of the pipe.

21-4.5 BOTTOM PREPARATION – The trench shall be machine excavated to a point not less than six inches below the barrel of the pipe. All loose earth shall be removed from the trench bottom and a bed prepared and compacted using bedding material consisting of crushed stone or gravel meeting the grading requirements of No. 67 aggregate State of Ohio, Department of Highways, Construction and Material Specifications.

21-4.6 FOUNDATION – The sewers are to be built on good foundations. Such measures as necessary and as approved by the Engineer shall be used to prevent settlement. If, in the Engineer's opinion, the material forming the bottom at the grade of the sewer is not suitable for foundation, a further depth shall be excavated and the same filled with granular material and compacted. Authorized excavation below grade will be paid for as specified in the contract. Extra payment will be allowed to cover the actual cost of the granular material delivered to the site for all authorized excavation below grade.

21-4.7 DRAINAGE – Should water be encountered, the Contractor shall furnish and operate suitable pumping plant equipment of capacity adequate to dewater the trench, dispose of such water, and to maintain drainage conditions, as approved by the Engineer. During laying and joint making operations, the water level in the working area shall be maintained at an elevation at least two (2) inches below the bottom of the bell of the pipe until, in the opinion of the Engineer, water damage to completed joints will not occur.

21-4.8 PIPE LAYING AND BEDDING – Pipe and special fittings shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times and no pipe shall be used in the work that does not conform to the appropriate ASTM specifications.

The Contractor shall maintain pipe line and grade in accordance with the project plans. The method of maintaining line and grade shall be approved by the Engineer prior to the start of work.

The pipe layer shall carefully prepare the bed for the pipe both from a grade and line standpoint using bedding material previously described. The bedding shall be a minimum of 4 inches. All rock or stones protruding above the prepared bed shall be removed.

The laying of pipe in finished trenches shall commence from the lowest point, with the spigot ends pointing in the direction of flow. All pipe shall be laid with ends abutting and true to line and grade. They shall be carefully centered so that when laid they will form a sewer with a uniform invert.

Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed or of the factory-made jointing material shall be clean and dry. Lubricants, primers, adhesives, etc., shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined and adjusted in such a workmanlike manner as to obtain the degree of watertightness required. In the event that pipe previously laid is disturbed due to any cause, the same shall be taken up, with joints cleaned and the pipe relaid in accordance with the foregoing specifications. Trenches shall be kept water-free and dry during laying, bedding and jointing for as long a period as required to give a watertight joint. After the pipe is laid, graded and aligned, the bedding material as previously described shall be brought up to the centerline of the pipe for full width of the trench and be so placed and compacted as to fill the space under the lower part of the pipe. The remaining side fill shall be made in accordance with the requirements for trench backfill herein.

21-4.9 TIMBERING – Unsupported open cut for sewers will not be permitted where soil conditions necessitate unusually wide trenches causing damage to street pavement, trees, structures, poles, or other private or public property. During the progress of the work, whenever and wherever it is necessary either to provide safe working conditions or to avoid the danger of damage to existing structures or structures being built, the Contractor shall, at his expense, support the sides of excavation by adequate and suitable sheeting, shoring and bracing. Such trench support material and equipment shall remain in place until backfilling operations have progressed to the point where the supports may be withdrawn without endangering structures. Sheeting may be cut off above the top of the pipe and pulled, when sheeting is pulled, it should be pulled in increments of three or four feet to avoid the possibility of breaking the pipe.

21-4.10 TRIMMING – All material excavated in trenching and all material used in construction of the work shall be deposited so as not to endanger the work or create unnecessary annoyance to the public. during the progress of the work, all material piles shall be kept trimmed and maintained in a neat, workmanlike manner.

21-4.11 TRENCH BACKFILLING – All trenches and excavation shall be backfilled immediately after pipe is laid and/or tested. Granular material may be gravel, crushed slag or crushed stone meeting the requirements for subbase material, Section 310.02, State of Ohio, Department of Transportation, Construction and Material Specifications. No material shall be used for backfilling that contains stones, having a dimension greater than three (3) inches, frozen earth, debris, or earth with an exceptionally high void content.

For backfill above the centerline and to a level of 12 inches over the top of the pipe, selected material shall be used, and placed in uniform layers not exceeding six inches in depth (loose depth) up each side. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of pipe settlement, misalignment and damage to joints. In lieu of the above described method, the Contractor may, at his own expense, use shovel-tamped granular material to backfill over the pipe.

Above the tamped backfill, the Contractor may complete the backfilling with mechanical equipment. This shall be done in such a manner that the material does not free fall onto the hand-placed cover. The backfill shall be so placed that it will "flow" onto the hand-placed cover from the section partially filled.

The Contractor shall consolidate the backfill in such a manner as will insure the minimum possible settlement and the least interference with traffic. Where sewers are located in or adjacent to pavements, all backfilling and material handling equipment shall have rubber tires. Through rights-of-way, “cat” type backfill equipment will be permitted. Granular material shall be used for backfill of trenches in pavements and driveways and at other places as ordered by the Engineer. The granular backfill shall be as specified under “Granular Backfill”. Periodic dressing of fill over the trench to improve drainage and safety conditions shall be made during the course of the contract.

Backfill material for perforated pipe underdrains, unless otherwise specified, shall be No. 57 washed stone free of foreign debris or deleterious material. The stone shall be placed in 6 inch layers and carefully tamped in such a manner to avoid lateral displacement. The stone backfill material shall extend to the street base or as otherwise shown on the plan sheets.

21-4.12 NOISE, DUST AND ODOR CONTROL – The Contractor’s performance of this contract shall be conducted so as to eliminate all unnecessary noise, dust and odor.

21-4.13 CLEANING UP – Immediately after a section of sewer is tested and accepted for payment, the ground surfaces shall be cleaned of all surplus material including stones, broken pipe, construction material, and all other debris by the Contractor, to the satisfaction of the Inspector. Contractor’s attention is directed to “Leakage Test” where only four sections shall be permitted to remain untested. Clean up and testing shall be maintained within the four section area.

21-4.14 GUARANTEE – The Contractor shall be responsible for the condition of the trenches for a period of one year from the date of the final estimate. The Engineer reserves the right to reject any portion of of the work during the term of this contract or guarantee period, should any gravel-backfilled trench settle or any other evidence so indicate that the backfill has been improperly placed or that the pipe joints are not properly sealed. The Contractor will be ordered to reopen the trench at those locations and replace the backfill or repair the pipe joints in the proper manner without additional compensation.

21-5 LEAKAGE TEST – SANITARY SEWERS

The Contractor shall conduct tests to determine the watertightness of the sewer when completed. The tests shall be observed by the Engineer but the Contractor shall furnish all labor, equipment and materials required in connection therewith including the necessary water.

The first leakage test shall be conducted prior to construction beyond the first four sections. After the first section passes test, construction may resume. The testing operation shall be continuous throughout the construction of the project and at no time during constructions shall there be more than four (4) sections not tested unless otherwise approved by the Engineer.

The sewer shall be tested in sections, complete with laterals. Sections are defined as the sewer extending between two manholes, from the inlet end of the downstream manhole, to the inlet end of upstream manhole (This includes the upstream manhole in the test for any given section).

Leakage through the joints of all sanitary sewer pipe shall not exceed the following allowable limit:

Sanitary Sewers. 200 gallons per inch of tributary pipe diameter per 24 hours per mile of length of the

computed equivalent for shorter lengths and shorted period of time. All sanitary sewers shall be tested.

Unless otherwise specified, storm sewers will not be leak tested.

Leakage tests shall be performed after all installed pipe and manholes have been cleaned and obstructions removed.

21-5.1 INFILTRATION TEST – This test is to be conducted when the height of ground water table is two feet or more above the elevation of the inside crown of pipe at the upstream limit of the section being tested. The infiltration test shall be made by installing a weir or other measuring device approved by the Engineer in the lower end of the sewer section to be tested. The quantity of ground water infiltration into the sewer shall be measured and shall no exceed the allowable leakage.

21-5.2 EXFILTRATION TEST – This test is to be conducted when the height of the ground water table is less than two feet above the elevation of the inside crown of pipe at the upstream limit of the section tested.

In general, a test section shall include the distance between two successive manholes. Should the test section fail the exfiltration test, the entire system installed shall be tested, either manhole to manhole or as a whole as directed by the Engineer. The inlet end of the upstream and downstream manholes shall be closed with a watertight bulkhead and the sewer, along with the upstream manhole, shall be filled with water until the elevation of the water in the upstream manhole is two feet higher than the inside crown of the pipe in the section being test, or two feet above the existing ground water in the trench whichever is the higher elevation. The length of section to be tested may be filled and maintained full of water for a period of approximately 24 hours prior to the start of the test. If the water level in the upper manhole has dropped during this 24 hour period the level shall be raised to the test elevation mark prior to the measurement of leakage. If the Contractor elects to test at any time during the 24 hour period, the water shall be set at the test elevation mark and the test made.

The exfiltration will be determined by measuring the volume of water that is required to be added to return the surface of the water in the upstream manhole to the test elevation mark. The test period shall be a minimum of one hour duration from the start of the test.

The Engineer, because of adjacent trench material consideration, may order that after the completion of the exfiltration test the test section of line shall be drained and the infiltration, under existing ground conditions, shall be measured within three hours by means of a weir located in the downstream manhole.

The allowable leakage is based on a maximum difference in elevation of eight feet between the level of water in the upper manhole and the invert of the bullheaded pipe at the downstream manhole. If the difference in elevation exceeds eight feet, the allowable leakage shall be increased five percent for each one foot in excess of eight feet.

21-5.3 AIR TEST – In lieu of exfiltration tests required for pipe sizes 8” through 24” under 21-5.2 and subject to approval of the Engineer on a job to job basis, the Contractor may request an air test for checking tightness of sanitary sewer pipe construction. Selected sections or sections of pipe between shall be

tested. Manholes shall be tested by plugging connecting pipes and filling with water to 2 feet from the crown of the highest entering pipe. After the filled manhole has been allowed to stand for 24 hours, no loss of water will be permitted in a four (4) hour period.

Air testing pipes will be accomplished only by use of equipment that has been approved by the Engineer and in accordance with the following steps:

1. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
2. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
3. After an internal pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
4. When pressure decreases to 3.5 psig, start stop watch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times for runs of single pipe diameter and for systems of 4", 6", or 8" lateral in combination with trunk lines shall be as published in tables by the National Clay Pipe Institute for vitrified clay pipe and ASTM C-924 for concrete pipe.

In the event the allowable leakage limits are not met, the Contractor shall determine the location where excess water is entering or leaving the sewer. The sewer and/or manholes shall be repaired in a manner satisfactory to the Engineer and retested until the leakage is within the allowable limits. The Contractor shall include, in the price bid per linear foot of sewer, the cost of all bulkheads, plugs, pipe stopper, pumps, compressions, water, weir, labor, delay, and any other items of cost necessary for the performance and completion of the required leakage test and for the cost of any repairs or adjustments which may be necessary to make the project conform to the required allowable leakage limits.

All leakage tests shall be conducted under the supervision of the Engineer or Engineer's representative.

21-6 MANHOLES AND INLETS

General. Manholes or inlets shall be built where shown on the drawings or where required by the Engineer. They shall be built in conformity with the requirements of the drawings and specifications. All sanitary sewer manholes shall be precast or cast-in-place concrete. Storm sewer manholes and inlets may be precast concrete, cast-in-place concrete or brick/block.

21-6.1 Precast Concrete Manhole Sections. Manhole barrel sections shall conform to the requirements of the "Specifications for Precast Reinforced Concrete Manhole Sections" ASTM C478 except that the circumferential reinforcement shall be not less than 0.18 square inches per lineal foot.

The Contractor shall submit to the Engineer such detail drawings, sketches and specifications as may be required to establish that the proposed manholes conform to the requirements of the plans and specifications. No manholes shall be furnished until the Engineer has approved the detailed drawings.

Manhole barrel sections may be used in any combination to obtain the desired depth. Manholes shall be constructed in such a manner that the total depth from invert to top elevation will allow a minimum of five courses of brick below the established grade.

Joints of the manhole sections shall be formed entirely of concrete employing a round rubber gasket and when assembled, shall be self-centering and make a uniform watertight joint. After testing and acceptance, the annular space exposed on the inside shall be filled with cement mortar.

21-6.2 Brick. All brick shall conform to Grade SW as specified in the "Standard Specifications for Building Brick" ASTM C62. Concrete brick may be used on approval of the Engineer, providing it meets all of the Physical Requirements for Grade SW in Table 1 of the above mentioned ASTM specifications.

All joints in the brickwork shall be smooth and completely filled with mortar which shall be composed of cement and a sand, mixed in the proportions of one bag of cement to two cubic feet of sand. The sand shall be measured loose in a bucket or in some other suitable measure of known volume. The cement and sand shall be mixed thoroughly and uniformly dry and then wet with water to make a stiff paste which will be plastic under the trowel, but not so soft as to run after being placed and shall be used before it has begun to stiffen. Mortar that has once set shall not be mixed and used.

The manholes shall be plastered on the outside and the inlets on the inside with ½ inch coat of mortar, as specified above, to which shall be added 8 pounds of slaked lime per bag of cement, after the completion of which, the plastered manhole or inlet shall be cured as directed.

Manhole steps shall be provided for all manholes. The vertical distance between steps shall not exceed 16 inches. All steps shall be firmly anchored into the sections of the manhole wall.

21-6.3 Manhole Bases and Flow Channels. Concrete for manhole bases shall be Class "B" concrete conforming to specifications for Class "B" concrete as defined in Chapter 11, except that no admixture is required.

Concrete for flow channels shall be Class "C" concrete conforming to specifications for Class "C" concrete as defined in Chapter 11, except that no admixture is required.

No mortar or concrete shall be placed in water, and no water shall be allowed to flow over or against the concrete before it has set for a period of time deemed sufficient by the Engineer to prevent damage to the structure.

Where there are changes in the direction of the sewer or entering branches to the manholes, the centerline of the invert shall have a true curve of as large a radius as the size of the manhole will permit.

21-6.4 Castings. Manhole frames and covers shall be of the heavy duty pattern. The cover and seat shall have machined bearing surfaces to prevent rocking and rattling. The minimum opening of the frame shall be 21 inches. The minimum dimension from bottom of frame to top of cover shall be 9-3/4 inches and the total combined weight of the cover and frame shall be at least 350 pounds. Inlet castings shall be on the drawings.

In addition, where indicated on the drawings, the manhole frames and covers shall be of the waterproof type with gasket seal and bolted lid.

21-6.5 Manhole Steps. The steps provided shall be manufactured of cast iron or aluminum, shall be 12 inches wide and 1 inch square. Alternate material or step size may be submitted to the Engineer for approval.

21-6.6 Covers, Stops, Connections, Etc. All castings, iron work, pipe connections, etc., shall be built into the masonry whenever required and in a manner approved by the Engineer. The manhole frame shall be securely mortared onto the top of the manhole.

All stub connections shall be pipe with same joint, strength and specifications as the sewer pipe. The stub shall be plugged with a stopper containing the same joint as the sewer pipe. The stopper used shall be equal to the sewer pipe material.

21-6.7 Drop Manhole Connections. Drop manhole connections shall be provided for lateral sewers when called for on the drawings or as ordered by the Engineer. Pipe and fittings shall be the same joint, strength and specifications as the sewer pipe. Concrete fill shall be Class "C" concrete conforming to specifications for Class "C" concrete as defined in Chapter 11.

21-6.8 Cold Weather. If the work is performed in cold weather, the Contractor shall, at his own expense, provide the necessary means for heating brick, sand and water, and for complying with all the requirements of the Engineer to thoroughly protect the masonry, during and after laying, from damage by frost. No masonry work or backfilling shall be done on days when, in the opinion of the Engineer, conditions are unsuitable for good construction.

21-6.9 Watertight Work. Manholes must be made watertight at all points and if, after the work is completed, leaks are discovered, they must be caulked or otherwise stopped. Any defects in the work discovered at any time shall immediately corrected.

21-6.10 Completion. All inlets and manholes upon their completion are to be left clean and free from rubbish and kept so until the acceptance of the work. Repairs or alterations to the manholes after performing the leakage test specified herein may be justification for a retest of the section of sewer involved.

Section 22

Water Supply and Distribution

22-1 FURNISHING AND INSTALLING PIPE, FITTINGS, AND SPECIALS

22-1.01 Description. This item shall consist of providing all the necessary labor, materials, tools, machines and equipment required to furnish and lay the pipe and fittings of the various sizes as shown on the construction drawings. This work includes excavating the trench to the line and grade shown on the drawings, furnishing and laying the pipe in the trench and jointing it, furnishing and placing joint restraints and concrete thrust blocks, backfilling the trench, repairing or replacing any main line sanitary sewers or storm drains, head walls, gas lines, service connections, or any other utilities or structures that may be disturbed or damaged by the Contractor's operation; disposing of all surplus excavation; flushing, testing and disinfecting the line in place; and all other work required for the furnishing and laying of the pipe lines and connections complete and ready for service as shown on the drawings and as covered in the specifications.

Included in this item is the furnishing and installing of all fittings required for satisfactory completion of the project including bends, tees, reducers, joint restraints, all concrete used in thrust blocks, blow-offs, sleeves, closure pieces, branch connections, connections to other lines or fittings, special castings for the installation of valves, any other fittings or specials, all fittings and pipe, except corporation stops and taps, for flushing, testing and disinfecting the line.

22-1.02 Handling. Pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

22-1.03 Valve Operation and Taps. Unless otherwise specifically authorized in writing, the Contractor shall not operate existing valves or make taps, whether for service lines or for flushing, testing or disinfecting; these operations shall be performed by City personnel only.

22-1.04 Ductile Iron Pipe. All ductile iron pipe used in the Work shall be designed in accordance with AWWA C150 and manufactured in accordance with AWWA C151. All pipe shall be cement lined and bituminous seal coated in accordance with AWWA C104 and shall have an outside coating of bitumastic enamel or approved equal.

The minimum wall thickness for pipe 24 inches or less in diameter shall be that given by Thickness Class 53, unless otherwise specified in the Supplemental Specifications. The required Thickness Class for pipe larger than 24 inches in diameter shall be stated in the Supplemental Specifications.

22-1.05 Fittings for Use with Standard Cast Iron Pipe. All fittings to be used with standard bell and spigot cast iron pipe, Class "D", shall be manufactured in accordance with AWWA C100. All fittings to be used with mechanical joint or push-on joint type cast iron pipe shall be manufactured in accordance with AWWA C110 and C111. All fittings shall be cement lined and bituminous seal coated in accordance with AWWA C104 and shall have an outside coating of bitumastic enamel or approved equal.

22-1.06 Fittings for Use with Ductile Iron Pipe. Fittings shall be minimum of Class 250, ductile iron manufactured in accordance with AWWA C110, or ductile iron compact fittings manufactured according to AWWA C153.

All fittings shall be provided with ends made in accordance with AWWA CH 111. All fittings shall be cement lined and bituminous seal coated in accordance with AWWA C104 and shall have an outside coating of bitumastic enamel or approved equal.

22-1.07 Joints for Ductile Iron Pipe and Fittings. All ductile iron pipe and fittings for ductile iron pipe shall be provided with either push-on joint ends or mechanical joint ends manufactured in accordance with AWWA C11. Unless otherwise specified by the Engineer, all mechanical joint fittings, except plugs, shall be furnished with ductile iron set screw retainer glands in lieu of standard mechanical joint glands. Unless otherwise specified, restrained plugs shall be used whenever plugs are called for on the plans. Alternate methods of joint restraint may be used upon approved of the Engineer.

Restrained joint pipe, not otherwise recognizable from the outside, shall have the bell painted red.

22-1.08 Excavation. For the security and safety of persons in and adjacent to trenches or construction operations, the specific safety requirements of the Industrial Commission of Ohio Relating to Construction, latest revision, shall be followed as applicable.

Excavation, other than rock shall include the loosening, removing, loading and trans- porting of all materials, whether wet or dry, of every name and nature, all seen and unforeseen obstacles, necessary to be removed, for any and all purposes essential to the construction and completion of all work under this contract. It shall also include the transporting and disposing of all surplus materials from the site of the job, the removal and disposal of paving of any type when necessary for the construction of water mains, appurtenances and other structures, and the removal and disposal of old pipe lines and other appurtenances that are in the way of new work.

The proposed location of the pipe lines and the connections to the existing pipe lines are shown on the plans. If, during the course of the work, unforeseen conditions arise, the horizontal or vertical alignment of the pipe line may be changed as directed by the Engineer.

The trench shall be excavated to a depth as shown on the plans, unless adjustments are necessary to clear utilities. If it is necessary to change the grade of the water line it shall be lowered, but not by more than two feet, unless specific approval is given by the Engineer to raise the grade or to lower it by more than two feet. Unless otherwise shown on the plans or approved by the Engineer, the water line shall be installed with a minimum cover of 4'-6" from the existing ground surface or the proposed final ground surface whichever islower. Unauthorized excavation below grade shall be filled with approved granular material, at the expense of the Contractor.

Excavation shall be of sufficient width to permit the installation of all mains to the line and depths called for on the drawings, or as previously noted, and for all sheeting, pumping and draining. No additional payment will be allowed for trenches excavated wider than necessary to properly install the water lines or trenches excavated deeper than necessary to clear unforeseen utilities or structures. In the construction of water lines, trenches shall be excavated wide enough to permit the pipe to be laid and joined properly and to allow the backfill to be placed as required, but in no case shall the clearance between the bell of the pipe and the sheeting or side of the trench be less than four inches (4") unless approved by the Engineer. Unless otherwise stated on the plans or in the Supplemental Specifications, trench width shall not exceed the nominal diameter of the pipe, plus 2 feet. The trench shall be constructed with the sides corresponding to parallel vertical planes. Holes for the bells shall be provided at each joint but shall be no larger than necessary for joint assembly and assurance that the pipe barrel will lie flat on the trench bottom. The length of trench or tunnel open at any one time shall conform to the limits prescribed by the Engineer.

22-1.09 Trench Excavation (Rock). Where excavation is made in rock or boulders, the trench shall be excavated at least 6 inches below the pipe for pipe 24 inches in diameter or less, and 9 inches for pipes larger than 24 inches in diameter. The pipe shall then be bedded in compacted granular material placed in the trench bottom in accordance with 22-1.12 Initial Backfill. Bulkheads of native clay soil shall be placed across the trench at 100 ft. intervals to resist the unnatural movement of ground water through the granular material. Said bulkheads shall be carefully compacted and shall extend approximately 3 ft. in a direction parallel to the pipe and shall extend from the bottom of the trench to a height of one half foot above the top of the pipe.

Under no circumstances will there be any blasting done in the City of Oakwood without written permission from the City Manager or his authorized agent.

No blasting shall be done within forty feet of the end of the main or other structure without specific permission from the Engineer. Blast shall be properly covered and the main, or other structure properly protected. Warning shall be given to all person in the immediate vicinity. Blasting methods and protective measures used by the Contractor shall be approved by the Engineer. The Contractor shall meet and satisfy all claims for damages resulting from blasting and shall save the Owner and the Engineer harmless from such claims.

The work "rock" whenever used as the name of an excavated material shall mean boulders and solid masonry larger than one-half cubic yard in volume, or solid ledge rock and masonry which, in the opinion of the Engineer, requires the following for its removal: drilling, blasting, wedging, sledging, barring, or breaking up with a power operated hand tool. No soft or disintegrated rock which can be removed with a hand pick or power operated excavator or shovel; no loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere; and no rock exterior to the minimum limits of measurement, which may fall into the excavation, will be measured or allowed when extra payment for rock excavation is set forth.

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 material, or large pieces or fragments of inorganic material which in the judgement of the Engineer should be removed, the Con- tractor 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 ODOT #2 stone, except that the last 4 inches below pipe grade shall be backfilled with 3/4" stone in 3 inch layers. The layers shall be thoroughly tamped so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb the finished surface over a maximum length of 18 inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools. Such additional work shall be done on the basis of payment to the Contractor for extra work.

Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Engineer, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling, timbers, or other materials, in accordance with plans prepared by the Engineer. Such additional work shall be done on a basis of payment to the Contractor for extra work.

Where necessary, the Contractor shall furnish, put in place and maintain such sheeting and bracing as may be required to properly support the sides and ends of the excavation to prevent injury to persons or property. This bracing and sheeting shall also be sufficient to protect all surface and subsurface structures and to prevent the under-mining of adjacent pavement, curb, sidewalks, and other structures. Existing house connections, sewer, water mains, gas mains, conduit lines, drain pipes and other utilities shall be supported across trenches until backfill is completed.

Excavated materials shall be promptly removed and disposed of when the materials are not suitable for backfill or when due to the location of the work on main thoroughfares or in congested areas, there is not sufficient room to permit the storing of the excavated materials. When the storing of the excavated material is permitted at the site of the work, the same shall be compactly piled, using plant bins or retaining walls, if necessary, to prevent the dirt from spreading over the pavement. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed. During the progress of the work, all material piles shall be kept trimmed and maintained in a neat, workmanlike manner. Adequate barricading and lighting shall be provided.

No opening shall be made before all materials, parts and special fittings necessary to complete the work are on hand and available. No opening shall be kept open longer than is necessary to properly execute the work for which the opening is made.

The information on the plans is believed to be correct. However, the Contractor shall view the job site and make an independent examination of the project site for soil conditions, locations and depths of utilities and underground structures. All underground utilities and structures shown on the drawings were obtained from survey and available records. However, the Owner does not assume responsibility for any such utilities or structures not shown nor for incorrect location and depth. The Contractor shall uncover and determine the exact location of any utility or structure that the water line crosses, at least two hundred feet (200') ahead of construction to permit adjustments in line and grade, if necessary, with- out undue complications and to provide the necessary protection during construction.

Asphalt and concrete pavements along the edges of the trench shall be cut evenly and neatly and carefully broken out. Only methods and equipment which will insure no damage to the adjoining pavement shall be used.

Lawns and trees shall be protected from damage. Trees that must be removed for construction shall be designated and marked by the Engineer in the presence of the Contractor. The Contractor is responsible for the removal of all fences necessary for construction and for the replacement of same in their original positions and condition. Payment for this work shall be included in the price bid for this Item. If any section of fence is damaged during the progress of construction, the Contractor shall replace the damaged part at no additional cost
to the City.

At all times during the progress of the work, and at no additional cost to the City, the Contractor shall do all pumping, draining, bailing or other work necessary to keep the trenches and excavations free from water. Water from the trenches and excavations shall be disposed of in such a manner as will neither cause injury to public health, nor to public or private property, nor to the work completed or in progress, nor to the surface of the streets, nor cause any interference with the use of same by the public.

In the area of construction, ingress and egress shall be provided by the Contractor to all properties along the way. If it becomes necessary to block walks or driveways, the Contractor shall provide, at no additional cost to the City, suitable temporary runarounds, bridging or other means of ingress and egress to the properties affected.

The Contractor shall comply at all times with the requirements of DIVISION III, Section 3, Maintenance of Traffic. Access to fire hydrants must be provided and no dirt or material shall be piled within ten feet (10') of a hydrant.

The Contractor shall provide during construction an effective means of keeping down the dust to the satisfaction of the Engineer in accordance with DIVISION I, Section 48, Pollution Control Requirements.

22-1.10 Laying Ductile Iron Pipe. Ductile iron water main and appurtenances shall be installed in accordance with AWWA C600. The Contractor shall become thoroughly familiar with the contents of AWWA C600 and shall keep a copy thereof on the job site for reference. For convenience, the Contractor and the Inspector may utilize the pocket booklet "A Guide for the Installation of Ductile Iron Pipe" published by the Ductile Iron Pipe Research Association; however, in the case of disagreement the requirements of AWWA C600 or the decision of the Engineer shall govern.

In addition to the requirements of AWWA C600, the following specifications shall apply to ductile iron pipe installation.

Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other means to prevent damage to materials. Under no circumstances shall materials be dropped or dumped into the trench.

Unless otherwise specified, ductile iron water main shall be layed on a 4 inch bed of ODOT Item 310, Grade "A" with 1 inch and larger stones removed from against the pipe.

The pipe and fittings shall be inspected for defects and, while suspended above grade, be rung with a light hammer to detect cracks.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space. Precaution shall be taken to prevent dirt from entering the joint space.

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer.

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. All pipe cutting shall be at the Contractor's expense.

Pipe shall be laid with bell ends facing in the direction of laying unless otherwise approved by the Engineer.

Defections in pipe joints in excess of the manufacturer's recommendations will not be permitted.

Pipe Jointing - Mechanical Joints. The mechanical joint for cast iron pipe requires that the spigot be centrally located in the bell. The surfaces with which the rubber gasket comes in contact shall be cleaned thoroughly just prior to assembly. These clean surfaces shall then be brushed with soapy water just prior to slipping the gasket over the spigot eng and into the bell. Soapy water shall also be brushed over the gasket prior to installation to remove the loose dirt and lubricate the gasket as it is forced into its retaining space.

The normal range of bolt torques to be applied to standard cast iron bolts in a joint and the length of wrench required to satisfactorily produce this torque are:

Dia. Of Bolt In.	Range of torque ft – lb	Length of Wrench In.
5/8	40-60	8
¾	60-90	10
1	70-100	12
1 ¼	90-120	14

The above torque loads may be applied with torque measuring or indicating wrenches. Torque wrenches may be used to check the application of approximate torque loads applied by men trained to give an average pull on a socket wrench of the length shown.

When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and last, the remaining bolts. Repeat this cycle until all bolts are within the above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint should be disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation practice shall not be permitted.

Pipe Jointing - **Push-On Joints.** The surfaces with which the rubber gasket comes in contact shall be cleaned thoroughly just prior to assembly. The gasket shall then be inserted into the groove in the bell. Before starting joint assembly, a liberal coating of special lubricant shall be applied to the spigot end. With the spigot end centered in the bell, the spigot is pushed home.

Trench Condition - Pipe shall be placed only in a dry trench and if water should accumulate in the trench, a temporary plug in the end of the pipe shall remain in place until the trench is pumped dry.

Cutting Pipe - Pipe shall be cut in a method approved by the pipe manufacturer, except that pipe shall not be cut with an oxyacetylene torch unless specifically approved by the Engineer.

Restrained Joints for Ductile Iron Pipe - The Contractor shall anchor all hydrants and restrain bends in excess of 11-1/4 degrees, tees, plugs, caps and dead end valves unless otherwise specified. Where called for on the plans, fittings and pipe shall be installed using restrained joints to prevent movement. Where the type of joint restraint is not specified on the plans or in the Supplemental Specifications, the Contractor shall submit the proposed method of joint restraint to the Engineer for approval prior to installation.

Restrained joint pipe, mechanical joint retainer glands or other approved restraining devices shall be installed in strict accordance with the manufacturer's instructions which shall also be provided to the Engineer. After installation of any restrained joint in which there might be any movement before the restraint becomes effective, the new pipe or fitting shall be firmly pulled home to take up all slack in the joint.

The length of pipe with restrained joints called for in the plans shall be considered a minimum for the specified test pressure and laying conditions. If the pipe line is tested at a higher pressure and/or without the stated minimum compacted pipe cover, additional restrained joints will be required and shall be furnished and installed by the Contractor at no additional cost to the City.

Concrete Thrust Blocks for Fittings - Where called for on the plans, concrete thrust blocks shall be poured at bends and tees. Concrete used shall have a minimum strength of Class "B" concrete per DIVISION II, Section 11, Concrete.

Thrust blocks shall extend from the fitting to undisturbed earth on the outside of the curve for all bends. Sides of the thrust blocks shall be formed, and shall be centered on the bend both horizontally and vertically. Tees shall be similarly blocked opposite the branch outlet. Size of thrust blocks shall appear on the drawings and shall indicate the area of the block bearing on undisturbed earth. When approved by the Engineer, precast concrete blocks may be used in constructing thrust restraint. When the use of blocks is approved by the Engineer, the Contractor shall ensure the blocks are appropriately placed to provide thrust restraint, shall ensure the force is being transmitted to the specified undisturbed earth bearing surface, and shall pour sufficient Class "B" concrete over the blocks to yield an integral thrust block.

22-1.11 Leaded Bell & Spigot Joints. No new leaded joints shall be used unless approved by the Engineer. When the use of leaded joints is approved by the Engineer, instructions for making the joints shall be included in the supplemental specifications.

When leaded joints are encountered in locations where new or replacement line is being installed, the existing leaded joint appurtenance may, if approved by the Engineer, be removed and a new, approved appurtenance installed.

Where leaded joints are found to be leaking, the Contractor may be required to repack the lead/hemp material by using a drive punch and hammer or similar equipment. Unless specifically authorized by the Engineer, no additional lead/hemp material shall be added to the joint.

22-1.12 Backfilling. Backfilling shall include the replacing of the excavated materials or placement of granular materials as specified after the water mains and other structures have been constructed, and the proper grading and shaping of the surface of the backfill.

The Contractor shall remove and dispose of all surplus excavated material as the work progresses, including material unsuitable for backfill.

Initial Backfill - For all water lines, the spaces between the pipe and the bottom and sides of the trench shall be carefully backfilled with fine granular material meeting the requirements of ODOT Item 310, Grade "A". The Contractor shall remove stones 1" and larger when such stones are in contact with the pipe.

Backfilling material shall be deposited in the trench to its full width on each side of the pipe, fittings and appurtenances simultaneously, in 6 inches layers to a point 12 inches above the top of the pipe. Each layer shall be compacted using a mechanical tamping or other method approved by the Engineer.

Final Backfill - After completion of the initial backfill, the remainder of the fill within a public way shall be granular, meeting the requirements of ODOT Item 310 Grade **"A",** and be compacted, in lifts, as appropriate to prevent settlement.

Final backfill in areas outside the public way shall conform to the same requirements as backfill within the public way except that the moisture and compaction requirements in unimproved areas may be relaxed by the Engineer after a determination that trench settlement will not be detrimental.

NOTE: Granular material, approved by the Engineer, excavated in the course of the construction at locations where granular backfill is required, will be used as granular backfill and no additional payment will be made the Contractor for this material.

Backfill Settlement - Backfilling specifications are intended to reduce settlement to a minimum amount consistent with economy. It is expected that some settlement may occur and the Contractor's responsibility for repair of such settlement shall continue for a period of one year from the date of completion of the contract.

Clean Up. All surplus materials furnished by the Contractor, all tools, temporary structures, stones and all other debris shall be removed from the site by the Contractor. All dirt, rubbish and excess earth from the excavation shall be hauled to a landfill provided by the Contractor and the construction site left clean to the satisfaction of the Engineer.

22-1.13 Preliminary Flushing of the Water Main. When required, or desired by the contractor with the approval of the Engineer, the completed water main shall be flushed to remove all fine loose particles of dust and dirt that were not removed during laying. Flushing will be accomplished by filling the line slowly with water and once it is filled, the blow offs and/or outlets provided for flushing will be opened and actual flushing started. The source of water shall be applied intermittently to create a surging action in the flow of water. Flushing will continue until the water leaving the outlets is clear. Flushing velocity of 2.5 fps shall be developed in all pipes unless the Engineer determines that conditions do not permit the required flow to be discharged to waste.

22-1.14 Hydrostatic Testing of the Water Main. A hydro-static test as required in Section 4 of AWWA C600 shall be applied, as directed by the Engineer, to the whole or to individual valved off sections of the mains and fire hydrant leads after all outlets, valves, tees, elbows, hydrants and other fittings and appurtenances have been properly plugged, restrained or blocked. The trench shall also be backfilled prior to hydrostatic testing but the Contractor may, with the approval of the Engineer, leave the joints uncovered for inspection during testing. The Contractor shall assume all risks associated therewith and shall repair any damage caused thereby at no additional cost to the City.

At the locations shown on the plans or approved by the Engineer, the Contractor shall furnish and install all taps and corporation stops to be used for testing and disinfecting. The Contractor shall coordinate the operation of main line valves by the City at least one working day in advance of the time the tap is needed and also at least one working day in advance of the testing. The Contractor shall furnish all materials, pumps, piping, connections, other equipment necessary for conducting the tests.

At the completion of all testing, the Contractor shall remove all corporation stops and replace with brass plugs. The installed plugs shall be inspected by the City before the excavation is backfilled.

Pressure Test - Each valved section of pipe shall be slowly filled with water and all air expelled from the line. If permanent air vents are not located at all high points, the Con- tractor shall install corporation stops at such points approved by the Engineer so the air can be expelled from the line. Air vents shall be left in place with the corporation stops capped or the stops removed and replaced with brass plugs as instructed by the Engineer.

The nominal test pressure for a test section shall be the larger of 150 psi or 1.5 times the average of the working pressures at the points of highest and lowest elevations in the test section. The actual test pressure shall be the nominal test pressure corrected to the elevation of the test gauge, and this pressure shall be applied to the main for a duration of at least one hour.

If there are indications of leaks under this pressure test, the Contractor shall locate them at no additional cost to the City. Any cracked or defective pipe, fittings, valves, joints, or other appurtenances discovered as a consequence of this pressure test shall be removed and replaced by the Contractor with approved material at no additional cost to the City, and the test shall be repeated until satisfactory to the Engineer,

Leakage Test - In conjunction with the pressure test described above, a leakage test shall be performed in accordance with AWWA C600, conducted at the same test pressure used above, again corrected to the elevation of the gauge. The leakage test shall be at least two-hours in duration during which time the test pressure shall not vary by more than + 5 psi.

Leakage is defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air expelled. No pipe installation will be accepted until or unless this leakage over a test duration of at least two hours is less than that allowed in AWWA C600, including the additional leakage allowance for metal seated valves. The nominal test pressure defined in these specifications shall be used to determine allowed leakage.

Should any test of individual or combined sections of pipe disclose leakage greater than the specified limit, the Contractor shall, at no additional cost to the City, locate and repair the leaks until the leakage is within the specified allowance.

Any testing performed against existing valves shall be at the Contractor's risk and in strict compliance with the requirements of the Engineer. If unable to achieve the required test the Contractor shall disconnect from the existing valve, plug and re-test until satisfactory results are obtained. Any damage caused to existing facilities shall be repaired at the Con- tractor's expense.

When hydrants are in the test section, the test shall be made against closed hydrant valves. After the test section has passed the leakage test, the isolation valve for each hydrant shall be closed and the hydrant valve opened. A visual inspection shall be made to determine that the isolation valve is not leaking.

22-1.15 Disinfecting the Completed Water Main. After satisfactory hydrostatic testing, the completed pipe shall be disinfected in accordance with AWWA C651. With the approval of the Engineer, the Contractor may use any method of disinfection described in AWWA C651. For convenience, the Contractor and the Inspector may utilize the pocket booklet "A Guide for the Installation of Ductile Iron Pipe" published by the Ductile Iron Pipe Research Association; however, in the case of disagreement the requirements of AWWA C651 or the decision of the Engineer shall govern.

The Contractor shall obtain approval to begin disinfection from the Engineer at least one working day prior to beginning disinfection and shall coordinate the disinfection process with said Engineer.

All corporation stops for chlorination taps and blow-off taps shall be furnished and installed by the Contractor where shown on the plans or as approved by the Engineer. All other material and equipment required for chlorination including sufficient tubing or pipe to extend outside the trench and an operable valve above ground level shall be furnished and paid for by the Contractor.

All valves and other appurtenances in the section of pipe under treatment shall be operated while the pipe line is filled with the chlorinated water.

Final Flushing and Test - Immediately following disinfection, all highly chlorinated water shall be thoroughly flushed from the newly laid pipe line at its extremities until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domesticuse.

After the final flushing and before the water line is placed in service, one or more sets of two bacteriological samples, collected 24 hours apart, shall be taken and tested by the City in accordance with the procedures required by the Ohio EPA, and shall show the absence of coliform organisms. At least one set of samples shall be collected from the new main and one from each branch.

Should the initial treatment fail to produce satisfactory results, the disinfection procedures shall be repeated until satisfactory results are obtained.

22-1.16 Certification. When required by the Engineer, the Contractor shall furnish an affidavit from each material manufacturer certifying that all the required tests have been made and that the pipe and fittings comply with the requirements specified.

22-1.17 Method of Measurement. The lengths for which payment will be made for furnishing and installing will be measured lengths along the centerline of the main line, or connecting or branch lines, in place from the shoulders of hub ends at which the new lines terminate, including the lengths of all pipe, fittings and valves in the various lines. For lines terminating in hydrants, measurement will be made to the hydrant center line. The length at bends or curves will be measured along the center lines to the point of intersection thereof. When the Contractor is responsible for excavation, backfill and restoration under Section 22-4, measurement under this item shall be made to the centerline of the pipe being tapped.

22-2 FURNISHING & INSTALLING GATE VALVES AND VALVE BOXES

22-2.01 Description. This item shall consist of providing all the necessary labor, equipment and material required to furnish and install gate valves, complete with valve boxes, of the type and size shown on the construction drawings and as specified herein. These valves are intended for approximately level setting on buried pipe lines in the water distribution system and are normally open, unless otherwise shown on the plans.

22-2.02 General. All gate valves provided shall conform to AWWA C500 or AWWA C509 except as modified herein.

All valves shall have non-rising stem, open right (clockwise), and have mechanical joint ends unless otherwise specified or approved by the Engineer. Metal seated valves con- forming to AWWA C500 shall be double disc, parallel seat, Mechanical joint ends shall con- form to the requirements of Section 22-1 and shall be provided with all necessary accessories for installation, complete. Valves shall be supplied with 2 inch wrench nuts conforming to AWWA C500. Valve shall be designed for a working pressure of 150 psi.

Valves 12-inch and smaller shall be of vertical design without by-pass valves. Valves 16- inch and larger shall be of horizontal design with bypass valves. Horizontal valves shall have totally enclosed extended gear cases and shall be designed for buried service.

22-2.03 By-passes. Valves 16-inch and larger in diameter shall be provided with by-pass lines of the sizes shown in Table 22-2.1. By-pass valves shall be the same size as the by- pass and shall conform to the requirements of these specifications for the specific valve size used.

TABLE 22—2.1 – Size Requirements of By-passes

Valve Diameter Inches	By-Pass Diameter Inches
16-20	3
24-30	4
36-42	6
48	8

22-2.04 Data to Be Supplied by Manufacturer. The City shall be furnished the catalog data and weight information described in AWWA C500, Section 1.3 and AWWA C509, Section 1.4. The data supplied shall include the number of turns to fully open or close the valve.

When specified in the purchase order or supplemental specifications, the manufacturer, prior to manufacture, shall submit for approval by the Engineer, three sets of drawings, certified as to the accuracy of the information contained thereon, showing the principal dimensions, general construction features and materials proposed for use for all parts of the valve and operator. Drawings shall be in sufficient detail to enable the Engineer to verify conformance to the requirements of the specifications. The valves shall be manufactured in accordance with these certified drawings after they have been approved by the Engineer.

The manufacturer shall, if requested by the City, supply records of any of the tests required by AWWA C500 and AWWA C509.

22-2.0S Certification. The Contractor shall furnish, at the time the valves are delivered, a sworn and notarized statement from the manufacturer certifying that the valves comply with all requirements of these specifications, and that all tests specified therein have been performed and all test requirements have been met

22-2.06 Valve Boxes. Each valve used in buried service shall be provided with a valve box meeting the requirements of 22-5. No separate payment shall be made for these valve boxes as their cost is to be included in the unit price bid for the various valve types and sizes.

22-2.07 Operation Of Valves. Unless otherwise specified, all valves which affect the flow of water through water lines in service are to be operated only by City of Oakwood personnel.

22-3 FURNISHING AND INSTALLING BUTTERFLY VALVES, ACTUATORS AND VALVE BOXES

22-3.01 Description. This item shall consist of providing all the necessary labor, equipment and material required to furnish and install butterfly valves complete with actuators and valve boxes of the type and size shown on the construction drawings and as specified herein. Valves and appurtenances, including actuators, shall be suitable for buried or submerged service in the water distribution system and are normally open, unless otherwise shown on the plans.

22-3.02 General. Butterfly valves shall conform to AWWA C504, Rubber-Seated Butterfly Valves, except as specifically modified herein. Valves shall be AWWA Class 150B designed for a non-shock shut-off pressure of 150 pounds per square inch and a maximum velocity of 16 feet per second. Valves shall open right (clockwise) and be suitable for bi- directional flow.

Valves for use with ductile iron pipe shall have mechanical joint ends furnished with high strength ductile iron tee head bolts, hex nuts, and rubber gaskets.

Valves for use with prestressed concrete pipe shall have Victaulic ends, Style 44.

22-3.03 Design Criteria and Materials. All butterfly valves, unless otherwise specified, shall meet the following design criteria and be manufactured of materials meeting the following specifications.

Bodies. Bodies shall be ductile iron conforming to ASTM A536, Grade 65-45-12.

Shafts. Unless otherwise approved, shafts shall be stainless steel or monel, turned, ground and polished and secured to the valve disc by means of one or more tangential fitted monel or stainless-steel taper pins driven into reamed tapered holes and held snug by means of a locking nut or hex-mated to valve disc and designed to exclude water.

Discs. Valve discs shall be designed to seat at 90 degrees to the pipe axis.

Seats. Seats for all size valves shall be designed for field removal and replacement by appropriately trained Department of Water personnel. Rubber seats shall be mechanically secured to either the body or the disc. Seats cemented, bonded or vulcanized to the body or disc shall not be permitted. The mating seat surface shall be 18-8 stainless steel or monel, smoothed and polished.

Operating Nuts. Butterfly valves for buried service shall be supplied with 2-inch wrench nuts conforming to the requirements of AWWA C500, Section 3.16.

Actuators. Actuators suitable for buried and submerged service shall be furnished integral with each valve. Actuators shall deliver an output torque equal to that given in Table 4, AWWA C504. Actuators having an output torque rating less that given in said Table 4 shall be permitted only if the manufacturer submits acceptable certified test results that substantiates that the maximum torque required to seat and unseat the valve under the most adverse design conditions is less than given in Table 4. The most adverse design conditions are considered to be the following: opening against the full design pressure of 150 psi with dry downstream and closing against a velocity of 16 feet per second at the design working pressure of 150 psi.
Worm gear operators shall be Type HBC as manufactured by the Philadelphia Gear Corporation or an approved equal.

All actuators shall be for right-hand (clockwise) opening.

22-3.04 Data to Be Supplied by Manufacturer. The City shall be furnished catalog data for each valve including illustrations and a parts schedule that identifies the materials to be used for making various parts. This information shall be in sufficient detail to serve as a guide for assembly and disassembly of the valve and for ordering parts. The data sub- mitted shall include a statement of the total net assembled weight for each size of valve and the number of turns required to completely open (close) the valve from the fully closed (open) position.

When specified in the purchase order or supplemental specifications, the manufacturer, prior to manufacture, shall submit for approval by the Engineer, three sets of drawings, certified as to the accuracy of the information contained thereon, showing the principal dimensions, general construction features and materials proposed for use for all parts of the valve and actuator. Drawings shall be in sufficient detail to enable the Engineer to verify conformance to the requirements of the specifications. The valves shall be manufactured in accordance with these certified drawings after they have been approved by the Engineer.

The manufacturer shall, if requested by the City, supply records of any of the tests required by AWWA C504.

22-3.05 Certification. The Contractor shall furnish, at the time the valves are delivered, a sworn and notarized statement from the manufacturer certifying that the valves comply with all requirements of these specifications, and that all tests specified therein have been performed and all test requirements have been met.

22-3.06 Valve Boxes. Each valve used in buried service shall be provided with a valve box meeting the requirements of 22-5. No separate payment shall be made for these valve boxes as their cost is to be included in the unit price bid for the various valve types and sizes.

22-3.07 Operation of Valves. All valves which affect the flow of water through water lines in service are to be operated only by City of Oakwood personnel.

22-4 FURNISHING TAPPING SLEEVES AND VALVES AND VALVE BOXES

22-4.01 Description. This item shall consist of providing all the necessary labor, equipment and material required to furnish tapping sleeves and valves, complete with valve boxes, of the type and size shown on the construction drawings and as specified herein.

22-4.02 General. Each tapping sleeve and tapping valve shall be provided as a matched set from a single vender. Valves shall be designed for a working pressure of 150 psi.

22-4.03 Valve Body and Ends. All tapping valves shall conform in all respects to the requirements of 22-2 except that inlet joints shall have a raised face and be drilled to con- form with the tapping sleeve provided to assure proper alignment. The outlet ends shall be mechanical joint with slotted holes. Seat rings shall be of sufficient size to permit passage of the tapping machine.

22-4.04 Sleeves for Cast Iron or Ductile Iron Pipe. All tapping sleeves shall be dual compression seal, either mechanical joint or caulk type, designed for use on the class of pipe being tapped. Sleeves shall be constructed of ductile iron conforming to ASTM A536 and designed for 150 pounds per square inch working pressure. The outlet side shall be flanged and grooved to fit a raised male flange on the tapping valve. These flanges shall be drilled and not cored or slotted. The bolting and gasket where the two halves are joined shall extend the full length of the sleeve.

Suppliers shall state for each size sleeve the minimum and maximum outside pipe diameter on which the sleeves may be used and, where applicable, supply all gaskets adapt- able to the full range of allowable outside diameters.

22-4.05 Installation. All tapping sleeves and valves shall be installed in accordance with the manufacturers' instructions.

22-4.06 Tapping of Concrete Pressure Pipe. Tapping of concrete pressure pipe shall be undertaken only with a tapping system manufactured or recommended by the manufacturer of the concrete pipe being tapped, and appropriate for that pipe. The tapping procedure shall be undertaken by specially trained personnel of the pipe manufacturer or an authorized agent of the pipe manufacturer.

Tapping valves shall meet the requirements of 22-4.03 except that the inlet flange shall match the flange of the tapping saddle being used.

22-4.07 Excavation, Backfill and Restoration. The Contractor shall be responsible for excavation to expose the main to be tapped, for backfill and for restoration as required for installation of tapping sleeves and valves.

22-4.08 Operation of Valves. All valves which affect the flow of water through water lines in service are to be operated only by City of Oakwood personnel.

22-4.09 Valve Boxes. Each valve used in buried service shall be provided with a valve box meeting the requirements of 22-5. No separate payment shall be made for these valve boxes as their cost is to be included in the unit price bid for the various valve types and sizes.

22-4.10 Thrust Blocks. Concrete thrust blocks of the sizes shown on the plans or designated by the Engineer shall be provided.

22-5 FURNISHING AND INSTALLING VALVE BOXES

22-5.01 Description. This item shall consist of furnishing all labor, equipment and materials to install valve boxes over buried valve operators at locations shown on the plans, or as directed by the Engineer, and as specified herein.

No payment under this item will be made for valve boxes to be included with valves furnished and installed under the requirements of 22-2, 22-3 and 22-4. Payment under this item will only be made for valve boxes placed or replaced over existing valves.

22-5.02 Valve Boxes. Valve boxes shall be constructed of ductile iron conforming to ASTM A536 and shall be adjustable three-piece, screw type, with a 5 1/4" shaft that can be extended from 48" to 60", Buffalo Pipe and Foundry Corporation No. B-5001, Alabama Pipe Company No. 10357, Clow No. F-2450, or approved equal. The ductile iron cover shall have the word "WATER" on top.

22-5.03 Valve Box Extensions. When valves are located deeper than can be accommodated by the standard shaft length on the valve boxes, extensions shall be fabricated from 6" diameter Schedule 40 PVC pipe conforming to ASTM D1785. The valve box extension shall be placed over the base and under the middle section and shall be of sufficient length to allow final adjustment of valve box height with the upper section in the normal manner.

22-5.04 Extension Shafts. If valves are not installed with the operating nut within 72" of the ground surface, a permanent extension shaft shall be furnished and installed. The extension shaft shall have an operating nut with the same dimensions and markings as that of the valve and shall be capable of transmitting the operating torque specified for the valve. The extension shaft shall be mechanically attached to the operating nut.

22-5.05 Installation. Valve boxes shall be supported so that no load can be trans- mitted from the valve box to the valve.

22-6 FURNISHING AND INSTALLING FIRE HYDRANTS

22-6.01 Description. The Contractor shall furnish all labor, tools, material and equipment necessary to furnish and install new fire hydrants at the locations shown on the plans or as ordered and specified.

The item shall include all excavation, furnishing and installing the new fire hydrant complete with proper jointing, blocking, backfilling and all other incidental work necessary to complete this item of work. Hydrant watch valves and ductile iron hydrant leads, where necessary, are to be installed under 22-1 and 22-2.

22-6.02 General Design Criteria. All fire hydrants shall be a center stem post, rising stem, compression type, suitable for use where hydrants are subject to freezing temperatures, and conforming in all respects to AWWA C502-85, Dry-Barrel Fire Hydrants, except as specifically modified herein.

Hydrants shall be traffic type furnished with a frangible break flange at the ground line, and a cast iron coupling or two-piece brass coupling on the stem at the ground line which shall be designed so that in case of breakage, only the flange and coupling need to be replaced to effect complete repair. This design must assure that the upper and lower sections of the hydrant will break apart cleanly without bending the stem and without damage to the working parts of the hydrant or the abutting parts of' the standpipe sections; also that there will be no leaking or flooding.

The hydrant shall be designed so that, if broken at the joint, repairs may be made by the use of simple tools and the minimum number of parts, and without the necessity of excavating or shutting off the water supply to the hydrant.

The hydrant shall be designed so that the stem and main valve may be removed through the top of the standpipe without excavating. The interior of the barrel shall be free from sharp edges and internal obstructions.

The upper section of the standpipe which carries the nozzle shall be secured to the lower section in such a manner that the upper section may be rotated 360 degrees with a minimum of eight positions of equal angles, without excavation or use of special tools.

Hydrant construction shall allow depth of bury to be increased without excavation.

Each hydrant shall be connected to the main with a 6-inch branch connection controlled by an independent 6 inch gate valve, except as otherwise specified.

22-6.03 Approved Models. Unless approved by the Engineer, the only fire hydrant approved for use in the City of Oakwood is the following:
Eddy 2640, Compression - Type, Break Flange, 5-1/4" Valve

22-6.04 Materials and Workmanship. All materials used in the construction of hydrants shall be of the best commercial quality in their respective classes.

All castings shall be clean and perfect, no plugging or patching allowed. The machine work on all parts must be true to gauge so that all parts shall be interchangeable from one hydrant to another of the same make and size. All hydrants delivered not conforming to specifications shall be rejected and returned to the Contractor at the Contractor's expense.

22-6.05 Detailed Specifications. All fire hydrants shall conform to the following detailed specifications.

Main Valve. 5-1/4" valve opening.

Depth of Bury. 5 feet unless otherwise specified or shown on the plans (measured from bottom of connecting pipe to ground surface).

Hydrant Inlet. 6" Mechanical joint side inlet.

Color. Hydrant below ground line, and upper standpipe section shall be painted with two coats of Bruning Silathane Enamel, Yellow #1235 or equal.

Hose and Pumper Nozzle Threads. City of Dayton, Ohio, Standard Thread Specifications, Revised 1974, available from the Service Department;

Hose Nozzles. Diametrically opposite, two 2-1/2" with Koroseal gaskets, 2-17/32" I.D. x 3-5/16" O.D. x 3/16" thick.

Pumper Nozzle and Cap. In horizontal line from hose nozzles, one 4" with Koroseal gasket 4-1/16" I.D. x 5-1/8" O.D.

Direction of Opening. Hydrants shall open right (Clockwise direction), indicated by arrow cast in bonnet or cap.

Operating Nut and Cap Nuts. Square, 1-1/4" in length, tapered from 7/8" top to 15/16" base.

22-6.06 Data to Be Supplied by Manufacturer. The City shall be furnished, at the time of the bid, catalog data for all hydrants including illustrations, and a complete schedule of parts and the materials of which they are made, inclusive of top and bottom extensions. This information shall be in sufficient detail to serve as a guide for assembly and disassembly of the valve and for ordering repair parts. The City shall also be furnished with instructions and recommended frequencies for lubrication and maintenance.

The manufacturer shall, if requested by the City, supply records of any of the tests required by AWWA C502.

22-6.07 Certification. The Contractor shall furnish a sworn and notarized statement from the manufacturer certifying that the hydrants comply with all requirements of these specifications, and that all tests specified therein have been performed and all test requirements have been met.

22-6.08 Other Requirements. As a part of the bid, four (4) each of all seat wrenches, spanner wrenches or any other tools needed to service and repair the hydrant shall accompany delivery.

22-6.09 Installation. Hydrants shall be furnished and installed at the locations shown on the plans. Unless otherwise shown on the plans or directed by the Engineer, fire hydrants shall be located within the right-of-way. Clear distance from the back of curb to the end of the 4" pumper cap shall be 2 feet minimum unless otherwise approved by the Engineer. Hydrants shall be of the proper length to suit the depth of cover over the water lines at the locations shown on the plans and, if necessary, hydrant extensions shall be furnished to obtain the proper length. When hydrant extensions are not included as a separate pay item for the project, the cost of extensions shall be paid by the City as extra work upon approval by the Engineer. Hydrants shall be located to clear all driveway openings by a minimum of 6 feet unless otherwise specified by the Engineer.

The pit or trench for the fire hydrant shall be so excavated that when the hydrant is installed, the base shall rest on undisturbed soil and the hydrant shall be set plumb with nozzle outlet approximately 18 inches from the ground line. Hydrants shall be set in accordance with existing or proposed grade line which shall be approximately 2 inches below the bottom of the break connection on the hydrant standpipe.

Thrust Blocking. The hydrant base shall be constructed by placing a 16" x 16" x 4" minimum concrete block against undisturbed soils or compacted #57 stone as needed; the hydrant shall then be set directly on this base.

Lateral thrust blocking shall be constructed by pouring Class "B" concrete per DIVISION II, Section 11, Concrete, into a formed area. The hydrant shall be wrapped in polyethylene plastic, prior to pouring concrete to prevent concrete from making direct con- tact with the hydrant. Unless otherwise specified, thrust blocking shall be supported by a 4 square foot minimum, undisturbed soil bearing surface. The Contractor must ensure that the hydrant drain plug is not covered with concrete. Cost of thrust blocking shall be included in the price bid for installing hydrant. The alternate method of constructing thrust blocking using precast blocks, as stated under Concrete Thrust Blocks for Fittings, paragraph 22-1.10, may be used for hydrants upon approval by the Engineer.

22-6.10 Backfilling. Initial backfill shall consist of a minimum 2 cubic feet of #57 stone placed around the base of the hydrant to allow for barrel drainage. In all cases, the #57 stone shall be laid to a depth such that the hydrant drainage plug is covered by 6" of stone. Final backfilling shall consist of granular material conforming to 22-1.12 or approved suitable excavated granular material, power tamped in layers as appropriate to prevent sub- sequent settlement. This #57 stone and granular backfill shall extend from the bottom of the pit or trench to 6" below the existing or proposed surface of the surrounding area for grass areas and as shown in the plans for paved or otherwise surfaced areas.

22-6.11 Hydrant Relocation. Relocation of a fire hydrant shall be accomplished by removing the existing hydrant, installing new 6-inch ductile iron pipe and fittings as required to set the hydrant at the location and elevation shown on the plans, or as directed by the Engineer, resetting hydrant, blocking and backfilling to complete the work. Payment for installing new ductile iron pipe and fittings as required by this paragraph shall be paid at the price bid per linear foot under Item 22-1.

22-6.12 Hydrant Abandoned. Where shown on the plans or directed by the Engineer, the abandonment of a fire hydrant shall be accomplished by closing the watch valve, removing the hydrant, and capping or plugging the water line at the watch valve. The plugging or capping shall be in accordance with 22-9. All abandoned hydrants shall be delivered to the City of Oakwood Service Yard at 210 Shafor Boulevard, Dayton, Ohio, unless other- wise directed by the Engineer. No additional payment will be made for this delivery.

22-7 FURNISHING AND INSTALLING CASING PIPE

22-7.01 Description. The Contractor shall furnish and install casing pipe where shown on the plans as herein Specified.

22-7.02 Requirements. The furnishing and laying of the casing pipe shall conform to the requirements and regulations of the appropriate agency, utility and the City. The Contractor shall prepare necessary shop drawings, working schedule, description of type of materials and methods of construction.

The Contractor shall, before commencing work on the encasement, present evidence to prove to the satisfaction of the Engineer previous experience in tunneling or boring through ground similar to that found on the project, or shall employ a superintendent able to furnish such evidence and shall keep such a supervisor continuously employed until the tunnel work is completed.

The Contractor shall notify the appropriate agency or utility at least two working days in advance of commencing any construction work on the encasement.

The Contractor shall be responsible for costs which may result due to the agency or utility requirements relative to the furnishing of watchmen, inspectors and supervision by their forces.

Sizing of casing pipe shall be a minimum of 6 inches larger than the bell and retainer ring of the carrier pipe.

22-7.03 Reinforced Concrete Casing Pipe. Reinforced concrete casing pipe shall be culvert pipe meeting the requirements of ASTM C-76 of the class shown on the plans.

22-7.04 Steel Casing Pipe. Steel casing pipe shall be steel pipe meeting ASTM A-139 Grade B and shall be installed within the limits and at the location shown on the plans. The casing pipe shall be galvanized with a minimum of two ounces per square foot and conform to ASTM A-120. Steel casing pipe shall have a minimum wall thickness of 0.38 inches unless otherwise approved by the Engineer.

22-7.05 Shop Drawings. The shop drawings referred to above shall be prepared by the Contractor and three copies shall be sent to the Engineer for review, checking and approval. If the shop drawings, methods of construction and work schedule meet with the approval of the Engineer, the Engineer will forward all three copies to the appropriate agency or utility for its approval. Upon receipt of approval, one set of prints shall be returned to the Contractor while the other sets will be retained by the Engineer and the appropriate agency or utility.

22-7.06 Placing of Casing Pipe. The placing of the casing pipe shall be accomplished by approved driving or tunneling methods.

The earth ahead of the casing working face shall be stabilized with 1:8 cement grout if necessary to prevent damage to the railroad, utility property or structures.

Granular material used in connection with the laying of the water line inside the casing pipe shall be furnished and placed to a depth shown on the drawings and paid for under this item.

After the pipe has been installed in the casing pipe and granular fill installed, each end of the casing pipe shall be sealed with a brick and mortar bulkhead.

22-7.07 Pressure Grouting. Any space existing outside the casing pipe shall be grouted at low pressure through grout holes provided in a sufficient quantity in the casing pipe. These holes shall be installed in suitable locations so that grouting can be done effectively. The pressure grouting shall preferably begin at the lowest middle hole of each grout section, grout holes above being open, and proceed upward progressively and simultaneously on both sides of the tunnel. Grouting shall be done as near the end of the lined tunnel as practicable and, if deemed necessary by the Engineer, grout stops shall be placed behind the sections at or near the end of the erected lining to permit grouting to or near the end.

22-8 ADJUST VALVE BOXES AND SERVICE BOXES TO GRADE

22-8.01 Description. This item shall consist of providing all labor, material and equipment required to raise or lower existing valve boxes and/or service boxes to the grade at the locations shown on the plans.

22-8.02 Construction. The Contractor shall excavate around the valve box or service box as required to permit the raising or lowering of the valve box or service box. The Con- tractor may adjust any screw type boxes without the use of additional material providing ample thread remains on the box to provide adequate rigidity to the box. Any boxes that are not of the screw type and any screw type boxes not having ample thread shall be provided with extensions per 22-5.03 to adjust the top to the required grade. When broken castings are found, new components conforming to 22-5.02 may be ordered installed by the Engineer to replace the existing castings.

After the box has been adjusted to the proper grade the hole shall be backfilled as specified in 22-1.12.

Any pavement or sidewalk damaged in connection with the work under this item shall be replaced in accordance with the appropriate sections of Oakwood's specification. The cost of said replacement shall be included in the price bid for adjusting valve boxes or ser- vice boxes to grade.

22-9 CUTTING AND PLUGGING (OR CAPPING) WATER MAIN

22-9.01 Description. This item shall consist of providing all labor, equipment and materials to cut and plug or cap existing water mains at points designated on the plans, removing abandoned pipe as required, placing temporary and/or permanent blocking, and backfilling.

22-9.02 Materials. Unless otherwise approved, the plugs and/or caps used in connection with the work under this item for cast iron or ductile iron pressure pipe shall have restrained joints. Concrete pressure pipe shall be plugged or capped in accordance with the manufacturer's recommendation. The concrete used in providing the blocking shall have a minimum strength of Class "B" concrete per DIVISION II, Section 11, Concrete.

22-9.03 Construction. The Contractor shall cut the existing pipe at the point designated. The method of cutting shall be approved by the Engineer. After the plug or cap is installed the Contractor shall install thrust blocking in accordance with specifications for hydrant blocking under Paragraph 22-6.09 to adequately brace the plug or cap. After the water line has been plugged or capped and the permanent blocking has been installed the hole shall be backfilled as specified under 22-1.14.

22-10 WATER SERVICE

22-10.01 Water Services. Water service laterals shall typically be replaced with the same pipe size as originally installed, unless otherwise shown on the drawings. In the case of new installations, a copper line shall be installed in one piece from the corporation stop to the house curb stop, and a minimum size of 1" lateral shall be used for this portion of the service. All laterals shall be Type K copper pipe with at least 1 foot of compacted sand placed around the pipe, and the remainder of the trench shall be backfilled with bank run gravel to the subgrade elevation. Curb stops shall have 360 degree rotation, and shall not be equipped with a drainage provision. The Contractor shall supply a cast-iron curb box of Mueller-Buffalo H-10334 style, or approved equal. Where the Contractor is required to connect a new copper service line to an existing lead connection corporation stop, the City is prepared to supply the required connection piece (tail piece).

When unforeseen conditions dictate the replacement of a water service, curb stop boxes shall be replaced by the Contractor as directed by the Engineer. All old curb stops and curb boxes taken out of service remain the property of the City of Oakwood and shall be delivered to the City yard at 210 Shafor Boulevard, by the Contractor.

Section 23

Seeding and Mulching

The Contractor shall perform seeding and mulching in accordance with the General Specifications of the Southwest Ohio Engineers Association (as modified by the City of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications except as supplemented below. The following directives have precedence over the other specifications referenced in all cases where the requirements conflict.

When called for in the plans, the Contractor will apply fertilizer at the rate of 40 pounds per 1000 square feet using "starter fertilizer" unless otherwise specified.

When called for in the plans, the Contractor shall apply lime at the rate of 50 pounds per 1000 square feet.

Grass seed used in the City of Oakwood shall be of the following mixture:

Rural Areas:

20%	Kentucky Blue Grass (Poa Pratensis)
45%	Kentucky 31 Fescue (Festuca Elatior, Var. Ky. 31) or Alta Fescue (Festuca Elatior, Var. Arundinacea)
10%	Red Top (Agroste's Alba)
5%	Alsike Clover (Trifolium Hybridum)
20%	Creeping Red Fescue (Festuca Rubra)

Lawn Areas:

50%	Kentucky Blue Grass (Poa Pratensis)
30%	Creeping Red Fescue (Festuca Rubra)
20%	Annual Ryegrass (Lelium Multiflorum)

Germination shall be a minimum of 98.5 percent for all varieties of grass seed.

All fertilizing and seeding shall be done in the months of April, May, June 1st to June 10th, September or October. The Contractor shall maintain and sufficiently water areas until seeding is completed and germination occurs.

Section 24

Sodding

The Contractor shall sod in accordance the General Specifications of the Southwest Ohio Engineers Association (as modified by the City of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications except as supplemented below. The following directives have precedence over the other specifications referenced in all cases where the requirements conflict.

Only sod furnished from a sod farm approved by the City Horticulturist shall be accepted for the city work. One approved sod farm is Tisher's "Green Velvet" Sod Farm, Upper Bellbrook Road, Greene County, Ohio.

All sod shall be installed within 36 hours after being cut. The Contractor must apply to the Inspector a copy of the sod farm's dated material ticket.

The Contractor shall excavate as necessary to insure that 6 inches of topsoil is laid prior to placing sod ensuring that the top of sod will be flush with the surrounding grade.

T-shaped pins, machine bent from 15 inch pieces of 8-gage low carbon bright steel with 8 inch leg, 4 inch head and 1 inch secondary drive may be used to secure sod on slopes in lieu of wood stakes.

Sod between the curb and walk shall be laid in strips 2 feet 6 inches long by 18 inches wide.

The Contractor shall keep all sodded areas thoroughly moist for 15 calendar days after sodding. The Contractor shall replace, at no cost to the city, any defective sod which has not been property watered or shows other distress for a period of 6 months after initial placement.

In areas where subgrade settlement has occurred during the first year after initial sod placement, the Contractor shall, at no cost to the city, remove the sod, add topsoil to fill depressions and replace sod to lay flush with the surrounding grade.

Section 25

Landscaping

Landscaping shall be performed in accordance with the General Specifications of the Southwest Ohio Engineers Association (as modified by the City of Oakwood) and the Ohio Department of Transportation Construction and Material Specifications except as supplemented below. The following directives have precedence over the other specifications referenced in all cases where the requirements conflict.

The City Horticulturist must approve the layout of planting and specimen stock before installing any plant material.

Bracing, either double stake or tripod is required after planting for all trees and shrubs, except for shrubs of less than 3 feet height.

The Contractor shall replace, at no cost to the City, all planting stock that does not survive the first 12 months after planting. Where plant stock is replaced, the Contractor shall guarantee the new stock to survive a full 12 month period from date of planting. If the replacement plant stock does not survive 12 months, the Contractor shall again replace the stock at no cost to the City.

Mulch placed on slopes shall be held in place with open type yarn cloth of other suitable material.

Trees shall be trimmed to provide at least a 2 foot clearance from any roof surface. Where tree branches interfere with required work, the Contractor shall cut the limbs, as directed by the Horticulturist, to prevent unnecessary tree damage.

Where vegetative plant materials other than sod (e.g. Ivy, myrtles, ground cover, etc.) are found within the work limits or other areas disturbed by the Contractor, the Contractor shall replace these materials to their original species, density and condition. Payment for this work within the work limits shall be at the unit price bid of sodding. No payment will be made for replacement of damaged materials outside the authorized work limits.

Section 26

Carpentry

Description. The Contractor shall furnish all labor, materials, equipment and incidentals required for the completion of all rough and finished carpentry as shown on the drawings and as specified herein.

Rough Lumber and Carpentry. All lumber for framing, furring, blocking, nailers, expansion curbing and as shown on the drawings, shall be construction grade Douglas Fir or No. 1 Southern Yellow Pine, kiln dried to a moisture content not exceeding 16 percent.

All lumber incorporated as an integral part of the roofing shall be prime painted on all sides and cut ends.

Baffles and Stop Planks. Baffles and stop planks shall consist of T & G, S4S California, all heart, redwood, of the sizes shown on the drawings.

Stop Planks. Stop planks for the flow control chamber shall be of the sizes shown, T & G, Pressure Creosoted Douglas Fir or No. 1 Yellow Pine.

Plank Walkway. Provide as shown on the drawings, a pressure treated plank walkway on the new building roof. The 2”x4” runners shall not be fastened to the roof and shall be installed prior to the gravel. All members shall be nailed with aluminum nails.

Chamfer Strips. The Contractor shall provide a wooden 3/4” Chamfer strip in all corners of concrete form work where exposed edges will result when the forms are stripped.

Section 27

Electrical Work

General. This item shall include all the electrical work required to complete installation of all equipment to complete the well pump operations, control valving, feeder pumping, flower operations, flow recording facilities and general building electrical service. Electrical work at the well field and valve pit is also included.

The completed work shall conform in every respect with any local governing codes and with the latest edition of the Ohio Building Code, the National Electrical Code, and the Standards of the National Board of Fire Underwriters for Electrical Wiring and Apparatus.

Extent of Work. The Contractor shall include all materials, labor and equipment to install complete the electrical work as hereinafter specified or shown on the construction drawings.

Work shall include but not necessarily be limited to, the following items as outlined:

Electrical service and entrance
Distribution, feeders and panels
Branch circuit wiring
Fixtures and wiring devices
Lighting and heating wiring
Motor control wiring
Temporary wiring for construction use

Work shall include installation of all conduit and necessary copper wiring, junction boxes, pull boxes, disconnects and electrical equipment as described within these specifications, or shown on the construction drawings.

Before submitting a proposal, the Contractor shall carefully examine the drawings and specifications, visit the site of the work, and make himself fully aware of existing conditions and limitations. The City will not be responsible for extra cost of work because of ignorance of existing conditions on the part of the Contractor. The electrical subcontractor shall coordinate his work with the general contractor.

Inspections and Tests. The Contractor shall obtain all permits required by all laws and regulations or public authority having such jurisdiction.

The Contractor shall test all wiring and connections for continuity and grounds before the fixtures are connected, and when directed, he shall demonstrate by megger test, the insulation resistance of any circuit or groups of circuits. Where such installation test pinpoint faulty insulation, the Contractor shall promptly remove the faulty conductor, replace same with new conductor and demonstrate by further tests the elimination of faults.

Supervision of Work. The Contractor shall have in charge of the work at all times during construction, a competent superintendent with adequate experience.

Workmanship. All materials and equipment shall be installed and completed in a first class workmanlike manner by craftsman skilled in this particular work.

The City reserves the right to direct the removal and replacement of any item which, in its opinion, shall not present an orderly or reasonably neat or workmanlike appearance, provided that such item can be properly installed in such orderly way by methods usual in such work. Such renewals or replacements shall be done by the Contractor when so directed in writing by the Engineer, and at the Contractor's sole expense.

Shop Drawings. The Contractor shall furnish to the Engineer, three (3) copies of shop drawings of all switches, circuit breakers, conduit, wire, poles, luminaries and lamps as required.

These drawings shall be submitted within thirty (30) days after award of contract.

Overload Protection. The electrical contractor shall check all of the overload protective devices after the electrical work is complete, but prior to operation of the equipment. He shall certify to the Engineer in writing that the proper protection is provided and that each of the heater units in the starting equipment will properly protect the motor to be controlled by the equipment.

Construction Methods. Exposed conduits shall be erected in a horizontal or vertical position using uniform bends or fittings attached to the supporting structure by hot dipped galvanized one (1) hole malleable iron clamps held in place by Pierce or equal expansion shields and rustproof bolts. All threaded joints shall be painted with red lead before assembly.

Underground conductor splices shall be made using "Scotchcast" molded resin, or equal, as per manufacturer's instructions.

Conduits embedded in concrete shall be placed and supported and supervision shall be provided during the concrete pouring to insure they are not displaced.

Conduits through concrete or masonry walls or floors shall be placed in sleeves and sealed with approved sealing compound after the conduit is in place.

All convenience outlets shall be duplex grounded type for three (3) prong fittings on the connection cord.

Connections to motors shall be made by means of a suitable length of weatherproof flexible conduit securely attached to the rigid conduit and the motor hood by an approved fitting.

Conduits inside the building shall be exposed as much as possible. All exterior circuits shall be installed in conduit underground or in cable duct.

Particular care shall be taken to make tight joints, to firmly secure all conduits, and to adequately ground all parts of the completed work.

Electrical Service. The existing electrical service is 115/230/460 volt, 60 cycle, single or 3-phase service. The Contractor shall extend the electrical service underground and through the building walls.

Grounding. System and equipment grounding shall be installed in accordance with Article 250 of the National Electrical Code. Equipment grounding conductors shall be used on all feeder branch circuits and these conductors shall be Code Grade Type THW-600 V color coded Green.

Branch Circuit Panelboards. The Contractor shall furnish and install, where shown on the plans, 200 ampere circuit breaker type panelboards. Panelboards shall have main breaker. Breakers shall be quick-break

mechanism and the breaker, when tripped, shall be in a clearly distinctive position from that of a manual OFF or manual ON. Panelboard to be Westinghouse NQP-3 or equal.

Circuitry. The Contractor shall furnish and install all necessary disconnects, wires, starters, panelboards, transformers and fuses.

The Contractor shall furnish and install separate switches for the lighting and heaters in the building. The switches shall be mounted on the building exterior adjacent to the entrance doors.

The Contractor shall furnish and install all electrical connections and controls and signal wiring necessary to complete the project.

All disconnect switches and motor control equipment shall be furnished in NEMA 12 enclosures.

A 100 ampere circuit shall be installed from the new distribution panel to the existing chlorine room panel.

Controls. The Contractor shall furnish and install new electrical equipment and modify existing equipment as necessary in accordance with the following:

The Contractor shall furnish and install a control system to operate two new well pumps, #2 in the Firwood well field and future #2 located at the soccer field. The existing control-input signals for the Oakwood water system are being received by a telemetering system supplied by Aquatrol Corporation in 1979, their Control System C3586.

The existing panel at well house #1 in the Firwood well field has controls for existing pump #1 and #2. A companion panel shall be provided and mounted adjacent to the existing panel for the control of future pump #3. The Contractor shall supply interconnecting wiring diagrams showing the interface between the two panels at the well field. Sketch #1 shows a schematic diagram of how the existing system functionally interfaces with the new work. The new companion panel shall be a NEMA-4 wall-mounted enclosure and shall contain the following major equipment.

a. Pump Control Module, Aquatrol #A2019A02 (1 required)
b. Setpoint station for pump #3, Aquatrol #A1002B01
c. Power supply (2), Aquatrol #PS-105, PS-109
d. Well pump Command Integrator, Aquatrol #2002E02

Pump RUN signals shall be retransmitted over the existing telemetering system to the dispatcher's panel (existing Unit 100) located in the basement of the City Building. It will be necessary for the Contractor to run tow sets of wires from Unit 100 to the system monitor located upstairs in the police dispatcher's office. When pumps #2 and #3 are running, an indicator light on the Rochester display panel will be energized. The Contractor will be required to supply one new nameplate legend for the Rochester unit with the following wording: "WELL NO. # RUN." The nameplate for well #2 is already in place.

The operation of the electric butterfly plant bypass valves shall be accomplished both at the water treatment plant and at the Oakwood City Building. A sequencing fail-safe control of these valve operations shall be included. The operating position of the three automatic valves will be annunciated in the dispatcher's office.

Portable Diesel Motor Generator Set. The Contractor shall furnish and install a portable diesel motor generator set to be used throughout the City in emergency electrical service. This unit shall be mounted on a

standard trailer and have single or tandem axles as required with a crank type tongue support post. Independent brakes for the trailer are necessary. The generator shall produce 230/460 volt, 3 phase power and be equipped with 50 foot leads and end receptacles compatible with the existing City hardware at the Firwood Circle distribution box. This unit shall have a stainless steel flexible exhaust pipe with a residential silencer, a full instrument panel and a main line circuit breaker.

The diesel generator set shall have full capacity when operating under full load for a minimum of 12 hours.

The motor generator set shall be enclosed in adequate housing.

The Contractor shall furnish catalog cuts and details of the unit proposed at the time of bid.

CONDUCTORS AND CONDUITS

Except where prohibited by the National Electrical Code (NEC), all conductors shall be run in conduit as follows:

* all underground conduit shall be rigid metallic conduit
* all aboveground conduit shall be non-metallic conduit, electric metallic tubing, or rigid metal conduit

All conduit to be installed to prevent water from entering conduit and all conduit terminals shall have bushings.

All conduit placed underground, in direct contact with the earth, or imbedded in concrete shall be specifically approved for each use by the NEC.

Where conduit is installed in concrete slab, the top of the conduit shall be at least 1-1/2” below the top surface of the slab where possible. Electrical contractor will be held responsible for maintaining all conduit in position during pouring of slab.

Conduit ends shall be trimmed inside and outside to remove rough edges. Caps shall be placed in the end of each conduit as soon as located to prevent filling with foreign material.

Changes in direction or conduit where concealed shall be made by means of standard radius bends, and where exposed, by means of non-metallic condulents.

In no place shall a conduit be run within three (3) inches of hot water pipes, except where crossing is unavoidable and, in the case, the conduit shall be kept at least one inch from covering of pipe crossed. Conduit shall be installed in such a manner as to insure against trouble from collection of trapped condensation, and all runs of conduit shall be arranged so as to be devoid of traps.

Conduit shall be supported on approved types of supports and secured by means of toggle bolts on hollow masonry units or expansion bolts in concrete or brick, machine screws on metal surfaces and wood screws on wood construction. Nails shall be used as a means of fastening boxes or conduit only to wood construction.

Because of different characteristics of copper and aluminum, devices such as pressure terminal or pressure splicing connectors and soldering lugs shall be suitable for the material of the conductor and shall be properly installed and used. Conductors or dissimilar metals shall not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors (such as copper and aluminum, copper and

copper-clad aluminum, or aluminum and copper-clad aluminum), unless the device is suitable for the purpose and conditions of use. Materials such as solder, fluxes, inhibitors, and compounds, where employed, shall be suitable for the use and shall be of a type which will not adversely affect the conductor installation or equipment.

Connection of conductors to terminal parts shall insure a thoroughly good connection without damaging the conductors and shall be made by means of pressure connectors (including setscrew type), solder lugs or splices to flexible leads, except that No. 8 or smaller solid conductors and No. 10 or smaller stranded conductors may be connected by means of wire-binding screws or studs and nuts having upturned lugs, or the equivalent.

Conductors shall be copper.

Section 28

Well Houses and Pumps

PUMP HOUSE AND PUMPS

General. The Contractor shall furnish and install one additional factory-built automatic pump in the Wiltshire pumping station.

The principal items of equipment shall include on vertical, close coupled, motor driven, non-clog sewage pump, valves, internal piping, additions to control panel with circuit breakers, motor starter and automatic level controls, and all additional internal and external wiring and conduit.

Operating Conditions. This pump shall be capable of delivering 1000 GPM of raw, unscreened sewage against a total dynamic head of 22 feet. The maximum allowable speed shall be 1170 RPM. The minimum rated horsepower of each pump motor shall be 7.5.

All openings and passages shall be large enough to permit the passage of a sphere 3 inches in diameter and any trash or stringy material which can pass through a 4-inch house collection system. The anticipated operating head range is from 12 feet minimum to 22 feet maximum.

Pumps. The pump shall be vertical, non-clog sewage pumps of heavy cast iron construction especially designed for the use of mechanical seals.

The bearing nearest the impeller shall be designed for the combined thrust and radial load and shall carry only radial loads.

The shafts shall be a solid stainless steel shaft through the pump and bottom bearing to eliminate corrosion within the pump or the mechanical seal.

The pump impellers shall be of the enclosed type made of close-grained cast iron and shall be balanced. The impellers shall fit on a tapered pump shaft and be keyed and secured to the pump shaft by a stainless steel cap screw equipped with a self-locking device.

The motor shall be attached to the pump volute by a one-piece cast iron adapter and backhead.

The pump shaft shall be sealed against leakage.

The pump volute shall be of heavy, cast iron construction, free from projections that might cause clogging or interfere with the flow through the pump.

The pump shall be supported by a heavy cast iron base to provide maximum rigidity and balance.

The pump shall be an ABS unit and shall be identical to the pumps now in place in the station.

A 2” galvanized lifting guide shall be fabricated and installed as shown on the drawings. The pump shall be equipped with a lifting chain capable of raising and lowering pump in a vertical position.

Motors. The pump motor shall be vertical, solid shaft, specifically built NEMA P-base, squirrel-cage induction type, suitable for 3-phase, 60-cycle, 230-volt electric current. They shall have Class F insulation, suitable for temperatures up to 115 degrees C., but the motors shall have Class B torque and low starting current, as specified for NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Leads shall be terminated in a cast connection box and shall be clearly identified.

The motors shall have 1.15 service factor.

The motor shall be fitted with heavy lifting eyes, each capable of supporting the entire weight of the pump and motor.

Control. The control equipment shall be mounted on top of the existing control panel within a NEMA Type 1, dead-front enclosure, fabricated of steel and reinforced as required. The circuit breaker, motor-starter section shall be provided with removable covers, complete with suitable latching devices. All circuit breakers, motor-starter reset buttons and pump control switches shall be mounted so that they are operable without opening the high voltage cabinet.

Thermal magnetic air circuit breakers shall be provided for branch disconnect service and over-current protection of all motor, control and auxiliary circuits. Magnetic across-the-line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give positive protection.

All switches shall be labeled and a coded wiring diagram shall be provided.

An encapsulated mercury float switch system shall be provided to control the operation of the additional pump with variations of rain water level in the wet well.

Piping. Pump discharge lines shall Class 150, bell and spigot ductile iron pipe. The discharge line from each pump shall be fitted with a bronze-fitted check valve and a bronze-fitted, double-disc gate valve.

Wiring. All power and control wiring in the pump station shall meet the requirements of the National Electric Code and be coded as indicated on the wiring diagram. All wiring outside the panel shall be in conduit.

Installation and Operating Instructions. The manufacturer shall further provide a complete and detailed Installation, Operating and Maintenance Manual covering installation and general operating procedures, the operation, maintenance and servicing procedures of the major individual components provided with the pump.

The manufacturer shall further provide the services of a factory-trained representative for a maximum period of one day to perform initial start-up of the pump and to instruct the Owner’s operating personnel in the operation and maintenance of the equipment.

Guarantee. The manufacturer of the lift station shall guarantee for one year from date of acceptance that the structure and all equipment will be free from defects in design, material and workmanship.

In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall provide a replacement part without cost to the Owner. He shall further provide, without cost, such labor as may be required to replace, repair or modify components such as pump, pump motor, sewage piping manifold, etc.

Miscellaneous. Mercury float switches, including ballast weights and solid urethane foam, shall be provided. The switches shall tilt when the water level rises to actuate pumps or controls.

Pumps shall be equipped with a guide rail system for raising and lowering. The pumps shall have cutter vanes or teeth to chop up rags and large or stringy solids in order to maintain smooth operation.

Shop drawings must be supplied for all mechanical and electrical components specified herein. No manufacture or on-site construction will be initiated prior to shop drawing approval by the Engineer.

WELL HOUSE #4 PUMP

Scope and Service Conditions. This covers vertical turbine type pump of the open line shaft type where the pumped liquid is utilized as the lubricating medium. The pump shall conform to applicable paragraphs of the American Standards Association Publication for Vertical Turbine Pumps, B 58.1, except as specified herein.

Pump shall be designed and constructed to operate satisfactorily with a reasonable service life, when installed in a typical water well pump application. The pump shall be the product of a manufacturer regularly engaged in the production and marketing of vertical turbine pumps. The pump shall be water lubricated.

Operating Conditions. Well house # 4 pump (1 required):

Design capacity:	500 gpm
Design head:	300’ Total Dynamic Head (TDH)
Maximum allowable speed	1770 RPM
Liquid to be handled:	Raw water
Stages”	10 stages maximum
Efficiency:	78%

The pump shall be as manufactured by Allis-Chalmers, Layne-Bowler, Fairbanks-Morse, Worthington, or approved equal. The city of Oakwood reserves the right to accept or reject all pumps.

Pump Construction

Bowl assembly: Pump bowl shall be flanged and bolted type made of close-grained cast iron. Flanges shall be of sufficient cross section to prevent deflection and shall be reinforced with for ribs (minimum) which are at least ½ the flange metal thickness. The diffuser portion of the bowl casting shall have maximum cross-section to insure long life. Threaded bowl connections shall not supplied.

Impellers shall be enclosed type of bronze, secured to the shaft with SAE 1213 steel tapered collets.

Pump bowl shall be provided with replaceable wear rings of SAE 60 bronze or ASTM B505 allow 836.

Shaft shall be AISI 416 Stl., rolled or forged, ground and sized to provide minimum deflection.

Belled suction of cast iron shall be provided to reduce entrance losses to a minimum.

Sleeve bearings of SAE 60 bronze shall be provided in bowl and in the suction bell. Bowl bearings shall be lubricated by the pumped liquid. Suction bell bearing shall be packed permanently with a non-soluble grease and fitted with an SAE 40 bronze sand collar.

Suction pipe: The Contractor shall furnish with the pumping unit, a 2 foot section of black steel, ASTM A53, Grade B suction pipe, 8" in diameter, threaded for attaching to the pump.

Column assembly: Discharge pipe shall be ASTM A53, Grade A steel pipe with threaded connections.

Line shafting shall be C-1045 steel rolled or forged and ground. Shaft sections shall be connected through suitable steel threaded couplings. Shaft sections shall not exceed ten feet in length. The head shaft shall be of AISI stainless steel.

Renewable shaft sleeves of 410 Stn. Stl. shall be "shrenkfit" on the line shaft at each bearing location. The outside diameter of the sleeve shall be larger than that of the shaft. "Undercutting" of shafting at sleeve locations shall not be permitted.

Bearings shall be provided at each column connection. Bearings shall be fluted rubber supported by non-threaded "spider" type retainers butted between the machined faces of the discharge column to insure proper shaft alignment.

Inline Discharge Head Assembly. Discharge head shall be fabricated steel "inline" type. Discharge pipe flange shall be 150 pound flat face type face and drilled per ASA standards. The discharge head base shall be machined to match the drilling of the suction barrel flange. Discharge pipe connection shall be furnished with ¼" coupling for pressure gauge connections. The discharge head shall be stress relieved after welding. Two lifting lugs shall be provided with capacity to support the weight of the entire pump. The discharge head mounting base shall be a round flange type with accurately machined surfaces. The top of the head shall be machined with a register fit for locating the driving motor. Cast discharge head shall be designed so that casting sections supporting the motor shall form a "tee" section for maximum torsional rigidity. Adequate opening shall be provided to permit easy access to the stuffing box and shaft couplings.

Stuffing box shall be made of cast iron and shall contain a minimum of five rings of graphited asbestos packings, two Teflon seal cages, and split tube cast iron packing gland. Seal water connections shall be through drilled holes with ¼" minimum I.P.S pipe taps. Cored holes shall not be supplied.

Rearing housing shall be one-piece construction made of cast iron. It shall have an accurately machined pilot which locates in a close tolerance counterbore in the discharge head. Pump stuffing box shall locate on this pilot and clamp bearing housing in place. A bronze sleeve bearing shall be provided in the bearing housing.

Shaft Coupling. A three-piece adjustable flanged type coupling shall be provided with vertical solid-shaft motors. The coupling shall be steel and designed to transmit the required torque and horsepower.

Driver. The pump shall be arranged for direct connection to a vertical, hollow or solid-shaft motor. The motor shall be 3.0, 60 Hz, 460 volt, 50 HP, high-service pump. The motor shall be completely non-overloading throughout the entire operating range of the pump. The city of Oakwood requests that the high-service pump electric motor be the same type as presently operating in well house #1. At the time of the bid, the Contractor

will state in writing if he intends to furnish any components different from the existing well house #1 pump and motor type.

Miscellaneous. All data plates shall be of stainless steel suitably attached to the pump. Data plates shall contain the manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

All machine bolts, nuts, and capscrews shall be of the hex head type.

Pump shall be equipped with a pneumatic type water level indicator.

Testing. The pump shall be fully tested on water at the manufacturer's plant before shipment. Tests shall consist of checking the unit at its rated speed, head, capacity, efficiency and brake horsepower, and at such other conditions of head and capacity to property establish the performance curve. Flow measurements shall be made with magnetic flow meter. Certified copies of test reports shall be submitted to the Owner.

Service. Manufacturer shall furnish services of a field engineer to check installation of the new high service pumps and supervise start-up including field testing prior to and in conjunction with the plant start-up work specified elsewhere in these specifications. At this time, voltage, current and power input shall be determined by the Contractor and drive-to-water efficiency calculated. The Engineer shall be advised one week prior to this testing date.

Water Depth Indicator. The manufacturer shall furnish ¼' diameter copper tubing assembly to be mounted inside the casing for pneumatically determining the depth of the water surface inside the casing.

Motor Starter. The Contractor shall furnish a motor starter and fused disconnect switch as shown on the drawings for well house #4.

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